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AN ANALYSIS OF PROFIT POTENTIAL OF MUSCADINE GRAPE PRODUCTION IN FLORIDA[1]

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Abstract. **Interest in producing muscadine grapes (Vitis rotundifolia Michk.) has increased in Florida as potential producers search for profitable crops to grow on their land. Muscadine grapes can be commercially produced in the areas of Florida that have the environmental characteristics necessary to produce high quality. A sizeable investment is required to establish and develop a muscadine grape orchard to the productive stage. When the orchard is fully productive, large amounts of yearly operating capital are also required. This large outlay of capital dictates careful planning and analysis. The potential markets must be examined before planting in order for the grower to choose cultivars best suited for the appropriate markets and the particular market suited for the location of the orchard. Potential markets for muscadine grapes are direct marketing, processed market, and the commercial fresh market. In this paper enterprise budgets are developed, potential markets are discussed, and potential returns are analyzed to aid the potential producers in their decision making.**

Many of the recent efforts at commercial muscadine grape production in Florida have been very successful and much interest in expansion has been evident throughout Florida. Presently more than 110 growers have grape acreage in many areas of Florida (3). Commercial growers have discovered that producing grapes fits in well with a mixed farming operation or as a one-crop enterprise. The environmental characteristics are ideal for quality muscadine grape production in many areas of Florida and new cultivars developed for Florida growing conditions have also helped to stimulate interest in commercial production (3).

Currently more than 500 acres of muscadine grapes are being grown in Florida representing an increase of over 300 % since 1975 (3). Production is spread throughout many areas of the state. The size of the vineyards vary from less than 1 acre to 60 acres with the average size about 5 acres (3). Pick-your-own vineyards have been the most popular and profitable, but fresh market production has also been very popular. At least 3 wineries are currently in production on a limited scale. The current and projected consumption of wine in Florida indicates that the industry has the potential for rapid expansion to meet the in-state wine demand (5).

Producing muscadine grapes involves extensive costs that begin with the preparation of land prior to planting. The sizeable investment required to establish and develop an acre of grapes to the productive stage dictates careful planning and analysis before committing the productive resources.

Marketing the crop is very important for any agricultural producer and different market alternatives must be closely evaluated. Producers must examine the markets to plan their production to suit the particular market outlet that is chosen. Potential markets for muscadine grapes are pick-your-own markets, processed markets, and commercial fresh markets.

In this report enterprise budgets are developed for a planning guide, potential markets are discussed, and potential returns are analyzed to aid producers in their decision-making. A positive return on investment may be possible when recommended production and marketing practices are followed.

Budgets

Muscadine grapes are deciduous perennials that do not reach full production for 3 to 5 years after the plants have been set and established. Consequently, the expected costs of muscadine grapes are three-fold: the cost of establishing the orchard, the cost of developing the plants to full production, and the cost of maintaining the grape operation during its productive years (4).

The expected costs of producing muscadine grapes are developed in enterprise budget format and these budgets may be used for forward production planning, financing, and management control (1). The cost estimates used in the budgets reflect data based on a commercial scale operation and assume that standard production practices are followed. The size of the operation is assumed to be 20 acres which is representative of many of the present commercial operations in Florida (3).

Establishment. Establishment costs are estimated at just over $3,700 per acre (Table 1). The budget includes variable expenses or "out-of-pocket" cash expenses which will vary with level of output and fixed costs which are overhead expenses. Fixed costs include depreciation, interest, repairs, taxes, and insurance and these expenses occur regardless of production.

The machinery costs included in the budget assume that the equipment is owned and operated by the producer. A land charge is included as a fixed cost and is based on a price of $1,000 per acre at 12% interest. An irrigation charge is also included and is based on a trickle system. Irrigation is necessary in many parts of Florida to insure a consistent supply of quality grapes.

Development. When properly managed, a commercial crop may be harvested during the third or fourth year. Development costs are usually incurred from years 2 through 3 or 4. The estimated per acre development costs for muscadine grapes were $705 (Table 2). A mowing and pruning expense has been included for the development period and increased chemical costs are also reflected.

