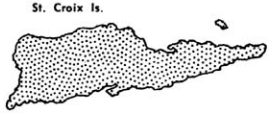
Virgin Islands
Agricultural Experiment Station
Report No. 10
April 1977

PROSPECTS FOR
GROWING GRAPES
IN THE U. S. VIRGIN ISLANDS



College of the Virgin Islands
Virgin Islands Agricultural Experiment Station
Darshan S. Padda, Director
St. Croix, U. S. Virgin Islands

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In the U.S. Virgin Islands

By G. A. Cahoon [1] and D. S. Padda [2]

This study is a part of the continuous effort by the Virgin Islands Agricultural Experiment Station to determine the agricultural enterprises, both plant and animal, that have economic potential in the Virgin Islands.

The grape, in some of its many species, hybrids and races, is grown over the greater part of the world except in regions of extreme cold. Grape growing is the world's biggest fruit industry (25 million acres). Grapes are grown widely wherever climate and soil permit. Over 8000 varieties have been named and described. Since the genus Vitis, with two sub-genera (Euvitis and Muscadinia) are grown in many areas of the world but primarily in the subtropical and temperate regions, considerable doubt existed as to the possibilities and limitations for production under the tropical environment of the U.S. Virgin Islands. There was a feeling among the Virgin Islands agriculture community that a cash crop such as grapes could greatly benefit the agriculture program of the islands. Therefore, the senior author was invited to visit the Virgin Islands in November, 1975 to help investigate the feasibility of grape production in the island. This report represents some of the available information and observations on which to base the best possible decision.

HISTORICAL BACKGROUND

In previous years, the U.S. Virgin Islands, especially St. Croix, produced considerably more food than it does today. At present a substantial effort is being made to increase local agricultural production; however, extensive acreages of good agricultural land are not available. Thus, St. Croix, St. Thomas, and St. John are all major importers of most food crops. As a typical example, 66,000 pounds of fresh grapes were shipped into the Virgin Islands during 1972 (12). This was only .7 pounds per capita as compared to 3.2 pounds for the United States. Retail prices received for these grapes frequently exceed $1.00 per pound, but the quality of grapes available in the Virgin Islands market is far inferior to that of mainland markets. An average price in a mid-western supermarket for the same type of grapes of better quality would be $ .40 – $ .80 per pound. All of these factors, it was felt, might make grapes a favorable crop to consider as the Virgin Islands Agricultural Experiment Station searched for new crops. The presence of many land holders with small acreages of land, submarginal by agronomic standards, is an additional incentive for considering the more intensive crops such as grapes, with high cash income possibilities (12).

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Fig. 1 Arbor of Mr. & Mrs. Jose A. Encarnacion, St. Croix. Clusters and berries are large. Grape is seeded and dark blue.

PRESENT GRAPE PRODUCTION

A limited survey of the islands, surprisingly enough, did result in the location of four individuals who had fruiting grape vines. They were: (Fig. 1, 2, 3) Mr. Jose A. Encarnacion and Cyril A. Garvey of St. Croix, Dr. Walter Phillips of Water Isle, St. Thomas, and Joseph Aubain of St. Thomas. A more detailed survey would probably find others.

Examination of the vines and fruit at these locations indicated that two had similar foliage while the others were definitely different (Figs. 4 and 5). There were also indications that grapes have been grown here intermittently by several individuals over a period of many years. Continuous production by a single individual for many years was not confirmed, however, it was noted that Moravian missionaries had an arbor near (presently a dairy and ice cream parlor) Christiansted, St. Croix at a much earlier date. Attempts at growing grapes had also been made many years earlier by McKinzie in the area of Estate Fountain Valley. Many varieties of grapes were tested for six years and successful grapes were raised, however, the exact data on the comparison performance of definite varieties are not available.

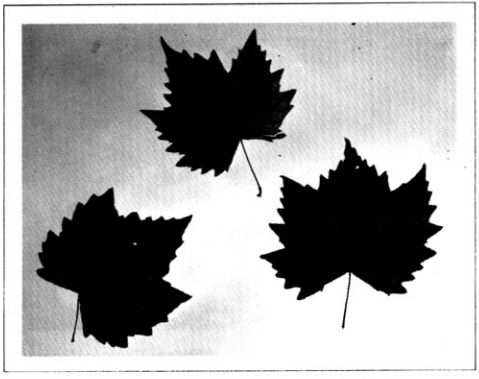
SOILS

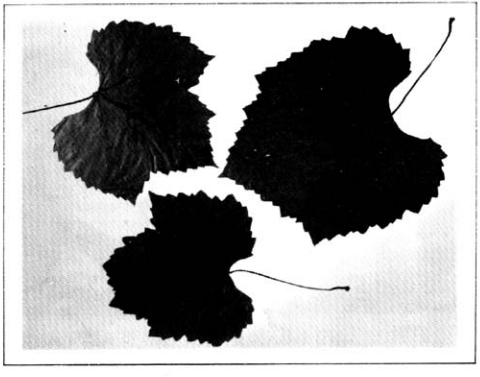
A recent soil survey (11) most aptly describes the terrain of the islands.

