‘Wolf-249’ and FBL 5-2M: An Autumn Celery Cultivar and Breeding Line for Florida

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Additional index words. *Apium graveolens*

In the Everglades agricultural area, the autumn celery (*Apium graveolens* L.) crop is seeded onto nursery beds between late May and early July. After 10 to 15 weeks, bare-root seedlings are transplanted to the field and grown for another 12 to 16 weeks before harvest. The harvest commonly begins in late November and continues through early January (see Table 1). The fall celery production season is one of four or five production periods in Florida, each with seasonally adapted cultivars. Over the recent past, this first production period has occupied about a quarter of the 3000 to 4500 ha grown annually on the histosols of southern and central Florida.

This celery crop is seeded and transplanted in weather conditions typical of tropical summers. While the autumn crop is on the seedbeds from June through August, monthly rainfall averages range from 331 to 540 mm; average highs and lows range from 30.3 to 32.6°C, and 17.5 to 21.4°C, respectively. Cultivars developed for this production period must be adapted to environments defined by hot, humid rainy weather. The purpose of this breeding program is to develop cultivars with improved yield and horticultural quality, acceptable disease resistance, and adaptation to the fall production period, which is presently dominated by ‘Floribelle M9’ (Wolf and Scully, 1992). ‘Wolf-249’ and FBL 5-2M were selected primarily for yield, adaptation, horticultural quality, and general superiority to the standard cultivar. Secondary emphasis was placed on visual appeal, including petiole appearance and stalk confirmation and color. Secondary emphasis also was placed on resis-

tance to early blight caused by *Cercospora apii* Fres. and bacterial leaf spot and brown stem, both of which are incited by *Pseudomonas cichorii* (Swingle) Stapp. (Pohronenezy et al., 1994).

Origin

FBL 5-2M was derived from two sequential single-plant selections extracted from ‘Floribelle M9’ (Wolf and Scully, 1992), with the progeny of the second selection bulked and tested. The code FBL 5-2M indicates a fall breeding line followed by the selection number.

‘Wolf-249’ was tested as breeding line M 249 and was developed by a combination of backcross and pedigree breeding methods. ‘Florida 2-14’ was the recurrent female parent for crosses made in 1977 and 1980, and a selection from ‘Florida 2-13’ made in 1959. Both ‘Florida 2-13’ and ‘Florida 2-14’ originated as selections out of ‘Utah 52-70’ (G. Talbott, personal communication) (Fig. 1). This breeding effort began in 1950 with the

accession of an F_4 breeding line identified as Cornell 50-256-2, which arose from a series of crosses involving elite New York germplasm and foreign introductions (H.M. Munger, personal communication). Derivatives of Cornell 50-256-2 were routinely used as parental germplasm in various Florida celery breeding programs and contributed to the development of ‘Earlibelle’, ‘Junebelle’ (Wolf, 1970a, 1970b), and ‘Floribelle M9’ (Wolf and Scully, 1992). Selection for bolt resistance within this New York line produced EES 756, an F_8 breeding line that was crossed to ‘Fla. 2-13’ and produced EES 1449. In 1968, PI 171499 from Turkey was crossed with EES 1449 to improve foliar disease (*C. apii* and *P. cichorii*) resistance. From an F_4 line catalogued as 2168-8-16, EES 76-139D1 was selected and crossed to ‘Fla. 2-14’. Subsequently, an F_3 progeny (M 225-5) was again crossed to ‘Fla. 2-14’ (Fig. 1) to recover certain desirable esthetic qualities related to appearance. This last cross produced the M 249 F_2 population from which M 249-1-2a was selected and bulk-produced in F_5 .

Description

‘Wolf-249’ and FBL 5-2M have intermediate growth habits between the ‘Crystal Jumbo’ and the ‘Ordinary Utah’ phenotypes (U.S. Dept. of Agriculture, 1981). Both genotypes are midseason lines that mature in 87 to 98 days from transplanting (Table 1). They commonly range in height from 75 to 80 cm, with an average height of 78 cm, and are sometimes 4 to 8 cm taller than ‘Floribelle M9’. The trimmed and stripped mature stalks in the “2, 2.5, 3, and 4”-dozen-sized market classes of both genotypes have from seven to 13 outer petioles with lengths ≥ 40 cm when

Fig. 1. Pedigree of ‘Wolf-249’.

Received for publication 14 Nov. 1994. Accepted for publication 11 Apr. 1995. Florida Agricultural Experiment Station Journal article no. R-03925. This research was supported in part by the Florida Celery Exchange, South Bay Growers, and Florida Agricultural Experiment Station Research Project BGL-03063. We extend our thanks and appreciation to A. Duda and Sons, D.D. Division Farms and South Bay Growers. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked *advertisement* solely to indicate this fact.

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Table 1. Celery activity schedule and days to harvest for seven test sites in the Everglades agricultural area.

Activity	Farm site						
	1	2	3	4	5	6	7
Seeding date	27 June 1991	29 June 1991	19 June 1992	10 July 1992	10 July 1992	21 July 1992	30 June 1993
Transplant date	26 Sept. 1991	28 Sept. 1991	11 Sept. 1992	22 Sept. 1992	30 Sept. 1992	19 Oct. 1992	30 Sept. 1993
Harvest date	30 Dec. 1991	3 Jan. 1992	14 Dec. 1992	22 Dec. 1992	6 Jan. 1993	14 Jan. 1993	4 Jan. 1994
Days to harvest	95	97	94	91	98	87	97

Table 2. Comparison of yield among breeding lines and the standard cultivar across seven sites and over 4 years.