Production. Annual maintenance costs for a productive muscadine grape orchard were estimated at $2,780 for a pick-your-own operation (Table 3). Maintenance costs will differ for the processed and fresh markets and should be noted by producers and potential producers. A fresh market operation will require increased harvest costs and pounds sold may decrease due to heavy culling by the buyers. A processed operation may result in lower maintenance costs but would require large capital outlays for mechanical harvesters. Maintenance costs are incurred from years 3 or 4 through the life of the orchard. Labor costs are relatively high due to the need for someone to work at the selling stand. An interest charge is included for both a selling stand and a fencing charge.

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Table 1. Estimated establishment costs per acre for muscadine grapes in Florida, 1983.

Item	Unit	Quantity	Price	Total cost
Variable expenses				
Lime (spread)	ton	2	$18.00	$ 36.00
Fertilizer (vines)	cwt	2	7.50	15.00
Fertilizer (sod)	cwt	3	6.65	19.95
Ammonium nitrate	cwt	1.5	8.25	12.38
Boron	lb.	2	1.40	2.80
Land leveling and terracing	hr	1	45.00	45.00
Seed (for sod)	lb.	20	1.10	22.00
Posts	each	190	2.50	475.00
End posts	each	20	4.00	80.00
Wire (12 gauge)[z]	lb	500	0.65	325.00
Miscellaneous equipment	acre	1	85.00	85.00
Vines	each	240	1.75	420.00
Herbicide[y]	acre	1	28.00	28.00
Insecticide[y]	acre	1	16.00	16.00
Fungicide[y]	acre	1	20.00	20.00
Machinery costs				
Tractor (40 hp)	hr	20	4.14	82.80
Equipment	hr	20	3.48	69.60
Pickup truck	mile	100	0.10	10.00
Irrigation[x]	acre	1	38.00	38.00
Labor	hr	132	3.75	495.00
Interest on variable expenses	$	2297.53	12.0%	275.70
Total variable expenses				$2573.23
Fixed costs				
Tractor	hr	20	7.02	140.40
Equipment	hr	20	3.94	78.80
Pickup truck	mile	100	.12	12.00
Irrigation[x]	acre	1	75.00	75.00
Land charge	$	1000	12.0%	120.00
General overhead	$	2573.23	5.0%	128.66
Total fixed costs				554.86
Total establishment costs				3128.09

[z]Costs based on 2 wire vertical trellising system.
[y]Chemical control recommendations are found in County Agents Handbook and Monticello ARC and Leesburg ARC Research Reports.
[x]Costs based on a trickle irrigation system.

Table 2. Estimated development costs per acre for muscadine grapes in Florida, 1983[z].

Item	Unit	Quantity	Price	Total cost
Variable expenses				
Lime (spread)	ton	1/3	$18.00	$ 6.00
Fertilizer	cwt	6	6.65	39.90
Ammonium nitrate	cwt	2.5	8.25	20.63
Boron	lb.	2	1.40	2.80
Vines (replant)	each	10	1.75	17.50
Herbicide[y]	acre	1	20.50	20.50
Insecticides[y]	acre	1	18.00	18.00
Fungicides[y]	acre	1	24.00	24.00
Mowing	acre	1	12.00	12.00
Pruning	acre	1	70.00	70.00
Machinery costs				
Tractor (40 hp)	hr	3.5	4.14	14.49
Equipment	hr	3.5	3.12	10.92
Pickup truck	mile	100	0.10	10.00
Irrigation[x]	acre	1	38.00	38.00
Labor	hr	25	3.50	87.50
Interest on variable expenses	$	392.24	12.0%	47.07
Total variable expenses				439.31
Fixed costs				
Tractor	hr	3.5	7.02	24.57
Equipment	hr	3.5	3.54	12.39
Pickup truck	mile	100	0.12	12.00
Irrigation[x]	acre	1	75.00	75.00
Land charge	$	1000	12.0%	120.00
General overhead	$	439.31	5.0%	21.97
Total fixed costs				265.93
Total development costs				$705.24

[z]Development costs are assumed to occur in years 2 and 3.
[y]Chemical control recommendations are found in County Agents Handbook and Monticello ARC and Leesburg ARC Research Reports.
[x]Costs based on a trickle irrigation system.