"St. Croix, the largest island of the Virgin Island group, is the most easterly possession of the United States and is approximately 100 miles south-southwest of San Juan, Puerto Rico. It is approximately 22 miles long and 6 miles wide (Fig. 6). There are approximately 54,400 acres of land area. St. Thomas is about 40 miles north of St. Croix and is 12 miles long and 3 miles wide, covering approxi-

Fig. 2. Arbor of Mr. & Mrs. Cyril A. Garvey, St. Croix. Clusters and berries are seeded, medium in size and dark blue.

Fig. 3 Commissioner of Agriculture, Mr. Oscar E. Henry, Dr. Walter H. Phillips, and Dr. Darshan S. Padda, examining a shoot from a grape vine grown at the Water Isle Botanical Gardens, St. Thomas.





Figs. 4 & 5 Comparisons of the two major leaf forms found in Virgin Islands.

mately 19,000 acres. St. John, 2 miles east of St. Thomas, is about 7 miles long and 3 miles wide and has approximately 12,000 acres."

"The island of St. Croix is characterized by a mountainous area in the north flanked by a rolling plain to the south. The mountains are broken by many narrow, steep-sided valleys through which intermittent streams discharge in southerly and southeasterly courses across the plain. Few deeply cut streams flow directly westward. Mount Eagle, the highest peak on St. Croix, is 1,165 feet above sea level. The eastern end of the island is mountainous also, but the elevation is not so high and the stream valleys are not so sharply incised."

"St. Thomas and St. John are characterized by irregular coastlines, numerous bays, steep slopes, and small drainage areas. For the most part, the topography is mountainous. Coastal plains are almost completely absent. There are no permanent streams or rivers. Intermittent streams discharge into the sea, but on their way form narrow, nearly level alluvial fans and terraces. Crown Mountain, the highest peak on St. Thomas, is 1,500 feet above sea level. Bordeaux Mountain, the highest peak on St. John, is 1,277 feet above sea level.

Seven major soil associations make up the land mass (7). They are: (1) descalabrado-jacana; (2) Aguilita-Fredensborg-Sion; (3) Fraternidad-Aguirre-Glynn; (4) Southgate-Parasol; (5) Cramer-Isaac; (6) Dorothea-Victory-Magens; and (7) Cornhill-Coamo-San Anton Associations. In general, most of the soils can be characterized as being steep and shallow, with gravelly or stony sub-soils (13). Soils such as the Aguilita series have limestone or marl in their profile. Several others are mixed with volcanic rocks.

Of the groupings listed, it would appear that soils such as the Fredensborg and Sion Series might be best adapted to grape culture. However, it should be pointed out that on small acreages, moderate slope steepness and even shallowness over rock might be satisfactory depending on the permeability and condition of the subsoil. Soft limestone or volcanic subsoils may not be a disadvantage judging by some of the rather famous grape growing areas of the world. Clay soils that are poorly drained should be avoided.

It should be emphasized that the soils are somewhat an unknown quantity at this point, since adequate on-site investigation was not given to the various soil types. Further investigations will have to determine the relative merits and limitations of the Virgin Island soil groups. It must be concluded at this point, however, that with most of the vegetation observed on the islands, cultivated or native, chlorosis, nutritional deficiencies, or other major abnormalities were not prevalent, indicating that with the wide adaptability of grapes the present soil conditions on the islands should not be the major deterrent to grape culture. Grapes are grown throughout the world on a wide range of soil types; from gravelly sands to clays and from shallow to deep, high fertility soils. Soil pH's range from 4.5 to 8.5. Varietal preferences are much more selective and will be discussed later.

