‘M77’ Ornamental *Miscanthus sinensis*

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‘M77’ (PP30,402), a perennial *Miscanthus sinensis* ornamental grass with significantly reduced seed production, was approved for release by the University of Georgia College of Agricultural and Environmental Sciences in 2016. We evaluated ‘M77’ at Tifton and Blairsville, GA, in comparison with *M. sinensis* var. *gracillimus*. Genotypes were evaluated for inflorescence and leaf height, canopy diameter, inflorescence length and number per plant, leaf length and width, and seed set. Data for each variable were subjected to analysis of variance, and Fisher’s least significance differences at $P \leq 0.05$ were used for mean separation.

Miscanthus sinensis is a vigorous grass native to Asia that is used as an ornamental and for biomass production. This species can be quite invasive (Meyer, 2004) because of its high seed production under various environmental conditions and especially at higher elevations (Meyer and Tchida, 1999). A broad range of morphologically variable ornamental cultivars has been released (Smith et al., 2004). Efforts have been made to reduce seed set and viability in various *Miscanthus* cultivars. Research has shown that triploid genotypes produce less seed (Ranney and Touchell, 2016; Smith et al., 2004). Others have shown that certain cultivars produce nonviable seed (Rounsaville et al., 2011).

Origin

During the Summer of 2005, Dave Dagan with Emerald Coast Growers in Pensacola, FL, visited our red/purple ornamental *Pennisetum* grass breeding program in Tifton, GA. He mentioned the need for a seed sterile *Miscanthus* cultivar because most *Miscanthus* cultivars have greater seed set at higher elevations, which tended to make this genus invasive. Emerald Coast Growers sent to us germplasm (which we designated M90) of

planted into a field nursery at Tifton, GA, on 21 Apr. 2006. On 9 Aug. 2006, 37 and 1 plants survived the 4- and 8-Kr treatments, respectively. Seven plants from the 4-Kr treatment had tillers with reduced seed set. One plant, 4-22-1-1, had tillers with no seed set. A sterile culm from 4-22-1-1 was designated M8-4 in 2008 and observed for seed set through 2009 at Tifton, GA. In 2010, M8-4 was designated as M8 and planted at Blairsville, GA. That year, M8 averaged one seed per inflorescence at Tifton (plant designated M8-4 in 2008 and 2009) and produced no seed at Blairsville, whereas the *Miscanthus* control produced numerous seed at both locations in nonreplicated tests. The seed

Miscanthus sinensis var. *gracillimus*. Unprotected roots of 59, 44, and 49 plants were irradiated with 4-, 8-, and 12-Kr, respectively, of Cobalt 60 radiation and trans-

Table 1. Height of inflorescence of two *Miscanthus sinensis* ornamental grasses (‘M77’ = experimental and M90 = var. *gracillimus*) grown at two locations in Georgia.

Entry	Ht of inflorescence (cm) ^z						
	Tifton ^y				Blairsville ^x		
	2012 ^w	2012/2013	2013/2014	2012/2014	2012/2013	2013	2012/2015
‘M77’	122	111	133	203	200	122	184
M90	145	143	136	208	212	144	210
LSD ^v	11	10	NS	NS	12	11	NS
GD ^u	180	182	197	197	154	116	162

^zPlant height measured from ground level to top of inflorescence.

^yTifton: Tests planted 18 Apr. 2012 and 13 Apr. 2013 and measurements taken 15 Oct. 2012, 30 Sept. 2013, and 9 Sept. 2014, respectively.

^xBlairsville: Planted 14 Apr. 2012 and 16 May 2013, and measurements taken 9 Sept. 2013 and 24 Sept. 2015, respectively.

^wYear designations are as follows: single year is year planted and year data recorded; double years are “year planted/year data recorded.”

^vLeast significant difference (LSD) at the $P \leq 0.05$ level. NS = nonsignificant.

^uGD = growth days of plants included in ratings.

Table 2. Height of leaves of two *Miscanthus sinensis* ornamental grasses (‘M77’ = experimental and M90 = var. *gracillimus*) grown at two locations in Georgia.^z

Entry	Tifton ^y				Blairsville ^x		
	2012 ^w	2012/2013	2013/2014	2012/2014	2012/2013	2013	2012/2015
	2012 ^w	2012/2013	2013/2014	2012/2014	2012/2013	2013	2012/2015
‘M77’	66	67	106	136	122	66	151
M90	90	76	100	140	144	89	140
LSD ^v	11	NS	NS	NS	11	10	NS
GD ^u	180	182	197	197	154	116	162

^zHeight of leaves measured from ground level to top of leaf canopy.

^yTifton: Tests planted 18 Apr. 2012 and 13 Apr. 2013 and measurements taken 15 Oct. 2012, 30 Sept. 2013, and 9 Sept. 2014, respectively.