Debt service for recapturing the establishment and development costs is also included. An annual expense must be included to reflect the amount that must be recaptured since a long range investment is necessary before the grapes would provide a return on the investment. The investment costs must be compounded to obtain future prices and then amortized over the life of the orchard to provide an annual expense needed to recapture the costs (2). The productive life is assumed to be 10 yr once the grapes reach the stage of commercial yields. In the example budgets, this figure is obtained by compounding each of the first 3-yr investments (Table 4). and amortizing the sum of the compounded investment for 10 yr at a rate of 12%.

Returns

Potential per acre returns for a pick-your-own operation at various yields and price levels are shown in Table 5. The importance of selling what is produced and the prices received are illustrated by these figures. As an example, at a price of $0.55/lb. and a yield of 5,000 lb., the producer would lose $30 per acre but at a yield of 7,000 lb. the net returns would be more than $1,000 per acre. Returns would vary for a fresh market operation and for the processed market operation with yields and prices also the major determinant of returns. Growers should remember that income will not be evident until sometime after establishment. Many new producers have gotten into a cash flow crunch caused by development costs beginning at day one but sales not starting until year 4. Planted acreage may be the factor that would utimately determine the returns on investment since the size of the operation may result in either higher or lower per acre returns than the assumed size of 20 acres that the example budgets reflect.

Marketing Alternatives

The marketing system for grape producers is complex. The basic marketing alternatives for grapes include direct market, processed market, and commercial fresh market. Marketing through certain channels has been difficult and may be costly. The fresh market is usually the most difficult to enter and may be the most costly.

Profits are often determined by the producers' ability to market his crop. A marketing plan that analyzes the mix of marketing decisions is very important. Such a plan should evaluate the type of grapes, pricing methods, promotion, and the location of the markets. Each individual producer must analyze these factors before deciding how to sell his grapes. Individual expertise in marketing may be the deciding factor.

Direct Market (Pick-Your-Own). The pick-your-own (PYO) concept has expanded rapidly in the past few years. PYO marketing, though, is not for every grower. When produce is marked PYO, the farmer or producer becomes a retailer and is confronted wth many of the same problems that all retailers face.

The advantages of PYO markets to producers include seasonal harvest labor is reduced, grading, packing, and storage is eliminated, container costs may be reduced, cash

Table 3. Estimated annual production expenses for maintaining one acre of muscadine grapes, pick-your-own operation, Florida, 1983.

Item	Unit	Quantity	Price	Total cost
Variable expenses				
Lime (spread)	ton	1/3	$18.00	$ 6.00
Fertilizer	cwt	10	6.65	66.50
Ammonium nitrate	cwt	3.5	8.25	28.88
Boron	lb.	2	1.40	2.80
Herbicide[z]	acre	1	20.50	20.50
Insecticide[z]	acre	1	26.00	26.00
Fungicide[z]	acre	1	32.00	32.00
Mowing	acre	1	12.00	12.00
Pruning	acre	1	120.00	120.00
Machinery costs				
Tractor (40 hp)	hr	5	4.14	20.70
Machinery	hr	5	3.12	15.60
Pickup truck	mile	100	.10	10.00
Irrigation[y]	acre	1	38.00	38.00
Advertising	acre	1	50.00	50.00
Labor	hr	200	3.75	750.00
Interest on variable expenses	$	1198.98	12.0%	143.88
Total variable expenses				$1342.86
Fixed costs				
Tractor	hr	5	7.02	35.10
Machinery	hr	5	3.54	17.70
Pickup truck	mile	100	0.12	12.00
Irrigation	acre	1	75.00	75.00
Interest on selling stand	$	200	12.0%	24.00
Interest on fencing	$	100	12.0%	12.00
Land charge	$	1000	12.0%	120.00
General overhead	$	1342.86	5.0%	67.14
Total fixed costs				$362.94
Recapture of establishment and development costs[x]				$1074.00
Total production costs				$2779.80

[z]Chemical control recommendations are found in County Agents Handbook and Monticello ARC and Leesburg ARC Research Reports.
[y]Costs based on a trickle irrigation system.
[x]Based on 10 yr at 12% ($6069 x .177).

is in-hand when the produce leaves the vineyard, middlemen are eliminated, less produce is lost because no grading is necessary and therefore yields may be higher, the producer has more control over prices.