Internal soil drainage and the associated soil aeration are extremely important factors in grape production. Not only can they limit production by physiologically reducing growth, but are frequently associated with disease problems. In many temperate areas of the world with moderate rainfall, irrigation is generally not needed, but good internal drainage is important to maintain adequate soil aeration. In the more arid areas of the world, good drainage is necessary to prevent accumulation of salts in the soil profile resulting from irrigation. This is especially important if the water contains high concentrations of salt. Most of the soil types in the seven associations were listed as having some well-drained series. Thus, soil drainage does not appear to be a major problem.

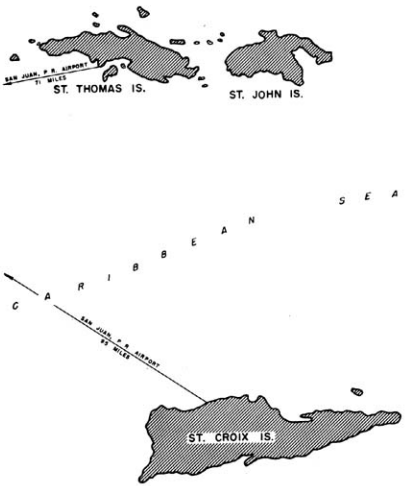


Fig. 6 The location of the U.S. Virgin Islands of St. Croix, St. Thomas and St. John in reference to one another and to Puerto Rico.

VARIETAL ADAPTATION AND ROOTSTOCKS

The genus *Vitis* has two subgenera: *Euvitis* and *Muscadinia. Vitis vinifera* species is by far the most popular and produces over 90% of the worlds grapes. *Vitis rotundifolia* is the best example of *Muscadinia.* As a general statement, cultivated grapes of the species *Vitis vinifera* are more tolerant to soils with high pH and lime content than many of the others, especially *Vitis labrusca.* Vinifera grapes are frequently more deep rooted than labrusca varieties, but soil types have much to do in regulating these characteristics. Rootstocks have done much to bridge the growing environment between species. They can also increase adaptability and/or resistance to nematodes, phylloxera, poor soil drainage, etc. However, the native habitat of either of these species is the warm temperate zone between 30° and 40° and not the tropics (23° north and south of equator).

A grape breeding program has been conducted in Florida and North Carolina for several years by J.A. Mortensen (4, 5) and W.B. Nesbitt (8). Several varieties of bunch grapes (sub-genus Euvitis) that are adapted to the sub-tropical areas and resistant to a virus known as Pierce's disease have been developed.

Similarly, new varieties of *Vitis rotundifolia* (sub-genus Muscadinia) that are native to the southeastern United States have been developed. Recommended varieties for trial include: Dixie, Carlos, Magnolia, Fry, Higgans, Welder, Noble, Hunt, Coward, Chief, Southland and Bountiful (8). Muscadine varieties are also available from other experiment stations and private nurseries in Georgia, Mississippi, and North Carolina (6). In India, Randhawa and Bammi (1) have reported that species of *Vitis vinifera* have been grown successfully in the tropical conditions of southern India around Poona, Bangalore, and Hyderbad. Thus, it is evident from such work that varieties and cultural practices adapted toward the tropics are being grown.

It was mentioned earlier that four residents of Virgin Islands had been visited who were growing grapes. The varieties being produced were not readily identified. Mr. Jose Encarnacion of St. Croix stated that his grape vines had been obtained from Mr. John Martin as Concord grapes and Mr. Martin had in turn imported his original vine from the sister Caribbean Island, St. Martin. The origin and variety names of the other vines of Dr. Walter Phillips and Cyril Garvey have also not been determined. However, they appear to be identical (Figs. 4 and 5) and very well adapted to Virgin Island conditions.

Experimental work on vinifera grapes at the Estacion Experimental Agricola, Rio Piedras, Puerto Rico, by Mr. Justo Lopez Garcia (3) was observed (Fig. 7, 8). The varieties Exotic, Ribier, Fortuna, Roja, and Fortuna Blanca, were performing satisfactorily in this southern coastal climate. Vigor and uneven ripening were some of the problems encountered. It was stated that some wild (native) varieties existed in the area, but they had not been collected and identified.

CLIMATE

Temperature: Since grapes have a rather wide range of soil adaptability, the major question in evaluating the potential for grape production in this area is temperature, rainfall, humidity, and related environmental conditions. As shown by Table 1, the maximum seasonal variation in temperature in the Virgin Islands is only 6°F. Similarly, the average diurnal fluctuations (day to night) are about 13°F (9). Such seasonal variations are small compared to most sub-tropical and temperate regions. Table 2 shows a comparison of temperature variations between some of the recognized grape areas in the world. These

Figs. 7 & 8 Grape vineyard at Estacion Experimental Agricola, Rio Piedras, Puerto Rico. Pictured are Mr. Justo Lopez Garcia, Horticulturist with Dr. Darshan S. Padda (top) and Dr. Garth A. Cahoon (bottom).

areas also represent extremes in climate and latitude for grape production. One of the areas most similar to the Virgin Islands that produces grapes is the Bangalore region of India. Yet, even here the seasonal variation is approximately 12 degrees (1).