Cultivar or breeding line	Yield (crates/ha)							Yield of grade sizes (crates/ha) ²						Total yield
	Farm site													
	1	2	3	4	5	6	7	1.5	2	2.5	3	4	6	
Wolf-249	2768	2305	2664	1668	2231	2572	2580	27.2	474	1003	586	208	9.14	2390
FBL 5-2M	2768	2407	2543	1915	2024	2288	2624	19.8	432	800	714	296	9.88	2362
Floribelle M9	2540	2281	2491	1626	2120	2254	2525	12.4	366	724	667	341	148.3	2258
M-246	2720	2083	2632	1332	2340	2073	2323	4.9	272	815	650	314	143.3	2199
FCE E-40	2384	2392	2318	1685	1522	2204	2466	9.9	366	573	744	304	135.9	2132
LSD (<i>P</i> ≤ 0.05)	266	184	183	400	412	238	136	23.7	124	139	126	79.3	55.4	93.4

²Grade sizes are denoted as 1.5, 2, 2.5, etc., indicating the number of dozens of plants packed in a crate.

Table 3. Comparison of 10 quality traits and the average petiole length and petiole count on a celery stalk.

Cultivar or breeding line	Petiole cracks ²						Petiole pith (no.) ³			Disorder		Petiole	
				Basal						Brown stem	Black heart	Length (cm)	Count
	Top	Nodal	Longitudinal	Outside	Inside		Top	Bottom	Middle				
Wolf-249	0.62	7.1	0.91	0.35	0.00		1.6	7.0	0.38	4.26	0.23	10.1	83.93
FBL 5-2M	1.26	13.1	1.56	0.17	0.03		9.4	8.5	0.76	7.97	0.41	9.9	82.86
Floribelle M9	1.20	14.6	2.20	0.44	0.06		9.5	8.6	1.06	6.47	1.14	10.2	76.10
M-246	2.00	18.3	2.41	0.44	0.56		4.8	4.4	0.65	5.14	0.56	8.9	81.83
E-40	0.83	14.6	2.68	0.88	0.91		11.8	17.3	3.09	8.32	1.32	10.6	68.83
LSD	0.99	2.65	0.94	0.47	0.61		2.58	2.48	0.72	1.44	0.81	0.27	4.14

²Average count per 10-stalk subsample.

³Average count per 10-stalk subsample measured at cross-sectional cuts made ± 2.5 cm above the first node (petiole top), ± 1.0 cm above the wing (petiole bottom), and at the midway point between the petiole base and the first node (mid-petiole).

measured from leaf tip to petiole base. On average, $\approx 79\%$ and 83% of the inner petioles are shorter than 40 cm for 'Wolf-249' and FBL 5-2M, respectively, with usually one inner petiole ≥ 40 cm. 'Wolf-249' and FBL 5-2M have a more robust appearance than 'Floribelle M9' as indicated by a higher frequency of larger grade sizes (Table 2). Stalk conformation is similar to 'Floribelle M9', particularly for FBL 5-2M. The heart formation of 'Wolf-249' and FBL 5-2M is mostly sparse, and ranges from three to four heart leaves for 'Wolf-249', while FBL 5-2M has up to five on Florida histosols. The petiole lengths of 'Wolf-249' and 'Floribelle M9' were essentially equivalent, while FBL 5-2M had a significantly shorter petiole than either, but still within the acceptable range (Table 3). Petiole width, as measured at the midpoint between petiole wing and the first node (U.S. Dept. of Agriculture, 1981), averaged 2.1 cm for 'Wolf-249' and 2.2 cm for FBL 5-2M and 'Floribelle M9'. Petiole count was highest for 'Wolf-249' followed by FBL 5-2M, both had more petioles than 'Floribelle M9' (Table 3). Cross-sectional petiole shape is moderately cupped for 'Wolf-249', deeply cupped for FBL 5-2M, and intermediate for 'Floribelle M9' (U.S. Dept. of Agriculture, 1981). Petioles and leaves are moderately glossy and a medium green with no anthocyanin coloring. FBL 5-2M is noticeably lighter green than the standard, while 'Wolf-249' is darker. Petioles are moderately ribbed with only slight stringiness (U.S. Dept. of Agriculture, 1981).

'Wolf-249' and FBL 5-2M were tested in seven site-year environments from Fall 1991 to Winter 1994 (Table 1) (Maynard, 1992, 1993, 1994). On average, 'Wolf-249' outyielded standard cultivar Floribelle M9 by 132 crates/ha, while FBL 5-2M produced an increase of 104 crates/ha (Table 2). Without exception, 'Wolf-249' and FBL 5-2M outperformed the standard cultivar in every test site. The superior yield of 'Wolf-249' is attributed to significantly higher yields in the 2.5-dozen-sized class and significantly lower yields in the smaller grade sizes, including the 4- and 6-dozen-sized crates (Table 2). The trend for both releases was toward higher yields of the larger plants and lower yields of smaller plants, although FBL 5-2M produced no meaningful improvement in any particular sized class, total yields were improved significantly (Table 2).

'Wolf-249' performed significantly better than the standard cultivar for nodal cracks, longitudinal cracks, top pith, and the incidence of brown stem and black heart (Table 3). For all of these traits, 'Wolf-249' had the lowest or near-lowest defect rate. FBL 5-2M had a lower defect rate compared to the standard cultivar, with the exception that the frequency of top cracks and brown-stemmed petioles was not significantly different. 'Floribelle M9' was more prone to pith development in the petiole top and at the mid-petiole than either FBL 5-2M or 'Wolf-249', but bottom pith was similar for the three genotypes (Table 3).

Availability

'Wolf-249' and FBL 5-2M are released by the Univ. of Florida Institute of Food and Agricultural Sciences to the Florida Celery Growers Exchange. Breeders seed was deposited with the Florida Foundation Seed Producers, Box 309, Greenwood, FL 32433, and stock seed with the Florida Celery Growers Exchange.

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