aceae: American elder; 3) Chenopodiaceae: mexicantea; 4) Malvaceae: ceasarweed (*Urena lobata* L.), teaweeds (*Sida* sp.); 5) Onagraceae: primrosewillow (*Ludwigia peruviana* (L.) Hara); 6) Phytolaccaceae: common pokeweed, 7) Rosaceae: blackberry; 8) Rutaceae: citrus; 9) Verbenaceae: lantana. Although wild grape may be the main source of PD bacteria, any plants, especially perennials, are potentially important RLB hosts.

Studies on citrus could be especially significant since RLB causing PD have been transmitted from citrus to grapevine (5), citrus inoculated with PD bacterium develops decline symptoms (7), and CB is presently the most serious disease of citrus.

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FLORIDA GRAPES: THE NEXT DECADE

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Abstract. **Grapes in Florida are receiving much greater attention than current planted acreage and economic activity would suggest. Reasons for this optimism are a 4-decade breeding effort which is overcoming very serious disease problems and producing higher quality, more versatile cultivars with improved fresh, processed juice and wine characteristics; progressive, enthusiastic grape growers; a sympathetic state legislature and a long-term commitment by the Florida Grape Growers Association and the state, regional and national agricultural research establishment. The 1970 decade has resulted in progress with both bunch** (Euvitis) **and muscadine** (V. rotundifolia) **grapes in the areas of breeding, culture and processing. For the well-being of the grape industry, it is essential that these efforts be increased during the 1980's and coupled with greater attention to fruit quality and fresh, processed and wine marketing. Grape development priorities of the 1980's will be discussed in terms of desirable, achievable goals for 1990.**

Of the 38 U. S. states which lay claim to a grape industry, Florida probably ranks about 19th in acreage (1). But there is promise of greatly increased future production. The decade of the 80's represents a very critical developmental period. It is, therefore, instructive to describe where the industry came from and how it will develop and contribute to Florida agriculture over the next 10 years.

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Looking Back

Except for the "Vineland" label which the Norsemen gave to Northeast North America about 1,000 years ago, the first recorded reference to grapes in the New World was from Spanish Florida in 1565 (17). From that time on inhabitants of Florida have been intrigued by the crop and consistently attempted to produce grapes and make wine (Table 1).

These efforts have faced many problems over the centuries, and it is a tribute to horticulturists in the state that grapes are successfully grown. A few hundred acres of *Vitis labrusca* were reported in the early 1890's, but the vines lacked vitality and longevity and the effort failed (23). Grape acreage increased remarkably in the 1920's, and 4 to 5 thousand acres existed as of 1926 (19). Most plantings were Munson hybrids—'Extra' (Florida Beacon), 'Carmen', 'R. W. Munson' and 'Armalaga' and were devoted to fresh markets locally and in the Northeast.

In the late 1920's disaster struck again in 3 forms—disease, depression and the fruit fly eradication program, disease being by far the most devastating. The Munson cultivars were plagued by short vine life (~10 years); susceptibility to rot and diseases associated with a hot, humid climate; high cultivation and marketing costs; and weak markets. Vine degeneration, later identified as Pierce's disease, and the Mediterranean fruit fly eradication program effectively curtailed Florida plantings and resulted in a dramatic decrease in acreage, completely negating the commercial potential of Florida grapes for several decades (21).

Turning the Corner

Fortunately, during and subsequent to the grape boom of the 1920's the seeds of future expansion were being

Table 1. Florida Grape Milestones.

