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The economic geography of the Ridge and Highlands citrus district of Florida

Earl M. Neel

To the Graduate Council:

I am submitting herewith a dissertation written by Earl M. Neel entitled "The economic geography of the Ridge and Highlands citrus district of Florida." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Geology.

Loyal Durand Jr., Major Professor

We have read this dissertation and recommend its acceptance:

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

July 18, 1963

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We have read this dissertation and recommend its acceptance:

Charles L. Cleland

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Hilton A. Smith
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THE ECONOMIC GEOGRAPHY OF THE RIDGE AND HIGHLANDS CITRUS DISTRICT OF FLORIDA

A Dissertation

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

by

Earl M. Neel

August, 1963

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CHAPTER I

INTRODUCTION

Florida ranks first among states in the United States in the annual production of oranges, grapefruit, and limes; and the state enjoys a similiar leading position in orange and grapefruit production among all the other citrus producing regions of the world.[1] In the 1958-59 citrus season Florida growers produced approximately 65 per cent of the commercial orange crop of the United States, or about one-quarter of the entire world supply, and Florida grapefruit production represented over 81 per cent of the United States crop, or almost three-quarters of the world total (Table I).

The commercial production of citrus fruits ranks as one of the major economic activities within the state of Florida. The annual income from citrus fruit production is second only to that of the tourist industry and is first among the several agricultural pursuits engaged in throughout the state. In 1959, the total value derived from the production of all agricultural commodities produced in Florida was 824.8 million dollars. During the 1958-59 season the income from citrus fruits accounted for approximately 42 per cent of that amount, or 347.8 million dollars. The income from vegetable crops ranked

[1]Florida, Department of Agriculture, Marketing Bureau, Annual Agricultural Statistical Summary, 1958-59 (Jacksonville: Florida State Marketing Bureau, 1959), p. 27.

TABLE I

WORLD CITRUS PRODUCTION, 1958-59

in Thousands of Boxes

Political Unit	Oranges	Grapefruit	Lemons	Limes
United States	133,000	43,400	17,000	200
Florida	86,000	35,200		
Spain	44,720		1,450	
Brazil	22,500			
Italy	26,770		11,600	
Japan	26,790			
Argentina	22,960	940	2,520	
Mexico	19,530			2,370
Algeria	8,000			
Egypt	8,400			1,100
Israel	14,200	1,720		
French Morocco	11,500			
South Africa	8,700	460		
Greece	6,490		1,660	
Cuba	2,250	200		
Jamaica		310		
Trinidad		1,000		
Turkey			1,390	
World Total	337,220	49,080	39,350	3,670

Source: Florida, Department of Agriculture, Marketing Bureau, Annual Agricultural Statistical Summary, 1958-59, p. 27.

second in value in Florida, 153.1 million dollars; livestock production was third at 84.0 million dollars.[2]

Most of the commercial orange and grapefruit production is concentrated in the middle peninsular section of the state. In this central area of Florida three fruit growing districts can be delimited on the basis of (1) location, (2) physical relationships to climate, and (3) quantity of production. The three major areas of production include the Tampa Bay District of the West Gulf Coast, The Indian River District of the East Atlantic Coast, and the Ridge and Highlands District of the interior (Figure 1). Both the Indian River and the Tampa Bay Districts have localized on terrain of relatively low elevation and relief. The moderating effects of the large water bodies these two districts parallel provide natural frost protection in winter. The Ridge and Highlands District has localized on the gently rolling uplands of the interior in respect to the natural frost protection provided by slope and cold air drainage, and somewhat by the moderating effects of lakes.

The Ridge and Highlands Citrus District, hereafter referred to as The Ridge and Highlands, is the most intensive area of citrus production, and is by far the most significant economically of the three districts. The Ridge and Highlands annually accounts for approximately 84 per cent of the combined citrus fruit production in Florida. The

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[2] _Ibid._, p. 5.

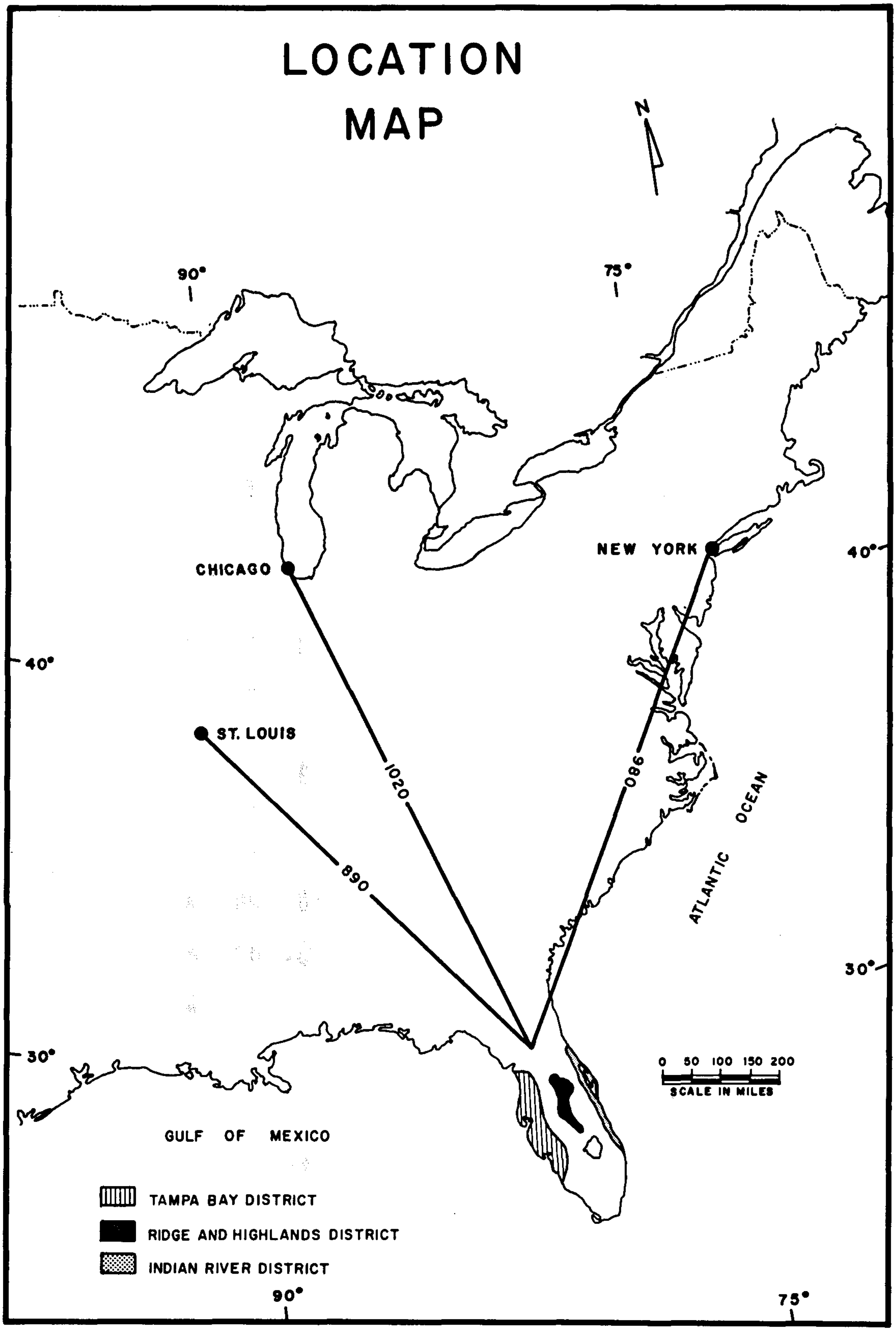

Figure 1. Location Map.

three core counties of the district, Polk, Lake, and Orange, alone account for 64 per cent of the orange production in the state and 63 per cent of Florida's grapefruit production.[3]

The Ridge and Highlands is an excellent example of regional specialization. Citrus trees dominate the landscape of the uplands, and the outcome of each year's fruit crop equally dominates the thoughts and actions of the individuals within this district. The concern for a prosperous citrus economy is restricted not only to the citrus growers and processors of the area. It is of equal concern to those persons engaged in wholesale and retail pursuits, who are not directly related to the citrus industry yet are almost entirely dependent upon it. The development of the citrus industry has been synonymous to the development of Central Florida. Tourism, livestock ranching, vegetable production, and other agricultural occupations are of less relative economic importance here.

The citrus landscape of The Ridge and Highlands in Florida extends almost uninterrupted over 140 miles from north to south through the peninsular portion of the state, approximately midway between the coastlines of the Gulf of Mexico and the Atlantic Ocean. Throughout its length the width of the citrus district varies locally from one to seventeen miles (Figure 2). The citrus district is located primarily in

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[3]U. S. Department of Agriculture, 1954 Census of Agriculture Vol. I, Part 18 (Washington: U. S. Government Printing Office, 1955) pp. 127-145.

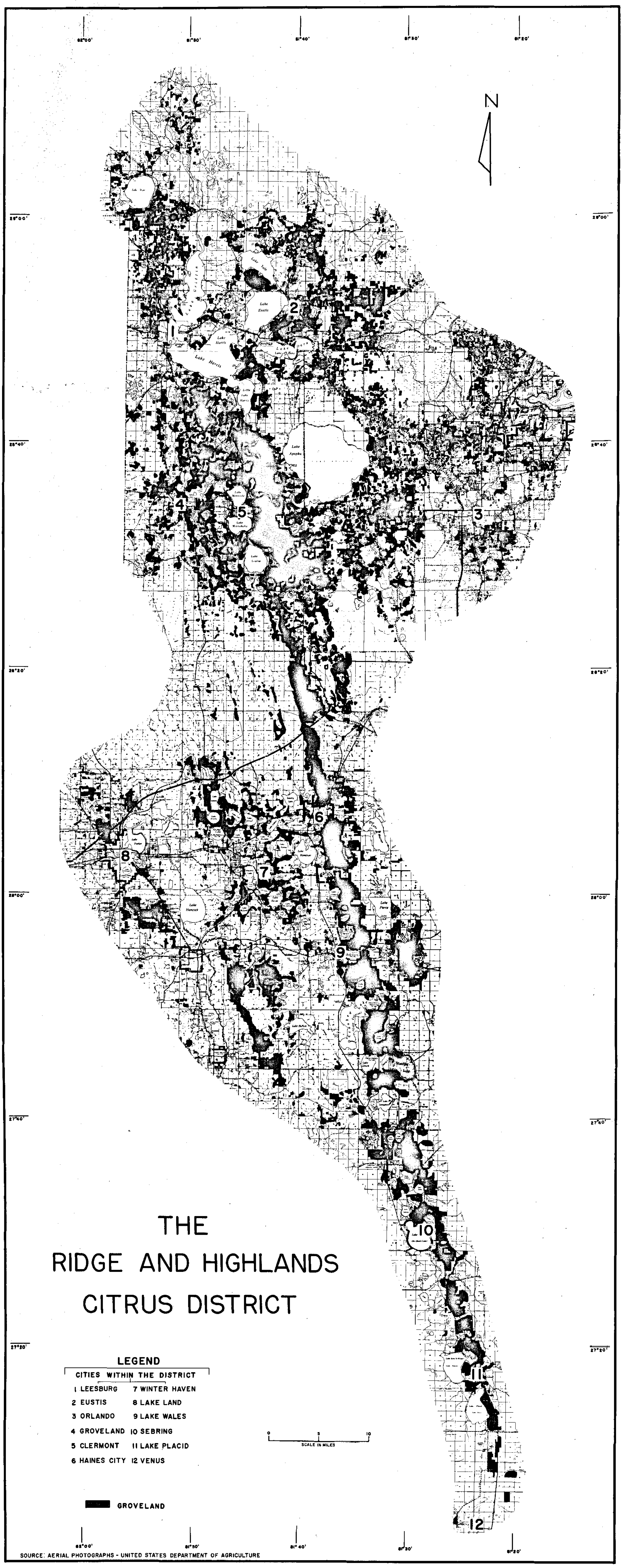

Figure 2. The Ridge and Highlands Citrus District.

Polk, Lake, and Orange counties of Florida, yet also includes small areas of Marion, Seminole, Osceola, and Highlands counties of the state (Figure 3).

Delimitation of The Ridge and Highlands can be made in relation to several significant geographic phenomena which approximately correspond to the areal extent of the groveland in the district. First, the sixty degree January isotherm marks the extreme poleward boundary of concentrated citrus production in this central portion of Florida. Like other major citrus growing areas of the northern hemisphere the central Florida district is located as close to its major market region as is climatically possible, yet unlike the other world producing areas the Florida district occurs farther equatorward. Most of the other northern hemisphere citrus producing areas, owing to mountain barriers, are not as subject to the non-periodic incursions of cold air masses as the Florida area, and these other world districts have localized immediately south of the fifty degree January isotherm.

Second, almost without exception groves planted in this section of central Florida are located near or above the one hundred foot contour line in elevation.

Finally, the majority of the groveland in the citrus district is underlain by one geologic formation. Land throughout The Ridge and Highlands which contains clays of this formation within twelve feet of the surface is premium groveland.

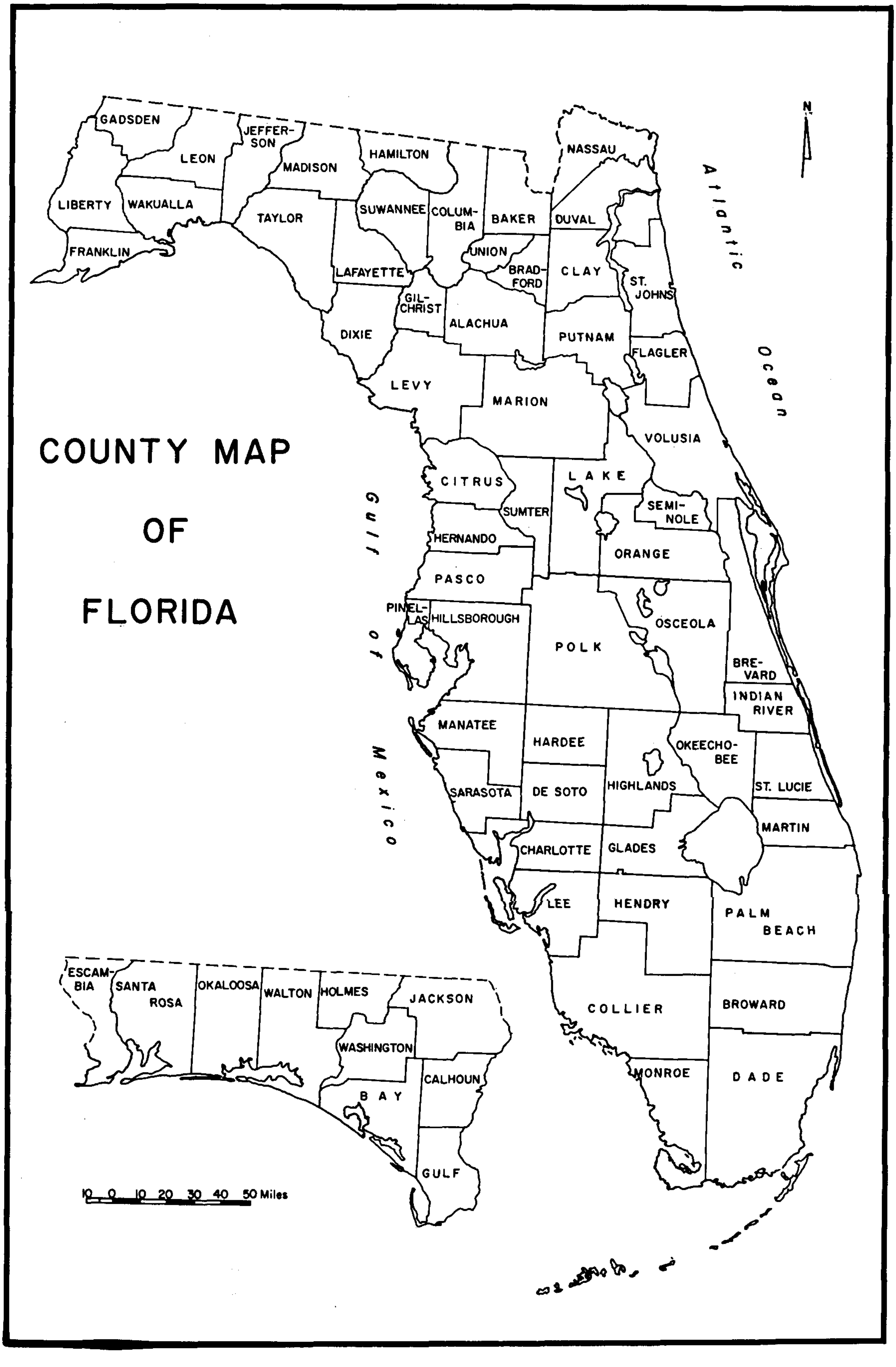

Figure 3. Location Map of Florida.

CHAPTER II

WORLD CITRUS REGIONS

The present location of world regions which specialize in commercial citrus production has been the result of numerous diverse, yet interrelated factors. The botanical characteristics of commercial citrus plants, the climate and soil requirements for growing marketable fruit, the historical spread and development of the citrus culture, the economic considerations in producing, transporting, and marketing citrus fruit, plus the technological advances in all phases of the citrus industry are several of the more important considerations which together have acted to delineate and intensify the areas of citrus production of today.

The major commercial citrus fruits of world significance include, ranked in order of relative importance by value, the orange, lemon, and grapefruit. Commercial citrus fruits of relative minor importance include the lime, tangerine, citron, and kumquat, mandarin, and pomelo. In examining the localization factors of commercial citrus regions major emphasis will necessarily be confined for the most part to two of the more important citrus fruits, the orange and grapefruit. Lemon production, however important elsewhere in the world, is absent from the Florida scene, and therefore is not relevant in a general investigation to be related to citrus culture in The Ridge and Highlands of Florida. Although the lemon shares many characteristics in common with the orange and grapefruit, such as botanical and economic,

the climatic requirement has restricted commercial lemon production to protected areas of the dry-subtropical climatic realm. The lemon is more susceptible to frost damage than the orange and grapefruit. Though the lemon was once produced in Florida, repeated losses due to frost damage and disease discouraged continuance in production. Then too, the soft, exceedingly juicy fruit produced in the humid subtropics of Florida had never gained wide acceptance in the commercial market regions of the world. The firm lemon with a more concentrated juice that is grown in the dry-subtropical climatic realm, as found in California and Mediterranean Europe, has long enjoyed preferential market acceptance.

I. COMMERCIAL CITRUS FRUITS--CHARACTERISTICS AND REQUIREMENTS

The citrus fruits are tropical broadleaf evergreen shrubs or small trees of the Rutaceae family, major genus Citrus. In total there are about fourteen species of Citrus, and genera that have been segregated from it. Among the more important commercial species of orange and grapefruit are the sweet orange (Citrus sinensis), sour orange (Citrus aurantium), king orange (Citrus nobilis), and grapefruit (Citrus maxima var. uvacarpa). Also the commercial species each have several varieties, such as the mandarins and tangerines (Citrus noblis var. deliciosa).[1]

In most world commercial citrus regions the orange and grapefruit trees are generally pruned to a height of less than thirty feet

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[1]For a more complete discussion of varieties see page 62.

to facilitate picking. The feeder root system is now known to extend within the soil down to a maximum depth of seventeen feet. A rather unusual characteristic of citrus plants is the fact that they do not develop root hairs. As a consequence the plants rely upon mycorrhiza (fungi), which are closely associated with the roots, for the absorption of liquids. The leaves of citrus trees are evergreen. The fruit has a thick rind (exocarp) with numerous oil glands. The flesh (endocarp) is juicy, and when peeled can readily be segmented into numerous juice sacs.[2] As a tropical perennial a tree can have both fruit and flowers at the same time.

All the citrus fruits contain considerable amounts of vitamin C, the antiscorbutic vitamin, as well as fruit acids and sugars. The rind yields a valuable essential oil. Oranges and grapefruit have long been popular table fruits; now they are marketed also in juice form, canned, and concentrated as well. Marmalade, confections, alcoholic and non-alcholic beverages, canned fruit sections, and chilled citrus salad are some of the many additional varied products of the citrus industries today.

The optimum conditions for the growth of citrus fruit trees are a temperature regime between 68° F. and 86° F., a rainfall regime of seventy-five to ninety inches, and well-drained soils. The limiting conditions to the commercial production of citrus fruits are the

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[2]Albert F. Hill, Economic Botany (New York: McGraw-Hill Book Company, Inc., 1937), pp. 429-435.

temperatures at which the fruit will freeze and the lowest temperature that citrus trees can endure for several days without dying. In general the critical low temperature for the fruit of the orange or grapefruit is 27°-28° F.; the killing temperatures for the orange or grapefruit is 19°-20° F., but the temperatures must exist for a day or two at one time. Actually, however, the production of a fruit which is most acceptable in the commercial markets of the world is enhanced by the non-periodic occurrences of almost freezing temperatures in the marginal tropical-subtropical climatic transition regions of the world. Owing to the cooler winter temperatures experienced in these fringe regions of the humid subtropics, dry subtropics, and desert realms the fruit of the citrus tree has a thinner rind with a greater amount of flesh, plus a higher ratio of sugars to acids than the fruit grown in the true tropics. To the contrary citrus trees in commercial production cannot tolerate an extended cool season or mild summer because the trees remain dormant so long that they produce very little fruit. There is no tree growth when temperatures average below 50° F. Likewise, tree growth is imperceptible when the temperature is above 95° F., although citrus trees can withstand temperatures as high as 125° F. As far as the water requirement for the commercial fruit production of citrus an annual rainfall of at least fifty inches is considered a minimum amount, and that precipitation figure must show a distribution of at least two inches in every month.[3]

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[3] E. A. Ackerman, "Influences of Climate on the Cultivation of Citrus Fruits," Geographical Review, XXVIII (1938), pp. 289-296.

The latter monthly requirement is necessary to prevent a loss of fruit. In order to meet these minimum water requirements irrigation is necessary in the dry (desert) and periodically dry (dry-subtropical) climatic realms. Today irrigation is used by some growers in the commercial regions of the humid subtropics during nonperiodic droughts in order to prevent a loss of one season's fruit crop. With temperature and water requirements satisfied citrus can be grown on any well-drained soil. Citrus trees cannot withstand waterlogged soils, but can be grown on a wide variety of soils ranging from acid to alkaline and from very light sands to heavy clays. Likewise, relative fertility is inconsequential insofar as usability is concerned.[4]

II. HISTORICAL ORIGIN AND SPREAD OF THE CITRUS CULTURE

The citrus fruits are all thought to be indigenous to the subtropical and tropical monsoon lands of southern China and southeast Asia, where some have possibly been cultivated for over three thousand years. Through the centuries the citrus culture has slowly spread from the region of its origin in Asia to the other world realms. Most citrus species have followed a similar route, though centuries apart, from southeastern Asia, to the Middle East, and from there to Europe, having been carried by Persians, Arab traders, and the crusaders. Finally

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[4]A. F. Camp, et. al, Citrus Industry of Florida, Florida State Department of Agriculture, Bulletin No. 2 (Tallahassee, Florida: Florida State Department of Agriculture, 1960), p. 21.

during the age of exploration the fruits were taken from Europe to the colonies of the New World, Africa, and Australia.[5]

The introduction of citrus fruits to the Americas was the indirect result of the beginning of the age of exploration. Columbus brought the first citrus fruits from the island of Gomera in the Canary Islands to Isabella, Hispaniola (Haiti) on his second voyage in 1493. After 1505 the Casa de Contratacion, organized in Spain for the purpose of promoting the exchange of products and supplies between the Old World and the New, was largely responsible for the spread of citrus fruits wherever the Spanish established colonies in the West Indies, Central America, the continent of North America, and South America during the 16th and 17th centuries. In the southeastern United States original Spanish plantings by 1577 reached from Florida to as far north as Santa Elena Island (Parris Island, South Carolina).[6] Later citrus fruits were introduced into California from Mexico in the early 1700's.[7]

III. COMMERCIAL REGIONS

The principal commercial citrus regions today are found in many of the areas of historical dissemination, but not the regions of origin.

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[5]Herbert John Webber (ed.), The Citrus Industry, Vol. I (Berkely, California: University of California Press, 1948, pp. 1-25.

[6]Ibid.

[7]Loyal Durand, Jr., Economic Geography (New York: Thomas Y. Crowell, 1961), p. 65.

The countries of Europe, North Africa, and the Middle East which margin the Mediterranean Sea; the Gulf States, California, and Arizona of the United States; Brazil, Argentina, and Mexico in Latin America; plus Japan, the Union of South Africa, and Australia together account for the bulk of the world's commercial citrus production.

The United States is the world leader among individual countries in the production of oranges, grapefruit, and lemons. In the production of limes the United States must necessarily relinquish first position to Mexico. The lime, not tolerant of frost, is limited to the true tropics. The only wet tropical climate in the conterminous United States, the tropical Savanna of the southern tip of Florida, has localized a small lime producing district located to the west of Miami. In the Mediterranean Sea region Spain is the major producer of oranges followed, in order, by Italy, Israel, and French Morocco. The separate orange production of Japan, Argentina, and Brazil is on a par with that of Italy. Italy (Sicily) ranks second to the United States in lemon production; far above other producing nations (Table I).

The present major commercial regions of citrus production were localized in the past in respect to two primary geographic influences; they are (1) the locational relationship of the areas of production to the principal market regions, as related to (2) a climate in the areas of production which would allow economic gain in the long run. The two major market regions for citrus fruits in the world are found in western Europe and the northeastern quarter of the United States. Prior to the

advent of rapid rail transportation and refrigeration facilities (about 1868) the movement of citrus fruits from producer to consumer was by slow overland or water transportation, and the fruit of this early period was necessarily consumed in fresh form. Also, the demand for fresh citrus was highly seasonal; the Thanksgiving and Christmas holidays were the peak periods for marketing the fruit.