^xBlairsville: Planted 14 Apr. 2012 and 16 May 2013, and measurements taken 9 Sept. 2013 and 24 Sept. 2015, respectively.

^wYear designations are as follows: single year is year planted and year data recorded; double years are “year planted/year data recorded.”

^vLeast significant difference (LSD) at the $P \leq 0.05$ level. NS = nonsignificant.

^uGD = growth days of plants included in ratings.

Table 3. Canopy diameter of two *Miscanthus sinensis* ornamental grasses (‘M77’ = experimental and M90 = var. *gracillimus*) grown at two locations in Georgia.

Entry	Canopy diam (cm) ^z					
	Tifton ^y			Blairsville ^x		
	2012/2013 ^w	2013/2014	2012/2014	2013	2014	2012/2015
‘M77’	58	91	151	100	54	184
M90	66	88	153	135	128	159
LSD ^v	NS	NS	NS	25	20	NS
GD ^u	182	197	197	116	130	162

^zCanopy diameter is the average diameter of the widest and the narrowest diameter of a single plant canopy.

^yTifton: Tests planted 18 Apr. 2012 and 13 Apr. 2013 and measurements taken 30 Sept. 2013 and 9 Sept. 2014, respectively.

^xBlairsville: Planted 14 Apr. 2012, 16 May 2013, and 15 May 2014, and measurements taken 9 Sept. 2013, 22 Sept. 2014, and 24 Sept. 2015, respectively.

^wYear designations are: single year is year planted and year data recorded; double years are “year planted/year data recorded.”

^vLeast significant difference (LSD) at the $P \leq 0.05$ level. NS = nonsignificant.

^uGD = growth days of plants included in ratings.

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sterile plant at Blairsville (elevation 594 m) was designated M77 and tested at Tifton (elevation 114 m) and Blairsville in replicated tests from 2012 through 2015. Tests consisted of five and three single-plant replications arranged in a randomized complete block design at Tifton and Blairsville, GA, respectively.

Description and Performance

The objective of this project was to develop a seed sterile *Miscanthus sinensis*. 'M77' (Supplemental Figs. 1 and 2) is a radiation-induced mutant of M90 (*Miscanthus sinensis* var. *gracillimus*), the original irradiated cultivar. Height of the 'M77' inflorescences were significantly shorter than those of M90 in four of the seven tests (Table 1). Height of the leaf canopy of 'M77' was significantly shorter than that of M90 in three of the seven tests (Table 2). Canopy diameter was significantly narrower for 'M77' compared with M90 in only two of the six tests (Table 3). This appeared to be associated with the year of establishment. There were only small differences in canopy diameter between the two cultivars following the year of establishment and, as expected, plants tended to become more robust as they became older. Differences in inflorescence length appeared to be small between the two cultivars and significant only in two of the five tests (Table 4). 'M77' usually had fewer inflorescences than M90, but this trait was significant in only two of seven tests (Table 5). Inflorescence number varied greatly from plant to plant, which was probably because of environmental effects. Leaf length and width were similar for 'M77' and M90 (Table 6). However, leaves of M90 were significantly longer than those of M77 at Tifton in 2013. Mature plant color for 'M77' was Green 143A according to the Royal Horticultural Society color index (Royal Horticultural Society, 2007).

The data show (Table 7) that seed set was greatly reduced for 'M77' compared with M90 and statistically significant for all years tested. In 2015, we also tested 75 and 12 clones of 'M77' at Tifton and Blairsville, respectively, for uniformity and seed set. All were sterile and uniform (as expected). Although 'M77' sets a small amount of seed, we wanted to know how many of the seeds produced actually germinated. In 2015, we tested the germination of seed harvested in 2014 from both Tifton and Blairsville (note: a very large number of inflorescences of 'M77' were harvested at Tifton and Blairsville to obtain enough seed to determine seed germination of this cultivar). Seeds were stored in small Kraft envelopes in a threshing shed for 6 months. Seeds were then planted in steam-sterilized soil and allowed to germinate for 45 d. During the germination period, the seeds were subjected to random wet and dry periods. Seedling emergence was rated at three dates during this period. None of the seed produced at Tifton germinated and only 32% of the seed harvested at Blairsville germinated

Table 4. Inflorescence lengths of two *Miscanthus sinensis* ornamental grasses ('M77' = experimental and M90 = var. *gracillimus*) grown at two locations in Georgia.

Entry	Length of inflorescence (cm)				
	Tifton ^z		Blairsville ^y		
	2012 ^x	2012/2013	2013	2012/2013	2012/2015
'M77'	20	36	20	33	28
M90	26	35	25	32	29
LSD ^w	2	NS	2	NS	NS
GD ^v	180	182	116	154	162

^zTifton: Tests planted 18 Apr. 2012 and 13 Apr. 2013 and measurements taken 15 Oct. 2012 and 30 Sept. 2013, respectively.