Date	Event	Significance
1565	Mention of local grapes in wine	First known wine in the New World
1885-1895	V. labrusca planted in Central Florida and failed	Unsuitability of introduced species demonstrated
1920-1930	Munson hybrids planted extensively and failed	Unsuitability of additional species demonstrated
1923	Florida Grape Growers Association founded	Growers commencing to cooperate and communicate
1933	Florida Legislature authorized grape research at Leesburg by special appropriation	Government research support initiated
1945	First cross of Pixiola x Golden Muscat made by L. H. Stover	Resulted in release of Lake Emerald grape in 1954
1950	Cross of Fla. 43-47 x Caco made by L. H. Stover	Resulted in release of Blue Lake grape in 1960
1951	Discovery by Stoner, Stover, and Parris that "grapevine degeneration" was Pierce's disease	Led to development of PD-resistant varieties
1956	Cross made by L. H. Stover between Mantey and Roucaneuf	Resulted in release of Stover bunch grape in 1968 (The first acceptable wine grape)
1958	New location for Farm and Laboratory at ARC, Leesburg by J. M. Crall	Provided new land and facilities for grape research
1959	First muscadines planted at ARC, Leesburg by L. H. Stover	Southland, Higgins and Chief still productive in 1980 from original planting
1967	Beginning of trial of 20 selections of muscadines from N.C. State Univ. at ARC, Leesburg	Resulted in release of Dixie in 1976 (jointly with N.C. State Univ.)
1968	Grape processing and utilization research initiated on wine and juice	Cooperative effort between breeders and food scientists emphasizing cultivar improvement for processing
1969	Beginning of larger populations in grape breeding	Increased the chances of getting superior cultivars
1973	FGGA wine competition initiated	Awareness and popularization of Florida grapes for wine
1973	Favorable production data obtained for recent muscadine introduction	Crystallized the superiority of certain muscadine cultivars in Florida
1973	Discovery by D. L. Hopkins that PD is caused by a bacterium instead of a virus	Control measures sought in different manner than previously
1978	Florida A & M University formed a Center for Viticultural Science and Small Farm Development	Additional attention to commercial grape growing
1979	Legislation to waive wine tax on local produce and license fee reduction passed	Financial incentive to produce wine from Florida grapes and other crops

planted. In 1923 a number of prominent growers in Central Florida founded the Florida Grape Growers Exchange and the Florida Grape Growers Association (FGGA). The Association is still an active voice in the state and has grown to about 200 members from the Panhandle to South Florida. The FGGA obtained legislative action initiating grape research at the Watermelon Lab in Leesburg in 1933, now known as the Institute of Food and Agricultural Sciences, Agricultural Research Center (ARC), Leesburg (*21, 27*). The realization that Florida's extreme climatic and disease problems severely restricted most grape varieties led the ARC to the evaluation and development of resistant varieties derived from local species crossed with introduced cultivars.

Of particular relevance was the breeding and release at Leesburg of the bunch grape cultivars 'Lake Emerald', 'Blue Lake' and 'Stover', all resistant to Pierce's disease (23, 21). Muscadine varietal improvement was also undertaken. These efforts were made easier by the fact that *Vitis rotundifolia* was indigenous to Florida and, consequently, resistant to Pierce's disease. Cooperative breeding research with other Southern states has resulted in substantial improvements over the native muscadines (19).

The Last Decade

During the 1970's a number of substantial advances were made in Florida viticulture.

Breeding. Larger populations of seedlings from crosses between bunch grapes were grown in order to expedite the development of superior potential varieties. Muscadine crosses were begun and continued between the most outstanding muscadine varieties available. New releases were made in 1976: 'Liberty' bunch grape and 'Dixie' muscadine. Testing procedures were developed to test seedlings at a young stage for resistance to anthracnose and Pierce's disease. Welder muscadine was described as a promising wine cultivar originating in Lake County (20).

Culture. Clean cultivation of vineyards was generally practiced 10 years ago, but experience has shown that mowing the row middles is much less damaging to vine roots near the surface than disking. Herbicide application under the vine row has been the greatest single improvement over hoeing or in-and-out rototilling to control weeds. Two materials, Paraquat and Glyphosate, have been very effective in vineyards around the state. Irrigation has been shown to improve the vine growth, yield and quality, thus irrigated grape acreage has been increasing, with a large amount being low-volume irrigation. The general techniques of grape production, such as fertilization, trellising, pruning, and insect and disease control, have been described in several publications (10, 11, 13, 21, 23).