The commercial cultivators of citrus fruits tended to locate in areas as close to the market regions as possible during the early periods of development. Most of the sub-tropical regions in the northern hemisphere which produce citrus for the European and United States markets share a similar location in respect to winter temperatures. In general, these producing areas are limited or bounded poleward by the cold month isotherm of 50° F. The citrus region of the southeastern United States including districts in Florida, Louisiana, and Texas is the major exception to the rule. All of the northern hemisphere citrus regions experience minimum cold months temperatures of freezing or below. However, the southeastern United States, lacking an east-west land barrier poleward, is more open to the penetration of cold air masses from the north, and thus more susceptible to minimum temperatures. As a consequence citrus growing in the Gulf region has been limited poleward by the 60° F. January isotherm. Early fruit growers in these citrus regions of the world, where non-periodic frosts are liable, found commercial production was economically feasible only if a very destructive freeze is experienced but once in every twelve to fifteen years.[8]

[8]Ackerman, op. cit. pp. 289-292.

Evidently, losses sustained in the short run owing to the freezing temperatures of the one year could be offset in the long run by the production of non-frost years. Growers in these regions have tried to provide additional insurance protection against losses from frost damage in these areas of somewhat marginal climates by planting groves on the warmer slopes above depressions to take advantage of cold air drainage and by using artificial means of climate control, such as the heating of groves with oil heaters.

The major commercial citrus regions of the world, once established, have, particularly in the past half century, greatly intensified through increases in planting and production. Expansion in the established commercial citrus regions has been the result of the successive introduction of new technologies, together with an increasing demand for citrus fruit products in the world market regions. First, the progressive realization of improved technologies such as rapid rail transportation, refrigeration facilities, canning, and quick freezing has enabled citrus producing regions to quickly place and sustain a supply of the many varied forms of a relatively high quality product at the market place. Meanwhile, continuing increases in market demand have extended the consumption from the traditional holiday period to throughout the year. While the technological advances certainly have made possible the increases in consumption, the increase in the demand, itself, has no doubt been stimulated by (1) the discovery of the value of vitamin C in citrus, (2) the dietary changes of western man which

favor a greater consumption of fruits and vegetables, (3) the increased product variation within the citrus industry, and (4) advertising.[9] To what degree each of these is responsible for increasing the consumption of citrus products would indeed be difficult to evaluate. In any case the realization of an almost daily need for citrus fruits, either real or imaginary has resulted in a rapid rise in the production of citrus products in most of the major commercial citrus regions in the world.

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[9]Durand, op. cit., pp. 63-64.

CHAPTER III

TOPOGRAPHY

The name, "Ridge and Highlands," used to describe the central Florida citrus region is somewhat misleading, physiographically. The district is located in the Floridian Section of the Atlantic and Gulf Coastal Plain, and generally corresponds to the limestone solution Lake District of the state.[1] Relative relief throughout the area is nowhere greater than 183 feet. Thus, the area presents a karst plain surface which is level to gently undulating, not the least rugged when compared to other, more formidable, landform regions in the United States. However, within peninsular Florida the terms Ridge and Highlands are used by the inhabitants of the area and are actually quite applicable in describing variations in the immediate surrounding physical landscape.

There are two major contrasting landform divisions in peninsular Florida. One is an almost level flat plain surface, locally called the flatwoods. The other, the Ridge and Highlands, is a discontinuous, gently rolling, pock-marked surface which rises above the general level of the flat plain. Cooke broadly recognizes these two different types of topography in his physiographic classification of the peninsular portion of the state.[2] They are: (1) the Central Highlands, which

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[1]Nevin M. Fenneman, Physiography of Eastern United States (New York: McGraw-Hill Book Company, Inc., 1938), p. 53.

[2]C. Wythe Cooke, Geology of Florida, Florida Geological Survey, Florida Department of Conservation, Geological Bulletin No. 29 (Tampa: Florida Growers Press, 1945), pp. 8-13.

extend along the northwest-southeast trending axis of the state; and, (2) the Atlantic and Gulf Coastal Lowlands, which together surround the former landform region (Figure 4).[3] Through examination, these two contrasting types of surface, highland and lowland, can be observed within the Central Highlands in the particular part of the state where the citrus district has localized.

There are several distinct separate highland areas which rise above the flat plain surface in the citrus district. The so-called Ridge of the Ridge and Highlands is the highest and most continuous highland in the district. It extends to the southeast from Lake Harris through Lake County, includes the small northwest section of Osceola County, continues throughout the length of Polk County, and on into Highlands County where it terminates near Venus, a total distance of 124 miles. The other highlands areas are not as continuous; collectively, they parallel the northwest-southeast trend of the Ridge. In Polk County there is a highland area east of the Ridge, one immediately west of the Ridge in the vicinity of Winter Haven, and another further west surrounding Lakeland. Two other highlands in Polk County occur south of the Lakeland and Winter Haven Highlands, respectively. Likewise, four highlands are located west of the Ridge in Lake County, although there they are more closely spaced. Similarly, two highlands extend east of the Ridge from southern Lake County into neighboring Orange

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[3]The Lowlands of Cooke generally correspond to Fenneman's East Florida Flatwoods and the Flatwoods and Hammock Lands of the Gulf Coast.

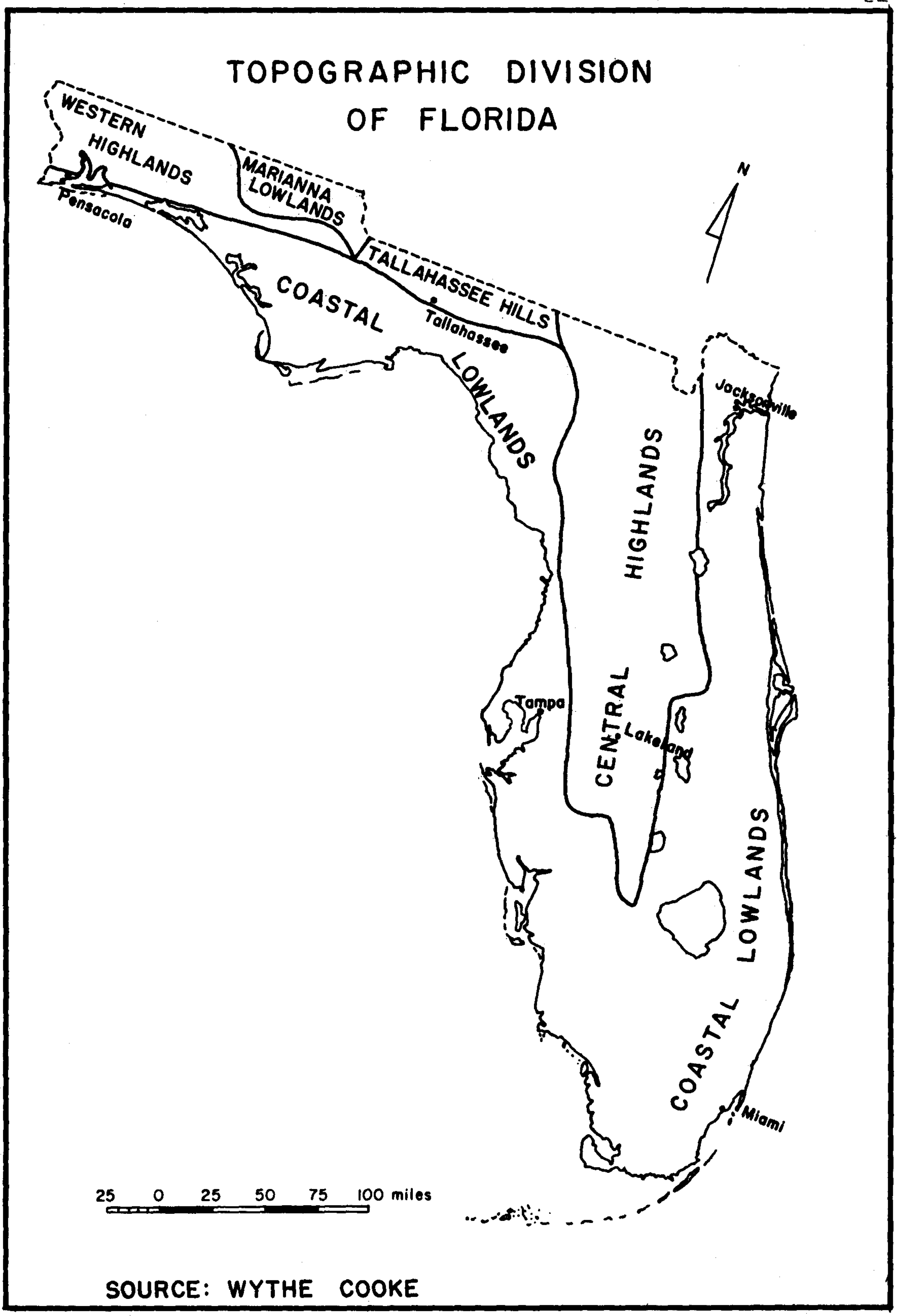

Figure 4. Topographic Division of Florida.

County toward Orlando; and another pair are located to the north around Eustis and Sorrento. Finally, another highland is located northwest of the Ridge extending from Leeburg in Lake County into southern Marion County, and from there continues northward out of the citrus district (Figure 2).

Throughout its length the Ridge generally stands above the adjacent highlands to the west and to the east. For example, the highest point of the entire citrus district, in fact, the whole of peninsular Florida, is found in Polk County north of Lake Wales in the Ridge at an elevation of 295 feet above sea level. The higher elevations found throughout the Ridge in Polk average at least above 250 feet. By comparison, the average maximum heights found in the several highlands of Polk County are approximately 180 feet. To the north in Lake and Orange Counties a comparison of the Ridge with the highland areas has similar relationships in maximum elevations, approximately 200 feet to 125 feet, respectively. Notably, the Ridge and the Highlands are somewhat lower in elevation in that northern area. To the south of Polk County, in Highlands County, the Ridge continues alone. The maximum elevations decline gradually to about 170 feet near Sebring and to 125 feet near Lake Placid (Figure 2).

The relative relief throughout the Ridge and Highlands is never excessive. The following sample locations support this statement. In the Ridge at Lake Wales the maximum and minimum elevations are 295 feet and 112 feet, respectively, or a relative relief of 183 feet. Near

Frostproof, south of Lake Wales in the Ridge, the maximum elevation is 175 feet, the minimum elevation seventy-eight feet, the relative relief ninety-seven feet. At the common corner of Polk, Lake, Orange, and Osceola counties, in the Ridge north of Lake Wales, the difference between a maximum elevation of 255 feet and a minimum elevation of 110 feet produces a relative relief of 145 feet. The relative relief is usually somewhat less in the several highland areas. The relief near Winter Haven in fifty-two feet, near Eustis seventy-five feet, around Fruitland Park fifty feet (Figure 2).

The gently undulating surface of the upland landscape in the citrus district is characteristically expressed throughout the area in the form of low, rounded, sandy hills and shallow concave basins. Many of the depressions contain permanent lakes. Most of the slopes are gentle. Steeper slopes, from fifteen to twenty-five degrees, border a few of the lakes. Often two or more adjacent lakes have coalesced. Other lakes which share a common narrow land divide have been connected by way of an artificial channel, and in some areas form a chain of lakes. On the whole surface drainage is almost entirely lacking. A few small surface streams do occur, but these streams usually disappear into a lake or sink. The majority of the precipitation that falls in the region runs off rapidly into the many lakes,or sinks into the sandy covering of the hills. In either case the water eventually reaches the underlying solution channels, and moves through and out of this karst region as sub-surface drainage.

The four main geologic formations involved in the topographic development of this section of central Florida are: (1) the Ocala (Eocene) limestone, (2) the Hawthorne (Miocene) formation, (3) the Citronelle (Plio-Pliestocene) formation, and (4) the Marine terraces (Pliestocene).[4] The subdued contrasts of this rather unique karst plain are primarily the result of three major influences: (1) the occurence of soluble rocks, (2) the materials covering a buried soluble stratum, and (3) the elevation above sea level in either present or past time.[5]

The Ocala limestone, an almost pure limestone formation, is the most extensive rock stratum underlying the citrus district. In fact, the Ocala formation is present throughout Florida. This limestone formation lies about 115 feet above sea level in Marion County in the vicinity of the Ocala uplift. From this point, just to the north of the citrus district, the Ocala limestone dips to the south beneath the district at the rate of about five feet per mile. At Auburndale the Ocala limestone lies about 160 feet beneath the surface.[6] Near Venus the formation occurs at almost 500 feet below sea level.

The Miocene Hawthorne formation, another major stratum throughout the entire state, overlies the Ocala limestone unconformably in the

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[4]Cooke, op. cit., pp. 3-13.

[5]Fenneman, op. cit., p. 46.

[6]Cooke, op. cit., p. 4.

citrus district. The Hawthorne is more diverse in composition than the Ocala formation. Primarily, the Hawthorne is found as a sandstone stratum, which, upon exposure, weathers rapidly into sand. Yet, in restricted areas it is composed of limestone.

The Citronelle formation overlies the Hawthorne throughout most of the area of the citrus district (Figure 5). The major exception is the Lakeland Highland. The Citronelle is composed of sand, gravel, and clay. Most of the sand and gravel is red or orange, and the clay, where mixed with sand or gravel is usually iron-stained. The maximum thickness of the Citronelle is unknown, but is thought to be from 250 feet to 340 feet.[7]

The Pliestocene terraces, overlying the Citronelle formation, complete the geölogic framework in central Florida. Only three terraces, the Brandywine, the Coharie, and the Sunderland, are found in this highland section of the state. The former shorelines of the Pliestocene seas have never been completely traced and correlated in Florida. Possibly, the irregular contour of the pitted surface has impeded such an investigation. However, Cooke has defined a seaward boundary for each of the terraces. The boundaries in Florida correspond in elevation to the terraces identified in the Sea Island Section and the southern sector of the Embayed Section of the Atlantic Coastal Plain by Fenneman.[8]

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[7] Ibid., pp. 229-237.

[8] Fenneman, op. cit., p. 27.

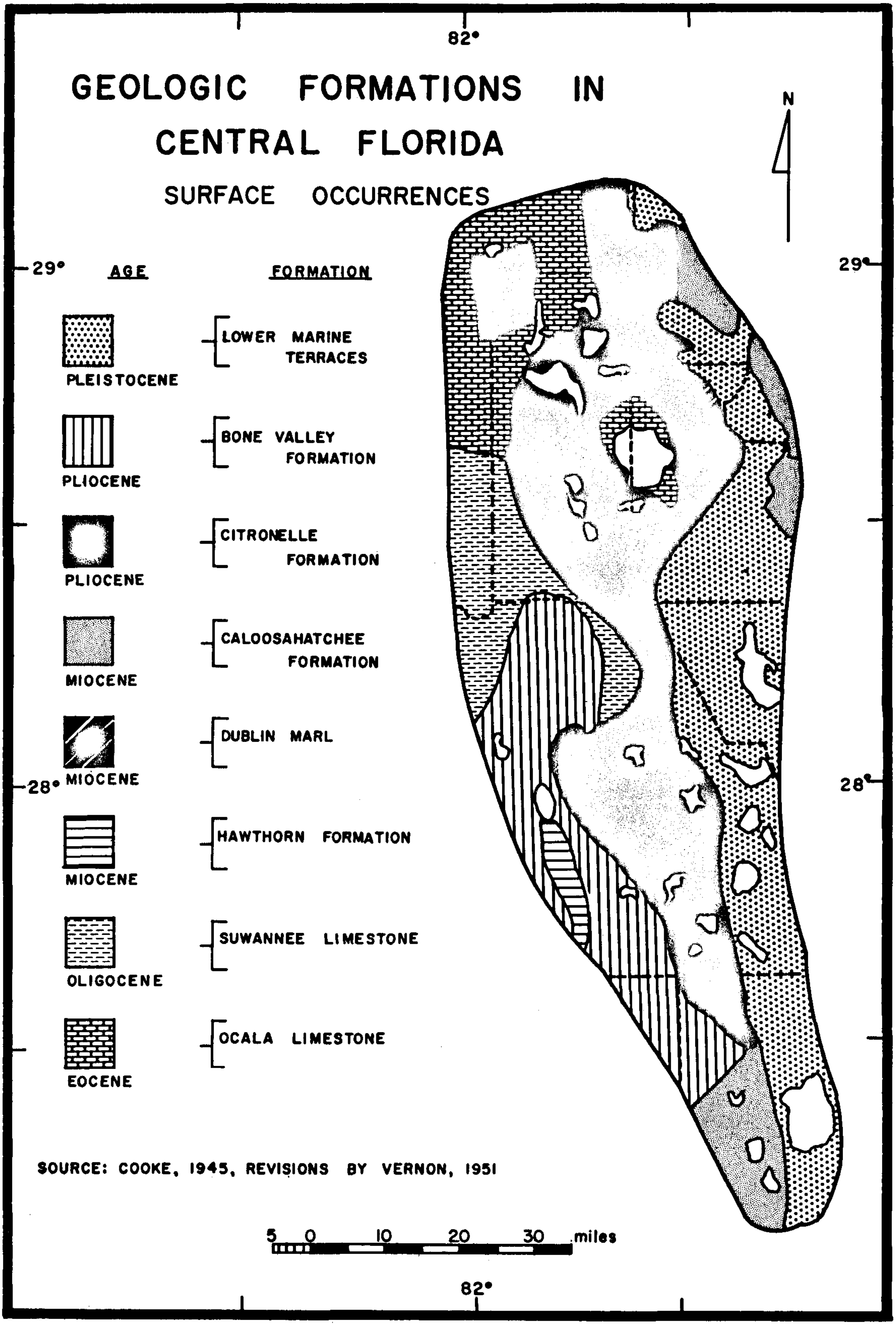

Figure 5. Geologic Formations in Central Florida.

The shorelines, so far as they have been traced, are essentially horizontal. All deformation of geologic strata in central Florida seems to have occured before the Pliestocene epochs. Figure 6 indicates the surface extent of the three Pliestocene terraces. Notably, the younger and lower Sunderland terrace, sand and clay, is bounded at its outer margin by the 100-foot contour line, and has the most extensive surface of the three terraces. The Brandywine terrace, predominately sandy, lies on either the Citronelle or Hawthorne formations, and is overlain by younger Pliestocene terraces, except where it is exposed (surface elevation over 215 feet). The Coharie terrace, also sandy, is intermediate in position between the Brandywine and the younger Sunderland. The present exposures of the Brandywine and the Coharie terraces were probably islands in the Sunderland sea. The maximum thickness of each of the three individual terraces is everywhere less than fifty feet.

The solution features of the landscape in central Florida are primarily associated with the Ocala limestone. Secondarily, the Hawthorne formation, where composed of limestone, accounts for some sinks. The Ocala limestone, if exposed, makes a flat surface. Throughout the rolling highland surface of the citrus district the sandy materials of the Hawthorne formation, the Citronelle formation, and the Pliestocene terraces, all being more resistant to erosion than the limestone of the Ocala formation or the Hawthorne formation, cap the hills, and thus, account for the differences in relief within the

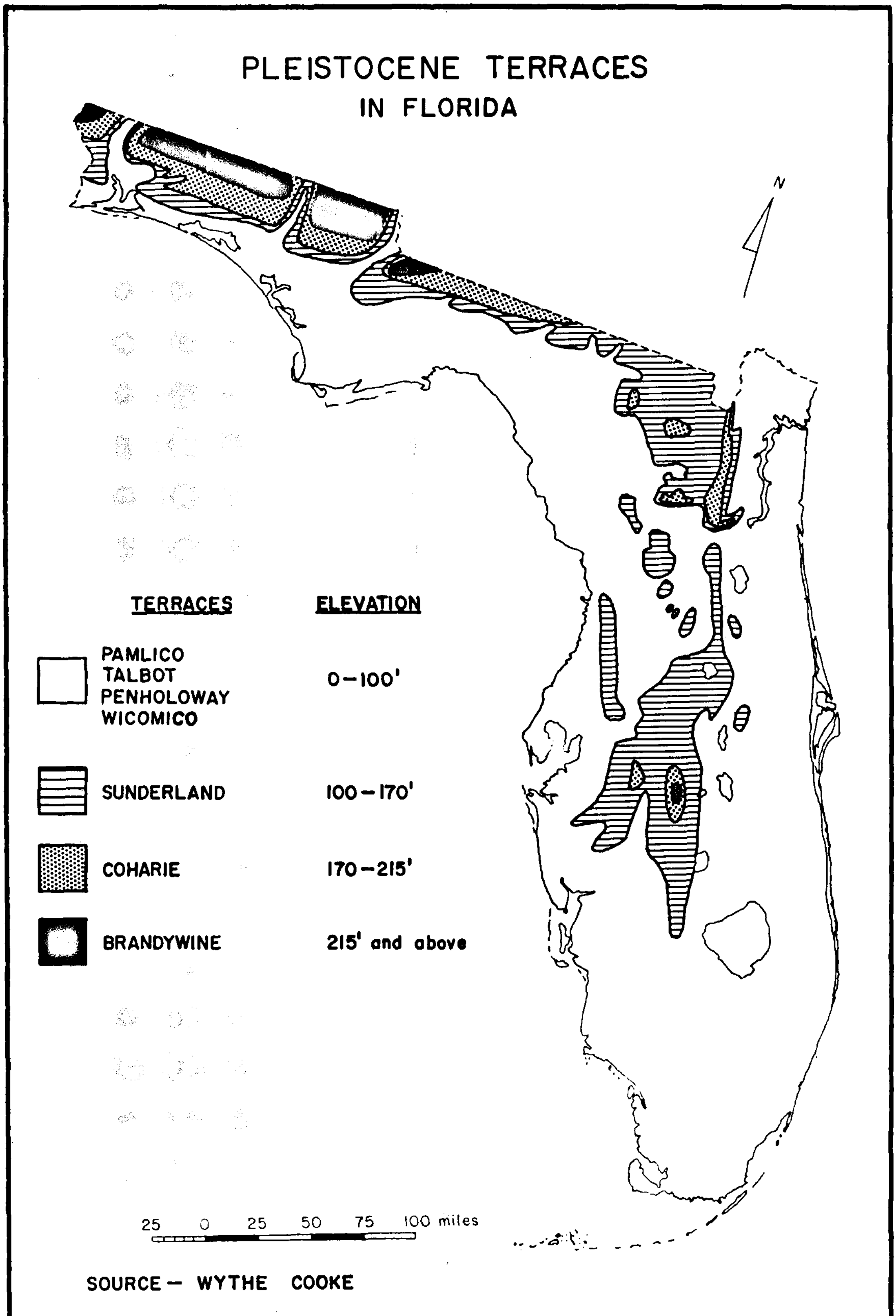

Figure 6. Pleistocene Terraces in Florida.

district. In the northern sector of the district, Lake County, where the Ocala limestone is not too deeply buried an intricate lacy pattern of innumerable shallow lakes occurs. Also, some larger deeper lakes like Lake Apopka and Lake Harris occur in this area. In this northern area all formations involved in the topographic development including the Ocala limestone are above sea level. Hence, the processes of solution are apparent today. The elevation above sea level and the pervious bedrock allow the free downward percolation of water. Present destruction of the surface by solution is evident. Southward through the citrus district the soluble strata (Ocala and Hawthorne) increasingly occur at greater depths. The solution sinks and lakes here are the result of a prior cycle of karst forming when the region was of higher elevation in respect to sea level than at the present time. In fact, successive oscillations in sea level in past time possibly caused several reactivations of the solution cycle in this karst district. Presently, a combination of the Citronelle formation and the Pleistocene terraces accounts for the elevation above sea level in most of the citrus district, certainly in the central and southern portions of the area (Polk and Highlands counties).

Perhaps the most peculiar feature of the district is that the circular depressions are found principally in the highlands rather than the lowlands. In explanation, White suggests the lowlands represent an area almost completely lowered by solution, whereas the highlands are underlain by former solution remnants which stood above the leveled

plain. The remnants were later covered with the sands of the Pliocene and Pliestocene seas. Reactivation of the old solution channels in these remnants has made the present depressions, which are now filled with the sands of the more recent formations.[9]

The intervening lowlands of the district occur everywhere in close juxtaposition to the mantle covering of the Ridge and Highlands. The lowlands, like the highlands of the district, are by no means continuous, nor are they restricted to only the lower elevations. To the contrary, lowlands are found at all levels of elevation throughout the area, and while some actually separate highlands, others are found within an individual highland area. Quite often the latter are expressed as small prairie flats, which are associated with lakes. The most distinctive characteristic of the lowlands is their tendency to be almost completely flat, and hence they present a very abrupt contrast to the proximate rolling upland surface.

The isolated hammock or low hill is a minor landform feature found within the area of the citrus district. Hammocks are actually small islands or minature highlands which rise above the general level of the flatwoods. The small hammocks owe their origin essentially to the same formations and processes which have shaped the larger highland areas.[10] The hammock lands differ from the highlands only in extent

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[9]William A. White, Some Geomorphic Features of Central Florida, Florida Geological Survey, Florida State Board of Conservation, Geological Bulletin No. 41 (Deland, Florida: E. O. Painter Printing Company, 1958), pp. 73-74

[10]Florida State Geological Survey, Twentieth Annual Report, 1927-1928 (St. Augustine, Florida: The Record Company, 1929), p. 191.

and relief. Many are only one to two acres in area, and rise but twenty-five to fifty feet above the level of the plain.

Several sluggish surface streams drain the lowlands of the district. The northeast is drained by tributaries of the St. Johns River, the southeast by tributaries of the Kissimmee River, the southwest by the Peace River, the west by the Hillborough River, and the northwest by the Withlacoochee.

CHAPTER IV

CLIMATE

Central peninsular Florida non-periodically lies within two different climatic realms, the Humid Subtropical and the Tropical Savanna (Koppen). The line drawn between the two climatic regions generally corresponds to an average position of the 64.4° F. January isotherm (Figure 7). However, location in the marginal, transitional boundary of both gives the peninsula a climate that is similar to, yet typical of neither of the broad climatic classifications. Thus, the climate of The Ridge and Highlands must necessarily be described as an entity unto itself.

