STATUS OF THE INDUSTRY

Viticulture Advisory Council

2024 Annual Report
November 19, 2024

2024 Viticulture Advisory Council
Status of the Industry Report

VITICULTURE ADVISORY COUNCIL
ANNUAL INDUSTRY REPORT

Sector: Florida Wine and Grape Growers Association
Representative: Sarah Aschliman

PART I: Sector Update

Introduction

The Florida Wine and Grape Growers Association, a grower-centered organization, is committed to advancing Florida's grape, wine, and grape product industries through education, research, and marketing initiatives. Our members include wineries, both commercial and hobbyist grape growers, winemakers, nurseries, and representatives from Florida A&M University, the University of Florida, the University of Central Florida, as well as students and industry vendors.

Product Status

The Florida Wine and Grape Growers Association remains a steadfast community, meeting year after year to promote and strengthen Florida's wine and grape industry. While membership has fluctuated over the years, we're proud to see our commercial memberships growing and becoming even more engaged. This increase in support from commercial entities has allowed us to expand our research, marketing, and educational efforts. However, as some of our longstanding hobbyist members have aged out or stepped back, we've seen a shift in our membership base, creating new opportunities for fresh enthusiasm and perspectives within our association. As of October 2024, we have 48 members in the organization, but we usually will receive more in the next two months to close out the year. As people start registering for the 2025 conference in January.

In 2024 We had our annual FWGGA conference in DeLand, Florida with 62 members in attendance. We came in slightly under budget for the entire event and had a large number of speakers and academic participants. Dr. Fritz Westover (Penn State U), Islam El Sharkawy, PhD. (FAMU), **Todd Steiner (Ohio State University), Dr. Ali Sarkhosh (University of Florida) and more spoke at the 2024 conference to name a few.**

The 2025 Conference will take place on January 16-17, 2025 in DeLand, Florida. We have another great lineup of speakers for our 2025 conference, promising an insightful and engaging experience for everyone involved. This year, we're hosting with a lively pirate theme, making it a fun and memorable way to kick off the new year. We're excited for the chance to connect with our industry colleagues, share knowledge, and strengthen our community in a festive, welcoming environment. We had requested of grant from the VAC to be used toward the Conference, speaker costs, and student participation incentives in the amount of $10,000.

To inspire and involve a new generation of winemakers and grape-growing enthusiasts, we're focusing on outreach through strengthening our networking within the industry, using our annual conference, and connecting with emerging wineries and wine hobbyists. Our goal is to build a bridge to those interested in viticulture and winemaking, showcasing the vibrant community and resources our association offers. We are planning on organizing public events (annual wine conference and a wine competition), bolstering our social media presence, and more therefore aiming to increase

awareness and visibility of the association, inviting newcomers to join us in shaping the future of Florida's wine and grape industry.

Market Status

On the grape growers' side of the association - no change in prices from grower to the wineries for fresh fruit commerce. There were more grapes produced this year than last year, yields were good and most were consumed by wineries and fresh market. Not much left on the vine.

Wine producers and manufacturers in Florida are currently facing a slowdown in sales. Retail sales through grocery stores and independent outlets have declined compared to last year, and traffic in tasting rooms has also decreased. This downturn may be linked to several factors: the current political climate, the economic pressures of inflation, and the tighter budgets many Americans are managing. Consumers seem to be rethinking how they spend on luxury items, whether it's alcohol or even THC-based products, and that shift is affecting our industry.

Growth Status

As an organization, we have brought on 2 new board members in 2024, which has been a nice addition. We would like to get our membership numbers up by at least 10% next year as a goal. Possibly doing a membership drive at the end of 2024 before the conference.

Industry Issues and Needs

We're actively exploring the possibility of launching a Florida International Wine Competition and are committed to finding the perfect venue where our wines can shine. Our goal is to host this competition at a location that not only offers high visibility but also allows attendees to sample and purchase wines, creating a meaningful fundraiser for our organization. Currently, we're working closely with the City of DeLand and the West Volusia Tourism Council to identify the ideal festival or event where our competition can become a standout feature. While our search is ongoing, we're optimistic about finding the right platform to showcase the best of Florida's wines to both local and international audiences.

Conclusion

Despite current challenges, the Florida wine and grape industry remains optimistic that sales will rebound as America's economic landscape becomes more stable. We're encouraged by the steady growth of new wineries and the issuance of new licenses each month, showing that interest in our industry is as strong as ever. Our dedicated network of farmers and wineries continues to collaborate and innovate, keeping the spirit of Florida's wine industry vibrant and resilient. Together, we're committed to ensuring that Florida remains a fantastic place for winemaking and grape growing.

Fresh Fruit Sector Report
Florida Viticulture Advisory Council November 2024

Fresh Fruit Representative
Phillip McKinnie

Introduction	
	General Overview of Florida's Fresh Fruit Market. Approximately 22 U-Pick operators within the state of Florida which is down from 2023's 25 confirmed locations. There are significantly more noncommercial hobbyist producers within the state not included in this report.
Market Status	
	Within the State of Florida, demand for fresh muscadine table grapes is relatively consistent, driven by consumption in two categories (Retail and U-Pick). Retail demand (e.g. Walmart, Publix, Winn Dixie) is dominated by established supply agreements with growers outside of the State predominantly from an emerging commercial vineyard in Florida but mostly from vineyards in Georgia and North Carolina. Independent retail chains (e.g. Piggly Wiggly, Grocery Outlet) often leverage local growers in a less formal manner to source table muscadine fruit grapes but volumes are unpredictable since these retailers often repackage under their proprietary store brand. The U-Pick market is a niche and seasonal opportunity dominated by vineyard owners with loyal repeat customers. As previously noted in prior reports, the market is fragmented, driven by hobbyists and low-volume producers. Pop up vendors along roads is representative of the current market which is opportunistic during the harvest period and extremely sporadic. As part of the market assessment, I canvased U-Pick operators and was able to confirm 25 documented organizations offering U-Pick and fresh fruit in the State of Florida. There are more but many operate roadside and once their lugs are sold they don't return. I randomly contacted over 15 of these organizations and was able to speak with 4 U-Pick and/or fresh fruit growers. These organizations rely on loyalists, Facebook, word-of-mouth and local press releases. Note, fresh fruit continues to be a part time opportunity where few rely on the sales of fresh fruit to make a living.
Product Status	
	For 2024's growing season, most growers reported higher than average yields. Of those reporting higher than average yields, the results were better than the previous five years. However, there were cases reported where

	yields were lower than average. Overall, the production year was better than most as reported by the growers.
Pricing	U-Pick vineyards are pricing product in the range of $1.50 - $2.00 per pound, while twenty-pound retail lugs are ranging from $20 - $30 per lug depending on market supply. This is consistent with prior years despite pricing pressures.
Growth Status	The fresh fruit market has potential. Increased activity in the U-pick sector can be fueled by a push in Agri-tourism marketing at the local and county level. It's projected this sector will grow in the low single digits range. There are several New regulations favoring Agri-tourism which could foster further growth in this area if operators were to pool resources.
Industry Issues & Needs	Opportunity. Agritourism is a trend that seems to be growing driven by the need for more family friendly activities. The fresh fruit industry in Florida, including muscadine growers, have an opportunity to take advantage of this trend. Challenges. Fairly flat market pricing driven by seasonal availability. Lack of a robust database to aid in identifying U-Pick operators as well as no formal guidelines to establish minimum thresholds. The industry would benefit from a State-level coordinated media effort to increase public awareness. There is continued interest in viticulture in the state with vineyards being installed at risk which could drive pricing down potentially resulting in oversupply.
Summary	
	Florida's fresh muscadine fruit market is limited to small U-pick operators, spec sellers and local markets. To grow this segment, emphasis should be placed on establishing minimum guidelines followed by the establishment of a formal directory located on FWGGA's website as well as the Department of Agriculture.

Wineries Sector Annual Report to the Florida Viticulture Advisory Council
November 14, 2024

Wineries Sector
Christian Slupe

The wineries sector of the Florida grape and wine industry consists of 21 Florida Farm Certified Wineries, according to *fdacs.gov.* However, an audit of this list is something that is needed using the qualifications that are outlined in Chapter 599 of the Florida State Statute. Throughout the list of wineries in Florida, a large variety of wines and products are produced and sold on-site and through distribution. Overall, tourism continues to slow across the state, leading to a decrease in customers on-site. Retail prices continue to remain steady for the most part. However, the input costs have increased substantially with labor, glass, ingredients, and other packaging materials rising.

Last year's growing season consisted of a milder winter, with a smooth transition into Spring and a mostly consistent bud break. Compared to the year prior, there were no late unexpected frosts around or after bud break that affected the crop heavily. Although a consistent bud break in Spring, ripening across the state was very uneven, mostly presenting itself in the weeks leading up to Harvest as sampling efforts were taking place. Rains throughout the growing season were very inconsistent; the year started with almost drought-like conditions. The rain, however, picked up towards the end of the year, aligning with previous years' average rainfall. Harvest took place around the same time as years past, overall yields were up compared to 2023 but below average looking back on five years of data. The Welder Varietal was the most bountiful, with Carlos coming in after that. Grape size overall was down slightly this year; fruit sets may have been heavier, but this was counteracted by the size of the berries at the time of harvest. Altogether, fruit quality was consistent and in line with expectations, sugar content was down slightly when compared to years previous.

The market for muscadine grapes in Florida has remained consistent for another year, most fruit continues to sell at $500 a ton for both red and white muscadine varietals. Georgia continues to sell fruit for cheaper disallowing much of a market to sell Florida-grown muscadine grapes to other Northern states. Wholesale and retail prices of wine produced in the State of Florida also remained consistent year over year, even with increases in input and labor costs. Increases in these costs led to a slight decrease in profits, while also seeing a drop in visitors to said wineries. Wholesale continues to be a challenge as resets in the marketplace continue to take place and reduce shelf space for Florida-produced wine as many retailers continue to produce privately labeled wine at a much lower price point, which typically ends up on the shelf next to our Florida-produced wines.

Growth in the wineries industry continues to be slow-moving, with visitation and sales not quite returning to pre-COVID-19 levels. Special and one-off events at wineries such as harvest festivals, U-picks, etc. are one area in which growth is being seen as it seems consumers are paying more for experiences over purchasing wine and wine-related items. A continued issue for wineries in Florida is the realization of the quality of muscadine wine and other fruit wines that are produced within the state. Along with this are the health benefits attributed to Muscadine grapes and them having higher overall phenolic compounds when compared to other grapes.

With wineries of all sizes across the state, an industry need that continues to be called for is increased promotion from individual wineries along with the industry as a whole. Many consumers are unfamiliar with Florida wines and what the wineries have to offer outside of just selling wines, such as tours, U-picks, festivals, and other events. Promotional reimbursement continues to assist in these efforts, fueling growth within the industry. Weather was not an issue regarding the growing season last year. However, we have seen it impact the growth of both grapes and fruit in the state of Florida for many years looking back. Increased diseases such as black rot and powdery mildew continue to affect grape growers in the state, with increased prices for fungicides and Herbicides, input costs are seemingly increasing along with everything else. Research to mitigate these issues and introduce cover crops to increase the natural absorption of nutrients rather than turning to fertilizer and other unnatural products is needed and would be beneficial to many.

In conclusion, wineries in the state of Florida have had a relatively stagnant year when it comes to growth in sales in-house and through distribution. Higher yields in the field helped many growers/sellers after a drop in the previous year due to a late spring frost. The largest focus for wineries going forward will be the retail market and increasing visitors to establishments to introduce and educate them on Florida wines and what Florida Farm Wineries have to offer.

Sector Update

Introduction

The Florida wine industry continues to represent a unique regional enterprise of small- to medium-sized wineries, including 21 Farm Wineries mostly situated along the I-4 corridor. These wineries produce Muscadine, Blanc Du Bois, and tropical fruit wines that reflect the state's diverse agriculture.

With an estimated $15B in total economic impact in Florida, wine continues to be a value-added beverage. As Florida sees 40 million visitors annually and expects population increase of more than 200,000 in 2024, Florida wineries have significant potential to expand their market presence, keep more wine revenue in the State, and provide jobs and tax revenue for Florida communities.

Production Status

This year's grape harvest faced environmental and economic challenges, with some vineyard operators reporting harvests as low as 50% of their projected yields. Insufficient chill hours (60 out of the required 200 in central Florida for example) delayed growth and impacted quality. Labor costs for grape harvesting have nearly doubled due to the necessary use of H2A labor, making it increasingly difficult to sustain profitable grape harvests. Grape pricing has remained stable (a price range of $1.50 to $2.00) for decades so the grape sector's profitability remains uncertain, much like many other Florida crops. Thankfully, raw material costs in the winery, such as corks, labels, and bottles, have seen a leveling off in the last couple years and allowed consistency and predictability for winery raw material costs.

Market Status

Over the past year, Florida consumers purchased an estimated $1.8 billion in wine at retail, with most of these purchases in the $5 to $15 range. While sales across most wine categories declined, sparkling and "luxury" wines priced over $20 per bottle showed growth, perhaps reflecting a shift in consumer preferences. In the "super premium" segment, where most Florida wines are priced ($11-$15), volume sales declined by 1% compared to last year, in line with a 3% nationwide decline.

In the second half of the year, consumer price sensitivity also increased pushing many "super premium" wine buyers into the lower price categories at and below $10 per bottle. "On-premise" alcohol retailers like bars, restaurants and many wineries saw the return of a summer, seasonal sales dip in June to September not seen since 2019.

Growth Status

Florida's wine industry is experiencing gradual but cautious expansion, buoyed by agritourism and direct-to-consumer sales. However, growth continues to be hampered by high tax, insurance, and litigation burdens in addition to rising labor costs. Florida wineries face a per-gallon excise tax that is around 90% higher than in California, their largest competitor, translating to nearly $2 more per gallon in costs.

This significant tax disparity limits competitive pricing opportunities for Florida wines and challenges their marketability.

Due to excessive litigation and property insurance challenges, many wineries have also seen insurance rates double in the last five years. Agritourism businesses, such as wineries, do have some State protection from liability risks on their properties but those laws remain untested in court, so they do not reduce insurance costs and no case law exists to prove the value of those protections. Labor costs for hourly, salary and tipped employees continue to rise as well with mandatory minimum wages in all those categories likely to result in a reduction in staff in all parts of the business. Established wineries will most likely shift to more automation, technology, and self-service strategies in the tasting room in the coming years.

Conclusion

The Florida wine industry faces several challenges, including high tax burdens, increased labor and insurance costs, as well as climate-related difficulties. However, the sector has substantial growth potential due to the state's tourism influx and rising population. With strategic legislative support, focused research, and enhanced consumer promotions, Florida wineries can strengthen their competitive edge and build a sustainable future in the massive Florida and overall U.S. wine market.

VITICULTURE ADVISORY COUNCIL
ANNUAL INDUSTRY REPORT

Sector: Processed Foods
Representative: R. George Cowie

The number of manufacturers of processed muscadine grape products is an aggregate of few commercial and many more "cottage" producers that operate under the protection of the Cottage Food Regulation. Cottage producers can manufacture foods deemed to have a low risk of food borne illness in their own homes with no registration or inspection. Jams, Jellies and Preserves fall under this definition. These products can be offered for sale at roadside stands and farmers markets, or websites direct to consumers, but not offered wholesale. Cottage producers must comply with laws for collection of taxes. Florida has few commercial manufactures using muscadines, but an increasing number of Cottage producers. Several Cottage producers were contacted for this report. They either ignored email and phone communication or were reluctant to share information about their operations.

2024 Harvest Season
The 2024 growing season was favorable overall to most growers. Yields were up compared to the 2023 season. The dry weather for most of the harvesting window of muscadines allowed for good quality and low disease.

Market Status
There is an opportunity for in-state manufacturing to produce juice and jelly commercially as co-packed products for produce stands, wineries, and other retail outlets. Most Florida retailers of grape products rely on co-packed products from out of state. Several boutique juice manufacturers contacted in Florida deal strictly with citrus products. Including grape production in their portfolio is a bit of a challenge due to the seasonal nature of grape production and the differences of the products. While some wineries have packed juice, or supplied juice packers with raw juice, the differing nature of processes and regulatory compliance make this a challenge.

Growth Status
Out of state packers of juice have reported a softer market in 2024 as compared to 2023. As stated above, cottage manufacturers are a group that is difficult to get volume numbers from. One can observe an opportunity for juice and jelly products in the state's many produce stores that cater to tourists as well as wineries that operate retail stores. Quality and product shelf life are paramount to a sustainable industry. Trying to dovetail grape juice into citrus operations or wineries have obstacles that, while not impossible, are obstacles none the less.

Nursery Sector Annual Report to the Florida Viticulture Advisory Council
November 14, 2024

Nursery Representation
J. R. Newbold, Forest Groves, Inc.

The nursery sector of grape production in Florida consists of only a handful of growers who sell primarily to retail garden centers or to the public directly, 2-3 large growers who supply big box stores in the southeast and gulf coast states, and 1 tissue culture operation who sells starter liners to other growers both in and out of state. None of the nurseries primary incomes are based on the propagation and sale of grape vines but rather this makes up a small part of their business compared to other species they grow and sell. The larger growing operations continue to think the grape industry is stable while the smaller growers feel that the market and industry is slowly decreasing. Several contacts commented that the industry needs to increase the development and marketing of "Florida grown, hybrid bunch grapes along with Muscadine".

Below is a summary of discussions with several of Florida's growers.

Hopkins Nursery in Immokalee, FL is a wholesale plant nursery growing between 1,000 and 2,500 1-gallon pots per year. They started with plants sourced from Agri-Starts and still provide a limited selection of the patented plants. They have started to propagate non patented varieties as well. They do not specialize in any specific variety, but always have the goal of keeping several in stock. Bill Hopkins reports that demand is steady. Their primary customers are large chain garden centers. His clients do continue to request hybrid bunch grapes.

Bob Wallace at **Chestnut Hill Tree Farm** located in Alachua, Florida is growing around 1,500 1g Muscadine vines per year. Grapes make up less that .5% of their 150 acre farm's product line, however they enjoy growing and selling them and plan to continue. Chestnut Hill primarily sells to garden centers and walk in customers in Florida and they use the grape product line to help sell other berry and fruit trees that they grow. With the end user being homeowners and weekend gardeners as opposed to commercial landscape applications it makes it very difficult to sell. Bob feels as though more marketing is needed to promote Florida grown Muscadine to help increase awareness that Muscadine is a great tasting grape.

Southern Tree Source of Monticello FL reports that they produce around 500- 2 gallon pots of primarily Southern Home and Southern Jewel annually. Their primary sales are to retail garden centers. They source their material from Agri-Starts. Muscadines are part of a "small fruit" mix that they offer. Buster feels like the market for muscadines is steady and possibly growing. His clients frequently ask for thin skinned varieties. He has worked with Blanc du Bois but had difficulties and has discontinued that plant.

Agri Starts is a large tissue culture liner operation in Apopka, Florida. They have historically grown tissue culture grape liners for sales to other growers who end up selling to retail garden

centers. Over the past several years Argi Starts has narrowed their spectrum of varieties and decreased their overall production volume. Ty Strode, Vice President, said that they will continue with Noble, Carlos and Southern Home (for the Door Yard market). In the recent past, they had produced as many as 9 different varieties. The Door-yard product seems to have the most predictable sales volume. They do still work on a contract basis with clients for their specific needs, and are looking into the idea of producing a larger plug at an increased price to justify the cost of handling the low volume. In 2024 Agristarts continues to inventory a few basic muscadine varieties. They have the protocols ready to employ if and when new varieties are developed and commercial demand is present.

AgriStarts is continuing to work with the University of Georgia and Paulk Vineyards of GA, on new license varieties. They also intend to work with the USDA's National Clean Plant Network on muscadine projects.

Mr. Strode stated that muscadine sales make up less than 1% of their annual revenue. They believe that breeding research is extremely critical to increase the popularity of "Florida Grown Muscadine". The future of the Muscadine as an edible fruit weighs heavily on breeding to produce a much more pleasant experience for the consumer. The potential for more vineyards and boutiques in Florida is growing and a breakthrough in new and improved Muscadine cultivars could make all the difference.

Dewars Nurseries Inc. is a 300acre farm located in Apopka, Florida that specializes in potted plants, roses, and ornamental edibles. Dewars currently produces around 6 different varieties of grapes primarily Muscadine and sells them in 1 gallon, 2 gallon, and 3 gallon containers. Dewers grows grapes strictly on contract primarily for the large box stores such as Walmart and Lowes along the gulf coast states from Florida to Texas. Dewar's production manager, Terrell, said that last year grape sales generated 1.5% of Dewars overall revenue. They have been very happy with their grape product line and plan to continue with it. They believe the market is stable for now but could see improvement with increased promotion.

Simpsons Nurseries located in Monticello, Florida is another large operation that supplies a wide range of plant product to retail nurseries, landscapers, and mass merchandisers as far north as VA and west to TX. Simpsons Nursery produces a mix of Ornamental trees, shrubs, fruit trees and ornamental edibles. Bunch Grape and Muscadine sales make up less than 1% of their total revenue however on a farm their size that is pretty significant. Simpson's primary customer base for grapes is Lowes, Home Depot, and Walmart. In recent years the annual sales volume seems to be settled around 35,000 - 1 gallon Bunch grapes and around 29,000- 1 gallon Muscadine grapes. They contribute their recent modest growth in sales to simply having better stock plants and quantities available for them to sell. They buy in tissue culture liners from AgriStarts which Simpsons believes gives them a much better starter plant thus increasing the amount of quality finished goods that they can sell. Simpsons plans to continue growing and selling Bunch grapes and Muscadine and monitor the market closely to adjust their numbers accordingly.

Currently, most Florida commercial wine grape producers are sourcing their stock plants for expansion or vineyard maintenance from either AgriStarts, of Apopka Florida or from several commercial nurseries in Georgia who provide bare root starter plants.

Presently the primary market segment for Florida grown grapes consist of large wholesale growers who supply the big box stores and garden centers. The market demand for these producers seems to be stable and growing slightly. The market for sales to wineries and vineyards continues to be modest as there is only minor growth in that sector. Florida researchers and breeders must continue to work on new cultivars that can improve the taste and experience for the end user and the Viticulture industry needs to continue to increase marketing the benefits of Florida Grown Hybrid Bunch-Grapes and Muscadines. New cultivars for the Fresh Market are needed for Florida, to include seedless fruit. On a positive note, the University of Florida and Florida A&M University are currently having positive results with trials of California bred bunch grapes that are purported to be "Pierse's Disease resistant". The addition of this class of grapes to Florida's field inventory could develop into a substantial step forward for Florida Viticulture.

In conclusion, there has not been much change in the Florida nursery sector in the past twelve months. Most of the same Florida nursery stock providers still have muscadine starter plants in their product mix and are focused on "big-box" retail outlets. Based on continued conversations with these producers, until progress is made with new cultivars, they will continue offering the current set of muscadine varieties at the current, modest production levels.

VITICULTURE ADVISORY COUNCIL

ANNUAL INDUSTRY REPORT- FY 2024

Area of Representation: Florida A&M University/ Center for Viticulture (www.famu.edu/Viticulture)

Representative: Professor Violeta Tsolova, Ph.D., Director

Introduction: *The Center's mission is to conduct basic and applied research and provide service that will promote the development of a viable viticulture industry in Florida (Florida Viticulture Policy Act. 1978, Florida Statute 599.003c)*

GOALS:

1. Develop new and improved grape cultivars for wine processing and fresh fruit market in Florida.
2. Improve the biotic and abiotic resistance of Florida grapes through classical and molecular breeding.
3. Promote the marketability of Florida grapes and value-added products through research and extension.
4. Develop best management practices for Florida grapes and selected small fruits.
5. Promote a strong graduate and undergraduate student experiential learning program that will encourage and attract outstanding scholars.
6. Develop a strong working relationship with Florida growers and private industry through extension and outreach activities.

Product Status: total of 2,533.5 lbs. / 1,149 kg grape was harvested and processed into experimental research wines.