^yBlairsville: Planted 14 Apr. 2012 and 16 May 2013, and measurements taken 9 Sept. 2013 and 24 Sept. 2015, respectively.

^xYear designations are as follows: single year is year planted and year data recorded; double years are "year planted/year data recorded."

^wLeast significant difference (LSD) at the $P \leq 0.05$ level. NS = nonsignificant.

^vGD = growth days of plants included in ratings.

Table 5. Number of inflorescences on two *Miscanthus sinensis* ornamental grasses ('M77' = experimental and M90 = var. *gracillimus*) grown at two locations in Georgia.

Entry	Number of inflorescences/plant						
	Tifton ^z				Blairsville ^y		
	2012 ^x	2012/2013	2013/2014	2012/2014	2012/2013	2013	2012/2015
'M77'	23	20	103	86	81	21	133
M90	34	57	95	127	108	83	153
LSD ^w	NS	NS	NS	23	NS	37	NS
GD ^v	180	182	197	197	154	116	162

^zTifton: Tests planted 18 Apr. 2012 and 13 Apr. 2013, and measurements taken 15 Oct. 2012, 30 Sept. 2013, and 9 Sept. 2014, respectively.

^yBlairsville: Planted 14 Apr. 2012 and 16 May 2013, and measurements taken 9 Sept. 2013 and 24 Sept. 2015, respectively.

^xYear designations are as follows: single year is year planted and year data recorded; double years are "year planted/year data recorded."

^wLeast significant difference (LSD) at the $P \leq 0.05$ level. NS = nonsignificant.

^vGD = growth days of plants included in ratings.

Table 6. Leaf length and width of two *Miscanthus sinensis* ornamental grasses ('M77' = experimental and M90 = var. *gracillimus*) grown at two locations in Georgia.

Entry	Leaf length (cm) ^z		Leaf width (mm) ^y	
	Tifton ^x		Blairsville ^w	
	2012/2013 ^v	2012/2015	2012/2013	2012/2015
'M77'	44	68	4.37	5.2
M90	53	52	4.57	5.5
LSD ^u	6	NS	NS	NS
GD ^v	182	162	182	162

^zTifton: Test planted 18 Apr. 2012 and measurements taken 30 Sept. 2013.

^yLeaf width (average from three culms) was measured in the center of the latest fully extended leaf.

^xLeaf length (average from three culms) was measured from the leaf collar to the leaf tip of the latest fully extended leaf.

^wBlairsville: Planted 14 Apr. 2012 and measurements taken 24 Sept. 2015.

^vYear designations are as follows: double years are "year planted/year data recorded."

^uLeast significant difference at the $P \leq 0.05$ level. NS = nonsignificant.

^vGD = growth days of plants included in ratings.

Table 7. Seed set on two *Miscanthus sinensis* ornamental grasses ('M77' = experimental and M90 = var. *gracillimus*) grown at two locations in Georgia.

Entry	Seeds per inflorescence ^z						Seed germination (%) ^y	
	Tifton ^x			Blairsville ^w			Tifton	Blairsville
	2012/2013 ^v	2012/2014	2015	2012/2013	2012/2014	2012/2015	2014	2014
'M77'	0.0	7	0	0.02	0.4	0	0	32
M90	0.02	256	588	24	51	138	42	70
LSD ^u	0.0	2	129	0.0	0.0	0.0	17	15

^zSeeds per inflorescence; each replication was the mean of four random inflorescences.

^ySeed germinations: Germination tests consisted of 25 seeds from four and three different plants (replications) harvested in Oct. 2014 at Tifton and Blairsville, respectively. Germination tests were conducted in April of 2015 to allow seeds to go through a dormancy period and simulate field conditions.

^xTifton: Tests planted 18 Apr. 2012 and 12 May 2015 and seeds were harvested in October of 2013, 2014, and 2015.

^wBlairsville: Planted 14 Apr. 2012, and seeds were harvested in Oct. 2013, 2014, and 2015, respectively.

^vYear designations are as follows: single year is year planted and year data recorded; double years are "year planted/year data recorded."

^uLeast significant difference (LSD) at the $P \leq 0.05$ level.

(Table 7), further reducing the invasive potential of ‘M77’, especially needed at higher elevations.

Availability

M77 is a patented cultivar by the University of Georgia. A field planting of breeder material for ‘M77’ is maintained at the University of Georgia, Tifton Campus. As a protected cultivar, M77 can be produced only

by nurseries licensed by the Georgia Research Foundation. ‘M77’ will be marketed as SCOUT™.

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Supplemental Fig. 1. 'M77' at vegetative stage.

Supplemental Fig. 2. 'M77' at flowering.