In general, the average climate of the citrus district is characterized by hot, wet summers and mild, comparatively dry winters, although in every month at least 1.20 inches of precipitation is recorded on an average. The district lies between the January isotherms of 60° and 64° F., and July temperatures average from 81° to 83° F. throughout the area. The growing season is highly variable; the number of frost-free days range between 310 to 365 days annually. Hence, a killing frost is liable, though not forthcoming, annually. The maximum concentration of precipitation is during the summer season, and occurs in convectional rainshowers, thunderstorms of short duration. The minimum amount of rainfall occurs during the winter months and is

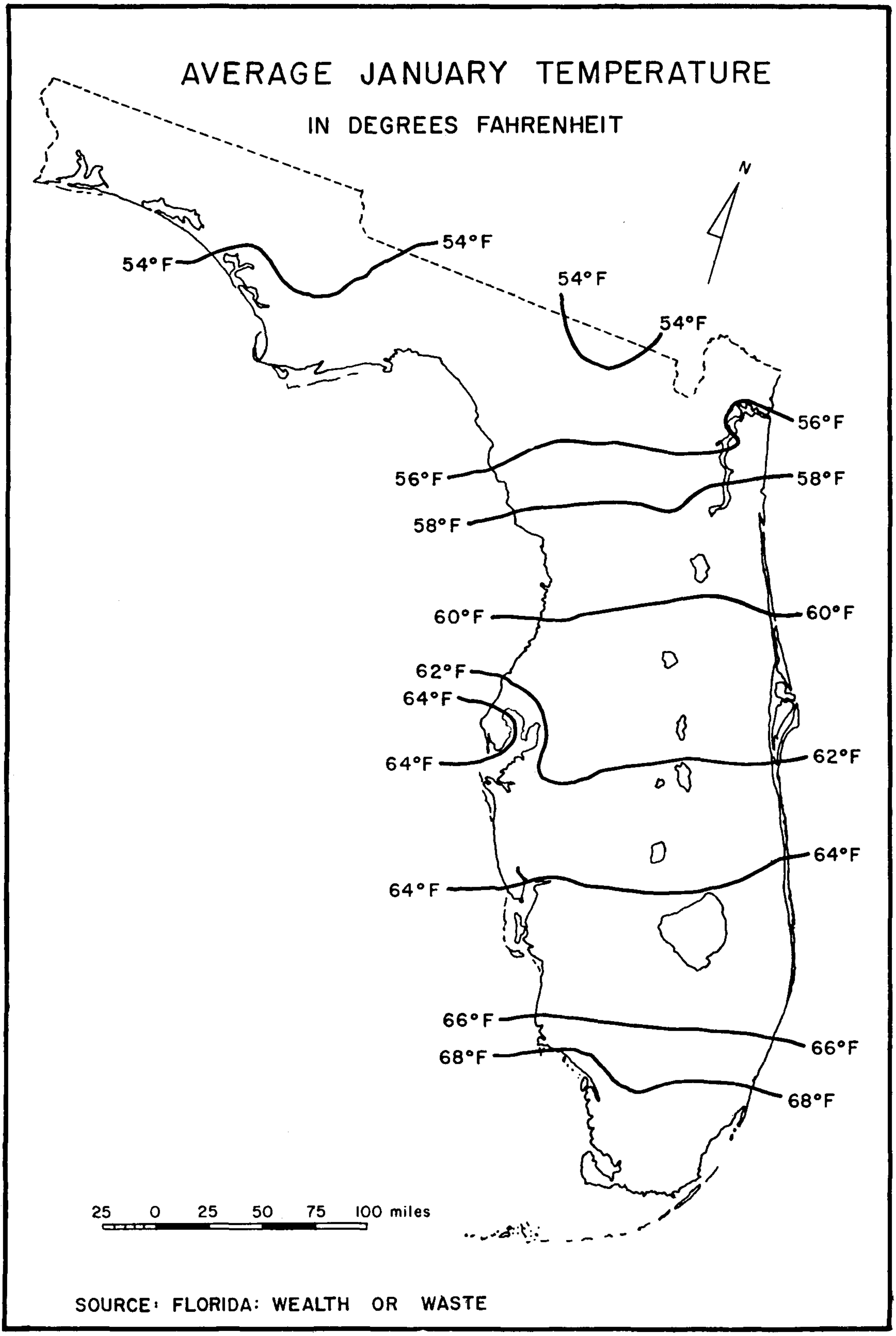

Figure 7. Average January Temperature.

frontal in origin.[1] Location of the region on the northern fringe of the tropical wind belt (easterlies) renders the citrus region subject to tropical storms (hurricanes).

These general climatic traits accentuate the transitional position of the district, reflecting characteristics of both the Humid Subtropical and Tropical Savanna climatic realms. For example, the distinctly drier low sun period is typical of the Tropical Savanna, yet on the average enough precipitation is recorded in every month to place the area in the Humid Subtropical realm. Likewise, the uncertain condition of a frost-free period from year to year demonstrates the intermediate position of the district, climatically. Actually, the climate boundary between the two major realms is an erratic, oscillating one; some years it can be defined as far north as Ocala.[2]

The data for the climatic station at Lake Alfred shows more specifically the month by month, as well as, the extreme seasonal variations in the annual climate (Figure 8). The Lake Alfred station is centrally located in the citrus district; other stations have only minor variations from the temperature and precipitation recordings registered at Lake Alfred. Relative uniformity in climate throughout the district is the result of several common causal factors. The

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[1]United States Department of Agriculture, Climate and Man, Yearbook of Agriculture: 1941 (Washington: Government Printing Office, 1941), pp. 809-810.

[2]Glenn T. Trewartha, An Introduction to Climate (New York: McGraw-Hill Book Company, Inc., 1954), p. 232.

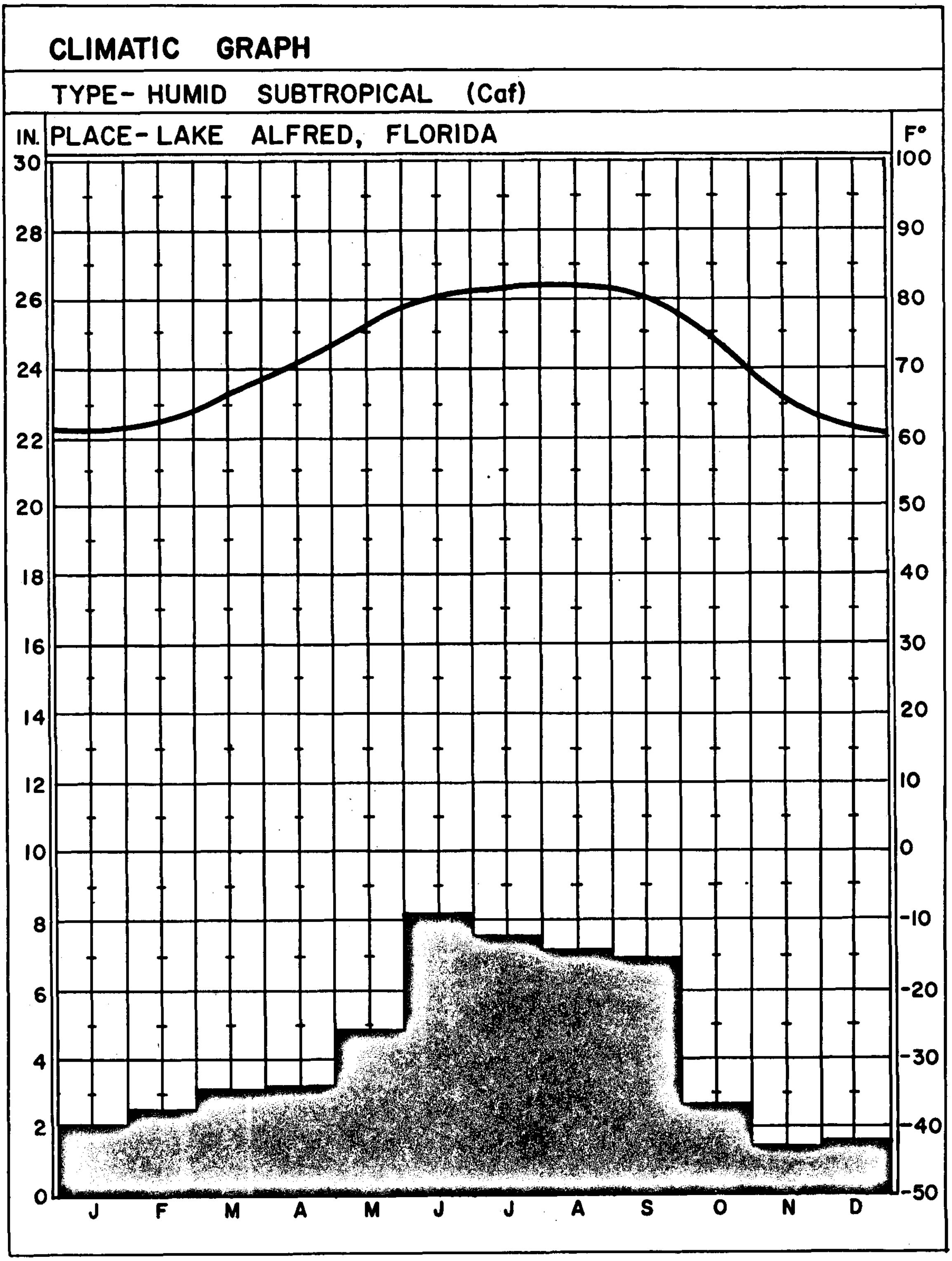

Figure 8. Climatic Graph--Lake Alfred, Florida.

entire district enjoys a similar location in respect to latitude (27° N to 29° N), thus an intermediate position between an influence from the low and middle latitudes, and an interior peninsula situation (no point is more than sixty miles from the open sea). Also the average elevation throughout the district is low. Temperature and precipitation differences from place to place within the district are primarily a result of local microclimates. However, there is a small latitudinal temperature gradient during the winter season: the progressive increase in temperatures is from north to south through the district.

The annual rainfall total in the citrus district is from forty-eight to fifty-five inches. Lake Alfred, the representative station, averages 51.14 inches yearly (Figure 8). At Lake Alfred over one-half of the annual rainfall (29.9 inches) is received in four months, June to September. If the rainfall of May and October is added, the six month period represents almost two thirds (37.30 inches) of the yearly total. The period from November to April is decidedly the dry season with only 13.84 inches of precipitation. There is, however, considerable variation from year to year in monthly receipts of rainfall. Some stations with long records show that totals in wetter years have been as much as double those of drier years.[3] The warm season rainfall comes in the form of convectional thundershowers which occur on an average of one-half the days at any given location. The showers are

[3]United States Department of Agriculture, op. cit., p. 818.

heavy downpours, but generally last only one or two hours. Hence, sunny days are prominent even during the so called rainy season. The rains are also local in nature; this fact accounts for a rather broad differentiation in rainfall totals from location to location within the district during any given season.

Occasional heavy (ten inches or more) and prolonged rains occur which are associated with tropical hurricanes. These storms usually originate in the Caribbean Sea from late summer to early autumn. As the hurricanes move northward either they pass over Florida, the Gulf of Mexico, or the Atlantic Ocean. In any case, the storms bring surplus amounts of precipitation to the citrus district. Since 1929, sixteen major hurricanes have crossed peninsular Florida; seven of these storms have passed through at least a portion of the citrus district.[4] The paths of these tropical storms vary from forty to seventy-five miles in width. The major damage to citrus areas in this district that have lain in the path of a hurricane has been with the winds (over 125 mph) rather than with flooding. The lakes, the sandy surface, and the solution channel subsurface of The Ridge and Highlands readily absorb the excessive rainfall. Other winds of high velocity occur occasionally in every season associated with the thunderstorms. These strong winds are short in duration and local in character. The

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[4]Warren O. Johnson, Winter Minimum Temperatures in Peninsular Florida, Federal-State Frost Warning Service, Weather Bureau, United States Department of Commerce (Lakeland, Florida: Federal-State Frost Warning Service, 1958), p. 70.

occurence of tornadoes is limited; only about two occur throughout the entire state in an average year.

During the cool season rainfall is associated with the importation of air masses and is cyclonic or frontal in origin. Rain occurs on an average of about one in four days.[5] The few foggy days that are experienced in the citrus district occur during the cool season. Approximately twelve to fourteen days of dense fog occur during the average cool season, and fogs generally are present only during the early morning hours.

Sometimes prolonged droughts of a month or more in duration are experienced in the area. The complete lack of rainfall during these dry spells is generally associated with an intensification of the subtropical Bermuda High over the Florida peninsula. These non-periodic droughts can occur at any time during the year, but usually occur in the spring or fall, particularly April and November during the seasons of transition from spring to summer with a predominance of sun control and autumn to winter with its cyclonic influence.

Typical of the citrus district, the warmest month temperatures of the Lake Alfred station average 82.4° F. A maximum of 103° F. has been recorded at this station, but this excessively high temperature is an exception to the rule. Generally, the afternoon thundershowers prevent a frequent occurence of extremely high temperatures

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[5]United States Department of Agriculture, loc. cit.

during the entire summer throughout this area. However, sensible temperatures are rather high, for the high temperatures of the summer are accompanied by equally high humidities.

The average January temperature in the citrus district ranges from approximately 60° to 63° F.; the Lake Alfred station records an average of 61.8° F. The average climatic statistics do not show the pertinent facts of the cool season weather which are so important to the citrus growers; they are the deviations from the norm. Location at the southeast corner of the North American land mass, and northern fringe of the subtropical wind belt, plus the absence of an east-west land barrier to the north renders the Florida peninsula subject to occasional importations of cold air with freezing temperatures. Peninsular location serves to moderate the winter temperatures as it does the summer temperatures, although the effect is realized principally along or near the coast. Coastal locations hardly ever have a freeze in the general latitude of the central citrus district. Generally, areas north of the 60° F. January isotherm are subject to frost annually, whereas areas south of the same isotherm are subject to an occasional frost. For example, Jacksonville, north Florida, in a forty-eight year period of record had only three years free of freezing temperatures, yet only eight had over ten days of freezing temperatures. Locations in the latitude of the citrus district of Central Florida in a forty year period of record had only one-half of the years with freezing temperatures and only one year with freezing temperatures over eleven

days. Miami, south Florida, in a thirty-six year period of record had only seven years of freezing temperatures and on only one day of each of these years.[6] The occasional cold waves bring extreme minimum temperatures to the citrus district ranging from 28° F. to 20° F., depending upon the intensity.[7] Usually, the freezes are of short duration, commonly not continuing for more than three days, and even then, the temperature generally rises above 32° F. during the daylight hours.

The cold air which causes the central Florida freezes is brought into the state by advection. Advective cooling is most effective in the peninsular portion of the state when an extensive cold, continental polar air mass (high pressure system) moves southeastward over the Great Plains and eastern Gulf States in conjunction with a mass of moist, tropical air (low pressure system) moving north-northeastward along the Atlantic coast, or similarly when a low pressure cell moves from the Gulf of Mexico eastward across the state. When one of these particular conditions exists, a proximity of high and low systems, the pressure gradient is steep enough to pull the cold air of the high into central Florida, otherwise the cold air mass usually passes north of the state out over the Atlantic.[8] While the cold air is being imported there is considerable wind movement. The wind of

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[6]Sigismond de Diettrich, "Florida's Climatic Extremes: Cold Spells and Freezes," Economic Geography, XXV (January, 1949), pp. 69-70.

[7]Warren O. Johnson, op. cit., pp. 19-44.

[8]United States Department of Agriculture, loc. cit.

advective cooling continually mixes the lower layers of air: this mixing tends to keep temperatures from dropping excessively low. Often this slight warming effect will prevent the formation of frost. However, if the air mass has temperatures freezing or below, freeze damage can occur, although the wind will prevent the formation of frost.[9]

Temperatures are generally further lowered by the effects of radiation after a cold air mass has moved into the citrus district. The clear sky and the dry evaporating calm wind of the high pressure system generally promotes cooling by radiation at night. The result is a temperature inversion; the air near the surface of the radiating earth is cooler than the air immediately above. As a consequence of radiation cooling the clear, calm second night of a freeze is usually colder than the windy first night, and thus frequently more damaging to vegetation.

During a radiation night microclimates are significantly quite varied locally. Frost need not be universal throughout the area. Several factors contribute to temperature differences. A major causal factor is the topography of the land. Temperatures on low ground or pockets will be much lower than temperatures on high ground. First, temperature inversions associated with radiation cooling cause lower elevations to be colder than adjacent high elevations. The higher

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[9] Warren D. Johnson, op. cit., p. 3.

elevations are on a level with the warmer upper air of the low ground areas. Second, cold air is more dense and thus heavier than warm air. Consequently, cold air will drain or flow downslope from the high to the proximate low lying land. Temperature recordings at Lake Alfred on the night of February 5-6, 1937, provide an excellent example of temperature variation with elevation resulting from temperature inversion. At twelve midnight the surface temperature was 32° F.; at twenty-two feet above the surface the temperature was 41° F.; at forty-nine feet above the surface the temperature was 52° F.; and at 113 feet above the surface the temperature was 54° F.[10] Table II gives two locations which can be analyzed for comparisons in local temperature variations. The two stations are only six miles apart. The Eagle Lake recordings are from a relatively low ground (frostpocket) location, whereas the recordings of Winter Haven are from a moderately high ground site. Most notably, the location at Winter Haven experienced no temperatures below 32° F. in ten of the twenty seasons. By comparison, the Eagle Lake site had temperatures below 32° F. in every season. The number of freezes and the duration of freezing temperatures during a given year are likewise greater at the low ground site. For example, compare the two locations for the season of 1939-40. Conversely, on the first night of a freeze when cooling is advective in nature there are no perceptible differences in low and high ground locations owing to the continual mixing of the lower layers of air by the winds.

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[10] Ibid., p. 4.

TABLE II

COMPARISON OF TEMPERATURES AT HIGH AND LOW GROUND LOCATIONS

Station: Winter Haven			Exposure: Moderately High						Station: Eagle Lake			Exposure: Low				
Season	Total Hours at and Below:															
	32°	30°	28°	26°	24°	22°	20°	18°	32°	30°	28°	26°	24°	22°	20°	18°
1937-38	3	1-							21	10	2					
1938-39	None								31	22	15	3				
1939-40	38	28	12	3	1-				80	57	34	23	16	6	1-	
1940-41	½-								47	30	16	8	3			
1941-42	4								33	17	3					
1942-43	8	3	1						33	17	10	2				
1943-44	None								45	30	4	3				
1944-45	1-								36	20	11	4				
1945-46	None								23	7	2					
1946-47	6	1-							28	15	10	7	2			
1947-48	7	4	1						8	4	2					
1948-49	None								10	5						
1949-50	None								2							
1950-51	1-								35	12	½-					
1951-52	None								3	1						
1952-53	None								9	2						
1953-54	None								1-							
1954-55	6								30	14	2					
1955-56	None								19	11	4					
1956-57	None								33	12	5					

Source: U. S. Department of Commerce, Weather Bureau, Winter Minimum Temperatures in Peninsular Florida, 1937-1957, pp. 37-38.

The numerous lakes and swamps in central Florida also moderate temperatures somewhat. Unfortunately the effect of these water bodies is realized primarily only a short distance around the shores, and on small islands in the lakes where they occur. However, considering the number of lakes, ponds, and swamps scattered throughout the district the total land area affected is considerable.

CHAPTER V

VEGETATION AND SOILS

I. VEGETATION

Three different types of natural vegetation complexes, the high pine lands, the flatwoods, and the hardwood hammocks, originally were found on land that currently is devoted in varying degrees to citrus groves within the confines of The Ridge and Highlands. The names used to describe these vegetation types equally suggest topographic divisions, and indeed the differences in vegetation do reflect relationships to changes in landform and soils as well. The climate has enough uniformity throughout the district to be of little or no consequence as far as variations inthe vegetation are concerned. Other types of vegetation climaxes within this district include scrub growth, wet prairies, dry prairies, and swamps. Primarily, the major tree types throughout the area are coniferous; the hardwood hammocks are one exception. In all cases the trees and most of the shrubs, as well, are evergreen; even the hardwoods are evergreen, owing to the mild winter temperatures of the semi-tropical climate of the district.

Perhaps the most extensive native vegetation type areally and certainly the most important as related to the present citrus landscape was the high pine lands. Most of this vegetation type has since been removed. The climax vegetation of the high pine lands usually was comprised of open stands of long-leaf pine (Pinus palustris) with an

occasional black-jack oak (Quercus marilandica), or sometimes turkey oak (Quercus laevis) or live oak (Quercus virginiana), note Figure 9. High pine land, as the name implies, was found on the higher elevations, the upland rolling topography of The Ridge and Highlands proper. Additional prominent vegetation types of the high pine forest are the shrub saw palmetto and wire grass, plus Spanish moss hanging from the limbs of the trees. Wide spacing of long-leaf pine species no doubt reflects the excessively drained condition of the sandy covering of the soils and the relatively low water table which exists in the uplands, despite copius amounts of rainfall throughout the district. Black-jack oak (scrub oak) has been usually found in the driest and barrenest portions of the high pine lands, especially in areas of second growth where the largest pines had been cut by lumbermen.[1]

The flatwoods vegetation typically consists of either long-leaf pine, slash pine (Pinus elliottii), or the tall cabbage palmetto (Sabal palmetto), plus a dense undergrowth of saw palmetto, with wire grass and the ever-present Spanish moss (Figure 10). Generally, the flatwoods are not well drained; the water table is everywhere near the surface. Long-leaf pine is usually found in the higher, drier, and, during normal climatic conditions, cooler locations; slash pine or cabbage palmetto replace the long-leaf pine in the lower, wetter, and normally warmer places. The flatwoods are interspersed with cypress

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[1]Florida State Geological Survey, Seventh Annual Report (Deland, Florida: The E. O. Painter Printing Co., 1915), p. 146.

Figure 9. Second Growth of Pine and Oak in the Ridge.

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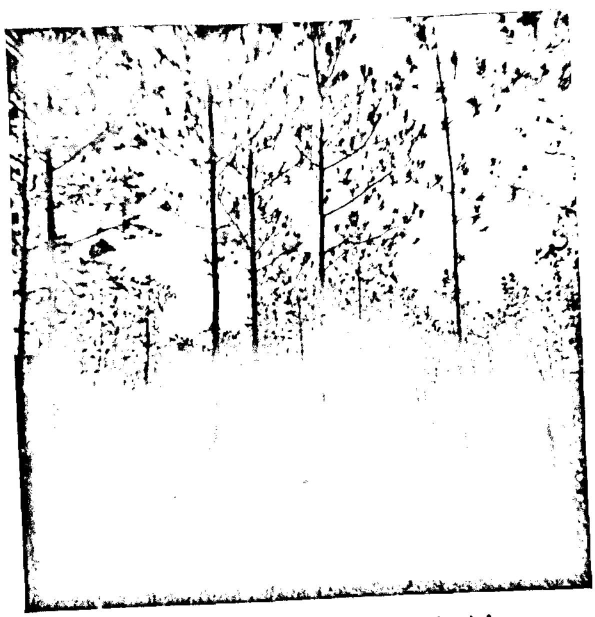

Figure 10. Flatwoods Vegetation.

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(Taxodiumdistichum) swamps in the lower, poorly drained areas and hardwood hammocks in the higher, better drained locations.[2] In location the flatwoods vegetation reflects the same relative position to the high pine lands as does the lowland topography it occupies compare with the Ridge and several highland areas within the citrus district; a location surrounding the uplands as well as occupying intermediate levels within the uplands. The flatwoods is a new, really experimental, area of citrus development. The number of grove plantings here do not begin to compare with those of the high pine lands. Consequently, much of the original type of flatwoods vegetation remains in the district. Types of vegetation other than the flatwoods are found in the low-lying level lands. Intermittent wet prairies and shallow ponds, which are usually dry in the spring, are found in depressions, and contain a stand of prairie grass; the wet prairies can have small hammocks of live oak. The live oak hammocks are always found on small well-drained mounds, which rise above the general level of the grassy plain. Dry prairies are also present in the district in similar landform areas. The flat grassy landscape is interrupted only by scattered pine or cabbage palmetto trees. Scrub and scrub thickets of different varities are comprised of dwarf oaks, pines and saw palmetto, and most often can be found in an intermediate position between the high pine land and the low pine flatwoods.[3]

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[2]C. Wythe Cooke, Scenery of Florida, Florida Geological Survey, Department of Conservation, Geological Bulletin No. 17 (Tallahassee: [n. n.], 1939), pp. 15-16.

[3]Florida State Geological Survey, Seventh Annual Report, op. cit., pp. 140-183.

The hardwood hammocks rise as high islands above the level of the coniferous flatwoods. (Figure 11). The soils of the hammocks are much better drained than those of the surrounding flatwoods. The several hardwood tree species of white oak (Quercus alba), magnolia (Magnolia grandiflora), and live oak, plus the short leaf pine are more closely spaced than the trees of the different pine lands, yet the broadleafs never occur in continuous stands of one species. The common saw palmetto and Spanish moss are also found along with the evergreen hardwoods in this vegetation complex. In addition, woody vines, absent in the pine lands, such as poison ivy and yellow jessamine occur in the hammocks.[4]

II. SOILS

The majority of the soils in The Ridge and Highlands are notoriously infertile. The soils provide little more than an inert host for cultivated plants. Topsoil throughout the area ranges from extremely sterile sands to, at best, sandy loams, most of which are highly acid. The leaching of plant nutrients from the soils is quite accelerated in the citrus area owing to the heavy annual rainfall. Most of the soils originally contained very little humus, and when cultivated, rapidly become deficient in essential mineral elements, especially nitrogen, phosphorus, and potassium. Owing to their sandy

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[4]*Ibid.*, pp. 170-176

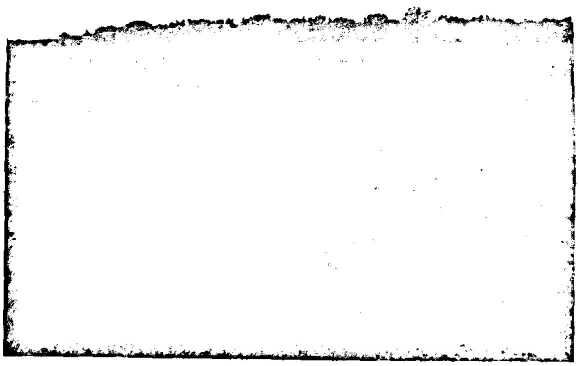

Figure 11. Live Oak Hammock.

character, the soils of the area do have three compensating features; they are relatively easy to cultivate, respond to the use of fertilizer, and are not easily eroded.