Table 1. *Record of grapes harvested for the 2024 vintage. Bunch grape totaled to 652 lbs. and Muscadine totaled to 1,881.5 lbs. for a grand total of 2,533.5 lbs.*

2024 Harvest Record		
Date	Variety	Weight (lbs)
7.3.24	Stover	151
7.10.24	Blanc Du Soleil	39.5
7.16.24	Famu 99	120.5
7.16.24	C30-7	25.5
7.16.24	Conquistador	14.5
7.18.24	C30-5	93.5
7.19.24	Black Spanish	134
7.24.24	Blanc Du Leon	73.5
Bunch Grape Total		652
8.15.24	Noble	280.5
8.20.24	Floriana	299.5
8.20.24	Noble	93.5

8.21.24	A27-10-10	119
8.22.24	Carlos	243
8.27.24	Carlos	269
8.30.24	Noble	254
9.4.24	Floriana	84.5
9.4.24	Noble	80.5
9.5.24	Noble	158
Muscadine Total		1881.5
Grand Total		2533.5

The harvest season started fairly early for the bunch grapes with Stover being harvested on July 3rd. Based on the juice analysis (Table 2), it could have waited a little longer to ripen more. Regardless, we were able to wither those grapes and produce 12L of dessert style wine which will go on to produce the 2024 Sunny White.
Next was Blanc Du Soleil, which was harvested on July 10th and was the biggest harvest for the variety ever. Based on acidity levels it was also harvested slightly early, but we were able to produce 8.4 L which will be bottled as a varietal wine, "2024 Blanc Du Soleil".
The red bunch grape varieties followed with FAMU 99, C30-7, and Conquistador. We decided to make a field blend and process them together.
C30-5 made a return after 4 years of no harvest. We were able to collect 93.5 lbs which has produced 35 L of full-bodied red wine which we are excited to blend together with other reds to make the 2024 New Red Blend. We expect this red blend to be similar to the 2019 Red Blend which has been a favorite and winning an award for best dry red at the 2022 FWGGA conference. The C30-5 is the secret ingredient to making full bodied reds here at the center. If we can figure out a way to increase production either with viticulture practices or crossing to a new genotype, then we could develop something very valuable.

Table 2. *Analysis of juices prior to vinification from the 2024 vintage.*

Juice Analysis			
Variety	pH	Titratable Acidity	Soluble Solids
Stover	2.97	9.7	14
Stover Withered	3.4	9.2	26
Blanc Du Soleil	2.97	15.5	16
Bunch Blend	3.33	9.6	13.2
C30-5	3.26	8.9	13
Blanc Du Leon	3.07	7.6	17
Noble Red 1	3.3	3.6	13
Noble Blush	3.24	3.8	13.6
Floriana Red 1	3.47	3.3	13.6
Noble Red 2	3.37	4	15
Floriana Red 2	3.61	2.5	15
A27-10-10	3.3	5.6	13.6

Carlos Free Run	3.18	5.1	14
Carlos Press	3.13	6.4	13
Carlos 3	3.19	5	13.6
Floriana Blush Press	3.57	1.8	15.8
Floriana Blush Free Run	3.65	2.2	16.4
Noble Free Run	3.58	2.9	18.2
Noble + Floriana Cryomacerated	3.46	3.7	17.4

The muscadine grapes ripened very quickly this year. There was a huge number of grapes on the vines this year and we nearly missed them due to Hurricane Debby which closed the university for nearly a whole week not to mention damaging the fruit and vineyard. Due to this, we were unsuccessful to wither any muscadines therefore we won't have withered wines to produce dessert style wines for this year. Despite collecting approximately 512 lbs., Carlos was harvested very late and the majority of berries were already lost. Noble and Floriana was collected at appropriate times but unfortunately it was an extremely hot heat wave which turned Noble into raisins in the greenhouse instead of gentle withering as intended.

Table3. *Total list of wine lots currently in the cellar to be completed. Remaining wines from 2022 total to 16.5 Gallons/ 83 bottles, 2023 wines total to 44.4 Gallons/224 bottles, and 2024 wines total to 134.6 Gallons/ 680 bottles. The grand total of wines currently in the cellar is 195.6 Gallons/987 bottles.*

Lot Name	Volume (liters)	Estimated Bottles
Vintage 2022		
2022 Blanc Blend	11.7	16
2022 White Temptation	50.8	68
2022 Total	62.5 L / 16.5 GAL	83
Vintage 2023		
2023-A27	2.0	3
2023 BLANC DU BOIS	2.5	3
2023 Blanc Du Soleil	2.0	3
2023 Black Spanish	25.3	34
2023 Carlos	28.0	37
2023 Floriana	35.3	47
2023 Floriana Noble Zeb Blend	7.6	10
2023 Noble	52.0	69
2023 STOVER WITHERED	13.5	18
2023 Total	168.2 L / 44.4 GAL	224
Vintage 2024		
2024 A27-10-10	25.5	34
2024 Bunch Blend	38.8	52

2024 Blanc Du Leon	15.7	21
2024 Blanc Du Soleil	8.4	11
2024 Black Spanish Blend	41.5	55
2024 C-30-5	35.0	47
2024 Carlos 3	22.0	29
2024 Carlos Free	22.5	30
2024 Carlos Pressed	26.7	36
2024 Carlos Spontaneous Ferment	37.4	50
2024 Dr Chen Floriana Red	22.5	30
2024 Dr Chen Noble Red	24.5	33
2024 Floriana Blush	43.7	58
2024 Floriana Red	43.8	58
2024 Noble Blush	31.0	41
2024 Cryo Macerated Red	23.7	32
2024 Noble Red	35.0	47
2024 Stover Withered	12.0	16
2024 Total	509.7L / 134.6 GAL	680
Grand Total (2022+2023+2024)	740.4L / 195.6 GAL	~987 Bottles

What new/additional research is needed (Plan of Work for 2024- 2025)?

Current Wine Lots in Wine Lab Cellar

Currently we have approximately 740 L of wine in the cellar of the wine lab that is aging and getting prepared for bottling (Table 3). This 740 L will yield approximately 987 standard 750 mL bottles. Starting with the 2022's, it is really only the white temptation that needs to go through secondary fermentation to become sparkling. We are planning to start this process by the end of the year because we are still finishing sparkling which are aging on the lees from 2021. For the 2023 wines, we are currently going through blending trials to establish base wines of which we can begin to start fining and aging before filtering and bottling. For the 2024's, they are still young wines and need to go through blending, fining, aging, and filtration before they will be ready to bottle. With the help of the growing team, we plan to get caught up on these wines and try to finish them before the 2025 vintage is here.

Analysis of wines to build-up the Southern Wine Database:

Figure 26. *Anton Paar Lyza 5000 Wine Analyzer. The Analyzer can measure 19 parameters in approximately 3 minutes per sample.*

With the recent acquisition of the 'Lyza 5000' we will be able to speed up and stream-line our wine analysis efforts, not only of our wines in house for winemaking purposes and research purposes, but perhaps we could start providing an analytical service for the industry at a more reliable pace. Previously, it would take too long for us to get back the results back to winemakers to really make a difference but now it is possible for a hobbyist or commercial winery to send in their sample to be analyzed and it can be sent back within one day. Moving forward we should explore this potential opportunity to not only use this equipment to analyze our samples but also generate income to make the wine lab a self-sufficient entity.

Industry Issues and Needs:

Disease/insect pressure:

Potential treat of the new invasive pest: citrus root weevil (*Diaprepes abbreviatus*) can pose potential treat for bunch grapes vineyards in FL. *Diaprepes abbreviatus* has a wide host range, attacking about 270 different plants including citrus, blueberries, sugarcane, vegetables, potatoes, strawberries, woody field-grown ornamentals, containerized ornamentals, and non-cultivated wild plants.

In the state, has been first reported in 1964, but recently the treat has been growing and the host range vastly expending. Currently the pest costs close to 70 million in crop losses in FL.

Summary

FLORIDA A&M UNIVERSITY
VITICULTURE
& SMALL FRUIT RESEARCH
COLLEGE OF AGRICULTURE AND FOOD SCIENCES

Research Productivity Report: October 1, 2023–September 30, 2024

www.famu.edu/Viticulture

- **Implementing annual and long - range plans and priorities for the Center that addressed the expressed needs of stakeholders or clientele groups**

Research & Innovation:

- **Grape Genetics and Breeding Program - PI Assoc. Professor Islam El-Sharkawy, Ph.D.**

Team Members: Islam El-Sharkawy (Program leader), Ren Zhongbo (Grape Breeding – Research Associate), Md Moniruzzaman (Grape Biotechnology – Research Associate), Pranavkumar Gajjar (Grape Phenomics & stress Physiology – Ph.D.), and Eniola Olaoye (Grape VOCs – MS).

Research Activities:

1- **Project title:** Breeding High-Quality Southern Grape Cultivars for Meeting Industry Demands in Florida.
Research team members: Islam El-Sharkawy (PD, CVSFR/FAMU), Violeta Tsolova, and Ren Zhongbo.
Goals and objectives: Development of new southern grape cultivars that exhibit both stress resistance and superior fruit quality traits to mitigate production costs and expand market opportunities.
Who cares and why? This project holds significant value for grape growers in Florida and the southeastern U.S. region, where unique climate conditions and disease pressures shape the challenges of viticulture. Enhancing disease-resistant grape cultivars will benefit regional growers by creating varieties better adapted to local conditions, potentially reducing dependency on chemical treatments and improving yields. By developing new cultivars and germplasm, the project aims to drive economic growth, increase market appeal, and provide sustainable options, benefiting both regional and national grape industries. With a focus on generating new knowledge and tools, this work aligns with broader national goals to improve the supply and market of value-added grape products, ultimately supporting U.S. agriculture by increasing consumer appeal, market profitability, and long-term sustainability.
What has the project accomplished since its initiation?
New bunch-grape and muscadine crosses to enrich Florida growers with new cultivars exhibiting high quality and disease resistance.
Evaluating new genotypes and identifying several advanced selections that can be promoted into new cultivars.
Research Results, Output, and Impact:
Identification of seven muscadine advanced selections suitable for red and white wine production. They are characterized by early even ripening, disease resistance, and high yield (Fig. 1).
Further, we completed thirteen cross-pollination trials (5 for bunch-grape and 8 for muscadine) and collected 4053 seeds (3438 for bunch and 615 for muscadine). These seeds are under the germination process to produce seedlings (Table 1).

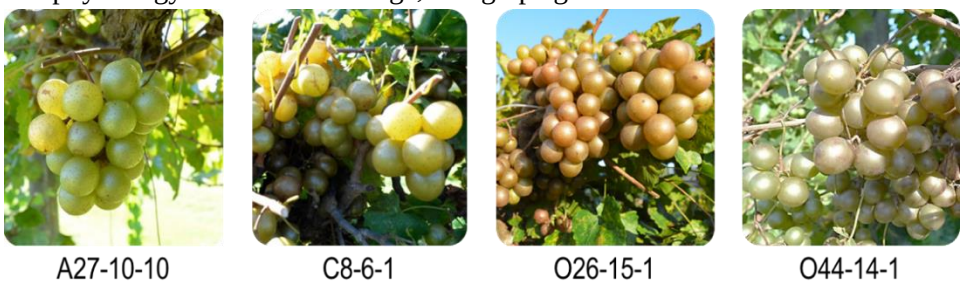
What new/additional research is needed (Plan of Work for 2024- 2025)?
Performing new crosses and continuing the evaluation process with other genotypes.

Fig.1: *Muscadine advanced selections suitable for wine production.*

Table 1: Grape Crosses.

Cross (♀ x ♂)	Objective	No. Seeds	No. Seedlings
Bunch Grapes			
Lake Emerald x Chardonnay	Wine, disease resistance	194	
O46-13-10 x Merlot	Wine, disease resistance	2307	
O46-13-10 x Chemn blanc	Wine, disease resistance	514	
O47-16 x Blanc du Bois	Wine, disease resistance	185	
Black Spanish x Stover	Wine, disease resistance	238	
Muscadine			
A5-14 x O47-9	Table, seedless	296	
O46-5-4 x Scarlet Royal	Table, seedless	166	
Majesty x A3	Table	153	
Scarlet x A19-13-10	Table, seedless	0	
Southern Home x O47-9	Table, seedless	0	
O15-2-1 x O47-9	Table, seedless	0	
O15-2-2 x O47-9	Table, seedless	0	
O32-23 x O47-9	Table, seedless	0	

2- **Project title:** Next–Generation Grape Breeding: Integrated Approaches to Identify Root-Hypoxia Resistance Mechanism in Native American *Muscadinia*.
Research team members: Islam El-Sharkawy (PD, CVSFR/FAMU), Pranavkumar Gajjar, Violeta Tsolova, Ali Sarkhosh (IFAS/UF).
Goals and objectives: (**a**) Evaluate the variability of hypoxia-tolerance traits in the muscadine population to determine the traits associated with tolerance; (**b**) Identify genetic variants and DNA markers associated with hypoxia tolerance/susceptibility; (**c**) Evaluate the changes in transcriptome profile during stress to identify transcription factors and gene network associated with hypoxia tolerance; (**d**) Evaluate the changes in metabolome profile during stress to identify metabolites and potential defense elicitors that can enhance resiliency of vines to stress; (**e**) Engage growers to muscadine grapes and technology on emerging more efficient vineyard management strategies; and (**f**) Develop training modules in grape genomics. The target is to expand the body of knowledge, disseminate accomplishment throughout the local communities, and recruit students into the plant genomics at FAMU.
Who cares and why? Grape growers in Florida and the southeastern region of the US, peer scientists in stress physiology and climate change, and grape geneticists and breeders.



The high event of flooding is forcing globally more climate disasters on agriculture than any other abiotic factor and has increased by ~65% over the last 25 years. Destruction due to flooding can vary

considerably, depending on the amount, intensity, duration, and spatial distribution of precipitations, all of which make ecosystems vulnerable worldwide. The current trend in agriculture demands liability in developing innovative genetic resources carrying adaptive traits capable of overcoming the climate challenges that can negatively affect grape industry sustainability.

What has the project accomplished since its initiation?

We are in the process of propagating a muscadine plant population to achieve project objectives.

Research Results, Output, and Impact: No results are available at the current stage.

What new/additional research is needed (Plan of Work for 2024- 2025)?

All project objectives are in progress.

3- **Project title:** Passionfruit: Laying the Groundwork for an Emerging Specialty Fruit Crop in Florida.

Research team members: Ali Sarkhosh (PD, IFAS/UF), Jonathan Crane (IFAS/UF), Steven Sargent (IFAS/UF), Islam El-Sharkawy (CVSFR/FAMU), and Stafford Crossman (UVI).

Goals and objectives: (**a**) Determine differences among germplasm lines and cultivars for disease and insect resistance, fruit harvest maturity, and yield and quality grown under both production systems; (**b**) Understand the cultural practices required of purple-skinned passionfruit cultivars (*P. edulis* type) grown in southern Florida and the Virgin Islands under open fields, and in central and north-central Florida under both open field and high tunnel environmental conditions; (**c**) Increase consistency of supply through improved harvest and postharvest management strategies to extend fruit shelf life and help growers handle their fruit better while improving their returns; (**d**) Develop production management guidelines for best practices for growers; (**e**) Educate growers on how to produce premium fruit with optimum yields for high value for both fresh and value-added markets.

Who cares and why? Florida fruit industry and growers.

The purpose of this project is to generate information to accelerate the viability and profitability of the passion fruit industry in Florida and the southern US. While no single crop is likely to fill the void left by the approximately 500,000 acres taken out of citrus production by citrus greening, Huanglongbing (HLB), and 2,400 avocado acres lost to laurel wilt, Florida has the unique climate to produce a wide variety of perennial crops that cannot be economically grown in most parts of the continental US. Passionfruit belongs to the Passifloraceae, which includes about 550 species. Passiflora is the most important genus in this family, with approximately 400 species.

What has the project accomplished since its initiation?

Variety trials are established at two sites at the UF/IFA and also at one Cooperating Farmers' farm in Chiefland.

Research Results, Output, and Impact: No results are available at the current stage.

What new/additional research is needed (Plan of Work for 2024- 2025)?

All project objectives are in process.

4- **Project title:** Building Capacity in Genomic Assisted Breeding Technologies: Identify Genomic Variations and Gene-Network Underlying Ripe Rot Tolerance.

Research team members: Devaiah Kambiranda (PD, SUAREC), Islam El-Sharkawy (CVSFR/FAMU), and Pranavkumar Gajjar.

Goals and objectives: (**a**) Identify *Colletotrichum* species dynamics and distribution of grape ripe rot; (**b**) Identify genetic variants and DNA markers associated with ripe rot tolerance; (**c**) Identify network associated with ripe rot disease resistance/susceptibility; (**d**) Determine phytochemicals spectrum exhibiting antifungal bioactivities; and (**e**) Provide hands-on experiential learning in modern plant breeding techniques to engage 1890 students in research and educational activities.

Who cares and why? Grape growers in Florida and the southeastern region of the US, peer scientists in stress physiology and climate change, pathologists, geneticists, and grape breeders.

There is no information on the diversity of *Colletotrichum* species infecting grapes in the southern U.S. Despite the widespread occurrence of the disease in grape-growing regions across the U.S., the molecular mechanism underlying ripe rot disease resistance in tolerant grapevines is poorly understood. Several

strategies, including population characterization, genomic, transcriptomic, and metabolomic will be employed to identify potent mechanisms underlying disease resistance.

What has the project accomplished since its initiation?

Muscadine grape skin and seed extracts from a population of 360 individuals were assessed for their ability to inhibit *Colletotrichum* spore growth. A QTL based on seed extract inhibition was identified. Several muscadine genotypes exhibiting sensitive, tolerance, resistance, and immunity phenotypes were identified via in vivo assay.

Research Results, Output, and Impact: No results are available at the current stage.

What new/additional research is needed (Plan of Work for 2024- 2025)?

Transcriptome and metabolome profiling comparing the immune and sensitive genotypes. Muscadine population analysis based on infected berries and leave tissues. Use these data to perform GWAS analysis and identify other OTLs associated with resistance. Generate publications.

Population analysis of muscadine grapes has revealed varied responses to ripe rot infection, with classifications as follows: susceptible (78.5-100% lesion zone), tolerant (45.5-65.8%), resistant (14.4-29.4%), and immune (0%) (Fig. 2 and 3). Additionally, testing of 354 individual muscadine seed extracts showed a broad range of antifungal efficacy against ripe rot spores (22.3 - 90.4% inhibition). This inhibition was independent of total phenolic, flavonoid, or anthocyanin content. Genome-wide association studies (GWAS) identified a significant QTL on Chromosome 16 linked to fungal growth inhibition (fig. 4).

Fig.2: *Changes in lesion area post-inoculating ripe muscadine berries with ripe rot (Colletotrichum gloeosporioides) spores under berry skin. Close-up view of ripe muscadine berry genotypes (control and 7 dpi) representing fungus response categories, including susceptible (A), tolerant (B), resistant (C), and immune (D) where the genotype was able to eradicate the deposited fungus spores.*

Fig.3: *The development in lesion size throughout 7 days post inoculating ripe berries of the susceptible (C5-1-1) and resistant (O23-5-2) muscadine genotypes with ripe rot (C. gloeosporioides) spores.*

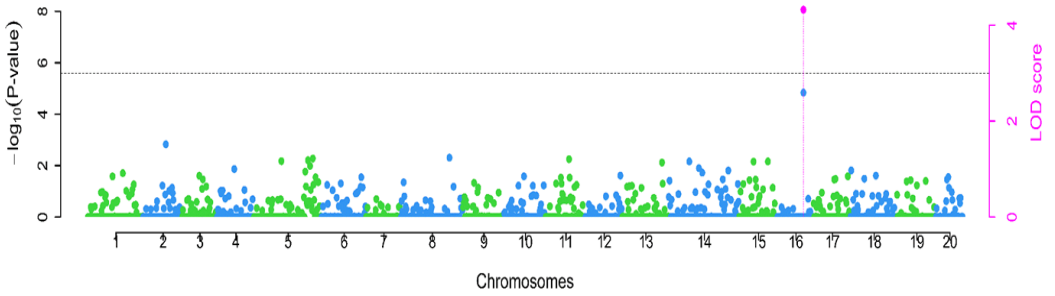


Fig.4: *GWAS results for the antifungal effects of muscadine seed extract trait. The dotted black line indicates the significance threshold at LOD= 3.0. The pink dot with a vertical dotted line refers to the*

significant QTN detected by multiple GWAS methods. The multiple GWAS methods used in plotting are the median value of –log10(p) from the mrMLM, FASTmrMLM, FASTmrEMMA, and pKWmEB.

5- Project title: Bioactivity-guided Discovery of Effective Anticancer and Antioxidant Compounds in Muscadine Grapes (*Muscadinia rotundifolia*).

Research team members: Islam El-Sharkawy (PD, CVSFR/FAMU), Ahmed Darwish, Pranavkumar Gajjar, Violeta Tsolova, Karam Soliman (Pharmacy/FAMU), Devaiah Kambiranda (SUAREC).

Goals and objectives: (**a**) Determine phytochemicals spectrum in selected muscadine genotypes exhibiting particular bioactivities; (**b**) Evaluate the changes in transcriptome profile among muscadine genotypes exhibiting differential bioactivity performance; (**c**) Develop socioeconomic evaluation of the factors influencing market capacity and consumer preferences; and (**d**) Engage consumers and stakeholder groups to muscadine grapes health benefit and transfer technology on emerging a more efficient cultivar development system.

Who cares and why? Grape growers in Florida and the southeastern region of the US, peer scientists in food nutrition, cancer biology, geneticists, and grape breeders.

Identify muscadine grape bioactive constituents efficiently involved in the inhibition of African-American Breast Cancer. The target is to develop new grape cultivars exhibiting superior fruit/vinification qualities along with particular nutraceutical values.

What has the project accomplished since its initiation?

All project objectives have been achieved.

Research Results, Output, and Impact: (**a**) Identify molecules associated with high breast anticancer activities; (**b**) Identify key component genes and gene network essential for triggering antioxidant and/or breast anticancer bioactivities; and (**c**) Expand the body of knowledge about profitability and investment associated to muscadine production.

What new/additional research is needed (Plan of Work for 2024- 2025)?

Generate manuscripts.

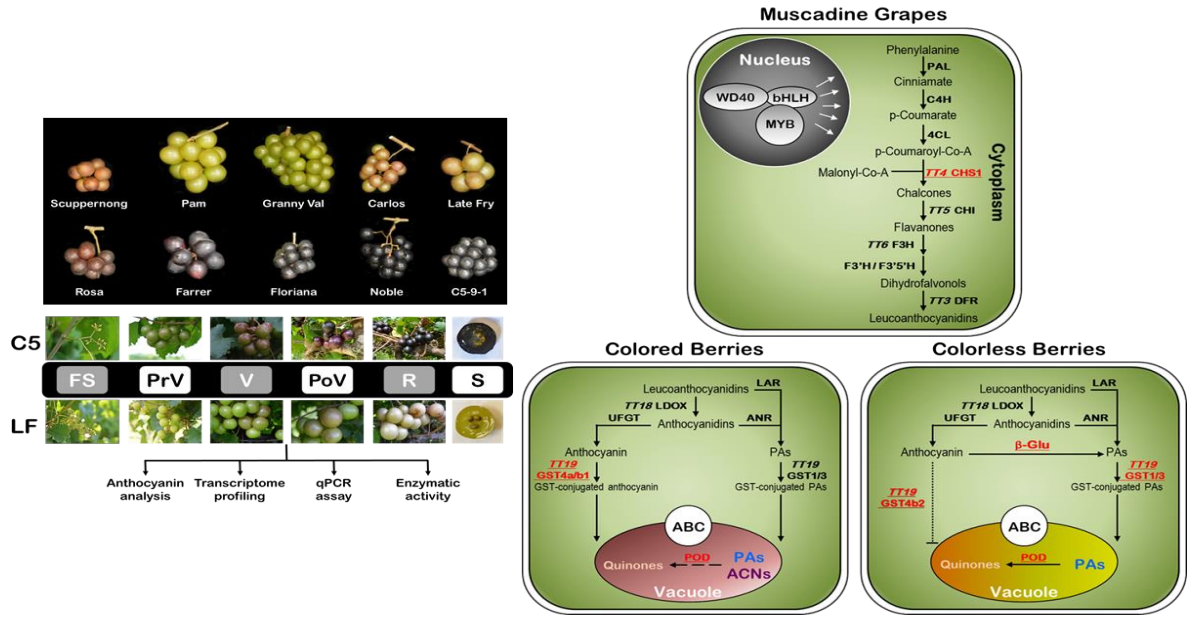


Fig. 5: *A representative image for muscadine genotypes used to determine berry color characteristics. Color changes during muscadine berry development of Late Fry and C5-9-1 (C5—"Ison × Fry") genotypes. Diagram of the anthocyanin pathway assigned with different anthocyanin-related genes in colored and bronze berries (Ismail et al., 2023; Nature-Communications Biology).*

6- **Project title:** Next–Generation Grape Breeding: Integrated Approach to Empower the Quality of Research and Training at Florida A&M University.

Research team members: Islam El-Sharkawy (PD, CVSFR/FAMU), Md Moniruzzaman, Violeta Tsolova, Ashraf El Kereamy (UC-Riverside).

