‘Tift H18’ and ‘Tift PA5’ Ornamental *Pennisetum alopecuroides*

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Additional index words. drought tolerant, ornamental grass, plant breeding, reduced-seed *Pennisetum*, seed-sterile *Pennisetum*

Pennisetum alopecuroides (L.) Spreng. is a perennial warm-season grass native to Asia and Australia. It is sometimes referred to “fountain grass”; however, be aware that a number of *Pennisetum* species are referred to as “fountain grass.” It is mainly used as an ornamental in the United States and it performs well in sunny locations. Cultivars usually range in height from 0.75 to 1.5 m (Missouri Botanical Gardens ‘*Pennisetum alopecuroides*’, n.d.).

Reduced seed production in vegetatively propagated ornamental plants is a desirable trait because it helps maintain the purity of the commercial cultivar. Seed set in *Miscanthus sinensis* has been reduced through ploidy manipulation (Ranney and Touchell, 2016) and gamma radiation (Hanna and Schwartz, 2019). ‘Desert Plans’ (Trucks, 2010) and ‘Ginger Love’ (Horvath, 2016) were cultivars developed from seedling selections, and ‘JS Jommenik’ (Spruyt, 2016) developed from a shoot mutation are among vegetatively propagated *P. alopecuroides* patented cultivars, but none report seed production for these cultivars in the patents. Blackman (2011) developed ‘Burgundy Bunny’ from a natural mutation and reported that no seed were observed, but did not report the comparison of this cultivar to a seed producing-genotype. Our objective was to use Cobalt 60 gamma radiation to reduce seed production in *P. alopecuroides* genotypes with desirable ornamental characteristics.

‘Tift H18’ (PP30724 P2) and ‘Tift PA5’ (PP31027 P2) are perennial *P. alopecuroides* grasses with desirable ornamental characteristics and significantly reduced seed production. Both were approved for release by the University of Georgia College of Agricultural and Environmental Sciences in 2016. We evaluated ‘Tift H18’ and ‘Tift PA5’ at

Tifton, GA (lat. 31.4505°N, long. 83.5085°W; elevation, 107.9 m) and Blairsville, GA (lat. 34.8762°N, long. 83.9582°W; elevation, 573.9 m) in comparison with Tift PA24, a seed-fertile *P. alopecuroides* with desirable ornamental characteristics. Cultivars were tested on soil types Tifton loamy sand and Transylvania clay loam at Tifton and Blairsville, respectively. The active growing seasons are April through November at Tifton and May through October at Blairsville. Average monthly rainfall for the growing season was 114 mm and 90 mm at Blairsville and Tifton, respectively. Average monthly high temperatures for the growing season are 26 and 28 °C, whereas average monthly low temperatures are 13 and 16 °C for Blairsville and Tifton, respec-

tively. 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 difference at $P \leq 0.05$ was used for mean separation.

Origin

Vegetative plants of *P. alopecuroides* var. Hameln were obtained from Emerald Coast Growers in Spring 2008. We harvested open-pollinated (OP) seed from the plants in 2008 and transplanted 400 plants from the OP seed into a field nursery in 2009. Seeds were harvested from 50 plants with the most desirable ornamental morphological characteristics, and these seeds were irradiated in 2010 with 10 and 15 Kr Cobalt 60 gamma radiation. One hundred sixty-nine and 154 plants from the 10-Kr and 15-Kr treatments, respectively, were established in the field in 2010. Three plants from the 10-Kr treatment and three plants from the 15-Kr treatment with one or no seed per inflorescence (many sectors) were selected. These six plants had desirable ornamental morphological characteristics and were numbered 1 through 6. These six plants were propagated vegetatively by sections of the plants, with 3 o’clock being “a” and, moving counterclockwise

Table 1. Height of inflorescence of three *Pennisetum alopecuroides* grasses (Tift PA24 is the seed-fertile control) planted at two locations in Georgia.

	Ht of inflorescence ^z						
	Tifton ^y			Blairsville ^x			
	2012	2014	2015	2012	2013	2014	2015
‘Tift’ entry	180 ^w	99	101	178	116	130	155
PA5	37	45	52	59	84	67	89
H18	28	30	39	—	70	—	53
PA24	62	51	83	107	126	106	106
LSD ^v	6	9	8	9	12	14	9

^zPlant height measured from ground level to top of inflorescence.^yTests planted 18 Apr. 2012, 2 June 2014, and 12 May 2015; measurements taken 15 Oct. 2012, 9 Sept. 2014, and 21 Aug. 2015.^xPlanted 14 Apr. 2012, 16 May 2013, and 15 May 2014; measurements taken 9 Sept. 2012, 9 Sept. 2013, 22 Sept. 2014 and 24 Sept. 2015 (data taken on 2014 plants).^wGrowth days of plants included in ratings.^vLeast significant difference at the $P \leq 0.05$ probability level.