Soil development in the citrus district has been the result of an interplay of bedrock, climate, vegetation, topography, and drainage conditions. Elements of the parent materials, vegetation, and the climate are each comparatively uniform throughout the district and account for the general characteristics of the soils. Locally, soil differences are more a re[illegible]

Figure 11. Live Oak Hammock.

Almost all soils [illegible] gin. These soils, which have weathered [illegible] ties of the original unconsolidat[illegible] of the Pliocene and Pleistocene [illegible] the materials of the parent roc[illegible] rtz, sand, mica, and probably origin[illegible] anitic rocks of the Appalachian [illegible] ibly these materials were reworked several times in the course of their removal to the present location where they were laid down in shallow seas with conflicting and alternating currents.[5] The copious amounts of rain which fall in the district have greatly affected the soils by somewhat altering the parent materials. Excessive leaching and

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[5] Florida State Geological Survey, Fourth Annual Report, 1910-11 (Tallahassee, Florida: [n. d.], 1912), p. 26.

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Soil development in the citrus district has been the result of an interplay of bedrock, climate, vegetation, topography, and drainage conditions. Elements of the parent materials, vegetation, and the climate are each comparatively uniform throughout the district and account for the general characteristics of the soils. Locally, soil differences are more a result of topography and drainage.

Almost all soils in the district are residual by origin. These soils, which have weathered in place, retain many characteristics of the original unconsolidated deposits of sands and sandy clays of the Pliocene and Pliestocene geologic formations. In composition the materials of the parent rock include quartizitic fragments, quartz, sand, mica, and probably originally feldspar, which indicate the granitic rocks of the Appalachian Mountains as a primary source. Possibly these materials were reworked several times in the course of their removal to the present location where they were laid down in shallow seas with conflicting and alternating currents.[5] The copious amounts of rain which fall in the district have greatly affected the soils by somewhat altering the parent materials. Excessive leaching and

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[5]Florida State Geological Survey, Fourth Annual Report, 1910-11 (Tallahassee, Florida: [n. n.], 1912), p. 26.

eluviation have carried away most of the soluble and fine clay particles, leaving a predominance of sand in the topsoils. Most soils have developed under forests and are acid. Notably the hardwood hammocks have accumulated more humus in the topsoil than the upland or lowland open pine lands.

Topography and related drainage characteristics form a basis for dividing the soils of the citrus district into two distinct groupings, which in turn each include several soil series. The two broad groupings are: (1) the well-drained upland soils of the ridge, highlands, and hammocks, and (2) the poorly-drained lowland or "flatwoods" soils (Figure 12).

The upland soils of the high pinelands consist primarily of the Lakeland (formerly Norfolk), Blanton, Eustis, and Orlando soil series, which usually occur in association. The Lakeland series, by far the most extensive of the four soils throughout the district, is usually found in the highest elevations of The Ridge and Highlands, and occurs in phase from level to the most strong slopes. Because of their sandy profiles these soils tend to be well-drained to somewhat excessively drained. The Blanton series is a somewhat similar soil and closely allied with the Lakeland in location. The Blanton is most typically found on the lower slopes, downslope from the Lakeland soils. The Eustis series is similar to the Lakeland in location and characteristic but commonly more fertile. Eustis soils usually occur where hardwoods grow as a dominate tree type in the upland. Eustis soils

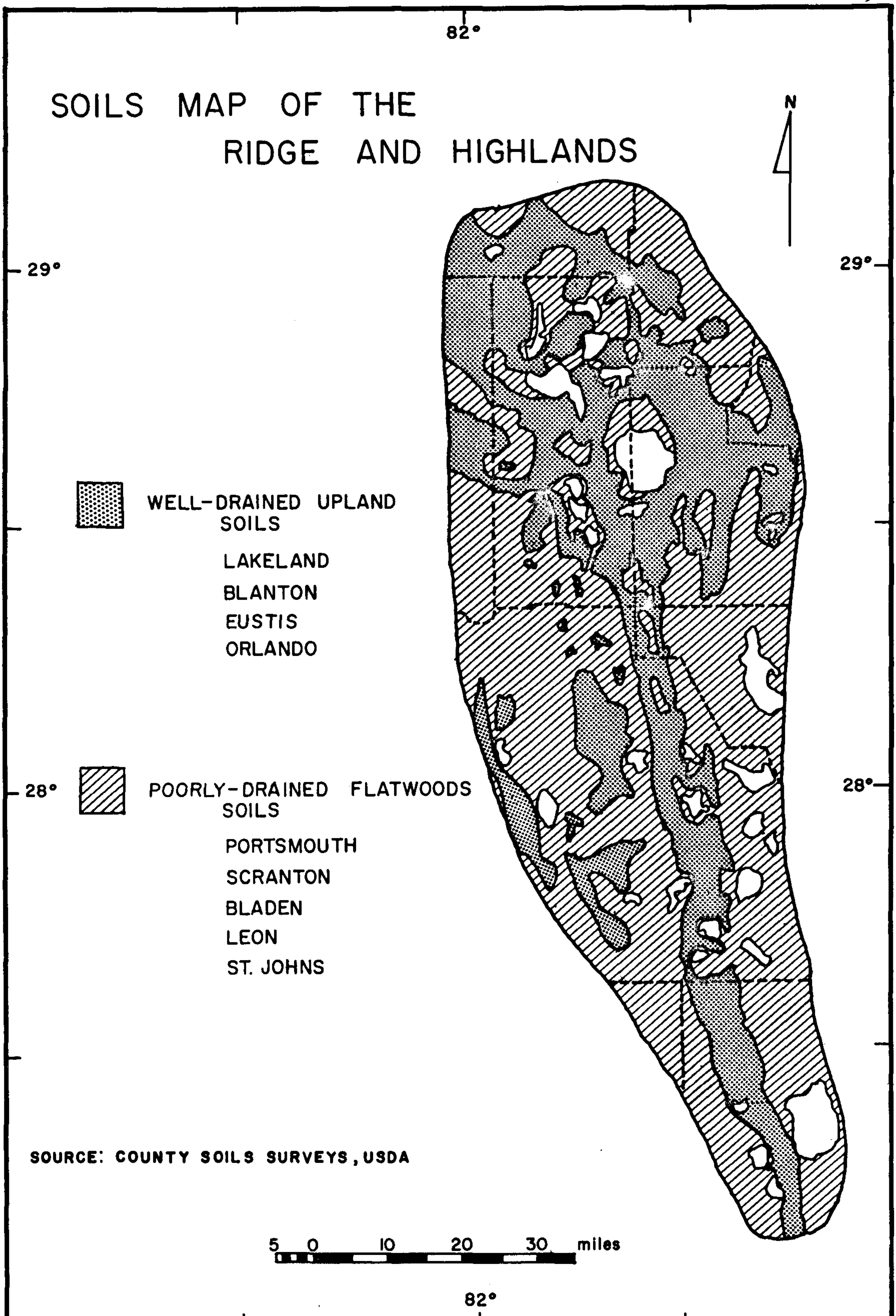

Figure 12. Soils Map of the Ridge and Highlands.

are most abundant in Lake County. The Orlando series is found at the lowest level in the highlands, primarily in Lake and Orange Counties. The Orlando soils vary in phase from flat to very gentle slope, yet the soils have adequate drainage; more often it results from downward percolation of rain water through the sandy sub-surface rather than by surface runoff.

Characteristically, the four major soils of the uplands have a very shallow topsoil, in which most of the fertility is accumulated, and a very poor sandy subsoil. A clay subsoil usually occurs immediately beneath the sand. The depth at which the clay is located varies from twenty inches to one hundred feet. The soil is more valuable for citrus culture in areas of the district where this clay lies only twelve feet or less beneath the surface. Where the clay is over twelve feet under the surface it is of little or no consequence to the citrus tree.

Individually, the Lakeland, Blanton, Eustis, and Orlando soil series have some variation in profile. The Lakeland soils have a grayish-brown loose sand surface of from zero to four inches, underlain by a yellow to pale yellow sand ranging in depth from thirty to seventy inches. The yellow sand overlies a thin layer of loamy sand that rests on a gray mottled friable sandy clay, which is several feet thick.[6] Blanton soils are distinguished from the Lakeland soils by their thicker

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[6] O. C. Bryan, Soils of Florida and Their Crop Adaptation, Florida State Department of Agriculture, Bulletin No. 42 (Tallahassee, Florida: Florida State Department of Agriculture, 1960), p. 19.

gray surface sand (3 to 8 inches) and a pale yellow to gray splotched subsoil.[7] Eustis soils, likewise, have a thicker gray surface than the Lakeland series. The Eustis can further be distinguished by the reddish color of the sandy subsoil which is underlain with beds of red friable sandy clay.[8] Orlando soils have a dark grey sandy surface ranging from eight to fifteen inches in depth. This surface sand lies on a pale yellow to grey sand subsoil, which rests on a brown sandy clay.[9]

The hammocks soils are represented generally by the same soil series as found in The Ridge and Highlands. However, soils of the hammocks tend to be somewhat higher in fertility than those of The Ridge and Highlands, and, though well drained, they are not excessively so. A stable supply of moisture is usually maintained throughout the year for plant growth.

The poorly drained flatwoods soils include the Leon, St. John, Portsmouth, Scranton, and Bladen series. The soils all share a common relatively low and flat location by comparison with soils of The Ridge and Highlands. The Leon and St. John's series, are sandy like the highland soils, but contain an organic hardpan, which usually occurs from between fourteen to thirty inches beneath the surface. The hard-pan in these soils is so close to the surface that the soils become

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[7]United States Department of Agriculture, Orange County Florida, Soils Survey (Washington: Government Printing Office, 1960), p. 56.

[8]Ibid.

[9]Bryan, op. cit., p. 20.

saturated with water during a wet period. The Scranton, Bladen, and Portsmouth series are similar in composition and drainage characteristics to the Leon, Portsmouth, and St. John's series; yet the former are found somewhat higher in location, and lack the organic hardpan of the latter. All of the flatwoods soils are highly acid, but generally are higher in humus content than the soils of the uplands.

The foregoing soils, of both the uplands and lowlands, represent the major soils either devoted to citrus plantings, or considered to be potentially, with proper management, utilizable for citrus plantings.[10] There are additional soil types found in the lowlands which are presently not considered significant in the future development of the citrus culture. They include the mucks and peaty mucks which are usually found in low areas near lakes, in swamps, or in the intermittent prairies; and the inundated swamp soils.

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[10]A. F. Camp, et. al, Citrus Industry of Florida, Florida State Department of Agriculture, Bulletin No. 2 (Tallahassee, Florida: Florida State Department of Agriculture, 1960), pp. 18-21.

CHAPTER VI

CITRUS ROOTSTOCKS AND VARIETIES

Growers have been able to adapt citrus production to the soils and microclimates of The Ridge and Highlands primarily through the use of several varieties and rootstocks. Not only has the quality of the fruit been improved and the quantity been increased, but the length of the season has been extended to the present eight month period by the introduction of late maturing varieties, particularly the Valencia orange. Stocks less susceptible to cold damage, seedless varieties of grapefruit for the fresh market, and varieties with firm fruit sections for canning are among the other accomplishments provided for by this scientific propagation.

I. ROOTSTOCKS

The use of a proper rootstock at any given grove site has been extremely important in The Ridge and Highlands, for rootstocks greatly influence the fruit bearing capability, the fruit quality, the cold tolerance, and the disease resistance of a citrus tree. Throughout the district where successful fruit production is found the actual selection of the proper rootstock has been based on the natural environment of the particular site chosen. In the early stages of the citrus industry in central Florida the rough lemon rootstocks were used on the high sandy soils, and the sour orange rootstocks on low, wet soils

and in relatively cold areas. Later, the Cleopatra stock, the sweet orange stock, and the grapefruit stock were added to the list of major rootstocks which through possessing diverse qualities were adaptable to varied physical situations.[1]

The rough lemon is the most widely used rootstock in The Ridge and Highlands. It has been especially utilized on the well drained to excessively drained soils in the high pinelands of the district. The drought resistant quality and adaptability of the rough lemon to the sandy highland soils is rendered by the relatively long tap root of the stock, which seeks out water.[2] Numbered among the additional attributes of the rough lemon stock are its exceptional heavy fruit yields and its high resistance to tristeza. However, the rough lemon cannot be used in colder areas or low, poorly drained soils.

The sour orange is the second most widely used rootstock. This stock was originally spread throughout the state by the Spaniards and Indians. The sour orange rootstock produces well on low lying heavy soils with an adequate supply of moisture, and the quality of the fruit is superior to that produced on the rough lemon stock. The sour orange is resistant to foot rot, a disease associated with poorly drained soils, and in cold hardiness ranks second only to the trifoliate orange rootstocks. Hence, the sour orange is well suited to the

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[1] Jack T. McCown, Citrus Rootstocks, University of Florida, Agricultural Extension Service, Circular No. 132 A, n. p., 1958, p. 1.

[2] Statement by Ken Enzor, grove production manager of Snively Groves, Inc., Winter Haven, Florida, Personal Interview.

relatively low areas of the highlands. On the other hand, it does not develop rapidly on the light, sandy soils which are found in the more favorable climatic locations of the uplands.

Today the sour orange is not utilized as a rootstock for new groves or in replacing trees in old groves as the stock is highly susceptible to the dreaded disease tristeza. This disease has killed several million citrus trees in Java, South Africa, and many countries of South America. Although the disease has not done a great amount of damage in Florida it is potentially a threat to the groves.[3]

Considerable planting was made on the sweet orange rootstock in The Ridge and Highlands during the 1930's. However, the sweet orange stock is not a popular one in plantings in the area today. This stock has been found not to be resistant to drought on light, sandy soils and it is highly susceptible to foot rot on low, moist soils. Likewise, it comes into bearing slowly when budded and even when mature does not bear heavily. Thus, it cannot compete favorably with the rough lemon or other rootstocks. However, the quality of the fruit produced on the sweet orange rootstock is excellent, and it is used on intermediate soils for speciality fruits when high quality production is the object.

The Cleopatra mandarin was planted widely in the sandy uplands of The Ridge and Highlands in the 1920's and early 1930's prior to the

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[3]A. F. Camp, et. al. Citrus Industry of Florida, Florida State Department of Agriculture, Bulletin No. 2 (Tallahassee, Florida State Department of Agriculture, 1960), p. 30.

discovery that mineral deficiencies were the cause of the problems experienced with the rough lemon rootstocks. Today the Cleopatra stock is considered to be the best replacement for the sour orange rootstock on low, wet soils. The Cleopatra is superior to the sour orange stock in that it is fairly resistant to tristeza, foot rot, and cold temperatures; yet it does not compare favorably to the sour orange stock in fruit size and yields.[4]

Although the grapefruit rootstock is seldom used today it was extensively planted during the early citrus history of The Ridge and Highlands owing principally to its characteristic of vigorous growth. Low tolerance of cold, susceptibility to damage by tristeza, and tendency to bear in alternate years account for a decline in the use of grapefruit as a rootstock.[5]

There are several miscellaneous rootstocks which are used sparingly or, are in the experimental stage. Any new stock, in order to be adopted would have to be superior in some aspect of characteristic in order to compete successfully with the major stocks in use today. There is presently a scientific search being conducted by the agricultural experimental stations in Florida for a cold tolerant stock which would be adaptable to low ground locations, particularly, now, that virgin high ground sites are scarce. For example, the trifoliate

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[4] *Ibid.*, pp. 31-32.

[5] McCown, *op. cit.*, p. 5.

orange, a deciduous rootstock which is highly resistant to cold, is being restudied in Florida as a possibility for low ground location. The trifoliate orange is resistant to tristeza and foot rot, and gives high yields of good quality fruit. It is currently budded with Satsuma oranges in the relatively cold areas of north and northeast Florida. The drawbacks, thus far, to the use of the trifoliate orange stock in central Florida is the low tolerance of the rootstock to the virus of exocortis, which is widespread in Florida.[6]

II. VARIETIES

The quality, yield, and season of maturity are perhaps the major concerns of the growers in The Ridge and Highlands when selecting a citrus variety to be budded to a rootstock. The different citrus varieties, like the rootstocks, do possess such characteristics as relative cold tolerance and disease resistance. However, the numerous varieties can be budded to any of the several rootstocks with success, especially now in conjunction with the scientifically directed fertilization programs. For example, the Hamlin orange variety would produce a good quality fruit on a sour orange rootstock, yet on a rough lemon stock the pulp of this variety had a tendency to be excessively dry. Through adaptations in fertilization and spraying the Hamilin grown on a rough lemon stock now produces a fruit equal in quality to that produced using the sour orange stock.

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[6]Camp, op. cit., p. 33.

There are numerous varieties of citrus fruits produced in The Ridge and Highlands; however, today, only a few standard varieties are planted. The older varieties still account for a large portion of the fruit crop, and are usually shipped with the modern variety to which they are most similar in appearance.

The varieties of orange are classified in three general categories according to the annual period of maturity and shipment to market. The classes are: (1) early season, (2) mid-season, and (3) late season. The Parson Brown and the Hamlin are the two major early season orange varieties of the central Florida district. These two varieties reach maturity, that is they are the first to pass the maturity test provided for by Florida law, in the latter part of October and through November. Among the most extensively planted midseason varieties, oranges which mature during December, January, and February, are the Pineapple, Homosassa, Jaffa, Temple, and early Florida seedlings. The Valencia is the major late season, March to July, variety. In addition to extending the harvest season and, thus, the fresh fruit marketing period, the Valencia is the most preferred variety for the frozen concentrate industry.[7]

During this century Florida has not been able to compete successfully with California in the fresh orange market. Even today, although Florida has surpassed California in total orange production,

[7]*Ibid.*, pp. 34-39.

the western citrus state retains command in the fresh fruit markets for the orange. The major consumer preference is for an orange with a smooth thick rind which is easy to peel, and a pulp which holds together; in other words, one that is easy to eat from the hand. The Washington Navel, the major orange variety of California, meets these fresh fruit demands of the consumer. Florida growers have never been able to adapt this Navel orange successfully to the state's environment, nor have the growers of the several districts in Florida been able to produce a variety equal to the Navel in the required market aspects. The Temple orange is the only Florida variety that could compete on an equal basis with the Washington Navel of California. However, the Temple has a name for poor quality. When the Temple was first introduced it was budded on the rough lemon stock and grown without the proper fertilizer supplements. Now, although the quality is much improved the Temple has not overcome its early poor market reputation.

The several varieties of grapefruit cannot be classified in the same manner as the orange varieties, for the grapefruit lack the seasonal characteristic of ripening. Among the major grapefruit varieties are the Duncan, McCarty, Foster, Marsh Seedless, Thompson or Pink Marsh, and Red-Flecked. The Marsh Seedless is preferred as a fresh fruit market variety owing primarily to its quality of seedlessness; it usually has not over two to eight seeds. The Marsh Seedless is not too well adapted to the canning industry as its juice has a relatively

low sugar and acid content compared to the seedier varieties and the fruit sections tend to fall apart when they are used for sectionizing. The Duncan or Florida Common, a seedy variety, is preferred for canning as it has the qualities the Marsh Seedless lacks. In the fresh fruit market most seedy grapefruit are shipped with the Duncan variety. The Foster, Thompson, and Red-Flecked varieties are shipped fresh in response to the market demand for pink grapefruit.[8]

A few varieties of mandarins are grown in The Ridge and Highlands that are marketed as speciality fruits. The mandarins are commonly called kid gloves oranges because in most varieties the skin has a smooth, fine texture and fits rather loosely on the fruit. The Dancy Tangerine is the most extensively planted mandarin variety in this central Florida citrus area. This variety of mandarin is commonly called a tangerine and consequently marketed under that name. The Satsuma, really a group of mandarin varieties, is found in The Ridge and Highlands, although owing to its exceptional cold tolerance has been more popular in plantings in northern Florida. The King Orange, a mandarin, has the appearance of an oversized tangerine, yet a taste similar to an orange. It is not found extensively in The Ridge and Highlands, but it is relatively important in the specialty fruit market.[9]

Separate blocks of tangerines and grapefruit were planted in many individual grower's orange groves in The Ridge and Highlands during

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[8]*Ibid.*, pp. 40-43.

[9]*Ibid.*, pp. 43-45.

the first quarter of this century. This practice has gradually declined until now most groves are planted to oranges alone, and most of the current grapefruit and tangerine varieties are planted as replacement stock.[10]

[10]Statement by Ken Enzor, Personal Interview.

CHAPTER VII

HISTORICAL GEOGRAPHY OF THE CITRUS INDUSTRY IN FLORIDA

The location in Peninsular Florida of The Ridge and Highlands, as well as the two other citrus districts of the state, the Tampa Bay District and the Indian River District, has been the result of a selective evolutionary process, which involved elements in the local physical environment in relation to cumulative technical knowledge acquired and implemented by the growers of the state. In this respect general localization of The Ridge and Highlands does not appreciably differ from that of other major world commercial citrus regions. Landform, climate, soils, scientific agriculture, refrigeration, and transportation development are among the several influencing geographical factors responsible for the present location. Only in detail does The Ridge and Highlands show variation in response to the elements when compared with other citrus producing areas of the world.

The citrus industry initially came to The Ridge and Highlands, about 1880, as an expansion from a prosperous citrus district in northeast Florida, which had localized in respect to water transportation to northern markets. The extension of commercial citrus plantings into The Ridge and Highlands coincided with the first rail and road building period in central Florida, which linked this area to the market regions of the north. Citrus tree plantings and production increased rapidly in central Florida during the last two decades

of the nineteenth century. If this production trend had continued, uninterrupted, The Ridge and Highlands would have probably become the leading citrus district of Florida in the early 1900's, in any case. Several severe freezes in Florida in the 1890's almost completely devastated the citrus industry throughout the state, but the district of northern Florida suffered the greatest number of tree losses. During the period of replanting which followed The Ridge and Highlands then emerged as the leading citrus area in the state.

I. EARLY HISTORY 1500-1800

Citrus fruits were first introduced into Florida by Spanish explorers and colonists. Although the exact date of introduction is unknown citrus fruits are believed to have been brought into the state some time between 1513, when Ponce de Leon first landed, and 1565, when St. Augustine was established. It is certain that sour oranges, sweet oranges, and probably lemons, limes, and citrons were introduced when this first colony at St. Augustine was founded. Citrus plantings were also introduced early in the other Spanish coastal settlements.[1]

The native Indians were, doubtless, responsible for the spread of the citrus tree, primarily the sour orange, from the coastal regions into the interior parts of northeastern Florida during this early period of the state's history. Later, in the eighteen hundreds settlers

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[1]See page 14.

from the United States found wild citrus trees, which they believed to be native, in various sections of this northern region. The Spanish evidently had given fruit to the Indians from the coastal plantings. Some trees were found along pathways. The trees apparently had grown from seeds dropped by the Indians during their travels. Plantings, actually small groves, were found on hammock lands near various lakes, the St. John's River, and the Indian River; site locations where the Indians had maintained villages. Perhaps other plantings which did not survive were made by the indigenous peoples. The plantings that did endure actually occupied what, today, is considered to be favorable locations in relation to soils and microclimates.

The most extensive of the wild Indian groves were located around Orange Lake in Marion County and Lakes Harris and Griffin in Sumpter County (now Lake County). Smaller groves were found near Lakes Weir, Bryant, Panasoffkee, Jessup, George, and Apopka; and Rivers Ocklawaha, Withlacoochee, St. Johns, Indian, and Halifax (Figure 13). The so-called native groves usually consisted of sour and bittersweet orange trees from twelve to fifteen feet in height with truly natural oak, bay, and magnolia trees. Some wild groves of sweet orange trees were found along the Indian River, and rough lemon and lime tree plantings were found farther south in the state.[2]

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[2]Herbert John Webber (ed.), The Citrus Industry, Vol. I (Berkley, California: University of California Press, 1948), pp. 25-31.