Goals and objectives: (**a**) Characterization of fruit-set programs among diverse grape genotypes; (**b**) Evaluate the changes in hormones accumulation profile throughout fruit ontogeny; (**c**) Evaluate the changes in transcriptome profile among grape genotypes exhibiting differential fruit-set program; (**d**) Subcellular localization of key component genes; (**e**) Identify different proteins that can interact with TFs strongly associated with each type of fruit-set; (**f**) Evaluate the function of genes associated with stenospermocarpy fruit-set, using CRISPR/Cas9–gRNA ribonucleoproteins strategy; and (**g**) Develop training modules in grape genomics and biotechnology.

Who cares and why? Grape growers in Florida and the southeastern region of the US, peer-scientists in grape system biology, geneticists, and grape breeders.

Identify key component transcription factor's gene and gene network associated with seedless stenospermocarpy fruit-set program. The target is to develop new muscadine grape cultivars exhibiting superior fruit qualities of seedlessness.

What has the project accomplished since its initiation?

All project objectives have been achieved.

Research Results, Output, and Impact: (**a**) Determine and evaluate phenotypical traits associated with seedlessness; (**b**) Determine the behavior of hormone accumulation associated with specific type of fruit-set program; (**c**) Discriminate and select only genes encoding Transcription Factors (TFs) for downstream experimental procedure; (**d**) Confirm and compare gene networks that can distinguish between different types of fruit-set programs; (**e**) Develop new muscadine genotypes exhibiting seedless large berries; and (**f**)

Expand the body of knowledge, disseminate accomplishment throughout the local communities and recruit students into the plant genomics at FAMU.

What new/additional research is needed (Plan of Work for 2024- 2025)?

Generate manuscripts.

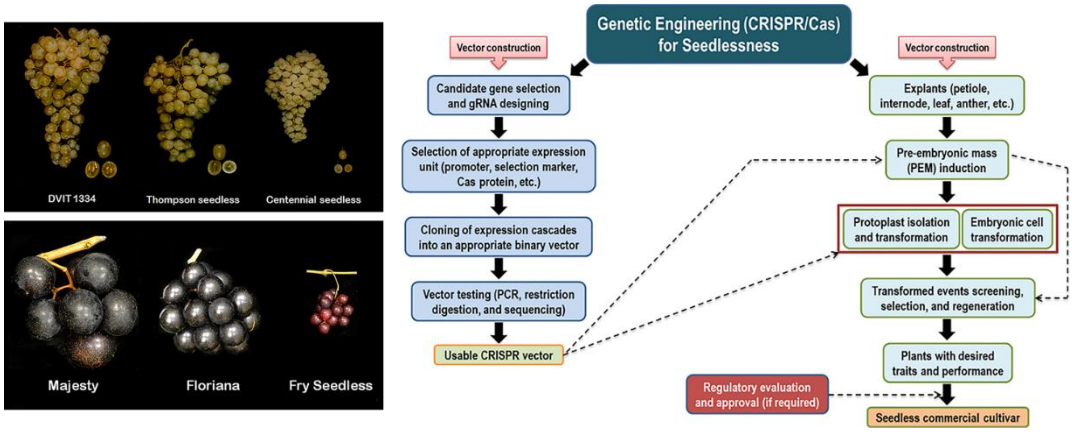


Fig.6: *Close-up cluster views of Thompson seeded mutant (DVIT 1334), Thompson seedless, and Centennial seedless grape genotypes exhibiting seeded, stenospermocarpy, and parthenocarpy fruitset programs, respectively. Close-up cluster view of muscadine cultivars Majesty (female flower, seeded), Floriana (perfect flower, seeded), and Fry seedless (perfect flower, parthenocarpy seedless). Visual scheme of gaining the seedlessness trait using genetic engineering (CRISPR/Cas) strategy (Moniruzzaman et al. 2023; International Journal of Molecular Sciences)*

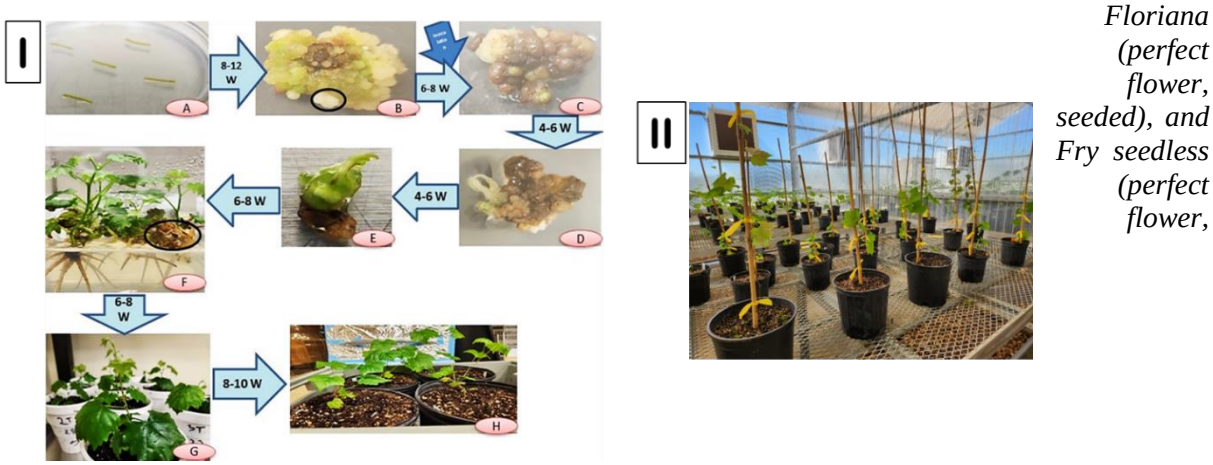


Fig.7: *(I) The procedure and timeline of pre-embryonic mass development, transformation, and transformed plant recovery. (A) Sterile petiole on media, (B) Embryonic callus induction, (C) Co-culture (5 days) of PEMs with A. tumefaciens and PEMs regeneration, (D) Plantlets proliferation, (E) Separated plantlets from PEM cluster, (F) Plant proliferation on Basta-selection media (circle indicates non-transformed Basta sensitive plant), (G) Established plants on soil, (H) Hardened plants in screen house. (II) A representative image of established muscadine AGL11 knock-out (MrAGL11-KO) mutant lines growing under controlled environment conditions.*

List of Publications

Refereed Publications:

1- Kaur P, Darwish AG, **El-Sharkawy I**, Singh A, Subramanian J. (2024) Comparative antioxidant activity and untargeted metabolomic analyses of sour cherry cultivars based on Ultra-Performance–Time of Flight–Mass Spectrometry. *Plants* 13: 1511.

2- Gajjar P, Ismail A, Islam T, Moniruzzaman M, Darwish AG, Dawood AS, Mohamed AG, Haikal AM, El-Saady AM, El-Kereamy A, Sherif SM, Abazinge MD, Kambiranda D, **El-Sharkawy I**. (2024) Transcriptome profiling of a salt excluder hybrid grapevine rootstock 'Ruggeri' throughout salinity. *Plants* 13: 837.

3- Ismail A, Pervaiz T, Comstock S, Bodaghi S, Rezk A, Vidalakis G, **El-Sharkawy I**, Obenland D, El-kereamy A. (2023) Unraveling the occasional occurrence of berry astringency in table grape cv. Scarlet Royal: A physiological and transcriptomic analysis. *Frontiers in Plant Science* 14: 1271251.

4- Gajjar P, Ismail A, Islam T, Darwish AG, Moniruzzaman M, Abuslima E, Dawood AS, El-Saady AM, Tsolova V, El-Kereamy A, Nick P, Sherif SM, Abazinge MD, **El-Sharkawy I**. (2023) Physiological comparison of two salt-excluder hybrid grapevine rootstocks under salinity reveals different adaptation qualities. **Plants** 12: 3247.

Refereed Publications (*In Progress*):

1- Darwish AG, Das PR, Olaoye E, Gajjar P, Ismail I, El Kayal W, Walters KJ, **El-Sharkawy I**. Untargeted flower volatilome profiling highlights differential pollinator attraction strategies in muscadine.

2- Ismail A, Gajjar P, Abuslima E, Mohamed AG, Islam T, Darwish AG, Nick P, El Kayal W, **El-Sharkawy I**. Drought resilience mechanism in grapevine is rich and harmonized symphony of which redox and osmotic balance play central roles.

3- Ismail A, Park M, Gajjar P, Mahboob M, Moniruzzaman M, **El-Sharkawy I**. Genome-wide characterization of Muscadinia rotundifolia MADS-box transcription factors emphasizing their roles during berry development.

4- Moniruzzaman M, **El-Sharkawy I**. Multiplex genome editing with CRISPR-spCas9 in muscadine grape.

5- Shum C, Sriskantharajah K, El Kayal W, Ahmed D, **El-Sharkawy I**, Subramanian J. Metabolomic exploration of black knot resistance in Japanese plums (*Prunus salicina* L.) reveals two antifungal compounds.

Professional meetings/presentations – local, state, regional, national, and international.

1- **El-Sharkawy I**. "Grape Breeding Program at Florida A&M University". The 2024 UF Grape Field Day, August 20, 2024.

2- Darwish AG, **El-Sharkawy I**. "The anticancer effects of muscadine grape extracts on racially different prostate cancer cells". The 137th Annual Meeting of the Florida State Horticultural Society, June 8 – 11, 2024.

3- Moniruzzaman M, **El-Sharkawy I**. "Application of gene-editing technology for the production of large berry seedless muscadine". The 137th Annual Meeting of the Florida State Horticultural Society, June 8 – 11, 2024.

4- Ren Z, Tsolova V, **El-Sharkawy I**. "'C1-12-2': An early ripening muscadine grape selection with high fresh market potential". The 137th Annual Meeting of the Florida State Horticultural Society, June 8 – 11, 2024.

5- Moniruzzaman M, **El-Sharkawy I**. (2024). "Multiplex genome editing with CRISPR-spCas9 system in muscadine grape". The 21st Biannual Research Symposium – Association of 1890 Research Directors (ARD), Nashville, TN, April 6 – 9, 2024.

6- Gajjar P, **El-Sharkawy I**. (2024). "Physiological comparison of two grapevine rootstocks under salinity reveals different adaption qualities". The 21st Biannual Research Symposium – Association of 1890 Research Directors (ARD), Nashville, TN, April 6 – 9, 2024.

7- Olaoye E, Darwish AG, **El-Sharkawy I**. (2024). "Determination of the fruit volatile profiles of muscadine grape cultivars (*Vitis rotundifolia* Michx.) using HS-SPME-GC/MS". The 21st Biannual Research Symposium – Association of 1890 Research Directors (ARD), Nashville, TN, April 6 – 9, 2024.

8- Ren Z, Tsolova V, **El-Sharkawy I**. (2024). "A new large fruit muscadine grape cultivar". The 21st Biannual Research Symposium – Association of 1890 Research Directors (ARD), Nashville, TN, April 6 – 9, 2024.

9- **El-Sharkawy I**. "Grape Breeding Program at Florida A&M University, Current & Future". Florida Wine and Grape Growers Association (FWGGA) – Annual Meeting, DeLand, FL, January 11 – 14, 2024.

10- **El-Sharkawy I**. "Grape Breeding Program at Florida A&M University, Current & Future". 2024 Southeast Regional Fruit & Vegetable Conference, Savannah, GA, January 8 – 11, 2024.

11- **El-Sharkawy I**. "Updates in Grape Breeding Program at Florida A&M University". The 2023 North American Grape Breeders & *Vitis-Muscadinia* Alliance Conference, University of Arkansas System Division of Agriculture (UA System), Don Tyson Center for Agricultural Sciences, Fayetteville, AR, October 3 – 5, 2023.

Extension - List activities:
Not Applicable.

Name of graduate students and title of theses:
Graduate Students Major Professor and Committee Chair:

1- Pranavkumar Gajjar (Ph.D., School of Environment, FAMU), Title: "Identification of physiological and molecular events associated with salt tolerance in grapevine rootstocks", 2021 – Present.

2- Eniola Olaoye (MS, CAFS, FAMU), Title: "Characterization of volatile organic compounds of muscadine (*Muscadinia rotundifolia*.) ripe berries" (**Graduated in 2024**).

Graduate Students Committee Member

1- Mohammad Tipu (Ph.D., Department of Horticulture at AHS-AREC, School of Plant and Environmental Sciences, VT), Title: "Physiological and molecular approaches toward unraveling the dynamics of fruit coloration and fruit drop in apple (*Malus* × *domestica* Borkh)", 2024 – Present.

2- Mujahid Hussain (Ph.D., NFREC, UF), Title: "Understanding the molecular mechanism of freezing tolerance of satsuma mandarin (*Citrus unshiu*) under unpredictable freezing conditions", 2023 – Present.

1- Kiara Ivy (MS, CAFS, FAMU), Title: "Evaluation of spread, establishment, and impact of natural enemies to manage red imported fire ants [*Solenopsis invicta* (Hymenoptera: Formicidae)] in northwest Florida" (**Graduated in 2024**).

2- Dupe Ogundipe (MS, CAFS, FAMU), Title: "Non-targeted metabolomic approach to evaluate bioactive profiles in Florida distinctive wines fermented with autochthonous yeast strains" (**Graduated in 2024**).

Name of undergraduate student involved:
1-Monica N. Roden (FAMU Undergraduate Student, CAFS), 2024, Research Assistant.

Proposal submitted:

1- USDA/NIFA – 1890 Capacity Building Program (CBGP) – Title "Next-Generation Grape Breeding: Uncovering Genetic and Metabolite Markers Underlying *Colletotrichum* spp Fungus Resistance in *Muscadinia*." *PI: Islam El-Sharkawy* – $500,000 (**Under Review**).

2- USDA/NIFA – 1890 Capacity Building Grant (CBGP) Program – Title "Biological Control of Botrytis Gray Mold: Discovering Resistance Mechanism in Southern Grapes". PI: Devaiah Kambiranda (SUAREC), *Islam El-Sharkawy (Co-PI)* – $470,287 (**Under Review**).

3- NSF – HBCU-EiR – Title "Excellence in Research: Decoding the Molecular Mechanism Governing Stenospermocarpy Seedlessness in Grapes". *PI: Islam El-Sharkawy* – $1,249,156 (**Under Review**).

4- USAID – Title "SMART-HORT Consortium: Sustainable Management and Advanced Resources Technologies for Horticulture" PI: Sherif M. Sherif (VT), *Islam El-Sharkawy (Co-PI)* – $4,500,000 (**Under Review**).

5- Florida Department of Agriculture and Consumer Services, Viticulture Advisory Council (VAC) Grants Program – Title "Breeding high-quality southern grape cultivars for meeting industry demands in Florida". Islam El Sharkawy (PD) – $25,000.

6- USDA/NIFA/SCRI-CAP – Title: "Through the Grapevine: Developing *Vitis* x *Muscadinia* Wide Hybrids for Enhanced Disease Resistance and Quality". PI: Renee T. Threlfall (UARK), *Islam El-Sharkawy (Co-PI)* – $7,099,701.

Proposal funded:

1- 2024–2028 USDA/NIFA/SCRI-CAP – Title: "Through the Grapevine: Developing *Vitis* x *Muscadinia* Wide Hybrids for Enhanced Disease Resistance and Quality". PI: Renee T. Threlfall (UARK), *Islam El-Sharkawy (Co-PI)* – $7,099,701.

Awards and recognition:

Awards and Scholarship awards for Ms. Eniola Olaoye (MS, CAFS, FAMU):

- The Black Winemakers Scholarship Fund. October, 2023.

Collaboration:

1- Florida Agricultural & Mechanical University (College of Pharmacy and Pharmaceutical Sciences) / Karam Soliman.
2- Virginia Polytechnic Institute and State University (Virginia Tech) / Sherif M. Sherif.
3- Southern University Agricultural Research and Extension Center / Devaiah Kambiranda.
4- University of Florida (IFAS) / Ali Sarkhosh.
5- University of Florida (NFREC) / Muhammad A. Shahid.
6- University of California (Riverside) / Ashraf El-Kereamy.
7- University of Sydney (Australia) / Brian Jones.
8- USDA-ARS (Grape Genetics Research Unit) / Lance Cadle-Davidson.
9- USDA-ARS (Grape Genetics Research Unit) / Gan-Yuan Zhong.

Other relevant information:

Fig. 8. The 2023 North American Grape Breeders & Vitis-Muscadinia Alliance Conference, University of Arkansas System Division of Agriculture (UA System), Don Tyson Center for Agricultural Sciences, Fayetteville, AR, October 3 – 5, 2023.

- **Biotechnology Program Area – PI Professor Mehboob Sheikh, Ph.D.**

Name of project (research projects that have been completed or in progress)

- Muscadine Grapes Polyphenolics - A Research Endeavor to Validate Its Efficacy Against Select Ailments.
- Elucidating the Contribution of Yeast Assimilable Nitrogen for Flavor Volatiles Production and Sensory Receptors of Florida Wines.
- Bio-prospecting of Muscadine Grape Phytochemicals for Regulating Adiposity to Control Obesity.

Research team members

- Dr. Mehboob Sheikh
- Dr. Meenakshi Agarwal
- Dr. Tushar Dhanani
- Dr. Imrul Ahmed
- Ms. Anse Kaplan

Goals and objectives

Our research on muscadine grape encompasses a wide array of biochemical, genomics and bioprocessing studies aimed at evaluating the potential of muscadine grapes in inducing cytotoxicity effects and apoptosis in various cancer cell lines, along with other ailments. In addition, we aim to improve the muscadine grape berry characteristics via functional genomics studies to promote muscadine grape use as table grape as well as enhance its finished wine characteristics to increase consumption and marketability of Florida wines. We also aim to investigate the utility of nitrogenous compounds naturally found in muscadine grape berry by diverse yeast strains, exploring variations in their metabolic pathways and identifying novel and

differentially evolved byproducts and components during vinification to enhance the finished wine characteristics, acceptance, shelf life and stability.

Who cares and why? specific target audience, importance of the specific problem

The projects address the limited marketability of muscadine grapes as a fresh fruit and wine, which faces challenges from bunch grape because of its distinct berry characteristics and wine's stability, shelf life, and inconsistencies in flavor and aroma component content and composition. Through targeted scientific research, we aim to better understand the underlying factors impacting these components for enhancing the wanted characteristics to ultimately increase consumer acceptance and expand the economic potential of muscadine grapes, wines and its products. Muscadine grape is also a rich source of nutraceutically desirable polyphenolics and flavonoids. Hence, we intend to diversify muscadine grape use besides wine for producing novel nutraceutics to serve as health supplements for mitigating various ailments. Outcome of this research will scientifically validate nutraceutic potency of muscadine grape paving way for creating new businesses opportunities encouraging further investment in the muscadine grape enterprise.

What has the project accomplish since its initiation? (and significant achievements for the reporting period)

Our extensive research on muscadine grape nutraceutics has revealed that muscadine grape extract addition significantly suppressed the multiplication and viability of various cancer cells indicating its potential as a health supplement to prevent cancers. In addition, the muscadine berry extract also suppressed lipid accumulation in adipose cells by upregulating and downregulating key genes within obesity pathways. Our bioprocessing research has successfully established baseline chemical profiles for raw juice and their fate during vinification from selected grape varieties, providing essential knowledge on critical component composition of berry constituents essential for producing superior and stable wines.

Research Results, Output and Impact

Diverse muscadine grape genotypes were evaluated for their ability to regulate cell growth and multiplication to determine its potential therapeutic value for managing breast cancer. Muscadine grape berry extracts showed ~50% mortality of MDA-MB-468 cells at the concentrations evaluated. Comparative analysis of stilbenes and other polyphenolics constituents content and cytotoxic activity of berry extracts showed positive correlation between stilbenes content and cytotoxic activity. In addition, the results also showed that additional berry constituents along with stilbenes may act synergistically and responsible for the observed cytotoxic activity and effectiveness of muscadine berry extracts to mitigate cancers.

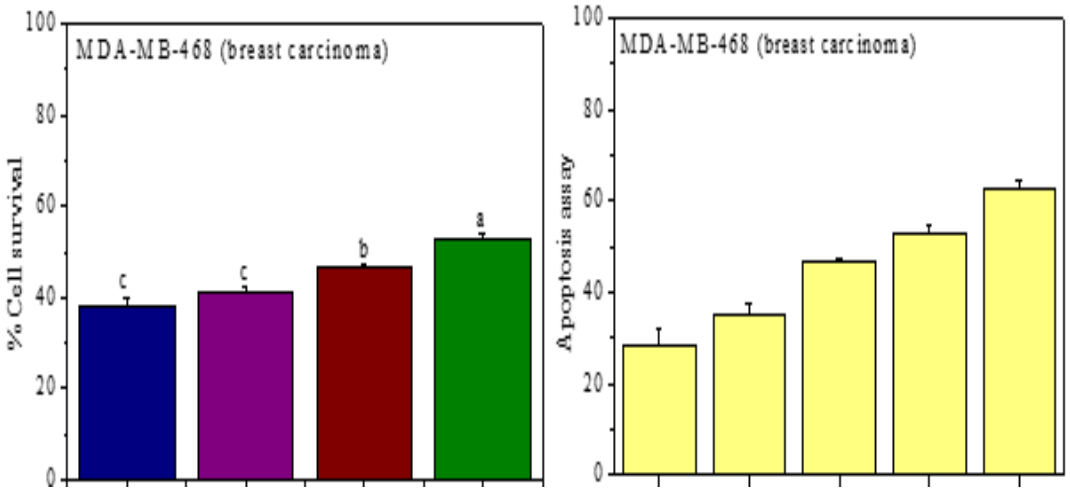


Fig1. Cytotoxic activity of muscadine grape berry extract against MDA-MB-468 cancer cells. Error bars represent SD values (n=4). Different letters on bars indicate significant differences (P < 0.05) among the genotypes. Note increasing cell death with increasing berry extract dose.

What new/additional research is needed (Plan of Work for 2024- 2025)?

Our nutraceutics studies showed that treatment of adipose cells with muscadine grape berry extracts resulted in distinctive changes in their gene expression. In berry extract-treated cells, genes such as *Adipor1, Hsp90ab1,* and *Ptpn1* exhibited decreased expression, while *Cntfr, Hrh1,* and *Zfp91* were upregulated. These findings reveal that muscadine grape berry extract induce significant shifts in gene expression and a marked reduction in lipid accumulation, indicating its potential to regulate obesity-related hormone activity. Highlighting the therapeutic potential of muscadine grape berry extract, rich in phytochemicals, this study presents a promising approach for addressing obesity-related complications.

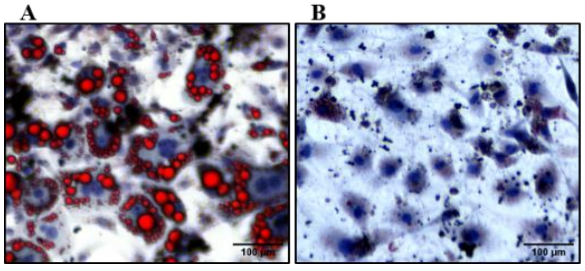


Figure 2: Effect of muscadine grape berry extract treatment on lipid accumulation. A) Control-Adipose cells without treatment with muscadine grape extract, and B) Treatment-Adipose cells treatment with muscadine grape extract

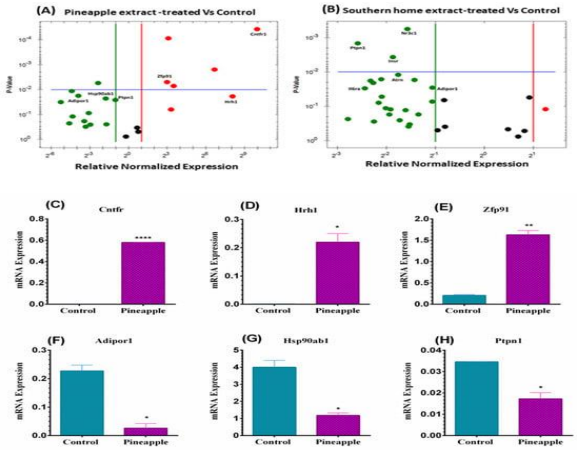


Figure 3: Obesity related gene expression induced by muscadine grape berry extract treatment in obesity cells. The red dots refer to upregulated mRNAs, green dots for the inhibited genes, and black dots for unchanged.

Our bioprocessing studies on the fate of juice components during its vinification showed significant changes in its constituents' content and composition with potential impact on its oenological characteristics. These data have potential application to regulate specific fermentation parameters for enhancing muscadine grape vinification protocol to enhance finished wine quality.