Harvesting. With the development elsewhere of improved machines for mechanical harvesting during the 70's, it is becoming feasible to have completely mechanized harvesting of grapes for processing. Most of the grapes in Florida are either handpicked or picked with some type of harvesting aid (i.e., catch frames, vibrators, etc.). For the fresh fruit market, grapes are handpicked and packaged. A problem with muscadine grapes is a wet-stem scar. Research has been conducted with chemical compounds that will give a dry-stem scar and a longer shelf-life. These materials look promising.

Trellising has seen some changes in the decade with the trellising system being established for the desired type of harvesting (i.e., U-pick—single or double wire; mechanical harvesting—Geneva Double Curtain).

Processing and Utilization. Although in many regions of the world grapes are synonymous with wine, there has been a distinct lack of developments in Florida other than isolated cases of home wine manufacture. Probably the most significant fact established over the last decade is that respectable table wines can be made from Florida grapes. Working with available bunch and muscadine cultivars and breeding lines and in cooperation with capable growers, considerable progress has been made in wine making procedures applicable to Florida grapes and in identification of promising germ plasm (3, 4, 5, 15). Emphasis has been on table wines with a 1 to 3 year shelf-life, without attempts to mimic the standard commercial wines of Europe or California.

In 1978 the FGGA was instrumental in persuading the Florida Legislature to pass bills eliminating the excise tax on wines manufactured in Florida and to reduce the license fee for commercial wine making from $1,000 to $50. These measures provided important incentives for state wine production. As a result of renewed grape interest, at lease 2 wine manufacturing operations are underway and about 4 more are in various stages of planning by Florida growers.

At this time we have one bunch grape, 'Stover' which makes a quite acceptable white wine (4). There are a few intriguing green grapes under investigation, but to date all purple bunch grapes lack pigment stability, are low in sugar ($\sim$15° Brix), high in acid ($>$0.9%) and possess pronounced *V. labrusca* (Concord) character. 'Carlos', the leading white muscadine wine cultivar in the South is susceptible to Pierce's disease, but Bronze muscadines, 'Welder' and 'Dixie' are resistant and comparable in character. Black muscadines 'Noble', 'Regale' and the older 'Tarheel' have greater pigment stability than earlier muscadines and are suitable for rosé and red wines. The extent of color and subsequent wine type is dependent upon manufacturing procedure (7). The southern cooperative breeding program involving the ARC Leesburg promises a steady improvement over these cited wine cultivars. However, those already available (Table 2) represents a modest start and a considerable improvement over a decade ago.

Table 2. Main Uses for 19 Grape Varieties Recommended for Florida.

	Uses[z]				
Bunch Grapes (green)	Fresh Market	Pick-Your-Own	Wine	Juice & Jelly	Home Garden
Lake Emerald		x	x		x
Stover	xxx	xx	xxx		xx
Bunch Grapes (purple)					
Blue Lake		xx		xxx	xx
Bunch Grapes (red)					
Liberty			x		x
Roucaneuf	x	x	x		x
Muscadine Grapes (bronze)					
Dixie	x	xx	xxx		xxx
Fry[y]	x	xx			xx
Higgins[y]		xxx	x		x
Summit[y]	xxx	xxx			xx
Triumph	x	xxx			xx
Welder		xx	xxx		xx
Muscadine Grapes (black)					
Albemarle	xx	xx		x	xx
Chief			x	xx	x
Cowart		xxx			xxx
Jumbo[y]		xx			x
Magoon	xx	xx	x	xx	x
Noble			xxx	xxx	
Regale			xx	xxx	
Southland	xxx	xx	x	xx	xx

[z]Three x's indicate highly suitable, two x's suitable, one x acceptable, and blank space indicates not recommended for the purpose indicated at column head.
[y]Female variety, requiring a pollinator variety nearby.

