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'Ga. 6-1-269' (Gold Delight™), A Bronze, Fresh-Fruit Muscadine Grape with Hermaphroditic Flowers and Large Berries

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Additional index words: *Vitis rotundifolia*, breeding, cultivar

Abstract

'Ga. 6-1-269' is a hermaphroditic muscadine grape (*Vitis rotundifolia*) with bronze berries that was released by the University of Georgia (UGA) College of Agriculture and Environmental Sciences. Yields of 'Ga. 6-1-269' in Tifton, GA and Citra, FL trials were similar to other popular fresh-market muscadine cultivars. Berry size is very large (15-16 g) and similar to the cultivars 'Ga. 6-2-26' (Paulk®) and 'Supreme'. Fruit rot susceptibility of 'Ga. 6-1-269' was less than the bronze check cultivar 'Ga. 1-1-48' (Hall®) and similar to the black check cultivars 'Ga. 6-2-26' and 'Supreme'. Harvest time of 'Ga. 6-1-269' was about 5 days after 'Ga. 1-1-48' and about a week before 'Ga. 6-2-26' and 'Supreme'. 'Ga. 6-1-269' is recommended as an early-midseason fresh market bronze muscadine cultivar.

Origin

'Ga. 6-1-269' PPAF originated in Tifton, Georgia, from the cross 6-1 ('Early Fry' × 'Tara'; Fig. 1). 'Early Fry' is a patent-expired cultivar from Ison's Nursery that was released in 1993 and is a popular early-harvest bronze cultivar. The listed parentage of 'Early Fry' ('Sweet Jenny' × 'Ison') was called into question by Simple Sequence Repeat DNA analysis and an alternative pedigree of 'Fry' × 'Triumph' was suggested (Cao et al. 2020). Positive attributes of 'Early Fry' are very large berry size, early harvest, and good flavor (Conner 2009). Negative attributes of 'Early Fry' are low and uneven productivity, female flowers, and a somewhat dark berry color (P. Conner pers. obs.). 'Tara' is a 1993 UGA release with hermaphroditic flowers, bronze berries, medium berry size, and an early harvest (Conner 2009; Lane 1993). 'Tara' was released to be a commercial fresh-fruit cultivar but has largely been abandoned due to poor flavor. The original seedling vine of 'Ga. 6-1-269' was selected for hermaphroditic flowers, large berry size, and good flavor. Over several years of evaluation in a selection block, in comparison to several other selections from this same progeny, it was noted that 'Ga. 6-1-269' had even production, good vine health, and less fruit rot than other selections of the same pedigree. In 2017, 'Ga. 6-1-269' was placed in replicated yield trials at the UGA Tifton-Campus. In 2019, a cooperative testing agreement was begun with the University of Florida and 'Ga. 6-1-269' and several other selections were planted in a replicated trial at Citra, FL at the UF-IFAS Plant Science Research and Education Unit.

Materials and Methods

The testing locations were Tifton, GA on an experimental farm (lat. 31°28'39.81"N, long. 83°31'39.61"W) and Citra, FL at the UF-IFAS Plant Science Research and Education Unit (lat. 29°24'34.15"N, long. 82°10'01.21"W). 'Ga. 1-1-48', 'Ga. 6-2-26', and 'Supreme' vines were included as check cultivars at each location. At the Tifton trial, four vines of each check cultivar and 'Ga. 6-1-269' were evaluated. Vines were planted in 2019 with a spacing of 6.1 m between plants in the row and 4.5 m between rows in randomized order. Vines were trained to a single wire trellis with two cordons per vine. Drip irrigation was used, and diseases and insects were controlled according to