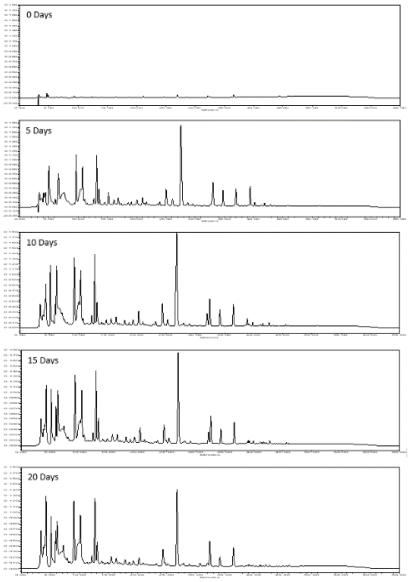


Figure 4. Changes in the polyphenolics profile of muscadine grape juice during its vinification. Note significant changes in polyphenolics content and composition of juice from day 0 to day 20 after the initiation of vinification

What new/additional research is needed (Plan of Work for 2024- 2025)?

Conduct comprehensive studies using diverse muscadine grape genotypes to identify the desirable combination of polyphenolics to enhance its potency to mitigate various ailments. Continue long term vinification studies to monitor the ongoing biochemical events during fermentation and storage to determine the fate of various juice components and stability of flavor and aroma volatiles. In addition, determine seasonal variability, apply advanced statistical models (e.g.,

OPLS-DA, ANOVA) to better understand relationships between grape constituent profiles and finished wine characteristics and expand sensory analysis with consumer panels to validate the acceptability of flavor profiles.

List of Publications - Refereed, non-refereed, proceedings, etc. (complete citation)

Messeha, S.S*., **Agarwal, M***., Gendy, S.G., Mehboob, S.B. and Soliman, K.F., 2024. The Anti-Obesogenic Effects of Muscadine Grapes through Ciliary Neurotrophic Factor Receptor (Cntfr) and Histamine Receptor H1 (Hrh1) Genes in 3T3-L1 Differentiated Mouse Cells. Nutrients, 16(12), p.1817. (*-**Equal first author**).

Professional meetings/presentations – local, state, regional, national, international (complete citation)

- M. B. Sheikh*, A. Kaplan, I. M. Ahmed, T. Dhanani and M. Agarwal 2024. Safeguarding the Phytochemicals Content and Composition and Health Value of Muscadine Grape Products to Preserve Health Value and Bioactivity. 21St Biennial Research Symposium. April.6-9. (Poster Presentation).
- M.B. Sheikh*, I. M. Ahmed, M. Agarwal, T. Dhanani. Effective Phytochemicals Content of Muscadine Grape for Promoting Apoptosis and Abrogation of Cancers Cell Growth to Prevent Cancer Progression. ARD Research Symposium, 2024, USA. (Oral Presentation).
- M. B. Sheikh*, M.A. Rahman, I M Ahmed, J Wang and Z Luo. 2024. Genome-wide transcript analysis of Muscadine Grape cv. Noble During berry Development. 21St Biennial Research Symposium. April.6-9. (Poster Presentation).
- M. Agarwal*, A. Kaplan, and M. B. Sheikh. Muscadine Grape Bioactives: A Natural Source of Antimicrobial Power. ARD Research Symposium, 2024, USA. (Oral Presentation).
- M. Agarwal*, M. B. Sheikh, S. S. Messeha, and K. F.A. Soliman. Muscadine Grape Bioprospecting: A Path to Adiposity Control. ARD Research Symposium, 2024, USA. (Poster Presentation)
- M. Agarwal* M. B. Sheikh, I. M. Ahmed and 11. T. Dhanani. Muscadine Grape and Gut Health: Prebiotics and Probiotics in Harmony. ARD Research Symposium, 2024, USA. (Poster Presentation)
- M. Agarwal*, T. Dhanani, I. M. Ahmed, and M. B. Sheikh. Exploring Muscadine Grape Phytochemicals to Support Healthy Aging. ARD Research Symposium, 2024, USA. (Poster Presentation).
- M. Agarwal. Muscadine Grape Bioactives: A natural source of Antimicrobial Power. CAFS seminar series, 2023, Florida A&M University, USA. (Oral Presentation).
- T. Dhanani*, I. M. Ahmed, M. Agarwal, M. B. Sheikh 2024. Genetic Variation in Metabolite Content and Composition and Its Effect on Bioactivity of Muscadine Grape Genotypes., 21St Biennial Research Symposium. April.6-9. (Oral Presentation).
- T. Dhanani. Delivered seminar on "From Farm to Table: Harnessing Non-destructive Technologies for Agri-Tech innovations" on October 10, 2023, at 2023 Fall Seminar Series organized by CAFS, FAMU. (Oral Presentation).
- T. Dhanani*, M. Agarwal, I. M. Ahmed and M. B. Sheikh 2024. Unlocking the Nutraceutical Potential of Muscadine Grapes: Dynamic Evolution of Metabolites During Berry Development., 21St Biennial Research Symposium. April.6-9. (Poster Presentation).
- T. Dhanani*, M. B. Sheikh, A. Kaplan, I. M. Ahmed and M. Agarwal 2024. An Innovative Technique to Maximize the Recovery of Polyphenolics for Enhancing Nutraceutical Properties of Muscadine Grape. 21St Biennial Research Symposium. April.6-9. (Poster Presentation).
- A. Kaplan*, M. B. Sheikh, I. M. Ahmed, T. Dhanani and M. Agarwal 2024. M. B. Sheikh*, A. Kaplan, I. M. Ahmed, T. Dhanani and M. Agarwal 2024. Safeguarding the Phytochemicals Content

and Composition and Health Value of Muscadine Grape Products to Preserve Health Value and Bioactivity. 21St Biennial Research Symposium. April.6-9. (Poster Presentation)

- I. M. Ahmed*, T. Dhanani, M. Agarwal and M. B. Sheikh 2024. Differences in the Molecular and Cellular Components Between Leathery and Non-leathery Skinned Grape Genotypes., 21St Biennial Research Symposium. April.6-9. 511p. (Poster Presentation)
- I. M. Ahmed*, M. Agarwal, T. Dhanani and M. B. Sheikh 2024. Characterization of Parthenocarpy-Related Gene/s Towards Development of Seedless Muscadine Grape Genotype. 21St Biennial Research Symposium. April.6-9. 512p. (Poster Presentation)
- I. M. Ahmed*, M. Agarwal, T. Dhanani and M.B. Sheikh 2024. Differences in the Molecular and Cellular Components Content and Composition Between Hexose- and Sucrose-Accumulators and its Effect on Berry Sugar Content., 21St Biennial Research Symposium. April.6-9. 237p. (Oral Presentation)
- I. M. Ahmed. Delivered seminar on "The Barley S-Adenosylmethionine Synthetase 3 Gene HvSAMS3 Positively Regulates the Tolerance to Combined Drought and Salinity Stress in Tibetan Wild Barley" on October 24, 2023, at 2023 Fall Seminar Series organized by CAFS, FAMU. (Oral Presentation).

Extension - List activities (if applicable)
Name of graduate students and title of theses (If applicable)
Name of undergraduate student involved (If applicable)
Proposal submitted – Title of Proposal, amount and funding agency

- Investigation into the Origin and Evolution of Sediment in Muscadine Wine to Enhance Acceptance, Marketability and Value- $ 49,998.30 FDAC/VAC
- Elucidating the Contribution of Yeast Assimilable Nitrogen for Flavor Volatiles Production and Sensory Receptors of Florida Wines- $49,996.65, FDAC/VAC
- Illuminating the Synthetic and Accumulation Patterns of Flavor Precursor Components in Maturing Grape to Enhance the Oenological Characteristics of Florida Wines - $50,000, FDAC/VAC
- Unveiling the Anti-obesity Property of Muscadine Grapes- 49,830.00, FDAC/VAC
- Exploring the Probiotic Potential of Muscadine Grapes- 49,940.00, FDAC/VAC
- Cardioprotection From Muscadine Grape Via Polyphenolics - A Research Endeavor to Validate Its Efficacy and Build Capacity in Nutrigenomics, USDA-NIFA-CBG. $500,000.00
- Developing Non-leathery Crispy Skinned Berry Via Gene Editing for Strengthening Genomic Technologies and Promoting Muscadine Grape Consumption- $500,000.00, USDA-NIFA-CBG.
- Investigating Vinification Events to Enhance Flavor and Aroma Characteristics of Florida Wines for Increasing Consumption and Marketability- USDA-NIFA-CBG. $497,002

Proposal funded - Title of proposal, amount, funding agency, and duration

- Muscadine Grapes Polyphenolics - A Research Endeavor to Validate Its Efficacy Against Select Ailments $50,000.00- FDAC/VAC- 9 months

Awards and recognition (complete citation)
Collaboration - participating institution/collaborator (if applicable)

- University of Florida
- Alabama State University
- Southern University

- **Viticulture and Product Development- PI Professor Violeta Tsolova**

FAMU-USDA Cooperative Agreement: The Southern Grape Clean Plant Center at FAMU

Research team members
Dr. Violeta Tsolova-Director

Dr. Islam El-Sharkawy- Assistant Professor, Grape Genetics

Ahmed Gamal Kamel Mohamed – Research Associate/Virus Diagnostics

1. Goals and objectives

1.1. Test vines for viruses in the foundation vineyard using testing standards.
1.2. Applying the standardized NCPN's SOPs.
1.3. Identify the strain of the virus from positively infected plants.
1.4. Eliminate viruses using "Meristem-tip culture."
1.5. Collaborate with other NCPN centers and industry stakeholders.

2. Who cares and why?

The growing domestic and export markets (wine & fresh) positively drive the sustainability and growth of the southern Muscadine grape industry. The availability of tested disease-free material from the currently preferred and newly developed cultivars is a growing industry demand.
The knowledge of plant viruses infecting muscadine grapes was significantly delayed and still needs more to be discovered. Muscadine grape (*Muscadinia* sp.) genetic incompatibility with *Vitis* sp. limits the use of classical viral diagnostics assays.
Since 2010, the Southern Grape Clean Plant Center at FAMU has been working diligently with the support of the regional/state grape industry and the NCPN for Grape to establish and maintain the G1-foundation block for southern muscadine and PD-tolerant bunch grape cultivars and to clean the newly released cultivars under FAMU and UGA muscadine breeding programs. We still lack adequate quantities of disease-free certified planting material and nursery certification systems for the southern grapes. We need all the support for diagnostic and pathogen elimination services for newly released southern grape cultivars and breeding lines (FAMU). We must also maintain the G1-foundation block and the field mothers under the screen.

3. The specific objectives of this research are:

3.1. Detection

Molecular-based methods have been standardized and are currently employed to detect six pathogens affecting grapevines. The targeted pathogens were selected based on relevant regional publications, significance, and prevalence. These protocols were developed in collaboration with Dr. Maher Al Rwahnih and obtained from the Foundation Plant Services (FPS) at UC Davis as part of the 2022 harmonization initiative presented to the network. The pathogens under investigation include Grapevine leafroll viruses (GLRaV-1, GLRaV-2, GLRaV-3), Grapevine red blotch virus (GRBV), Vitiviruses (GVB), and Tomato ringspot virus (ToRSV).

3.2. Propagation

At the G1 foundation vineyard and G1 screen houses, we maintain accessions for propagating muscadines and southern bunch grapes, which have previously been tested against 21 pathogens. Florida will continue to produce and distribute pathogen-tested G1 muscadine material to nurseries and other stakeholders as needed.

3.3. Maintenance

The newly tested materials for all targeted pathogens will be preserved in tissue culture and the screenhouse. The Florida Clean Plant Center will conduct periodic audits to monitor existing and new pathogens.

3.4. Education and Outreach

Both principal investigators will collaborate with other grape clean plant centers and the NCPN education and outreach group to keep stakeholders updated. The PIs will participate in the NCPN annual meeting, Tier 2 Governing Body meetings, research and extension events, industry meetings, field days, and other gatherings. The FAMU Clean Plant Center for Grape will host its annual Vineyard BMP Workshop in February 2024 and revise the "Muscadine Production Guide for FL" and the "Post-Harvest Disease Prevention Fact Sheet."

4. What has the project accomplished since its initiation?

4.1. Materials and Methods:

4.1.1. Plant Material

4.1.1.1. Clean Vineyard "G1-Foundation" block: A total of 141 grapevines from 21 different cultivars (10 *Vitis vinifera* "Bunch grapes"; 11 *Muscadinia rotundifolia* "Muscadine grapes").

4.1.1.2. Screenhouse: A total of 26 Mother grapevines from different cultivars (11 *Vitis vinifera* "Bunch grapes"; 15 *Muscadinia rotundifolia* "Muscadine grapes").

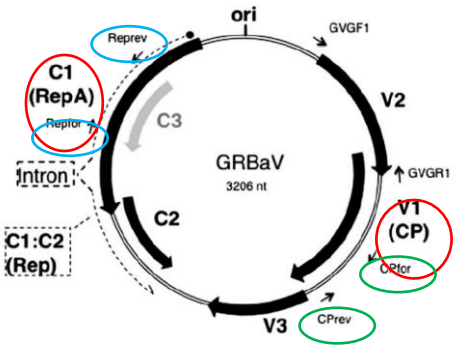
4.1.2. Total Nucleic Acid "TNA" Extraction

4.1.2.1. TNA extracted using the CTAB method, according to Krenz et al. (2014).

CTAB formulation (100 mM Tris-HCl, pH 8.0; 20 mM EDTA; 1.4 M NaCl; 2% cetyltrimethylammonium bromide [CTAB]; 0.5 M glucose, 0.2% β-mercaptoethanol, preheated to 60°C).

4.2. Testing DNA Viruses:

4.2.1. Multiplex end-point PCR for GRBV according to Krenz et al. 2014/Target regions



Grapevine red blotch-associated virus is widespread the United States. B. Krenz, J. R. Thompson, H. L. McLane, M. Fuchs, and K. L. Perry First, second, third, and fifth authors: Department of Plant Pathology and Plant-Microbe Biology, 334 Plant Science, Cornell University, Ithaca, NY 14853; and fourth author: Department of Plant Pathology and Plant-Microbe Biology, Cornell University, New York State Agricultural Experiment Station, Geneva, NY 14456.Accepted for publication 29 April 2014.

Sudarshana, M. R., Perry, K. L., and Fuchs, M. F. 2015. Grapevine red blotch-associated virus, an emerging threat to the grapevine industry. Phytopathology 105:1026-1032.

4.2.2. Primers

The selected primers are according to the assay by Krenz et al. 2014

4.2.2.1. The primers used for the amplification of the Coat Protein (CP)

CPfor (5′-AGCGGAAGCATGATTGAGACATTGACG**-3′; nucleotide positions 1073 to1099)**

CPrev (5′-AACGTATGTCCACTTGCAGAAGCCGC**−3′; nucleotide positions 1329 to 1304).**

The band size of the CP gene is 257 bp.

4.2.2.2. The primers used for the amplification of the replication-associated protein (RepA)

Repfor (5′-CAAGTCGTTGTAGATTGAGGACGTATTGG**-3′; nucleotide positions 2567 to 2595)**

Reprev (5'-AGCCACACCTACACGCCTTGCTCATC**-3′; nucleotide positions 2884 to 2850).**

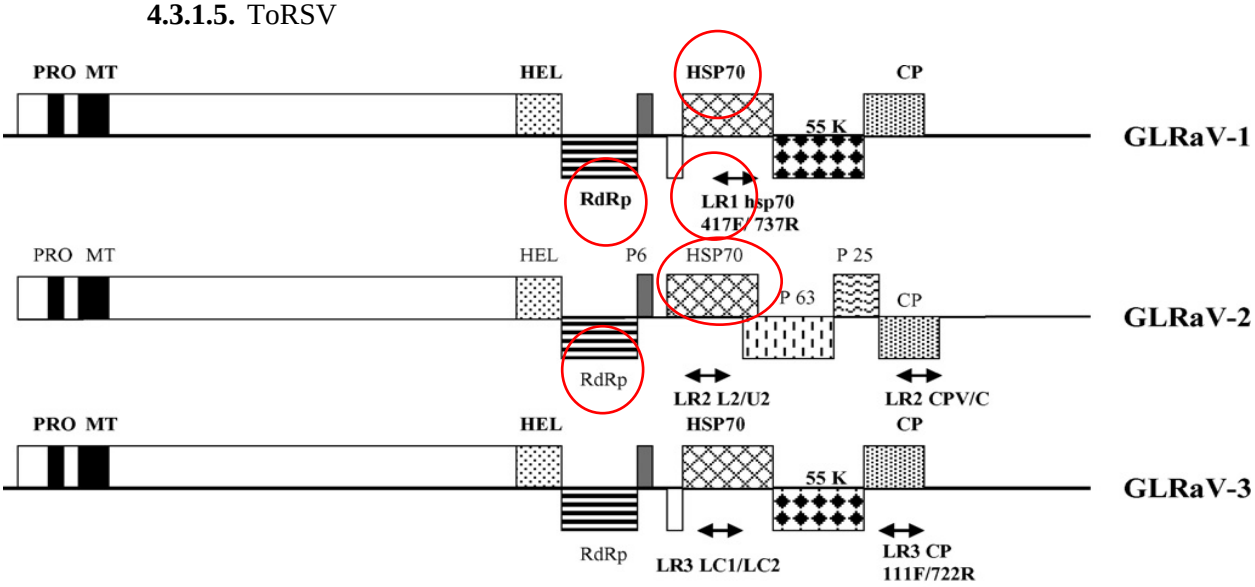
The band size of the RepA gene is 318 bp.

4.3. Testing RNA Viruses: RT-qPCR GLRaV-1, GLRaV-2, GLRaV-3, GVB, and ToRSV

After testing for GRBV, TNA samples undergo double treatment with TURBO DNase. Following this treatment, Nanodrop readings are taken for concentration (ng/µL) and A260/280 and A260/230 ratios using the Nanodrop 2000C. We assess the integrity of the RNA samples by running a 3 µL aliquot on a 1.2% agarose gel to check the 18S and 28S bands. Once the samples pass this integrity check, they are stored at -20 °C and labeled as stock solutions. Working RNA solutions are prepared at one ng/µL, resulting in a final two ng/µL concentration in each RT-qPCR sample.

4.3.1.RT-qPCR/Target regions

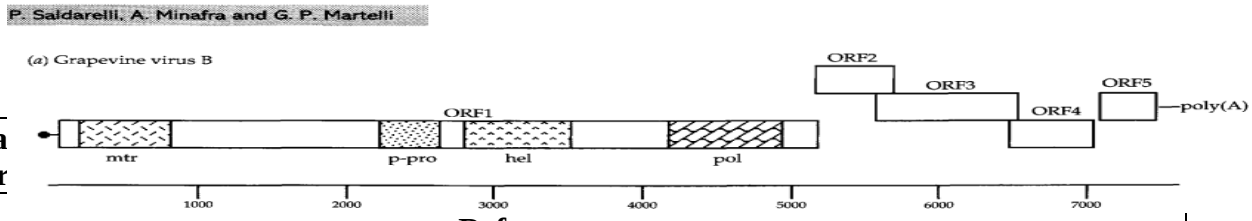
4.3.1.1. GLRaV-1
4.3.1.2. GLRaV-2
4.3.1.3. GLRaV-3
4.3.1.4. GVB
4.3.1.5. ToRSV



GVB

ToRSV

RNA2



Ta
Gr

Reference gene			
18S	Osman, F. 2008; Rowhani, A.	18S rRNA 449 f	GTGACGGAGAATTAGGGTTCGA
		18S rRNA 498 r	CTGCCTTCCTTGGATGTGGTA
		18S rRNA 475 p	CCGGAGAGGGAGCCTGAGAAACGG
Closteroviruses			
Grapevine leafroll-associated virus **GLRaV-1**	Klassen, V. A 2010; Osman, F.; M. Al Rwahnih, A. Rowhani	LR1F2a	ACCTGGTTGAACGAGATCGCTT
		LR1F2b	ACTTGGTTGAACGAGATTGCTT
		LR1F2c	ACCTGGTTGAATGAGATCGCTT
		LR1R2	GTAAACGGGTGTTCTTCAATTCTCT
		LR1P2	ACGAGATATCAGTGGACGGA
Grapevine leafroll-associated virus **GLRaV-2**	Klassen, V. A 2010; Osman, F.; M. Al Rwahnih, A. Rowhani	LR2F2	CGATTCTAACCACATGACTTTTGG
		LR2R2a	GGACCGAGTAATGAGGTTTTAAACG
		LR2R2b	GGACTGAGTAGTGTGGTTTTAAACG
		LR2R2c	GGACTGAATAGTGTGGTTTTAAACG
		LR2P2	CGTTGGGTGGGTTGCGATTCGAG
Grapevine leafroll-associate	Klassen, V. A 2010; Osman, F.; M. Al	LR3F3	GGGTCAAGTGCTCTAGTTAAGGTCA
		LR3R3a	AAAGTGTCCACCAGTCTCAGTCC
		LR3R3b	AAAGTGTCCACCAATCTCAGTCC

d virus **GLRaV-3**	Rwahnih, A. Rowhani	LR3P3a	TTGCCGCAGATATCTA
		LR3P3b	TTGCCGCACATATC
Vitiviruses			
Grapevine Virus B **GVB**	Osman, F. 2008; Rowhani, A.	GVBF1	CTAGGAGTGCGGCTAAACGAA
		GVBF2	GGAGTGCGGCCAAACGA
		GVBF3	CAAGGAGTGCGGCTAAACGAA
		GVBR1	CCTTAACCTCGTCCTGTGATATGGT
		GVBR2	CCTTCACCTCATCYTGGGATCGTGT
		GVBP1	CTCGTTATGGTCGCTGTTACTGTTGTGGTAG
		GVBP2	ACCGTTACGGCCGTTGTTACTGTTGTGGTAG
Secoviridae			
Tomato Ring Spot Virus **ToRSV**	Joe Tang, Lisa I Ward 2014	ToRSV-UTRf	AATGGTTCCCAGCCACTT
		ToRSV-UTRr	AGTCTCAACTTAACATACCAC
		ToRSV-UTRp	AGGATCGCTACTCCTCCGTCAAC-BHQ-1

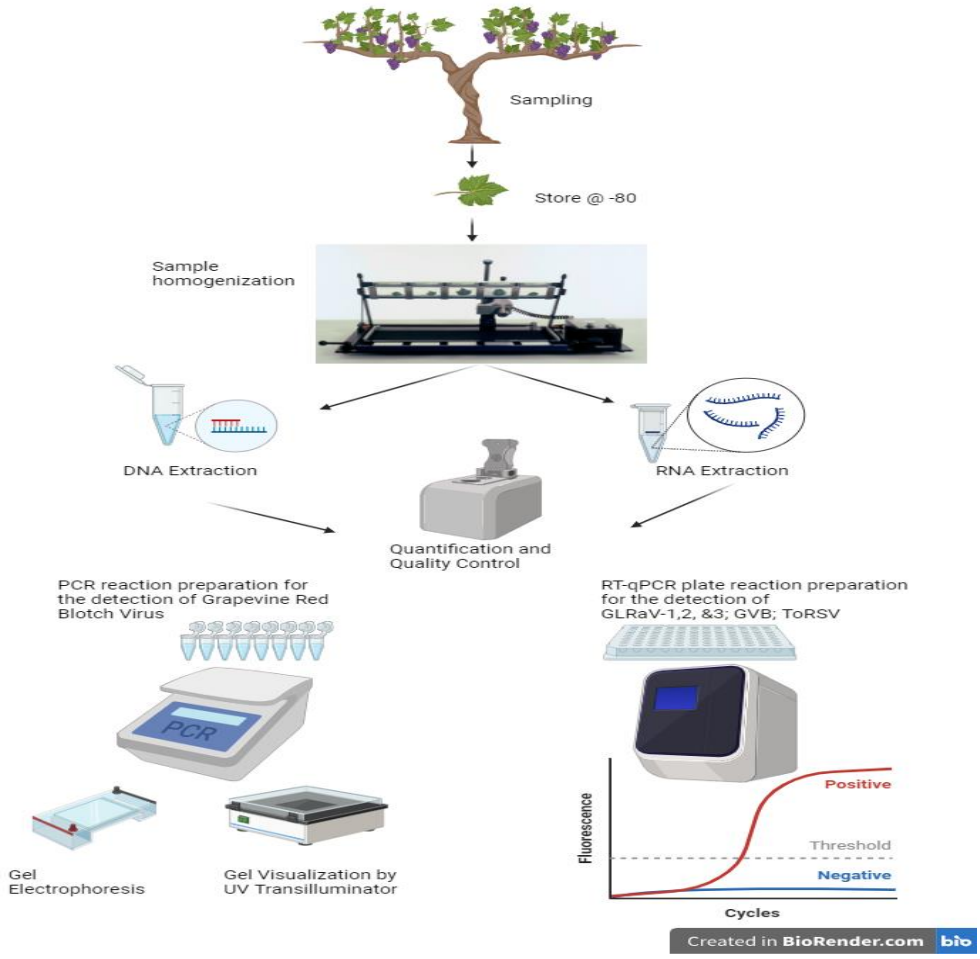
4.4. High-throughput Sequencing at Foundation Plant Service – UC Davis

Under the collaboration and service agreement among the NCPN centers, we submitted seven samples for sequencing at FPS-UC Davis. This is a crucial step for validating our findings and evaluating the sensitivity of our assays in detecting GLRaV-1, GLRaV-2, GLRaV-3, GVB, ToRSV, and GRBV.