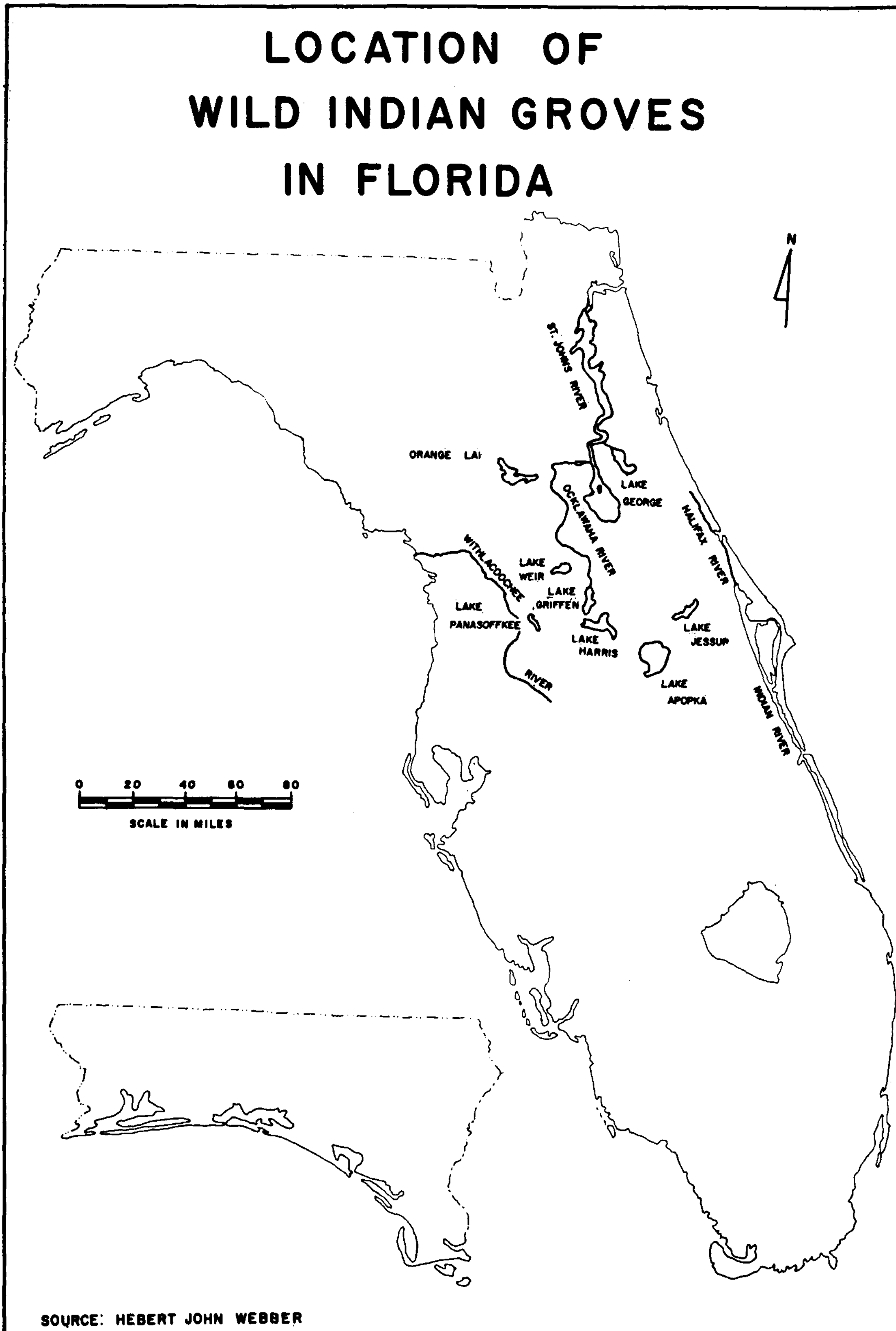

Figure 13. Location of Wild Indian Groves in Florida.

II. COMMERCIAL DEVELOPMENT 1821-1860

The development of a commercial citrus industry in the state was not realized until after the annexation of the Florida territory from Spain by the United States in 1821. Prior to this date, although Spanish settlers had grown citrus fruits and the several wild groves had developed, no attempt of a commercial nature had been tried. After 1821, United States settlers began to move into the Florida territory from the north, principally Georgia and Alabama. The Spanish plantings and the wild groves the settlers found in northeast Florida were soon used as a nucleus with which to establish a commercial citrus enterprise. These original seedling groves were expanded and new groves were planted during the ensuing decades. By 1859 the major commercial orange groves were found at the following locations: Ft. George Island, Drayton Island, St. Johns River, Merritt Island, Sanford, Orange Mills, and East Palatka (Figure 14).[3]

Relatively rapid progress was made in the, then, new citrus district of northeast Florida. (Figure 15). For example, in the few years prior to 1835 St. Augustine produced approximately two and one-half million oranges annually, which found a ready market in the port cities of Boston, New York, Baltimore, Charleston, and others. However, the year 1835 witnessed the first major setback to the development of

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[3]*Ibid.*

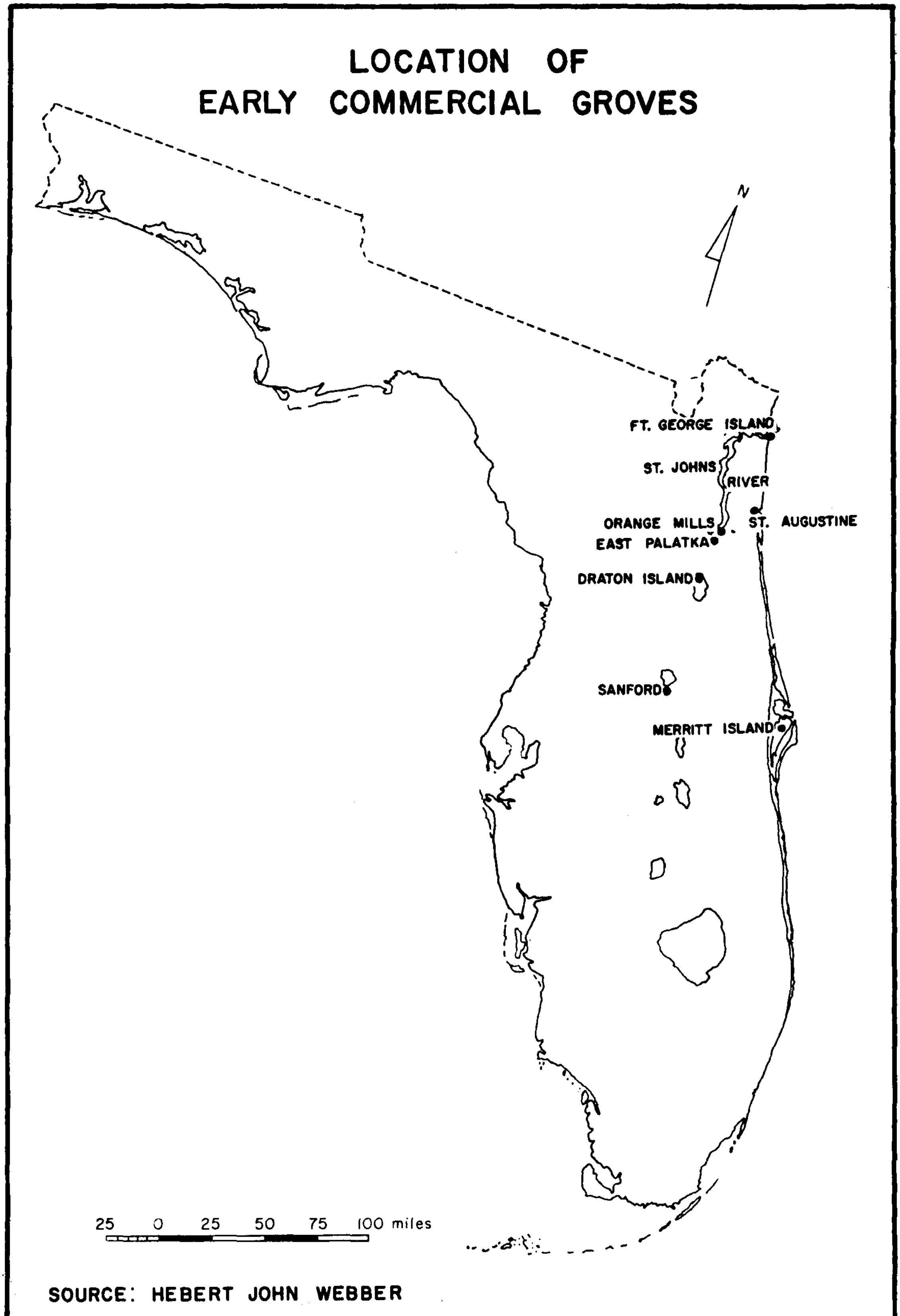

Figure 14. Location of Early Commercial Groves.

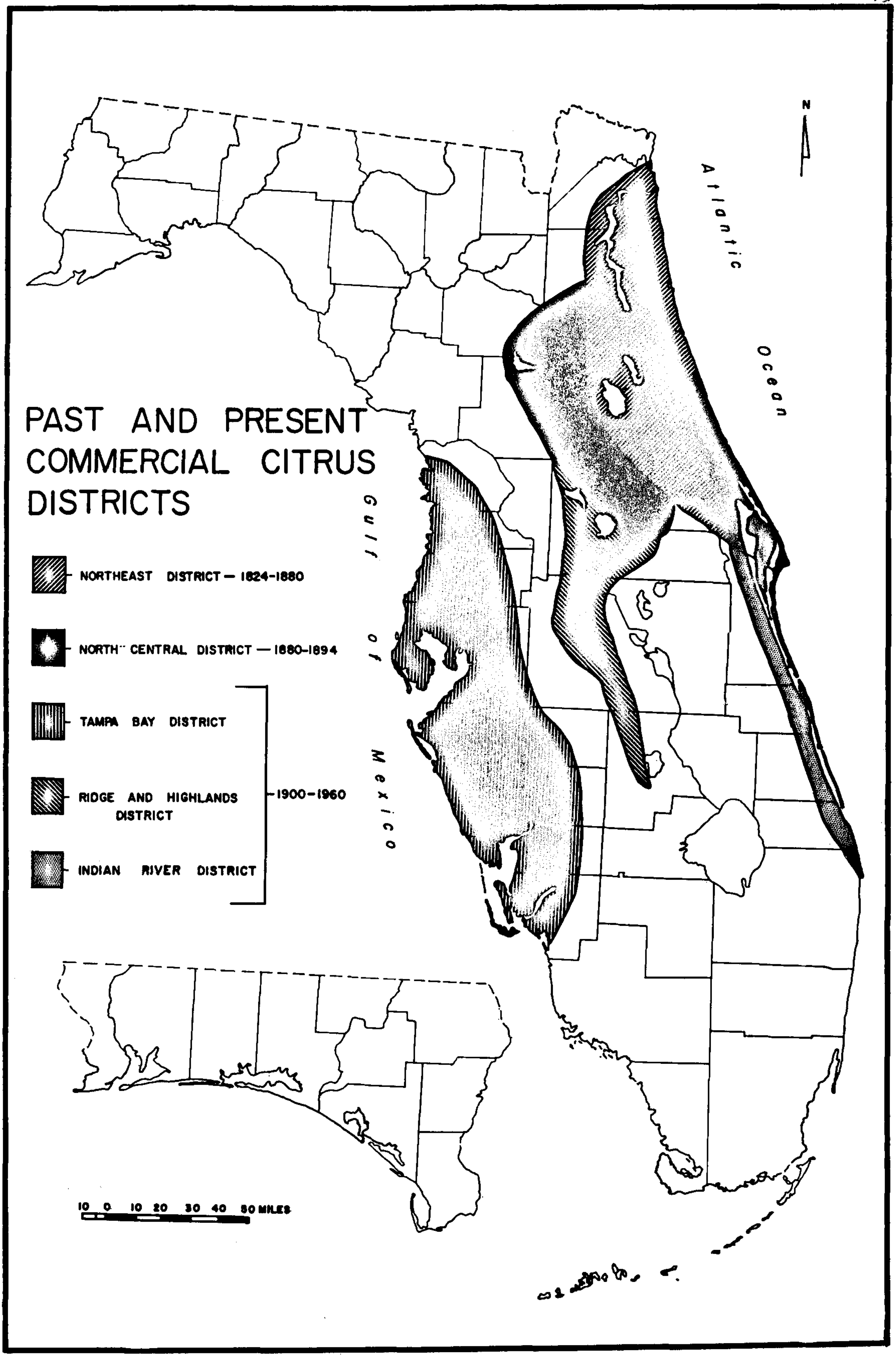

Figure 15. Past and Present Commercial Citrus Districts.

commercial citrus production in this northeastern area of Florida. On February 9 of that year a severe damaging freeze was experienced in the young citrus district. Extremely cold temperatures completely killed many orange trees, as well as destroyed the on-tree crop. Not to be dismayed, the growers of northeast Florida immediately began to replant orange trees within the district. Expansion again proceeded at a steady pace.[4]

The site location of orange groves during this early period of commercial development was restricted to either coastal locations, locations along navigable rivers, or near lakes connected to the rivers (Figure 14). These type locations were necessary because commerce at that time was entirely dependent upon water transport. Land transportation was almost nonexistent. There were no railroads in Florida in those days, and transportation by roadway was extremely difficult, as well as slow.

Even by boat the methods of hauling and shipping were very crude and hazardous. The oranges were packed in barrels padded with Spanish moss. The barrels were then loaded on sailing schooners which carried the fruit to the several port cities of the eastern seaboard. Most of the oranges were marketed as luxury fruits during the holiday season when few fruits were available in the frozen north of the United States.[5]

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[4] Ibid.

[5] A. F. Camp, et. al, Citrus Industry of Florida, Florida State Department of Agriculture, Bulletin No. 2 (Tallahassee, Florida State Department of Agriculture, 1960), pp. 6-15.

III. PERIOD OF EXPANSION 1865-1899

During the three decades following the Civil War commercial citrus development increased rapidly in northeast Florida and began to expand along the rivers and lakes into the north central sector of peninsular Florida (Figures 15 and 16). Two entirely unrelated innovations stimulated the intensification and expansion of the industry. One was the introduction of standard varities; the other was the advent of the railroads.

Beginning in 1870 the best orange trees were named as varieties and propagated by budding or grafting. Prior to that time all plantings had been seedlings, which were probably propagated from certain choice trees. The development of standard varieties has, through time, greatly facilitated standardization in many aspects of the citrus industry, particularly in the production phase and the marketing phase. Some imported varieties began to be used in 1875, but so called native varieties have always dominated the commercial industry.[6]

The establishment of the railroad systems in Florida brought an intensification in citrus production, and remarkable changes in the distribution of citrus locations throughout the state. In 1881 Jacksonville for the first time in its history was connected by a railline to Savannah, Georgia, and by way of Savannah linked with the major market cities of the eastern United States. This railway was the

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[6] Webber, loc. cit.

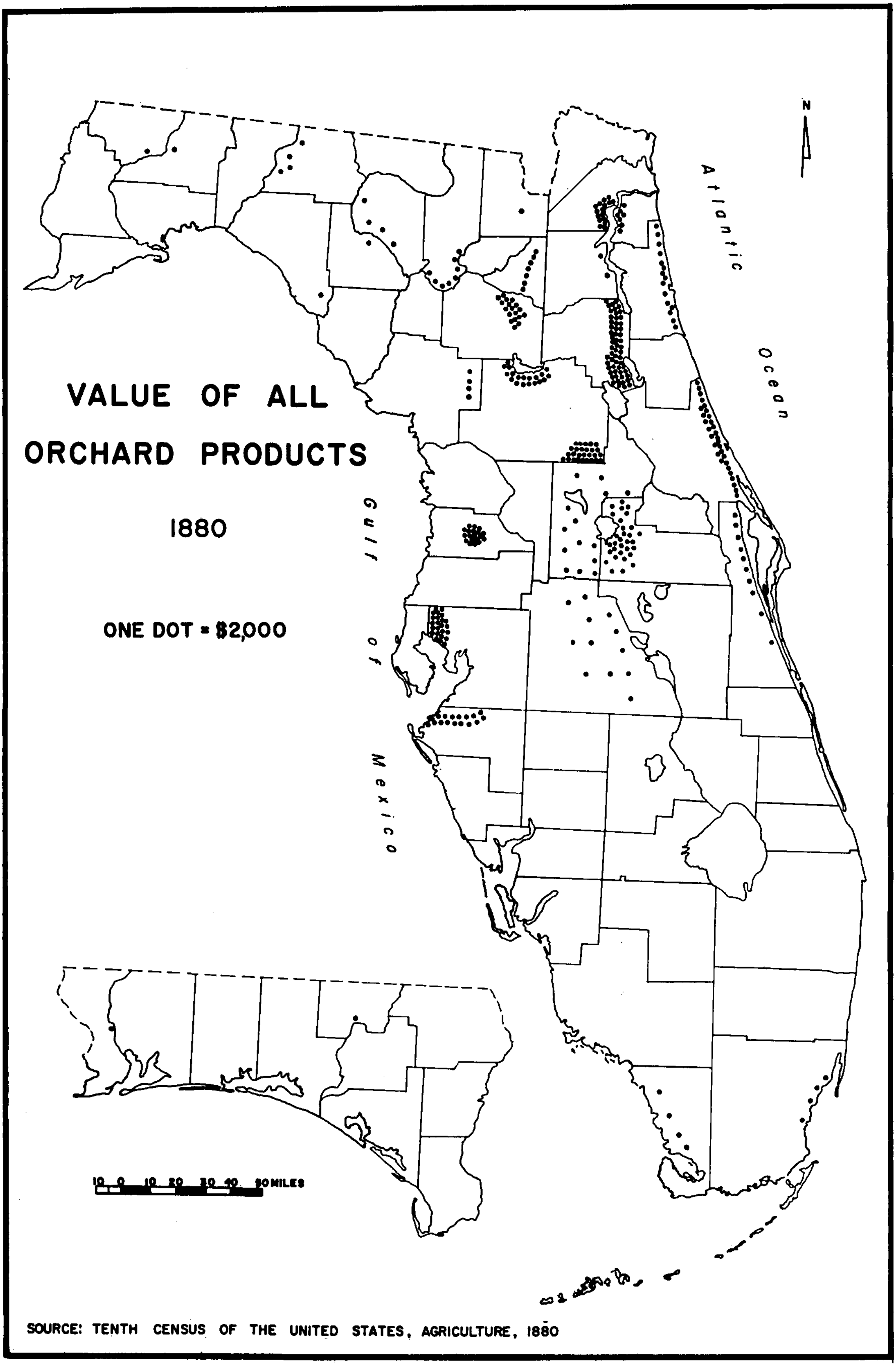

Figure 16. Value of All Orchard Products, 1880.

first line of the Plant System, now the Atlantic Coast Line. An increase in citrus plantings was an almost immediate result associated with the introduction of rail transport in northeast Florida. The growers of the district, at last, had a relatively less hazardous and more rapid means of placing their fresh fruit products in the market regions.

The Plant System, once established, was quickly extended through the interior region of central Florida. By 1884 the line had been laid from Jacksonville to Tampa, by way of Palatka and Sanford. Branch lines were soon built to sites which are now towns in The Ridge and Highlands, like Leesburg, Orlando, and Bartow. Beginning in 1886, the Flagler System was extended south along the east coast from Jacksonville through the present Indian River Citrus District, reaching Palm Beach by 1894 (Figure 17).[7]

The introduction of the railroad systems in peninsular Florida was accompanied by a new wave of settlement. Prior to this time the average population density of central and southern Florida, both interior and coastal regions, was less than two persons per square mile; and north central peninsular Florida averaged somewhat higher with from two to six persons per square mile. The establishment of the railroads was truly responsible for the economic development of Central Florida. Besides providing a routeway and means of transport into the region for

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[7]Kathryn Turner Abbey, Florida, Land of Change (Chapel Hill: University of North Carolina Press, 1941), pp. 354-362.

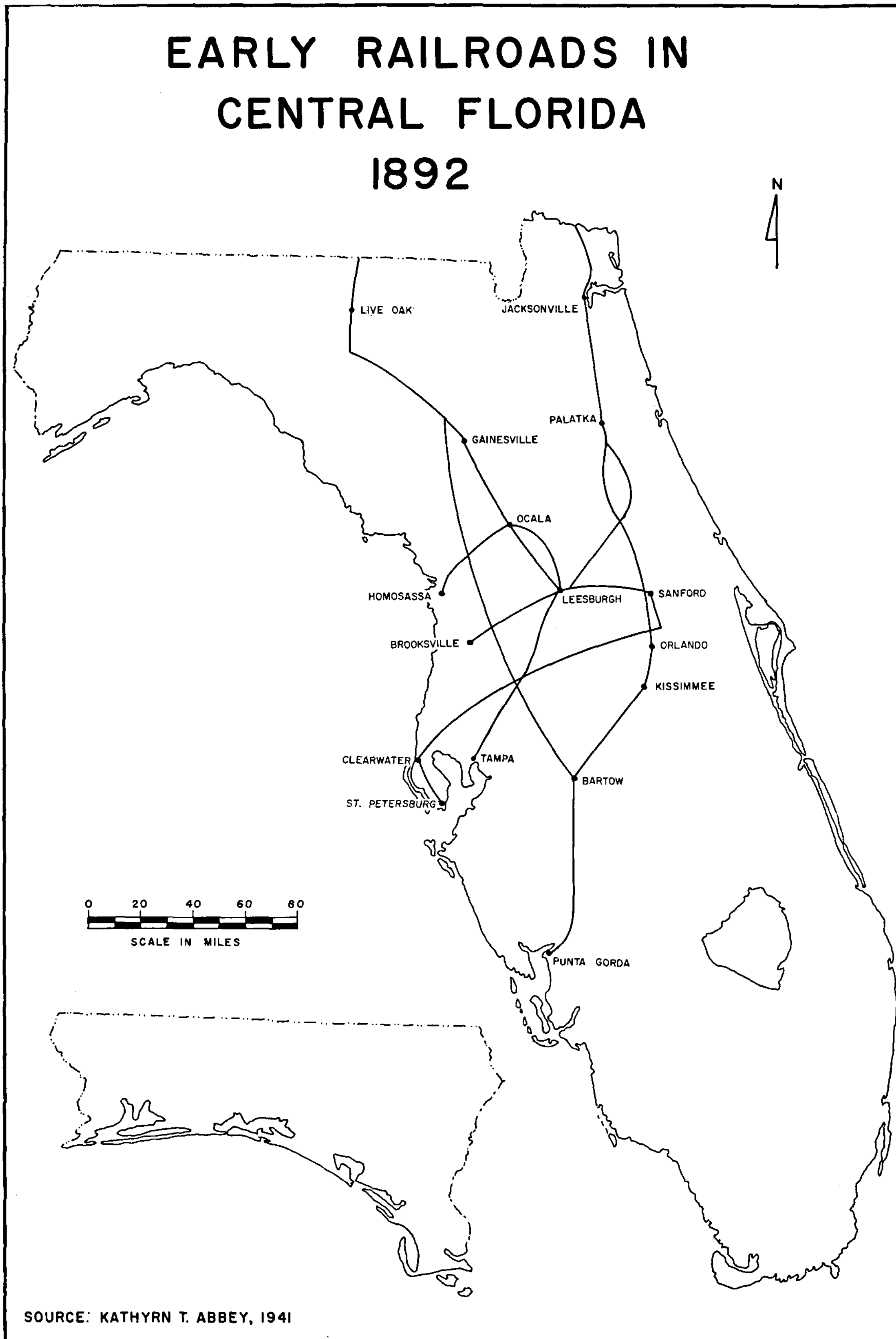

Figure 17. Early Railroads in Central Florida, 1892.

the settlers, the railroads linked the new residents to civilization, giving them a ready market outlet for their produce, which has evidently been a necessary factor for successful colonization during the late nineteenth and early twentieth centuries. Most of the settlers during this period came into central Florida from north Florida and from the neighboring states of Alabama, Georgia, and South Carolina. The crops planted during this period were diverse, including corn, sweet potatoes, rice, sugar cane, cotton, and peanuts.[8]

The advent of the railroads allowed for the first time the planting of commercial citrus groves away from the river and coastal locations. The new settlers of north-central and central Florida early began to plant orange trees along with other crops. The first locations were not just near the towns being established along the raillines; they were most often in and immediately adjacent to the sites of settlement. These early plantings in the towns of The Ridge and Highlands later served as nuclei for expansion.

During the period from 1880 to 1894 commercial citrus development was most rapid in north-central Florida. By 1890, even though the groves were again expanded in the northeast district, production in the north-central area, localized by both lake and river transport, and rail transport, exceeded that of the former area (Figure 18). Thus, a shift southward and toward the interior of the state in the center of citrus

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[8]United States Department of Agriculture, Polk County Florida, Soil Survey (Washington: Government Printing Office, 1927), p. 5.

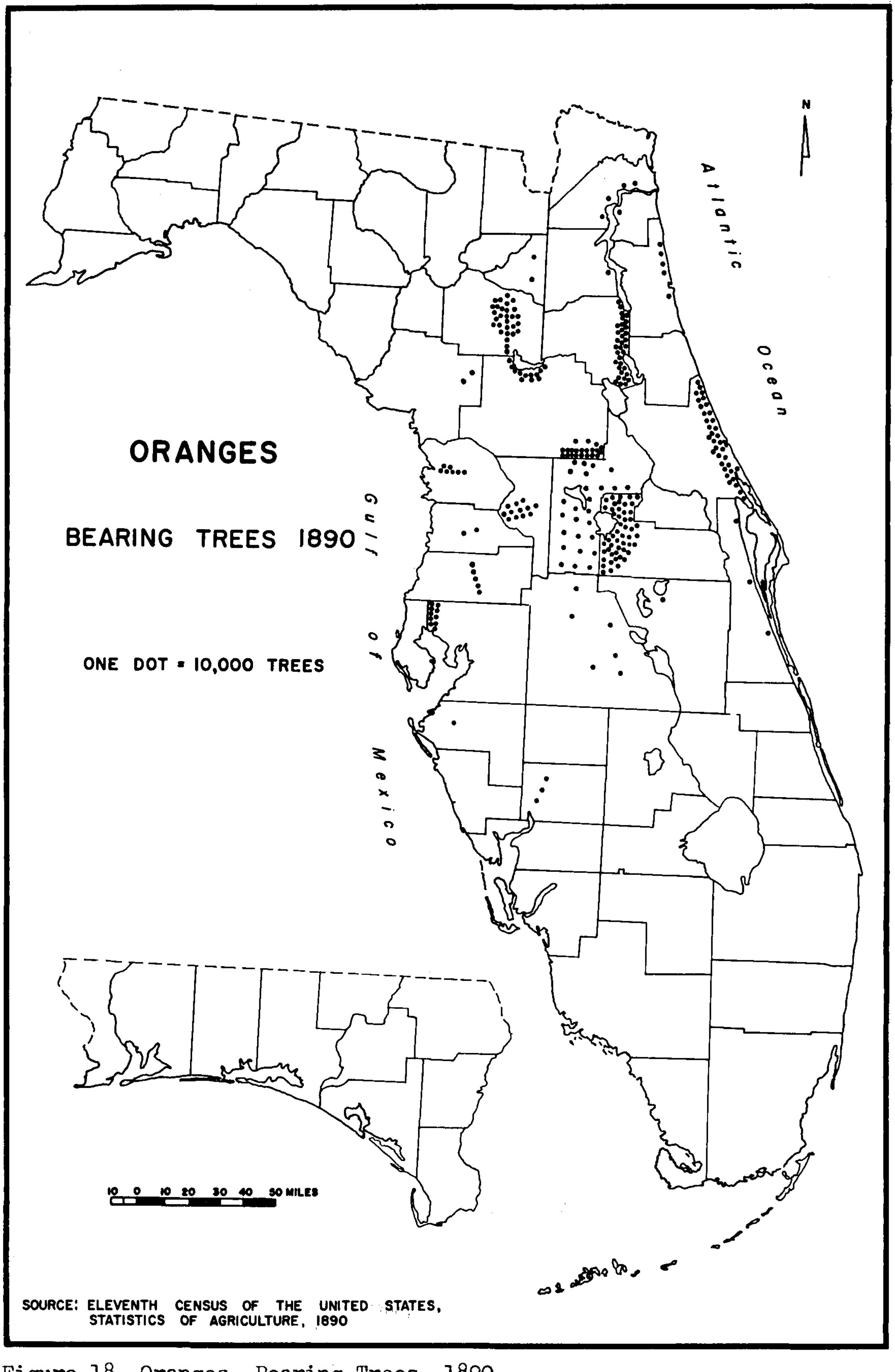

Figure 18. Oranges, Bearing Trees, 1890.

production had begun. This change would have, undoubtedly, been more spectacular by 1900 had it not been for a series of severe freezes during the 1890's which completely disrupted commercial citrus production in the state. Figure 18 shows only the number of bearing orange trees recorded in the United State's Eleventh Census of 1890. If the number of non-bearing orange trees recording in that census are added to the number of bearing trees the total number would be a projection of the number of bearing trees to be expected eight or less years later (Figure 19). Hence, if Florida had not experienced two freezes in the winter of 1894-95, known throughout the state collectively as the "Big Freeze," and another freeze in 1899, increases in the north-central district would have accentuated the general trend of the period. During this same twenty year period orange tree plantings also increased in both the Tampa Bay and Indian River Districts, likewise in tune with the general southward shift in commercial citrus expansion in Florida.