— = data lost.

Table 2. Height of leaves of three ornamental *Pennisetum alopecuroides* grasses (Tift PA24 is the seed-fertile control) planted at two locations in Georgia.

	Ht of leaves ^z							
	Tifton ^y				Blairsville ^x			
	2012	2013	2014	2015	2012	2013	2014	2015
‘Tift’ entry	180 ^w	170	99	101	148	116	130	155
PA5	55	32	33	30	41	54	32	51
H18	49	12	20	20	—	55	—	33
PA24	86	41	34	54	60	73	50	83
LSD ^v	9	8	7	5	5	9	10	5

^zHeight of leaves measured from ground level to top of leaf canopy.^yTests planted 18 Apr. 2012, 13 Apr. 2013, 2 June 2014, and 12 May 2015; measurements taken 15 Oct. 2012, 30 Sept. 2013, 9 Sept. 2014, and 21 Aug. 2015, respectively.^xPlanted 14 Apr. 2012, 16 May 2013, and 15 May 2014; measurements taken 9 Sept. 2012, 9 Sept. 2013, 22 Sept. 2014, and 24 Sept. 2015 (data taken on 2014 plants).^wGrowth days of plants included in ratings.^vLeast significant difference at the $P \leq 0.05$ probability level.

— = data lost.

Received for publication 10 Mar. 2020. Accepted for publication 13 Apr. 2020.

Published online 14 May 2020.

We thank the University of Georgia Research Foundation and Georgia Seed Development for financial support. We also appreciate the cooperation and/or assistance of Ray Covington, Larry Baldree, Leanna Leach, Amanda Webb, and Jacob Kalina.

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around the plant, “b” being 12 o’clock, “c” being 9 o’clock, and “d” being 6 o’clock. The plants were transplanted to the field in 2011. As many propagules as possible were obtained from each section. Inflorescences from six plants from section 4b (15-Kr treatment) set various amounts of seed, but one plant (field entry 133) produced no seed and became ‘Tift H18’.

Seeds of the plant collection Tift PS989 (mixed genotypes of *P. alopecuroides* sent to the United States from Korea in 1989) were irradiated on 11 Nov. 2010 with 10 Kr Cobalt 60 gamma radiation, and 256 plants were planted into the field on 29 Mar. 2011. In 2011, six of the 256 plants grown from the 10-Kr-treated seeds were evaluated and selected based on morphological desirability and reduced seed set. OP pollinated seeds (a second generation of seeds) from these six selected plants were harvested and irradiated with 10 Kr Cobalt 60 on 10 Jan. 2012. Sixty-four plants were established in the field in 2012 from only one of the six plants selected in 2011. Plants grown from irradiated seeds usually have chimeras or sectors for the traits of interest. Therefore, each of the 64 plants was divided into four quadrants (as described earlier for ‘Tift H18’), and five or more inflorescences from each quadrant were examined for seed set. A highly seed-sterile sector “a” from plant no. 60 was selected and propagated asexually to produce ‘Tift PA5’.

‘Tift H18’ (Supplemental Figs. 1 and 2) and ‘Tift PA5’ (Supplemental Figs. 3 and 4) were tested at Tifton and Blairsville from 2012 through 2015. Evaluation tests consisted of five and four single-plant replications arranged in a randomized complete block experiment at Tifton and Blairsville, GA, respectively. Propagules were rooted and established in the greenhouse 6 weeks before being transplanted to the field on 160-cm centers. Weeds were controlled by both chemical and mechanical methods. Plots were irrigated only at planting to

ensure uniform establishment. Other experimental entries were included in each test. Tift PA24 was selected from Tift PS1122 and served as the seed-fertile control with desirable ornamental characteristics (Supplemental Fig. 5).

Description and Performance

‘Tift H18’ and ‘Tift PA5’ were significantly shorter from ground level to top of inflorescences (Table 1) and to top of leaf canopy (Table 2), and had a smaller canopy diameter (Table 3) compared Tift PA24. However, in the 2014 Tifton test, ‘Tift PA5’ had similar inflorescence and leaf height as Tift PA24. Inflorescence and leaf height of ‘Tift H18’ were significantly shorter than those of ‘Tift PA5’ in all tests where these two cultivars were compared. Canopy diameter was significantly less for ‘Tift H18’ compared with ‘Tift PA5’ in the 2015 Blairsville test, but significantly larger in the 2012 Tifton test, whereas canopy diameter was similar in the 2015 Tifton test. Inflorescence number was significantly less for ‘Tift H18’ and ‘Tift PA5’ or similar to Tift PA24 except in the 2015 Blairsville test, in which ‘Tift PA5’ produced significantly more inflorescences than ‘Tift H18’ and Tift PA24 (Table 4). Inflorescence length was generally significantly shorter or equal to Tift PA24. In the 2012 Blairsville test, ‘Tift H18’ inflorescences were significantly longer than those of either ‘Tift PA5’ or Tift PA24 (Table 5). Leaf length and width were significantly narrower in all tests for ‘Tift H18’ and in