4.5. Propagation of dormant cuttings from tested plant material

We obtained 704 dormant cuttings from the G1-Foundation, taken from our tested Bunch-grapevines, and planted them in 497 pots at the Florida Clean Plant Center greenhouse. The success rate of the cuttings varied by cultivar, but we successfully propagated most of the bunch grape varieties.

4.6 Workflow for Molecular Virus Diagnostic FAMU/Viticulture Grapevine Diseases Clinical Lab:



5. Results

5.1. Testing

Deliverables Metrics					**Reporting Period**: September 1, 2023 – September 31, 2024	
Diagnostics conducted					**1- Samples: 39 (field samples), 10 (Screenhouse)** **2- cPCR:** **a. Grapevine Red Blotch Virus (GRBV) = 167 Vines x 2 (Technical Replicates) = 334 reactions** **3- qRT-PCR** **a. Grapevine Leafroll-associated Virus 1 (GLRaV-1) = 65 Vines x 3 (Technical Replicates) = 195 reactions** **b. Grapevine Leafroll-associated Virus 2 (GLRaV-2) = 65 Vines x 3 (Technical Replicates) = 195 reactions** **c. Grapevine Leafroll-associated Virus 3 (GLRaV-3) = 65 Vines x 3 (Technical Replicates) = 195 reactions** **d. Grapevine Virus B (GVB) = 65 x 3 (Technical Replicates) = 195 reactions** **e. Tomato Ring Spot Virus (ToRSV) = 65 x 3 (Technical Replicates) = 195 reactions** **4- Total Number of Reactions for the Diagnostics conducted = 1309 reactions**	

Accessions are maintained in the foundation.

#	Cultivar	Grapevine location			Total	Infected						Healthy	Comments
		G-Foundation	Screenhouse	Research Vineyard		GRBV	GLRaV-1	GLRaV--2	GLRaV-3	GVB	ToRSV		
					Rootstocks								
1	**Tampa**	2	0		2	0							
2	**Florilush**	10	2		12	**1** (Florilush_2)							
					Bunch/Hybrids								
3	**Black Spanish**	9	0		9	9						0	
4	**Lenoir**	4	2		6	6						0	
5	**C-30-5-V4**	9	0		9	0							
6	**Blanc Dubois**	22	0		22	0							
7	**Suwanne**	9	4		13	0							
8	**Lake Emerald**	5	0		5	0							
9	**Conquistador**	9	1		10	0							
10	**C-30-5 V3**	12	0		12	0							
11	**Stover**	0	2		2	0							
	Muscadines												
#	**Cultivar**	**G-Foundation**	**Screenhouse**	**Research Vineyard**	**Total**	**Infected**						**Healthy**	
						GRBV	**GLRaV-1**	**GLRaV-2**	**GLRaV-3**	**GVB**	**ToRSV**		
12	**Carlos**	12	2	1	15	**1** (Carlos_1)	0	**4** (G.15.1.1; G.15.2.2, G.15.6.1, G.15.6.2)	0	**3** (G.15.4.2, G.15.6.1, T3.17.5.2)	0	0	**GVB** confirmed by HTS **GLRaV_2** Confirmed by both RT-qPCR and HTS
13	**Welder**	3	1		4	0	0	**3** (G.16.1.1, G.16.1.2, G.16.2.1)	0	**1** (Welder_1)	0	0	**GVB** confirmed by HTS
14	**Fry**	5	3		8	0	0		0	0	0	8	
15	**Ison**	3	3		6	0	0	**1** (G.18.2.1)	0	0	0	5	
16	**Supreme**	1	4		5	0	0	0	0	0	0	5	
17	**Darlene**	7	1		8	0	0	**1** (G.20.4.1)	0	0	0	7	
18	**Magnolia**	5	1		6	0	0	0	0	0	0	6	
19	**Noble**	2	0		2	0	0	0	0	0	0	2	
20	**Majesty**	1	0	3	4	0	0	0	0	**1** (G.23.1.1)	0	3	**GVB** confirmed by HTS
21	**Floriana**	0	0	3	3	0	0	**1** (C.16.3.1)	0	0	0	2	**GLRaV_2** Confirmed by both RT-qPCR and HTS
22	**Onyx**	0	0	3	3	0	0	0	0	0	0	3	

5.2. HTS results

The High-Throughput Sequencing (HTS) results at FPS - UC Davis corroborated our findings regarding GLRaV-2. Additionally, they identified GVB in our samples despite our GVB detection assay returning negative results. Upon comparing the sequences obtained for GVB from HTS with our primers, we discovered several mismatches in the probe and reverse primers. This led us to conclude that the GVB strains affecting our vines differ in sequence from those represented in the primers used in our assay. Furthermore, HTS detected no GRBV in the samples we submitted for sequencing.

5.3. Propagation

We propagated a total of 704 cuttings in 497 pots. Of these, 275 cuttings successfully established themselves, yielding a success rate of 39%. This indicates a promising level of propagation efficacy for our project.

Total No. of Pots	**497**
Total No. of Cuttings	**704**
Total No. of Successful Cuttings	**275**
Success rate %	**39%**

6. Research Results, Output, and Impact

6.1. Guaranteeing planting material that is true to type and free from propagative diseases is essential for muscadine and PD-tolerant bunch grape southern cultivars. Choose quality to ensure a healthy and productive crop.

6.2. G1 foundation block under screen/greenhouse and field for muscadines/southern grape industry needs.

6.3. Foundation-level clean material distributed to nurseries and other stakeholders.

6.4. Accurate, sensitive, and comprehensive detection methods for producing clean planting material for southern grapes and muscadines.

6.5. Risk mitigation measures of the diagnostic methods limitations by program quality coordination and management.

6.6. Utilizing the best practices approach to safeguard and back up the foundation material.

6.7. Relevant information to the community of practices in extension, education, and outreach on the importance of using clean planting stock for muscadines and southern grapes.

7. What new/additional research is needed (Plan of Work for 2023- 2024)?

7.1. The goal of identifying GRBV phylogenetic clades from infected vines is to determine the prevalent strains affecting Muscadine and Bunch grapes at the Southern Grape Clean Plant Center at FAMU. This process involves characterizing the GRBV isolates obtained from these infected vines. We will employ PCR and nested PCR techniques to amplify the GRBV fragment and clone it into a vector for further analysis. This comprehensive approach will provide valuable insights into the strains present in the region.

7.2. Designing new primers to detect GVB (ongoing) by endpoint RT-PCR. Design new primers based on the results obtained for detecting GVB by RT-qPCR.

7.3. Expanding the list of pathogens to include more imminent threats to the region and the industry.

8. Professional meetings/presentations – local, state, regional, national, international (complete citation)

8.1. 1890 Association of Research Directors (ARD) research symposium, Nashville, TN, April 2024
8.2. 2024 Annual NCPN Meeting, Davis, CA, January 26, 2024.

9. Extension - List activities (if applicable)
10. Name of graduate students and title of theses;
Dupe Stella Ogundipe, CAFS /M.S. Graduate Student Ag Sc/Plant Science track
11. Name of undergraduate student involved.
Ms. Jasmine Eason, senior CAFS/Pre-Vet major.

12. Proposal submitted – Title of Proposal, amount, and funding agency
12.1. The Muscadine/Southern Grapes Clean Plant Network Proposal for FY 2024 ($76,662)
12.2. 2024 CBG Grant proposal (as Co-PI)

13. Collaboration - participating institution/collaborators: National Clean Plant Network Grape: UC, Davis, NCSU, Cornell University, Missouri State University, Washington State University, FDACS/Plant Industry, Kenya Egerton University, Israel, ARO/Volcani Center, Austria, BOKU University, France, Institute Lasalle, Beauvais.

- **Vinification and Bioprocessing – PIs Allen Frank Humphries, M.S. & Professor Violeta Tsolova**

Project # 1: "New Climate Smart Muscadine Management Practices: Utilizing Arbuscular Mycorrhizal Fungi (AMF) Inoculated Under-Vine Vegetation (UVV) to Reduce Pesticide Applications and Enhance Student Experiential Learning at FAMU" USDA/NIFA Capacity Building Grant Program, FY2023-2025, $298,760.

Research team members
Allen Frank Humphries- Research Enologist

Dr. Violeta Tsolova- Professor and Director

Eryse White- Undergraduate Research Assistant

Camden Kruis- Undergraduate Research Assistant

Zebadiah Hudson- Vintner Assistant

Goals and objectives
The main objective of this research project is to build research capacity in sustainable vineyard management strategies for southern grapes and FAMU's Center for Viticulture and Small Fruit Research with the purpose of generating new knowledge about Florida grapes and wines and serve as a technological training platform for young professionals, industry clientele, and extension personnel.
Specific Objectives:

1) Convert existing rows of a conventionally managed vineyard at FAMU CVSFR to adapt climate smart practices: Under-vine vegetation (UVV) and Arbuscular Mycorrhizal Fungi (AMF).

2) Install Real-Time vineyard monitoring system to measure conditions and use software to model and estimate risk of diseases and pests.
3) Collect soil and plant samples from experimental plots over the span of the project and submit to Biome Makers.
4) Produce 72 total experimental wine samples and 72 total juice samples (2 seasons) to evaluate each climate smart variation and for influences on vinification properties and healthy compounds.
5) Develop a new "Climate Smart Muscadine Production Guide" to summarize results of the study to easily make available to industry partners, researchers, and hobbyist grape growers.
6) To provide research curricula and training for one (1) graduate student at the master level and two (2) undergraduate student researchers.

Who cares and why?

Viticulture and winemaking are some of the most ancient professions on the planet with evidence dating back to over 8000 years ago. However, not even this timeless tradition of growing grapes is immune to the effects of climate change. Climate change has already begun to affect the quality of wine being produced in classical growing regions around the globe. Merlot, one of the most popular red wine grapes in the world, is being threatened by increased temperatures, severe droughts, and erratic weather patterns, that affect ripening and subsequent wines characteristics and quality (van Leeuwen et al 2019). Champagne is in a similar situation of being altered by the shifting climate, causing increased sugar and alcohol content (Boyer 2021). Eventually if the trend of increasing temperatures does not cease, these and other classic styles of wine could be altered or lost completely.

When it comes to climate change, the state of Florida is ground zero. Here, many effects are already being felt including rising temperatures, erratic rainfall and weather patterns, and the introduction of new harmful pests and diseases. Florida has a huge economic impact associated with agriculture industry amounting to $7.8 Billion in 2019 (Florida Department of Agriculture and Consumer Services). The state is also among the top 3 wine markets in the country and is ranked among the top 10 wine producers in the nation (Florida Wine and Grape Growers Association) estimated to generate an economic impact close to $1 Billion in 2010 (Stonebridge Research Group LLC). Due to climate change, this major agricultural and economic resource is in jeopardy.

Florida is home to numerous biotic and abiotic challenges such as high levels of fungal and bacterial pathogens, weed pressure, erratic rainfall, and high temperatures. Due to their resilience, viticulture in the southern United States is based solely on southern grapes, muscadines (*V.*

Rotundifolia) and hybrid bunch grapes, which are unique compared to mainstream 'vinifera' grapes (*V. vinifera)* grown elsewhere such as California and European countries. Unfortunately, even with these native and resistant varieties, there is still a need for more control over these pests to ensure a bountiful harvest.

To combat the challenges at hand, vineyards in the southeast U.S. primarily utilize conventional management strategies including the generous application of herbicides, fungicides, and insecticides to protect grapevines and the valuable harvest. These pesticides can be expensive, dangerous to human health, harmful to the vines if inappropriately applied, and detrimental to beneficial fungi and other soil microbiota. The pending "Roundup Lawsuit 2022" is on its way to completely oust the herbicide which is currently used as the major weed control in Florida and southern vineyards. This type of management is becoming outdated and can also have negative effects on the environment and rural communities if left unchecked. Meanwhile, other grape and wine producing regions around the world are transitioning toward more modern and sustainable viticulture systems.

What has the project accomplished since its initiation?

Over the reporting period the following accomplishments were completed:

1) Conversion of existing rows of a conventionally managed vineyard at FAMU CVSFR to adapt climate smart practices: Under-vine vegetation (UVV) and Arbuscular Mycorrhizal Fungi (AMF) (Figures 1-5).
2) Installation of Real-Time vineyard monitoring system (Figures 6-9)
3) Collect soil and plant samples from experimental plots over the span of the project and submit to Biome Makers (year 1) (Figures 10-11).
4) Collection and analysis of juice samples from each vine in the experiment (year 1)
5) Provision of research curricula for (2) undergraduate research assistants

Research Results, Output and Impact

Objective 1. Conversion of existing rows of a conventionally managed vineyard at FAMU CVSFR to adapt climate smart practices: Under-vine vegetation (UVV) and Arbuscular Mycorrhizal Fungi (AMF).

Summary of Results for Objective 1: 12 panels (24 vines) were selected in the BMP vineyard for the field experiment. 7 Treatment groups were setup as follows: Arbuscular Mycorrhizae Fungi (AMF) only, Under-vine vegetation (UVV) only, AMF + UVV only, No Mgmt., Conventional Mgmt., AMF + Conventional, and UVV + Conventional (see Figures 1-3 for more information). AMF and UVV used for this experiment was 100% endomycorrhiza (*G. intraradices*) and White Dutch Clover (*T. repens)* respectively.

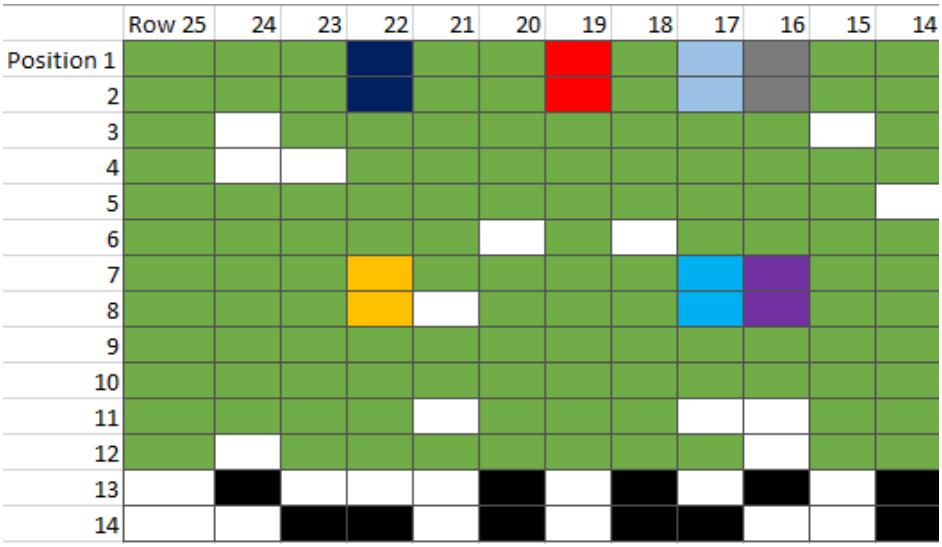


Figure 1. *Experimental layout of the Climate-Smart field experiment at FAMU CVSFR Best Management Practices (BMP) vineyard cv. Carlos block. See figure 3 for the explanation of each color*

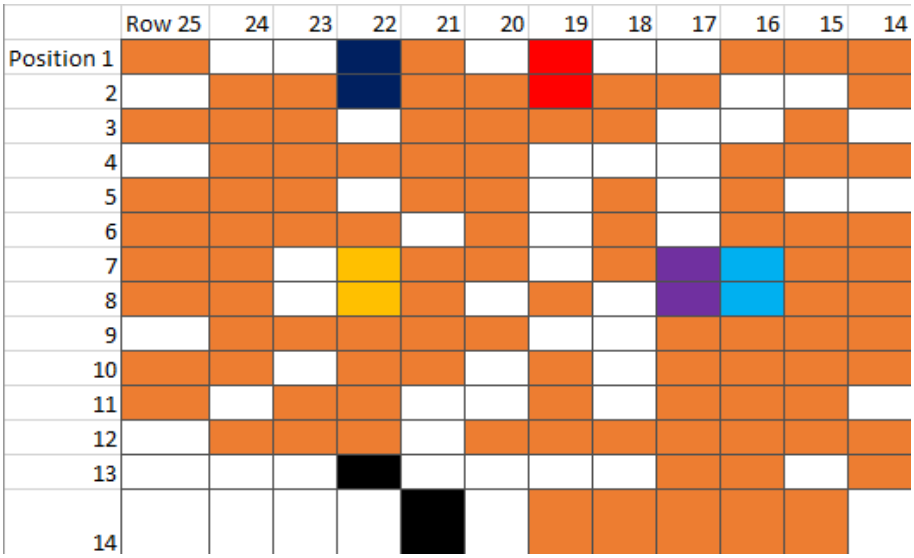


Figure 2. *Experimental layout of the Climate-Smart field experiment at FAMU CVSFR Best Management Practices (BMP) vineyard cv. Noble block. See figure 3 for the explanation of each color.*

Carlos	Noble	Color Key	Treatment type
17-4	16-4		AMF Only
16-4	17-4		Clover Only
22-1	22-1		AMF + Clover Only
22-4	22-4		No Mgmt
19-1	19-1		Conventional Mgmt
17-1	n/a		AMF + Conventional Mgmt
16-1	n/a		Clover + Conventional Mgmt
			Bunch Grape
		White	No vine present

Figure 3. *Key explaining the colors and corresponding climate-smart treatments in the field experimental layout of Figures 1 & 2.*

Figure 4. *Undergraduate research assistant, Eryse White, and vintner assistant, Zebadiah Hudson, inoculating the experimental rows with arbuscular mycorrhizae fungi (AMF).*

Figure 5. *Vintner assistant, Zebadiah Hudson, and undergraduate research assistant Camden Kruis, watering-in the under-vine vegetation (UVV) seeds and AMF inoculum.*

Objective 2. Installation of Real-Time vineyard monitoring system
Summary of Results for Objective 2: The installation of the real-time vineyard monitoring system has been completed and includes (2) weather stations connected to 24 leaf wetness sensor and 24 soil moisture sensors. Each vine in the experiment has (1) leaf wetness sensor and (1) soil moisture sensor which collects data and sends wirelessly to the weather stations. The weather stations then transmits the data to the cloud where the research team can access via hobolink.com. Figures 6-9 show how the weather stations, leaf sensors, and hobolink dashboard appear.

Figure 6. *Weather station #1 set up in the experimental vineyard and equiped with anemometer. The station communicates wirelessly to 10 leaf wetness sensors and 10 soil moisture sensors in the block. That data is transmitted wirelessly to the cloud where we can access at any time to monitor moisture levels in the canopy and in the soil.*

Figure 7. *Leaf sensor installed directly on the trellis wires of the experimental vineyard. This sensor records and transmits wirelessly moisture in the canopy. This data can be used to predict risk of pathogen outbreaks that can compromise the harvest*

Figure 8. *Weather station # 2 set up in the experimental vineyard and equiped with a rain gauge. The station communicates wirelessly to 14 leaf wetness sensors and 14 soil moisture sensors in the block. That data is transmitted wirelessly to the cloud where we can access at any time to monitor moisture levels in the canopy and in the soil.*

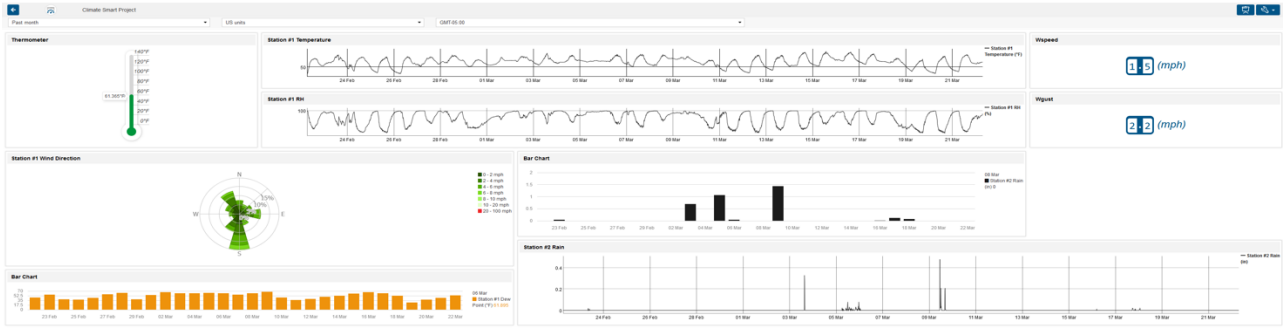


Figure 9. *Screenshot of the 'HOBOlink dashboard' where all of the real-time vineyard monitoring data is transmitted. This dashboard displays current temperature, relative humidity, wind speed, wind gust, wind direction, rainfall, leaf wetness, and soil moisture.*

Objective 3. Collect soil samples and analyze for soil nutrients and microbiota community composition

Summary of results for Objective 3: (12) aggregate soil samples were collected from the Climate-smart field experiment ((1) sample from each panel which contains (2) vines each). Each sample contained approximately 600 grams of soil (Figures 10-11). After collection, samples were stored at -20 C until ready to be delivered to Waters Agricultural Laboratory in Camilla, GA. Once delivered on April 17th, 2024, the samples were analyzed for Total Soil Digestion (TSD) and Soil Microbiome using amplicon-based sequencing. Results were received in the form of reports and raw data via email on April 30th, 2024 (Figures 12-13). There were 1190 species of bacteria and 433 species of fungi found in the 12 samples.