From all available information, the lowest temperatures are insufficient to satisfy the rest period of most commercial varieties. However, there is evidence to indicate that *V. vinifera* grapes, when placed under moisture stress and this moisture stress is coordinated with pruning, girdling, or defoliation, can induce flowering (1). Also, as discussed in the previous section there are grape varieties, such as *Vitis munsoniana* and *rotundifolia,* that require a minimal amount of low temperature chilling (5). Some of these including bunch grapes (sub-genus Euvitis), have been recommended for production in Florida. Experimental work being carried on with *Vitis vinifera* at the Subestacion-de fortuna in Puerto Rico is of interest in this regard (3).

Rainfall: As mentioned in the previous section, moisture for adequate production is a major necessity to consider in determining the potential for grape production in an area. This can be provided as rainfall, irrigation from ponds, lakes, rivers or wells. According to Martin J. Bowden, et al. (2) rainfall is a factor limiting the production of most agricultural crops on St. Croix. As shown by Fig. 9, annual rainfall ranges from 25 to 55 inches per year for various parts of the island. Differences from year to year are also extremely variable (Fig. 10).

Monthly rainfall variations as shown by Figs. 11 and 12 indicate that the months of September, October and November are wettest while February, March and April are the driest. According to the procedures used, moisture deficit months (those months in which moisture losses by evaporation, transpiration, etc., exceed precipitation) are generally much greater than months with a moisture surplus. Anna's hope was the only station of the six in the study that had the water deficit removed for three consecutive months during an average year.

IRRIGATION

Water from wells, lakes, streams, etc., are a means whereby crops can be irrigated during moisture deficient months to increase production. Such possibilities on St. Croix and St. Thomas appear to be minimal, especially when urban and municipal needs of the people are considered. However, there are other possibilities such as the re-cycling of municipal sewage water (14) or the surface consolidation of water (accumulating the runoff from a larger watershed area in order to supply a more limited acreage) (13) that are being explored or exploited. Use of trickle irrigation to maximize water application efficiency is readily adaptable to grape culture and should receive consideration.

DISEASES AND INSECTS

From the limited study conducted on the grapes found in the Virgin Islands and in Puerto Rico, disease does not appear to be a major limiting factor. In fact, the primary diseases of grapes, such as the mildews, black rot, anthracnose, botrytis, etc., are not well adapted to these climatic conditions. Rainfall during the ripening period usually produces more problems than high temperature conditions. Pierce's and other similar virus diseases, nematodes, and phylloxera would be more suspect problems under the tropical climatic conditions of the islands. Any study to be undertaken in the future should be initiated, as far as possible, with disease (including viruses) and insect-free plant material.

TABLE 1. – Maximum and Minimum Mean Monthly Temperatures at St. Croix, U. S. Virgin Islands (Degrees F.).

Month	Mean Daily Maximum	Mean Daily Minimum
January	83.1	70.0
February	83.2	70.0
March	84.3	70.7
April	85.6	72.5
May	86.4	74.3
June	87.8	75.7
July	88.0	75.8
August	88.5	75.7
September	88.1	75.0
October	87.6	74.8
November	85.9	73.3
December	84.3	71.7

TABLE 2. – Mean Monthly Temperatures (Degrees F.) for Several Grape Growing Areas of the World and St. Croix, V.I.

Location	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Hyderbad, In.	70.9	75.0	81.3	86.0	88.0	83.0	78.0	77.2	77.1	77.0	72.1	69.1
St. Croix, VI	76.0	75.9	76.4	80.0	79.2	80.4	80.8	81.0	80.5	79.6	78.2	76.7
Algiers, Alg.	54.0	55.0	57.5	61.5	66.0	71.5	71.5	78.0	75.0	68.5	61.0	55.5
Davis, Calif.	44.5	48.8	52.1	57.2	63.1	70.0	74.6	73.2	69.2	61.4	52.1	45.0
Fresno, Calif.	45.3	49.8	54.0	60.4	67.3	73.9	80.6	78.3	73.8	64.2	53.4	45.7
Bordeau, Fr.	41.5	44.0	48.5	55.5	59.0	66.0	70.5	70.0	66.5	57.0	48.5	43.0
Trier, Germany	33.6	34.7	42.6	48.9	56.7	63.2	65.3	63.7	57.7	48.4	40.8	37.0
Wooster, Oh.	27.0	27.8	37.3	48.2	58.4	67.6	71.5	69.7	63.5	52.0	40.3	30.0