four of six tests for ‘Tift PA5’ compared with Tift PA24 (Table 6). Gamma radiation of seeds successfully reduced seed set in these selections (Table 7). ‘Tift H18’ produced significantly less seed per inflorescence than Tift PA24 in all tests. Germination tests were conducted on seeds produced by ‘Tift H18’ and Tift PA24. Seed were stored in manila envelopes for six months at room temperature in the threshing shed and then allowed to germinate for 45 d at 27 °C in steam-sterilized soil in the greenhouse. Germination of the few seeds produced by ‘Tift H18’ was 48% compared with 93% for Tift PA24, further reducing the seed-producing potential of ‘Tift H18’. ‘Tift PA5’ did not produce any seed in any of the tests and appears to be seed sterile. Although we have not determined the cause of seed sterility in these cultivars, research with mutagens in our laboratory (unpublished) has shown that Cobalt 60 gamma radiation can break chromosomes, thereby resulting in irregular segregation at microsporogenesis and megasporogenesis, and pollen and egg cell abortion.

‘Tift H18’ compares favorably with ‘Tift PA5’ at Tifton, but overall this selection did not perform as well in the replicated tests at Blairsville. We have no replicated data, but it appears that ‘Tift H18’ is sensitive to atrazine on heavier clay soils. However, we observed that ‘Tift H18’ performed well in isolated plantings where no herbicides were used. Mature plant color for ‘Tift PA5’ and ‘Tift

Table 4. Number of inflorescences per plant of three ornamental *Pennisetum alopecuroides* grasses (Tift PA24 is the seed-fertile control) planted at two locations in Georgia.

	Number of inflorescences per plant				
	Tifton ^z			Blairsville ^y	
	2012	2014	2015	2014	2015
‘Tift’ entry	180 ^w	99	101	130	155
PA5	—	58	67	54	100
H18	14	61	63	—	44
PA24	79	135	62	75	67
LSD ^w	33	42	16	43	19

^zTests planted 18 Apr. 2012, 2 June 2014, and 12 May 2015; measurements taken 15 Oct. 2012, 9 Sept. 2014, and 21 Aug. 2015, respectively.

^yPlanted 15 May 2014; measurements taken 22 Sept. 2014 and 24 Sept. 2015 (data taken on 2014 plants).

^wGrowth days of plants included in ratings.

^wLeast significant difference at the $P \leq 0.05$ probability level.

— = data lost.

Table 3. Canopy diameter of three ornamental *Pennisetum alopecuroides* grasses (Tift PA24 is the seed-fertile control) planted at two locations in Georgia.

	Canopy diam (cm) ^z			
	Tifton ^y		Blairsville ^x	
	2012	2015	2014	2015
‘Tift’ entry	180 ^w	101	130	155
PA5	48	62	61	103
H18	62	61	—	55
PA24	81	98	123	136
LSD ^y	10	9	25	7

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

^yTests planted 18 Apr. 2012 and 12 May 2015; measurements taken 8 Oct. 2012 and 21 Aug. 2015, respectively.

^xPlanted 15 May 2014; measurements taken 22 Sept. 2014 and 24 Sept. 2015 (data taken on 2014 plants).

^wGrowth days of plants included in ratings.

^wLeast significant difference at the $P \leq 0.05$ probability level.

— = data lost.

Table 5. Inflorescence length of three ornamental *Pennisetum alopecuroides* grasses (Tift PA24 is the seed-fertile control) planted at two locations in Georgia.

	Inflorescence length (cm) ^z					
	Tifton ^y		Blairsville ^x			
	2012	2015	2012	2013	2014	2015
‘Tift’ entry	180 ^w	101	178	116	130	155
PA5	10	7.3	9	11	8	12
H18	9	8.8	14	14	11	15
PA24	13	11.1	13	15	13	15
LSD ^y	1	0.8	1	1	2	1.4

^zInflorescence length is the mean of three inflorescences per plant.

^yTests planted 18 Apr. 2012 and 12 May 2015; measurements taken 15 Oct. 2012 and 21 Aug. 2015, respectively.

^xPlanted 14 Apr. 2012, 16 May 2013, and 15 May 2014; measurements taken 9 Sept. 2012, 9 Sept. 2013, 22 Sept. 2014, and 24 Sept. 2015 (data taken on 2014 plants).

^wGrowth days of plants included in ratings.

^wLeast significant difference at the $P \leq 0.05$ probability level.