Figure 10. *Soil probe with soil sample from experimental vineyard.*

Figure 11. *Soil probe next to a vine in the experimental vineyard. 10 soil samples were taken from each panel.*

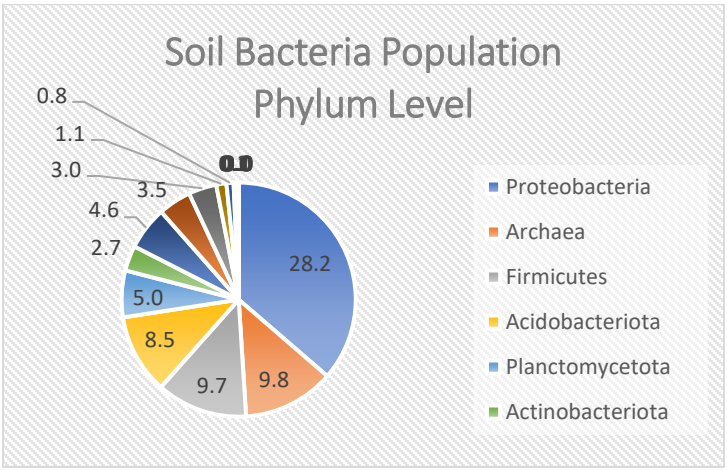


Figure 12. *Pie chart displaying the bacterial population classified by phylum in soil samples collected from the experimental vineyards. Proteobacteria was the most dominant phylum followed by Archaea and Firmicutes.*

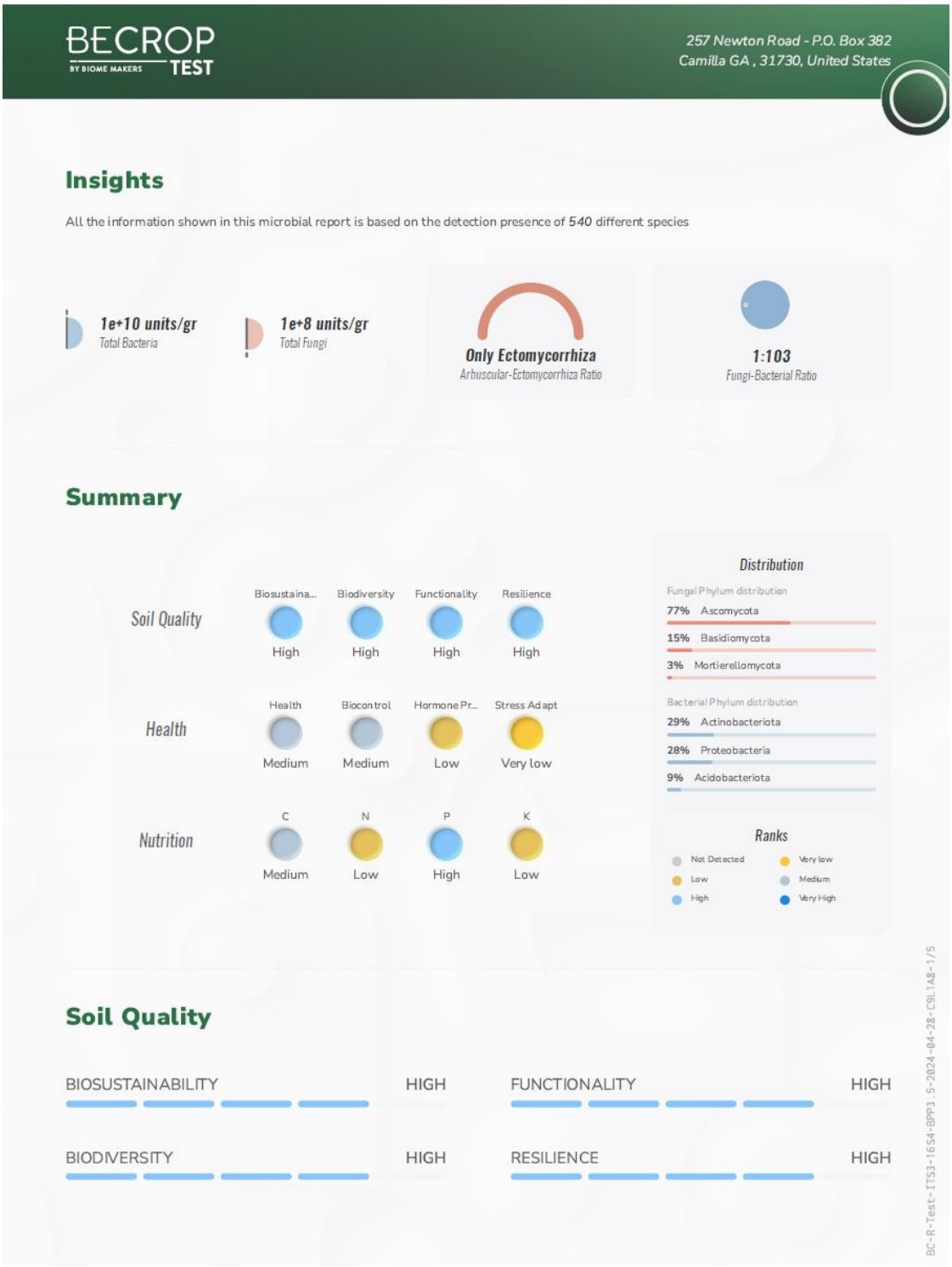


Figure 13. *Summary of the 'Be Crop' report generated from analyzing soil samples collected from the experimental vineyard. A report for each of the 12 samples was generated gives us insight into the base-level soil microbiome of the experimental vineyard in addition to soil nutrient and quality. Samples will be collected moving forward to determine the effect of UVV and AMF treatments on the soil microbiome.*

Objective 4. Collection and analysis of juice from experimental vineyard

Summary of results for Objective 4: Muscadine grapes in the Climate-Smart field experiment were harvested on August 22nd (Carlos), August 28th (Carlos), and September 11th (Noble), 2024. Berries were collected and kept separate to make representative batches for each individual vine. After weighing the berries, each batch was processed into juice and 100 mL of sample was collected for analysis. 50-mL of sample was used for basic vinification analysis (pH, Titratable Acidity, and Soluble solids) (Table 1 & 2). The remaining 50-mL was used for analyzing using the Lyza 5000 wine analyzer (Figure 12). These results will serve as a baseline for future evaluation of the experimental treatment's effect on the vinification properties of the muscadine grapes.

Table 1. *Vinification properties of grapes harvested from each Carlos vine in the Climate-Smart Muscadine Project field experiment.*

Vine/Location	Climate-Smart Treatment	pH	Titratable Acidity (g/L TAE)	Soluble Solids (brix)
C16-1-1	Clover + Conventional Mgmt	3.22	4.7	14.6
C16-1-2	Clover + Conventional Mgmt	3.31	3.9	13.2
C16-4-1	Clover only	3.33	2.6	14.4
C16-4-2	Clover only	3.31	3.5	15.0
C17-1-1	AMF + Conventional Mgmt	3.18	3.2	14.2
C17-4-1	AMF Only	3.18	4.4	14.6
C17-4-2	AMF Only	3.32	3.4	14.6
C19-1-1	Conventional Mgmt	3.18	2.6	13.4
C19-1-2	Conventional Mgmt	3.29	2.6	14.4
C22-1-1	AMF + Clover	3.32	3.5	15.6
C22-1-2	AMF + Clover	3.19	3.5	15.2
C22-4-1	No Mgmt	3.30	3.1	14.6
C22-4-2	No Mgmt	3.30	2.3	14.2

Table 2. *Vinification properties of grapes harvested from each Noble vine in the Climate-Smart Muscadine Project field experiment.*

Vine/Location	Climate-Smart Treatment	pH	Titratable Acidity (g/L TAE)	Soluble Solids (brix)
N16-4-1	AMF Only	3.56	2.6	17.6

N16-4-2	AMF Only	3.54	2.8	19.0
N17-4-1	Clover Only	3.56	3.4	19.0
N17-4-2	Clover Only	3.50	3.2	18.6
N19-1-1	Conventional Mgmt	3.31	4.1	17.0
N19-1-2	Conventional Mgmt	3.49	2.1	18.4
N22-1-1	AMF + Clover	3.47	3.3	18.4
N22-1-2	AMF + Clover	3.57	2.9	18.6
N22-4-1	No Mgmt	3.67	1.6	17.2
N22-4-2	No Mgmt	3.44	4.2	18.6

Table 3. *Lyza 5000 analysis results for ethanol, Glucose +fructose, glucose, fructose, titratable acidity, volatile acids, tartaric acid, density, extract, must weight, pH, glycerol, and yeast available nitrogen (YAN) for Noble cv. Juice from berries collected for the climate smart field experiment.*

Name	Ethanol [%vol]	Glucose + Fructose [g/L]	Glucose [g/L]	Fructose [g/L]	Titratable Acidity (pH=7.0) [g/	Volatile Acids [g/L [A]]	Tartaric Acid [g/L]	Density [g/ml	Must Extract [g/L]	Must Weight [°Bx]	pH []	Glycerol [g/L]	YAN [mg/L [N]]
N16-4-1	0.2	153.2	58.8	94.4	3.3	0.7	9.5	1.0719	192.9	17.34	3.61	0.5	417
N16-4-2	0.2	151.3	58.6	92.7	3.4	0.6	8.5	1.0704	189.0	16.99	3.60	0.4	376
N17-4-1	0.2	127.3	37.6	89.7	3.8	1.4	16.5	1.0704	189.1	16.98	3.66	1.7	695
N17-4-2	0.3	164.7	66.5	98.2	3.5	0.6	9.7	1.0769	206.4	18.53	3.60	0.6	395
N19-1-1	0.2	119.7	38.0	81.7	4.6	0.9	15.0	1.0648	174.3	15.68	3.43	1.3	565
N19-1-2	0.2	162.5	61.6	100.9	3.0	0.7	9.6	1.0762	204.1	18.34	3.54	0.9	387
N22-1-1	0.2	151.5	57.4	94.1	3.9	0.8	11.2	1.0747	200.1	17.99	3.60	1.1	458
N22-1-2	0.2	156.2	59.8	96.4	3.5	0.8	10.9	1.0758	203.2	18.26	3.67	1.0	445
N22-4-1	0.1	146.3	52.0	94.3	2.3	0.7	10.0	1.0700	187.5	16.88	3.61	1.0	406
N22-4-2	0.3	127.2	39.4	87.8	4.4	1.2	16.3	1.0703	189.1	16.96	3.61	1.6	654

Table 4. *Lyza 5000 analysis results for ethanol, Glucose +fructose, glucose, fructose, titratable acidity, volatile acids, tartaric acid, density, extract, must weight, pH, glycerol, and yeast available nitrogen (YAN) for Carlos cv. Juice from berries collected for the climate smart field experiment.*

Name	Ethanol [%vol	Glucose + Fructose [g/L]	Glucose [g/L]	Fructose [g/L]	Titratable Acidity (pH=7.0) [g/L [T	Volatile Acids [g/L [A]]	Tartaric Acid [g/L]	Density [g/mL	Must Extract [g/L]	Must Weight [°Bx]	pH []	Glycerol [g/L]	YAN [mg/L [N]]
C16-1-1	0.2	130.7	55.3	75.4	5.6	0.4	7.8	1.0605	163.0	14.65	3.28	0.4	268
C16-1-2	0.1	119.3	49.9	69.4	4.1	0.4	7.2	1.0551	148.6	13.39	3.42	0.5	274
C16-4-1	0.1	121.9	48.0	73.9	3.8	0.6	8.7	1.0577	155.4	14.00	3.44	0.5	370
C16-4-2	0.2	130.5	52.8	77.7	4.3	0.5	8.3	1.0607	163.4	14.71	3.42	0.3	359
C17-1-1	0.1	125.2	51.4	73.8	4.5	0.5	8.0	1.0579	155.8	14.04	3.33	0.6	275
C17-4-1	0.1	123.3	51.1	72.2	5.0	0.5	8.9	1.0585	157.4	14.18	3.35	0.2	358
C17-4-2	0.1	128.7	52.5	76.2	4.2	0.5	7.8	1.0602	162.0	14.59	3.44	0.3	358
C19-1-1	0.1	122.2	49.2	73.0	4.1	0.4	7.0	1.0554	149.3	13.45	3.33	0.5	236
C19-1-2	0.1	126.2	50.3	75.9	3.8	0.6	8.2	1.0590	158.9	14.32	3.43	0.4	359
C22-1-1	0.1	105.2	31.5	73.7	4.4	0.9	13.5	1.0576	155.3	13.98	3.39	1.2	571
C22-1-2	0.1	137.2	56.2	81.0	4.4	0.5	8.1	1.0629	169.2	15.23	3.37	0.3	331
C22-4-1	0.2	128.4	52.7	75.7	4.1	0.5	7.6	1.0593	159.9	14.38	3.41	0.4	322
C22-4-2	0.1	123.3	49.2	74.1	3.6	0.6	7.8	1.0577	155.3	13.99	3.44	0.5	349

What new/additional research is needed (Plan of Work for 2024- 2025)?

Task	Planned date of completion
Complete data analysis on bacterial and fungal populations	3/2025
Collect soil samples for year 2	3/2025
Collect plant volatile samples	7/2025
Harvest grape samples	8/2025
Prepare experimental wines	10/2025

Name of undergraduate student involved
Eryse White- Senior Agricultural Sciences Major
Camden Kruis- Senior Agricultural Sciences Major

Project # 2: "Identifying commercially significant autochthonous yeasts from Florida vineyards for new signature wine styles", FDACS-Specialty Crop Block Grant Program (SCBGP), 2022-2025, $134,969.

Research team members
Allen Frank Humphries- Research Enologist

Dr. Violeta Tsolova- Professor and Director

Eryse White- Undergraduate Research Assistant

Camden Kruis- Undergraduate Research Assistant

Juniper Yana- Undergraduate Research Assistant
Dupe Ogundipe- Graduate Research Assistant

Goals and objectives
Objective 1- Cultivate, isolate, and identify various yeast species found in the juice and spontaneously fermented musts from varieties of muscadine grapes grown in vineyards across Florida. (08/2023- 06/2024)
Objective 2- Evaluate unique yeast specimens for winemaking quality based on the detection of desirable aroma compounds utilizing Gas Chromatography-Mass Spectrometry (GC-MS) (07/2024-12/2024)
Objective 3- Publish findings in academic journals and disseminate results to stakeholders in the form of workshops and webinars. (01/2025-06/2025)

Who cares and why?
Issues with using generic commercial yeast:

Most southern winemakers inoculate their muscadine musts with commercial-ready strains of *Saccharomyces Cerevisiae* yeast. These yeasts are easily available but since they originate and are based on V. vinifera winemaking, resulting wines may lack individuality due to low microbial diversity. This is a problem, because muscadine grapes have a unique flavor and aroma profile and should be fermented with yeasts that complement these properties. Instead of attempting to force

muscadine wine to fit into the same category as vinifera-style wines, there is an opportunity to make them more distinct, pleasurable, and marketable by exploiting beneficial indigenous yeast species. Spontaneous fermentation is a simple option for winemakers to utilize indigenous yeasts and has gained popularity in recent years. Instead of inoculating with commercial yeast, this method allows native yeasts to ferment the must into wine. Beneficial yeast may be present to develop unique flavors and aromas, but an issue with this method is that spoilage yeasts may also be present and cause the wine to be undrinkable. This makes spontaneous fermentations risky and unreliable.

Florida needs a specialized Muscadine winemaking yeast:

Due to the lack of individuality of commercial strains and the unpredictable nature of spontaneous fermentation, selected strains of yeast that are adapted to muscadine winemaking would be highly beneficial to the industry. Determination and selection of strains that complement specific wine regions and microclimates is becoming increasingly popular for improving wine quality and authenticity (Zhang 2020). This assumes that for every variety of grape, there may also be an ideal or optimal yeast strain to fully optimize the potential of the wine (Jankura 2020). If Florida winemakers had the option, they may prefer to incorporate yeast which has been proven to specifically improve muscadine wine quality and enhance regional character. This would help producers create new styles of muscadine wine that stand out. Consumers could appreciate the distinctness rather than compare it to vinifera-style wines.

What has the project accomplish since its initiation?

Accomplishments:

- Inoculation and cultivation of 100 yeast specimens from Juice samples muscadine cultivar Noble vintage 2023. (273 total specimens thus far for the project).
- Extraction of DNA and Amplification of ITS1/ITS4 gene from 89 yeast specimens. (184 total amplifications thus far for the project).
- DNA Sequencing completed on 78 yeast specimens. (173 total specimens sequenced thus far for the project).
- Identification of 78 yeast specimens using Bioinformatic tools (173 total specimens identified thus far for the project) (see supplemental document)
- Cryopreservation of 51 yeast specimens which have been successfully identified (196 total cryopreserved specimens thus far for the project).
- Collection of must samples from 2024 spontaneous fermentations (3 replicates taken every day for 15 days = 45 samples total).
- 112 industry representatives and other stakeholders were engaged with the research over the reporting period. This includes visitors to the FAMU Center for Viticulture, and attendees of workshops and professional presentations, who were educated about the research being done to isolate a specialized Florida winemaking yeast (222 total for the project thus far).

Research Results, Output and Impact

Summary of Results for Objective 1: Inoculation and cultivation of 273 total yeast specimens (Figure 14-16), Extraction of DNA and Amplification of ITS1/ITS4 gene from 184 specimens (), DNA Sequencing completed on 173 specimens (), Identification of 173 specimens using bioinformatic tools (), Development of the 'Biorepository for Florida Autochthonous Yeast' which contains 196 specimens, Collection of samples from 2024 spontaneous fermentations (),

and 222 industry representatives and stakeholder engaged at FAMU CVSFR, workshops, and professional presentations.

Figure 14. *Lincoln Highschool senior extern, Mr. Lance Rainy, pouring WLN media in petri dishes for culturing the yeasts specimens.*

Figure 15. *Incubator with yeast specimens cultivated on WLN plates located in the Wine Analytical Lab. The yeast specimens are kept in the wine lab to prevent contamination to other experiments in the center.*

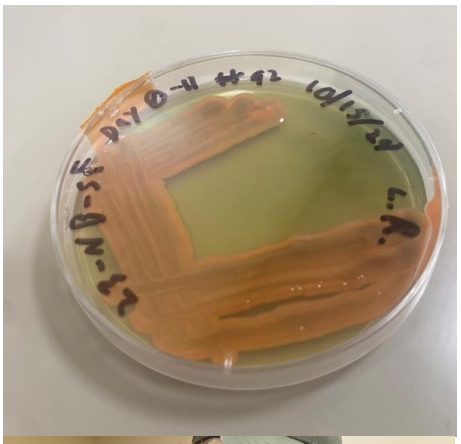


Figure 16. *An interesting orange yeast that has been cultured. Currently in process of being identified. We have only found (3) cultures that exhibit orange coloring like this. Literature review suggests it can be from the production of beta-carotene.*

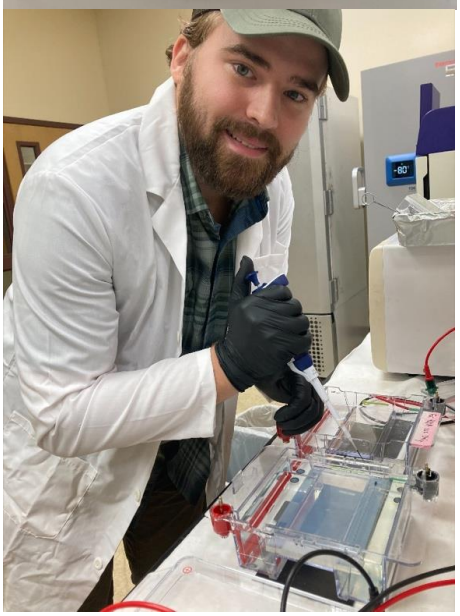


Figure 17. *Undergraduate Research Assistant, Mr. Camden Kruis, loading an agarose gel with the amplified ITS1/ITS4 PCR products generated from the yeast specimens. The agarose gel electrophoresis technique allows us to measure the size of the PCR product and determine the purity of the yeast culture before sequencing.*

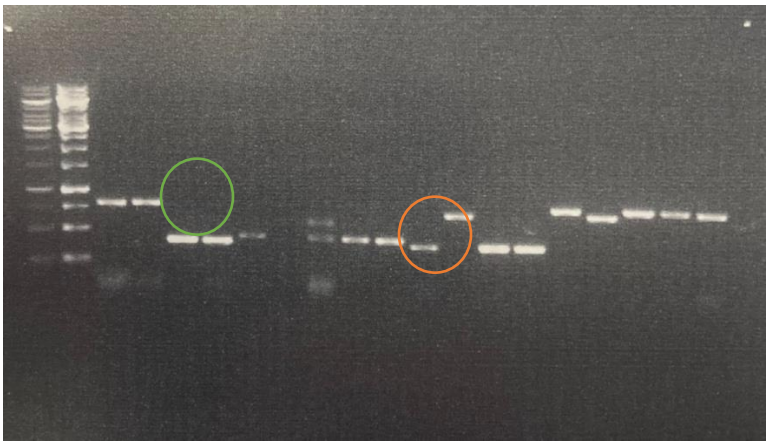


Figure 18. *Image of an agarose gel electrophoresis with PCR products from yeast specimens. The PCR product circled in orange is an example of a successful amplification and compared to the ladder is around 800 base pairs (bp) in size. This fragment can continue on in the process to be*

purified and sequenced in order to identify what species of yeast the specimen is. The fragments circled in red is an example of contaminated sample because there are (2) bands. This means that the culture in not pure and contains two yeasts species. This requires another round of culturing before it can move on to be identified.

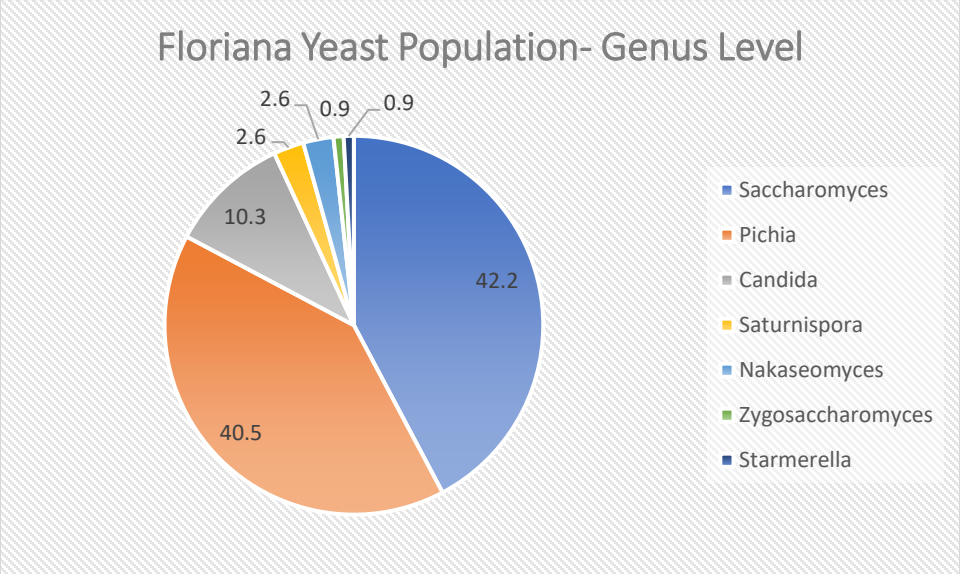


Figure 19. *Yeast population based on genus level classification. 7 genera were isolated and identified in the spontaneously fermented Floriana must. Listed from most abundant to least abundant; Saccharomyces (42.2%), Pichia (40.5%), Candida (10.3%), Saturnispora (2.6%), Nakaseomyces (2.6%), Zygosaccharomyces (0.9%), and Starmerella (0.9%).*

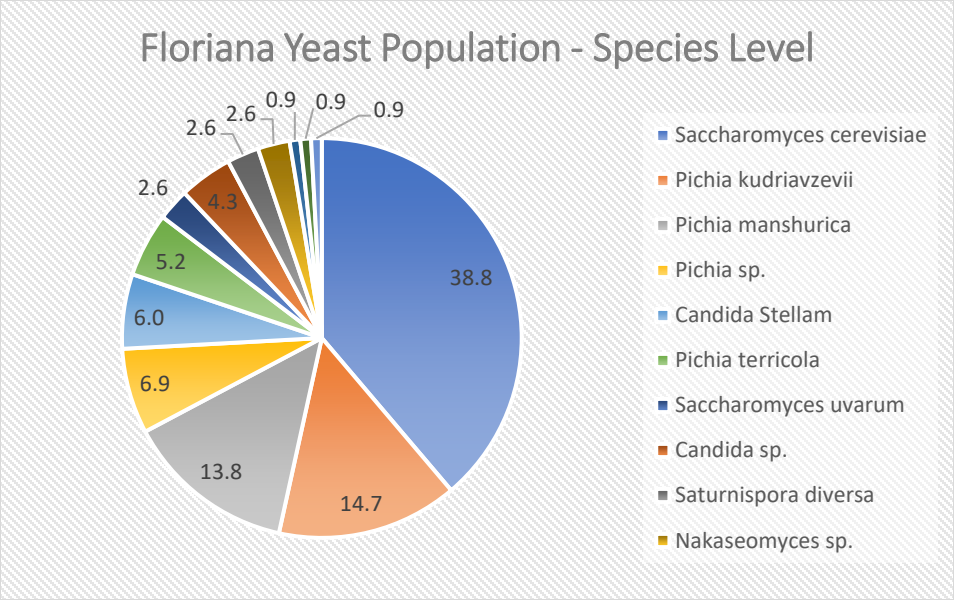


Figure 20. *Yeast population organized based on species level classification. There was a diverse number of species isolated from the Floriana samples (10). Each have their own impact on wine quality however the major players found in the samples were 1. Saccharomyces cerevisiae (38.8 %), 2. Pichia kudriavzevii (14.7 %), and 3. Pichia manshurica (13.8 %).*

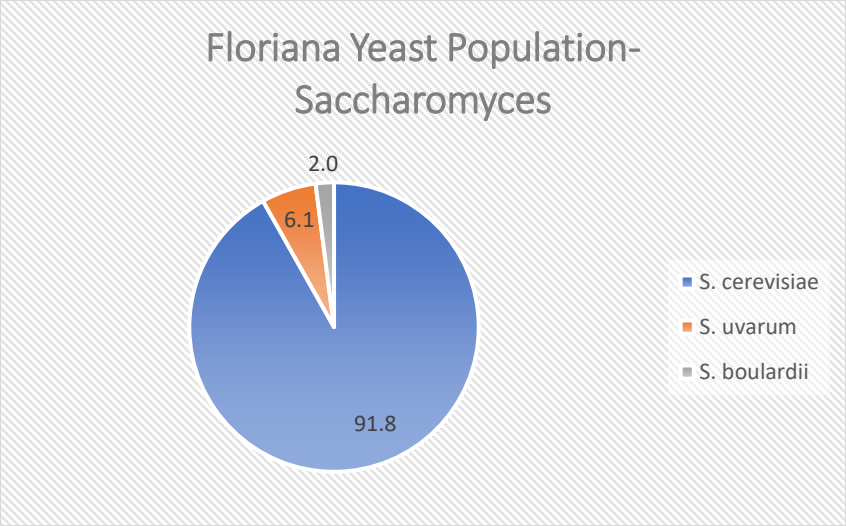


Figure 21. *Pie chart representing the proportion of Saccharomyces species isolated from Floriana spontaneous fermenting juice. 91.8% of the specimens isolated from Floriana was S. cerevisiae. This is the most common yeast used in commercial fermentations by winemakers. However, there is a good chance that these 'wild' yeasts can possess unique metabolic pathways to generate new aroma and flavors to enhance regional characteristics. Therefore, these yeasts will be interesting for future evaluations. A smaller population of other Saccharomyces species was detected. S. uvarm and S. boulardii made up 6.1% and 2.0% respectively.*