Included as disadvantages to producers are the necessity for liability insurance for accidents, longer work hours during the advertised times, the logistics of getting customers to the produce rather than the produce to the customers (5).

Processed Market. The processed market is an alternative (or back-up) market to fresh commercial sales, or is selected initially due to market price, proximity to processor, or convenience because of simplified harvesting and marketing. The decision by the producer to market his grapes through the processed market eliminates the merchandising risk of not selling the product. In the processing market, contractual commitment may be necessary between grower and processor.

Table 4. Investment for establishment and development for years 1-3, compounded at 12%.

Years	Annual investment		Compounding factor (12%)		Compounded investment
1	$3,128	x	1.405	=	$4,395
2	705	x	1.254	=	884
3	705	x	1.120	=	790
Total compounded interest					$6,069

The advantages of the processed grape market alternative include minimal time necessary by grower for marketing activities, grower is assured of market for his fruit once the contract is signed, contracts can usually be negotiated for any quantity, price and terms of sale are known in advance of harvest or delivery, seasonal harvest labor and associated costs may be reduced compared to the fresh market, grading, packing, storage, and containerization costs are reduced or eliminated.

Disadvantages of the processed grape market include grower has reduced control over price received, loss of marketing flexibility once the contract is negotiated, investment is expensive if mechanical harvesting is necessary to meet delivery requirements to the processor at the time specified (5).

Fresh Market. Current production of Florida fresh grapes is widely dispersed over the state, making it extremely difficult for the industry to provide commercial quantities of grapes by individual growers for significant retail marketing. However, producers with larger acreages have been successful in marketing grapes through independent retail food stores and chain supermarkets. Packing, assembling, storing, and distributing consistent supplies of high quality grapes to supermarkets has been achieved by a few producers who have entered the fresh market (5).

Supplying prescribed quantities of a specified quality of produce consistently throughout the marketing season is most important for successful commercial marketing of fresh grapes. This means delivering guaranteed quantities at agreed upon times and locations in the buyer's specified packaging, whether open lugs or cellophane-wrapped plastic pint containers or prepackaged and prepriced or with point-of-sale materials. The quality must be uniform, meeting the produce manager's specifications as to color, cultivar, sizing, or absence of wet scarring or foreign materials.

Advantages to producers from marketing grapes in commercial fresh market channels include minimal grower time necessary for marketing activities after the initial buyer contact, grower is assured of an outlet for his grapes once an agreement is reached, exact price and terms of sale are usually known in advance of harvesting or delivery, usually a higher price (compared with processing) is received.

Disadvantages include employment of piece-rate seasonal harvest labor is required, investment in grading, packing, and refrigerated storage facilities is necessary, increased cost

Table 5. Net returns (in dollars) per acre at varying yield and price levels for muscadine grapes.

Yields (lb./acre)	Price/lb.						
	$.40	$.45	$.50	$.55	$.60	$.65	$.70
4000	−1,180	−980	−780	−580	−380	−180	20
5000	−780	−530	−280	−30	220	470	720
6000	−380	−80	220	520	820	1,120	1,420
7000	20	370	720	1,070	1,420	1,770	2,120
8000	420	820	1,220	1,620	2,020	2,420	2,820
9000	820	1,270	1,720	2,170	2,620	3,070	3,520

of containers and associated warehouse storage, loss of marketing flexibility once a commitment is made to a retailer.