The "Big Freeze" of 1894-1895 has been widely acclaimed by economic geographers, citrus growers, and citrus scientists as an almost singular causal factor in the decline of citrus production in northeast Florida and the subsequent rise of production in the central portion of the state. Actually, as noted above, a relative decline in the north-east and increase to the south was already in progress. The "Big Freeze" and the freezes of 1899 did cause an absolute decline in the northeast.

The northeast was not the only citrus area in Florida to suffer immediate losses as a result of the freezes near the turn of the century.

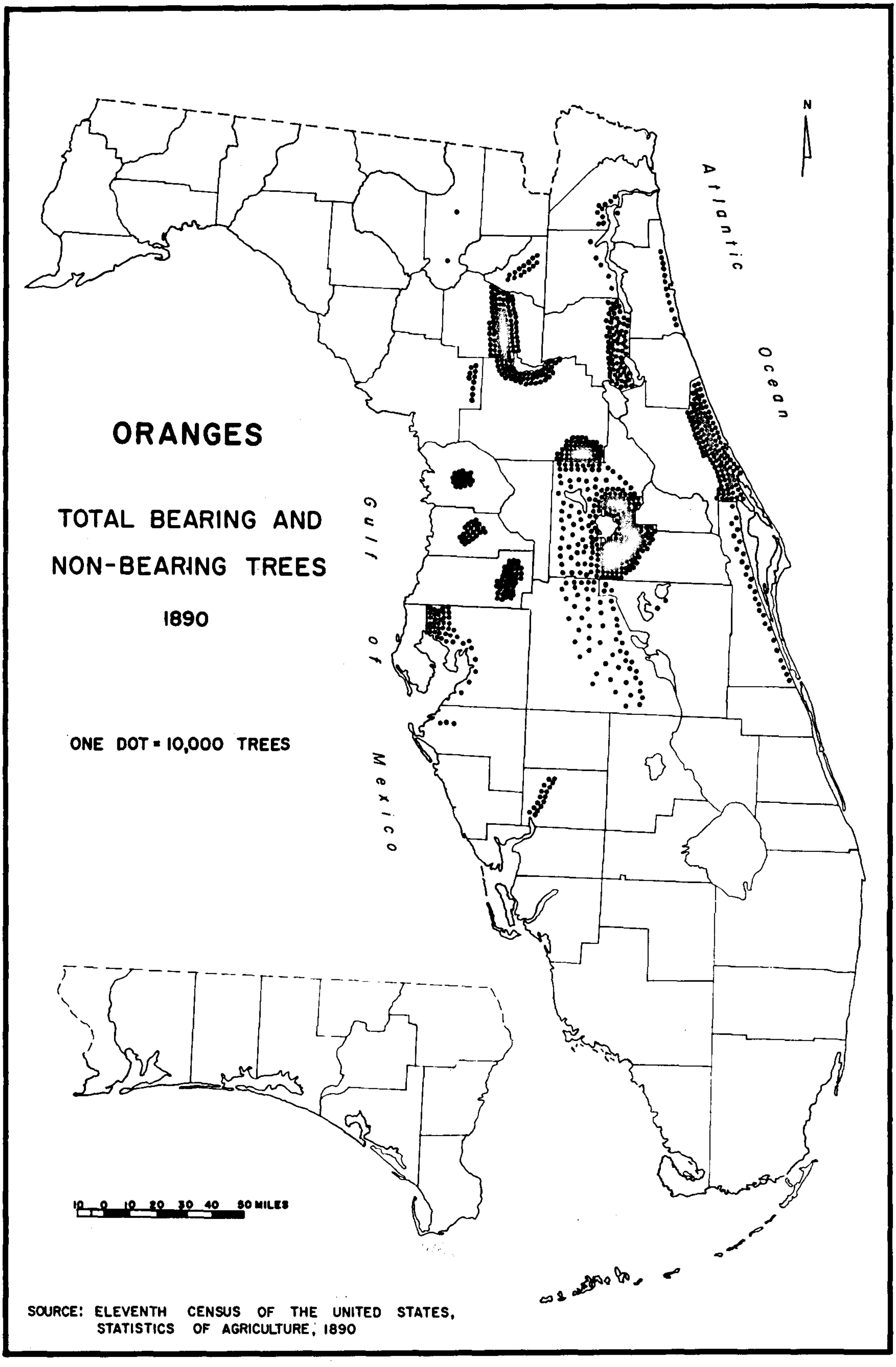

Figure 19. Oranges, Total Bearing and Non-Bearing Trees, 1890.

The citrus crop, and many trees as well, were lost throughout the entire peninsula, except in the extreme southwest section. Citrus production for the state had reached five million boxes by 1893-94, the year before the freeze. The state's production for the season following the freeze, 1895-96, decreased to one hundred and fifty thousand boxes. The total number of orange trees recorded in the state in 1900 represented only 27 per cent of the 1890 total. (Figures 19 and 20). The recovery of groves began immediately following the "Big Freeze"; however the freeze in 1899 again totally ruined the gains made in the northeast district. The northeast never again attained the citrus acreage it had accumulated prior to this period of freezes.

Florida lost its position to California as the leading citrus producing state in the nation during this period of freezes near the turn of the century. The year before the "Big Freeze," California produced only about two and one half million boxes of oranges, compared to Florida's five million boxes. Naturally, Florida fell far behind California during the years of the freezes; in fact, the former state did not equal the production figure of the pre-freeze years again until the season of 1909-10. By that time California had greatly increased its production capacity and was producing three times as much citrus as Florida.

IV. CENTRAL FLORIDA LOCALIZATION 1900-1920

The beginning of the twentieth century ushered in a new era of development in the commercial citrus industry in Florida. The citrus

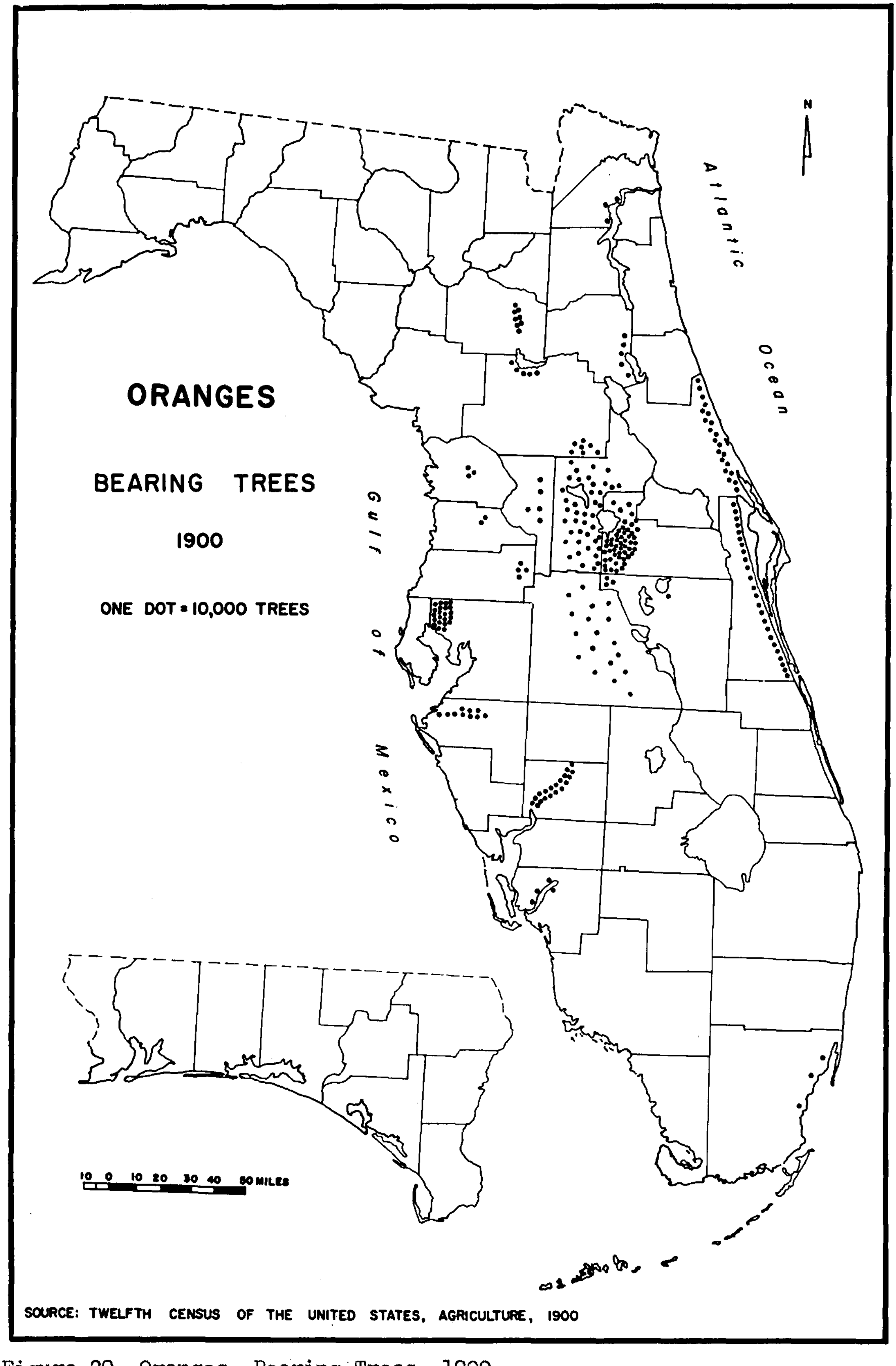

Figure 20. Oranges, Bearing Trees, 1900.

district of northeast Florida had passed its golden era; the challenge for leadership of the citrus district in north central Florida had been short lived; particularly in the northern half of the sector, Alachua and Marion counties. Heretofore, groves plantings were related to water and land transportation, and local soils; now for the first time in the history of the state's citrus industry attention was focused on the protection of citrus plantings from the hazards of frost damage. The first adjustment was an almost wholesale migration south of the citrus production of the northern districts. Although tree losses had been great in central Florida during the freezes of the late 1890's, percentage-wise they were small when compared with losses in the northeast and northern portions of the north central districts. All counties south of the latitude of Marion county, actually had an overall increase in the number of bearing trees during the decade from 1890 to 1900, despite the losses suffered in the "Big Freeze," (Figures 18 and 20).

The new era of development of the citrus industry was then centered in the present districts of The Ridge and Highlands, Indian River, and Tampa Bay; it was based upon the planting of new groves rather than the rehabilitation of old ones (Figure 15). Only in parts of Lake, Orange, and Seminole counties is there any overlap in the old centers of production and the modern ones. This southern area of the old north-central Florida citrus district is today the northern fringe area of The Ridge and Highlands. In this respect one might say this present marginal area acted as pivot between the old and new centers of production.

By 1920 increases in citrus plantings and production occupied general locations that are representative of the patterns of localization which exist today (Figure 21). Access to rail transportation, and still water transportation were necessary requisites which localized areas of plantings in the new citrus districts of the time. The individual site locations of groves in The Ridge and Highlands were for the most part the result of trial and error in selection over a several year period of observation; the intentional location of groves on slopes in order to take advantage of cold air drainage on nights of potential frost was not as yet realized. However, growers throughout The Ridge and Highlands soon discovered that citrus trees planted on high pine land, what they called "black-jack oak land," were more apt to survive during a freeze than citrus trees planted in the flatwoods, and lower slopes of the highlands. Black-jack oak land became a synonomous term for good citrus land.[9]

The citrus tree was also well adapted to the black-jack oak areas of the high pinelands owing to the well drained characteristic of the soils, yet most of the true high pineland soils were too excessively drained in natural characteristic to be readily adapted to the citrus culture of the 19th century. Although annual rainfall exceeds forty-eight inches the droughty nature of these sandy high pineland soils combined with the high temperatures of the climate renders

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[9]Camp, op. cit., pp. 7-8.

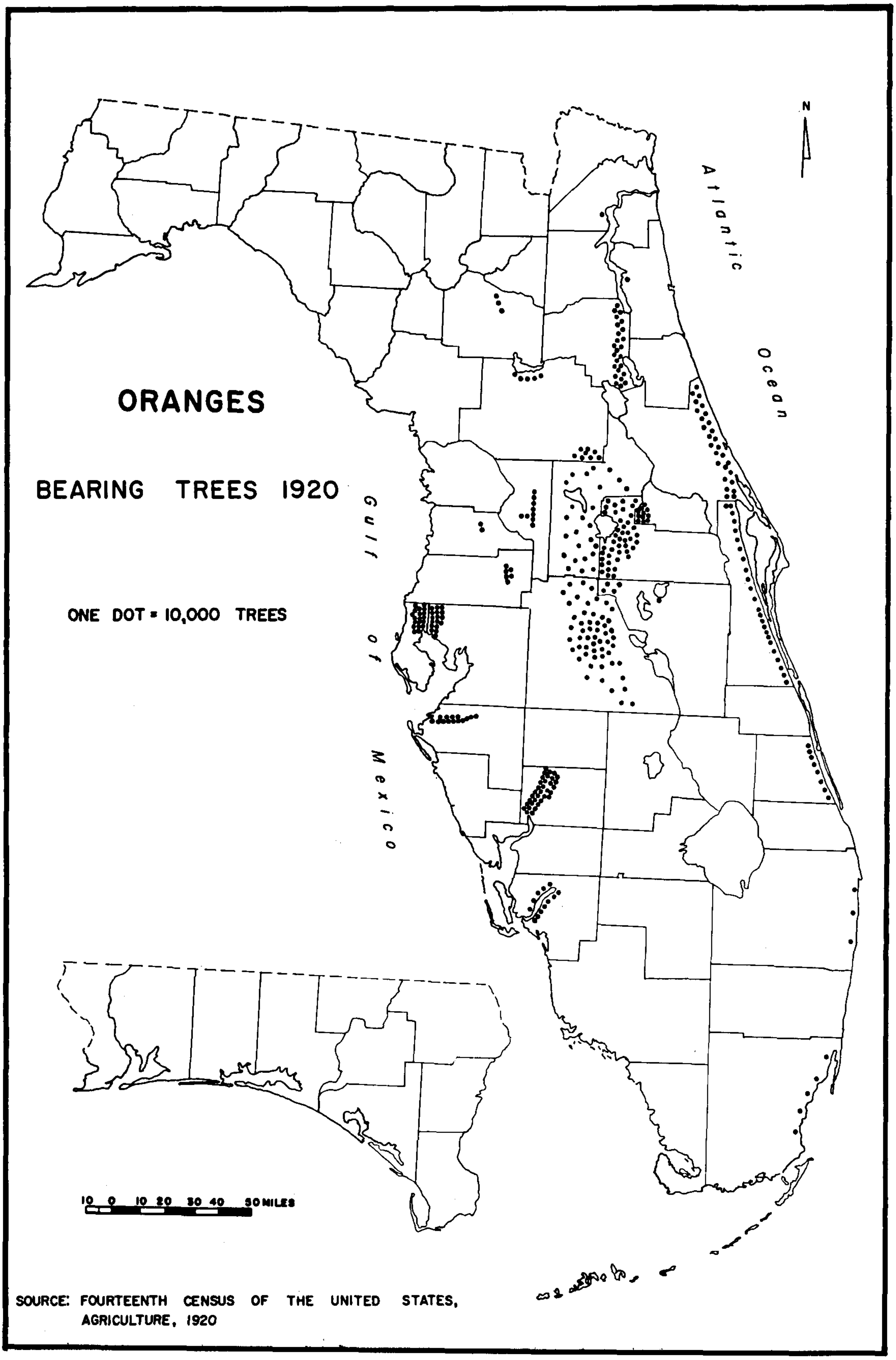

Figure 21. Oranges, Bearing Trees, 1920.

an evapotranspiration ratio to the area similar to the dry margins of the humid climates as found in Texas, Oklahoma, Kansas, and Nebraska, insofar as related to potential available moisture for plant growth.

Fortunately, during the first decade of the twentieth century it was discovered that through the use of a rough lemon root stock orange trees could be grown on the excessively drained soils of the highlands, which actually were the most favored locations in respect to frost protection.[10] The use of commercial fertilizer also was introduced for the first time in the citrus areas of Florida during this period. Owing to the infertile character of the Florida soils, particularly those of the high pinelands, the value of fertilizer was soon realized in both the new as well as the old districts. Today, the majority of the citrus acreage is found in the high pinelands. Thus, the introduction of the rough lemon root stock and commercial fertilizer, though not causing, have certainly allowed increases in production within the district, which have followed in the succeeding decades.

The grapefruit first made an appearance in the commercial fruit markets of the United States during the 1880's, yet the production of grapefruit was relatively insignificant compared with that of the orange until this period of the early twentieth century. Although the grapefruit was introduced in Florida as early as 1809, it was considered only as an ornamental, and several years elapsed before this variety of

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[10] Camp, op. cit., p. 8.

citrus was realized, even by the local people, to be an edible and nutritious fruit. Knowledge of this value was gradually passed on to the tourists from the northeastern United States, and in time the grapefruit became a popular breakfast fruit.[11]

The history of localization of the major grapefruit producing districts differs greatly from that of the orange districts in Florida, although the areas today coincide. This difference is primarily a result of the location of the initial areas of planting in Florida, plus the relatively late period of major commercial development. Don Phillippe, a Spanish nobleman, first introduced the grapefruit to Florida from Jamaica in 1809, in the Tampa Bay area near what is now Safety Harbor.[12] Hence, grapefruit culture, unlike that of the orange, began in central rather than north Florida. Plantings of grapefruit trees spread very slowly through Florida during the nineteenth century owing to the general lack of commercial interest in the fruit. Once the commercial value was realized grapefruit plantings increased quite rapidly. The first period of expansion happened to occur following the freezes of the 1890's. This was at the time the orange industry was in the process of regrouping and moving southward.

In general, the first commercial grapefruit plantings were made in the new districts of commercial orange production. The greatest

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[11] Webber, op. cit., pp. 25-31.

[12] Ibid.

intensity of grapefruit production was around Tampa Bay, the original area of introduction; from there the grapefruit spread into the neighboring Ridge and Highlands. By 1920, grapefruit plantings had increased in the Tampa Bay and Ridge and Highland Districts; and had expanded into the Indian River District to the east, as well as, somewhat into northeast Florida (Figure 22). The general pattern of the location of grapefruit producing areas that exist today was set by the end of the second decade of this century, just as in the orange producing districts.

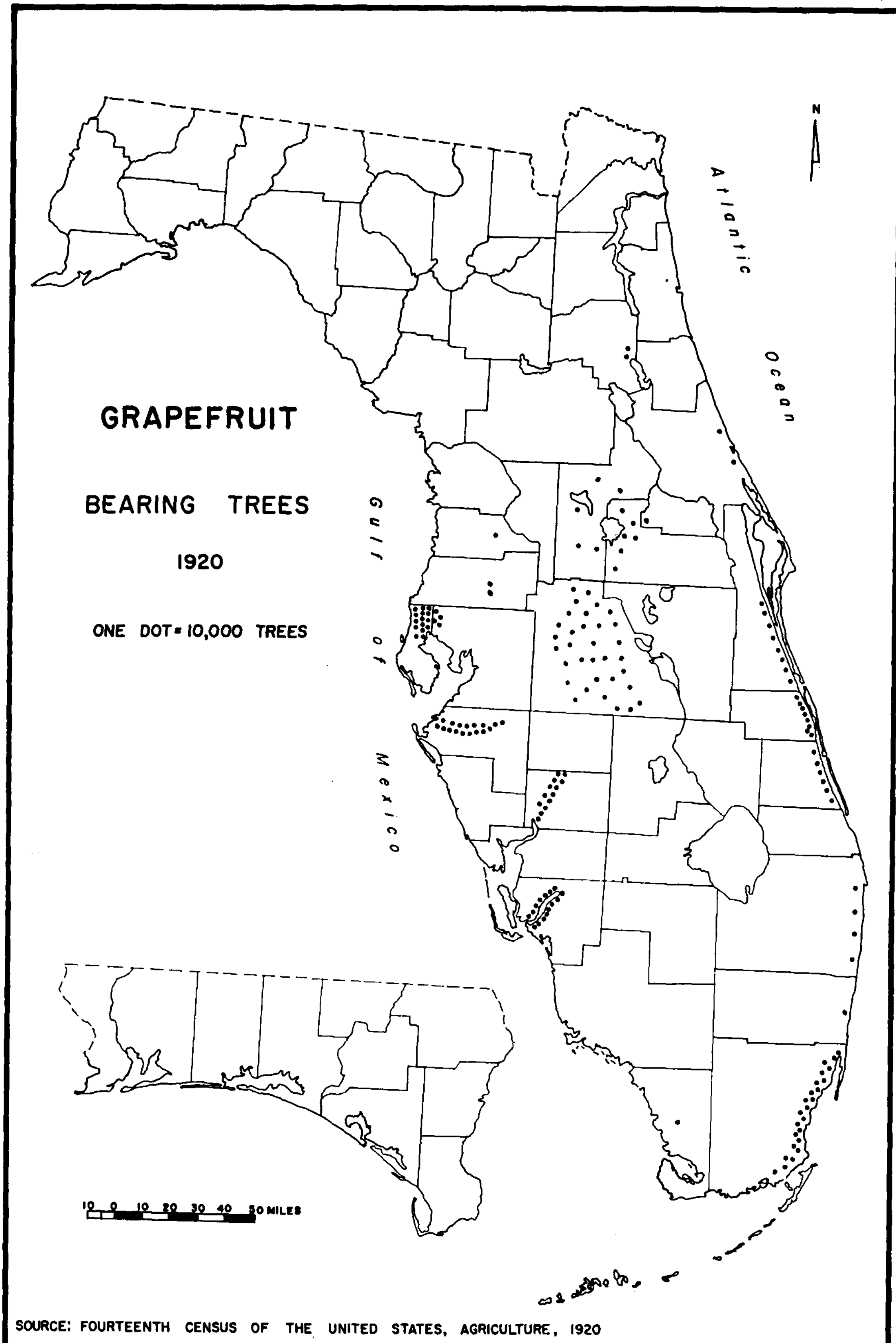

Figure 22. Grapefruit, Bearing Trees, 1920.

CHAPTER VIII

INTENSIFICATION IN THE RIDGE AND HIGHLANDS CITRUS DISTRICT

Successful citrus tree plantings have continued to increase the total land area of commercial production within The Ridge and Highlands. Expansion from the multi-nucleated core of the district, which had been well established by 1920, proceeded during the ensuing decades of this century, gradually completing the present outline of this fruit growing district in Florida. An increasing demand for citrus in the nations' markets, a continued rail and road building program in the citrus district, the introduction of scientific agriculture, the introduction of processing industries, and finally a decline in other citrus fruit districts in the United States are factors which collectively are responsible for the current degree of intensification of fruit production in The Ridge and Highlands.

I. PERIOD FROM 1920 to 1940

Intensification of citrus fruit growing in The Ridge and Highlands during the third and fourth decades of the twentieth century was accomplished, first, by the planting of trees along the relatively higher elevations near the towns of the district, thereby extending the existing groves of the time.[1] Later, younger trees were planted

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[1]Summation of Statements by Agricultural County Agents in Study Area, Personal Interview.

downslope from these groves (Figure 23). By 1940 The Ridge and Highlands was much more developed in citrus plantings than the òther citrus districts of the state (Figures 24 and 25).

The maximum extension of planting downslope at any individual site was a selective process involving time. The frost hazard was the primary determinant. A downslope site would be allowable for several years, and then the damaging sub-freezing temperatures of one year would necessitate a reevaluation.

The growers were aided during this period of the state's citrus history by a growing wealth of knowledge about microclimates and their relationships to grove site location. The temperature differences between high ground and low ground sites in a local area owing to the principal of cold air drainage downslope on a night of excessive terrestrial radiation was realized as common knowledge throughout the citrus district. The citrus grower was no longer dependent upon the empirical observation of "black-jack oak land" in locating a new grove, yet still the downslope extension of planting was necessarily controlled by the trial and error method over a period of several years.