Table 6. Leaf characteristics of individual plants of three ornamental *Pennisetum alopecuroides* grasses (PA24 is the seed-fertile control) planted at two locations in Georgia.

'Tift' entry	Leaf length ^z (cm)			Leaf width ^y (mm)		
	Tifton ^x		Blairsville ^w	Tifton ^x		Blairsville ^w
	2012	2015	2015	2012	2015	2015
PA5	24.7	23.4	28.8	5.0	4.7	9.6
H18	21.0	21.0	28.3	3.7	4.6	3.8
PA24	26.8	33.6	40.2	6.5	7.4	9.6
LSD ^v	5.1	3.3	10.9	1.4	0.7	1.1

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

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

^xTests planted 18 Apr. 2012 and 12 May 2015; measurements taken 15 Oct. 2012 and 21 Aug. 2015, respectively.

^wPlanted 15 May 2014 and measurements taken 24 Sept. 2015 (data taken on 2014 plants).

^vLeast significant difference at the $P \leq 0.05$ probability level.

Table 7. Seed set per inflorescence of three ornamental *Pennisetum alopecuroides* grasses (Tift PA24 is the seed-fertile control) planted at two locations in Georgia.

'Tift' entry	Seeds per inflorescence ^z				
	Tifton ^y		Blairsville ^x		
	2013	2015	2013	2014	2015
PA5	0.0	0.0	0.0	0.0	0.0
H18	0.3	0.0	—	1.8	0.1
PA24	15.4	91.5	121	102	71.2
LSD ^w	0.3	0.0	26	29.4	1.3

^zEach replication was the mean of four random inflorescences.

^yTests planted 13 Apr. 2013 and 12 May 2015; measurements taken in Oct. 2013 and 2015.

^xPlanted 16 May 2013 and 15 May 2014; measurements taken 9 Sept. 2013, 22 Sept. 2014, and 24 Sept. 2015 (data taken on 2014 plants).

^wLeast significant difference at the $P \leq 0.05$ probability level.

— = sample lost.

H18' was Green-141B and -139B, respectively, according to the Royal Horticultural Society (2007), whereas inflorescence colors were Greyed Orange-165B for both 'Tift PA5' and 'Tift H18'.

'Tift PA5' and 'Tift H18' have desirable ornamental characteristics and will be culti-

vars with significantly reduced seed production. 'Tift PA5' and 'Tift H18' are finer and more petite cultivars best suited for pot arrangements and isolated plantings. Although we have tested these cultivars in only U.S. Department of Agriculture hardiness zones 7 and 8, this species is reported to

grow in zones 5 to 9, but this species may not be a reliable winter-hardy perennial in zone 5 (Missouri Botanical Garden website: "*Pennisetum alopecuroides*").

Availability

'Tift H18' and 'Tift PA5' are patented cultivars by the University of Georgia. A field planting of breeder material for 'Tift H18' and 'Tift PA5' is maintained at the University of Georgia, Tifton Campus. As protected cultivars, 'Tift H18' and 'Tift PA5' can only be produced by nurseries licensed by the Georgia Research Foundation. 'Tift H18' will be marketed as Praline™ and 'Tift PA5' will be marketed as Hushpuppy™.

Literature Cited

- Blackman, L. 2011. *Pennisetum* plant named 'Burgundy Bunny'. US PP21917 P2.
- Hanna, W.W. and B.M. Schwartz. 2019. 'M77' ornamental *Miscanthus sinensis*. HortScience 54:1–3.
- Horvath, B. 2016. *Pennisetum alopecuroides* plant named 'Ginger Love'. US PP26442 P2.
- Missouri Botanical Gardens '*Pennisetum alopecuroides*'. (n.d.) 10 Apr. 2020. <<https://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?taxonid=285289&isprofile=1&basic=Pennisetum%20alopecuroides>>.
- Ranney, T.G. and D.H. Touchell. 2016. *Miscanthus sinensis* grass named 'NCMS1'. US PP26387 P3.
- Royal Horticultural Society. 2007. RHS colour chart. 5th ed. Royal Horticultural Society, London.
- Spruyt, J. 2016. *Pennisetum* plant named 'JS Jommenik'. US PP27435 P2.
- Trucks, G.M. 2010. *Pennisetum* plant named 'Desert Pains'. US PP20751 P2.

Supplemental Fig. 1. 'Tift H18' at anthesis in maintenance plots (year of establishment) in Tifton, GA.

Supplemental Fig. 3. 'Tift PA5' in research plots (year of establishment) in Blairsville, GA.

Supplemental Fig. 4. 'Tift PA5' in maintenance plots (year of establishment) at Tifton, GA.

Supplemental Fig. 2. 'Tift H18' at anthesis in yard (year of establishment) in Blairsville, GA.

Supplemental Fig. 5. Tift PA24 in maintenance plots at Blairsville, GA (1-year-old plants).