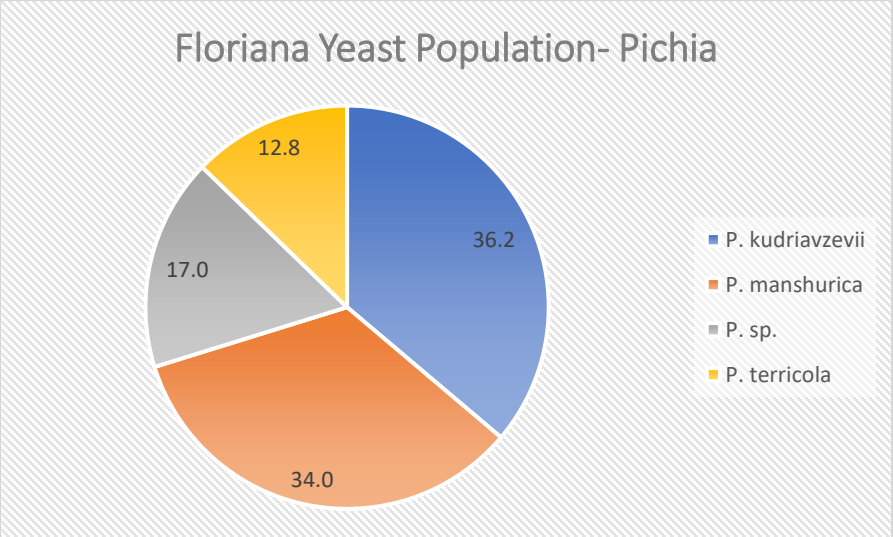


Figure 22. *Pie chart representation of the population of Pichia species isolated from Floriana spontaneous fermenting juice. P. kudriavzevii, P. manshurica, P. species, and P. terricola made up the Pichia population at 36.2%, 34.0%, 17.0%, and 12.8% respectively. Although pichia species can include species involved in wine spoilage, some research suggests they can also increase complexity and produce interesting aromas in the wine as well. Therefore, these specimens will be important to evaluate in the next phase of the project.*

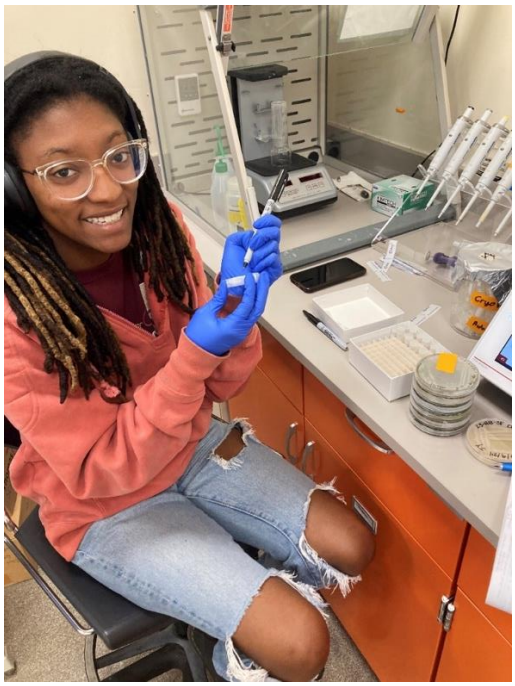


Figure 23. *Undergraduate Research Assistant, Ms. Eryse White, preparing to cryo-preserve a batch of specimens. The yeasts are transferred from the WLN plates to the cryo-vials containing glycerol and peptone to prevent damage in the -20 C freezer.*

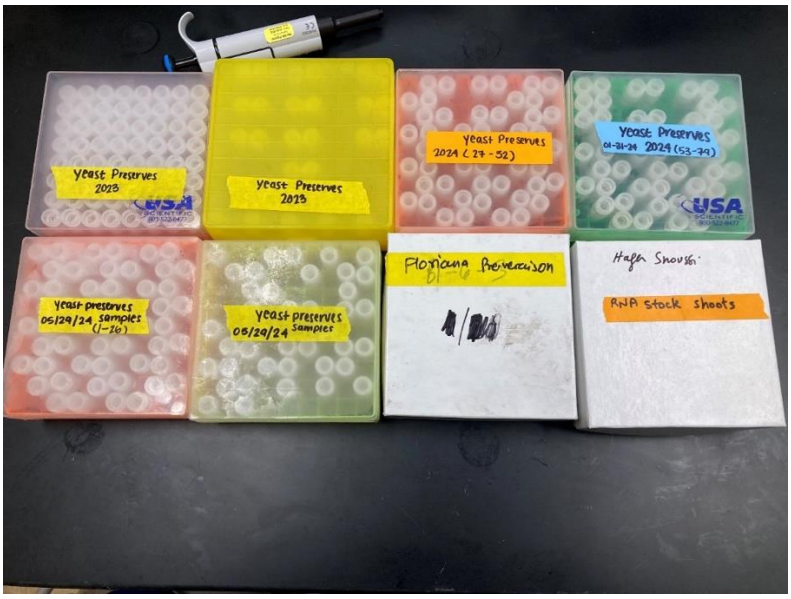


Figure 24. *The 'Bio-repository of Florida Autochthonous Yeasts' which currently holds 196 yeast specimens. It is stored in a -20 C freezer in the Viticulture Lab. When ready, we can re-inoculate the specimens in synthetic grape juice to evaluate their winemaking capabilities.*

What new/additional research is needed (Plan of Work for 2024- 2025)?

Upcoming Research Activity	Anticipated Completion
Cultivate remaining yeast specimens from the 2023 Floriana and 2023 Noble spontaneous fermentations	12/2024
Inoculate and cultivate 2023 Carlos samples	2/2025
Complete colony PCR on all remaining yeast specimens	2/2025
Sequence all PCR products from yeast specimens	2/2025

Identify DNA sequences using bioinformatic tools	3/2025
Cryo-preserve successfully identified yeast specimens	2/2025
Summarize results and prepare students to present at 2025 FWGGA conference	1/2025
Travel to 2025 Florida Wine and Grape Growers Association (FWGGA) Annual Conference to present research to industry stakeholders	1/2025
Evaluate winemaking potential of yeast specimens using synthetic grape must	4/2025
Analyze 2024 spontaneous fermentations using digital qPCR	3/2025
Summarize all results and generate publications and final report	7/2025

Name of graduate students and title of theses:
Dupe "Stella" Ogundipe, "Identification and Genetic Characterization of the Isolated FL Autochthonous Muscadine Wine Yeast Sp. In 'Floriana', 'Noble', and 'Carlos' Varietals." Graduated Summer 2024.

Name of undergraduate student involved:

Camden Kruis, Undergraduate Research Assistant
Eryse White, Undergraduate Research Assistant
Juniper Yana, Undergraduate Research Assistant
Lance Rainey, Highschool Extern, Lincoln Highschool

List of Publications - Refereed, non-refereed, proceedings, etc. (complete citation)
Professional meetings/presentations – local, state, regional, national, international (complete citation)
Humphries 2024, "Uncorking the Latest Trends in Winemaking", Florida Wine and Grape Growers Association Annual Conference, Deland, FL, January 13th, 2024.
Humphries 2024, "A Taste of Florida Viticulture" Capital Rotary Club, Tallahassee FL, February 13th, 2024.
Humphries 2024, "Wine BMP: Post Fermentation Techniques for Improved Wine Quality", Vineyard & Wine and Best Management Practices Workshop, CVSFR, February 16th, 2024.
Humphries 2024, "Applying Climate Smart Practices in Florida Muscadine Vineyards to Reduce Herbicide Dependency", FAMU School of the Environment Spring 2024 Seminar Series, March 22nd, 2024.
Dupe, O., **Humphries, A.,** El-Sharkawy, I., Darwish, A., Olaoye, E., Tsolova, V., "Non-Targeted Metabolomic Approach to Evaluate the Bio-active Profiles in FL Distinctive Wine Fermented with Autochthonous Yeast", 2024 Association of Research Directors Research Symposium, Graduate Student Oral Presentation, Nashville, TN, April 7th, 2024.
Kruis, C., **Humphries, A.,** Darwish, A., El-Sharkawy, I., & Tsolova, V., Undergraduate Poster Presentation "Bio-Conversion Study of Muscadine Healthy Grape Compounds from Fruit, Pomace, and Wine for Added Value and Increased Industry Revenue, April 7th, 2024, Nashville, TN. *Awarded 1st Place.

Humphries 2024, “A Taste of Florida Viticulture”, FSU OLLI Viticulture Visit, Tallahassee FL, April 26th, 2024.
Humphries 2024, “A Taste of Florida Viticulture”, Emerging Crop Production Forum, UF/IFAS North Florida REC, Quincy, FL, May 16th, 2024.
Voltarelli, M., **Humphries, F**., Tsolova, V., “Adaptive Strategies in Grape Agriculture: Harnessing Muscadine Innovative Processing Strategies for Climate Resilience in the Southeastern United States”, AISSA under 40, Poster Presentation, University of Florence, Italy, June 26th-27th.

Extension - List activities (if applicable)
October 5th, 2023- Rashad Reed/Charles Sherrod Institute- Email Consultation
October 9th, 2023- Tony Carrano Site Visit
October 12th, 2023- FAMU/FSU Honors Program
October 12th, 2023- GHF recap article submission
October 16th, 2023- World Food Day Viticulture Display and Muscadine Aqua Sampling
October 18th, 2023- Tallahassee Garden Club Viticulture Visit
October 19th, 2023- Sun Belt Ag Expo, Viticulture Exhibit, Muscadine Aqua and Delights Sampling
October 21st, 2023- Andy Fowler email consultation- winemaking and delights
October 25th, 2023- Julien Bousquet- Sabbatical inquiry from University of Quebec
October 25th, 2023- Vincent Moore- email contact for scheduling site visit
October 26th, 2023- Trevor Hylton extension office pruning demonstration planning email
October 27th, 2023- CAFS Alumni Mixer- Viticulture Display and Wine Sampling
October 27th, 2023- email consultation- Grace McDonald
October 27th, 2023- email consultation- Brad Bellingrath
October 30th, 2023- World Food Day- Research Poster Symposium- Viticulture Display and Muscadine Aqua Sampling
November 6th, 2023- Kenya- Egerton University Faculty Visit
November 7th, 2023- Vincent Moore/Magnolia Ridge Site Visit
January 12th- “Wine Making Bootcamp”- Florida Wine and Grape Growers Association Annual Conference
January 13th- “Uncorking the Latest Trends in Winemaking”, Florida Wine and Grape Growers Association Annual Conference
January 16th- USDA/NIFA Director, Dr. Misra’s CAFS Visit
January 16th- Sue Elliot Request for FAMU Viticulture to conduct next year’s Boot camp
January 18th- Goodwood museum invite to “Vines of Diversity” wine tasting event
January 23rd- Legislature Spouses Viticulture Tour
February 6th- Phone Consult- Ed Acuff, Hobbyist Grape Grower, Tallahassee, FL.
February 5th- Site Visit- Joel Grullion, Grape Grower, Pavo, GA.
February 16th- Vines of Diversity- Educational Wine Sampling, Goodwood Museum, Tallahassee, FL.
February 21st- FAMU Day at the Capital- Educational Exhibit
February 22nd- email consult- Dan Selman, Hobbyist Grower, Tallahassee, FL.
February 22nd- Phone Consult- Pete Bowers, Tallahassee, FL.
February 28th- Site Visit- Jacky and Wayne Cocke, Hobbyist Growers, Havana, FL.
February 29th- Site Visit- Allen Cooley, Summer Crush Vineyard and Winery, Ft. Pierce, FL.

March 1st- Site Visit- Megan and Jared Cooper, River House Vineyard, Palm Bay, FL.
March 7th- Cheryl Hanes Viticulture Visit- Pruning Demonstration, FAMU CVSFR.
March 15th- Cheryl Hanes follow-up email consultation
March 15th- email consult, Monroe Rogers, Hobbyist Grape Grower, Havana, FL.
March 20th- MCL JASCO CAFS Exhibit
March 28th- Viticulture Educational Exhibit, Future Farmers of America (FFA), FAMU CAFS Visit
April 8th- ARD Symposium Wine Sampling Session- Virtual Wine Evaluations
April 11th- email consultation, Bill Morarity, Grape Grower, LaBelle, FL.
April 22nd- Site Visit- Mr. Bill Hodges, Jefferson Co. FL
April 22nd- Viticulture Center Visit- Mr. Bill Hodges and spouse, FAMU CVSFR.
April 25th- email consultation- Megan Cooper, River House vineyard, Palm Bay, FL.
April 26th- OLLI viticulture visit and tour
May 3rd- Gregory Gerami Viticulture Visit and Tour
May 6th- Dr. Gainous Phone Consultation
May 26th- email consultation- Mr. Moya, Hobbyist Grape Grower, Dade Co., FL.
May 28th- email consultation- Mr. Moya, Hobbyist Grape Grower, Dade Co., FL.
June 3rd- Teen Leaders of America Recruitment and CAFS- Educational Viticulture Exhibit, Perry-Paige.
June 4th- Muscadine Delight Sampling Exhibit at Association of Public and Land-Grant Universities (APLU) "Scoops of Science" showcase, Washington, DC.
July 5-9th- Email consultation- Megan cooper (Riverhouse Vineyard)
June 12th- Food Science Summer Camp Visit/tour and DIY DNA Extraction
June 14th- ERCCD site visit
June 18th- Site Visit with Lynn Jones, Jake Gaither Garden Club, Orange Ave. Community Garden.
June 26th- FAMU GHF Planning Committee Meeting
July 10th- Harvest Festival Committee Meeting
July 12th- Viticulture Educational Exhibit- Youth Leadership Program Visit, Perry-Paige Auditorium (20)

July 15th- Viticulture Visit and Tour

July 16th- Email consult with Anthony Carrano
July 16th- Melissa Mastro Visit/Tour
July 17th- Email consult with Allen Cooley of Summer Crush Vineyard and Winery.
July 24th- AMIKids Viticulture Visit and DIY DNA Extraction Educational Exercise
July 30th- Future Farmers of America Student, Marissa, Viticulture Tour and Visit- Writing a speech about Florida Viticulture.
July 30th- email consultation- David Torcise, Heritage Market, Redland, FL.
August 1st- Wakulla Master Gardner Viticulture Tour and Visit
August 16th- Tallahassee Scientific Society
August 16th- Gathering Oaks Kids Visit and Tour DIY DNA Extraction and Viticulture Tour
August 21st- GHF Meeting
September 17th- Phone Consult with Thomas Lynch
September 19th- Viticulture Visit and Tour- Mr. Frank Barnes

September 23rd- E&J Gallo Viticulture Center Visit and Tour

Name of graduate students and title of theses (If applicable)
Ms. Dupe "Stella" Ogundipe, "Identification and Genetic Characterization of the Isolated FL Autochthonous Muscadine Wine Yeast Sp. In 'Floriana', 'Noble', and 'Carlos' Varietals." Graduated Summer 2024.
Name of undergraduate student involved (If applicable)
Camden Kruis, Undergraduate Research Assistant
Eryse White, Undergraduate Research Assistant
Juniper Yana, Undergraduate Research Assistant
Lance Rainey, Highschool Extern, Lincoln Highschool

Proposal submitted – Title of Proposal, amount and funding agency

"Bioprospecting Cover Crops for Florida Vineyards to Minimize Herbicide Application and Improve Soil Health", $26,907, FDACS-VRGP.

"Analyzing the Preferences of Florida Wines Throughout Consumer Life Cycle", $49,940, FDACS-VRGP.

"Role of Muscadine Grape Pomace Components in Colorectal Cancer Prevention in High-Risk African American Communities", $493,555, USDA/NIFA CBG.

"Establishing a Pilot Nursery at FAMU's Center for Viticulture as the Instructional Platform for Digital Agriculture and a Research Commercialization Outlet" $285,128, USDA/NIFA CBG.

- **Vineyard and Small Fruit Field Management -Vineyard Manager Jiovan Campbell, M.S.**

FAMU Research Vineyard Calendar of Activities

OCTOBER 2023

A guided tour was organized for a UC Davis college delegation, showcasing our various programs and resources. The students were able to interact with the delegates and showcase their work. Additionally, we conducted dormant pruning and trimming of the chestnut trees to promote healthy growth and improve their appearance. We installed a new, more efficient drip irrigation system to ensure the landscape remains vibrant and sustainable. These efforts reflect our commitment to maintaining a welcoming and well-managed landscape. The destroyed mailbox was also replaced. The field support technicians continued regular vineyard care, which included fixing downed and weakened posts and tightening the trellises.

NOVEMBER 2023

Grapes were planted in the empty spaces within our B and D Block in the East Vineyard, optimizing the use of available land to enhance productivity. This planting will help fill gaps and ensure better vine health and yield. Additionally, the site for the future installation of a new vineyard block was identified on the West side of the Vineyard. Factors such as soil quality, drainage, sunlight exposure, and accessibility are carefully evaluated to ensure the new site supports healthy grapevine growth. This strategic planning will lay the groundwork for expanding

our vineyard operations and meeting future production goals. The site was measured, flagged, and labeled for installation. Regular greenhouse plant care and upkeep were done.

DECEMBER 2023

A visit to the UF Farm in Quincy provided valuable insights into their irrigation setup and practices. During the tour, we observed the systems designed to optimize water use and enhance crop productivity. The farm staff shared their experiences and recommended companies for us to use for our irrigation upgrade. This hands-on observation allowed us to understand the practical applications of sustainable irrigation methods and consider how we might implement similar practices in our operations. Overall, the visit was an informative experience that highlighted the importance of effective irrigation in modern agriculture.

The installation of the new Vineyard on the West side of the Vineyard began. This infrastructure is critical to support future grapevine planting. This strategic approach will help us maximize the potential of the vineyard block and ensure a successful transition when we introduce the grapevines. Sanitation and maintenance of research greenhouses and screen houses were done. Routine care for the plants in the research greenhouses and screen houses was done.

JANUARY 2024

Dormant pruning of the research vineyards commenced in late January in anticipation of a cold front, allowing us to mitigate potential frost damage. This essential process prepares the grapevines for the growing season, ensuring optimal health and productivity. As part of our planning and strategy, we reviewed last year's performance and established clear goals for the year ahead. Additionally, a maintenance services walkthrough was conducted to identify necessary improvements that are urgently needed, including the addition of a ramp to the mobile storage unit and essential repairs to the facilities. These proactive measures will enhance operational efficiency and support Vineyard's overall success.

The Florida Wine and Grape Growers Associations Annual Conference had the FAMU Center for Viticulture and Small Fruit Research team successfully organize a vineyard and winemaking workshop/boot camp designed to educate participants on the entire process, from grape cultivation to wine production. Attendees learned about vineyard management techniques, including pruning, pest control, and irrigation, while gaining insights into winemaking's fermentation and aging processes. Hands-on activities allowed participants to engage directly with the equipment and practices used in the industry, enhancing their understanding and skills. This workshop fostered a deeper appreciation for viticulture and enology and encouraged networking among local growers and wine enthusiasts. Overall, the event was a valuable opportunity for community members to connect and share their passion for wine.

The Southeast Regional Fruit and Vegetable Conference was right after FWGGA. The conference featured a diverse range of educational sessions covering topics such as sustainable farming practices, pest management, and market trends. Attendees had the opportunity to participate in hands-on workshops, panel discussions, and networking events, fostering collaboration and knowledge sharing. Additionally, a trade show showcased the latest technologies and innovations in the fruit and vegetable sector. This event enhanced participants' skills and insights and reinforced our commitment to supporting the growth and sustainability of the region's agricultural community.

FEBRUARY 2024

Winter Vineyard and Wine Best Management Practices (BMP) Workshop was held to showcase Wine BMP, Vineyard BMP, Pesticide Application, New invasive pests for Florida, and a practical

pruning demonstration session. The workshop aims to educate local growers and the community on best practices for vineyard care. The workshop covered various topics, including pest management, soil health, and efficient irrigation techniques, empowering participants with the knowledge to improve their grape production. Experts in the field shared insights and provided hands-on demonstrations, fostering an interactive learning environment. The event enhanced attendees' skills and strengthened community ties, promoting a collaborative approach to sustainable viticulture. This initiative underscores our commitment to supporting local agriculture and advancing the collective expertise of vineyard management.

The field support technicians were still doing dormant pruning of the vines. The well and pump were tested for a proper reading of pressure and gallons per minute capable of running individual irrigation zones of the irrigation plan for the East side of the Vineyard. Several installers visited to give quotes and recommendations on the best installation system.

MARCH 2024

The field support technicians removed the dead vines, vine trimmings, and debris from throughout the Vineyard and collected them at two locations, one on each side of the Vineyard for removal. Poles and trellises were replaced, and the vines secured to the trellises. As we progressed through the growing season, we closely monitored bud break and assessed the health of the grapevines. Regular observations allow us to identify issues early and ensure optimal growth conditions. We have also begun implementing vineyard weed control measures to minimize competition for nutrients and water. In addition, our blueberry trap crop plants have been cleaned, fertilized, and pruned to promote better fruit production and overall plant health. Regular maintenance in the Vineyard continues to be a priority, ensuring that all plants receive the necessary care and attention for a successful harvest. These proactive steps reflect our commitment to maintaining a thriving and productive agricultural environment.

APRIL 2024

We have completed fertilization across our crops to support robust growth and enhance nutrient availability. Additionally, a tree service was engaged to remove debris and prune plant material, ensuring a clean and safe environment for our plants. This service has significantly improved the overall aesthetics and health of our landscape. We are applying targeted sprays to manage insect pests and fungal diseases in the Vineyard. These treatments protect the vines during critical growth stages, ensuring healthy fruit development. Regular assessments will follow to gauge the impact of these treatments.

MAY 2024

Monitor the flowering of the grapevines, which is crucial for fruit development. We are implementing targeted disease management practices based on current observations to combat potential diseases. Regular maintenance and inspections to ensure all equipment is ready for the upcoming tasks in the Vineyard. We are conducting regular care for plants in the greenhouses and screen houses, which includes monitoring moisture levels, adjusting environmental controls, and ensuring proper fertilization. Routine tasks involve pruning, repotting, and checking for pests or diseases to maintain optimal health and growth.

In landscaping, we perform maintenance tasks such as mowing, weeding, and mulching to enhance aesthetics and support plant health. The Vineyard's ongoing care includes canopy maintenance and pest and disease monitoring. These combined efforts ensure that all plants, whether in greenhouses, screen houses, or the Vineyard, receive the attention they need for thriving growth.

The new irrigation system has commenced, enhancing water efficiency and supporting optimal plant growth.

JUNE 2024

We have set up insect traps specifically for citrus weevil, an important measure to monitor and manage pest populations. These proactive steps will help us maximize our harvest success and protect the integrity of our crops. Summer pruning for canopy management is underway to enhance light penetration and air circulation within the Vineyard.

JULY 2024

We are implementing irrigation practices to manage heat stress on our crops, ensuring they receive adequate moisture during this critical period. Additionally, we are finalizing harvest logistics and schedules to ensure a smooth operation. Conducting taste tests is part of our strategy to determine the optimal harvest times for bunch grapes. July saw the start of ripening stages for the bunch grapes, and as such, they were monitored following guidelines from the Research Enologist to ensure harvest was done at the most optimal time.

AUGUST 2024

We have finalized the logistics and schedules for the upcoming harvest, ensuring that all necessary resources are in place for an efficient operation. To determine optimal harvest times, we conducted taste tests, assessing the flavor profile and ripeness of the grapes. Based on these evaluations, we are beginning the grape harvesting process, focusing on varietal readiness to ensure that each type is picked at its peak quality. Being the busiest month saw continued fixing of downed poles and wires, canopy management, and all vineyard upkeep, prepping tractors, trailers, tables, tents, and chairs, securing the facility, and testing all equipment and facilities for the festival. All while harvesting grapes for winemaking and research.

Busy preparing for the harvest festival, focusing on various tasks to ensure a successful event. This includes finalizing logistics, coordinating vendor arrangements, and setting up activities for attendees. We are also enhancing the festival grounds, ensuring everything is in place for an enjoyable experience. Our team is working diligently to promote the event within the community and prepare for various attractions, from food stalls to entertainment, for a family fun day and health fair.

SEPTEMBER 2024

Due to inclement weather and storms, the decision has been made to cancel this year's annual harvest festival. Safety concerns for participants and staff were paramount, and the adverse weather conditions have rendered the event unfeasible.

Cleanup following the aftermath of Hurricane Helene was done. There were many downed rows of grapes that required replacing many posts and redoing the trellises. After the cleanup was completed, the field support crew started regular landscape maintenance and upkeep of the Vineyard's best management practices.