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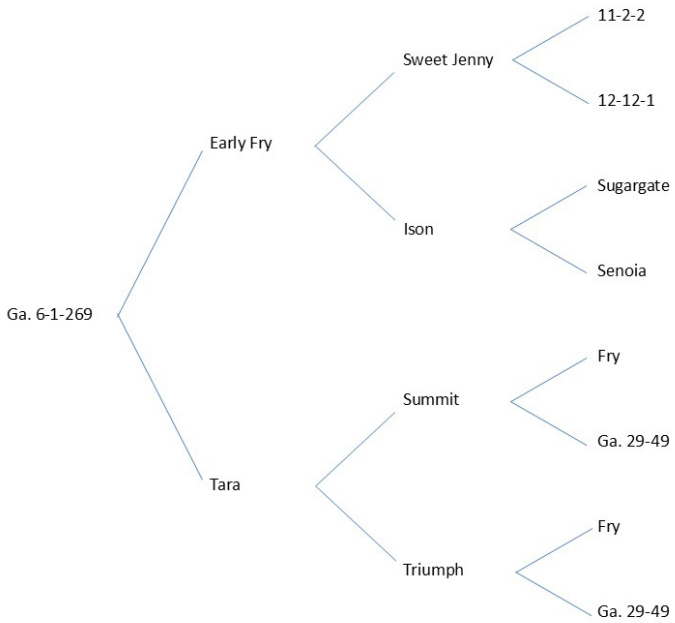

Figure 1. Pedigree of 'Ga. 6-1-269' muscadine grape.

commercial guidelines (Hoffman et al. 2020).

In the Tifton trial, yields of each vine were estimated by marking a 1 m section in the middle of the south cordon of each vine and collecting the berries from that section as they ripened. Vine yield was calculated by multiplying the sample yield by the total cordon length (6.1 m). Vines were harvested from year three (2019) to year eight (2024) except that harvest in year four (2020) was not taken due to the Covid crisis. Vines were harvested one to four times depending upon the uniformity of ripening, with the first harvest occurring as soon as approximately 30% of the berries were ripe. Percentage harvest at each harvest date was determined by dividing the harvest weight of the harvest by the total yearly harvest for the vine.

Once the yield was weighed to give the total yield weight, the berries were then sorted. Berries with any visible signs of decay were removed and weighed to calculate percent berry rot. Of the undecayed berries, berries were sorted into those which had pedicel scar splits (large cracks in which the interior flesh was visible), pedicel scar tears (peeling back of the berry epidermis), and dry pedicel scars. Percentage of each of these categories was calculated by dividing the weight of each category by the total weight of all three categories and then multiplying by 100. Rotted berries and berries with pedicel scar split are commonly removed when commercial growers pack fruit, so percent usable yield was calculated by the formula 100 × (1 - % berry rot / 100) × (1 - % pedicel scar split / 100). Ten berries were immediately randomly selected from the usable yield sample and measured for berry weight, berry diameter, and number of seeds. All ten berries were then crushed together to provide juice to determine percent soluble solids.

The Citra trial was conducted similarly to the Tifton trial except that the trial vineyard was separated into 4 blocks and in each block two replicate vines of each cultivar were planted. Total yield of each vine in the block was measured and then divided by two to get each of four replicate vine yields.

Differences between cultivars were determined using one-way analysis of variance (ANOVA) with mean separation by the Holm-Sidak test ($P<0.05$). Percentage data was analyzed after arcsine-square root transformation. Statistical analysis was performed using SigmaPlot 12.3 statistical software (Systat Software, San Jose, CA).

Description and Performance

Vines of 'Ga. 6-1-269' are hermaphroditic (perfect flowered) and thus do not need a pollenizer. Vines of '6-1-269' were vigorous, with drooping canes growing 1.2 to 1.4 m in a growing season. Typical cane diameter was 3 to 10 mm in diameter and in-

