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'O18-11-1' and 'O19-3-8', Two Seedless Muscadine Hybrids with Commercial Production Potential

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'O18-11-1' and 'O19-3-8' are the two seedless muscadine breeding lines from the Center for Viticulture, Florida A&M University. Both have produced parthenocarpic seedless fruit. Fruit set has been very low and fruit size has been small. These characteristics could be improved significantly by using the newly developed vineyard management system at Florida A&M University. Under the improved management, more than 60% of flower clusters can set fruit, and fruit can almost double in size. These increases show the potential for these breeding lines to grown commercially in the future.

Table grapes, mostly seedless, have a huge impact on the U.S. economy, which saw production of 1,039,950 tons of fresh grapes in 2016, valued at $1,560,129,000 (USDA, 2017). In the southeastern United States, where bunch grape (*Euvitis*) production is limited by Pierce's disease (PD), muscadine grapes (*Vitis rotundifolia* Michx.) are a sustainable crop, and table muscadines have become a successful industry. Since seedless grapes are overwhelmingly preferred by consumers, the muscadine industry needs seedless muscadines, unfortunately however, currently there is not a single seedless muscadine grape on the market today since there are no commercial cultivars.

'Fry Seedless' (Farrer × Redgate, Ison Nursery, GA, 1990, USPP7296 P) is the only seedless muscadine grape cultivar available. Problems include but not limit to small fruit and very low and unstable yields, which have made commercial production difficult.

To improve the quality of Florida's grapes and wines, the Florida A&M University (FAMU) Grape Breeding Program has been focusing on muscadine wine and table grape breeding for the past two decades. More the 15 seedless muscadine hybrids have been obtained, and are being evaluated. All currently available seedless muscadine hybrids, including 'Fry Seedless', are unable to be used commercially due to their extremely low and unstable yields, possibly caused by stigma necrosis during blooming (Fig. 1). The primary work indicates that the productivity of some seedless muscadine grapes could be increased with an improved management system (Ren and Sharkawy, 2017). Greater fruit set and larger fruit have been obtained with FAMU seedless muscadine hybrids 'O18-11-1' and 'O19-3-8', by improving the vineyard management system. These hybrids show promise for commercial production.

Origin

'O18-11-1' is a breeding line selection from FAMU muscadine hybrid 'O23-1-5' open pollinated. 'O23-1-5' is a decedent from cultivar 'Pam' open pollinated. 'O23-1-5' produces very large fruits with female flowers.

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Fig 1. Blooming cluster of 'O19-3-8'. Note the browning/necrosis of stigmas, extended stamens of the flowers.

'O19-3-8' is a hybrid of the muscadine germplasm collection tetraploid (4×) 'Summit' crossed with 'Ison', both 'Summit' and 'Ison' are recommended for the table grape industry.

The two hybrids were selected primarily for their seedless fruit. After vegetative propagation, they have been evaluated in the vineyard of the Center for Viticulture, Florida A&M University (FAMU), Tallahassee FL.

Prominent Features of 'O18-11-1' and 'O19-3-8'

Seedless fruit. Both breeding selections produced parthenocarpic fruit (Fig. 2, Fig. 3).

Larger fruit. 'O18-11-1' and 'O19-3-8' have produced large fruit weighing 3.7 g and 5.3 g, respectively (Fig. 2, Fig, 3, Table 1) with improved vineyard management, which are the largest fruits ever reported with seedless muscadine grapes. By comparison, 'Fry Seedless' produced 2.3 g fruit under the same conditions.

Increased production potential by improving vineyard management. Productivity, measured by total fruit weight per shoot harvested, has increased significantly by improving vineyard management. For 'O18-11-1' productivity increased from 0.3 g to 34.5 g per shoot. For 'O19-3-8' productivity increased

Fig. 2. Fruit cluster, berry, and parthenocarpy seedless of 'O18-11-1'.

Fig. 3. Fruit cluster, berry, and parthenocarpy seedless of 'O19-3-8'.