Summary

If good management and marketing practices are followed and adequate yields are maintained, muscadine grape production may be profitable and the industry will have the potential for expansion. Markets must be carefully analyzed before production decisions are made. The Florida muscadine grape producer has 3 primary market outlets; direct or pick-your-own market, processed market, and commercial fresh market. Marketing decisions should be influenced by factors that include cultivar, yield potential, production costs, harvesting and marketing costs, management expertise, capital requirements, and an estimate of market potential.

Producers should evaluate costs by enterprise budgeting and analyze the markets before making production decisions. Although grape orchards are costly to establish, develop, and maintain, profits may be realized if good management practices are maintained.

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COLD HARDINESS OF TWO CULTIVARS OF AVOCADO AND A MANGO

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Abstract. **Laboratory cold hardiness tests conducted in mid-winter show 'Mexicola' and 'Gainesville' avocado** (Persea americana **Mill.) trees surviving −7°C to −10°C in Gainesville, Florida without leaf damage. These cultivars have the ability to gain resistance to cold (acclimate) in response to temperatures from 6 to 13°C. 'Mexicola' and 'Gainesville' acclimated 2.3°C in Gainesville and Homestead although acclimation began at a higher temperature in Homestead. Potted seedlings of turpentine mango** (Mangifera indica **L.) growing in Gainesville were killed between −3 and −5°C with no evidence of acclimation when exposed to temperatures optimum for acclimation.**

Avocado and mango trees are tropical fruit plants of economic importance that have been introduced into areas of Florida that occasionally have frosts. Florida produced 490,000 hecto liters of avocados in 1982 worth $16,656,000 dollars (7, 9). Area planted to mango increased from 700 ha in January, 1980 to 890 ha in January, 1982 (8).

The avocado has been divided into 3 races; Mexican, Guatemalan, and West Indian. The 3 races have different responses to cold with Mexican injured at −8.8° to −6.6°C, West Indian injured at −6.1° to −3.8°C and Guatemalan falling between the 2 (11).

Cold weather poses a threat to existing avocado producing areas. 'Booth-8', the second most important avocado in Florida in the 1950s, suffered severe injury at −4.4 to −2.7°C in 1958 (16). Avocado acreage in South Florida is being forced to more northern areas by urban expansion with additional threat of freezing weather (17). Outside the commercial production areas, much interest exists in cold hardy avocados as dooryard trees in north and central Florida and as an additional fruit crop in citrus areas (14).

Resistance to freezing for brief low temperatures is crucial. Understanding the freezing process is of utmost importance. Also, little is published about the cold hardiness of Florida cultivars or if they do cold acclimate.

Early attempts were made to determine the cold hardiness of avocado cultivars by examining the freezing point depression of expressed sap (11). Halma (10) showed that the expressed sap method was not accurate. During the 1930's and 40's many observations were made after freezes although these reports are conflicting. Hodgson (12) observed that young Mexican race trees were killed to the ground by −9.4°C and that mature trees suffered substantial damage, but Camp (1) reported Mexican race trees survived −9.4°C with little damage. Hodgson (13) subsequently reported dieback of new growth on cold-damaged Mexican avocado trees. Camp and Wolf (2) reported avocado trees withstanding temperatures of −2.2 to −2.7°C, but the race was not specified. Mexican avocado trees, 'Mexicola' and 'Gainesville', have withstood temperatures of −6.6 to −9.4°C (14, 15).

Water stress has been reported to induce cold hardiness in citrus (19, 21), and *Cornus* (4) among others. Increased cold tolerance is a result of decreased tissue hydration.

Weiser (20) reported that short days initiate the first step of acclimation in many woody plants. Young (22) observed citrus trees cold acclimated more in response to low temperatures than to photoperiod. Increased cold hardiness in avocados growing in Gainesville cannot be explained by a difference in photoperiod since the photoperiod in Homestead and Gainesville are similar.

Mango trees show high susceptibility to cold injury. Young trees are damaged by temperatures of −0.5°C. Variability among cultivars is apparent after a cold spell, but precise information on this subject is non-existent (3), nor is it known if mangos can acclimate to cold.