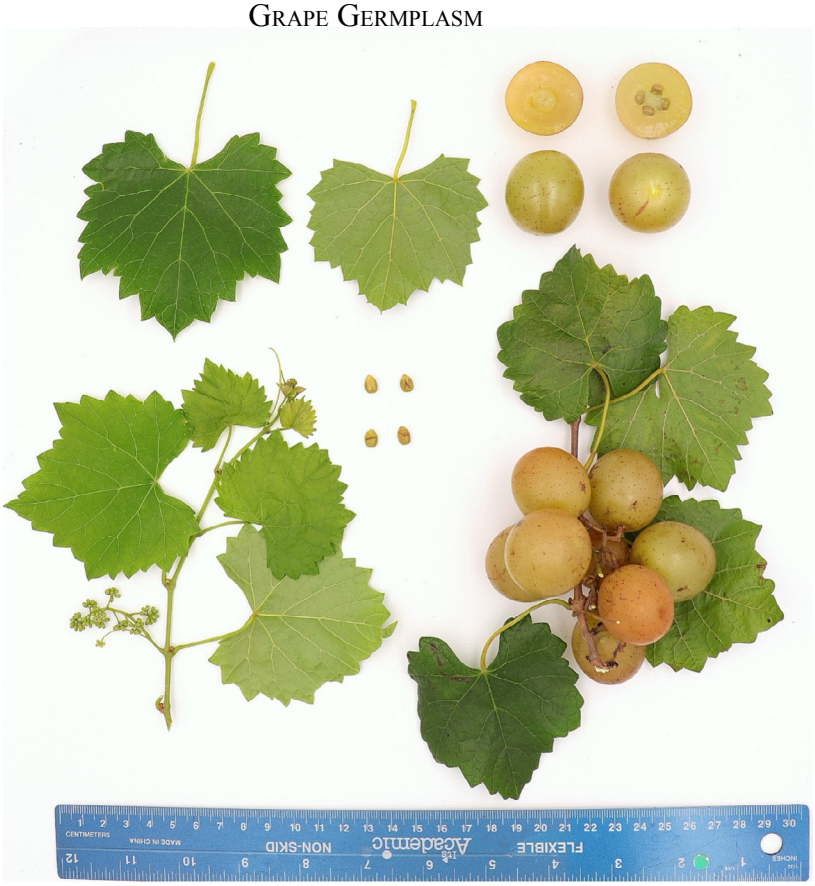

Figure 2. Leaves, shoot tip, flower cluster, fruit, and seed of 'Ga. 6-1-269' muscadine grape.

ternode length was 2.5 to 3.5 cm. Leaves averaged 89 to 91 mm in length and 88 to 92 mm in width. The leaves are circular with broadly toothed margins and glabrous on both upper and lower surfaces (Fig. 2). Petiole length is 6-7 cm and the petiolar sinus is open and "U" to "V" shaped.

Female muscadine cultivars generally have much lower yields than hermaphroditic cultivars, and the industry is moving away from them towards hermaphroditic cultivars for this reason (Conner and Worthington 2024; Hoffman et al. 2020). One exception is the cultivar 'Supreme', which has female flowers but often yields as well as hermaphroditic cultivars and is currently the most popular fresh-market muscadine cultivar. However, 'Supreme' is often stressed with those yield levels, and as we saw in the final year of the Tifton trial, vine death or decline is common. Our two other check cultivars were the recent UGA releases 'Ga. 1-1-48' (Conner 2014) and 'Ga. 6-2-26' (Conner 2017), both of which have hermaphroditic flowers and were released for the commercial fresh-market industry. 'Ga. 6-1-269' yielded in Tifton very similarly to all of the check cultivars (Table 1), indicating acceptable yield potential. 'Ga. 6-1-269' yielded similarly to 'Ga. 6-2-26' and 'Supreme', and better than 'Ga. 1-1-48' in the Citra test. Overall, these results indicate 'Ga. 6-1-269' has adequate yield for the fresh-market industry and is similar in productivity to other recent hermaphroditic releases. In addition to overall yield, we also record "usable yield", which is the yield of berries which are free from rot and pedicel scar splits which would cause spoilage in storage. Usable yield followed similar trends to total yield, and the percentage usable yield was nearly identical among all cultivars in the Tifton trial (Table 1). In the Citra trial, percentage usable yield was of 'Ga. 6-1-269' was similar to 'Ga. 6-2-26' and 'Supreme', and higher than 'Ga. 1-1-48' (Table 2).

In general, fruit rot is much higher in bronze-colored cultivars than in black-colored cultivars, for unknown reasons (Chen et al. 2001; Conner 2017; Hoffman et al. 2020). Ga. 6-1-269 berries were yellow-green to yellow in color with riper berries appearing more yellow (Figs. 1-2). In Tifton, fruit rot of 'Ga. 6-1-269' was similar to the black cultivars Ga. 6-2-26 and Supreme, and

Table 1. Yield (kg/6.1 m vine) of 'Ga. 6-1-269' and standard muscadine cultivars at Tifton, GA in the third and fifth through eighth[z] years of growth (2019, 2021-2024).