Progress has not been as promising for other products. Grape juice is an appealing outlet, in view of the proximity of grape production to the citrus industry, its extensive technical and marketing base, and the full availability of processing facilities during the summer when citrus is unavailable. However, pasteurized grape juices from selected Florida-grown cultivars approach, but do not equal commercial juice packs in quality and acceptability (6). The distinctive flavor of fresh muscadine juice is diminished by thermal processing, and consumers lack familiarity with non-Concord types. Recent utilization research in Georgia illustrates the quality and versatility of muscadines, and the commercial potential of specialty products—juice blends, dried pulp and skin—seems good (14).

Very respectable home conserves are produced throughout Florida, and these products are contributing to the increased popularization of local grapes (16), although no commercial enterprises are known. Florida grapes, particularly muscadines, make good flavored but seedy raisins. Work toward a practical device to remove the large seeds is underway and will be essential if the pleasing dried-fruit texture and flavor is to be popularized (9). Despite the fresh flavor quality of many bunch and muscadine cultivars, most consumers are so accustomed to the ease of eating seedless grapes that this consideration overrides the sensory appeal of seeded types.

Marketing. This most critical aspect of the grape industry has often been neglected by growers. The grape boom of the 1920's was catalyzed by markets in the Northeast (26). However, this was before the development of efficient transcontinental fresh produce transportation, the seedless grape or the vast expansion of table grapes in the West. It is, therefore, unlikely that Florida could have retained or expanded the long-distance market, even if nature (Pierce's disease) had not intervened.

Limited fresh market trials have been conducted with both bunch (24) and muscadine grapes (12). Again, the presence of seeds and consumer unfamiliarity stand as limitations, along with short shelf-life and variable quality. Presently, the most reliable outlets for Florida grapes are U-pick operations which have expanded rapidly. In 1970 there were about 3 outlets in the state, contrasted to at least 28 in 1980. Near urban areas the U-pick potential is large. However, away from population centers, market saturation can be a problem, and more emphasis upon fresh market promotion is needed. There are positive indications though, of an increasing local demand. In 1980 about 30 tons were readily sold through retail stores and about 15 tons more passed through wholesale outlets.

Looking Ahead

Problems. Many of the constraints facing the grape industry are common to Florida agriculture. As early pioneers discovered and present growers are critically aware, cultivating grapes in Florida is quite a challenge. The hot, humid ripening season, combined with highly variable rainfall; year-round insect populations; and relatively infertile, permeable soils call for special disease resistant varieties and careful, extensive cultivation inputs.

To these traditional constraints must now be added energy. Florida agriculture is notoriously energy intensive; in fact, the highest in the country. Grape growing is no exception, as reflected in production costs. An ongoing IFAS effort to reduce energy inputs into agriculture by economically and environmentally sound means is in the early stages, but should be relevant to grape production and processing (25).

Neither bunch nor muscadine grapes have particularly good shipping or holding characteristics compared to those of vinifera table grapes, and the problem of seeds has been noted. Some muscadine cultivars are amenable to machine harvest and density grading (2, 18), although machinery and techniques require substantial refinement. For some varieties lack of a dry-stem scar or uneven ripening negate this potential labor saving harvest advantage.

Even when fresh fruit quality is ideal and short storage life is not limiting, difficulties can occur. Some of the lowest quality commercial table wines are manufactured in the Southeast from local grapes. Often this is due to inferior varieties and/or poor enology practices. However, it may also involve a casual attitude toward quality control and merchandising. Since it is evident that good quality wines can be made from grapes grown in the Southeast (7, 8), it is incumbent upon the industry to promote only quality wines. "If you wouldn't consume it, don't sell it" is important advice.