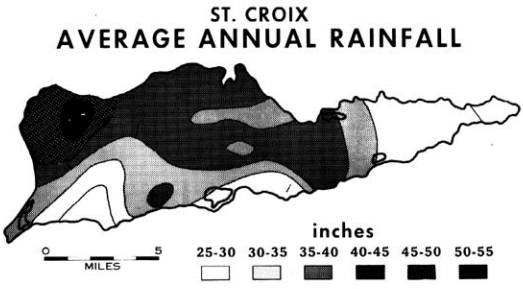
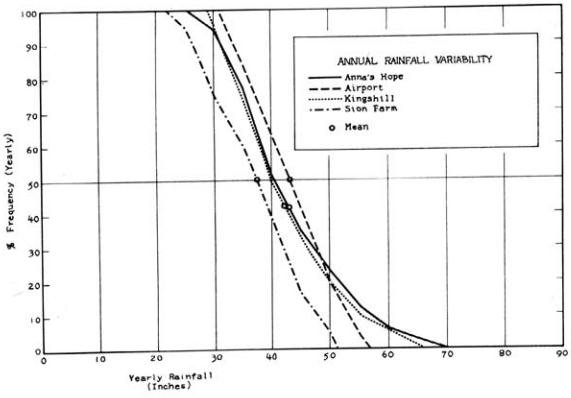


Fig. 9 Annual average rainfall on the island of St. Croix. (Reproduced from the publication "Water Balance of a Dry Island") (2).



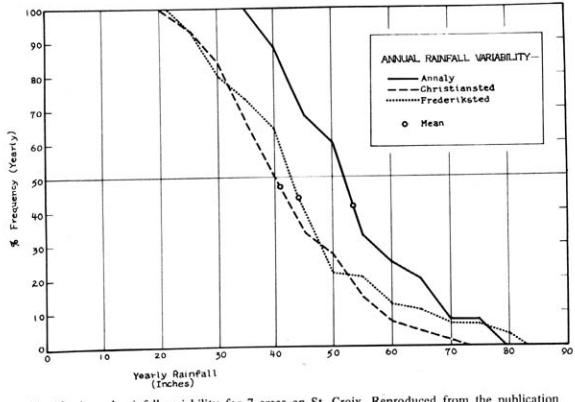


Fig. 10 Annual rainfall variability for 7 areas on St. Croix. Reproduced from the publication "Water Balance of a Dry Island" (2).

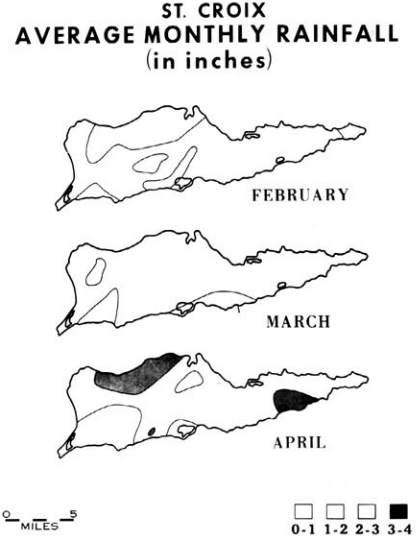


Fig. 11 Monthly average rainfall (in inches) on St. Croix for the 3 driest months (Feb., Mar., Apr.). Reproduced from the publication "Water Balance of a Dry Island" (2).

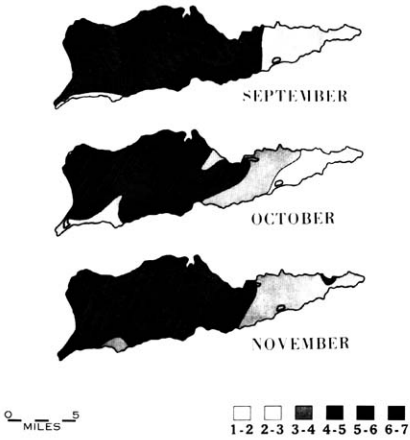


Fig. 12 Monthly average rainfall (in inches) on St. Croix, for the 3 wettest months (Sept., Oct., Nov.). Reproduced from the publication "Water Balance of a Dry Island" (2).