Table 1. The flower and fruit characteristics of FAMU seedless muscadine hybrids 'O18-11-1' and 'O19-3-8' in Tallahassee, FL.

	Flowers						Fruits		
Cultivar	Flowers /cluster[y]	Stamens	Functional pollen	Capstick	Stigma necrosis	Seedlessness	Size[z] (g)	SSC[z] (%)	Dry scar (%)
'Fry Seedless'	74~150	longer than stigma	no	common	common	parthenocarpy	2.3	17.8	100
'O18-11-1'	68~224	longer than stigma	no	rare	common	parthenocarpy	3.7	16.0	100
'O19-3-8'	38~ 73	longer than stigma	no	few	common	parthenocarpy	5.3	16.8	100

[z]With improved vineyard management vines.
[y]Ten random flower clusters.

Table 2. Horticultural characteristics of FAMU seedless muscadine hybrids O18-11-1 and O19-3-8 in Tallahassee, FL.

		Shoot	Shoot	Lateral shoot/	PD	Flower cluster		Productivity		Ripe
Cultivar	Vine vigor	inter node length (cm)	inter node circle (cm)	primary shoot[w]	score (0~5)	fruiting rate[z] (%)	Fruit no./ cluster[z]	Standard[y] (g/shoot)	Improved[z] (g/shoot)	rot (%)
'Fry Seedless'	vigorous	5.8	2.3	2.56	0	43.8	9.4	2.4	15.0	0
'O18-11-1'	vigorous	5.4	2.1	1.10	0	68.2	12.4	0.3	34.5	0
'O19-3-8'	moderate	4.3	1.8	0.16	0	63.6	8.5	5.1	31.8	0

[z]Average from 20 random shoot from improved vineyard management vines.
[y]Average from 20 random shoot from FAMU standard vineyard management vines.
[w]Average from 20 random spurs.

from 5.1 g to 31.8 g per shoot (Table 2). These are about 1/3 the productivity of one of the leading and most productive seeded table muscadine cultivars, 'Ison' (Ren and Sharkawy, 2017), which means these could be commercially accepted yields. The productivity improvements were apparently the results of better fruit set and increased fruit size. This shows that high productivity of 'O18-11-1' and 'O19-3-8' can be obtained by improving the vineyard management system. These improvements could lead the two hybrids to produce enough large fruits to make them commercial in the future.

Fewer lateral shoot developing. The number of lateral shoots produced by a primary shoot in 'Fry Seedless' was 2.5, compared to 1.1 and 0.2 in 'O18-11-1' and 'O19-3-8' (Table 2), respectively. More lateral shoots could not only make the microclimate inside the canopy worse with overcrowded shoots, but also increase the difficulty in vineyard management, so less lateral shoot development is a preferred horticultural trait.

Remarkable Flower Characteristics

Flower clusters. 'O18-11-1' had large flower clusters, each comprised of 68–225 flowers, while the flower clusters of 'O18-3-8' were smaller, consisting of 38–73 flowers (Table 1).

Pseudo-hermaphroditic/perfect/self-fertile flowers. The individual flowers of 'O18-11-1' and 'O19-3-8' have both stamens (consisting of anther and filament) and pistils (consisting of stigma, style, and ovary). The stamens are longer than the stigmas, while there was no functional pollen inside the anthers (Table 1). Therefore, the flowers are not self-fertile.

Stigma necrosis. Stigma necrosis has been common with all the seedless muscadine grape cultivars available, including 'O18-11-1' and 'O19-3-8.' This has only been observed in seedless muscadine grape vines, and not with seeded muscadine grape nor the normally fruiting seedless hybrid vine 'JTH', a FAMU breeding line from V. *vinifera* × V. *rotundifolia*. It is speculated that stigma necrosis during blooming could be related to the very low fruit set among seedless muscadine vines (Ren and Sharkawy 2017).

In brief, the good fruiting and large fruits produced by 'O18-11-1' and 'O19-3-8' with improvement vineyard management, showed the high value of these two hybrids in seedless muscadine grape production, continuing the work could help achieve their commercial potential.

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