Cultivar	No. vines	Total Yield (kg)[y]	Usable yield (kg)[xy]	Percent usable yield[y]
Year 3				
Ga. 6-1-269	4	37.9	36.1	95.6
Ga. 1-1-48	4	23.7	21.8	86.6
Ga. 6-2-26	4	41.9	38.6	92.2
Supreme	4	22.5	19.3	87.5
Significance		N.S.	N.S.	N.S.
Year 5				
Ga. 6-1-269	4	39.0	30.8	82.9
Ga. 1-1-48	4	33.9	30.7	90.7
Ga. 6-2-26	4	58.7	49.8	85.1
Supreme	4	41.6	33.3	81.2
Significance		N.S.	N.S.	N.S.
Year 6				
Ga. 6-1-269	4	57.8	50.9	88.4
Ga. 1-1-48	4	42.6	39.3	93.0
Ga. 6-2-26	4	38.2	33.8	89.5
Supreme	4	55.0	49.2	88.8
Significance		N.S.	N.S.	N.S.
Year 7				
Ga. 6-1-269	4	40.2	38.4	95.6 a
Ga. 1-1-48	4	54.0	46.1	85.3 b
Ga. 6-2-26	4	45.4	43.6	96.0 a
Supreme	4	69.3	65.9	94.6 a
Significance		N.S.	N.S.	0.002
Year 8				
Ga. 6-1-269	4	71.6	62.3	86.6
Ga. 1-1-48	4	50.9	45.8	91.1
Ga. 6-2-26	4	52.6	49.9	94.6
Supreme	4			
Significance		N.S.	N.S.	N.S.
Average				
Ga. 6-1-269	4	49.4	43.9	89.9
Ga. 1-1-48	4	40.9	36.6	89.3
Ga. 6-2-26	4	48.2	43.3	90.2
Supreme	4	41.5	37.2	90.0
Significance		N.S.	N.S.	N.S.

[z]Year 4 was 2020 and harvest was interrupted by the COVID-19 crisis.
[y]Mean separation within columns by Holm-Sidak test, $P<0.05$.
[x]Usable yield is total yield minus weight of rotted berries and berries with pedicel scar splitting.

Table 2. Yield (kg/6.1 m vine) of 'Ga. 6-1-269' and standard muscadine cultivars at Tifton, GA in the third and fifth through eighth[z] years of growth (2019, 2021-2024).

Cultivar	No. reps	Total Yield (kg)[z]	Usable yield (kg)[yz]	Percent usable yield[z]
Year 3				
Ga. 6-1-269	4	7.5 ab	7.2 ab	96.3 a
Ga. 1-1-48	4	4.0 b	3.5 b	87.6 b
Ga. 6-2-26	4	5.2 ab	5.1 b	97.3 a
Supreme	4	8.8 a	8.4 a	95.7 a
Significance		0.007	0.004	<0.001
Year 4				
Ga. 6-1-269	4	20.0 a	18.3 a	91.3 b
Ga. 1-1-48	4	11.7 b	10.5 b	89.3 b
Ga. 6-2-26	4	12.5 b	12.0 b	96.2 a
Supreme	4	14.1 ab	12.9 b	91.5 b
Significance		0.009	0.008	<0.001
Year 5				
Ga. 6-1-269	4	19.5	17.6	89.2
Ga. 1-1-48	4	17.7	15.5	87.5
Ga. 6-2-26	4	18.3	16.6	90.6
Supreme	4	24.00	22.2	92.4
Significance		N.S.	N.S.	N.S.
Year 6				
Ga. 6-1-269	4	27.6 a	23.8 a	85.8 ab
Ga. 1-1-48	4	9.6 b	6.9 b	71.4 b
Ga. 6-2-26	4	22.0 a	19.3 a	87.9 a
Supreme	4	25.9 a	22.8 a	88.4 a
Significance		<0.001	<0.001	<0.001
Average				
Ga. 6-1-269	4	18.7 a	16.7 a	90.7 b
Ga. 1-1-48	4	10.8 b	9.1 b	84.0 c
Ga. 6-2-26	4	14.5 ab	13.3 ab	93.0 a
Supreme	4	18.2 a	16.6 a	92.0 ab
		0.003	0.002	<0.001

[z]Mean separation within columns by Holm-Sidak test, $P<0.05$.
[y]Usable yield is total yield minus weight of rotted berries and berries with pedicel scar splitting.

Table 3. Flower and fruit attributes of 'Ga. 6-1-269' and standard muscadine cultivars at Tifton, GA in the third and fifth through eighth[z] years of growth (2019, 2021-2024).