DISCUSSION AND RECOMMENDATIONS

A review of most of the factors involved in the production of grapes has been presented. This has included soils, topography, climate, (temperatures, relative humidity, rainfall) irrigation, varieties, insects, diseases, and a brief history of island grape production. The relative importance of these factors, from the authors' point of view, has been discussed and can hopefully be used to help determine whether commercial grape production should be attempted in the Virgin Islands.

The fact that temperatures are so uniform throughout the year (6° maximum fluctuation) is undoubtedly the greatest single factor against the feasibility for grape production. Yet, in at least two tropical areas of the world, southern India and Brazil, not one but two crops of grapes are being produced per year (10). To accomplish this the vines are manipulated both by cultural practices and taking advantage of weather conditions. It has been shown that moisture stress within the vine, resulting from low rainfall, or withholding irrigation water, can be used to a degree to compensate for low temperatures. Pruning and foliage removal followed by the application of water (irrigation and/or rainfall) can be used to induce flowering. A step by step procedure would be as follows: (1) withhold water until the soil is dry and the vine is under stress; (2) prune the vine and remove foliage, then; (3) apply water to the soil. Resumption of growth and flowering will usually result.

The question exists as to whether two such periods can be used in the Virgin Islands and will it be necessary to correlate both pruning periods with moisture instead of temperature changes. Two examples were found on St. Croix which indicates that this procedure might be possible. Mr. Jose Encarnacion pruned his vines approximately every 6 months. The vines appeared to respond with flowers and a crop each time. Any research program that might be attempted would need to investigate the relationship between time of pruning, crop yield and maturity.

There is no doubt that certain varieties will respond much more readily than others to the previous scheme and the climate of the islands. Vinifera varieties for example, adapted to the subtropical regions of the world, should respond more favorably than labrusca cultivars. Muscadine grapes (*Vitis muscadinia*) as a group are more adapted to warm climates than either vinifera or labrusca, except that they differ in character from the traditional bunch type grapes. Crosses between vinifera and muscadinia are also available (5 and 8).

An experiment being conducted in Puerto Rico at the Subestacion De Fortuna has shown that some of the more traditional vinifera table grape varieties will produce moderately well (3). Lack of vigor and uneven ripening have been one of their major problems indicating poor climatic adaptability. The vines planted in 1964 on their own roots would appear to be growing with high populations of soil nematodes and perhaps even phylloxera. Girdling has been used to facilitate fruit maturation. It is possible that such chemicals as Alar, Ethephon, gibberellic acid or others could also be used to increase return bloom and fruit set. It was their practice to prune only once a year, during the second week of January, and harvest the crop the second week of May.

Observation of the vines of Walter Phillips of Water Isle, St. Thomas and Cyril Garvey of St. Croix indicated that there is a selection of grapes very well adapted to island soil and climatic conditions. Whether or not this grape is native has not been determined. Cuttings of these vines were gathered and are being propagated at the Virgin Island Agricultural Experiment Station on St. Croix. It is recommended that in any investigation attempted

this selection be grown on its own roots as well as used as a rootstock to test other selected cultivars.

Most recorded literature on the subject of growing grapes in the tropics indicates that the vines lack longivity (short lived). It is difficult to determine whether this is due to soil insects and disease or physiological causes. Any experimental investigations should determine the potential problems of phylloxera, nematodes, Pierce's disease, and others.

Soils and topography offer some limitations, but relatively speaking, they are less doubtful factors than climate (temperature and moisture). It would appear most logical in terms of the present agricultural situation, if grapes were grown, that many small plantings be distributed over the island in the most favorable locations and soils rather than large commercial plantings. This would fit most logically with the present size of land holdings. Since foliage and fruit diseases such as downey and powdery mildew, Botritis, or Black rot do appear to be the major problems that are in the high humidity areas of the midwest and eastern United States, small plantings would be possible on the islands.

Equipment costs are a limiting factor to small plantings under high disease conditions. This presumably would have the potential to supplement the income of many individuals who would receive the direct benefit from a cash crop rather than create jobs for a limited number. Also, since an acreage of suitable land does not exist in large parcels, the best use of the land would be met by using the small land holdings.

Further, grapes could possibly be grown in small plots on slopes that would not be commercially feasible. Water for irrigation might also best be obtained for small plantings distributed over the islands. As discussed previously, this water might come from reclaimed sources, wells, ponds, etc. Trickle irrigation could also be used to make the most efficient use of available moisture.

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