Methods and devices of frost protection also became widespread throughout The Ridge and Highlands during the 1920's and 1930's. The universal use of these devices has no doubt allowed many grove site locations to continue production and in some cases has saved the on-tree crop.

Increases in citrus tree planting and fruit production from 1920 to 1940 in The Ridge and Highlands were primarily related to a

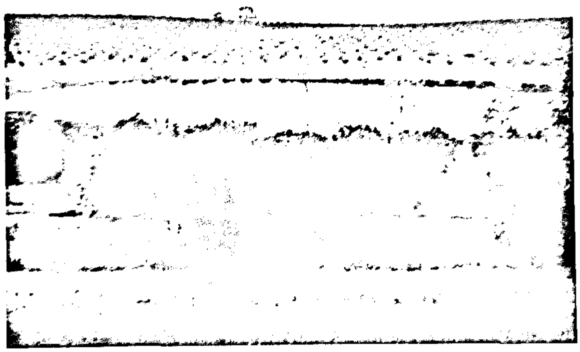

Figure 23. Grove Landscape in the
Ridge and Highlands.

Figure 23. Grove Landscape in the Ridge and Highlands.

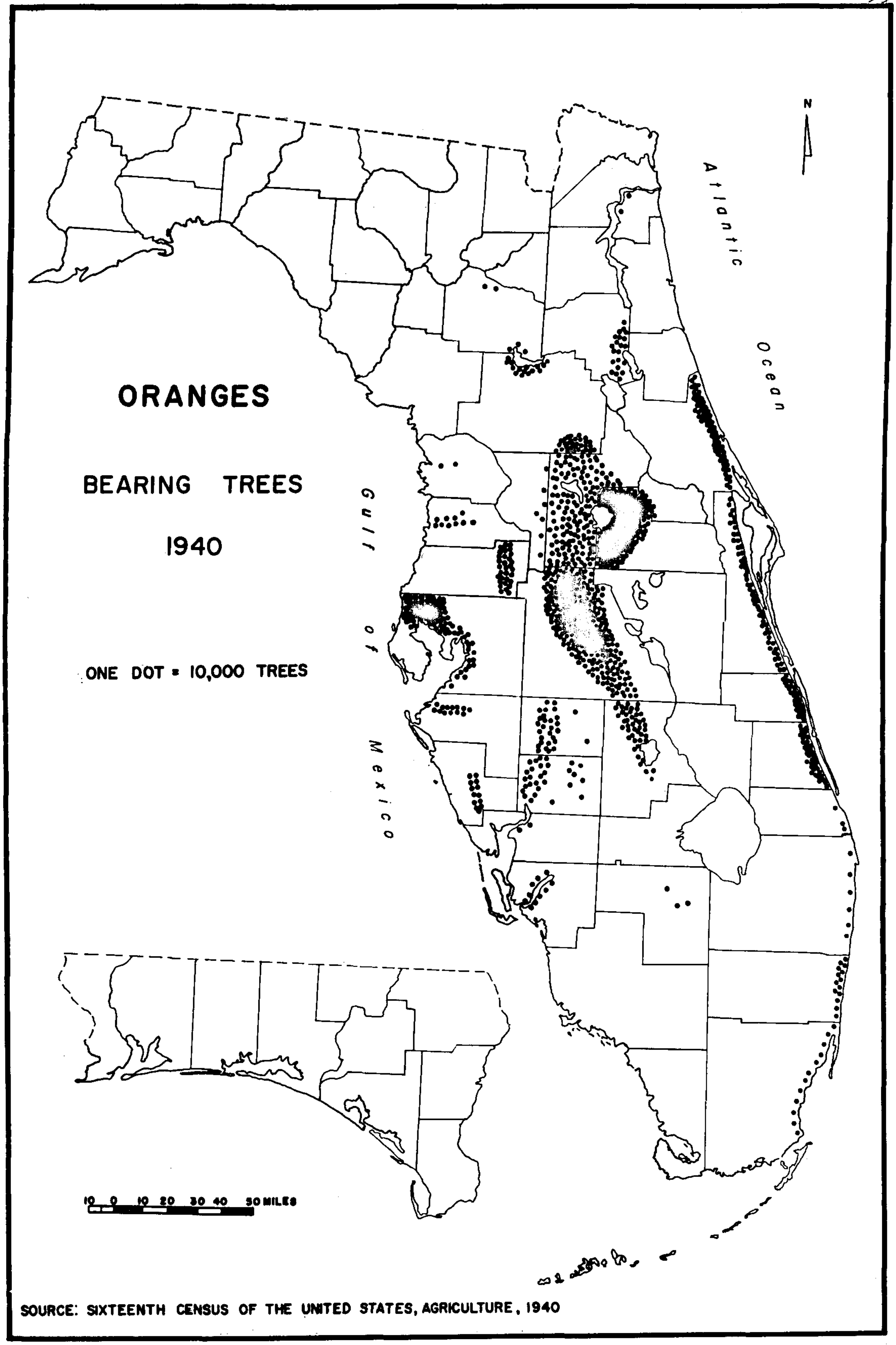

Figure 24. Oranges, Bearing Trees, 1940.

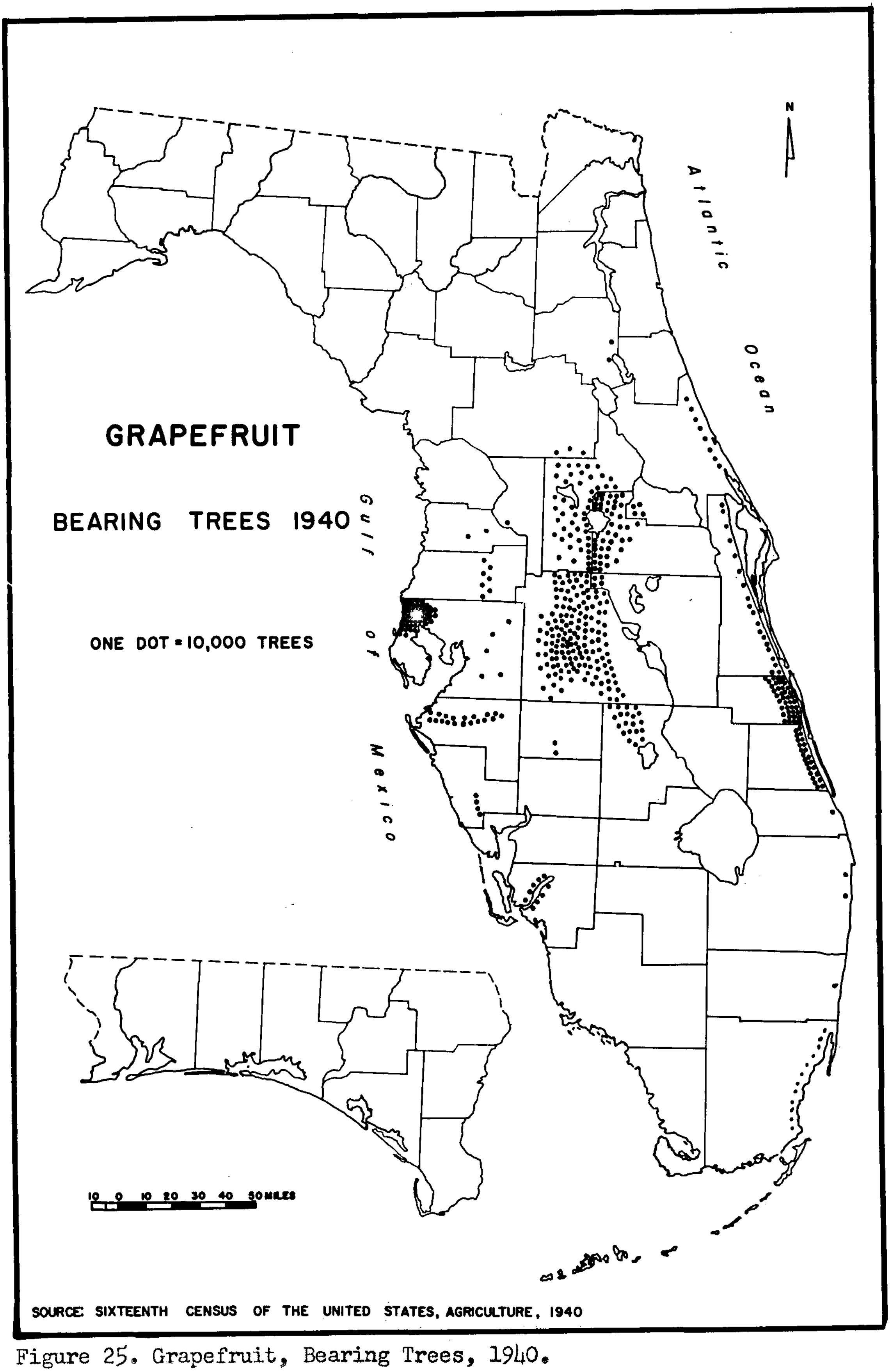

Figure 25. Grapefruit, Bearing Trees, 1940.

rising demand for citrus. As such, most of the planting of the period was a natural expansion in relation to market growth. Conversely, some tree plantings were most unnatural in this respect, more speculative in nature, yet in keeping with the economic tempo of the time. These were the years of the infamous "Florida Boom," and the citrus industry was subjected to the perils of the period. Real estate men throughout Florida were responsible for speculatory tree planting and consequent sale in order to gain a quick return. The ultimate result in time was a serious problem of excessive citrus groves and overproduction.[2]

The threat of economic ruin owing to the overproduction of citrus fruits throughout the state was averted at that time by the introduction of the processing and canning industries. Canned single strength juice and fruit sections soon gained popularity in the major markets of the United States. To the consumer the canned products meant a year-round supply of citrus which was available in a convenient form to store and prepare. However, to the Florida grower the canned forms represented a medium through which to market his surplus crop.

A program of research for new uses of citrus fruits was introduced during this twenty year period and has continued to the present. Research has led not only to product variations in the edible forms of citrus, but also to a variety of by-products such as citrus

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[2]Warren Strain, "The Florida Citrus Crop," Economic Geography, Vol. XVIII, (January, 1952), pp. 24-25.

pulp, molasses, and essential oils. The citrus growers and processors of the state have been aided in their quest for additional forms in which to market their products by both the Florida State Experiment Station established at Lake Alfred and the United States Department of Agriculture Station located at Winter Haven.

The expansion of grove sites during the 1920's and 1930's in The Ridge and Highlands was necessarily related to a continued extension of the transportation network in central Florida. The individual commercial citrus grove of Florida has, at any period in the state's agricultural history, been dependent upon an efficient mode of transportation for its existence. The grove itself must be connected by roadway to a fruit packing or processing plant. The plant facility, in turn, must be linked to the major market regions by either railline, highway, or ship. During the decades of the Florida Boom, secondary gravel and asphalt roads were built throughout The Ridge and Highlands; clay surfaced roads were extended throughout the areas of grove plantings from these secondary roads.

The development and use of the rough lemon root stock in The Ridge and Highlands has been responsible, perhaps as much as any other factor introduced by man, for the present degree of intensification of citrus production in the district. Before the rough lemon root stock was introduced root stocks of the sour orange and sweet orange varieties were mainly used. Neither of the two latter stock varieties were completely satisfactory on the sandy droughty soils of low fertility in the high pinelands.

The rough lemon root stock became increasing popular after its introduction around 1905 owing primarily to its suitability to large scale planting. The rough lemon stock grew fast and well, and was easily budded in the nursery. The budded stock, when transplanted, would produce a tree quickly on the high pineland soils, which were relatively frost free. In addition, the lemon stock has a relatively high tolerance of a tree killing or stunting disease, tristeza, a disease which has been most damaging to plantings on sour orange root stocks.

For a time groves planted with the rough lemon root stock were plagued with problems. There was a marked tendency for the trees to bear in alternate years, and usually there would be a heavy loss of leaves when a crop was carried by the trees. Also, the fruit was of inferior quality. Generally the fruit could be characterized as having a coarse, thick skin, a lack of flavor, and a very poor orange coloring.

These adverse fruit and tree conditions were first blamed on the rough lemon root stock. Later it was discovered that the troubles were owing to mineral deficiencies which are inherent in the soils of the high pinelands. Through fertilizer applications of the so-called minor elements the tree and fruit problems were remedied. As a consequence the rough lemon stock became the most popular for grove planting in the high pinelands. Varieties budded to the sour orange root stock still produce a fruit of better quality than those on the rough lemon stock, yet the quality of fruit produced with varieties budded on the

latter are of good quality and with proper applications of fertilizer bear much heavier on the droughty soils of the high pinelands.[3]

II. PERIOD FROM 1940-1963

The history of continued intensification of citrus fruit production in The Ridge and Highlands from 1940 to 1960 is almost a reiteration of the preceding two decades, only with a somewhat more modern setting. Citrus tree planting was again on a grand scale (Figures 26 and 27). Most of the increased planting was the result of a rising market demand for citrus products related to population increases in the United States and a general rise in fruit consumption in the diet of the average American consumer. Some of the increase in planting and production was related to an increase in demand in foreign markets, particularly Canada, and some, doubtless, was related to an absolute decrease in citrus acreage and decline in citrus production in California, owing to the spread of urbanization. In 1954, the state of Florida, always the leading grapefruit producer of the United States, finally closed the gap and surpassed California in orange production.

During the early 1950's overproduction, once more, threatened the citrus economy of the state. Invention, again, can be credited with saving this important sector of the state's economy from depression.

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[3]A. F. Camp, et. al, Citrus Industry of Florida. Florida State Department of Agriculture, Bulletin No. 2 (Tallahassee, Florida State Department of Agriculture, 1960), pp. 6-15.

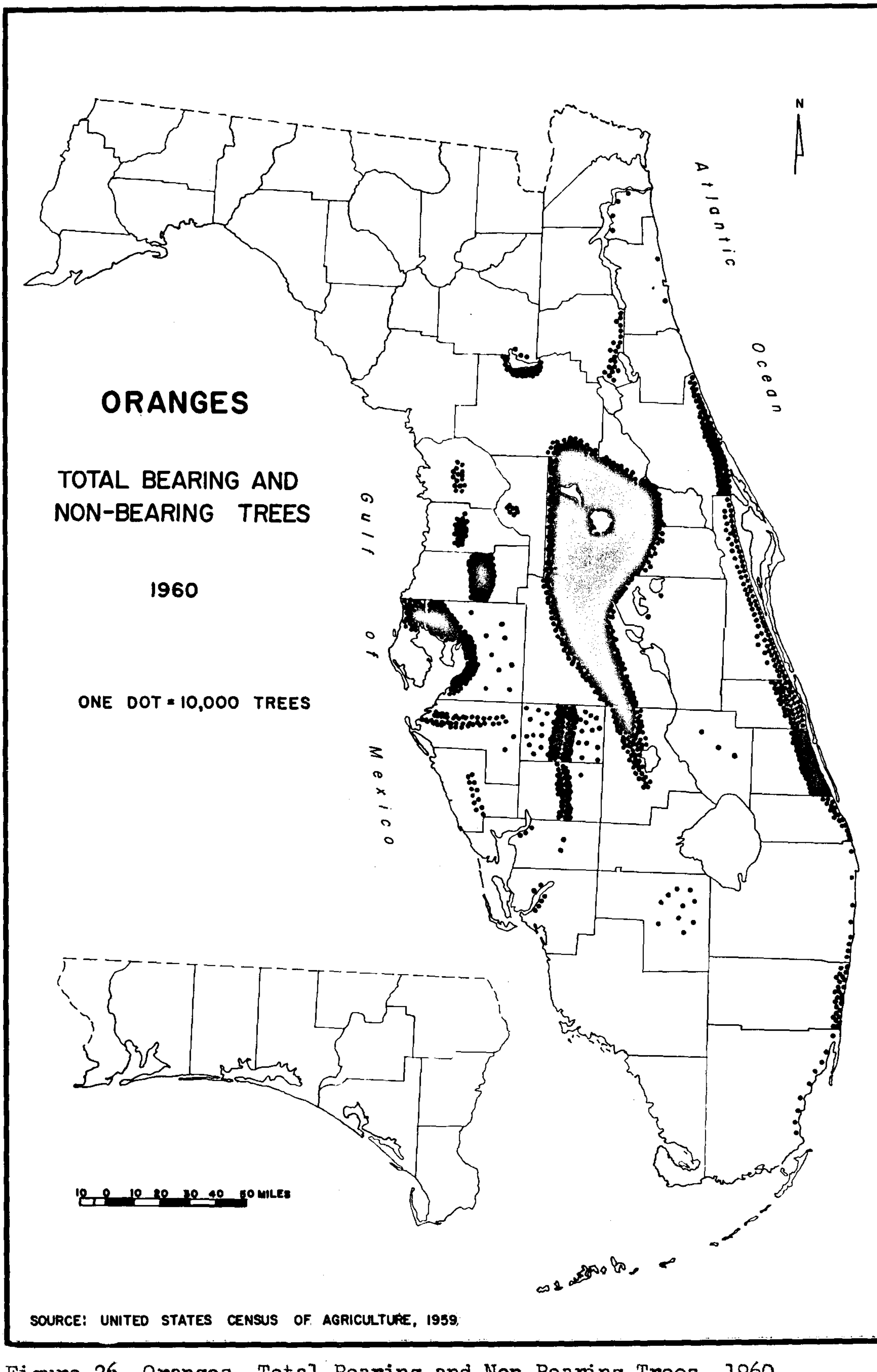

Figure 26. Oranges, Total Bearing and Non-Bearing Trees, 1960.

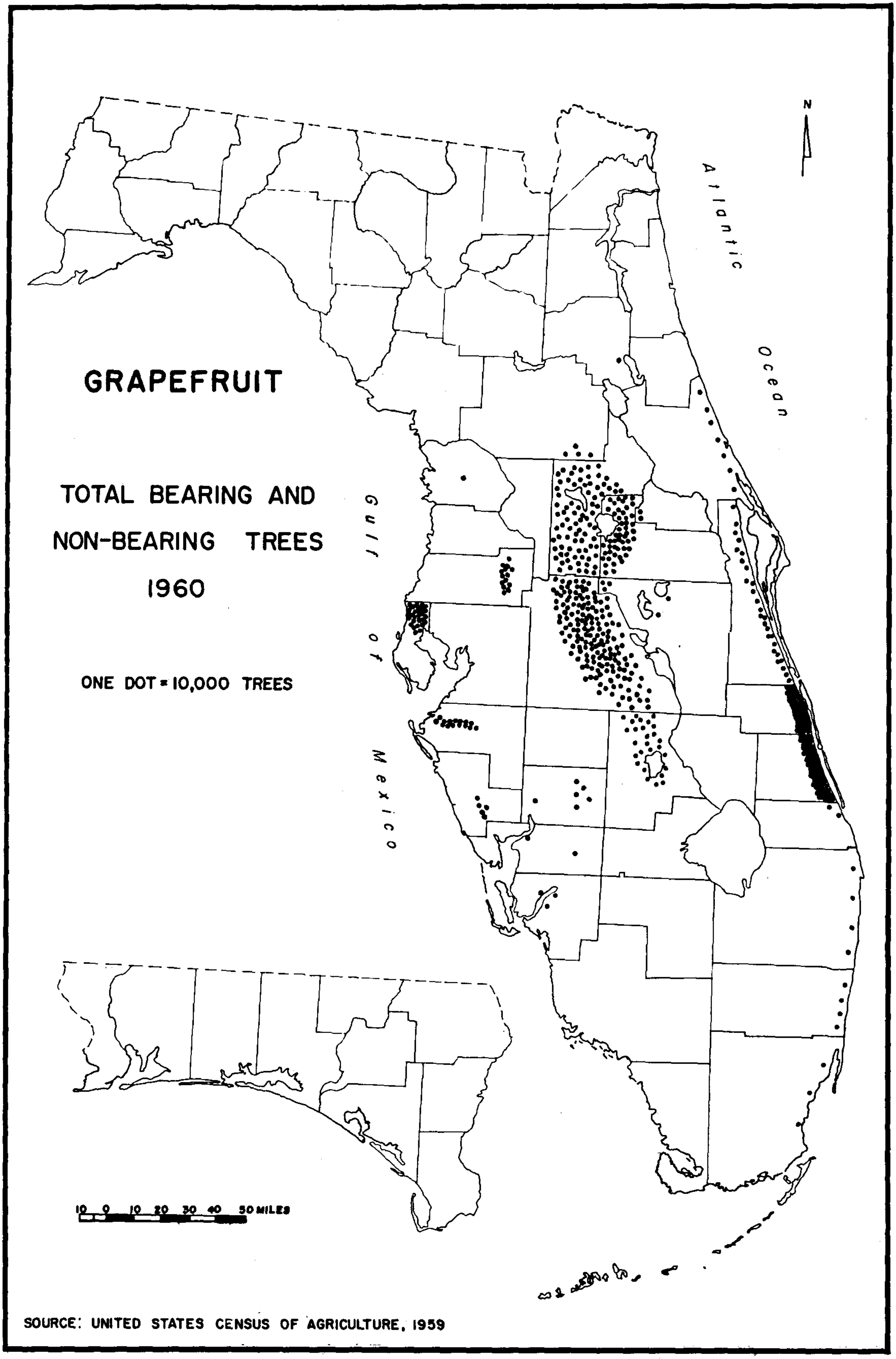

Figure 27. Grapefruit, Total Bearing and Non-Bearing Trees, 1960.

In this instance the introduction of processing frozen concentrated citrus juices relieved the citrus growers of the district of their surplus fruit crop.[4] In the few ensuing years frozen concentrated citrus has become so popular in consumer markets that now over one-half of the entire Florida citrus crop is utilized in this form. In fact, processing, in general, is no longer merely a method of disposing of the surplus fruit crop in Florida. Rather, the processing of canned single strength juices, fruit sections, and concentrate juices presently account for the marketing of approximately two-thirds of the state's citrus.

New roads constructed during the 1940's and 1950's continued to open up new areas to citrus tree planting. For example, United States Highway 27, which follows the Ridge in southern Lake and northern Polk counties, was not completed until 1949, and this section had no secondary roads. This area has always fulfilled the natural requirements of prime citrus land. The slope of the terrain is great enough for adequate air drainage for frost protection, and the sandy soils are underlain by clay, an asset for fertilization and irrigation. Yet, this portion of the Ridge had remained unused owing to its inaccessibility until the highway was built. The citrus tree planting along

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[4]Frozen concentrate citrus juice is made by evaporating normal single strength juice under vacuum at a low temperature (60-80 degrees F.). The end product is about one-fourth of the original volume. The concentrate is frozen for preservation because it is not pasteurized. Pasteurized concentrated juice can be made, but it suffers flavor loss in processing and storage.

this highway following its completion actually linked the north half of the citrus district to the southern half; thereby creating a contiguous line of citrus groves along the Ridge.

Citrus tree plantings elsewhere in the district during this period were again made by extensions downslope from existing groves. This time it was not a case of trial and error method by the growers, for they had full knowledge of the frost hazards. It was done with the realization that the trees might be lost, and then it would be necessary to plant new ones in their place. However, the production of a few frost free years can offset the cost of planting involved, and, hence, bring a profit in the long run.

Beginning in 1960, wind machines were introduced into The Ridge and Highlands. The wind machine has allowed the planting of citrus trees in the relatively low pockets of the uplands and on flat lands with well drained soils at the margins of groves. The wind machine is a giant fan propelled by a liquid fuel (Figure 28). The object of the wind machine is to prevent frost on a cold night of excessive terrestrial radiation. In principle the machine mixes the air in a grove to prevent a temperature inversion with colder air settling near the surface. One wind machine when in operation will circulate air through about ten acres of groveland. These machines evidently have proved successful. One large citrus corporation purchased several additional wind machines in 1961 as a result of the successful performance of a few machines in a minor freeze that winter.[5]

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[5]Statement by Ken Enzor, Personal Interview.

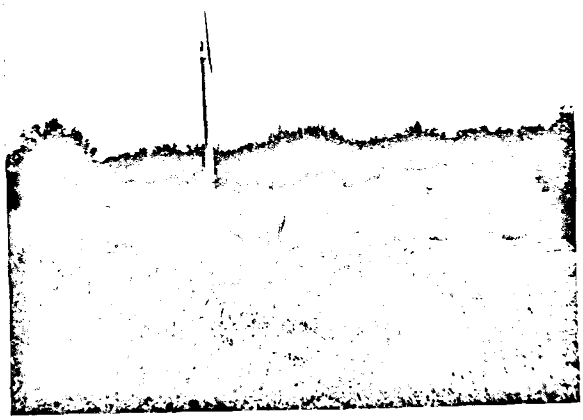

Figure 28. Wind Machine.

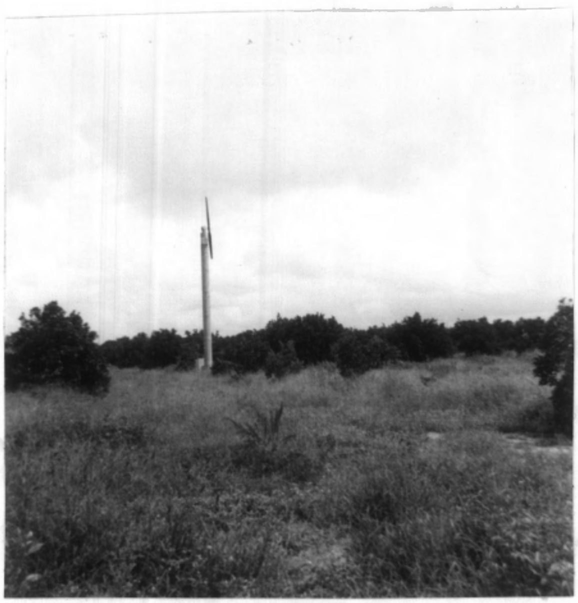
Figure 28. Wind Machine.

However, although the general acceptance has been rather rapid; the machines, as yet, are not a major landscape feature in the district.