Florida grapes and grape products are in competition with similar items (and other fruits) from established regions of the U.S. and overseas. Most of these enterprises have a considerable lead in technical information, operating and marketing experience, consumer familiarity and economics of scale. To compete will require above average products, marketing efforts and perseverance.

Promises. Let's now look at the bright side. Florida grape growers are a progressive and innovative group. Many of the most promising cultivars or breeding lines and cultural practices are a result of the dynamic interchange of ideas and a sharing of germplasm between growers and researchers. A number of growers have ambitious, expansive yet realistic plans and, most importantly, have demonstrated their serious intent by a substantial time and financial investment.

Behind these developments is a serious grape research effort on a state, regional and national basis. Within Florida, IFAS has a long term continuing research commitment originating with the ARC Leesburg in 1933 (27). Recently, Florida A & M University in Tallahassee inaugurated a Center for Viticultural Science and Small Farm Development. The program goals are: marketing and organizational assistance; storage preservation and product development; and vineyard development and research (22). Florida is cooperating with other Southern states in a regional project of wine cultivar evaluation and selection together with germ plasm exchange among participating states. The USDA through the Citrus and Subtropical Products Lab, Lake Alfred, is also involved in grape product development (9).

Experience in the Southeast clearly indicates a market for local grapes and grape products. Florida, with its expanding population and significant tourist trade has a distinct regional advantage. Visitors and inhabitants alike appreciate products with a Florida theme (i.e., citrus, honey, tropical fruits, etc.). Promotion to that end, if done tastefully, could go a long way toward popularizing Florida grapes. Do not grapes predate citrus in the state?

A Prescription for Success

The development needs of the Florida grape industry (or any other viable agricultural enterprise, for that matter) inevitably will exceed the resources devoted to it. Consequently, it is essential to set realistic goals to optimize the support available and to coordinate the diverse interests addressing grape problems in state (Table 3). With a crop as sensitive to environmental conditions and cultural practices as grapes, continual vigilance is required just to stay even. Although a small acreage crop here, grapes are most emphatically not a small-input, simple crop. The care, attention to detail and patience (not to mention time and capital) needed to nurse vines to the bearing stage, maintain them and to profitably sell *grapes is not for the* average farmer. Similarly, processing and utilization enterprizes call for an exceptional commitment by all concerned.

Table 3. Grape Research and Development Goals for 1990.

Cultivars and Production

Adequate Florida agricultural workers trained in the art and science of viticulture in order to more efficiently produce, harvest, and market grapes.

Seedless varieties with earliness, good size, quality and disease resistance for Florida fresh fruit or raisin production.

Other even-ripening new varieties suitable for machine harvesting (dry stem scar in muscadines) and processing into wine, juice, jelly, or other products.

Superior rootstock varieties with resistance to nematodes, Pierce's disease, grape root borer, pathogenic fungi, drought, and high water table.

Effective grafting and budding techniques to facilitate rapid and economical production of grafted plants in nurseries.

Sufficient knowledge of Pierce's disease and grape root borer to devise a satisfactory control of these pests.

Practical reduction of fossil fuel expenditure in grape production by more efficient mowing, spraying, and other vineyard operations requiring fuel-consuming equipment.

Practical chemical growth regulators for easing mechanical harvest, promoting fruit set, and other purposes.

Continued testing of grape cultivars in different areas of the state to establish where the most favorable zones are for viticulture.

Processing and Utilization

Wine manufacturing procedures capable of overcoming some of the limitations of presently available cultivars, producing superior wines from new introductions, and turning out versatile wine types.

Processing equipment and technical information suitable for small-scale commercial wine and juice production.

Gentle, efficient machine harvesting and grading equipment for both bunch and muscadine cultivars.

Grape juice handling and processing techniques adaptable to citrus processing facilities.

Wine and juice quality standards above the national average.

Marketing

A viable Florida Grape Growers Association cooperative for more efficient harvesting, storage, and marketing, serving the needs of growers in all areas of Florida.