Cultivar	Flower type[y]	Berry color	Avg. day of first harvest	Berry rot (%)[x]	Berry stem scar split (%)[x]	Berry stem scar tear (%)[x]	Dry scar (%)[x]	Berry wt. (g)[x]	Berry diam. (mm)[y]	Percent soluble solids of all harvests[x]
Ga. 6-1-269	H	Bronze	222 b	2.0 b	8.1 ab	18.9 b	70.9 b	14.8 b	29.4 a	14.5
Ga. 1-1-48	H	Bronze	218 c	7.5 a	3.2 b	8.0 a	81.3 a	11.0 c	26.6 b	14.9
Ga. 6-2-26	H	Black	233 a	2.9 b	5.8 ab	8.5 a	82.8 a	16.6 a	30.3 a	14.8
Supreme	F	Black	232 a	1.6 b	10.3 a	22.1 b	66.0 b	15.9 ab	29.8 a	14.6
Significance			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	N.S.

[z]Year 4 was 2020 and harvest was interrupted by the COVID-19 crisis.
[y](**H**) hermaphroditic, (**F**) female.
[x]Mean separation within columns by Holm-Sidak test, $P<0.05$.

Table 4. Fruit attributes of 'Ga. 6-1-269' and standard muscadine cultivars at Citra, FL in the third through sixth years of growth (2021-2024).

Cultivar	Berry rot (%)[z]	Berry stem scar split (%)[z]	Berry stem scar tear (%)[z]	Dry scar (%)[z]	Berry wt. (g)[z]	Berry diam. (mm)[z]	Percent soluble solids of all harvests[z]
Ga. 6-1-269	4.5	4.8 ab	19.2 a	71.5 b	16.2 a	29.2 a	17.2 bc
Ga. 1-1-48	7.9	8.1 a	8.9 b	75.1 b	12.9 b	27.2 b	18.9 a
Ga. 6-2-26	4.4	2.7 b	6.3 b	86.6 a	17.2 a	30.1 a	17.4 b
Supreme	4.9	3.1 b	22.6 a	69.5 b	17.1 a	30.3 a	16.5 c
Significance	N.S.	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

[z]Mean separation within columns by Holm-Sidak test, $P<0.05$.

Figure 3. 'Ga. 6-1-269' muscadine grape with fruit on the vine ready to harvest.

superior to the bronze cultivar Ga. 1-1-48. The same trend was seen in the Citra test, but differences were not significant. This potential resistance to fruit rot is an important attribute of 'Ga. 6-1-269', especially in the coastal plain and deep south where rainy weather in August can lead to severe losses to ripe rot (*Colletotrichum gloeosporioides*), bitter rot (*Greeneria uvicola*), and macrophoma rot (*Botryosphaeria dothidea*) (Hoffman et al. 2020). Symptoms of Pierce's disease (*Xylella fastidiosa*) have not been observed on 'Ga. 6-1-269'. Percentage dry scars of 'Ga. 6-1-269' was similar to 'Supreme' and less than 'Ga. 1-1-48' and 'Ga. 6-2-26' (Tables 3-4) which were released in part due to their superior picking ability (Conner 2014; Conner 2017). However, this did not result in significantly lower usable yields (Tables 1-2).

Berry size of 'Ga. 6-1-269' is similar to, or slightly less than, 'Supreme' and 'Ga. 6-2-26', but higher than 'Ga. 1-1-48' (Tables 3, 4). This size range will make 'Ga. 6-1-269' the largest hermaphroditic bronze cultivar available, and the first hermaphroditic bronze cultivar in the very large berry size category (14-16 g). Flavor of 'Ga. 6-1-269' was good, and percent soluble solids was similar to the check cultivars. Seed number of 'Ga. 6-1-269' was similar to 'Ga. 6-2-26' and similar to, or more than, 'Supreme' and 'Ga. 1-1-48' (Tables 3, 4). Harvest times of 'Ga. 6-1-269' was about 5 days after 'Ga. 1-1-48' (Fig. 4), and about a week ahead of 'Ga. 6-2-26' and 'Supreme' at Tifton, making it an early midseason cultivar. Limited data is available to determine the cold hardiness of 'Ga. 6-1-269' vines, and large plantings should not be made in the northern muscadine regions until more data is available. 'Ga. 6-1-269' is easily propagated by softwood cuttings rooted under mist during June and July.