Figure 1: 2024 *FWGGA Annual Conference, DeLand, FL: Vineyard Best Management Practices Boot Camp.*

Figure 27: *Aftermath of Hurricane Helene (FAMU -Viticulture, September 28, 2024).*

UF UNIVERSITY of FLORIDA
Institute of Food and Agricultural Sciences
Horticultural Sciences Department

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Report for FL VAC Meeting on November 14th
Date: November 1st, 2024

Education

UF/IFAS 2024 Grape Field Day

The 2023 Grape Field Day, presented by UF/IFAS Extension, took place on August 20th at the UF Plant Science Research and Education Unit in Citra, FL. The day provided attendees with updates on UF and FAMU grape research, as well as aspects of marketing and promoting grape products, agrotourism, and more.

UF/IFAS Extension presents

GRAPE Field Day

Tuesday, August 20, 2024
9:00 a.m. to 3:00 p.m.

2556 West Highway 318, Citra, FL 32113
Frank Stronach Conference Center
UF Plant Science Research
and Education Unit (PSREU)

NO REGISTRATION FEE.

Register at or visit

PLEASE RSVP BY AUGUST 13 or call Lesley Reddick (352) 591-2678

Questions?
Contact Ali Sarkhosh
UF/IFAS Horticultural
Sciences Department
sarkhosha@ufl.edu
or (352) 273-4788

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TIME	AGENDA
9:00 a.m.	**Registration and Welcome** Dr. Ali Sarkhosh, UF/IFAS Horticultural Sciences Department and PSREU team
9:30 a.m.	**Vineyard Walk and Talk**
11:00 a.m.	**Fresh Market Muscadine Testing and Student Presentation** Dr. Ali Sarkhosh, UF/IFAS Horticultural Sciences Department
12–1:00 p.m.	**LUNCH**
1:00 p.m.	**Research Update on Pierce-disease Resistant Grape Cultivars** Dr. Ali Sarkhosh, UF/IFAS Horticultural Sciences Department
1:30 p.m.	**Implications of Canned Muscadine Wine on the Bioactive Components Found in Wine** Dr. Katherine Thompson-Witrick, UF/IFAS Food Science and Human Nutrition Department
2:00 p.m.	**Insect Pest Management of Key Pests in Grapes'** Dr. Oscar Liburd, UF/IFAS Entomology and Nematology Department
2:30 p.m.	**Grape Breeding Program at Florida A&M University** Dr. Islam El Sharkawy, FAMU/Center for Viticulture and Small Fruit Research
3:00 p.m.	**Adjourn**

One highlight of the event was testing the freeze-dried muscadine and fruit of different fresh muscarine cultivars provided by the lab of Dr. Ali Sarkhosh, Associate Professor and Extension Specialist.


Noble
Carlos
Southern Home
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Alachua
Hall
Paulk
Supreme
riumph

Meeting Master Gardener in Levy County on August 22

We also had a master gardener education session on muscadine in Levy County.

Statewide Extension Ants In-service Training

We organized a state-wide In-service training for state extension agents on August 15. The attended provided information on growing muscadine, differences among muscadine cultivars, freeze-dried muscadine, and testing fresh muscadine cultivars.

UF/IFAS Research Project Progress update:

(1) Grape Maturity and Wine Quality: Harvest Time Prediction of PD-resistant Winegrape Cultivars Grown in Florida Climate

PI: Ali Sarkhosh, Horticultural Sciences Department

Introduction

Grapes are an important fruit crop grown all over the world, but pierce's disease is one of the major limiting factors for growing grapes in warm and subtropical regions. Pierce's disease is caused by bacterium *Xylella fastidiosa* that cause blockage of xylem in trunk and restrict the transport of water and nutrients that resulted in plant death. The disease prevalence is very low in the regions with colder winters but the southeastern US especially Florida has relatively warm winters that makes feasible conditions for pierce's disease. The disease is spread by glossy winged sharpshooter, which is a subfamily of leafhopper insects. To combat the issue of this disease, breeders are developing pierce's disease resistant grape cultivars, that can either make plants less attractive to the vector or improve resistance against the bacteria.

Different hybrid cultivars have been developed at the University of California that can prevent disease and make grape cultivation possible in warm regions. Florida has a warm climate with very high humidity that can also be problematic for successful grape production. Therefore, it is important to evaluate the pierce's disease resistant grape cultivars grown under the environmental conditions of Florida to observe the challenges faced by grape cultivation and quality production. The primary objective of this project is to evaluate and identify the grape cultivars that have desirable traits of growing grapes in Florida.

Methodology

Plant material

To evaluate the performance of Pierce's disease resistant grapes cultivars in Florida, 'Camminare Noir', 'Paseante Noir', 'Errante Noir', 'Ambulo Blanc' and 'Caminante Blanc' cultivars developed at University of California, Davis along with 'Black Spanish' and 'Blanc Du Bois' were planted at Plant Science Research and Education Unit, Citra, Florida during winter 2020. All the cultivars were grafted over the 'Salt Creek' rootstock and planted at 12' X 6'. The experiment was laid out under completely randomized block design with four replications and each replicate had eight vines. Grapevines were observed for plant health, pierce's disease symptoms and laboratory testing for disease, and mortality.

Fruit Harvesting

After veraison, 5 berries from a cluster of each cultivar were randomly selected to test the total soluble solid (TSS). TSS was determined on a weekly basis to determine the harvest maturity. After reaching the optimum level of TSS, fruit of each cultivar were harvested and transported to UF Fruit Crops Laboratory for further analysis.

Physical parameters

Total yield was determined by weighing the total harvested fruit from each replication. To determine the bunch weight, bunch compactness and unmarketable berries (%), eight bunches of each replication were randomly selected. Bunch compactness was determined according to code # 204 from the 2nd edition of OIV descriptor list for grape varieties and *Vitis* species and expressed in score. After recording the fruit weight, unmarketable berries were removed from each cluster and recorded weight again. The unmarketable berries percentage was determined based on the difference between the fruit weight before and after removal of rotten and damaged berries. Average berry weight was recorded by randomly selecting 20 berries from each selected bunch for evaluation of physical parameters.

For further evaluations of biochemical parameters and bioactive compounds, approximately 100g of berries from each replication were stored at -20 ºC.

Figure 1. Pictorial view of grape bunches of different pierce's disease resistant grape cultivars grown in Florida

Biochemical Parameters and bioactive compounds

Berries from stored samples were blended and centrifuged at __ rpms for 20min at 4 ºC. The resulting supernatant was used to determine the TSS and titratable acidity (TA). The TSS was determined by using an automatic compensated refractometer. To determine TA, 3ml of fruit juice was titrated against 0.1N NaOH using an automatic titrator (Metrohm 814 USB Sample Processor, Herisau, Switzerland). TA was expressed as the percentage of acid in fruit juice based on the molecular weight of tartaric acid. Total phenolic content (TPC) was determined using the Folin-Ciocalteu regent method and absorbance was recorded at 765nm using microplate reader (Singleton, 1966). To determine the total antioxidant, ferric reduction antioxidant power (FRAP) assay method was used as described by Benzie and Strain (1996). Total anthocyanins were determined using pH differential method illustrated by Giusti & Wrolstad, 2001.

Results

During the first three years of cultivation, no symptoms of pierce's disease and mortality were observed in the grown cultivars.

Physical parameters

There was significant difference in yield data of the cultivars with highest yield in 'Errante Noir' having 6.8Kg of fruit per plant. Significant differences ($P \leq 0.05$) were recorded in bunch weight of the pierce's disease resistant grape cultivars grown in Florida. Highest bunch weight (412.76g)

was recorded in 'Black Spanish' cultivar whereas minimum bunch weight was recorded in 'Caminante Blanc' having average bunch weight of 141.63g. Average berry weight also showed significant differences among cultivars and 'Blanc du bois' depicted the highest average berry weight (3.64g). Bunch weight was recorded in score and was found to be significantly different among various cultivars. 'Ambulo Blanc', 'Black Spanis', 'Caminante Blanc', 'Camminare Noir' and 'Paseante Noir' were ranged among the high compact bunch grapes wheres 'Blanc Du Bois' and 'Errante Noir' were having medium loose clusters. Among cultivars, 'Ambulo Blanc' was having highest Bunch compactness (8.9) while minimum was recorded in 'Blanc Du Bois' (5.6). The highest unmarketable berry percentage was recorded on 'Paseante Noir' having 23.2% of unmarketable berries whereas minimum unmarketable berries were recorded in 'Errante Noir' (1.41%).

Biochemical Parameters and bioactive compounds

Significant differences were recorded in biochemical parameters of different grape cultivars. 'Paseante Noir' was having the highest TSS (17.65%) and maturity index (19.47). The lowest TA (7.12) was recorded in 'Blanc Du Bois', making it second in maturity index after 'Paseante Noir'. Black Spanish depicted highest TA that was 2.23%, therefore the maturity index was lowest in same cultivar. The bioactive compounds of different pierce's disease resistant winegrapes had significant differences ($P \leq 0.05$) among the cultivars. The highest TPC and total antioxidants were recorded in 'Paseante Noir' cultivar, that were 35.8mg GAE L^{-1} and 30.23µmol TE L^{-1}, respectively. Colored cultivars were having significantly higher total anthocyanins and maxim value was recorded in Black Spanish that was 30.23 mg L^{-1}.

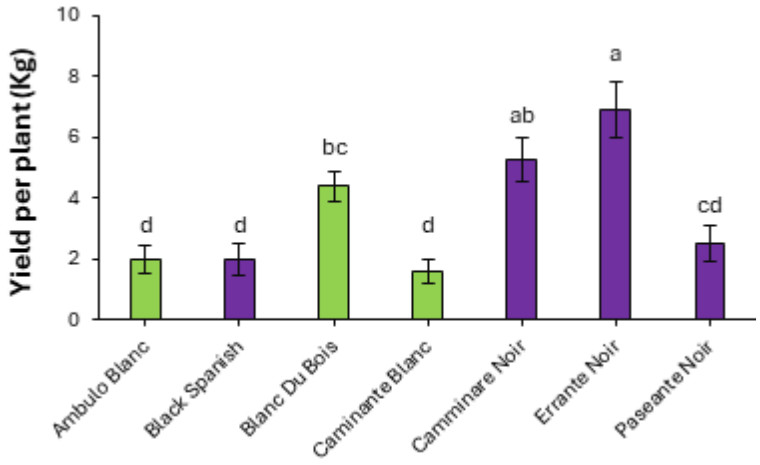

Figure 2. Yield per plant of different pierce's disease resistant grape cultivars grown in Florida.

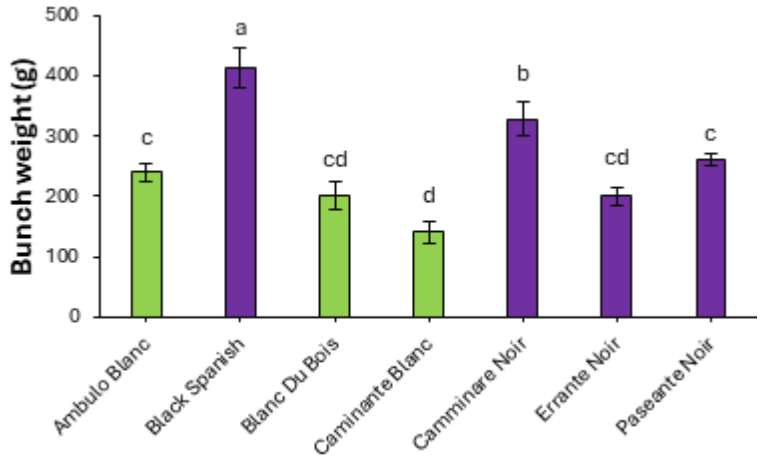

Figure 3. Bunch weight of different pierce's disease resistant grape cultivars grown in Florida.

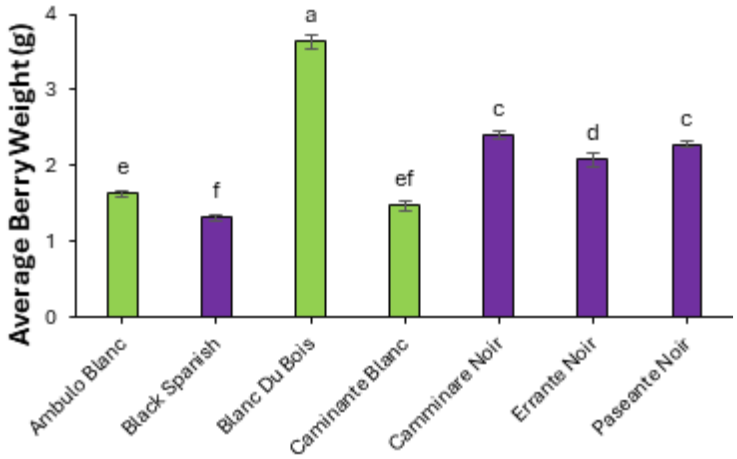

Figure 4. Average berry weight of different pierce's disease resistant grape cultivars grown in Florida.

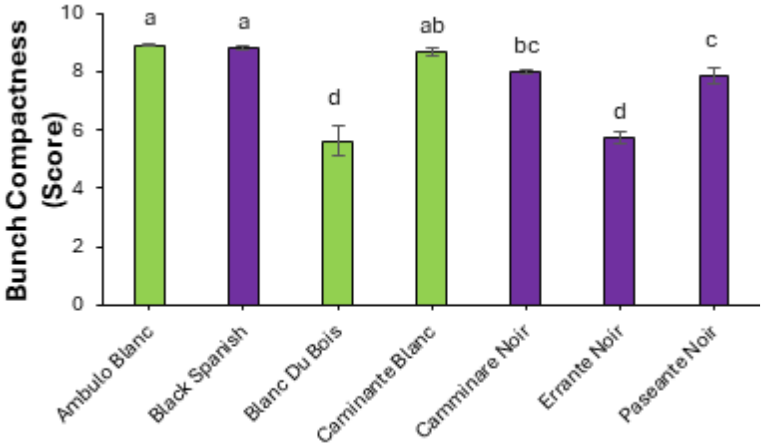

Figure 5. Bunch compactness of different pierce's disease resistant grape cultivars grown in Florida.

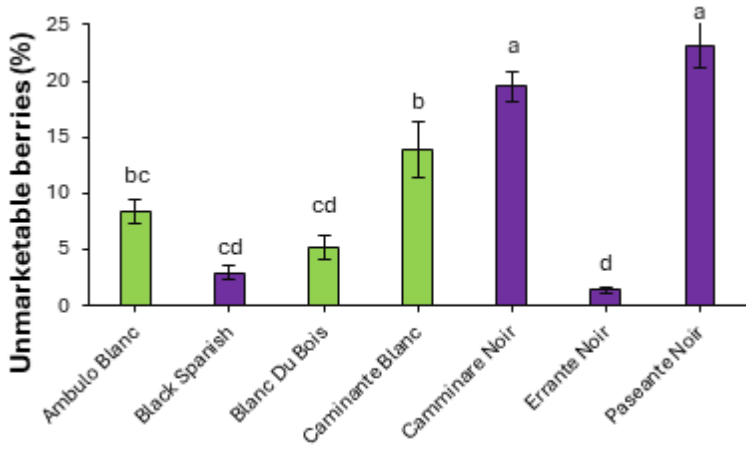

Figure 6. Unmarketable berries of different pierce's disease resistant grape cultivars grown in Florida.

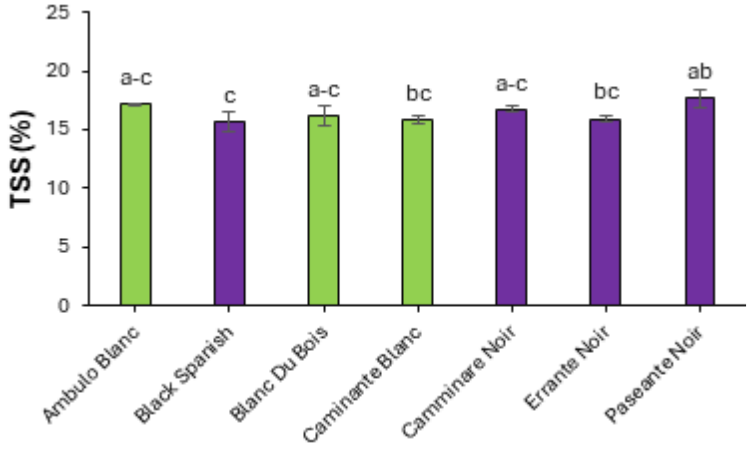

Figure 7. TSS of different pierce's disease resistant grape cultivars grown in Florida.

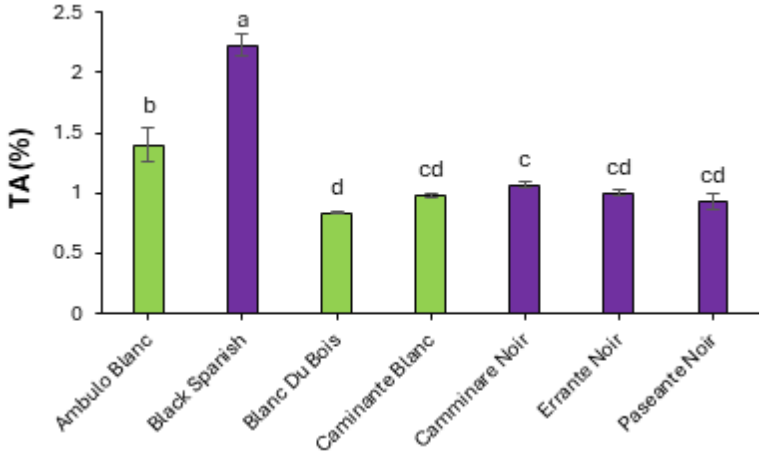

Figure 8. TA of different pierce's disease resistant grape cultivars grown in Florida.

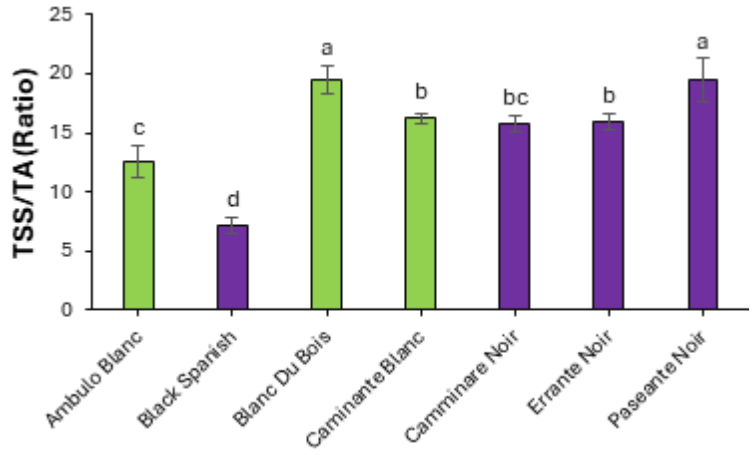

Figure 9. Maturity index (TSS/TA Ratio) of different pierce's disease resistant grape cultivars grown in Florida.

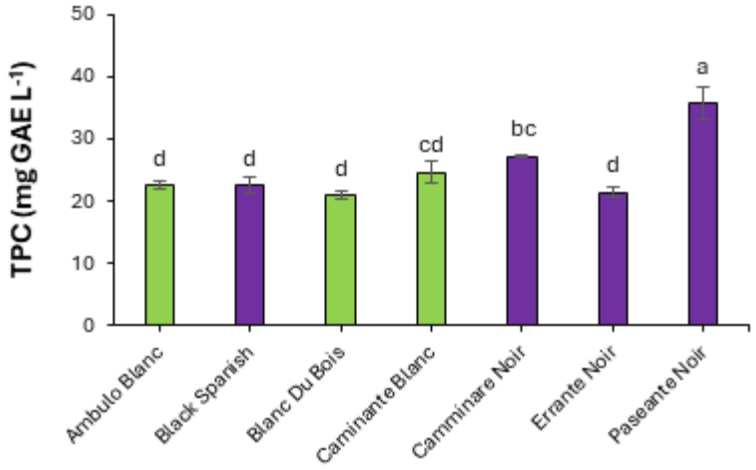

Figure 10. TPC of different pierce's disease resistant grape cultivars grown in Florida.

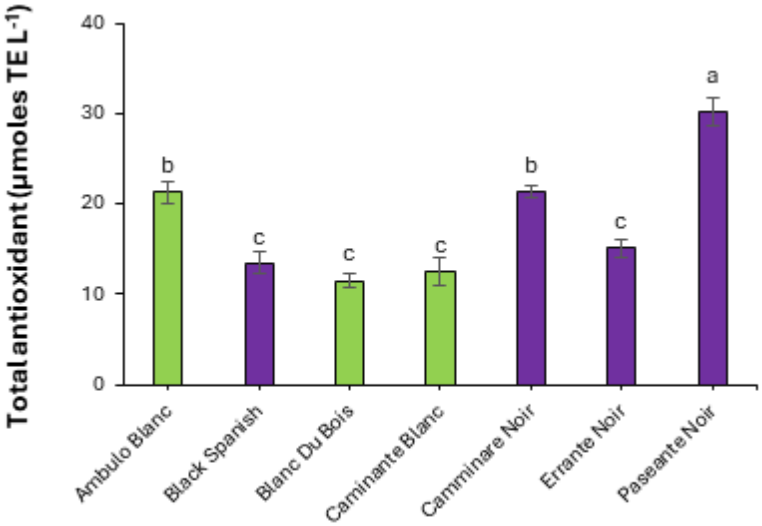

Figure 11. Total antioxidants of different pierce's disease resistant grape cultivars grown in Florida.

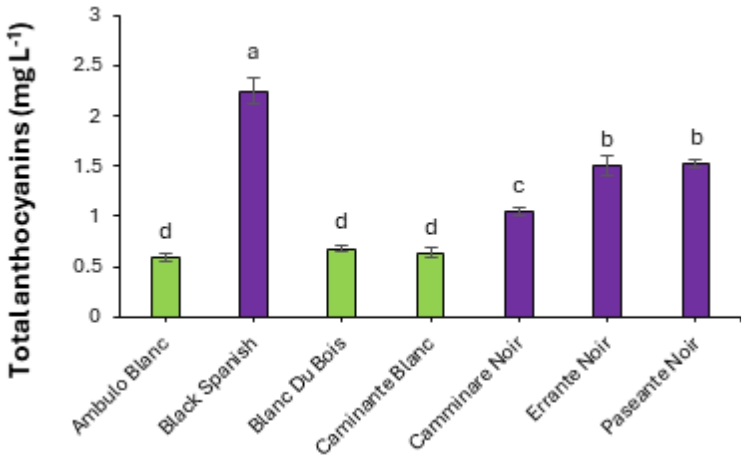

Figure 12. Total anthocyanins of different pierce's disease resistant grape cultivars grown in Florida.

(2) Growth-manipulating Techniques: Management Strategy to Harvest Wine Grapes During the Late Fall in South/Central Florida to Improve Berry Composition and Wine Quality
PI: Ali Sarkhosh, Horticultural Sciences Department
The vines in research plots in Central and South Florida were damaged by recent hurricanes for this project, causing significant delays in starting the project.

(3) Optimize the flavor and aroma of Florida Muscadine wines using machine learning to integrate multi-omics and sensory analyses
PI: Liwei Gu, Food Science and Human Nutrition Department
Sensory assessment of wine by the taste panel has been approved, and 20 panelists were recruited. Fifteen sample collection kits were sent out, and two sets of samples were received. In addition, we collected 15 Noble wines, 12 Carlos wines, and 3 noble-Carlos mixed wines of various flavors. The sensory assessment will start in November after the panelists have been trained. Analysis of organic aromas on GC-MS/MS and flavor metabolomics on HPLC-MS will be done in the next three months. We expect to establish the first and fundamental layer of machine learning to predict wine aroma and flavor by wine volatilomics and flavoromics. We anticipate identifying discriminant metabolites that would contribute to and differentiate wine aroma and flavors.

(3) How various processes for reducing ethanol affect the sensory and physicochemical characteristics of Florida wine
PI: Andrew MacIntosh and Katherine Thompson-Witrick, Food Science and Human Nutrition Department
Funds released as of Sept 18th 24

- IRB has been written and submitted for approval
- An undergrad student (Alexandra A. Escalera) has been hired and is currently undergoing laboratory training including safety and sampling protocols.
- The first “control” wine fermentation experiment has been completed under the supervision of Master student “Patricia Patricio”

Overall the grant is progressing on schedule, minor difficulties have included a new IRB approval process for the planned spring sensory panel, and late sourcing of grapes (purchasing was delayed until funds were released). These difficulties are not expected to significantly impact the overall flow of work.