Economical, efficient postharvest handling and storage treatments capable of extending shelf life throughout the interstate distribution system.

Integrated production, handling, processing, distribution and marketing systems which will optimize fresh and processed grape product quality at economical prices to consumers while yielding a fair return to growers and distributors.

Since grapes are the world's major fruit crop, there is much pertinent research being performed globally. Much can be gleaned from these efforts, keeping in mind, however, the uniqueness of Florida and our specific problems and potential. The need to cultivate a positive image and favorable consumer awareness is quite critical. Only quality products, reasonably priced, and honestly merchandised can change Florida grapes from a botanical curiosity (in the minds of many) to a welcome addition to the food supply.

The Next Decade

Where do we wish the Florida grape industry to be by 1990 and how can we get there?

Breeding. New seedless cultivars with disease resistance for production in Florida are expected to be forthcoming from the breeding program. This opens the possibility of better competition in fresh market sales and possibly raisin production. Earlier ripening bunch grapes are expected which will be available for June markets when grape prices are higher. Muscadine varieties with high yields, good quality, uniform ripening and high percentage dry scar are expected from the muscadine breeding program.

Culture. There will be many changes in grape production. First, will be improved herbicides for weed control and more effective substances for insect and disease control. Improvement in the integrated pest management for grape problems is expected. Spray and fertilizer programs geared for improved yields will also be developed.

Second, improvements will be made in irrigation, and low energy consumption, low water use, low-volume irrigation systems will be used. The choice of trellising will continue to be dictated by the harvesting method chosen and vine pruning will be adapted for mechanical harvesting.

Handling and Harvesting. Use of growth regulators as harvest aids and for improved fruit set are expected. While the U-pick vineyards are here to stay, improved harvesting and handling technology will encourage grower harvested fruit for various other outlets. There will be a mesh of mechanization, trellising and pruning practices to facilitate the overall harvesting operations. The use of chemicals for improved abscission of grapes will be seen along with other improvements in the handling process (i.e., density separation of green vs. mature grapes). Reliable cold storage between vine and marketplace will increase the shelf-life of present or newly developed varieties.

Processing and Utilization. There should be wide regional availability of at least several bunch and muscadine cultivars capable of making unique, appealing commercial white and red wines and improved enology practices to optimize cultivar quality. These varieties probably do not exist, except as desirable traits in germ plasm now or soon available. As is the case in traditional wine regions, there should be a range of stable color and flavor characteristics for both varietal and blended wines and, of course, continual testing, selection and introduction of cultivars.

In our opinion, these improvements need not be in the direction of increased vinifera character. The quality and versatility of Florida grapes can be enhanced and wine making procedures developed so that we need not imitate the successful wines produced elsewhere, although germ plasm contribution from major *Vitis* species will be welcome.

While relatively fresh (1 to 3 year) wines are our immediate and continuing practical goal, by 1990 we hope to be moving toward a few exceptional aged wines for the premium trade and perhaps distinctive carbonated and fortified wines as well—the type of products which will clearly say that Florida wines are coming of age.

In a similar sense, we hope to see a range of processed grape products—single strength canned juice, frozen concentrate, juice blends; condiments proudly bearing a Florida label; and flavorful raisins (from an efficient deseeding procedure, or seedless varieties).

A Note of Caution

"Florida . . . is destined to become a great grower of grapes . . . Large acreages will be planted and the grape crop of Florida will be one of the big crops of the State in the near future . . .

The industry has reached the point where it is safe, for all the problems of land types, varieties, locations, methods of pruning, trellising and spraying have been worked out, at least to the point where the proposition is a commercial success."

This opinion was voiced prematurely 54 years ago at the 39th meeting of this Society (26). We share some of the same optimism, tempered by the benefit of hindsight and the knowledge of the magnitude of the task. Will we feel differently in 1990?

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