Availability

'Ga. 6-1-269' will be a patented cultivar (USPP applied for) and is owned by the University of Georgia Research Foundation. 'Ga. 6-1-269' will be marketed under the name Gold Delight™. Propagation rights are controlled by the University of Georgia Research Foundation, Technology Commercialization Office, GSRC Boyd Building, Athens, GA 30602-7411 (www.ovpr.u'Ga. 6-1-269'edu/tco/). A list of nurseries licensed to propagate 'Ga. 6-1-269' muscadine can be obtained by contacting the author.

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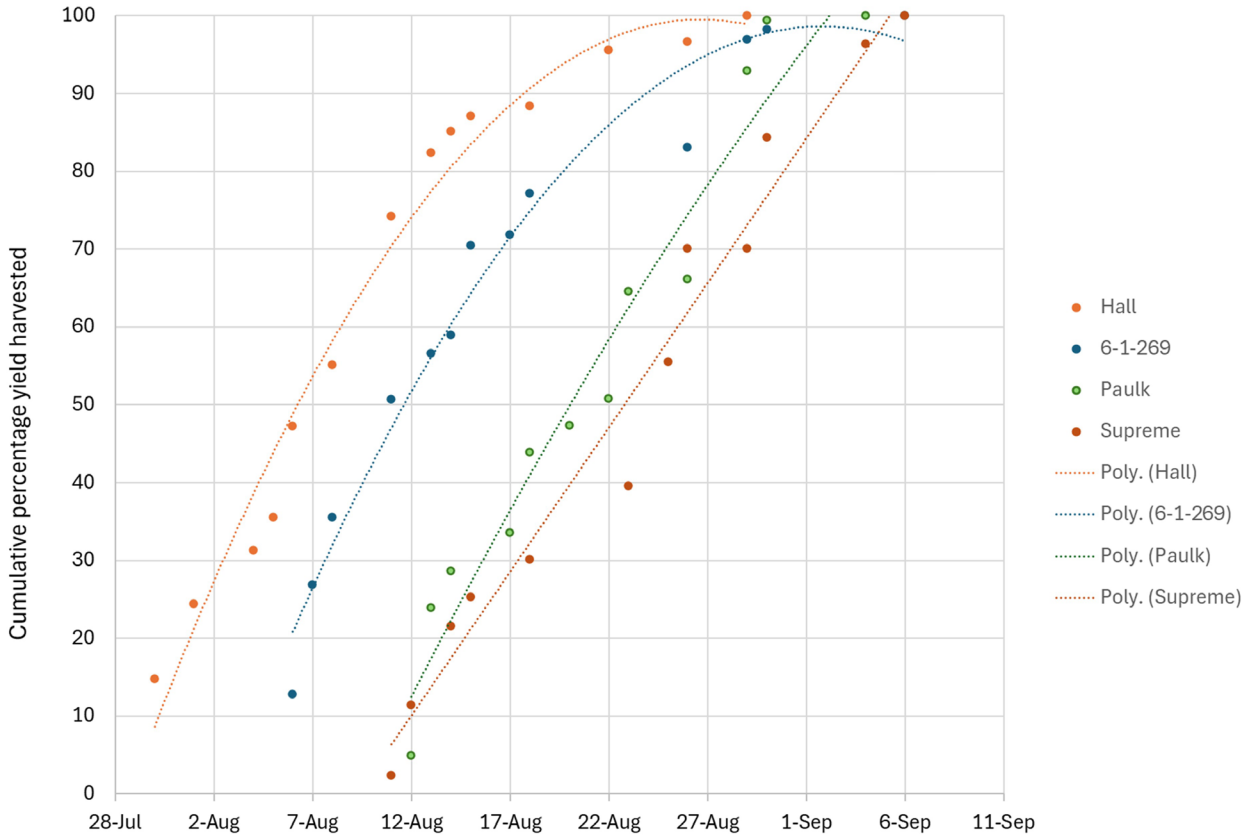

Figure 4. Cumulative harvest date of 'Ga. 6-1-269' and standard muscadine grape cultivars at Tifton, GA in the third and fifth through eighth years of growth (2019, 2021-2024).

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