CHAPTER IX

CITRUS FRUIT PRODUCTION

Citrus fruit production, from the seed bed to the harvesting of mature fruit, has become a highly specialized agricultural activity in The Ridge and Highlands. The growing of citrus fruit in the district is characterized by such modern scientific practices as the selective propagation of root stocks and varieties, and planned programs of fertilization, irrigation, and disease control. Increased mechanization, as well as continued experimentation, is commonplace in all phases of grove caretaking.

The typical grove caretaker, whether he is a corporation foreman, co-operative foreman, private owner, or caretaker for a private owner, is knowledgable of the time tried and latest developments of his trade. Most often the grove owner or caretaker is an individual who either has grown up with the citrus business, or has attended an agricultural college to learn his trade. These men of agricultural skill through their continued scientific adaptation of agricultural practices to the natural environment in The Ridge and Highlands have been able to improve the quality of their fruit product and increase yields per acre.

Grove caretaking in The Ridge and Highlands includes a number of varied activities which collectively extend the work of the agricultural industry throughout the entire year. Some of the activities such as harvesting, cultivating, fertilizing, and pruning are seasonal.

Other activities, frost protection, disease control, and irrigation bridge the gap from being almost periodic to non-periodic in practice.

The amount of labor required for citrus production in The Ridge and Highlands fluxuates seasonally. Most of the chores of this agricultural industry are accomplished by a small year round labor force. However, the harvest season, which now extends from October to July, witnesses a gradual influx of migratory labor from about September to March to augment the local labor supply. From December to May the number of migrant laborers averages from eighteen to twenty thousand persons. The migrants are either Caucasian or Negro, most of whom come to the citrus district from other commercial fruit areas in the eastern United States. March is the peak month of the harvest season; some mid-season fruit varieties are still in production and the late season varieties are reaching maturity. Beginning in April there is a steady outflow of the supplemental labor force as the amount of the crop coming into maturity decreases. The migratory workers move on north to other fruit speciality areas; some eventually reach the cherry districts of Michigan. The local labor remains in the district to pick the remainder of the fruit; to cultivate, to fertilize, to spray, and to irrigate, if necessary, the groves; and, or, to do odd jobs such as pruning, budding nursery stock, top working trees, or mending field crates.

The citrus landscape in The Ridge and Highlands appears to be continuous grove with mile after mile of fruit trees, interrupted only by citrus towns, karst depressions, lakes, and upland flats (Figure 2).

There are few fences dividing properties and very few houses occur in the groveland. As a general rule the growers live in the towns and do not visit the grove every day. The typical grove owner in The Ridge and Highlands has full time employment outside the grove which may or may not be directly associated with the citrus growing industry.

Actually the grove landscape is divided into small landholdings. A five to ten acre grove is most typical for the district. Generally, the older groves around the towns of the district show a concentration of five and ten acre properties. Larger groves, twenty acres or more are located in the newer areas of planting. Small growers still hold a majority in The Ridge and Highlands, although the trend is toward larger landholdings by corporations, usually packers and canners. An individual small grower's total landholding may not be contiguous; he may have a five acre grove in one section of the district and a ten acre grove in another section. Even the large landholdings of the corporations, one to two thousand acres or more, are not consolidated into continuous acreages.

Individual grove properties are rectangular in shape as they are based on the United States Rectangular Land Survey System in this central section of Florida. The rectangular pattern resulting from property lines is sometimes apparent, sometimes not. The rows of trees reflect the rectangular pattern and also the fringe areas of the uplands show the abruptness of the square property line. Elsewhere, particularly on the fringes of the uplands, and at the margins of depressions and

flats in the uplands, the edges of the groves are quite irregular in outline reflecting the limiting qualities of poorly drained soils and frost hazard in location. In these marginal areas as much as one-quarter or more of a property may not be planted to citrus trees owing to the limiting characteristics of its physical condition.

Doubtless, there are many acres scattered throughout The Ridge and Highlands which are physically suitable for the growing of citrus trees, yet are too small to be considered economically usable by a grower because the small potential groveland is only a fraction of a large parcel of property. For example, an acre or two of potential groveland can be found adjoining an existing grove, but the small plot of groveland is a part of a quarter section of property. Construction of an access road would be necessary for the present owner to utilize the groveland, or in order for the grower on the adjoining bit to make use of this groveland it would be necessary that he purchase the unusable portion of the property as well. Hence, many small acreages of citrus land continue unplanted owing to the fact that the physical lines and cultural property lines do not coincide.

I. PROPAGATION AND PLANTING

Although the citrus industry of Florida started with seedling trees, propagation practices have changed this to the point that now all plantings are made with budded stock. In The Ridge and Highlands as elsewhere in the state, citrus growers choose a citrus variety and

and rootstock combination for budding which will best provide the desired characteristics of quality and quantity in production, and yet, be adaptable to the particular natural elements which occur at the individual grove site. The propagation of citrus plants was for a time a speciality of the nursery. However, today this skill is included in the work schedule of many growers as well.

The requirements for the seed bed of a citrus nursery are much the same as those for a grove site, that is a well-drained soil and a relatively frost-free location. Soil fertility is not a major consideration as liberal amounts of fertilizer are used. In addition many seed beds are provided with an overhead irrigation system to maintain adequate soil moisture, and some few are located under a lath shade in order to conserve soil moisture. An elevated seed bed is shown in Figure 29.

The rough lemon, sour orange, and sweet orange rootstocks are all planted in the seedbed after the threat of frost is passed as young seedlings are killed when frozen to the ground. The trifoliate stock can be planted in the fall for it can survive frost. Seedlings are usually transplanted after eighteen months in the seed bed; only the best specimens are used. Seedlings are closely spaced in the nursery in order to facilitate intensive care. The nursery rows are planted from three to four feet apart with the seedlings about a foot apart in the rows. The seedling is grown in the nursery one full year before being budded with a desired variety.

Budding is usually done in the fall (dormant budding), although it is also done in the spring and summer. The budwood is taken from

Figure 29. Elevated Seed Bed.

Figure 29. Elevated Seed Bed.

bearing trees of the particular variety desired. As the bud begins its growth the seedling top is either cut off, or if the seedling is large the top is lopped, cut partially through (Figure 30). Lopping allows the bud a good beginning in growth and at the same time leaves some top to support the root system. This practice also eliminates the probability of the bud being flooded by excessive sap; something which can happen if the top is completely removed. After the bud shoot has grown to over six inches in length the seedling top is completely cut off. As the bud shoot grows it is staked and tied in order to train it to grow upright. Later, when the budded seedling is from one to three feet in height it is topped with clippers; this starts the formation of the tree.

Nursery stock is cultivated frequently during the year with the exception of the autumn season. Infrequent cultivation in the fall allows the citrus tree to harden before the frost season. Fertilizer is generally applied three times yearly in the nursery, in the early spring, in June, and in late August or early September.

The budded trees are usually allowed to grow in the nursery at least one year prior to being planted into the grove.[1] Some growers using their own nursery stock prefer leaving the trees in the nursery for two or three years as the plants are easier to care for owing to the

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[1] A. F. Camp, et. al, Citrus Industry of Florida, Florida State Department of Agriculture, Bulletin No. 2 (Tallahassee, Florida: Florida State Department of Agriculture, 1960), pp. 50-68.

Figure 30. Lopped Seedling in Nursery.

Figure 30. Lopped Seedling in Nursery.

fact that they are more closely spaced in the nursery than in the grove.[2] Trees are removed from the nursery and planted in the grove most commonly in the winter or early summer.

The spacing of citrus trees in the groves of The Ridge and Highlands is significant in regard to cultivation practices as well as in relation to total fruit production. Any spacing employed must take into account the mandatory use of mechanical equipment. The number of trees planted in a grove is usually a compromise. In general citrus trees closely spaced in a grove will result in higher yields per acre up to fifteen years, but then it is necessary to remove some trees so that the grove can be cared for. Conversely, a wider spacing will result in low yields per acre at first, yet heavier yields following the first fifteen year period.

In recent years most groves have been planted with a spacing of twenty-five feet by twenty-five feet for orange trees and thirty feet by thirty feet for grapefruit trees. The former spacing results in 69.7 trees per acre, the latter in 48.4 trees per acre. In many older orange groves a spacing of twenty feet by twenty feet was used, which gave the groves 108.9 trees per acre.

These older plantings were difficult to maintain until hedging was introduced. Hedging usually consists of trimming rows of citrus trees in one direction with a vertical mechanical pruner, a hedger.

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[2]Statement by Ken Enzor, Personal Interview.

The object of hedging is to provide a six to eight foot aisle between the rows of trees so the essential heavy equipment can pass through. This practice has a very small, if any, adverse effect on production for very little of the bearing surface of the tree is lost in the hedging operation.[3]

In the closely spaced groves hedging must be done periodically. Even the twenty-five by twenty-five plantings after several years require hedging in order to facilitate efficient use of cultivating and spraying equipment.

A spacing of fifteen feet by thirty feet (96.8 trees per acre) is considered feasible when the grove is young if alternate trees are removed between the tenth and fifteenth years, leaving a spacing of thirty feet by thirty feet. This practice, double planting, is considered excellent for a grove owner who wishes a quick return on his investment. If the alternate trees are not removed by the twentieth year of the grove's life mechanical maintenance becomes increasingly difficult.

The number of trees per acre is much greater in other world citrus regions where a more intensive use of hand labor is economically feasible. Spanish groves, for example, are spaced from ten feet by ten feet up to eighteen feet by eighteen feet, and hand pruned so that the branches just touch. The former spacing results in 400 trees per acre. Unfortunately, the extensive use of mechanical equipment and high cost

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[3]David S. Prosser, Hedging Machine for Citrus Groves, University of Florida, Agricultural Experiment Station, Bulletin No. 519 [n.p.], pp. 2-11.

of labor in The Ridge and Highlands precludes the possibility of employing Spanish methods.[4]

II. PERIODIC GROVEWORK

Practices of cultivation, fertilization, spraying, and pruning are almost completely standardized in The Ridge and Highlands, although they do vary somewhat in detail. Likewise, these operations are almost entirely mechanized, with the exception of some hand pruning. Until the 1930's hoeing under the trees was still a general practice, but it was finally abandoned owing to labor costs. The groves of the district are cultivated in the fall, winter, and spring; a cover crop is allowed to grow during the summer. In the fall, after the summer rains are over, the cover crop is disked into the soil or plowed under. The groves are harrowed at anytime during the winter if there is a warm moist period of duration in which the cover crop begins growth. The groves are again cultivated at the end of the spring dry period, around the middle of May.

Plowing the cover crop under incorporates some organic matter into the infertile soils of the uplands. Keeping the grove clean cultivated during the fruit season serves several additional purposes. One, clean cultivation eliminates the citrus trees' competition for moisture during the fall, winter, and spring. Two, it diminishes the

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[4]Camp, _op_. _cit_., pp. 97-99.

potential fire hazard of the relatively dry spring months. Three, the clean floor of the grove does not impede the drainage of cold air during a possible winter freeze.

Erosion by water is not a major problem in the area, but some damage is done by wind erosion. Sand blast caused by occasional strong winds when the groves are clean cultivated can cause injury to the citrus fruit and trees. Some growers leave a strip of the cover crop down the middle of the aisle between tree rows in their grove to help retard the movement of sand and minimize losses due to sand blast (Figure 31).

The cover crop is allowed to take over in the groves during the summer months when there is usually an abundance of precipitation and certainly no danger of frost. The cover crop in most groves is comprised of an admixture of native grasses and weeds (Figure 32). Legumes are not generally used for they are extremely difficult to grow on the sandy soils of the district. The cover crop is usually mowed or chopped with a mechanical chopper once each summer; either practice allows a second crop to grow.

In addition to adding humus to the soils, the cover crop protects the soils from the sun's heat during the summer, and the non-cultivation practice of the summer retards the natural loss of organic matter through oxidation during that period. Most growers in the district today fertilize the middles of the groves as well as around the trees in order to encourage the growth of the cover crop.[5]

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[5] Ibid, pp. 109-112.

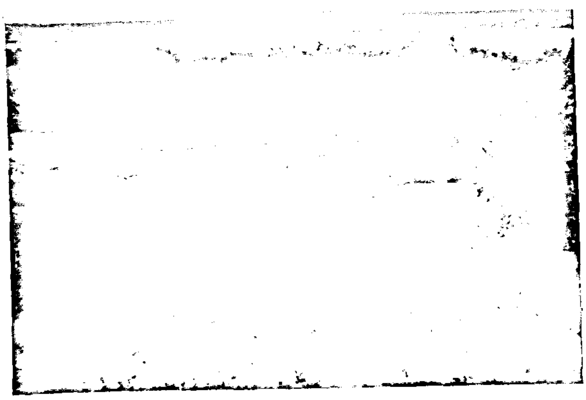

Figure 31. Cover Crop Left in Grove Middles After Cultivation

Figure 31. Cover Crop Left in Grove Middles After Cultivation

Figure 32. Cover Crop During Summer.

Figure 32. Cover Crop During Summer.

Most groves in The Ridge and Highlands receive major fertilizer applications three times a year, and this also is accomplished during the fall, winter, and spring. The time of year that the application of fertilizer is made either precedes or coincides with the periods of growth, in January or February before the spring growth, May or June before the summer growth, and in October or November during the fall growth. The average amount of fertilizer used at each application is approximately one and two-thirds pounds per box of anticipated production.

The simplest fertilizer program adhered to in the citrus district is one of three equal applications per year, although many growers vary the amounts and elements of fertilizer in each application. Often in the past growers relied upon tree or fruit reaction to determine the nutritional needs of the grove. However, this practice proved to be misleading for many mineral deficiencies will not appear for several years, and then, suddenly, there is a rapid tree decline or a decline in production.[6] Today, soils testing is done in the grove by progressive growers in order to determine nutritional needs (Figure 33).

Fertilizer programs are related to the needs of the particular rootstock and variety used in a grove, and to the soils. The major citrus soils of The Ridge and Highlands are the sandy Lakeland, Blanton, Eustis, and Orlando, all of which are acid and infertile. The nutritional program used presently includes all of the elements required of

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[6] H. J. Reitz, et. al., Recommended Fertilizers and Nutritional Sprays for Citrus, University of Florida, Agricultural Experiment Stations, Bulletin No. 536A [n.p.], 1959, pp. 1-3.

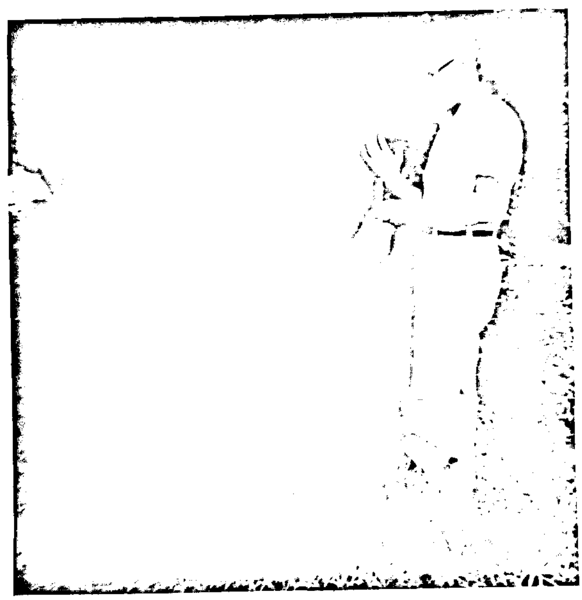

Figure 33. Taking a Soil Sample.

Figure 33. Taking a Soil Sample.

plants; they are nitrogen, phosphorus, potassium, calcium, magnesium, manganese, copper, zinc, boron, molybdenum, iron and sulphur. Manganese, copper, zinc and molybdenum are applied directly to the trees as sprays. The practice of utilizing all of these elements had its inception in 1935 when the minor element deficiences which caused tree decline and low quality fruit were finally realized. Dolomitic lime is usually applied separately to neutralize soil acidity. The fertilizer application is made by a mechanical spreader, which distributes the material from trunk to trunk between the rows of trees.[7]

Preventative and corrective spraying of citrus groves against damaging diseases is another perrenial activity in The Ridge and Highlands. Presently an estimated 90 per cent of the groves in the district are on some type of spraying schedule.[8] Some groves receive as many as four or five spray applications during the year, whereas others receive as few as one a year. The average spray schedule in a preventative program includes a winter, spring, and summer spraying, plus a spraying at the end of the summer.

The control of some diseases in the citrus district is particularly important to the grower for the fresh fruit market owing to the adverse affect they have on the appearance of the fruit, and thus, resultant lowered grades and prices for the fruit. Of course, all

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[7]Camp, op. cit., pp. 109-112.

[8]Summation of Statements by Agricultural County Agents in Study Area, Personal Interview.

growers are concerned over diseases which reduce the amount of production, and diseases which increase the tree sensitivity to cold and drought.

There are innumerable pests found in The Ridge and Highlands; the most damaging to fruit, foliage, or tree include melanose, lemon scab, psorosis, exocortis, rust mites, purple mites, six spotted mites, purple scales, Florida red scales, and white flies. In addition, tristeza and spreading decline are two diseases, which, although do not completely kill citrus trees, do render them entirely unfit for production. Of all the diseases prevalent in The Ridge and Highlands purple scales cause the greatest loss in fruit dropage, yet the control of rust mites is of the greatest total expense to growers.[9]

The rust mite is a good example of a disease which if not controlled can cause a discoloration of the fruit, and consequently a lower grade and price on the fresh fruit market. This disease can also be damaging to the tree foliage. Rust mites are present in the groves of The Ridge and Highlands throughout the year. The mites are triangular in shape and are so small they cannot be seen without the aid of a magnifying lens. Rust mites are known to be the cause of a smooth brown marking on the fruit.[10]

The check for rust mites includes the leaves as well as the fruit. The grove worker in Figure 34 is checking for rust mites with a

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[9]James T. Griffiths and W. L. Thompson, Insects and Mites Found on Florida Citrus, University of Florida, Agricultural Experiment Stations, Bulletin No. 591 [n.p.], 1957, p. 4.

[10]Camp, op. cit., pp. 133-142.

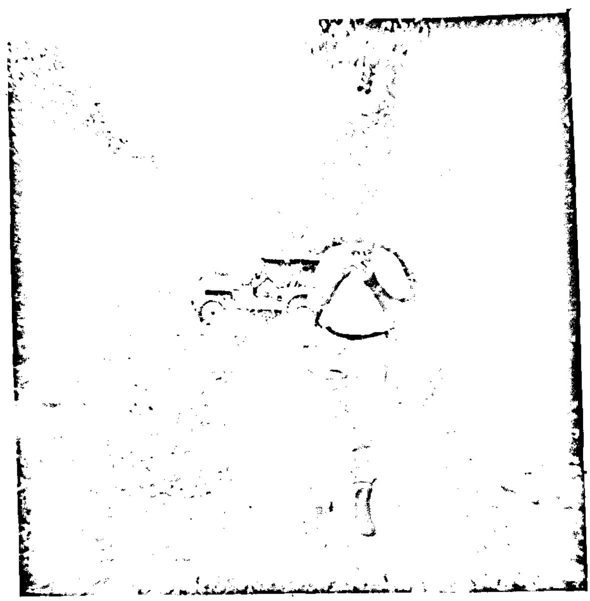

Figure 34. Checking for Rust Mites.

Figure 34. Checking for Rust Mites.

ten power lens. He and a co-worker each will pick five fruit and five leaves at random from this block of parson brown oranges. If the count of mites is over 10 per cent the production manager in the jeep will include this grove in the spraying schedule. The manager has contact by two-way radio with two company spraying units, which are working in other groves in this area (Figure 35).

Hand pruning of citrus trees in The Ridge and Highlands of Florida is comparatively minor when compared to other world regions owing primarily to high labor costs. What little pruning is done is usually accomplished during the summer, the slack labor season, by the fruit pickers who are year-round residents in the district. Most of the pruning involves the removal of deadwood which is a host for fungi. Some pruning of the lower limbs to facilitate the use of grove equipment was done in past years, but now most of this is accomplished by hedging machines.[11]

III. NON-PERIODIC GROVEWORK

Irrigation and frost protection both are in a category of "only when necessary" on the grovework agenda. Frost protection by artificial means has become a common practice for the majority of growers in The Ridge and Highlands. Conversely, irrigation, although it is on the increase in the district, is not so unanimously widespread in

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[11] *Ibid.*, p. 130.

Figure 35. Spraying for Rust Mites.

Figure 35. Spraying for Rust Mites.

practice as is artificial frost protection; and is, in fact, a subject of controversy among the citrus growers.

The total average amount of precipitation registered in The Ridge and Highlands, would be adequate for citrus fruit production if it were evenly distributed throughout the year. However the distribution is irregular in the average year and varies appreciably from year to year. Most often a drought can come in the spring from February to May, and occasionally in the fall from September to November. Actually, a prolonged dry period can even be experienced during the supposedly rainy season of summer. A drought in the spring can prevent the setting of a crop or the loss of leaves and young fruit. In the fall a prolonged dry period can cause a loss of leaves and the more mature fruit. Also, a drought in the autumn tends to lower the cold resistance of the citrus trees, an occurrence which can be disasterous if followed by a cold winter.

Irrigation in The Ridge and Highlands is practiced only during a dry period when a grove is in wilt or when a grove is about to go into wilt. The general practice is to introduce two or three acre inches of water at each application. The source of irrigation water is found in the many karst lakes of the district and deep wells which tap the sub-surface water supplies. Water is pumped by portable gas or diesel engines, and carried by aluminum pipe laid in the grove middles, where the water is administered through a perforated sprinkler pipe (Figure 36).[12]

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[12]*Ibid.*, pp. 142-150.

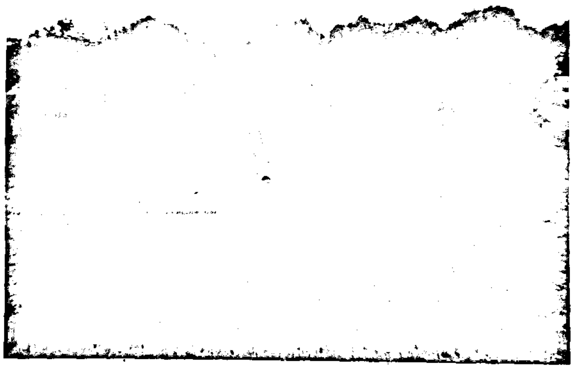

Figure 36. Grove Irrigation.

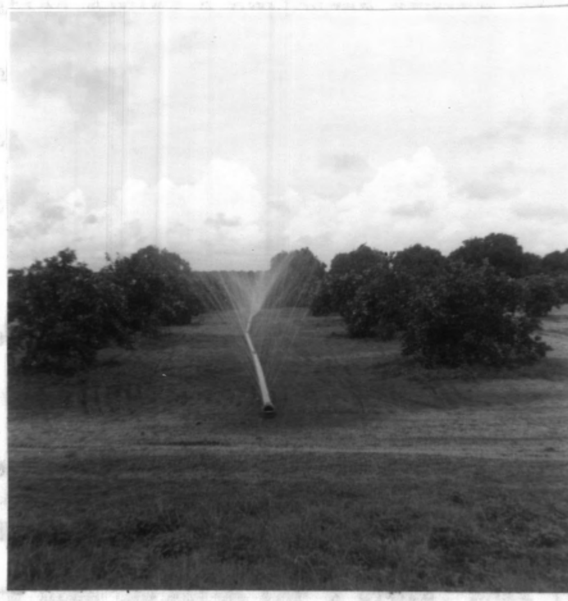

Figure 36. Grove Irrigation.

The amount of acreage subject to irrigation varies greatly from county to county in The Ridge and Highlands. In Polk, Lake, and Highlands counties an estimated 50 to 60 per cent of the acreage is irrigated when necessary. Percentages of land irrigated in the other counties of the district are as follows: Orange, 15 per cent; Osceola, 25 per cent; Seminole, 25 per cent; and Marion, 10 per cent.[13] Many growers feel that the benefits of irrigation do not justify the costs in the long run. The cost of irrigation during a prolonged drought of one year can nullify the profit of that season. Some growers would prefer to lose the crop of one year rather than to irrigate during every dry spell, for once irrigation is practiced it becomes necessary to continue as the trees become adapted to a uniform supply of moisture throughout the year. However, the acreage subject to irrigation is increasing gradually.

There are three general aspects to the frost protection of citrus groves in The Ridge and Highlands. The first and best protection against frost is the warm site location for a grove, that is one which has slope and good air drainage, and, or proximate location to lakes. Second, an adequate fertilization and spray program affords a greater degree of cold protection. Healthy fruit trees have a greater cold tolerance than do deficient and diseased trees. Third, artificial frost protection is an additional measure when needed. Firing a grove

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[13]Summation of Statements by Agricultural County Agents in Study Area, Personal Interview.

has become a traditional method of artificial frost control. The use of the wind machine for frost protection may become more widespread in the future.[14]

Firewood and oil burners are commonly used today to fire a grove as a frost protection measure. In using either, the principle employed is the same. The objective when firing a grove on a night when potential temperatures may cause frost damage to fruit is not to heat the trees. Rather, the goal is to heat the air in the grove so as to create an artificial blanket of warm air above the earth's surface. This is accomplished by lighting a double row of fires (about seventy per acre) on the north and west sides of a grove. The artificial covering of warm air in the grove acts to retard the escape of heat, terrestrial radiation, from the ground. Thus, the artificial heating keeps the minimum temperature above the low point it would have attained naturally.

Firing is only effective on a night in which air movement is almost nil. However, a relatively still night, usually the second or third night after the passage of a cold front, is generally the type of prevailing condition which exists when frost is most liable in the citrus district. Nevertheless, occasionally temperatures accompanying cold air masses are so extremely cold that artificial frost protection measures are of little or no value. Such was the case during a devastating freeze in December of 1962.

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[14] See page 104.

IV. HARVESTING

Harvesting of citrus fruit in The Ridge and Highlands bridges the gap between the individual grower and the processor; the work is done in the groves, but the laborers, the picking crews, are employed by the processors. The most common type of sale of fruit is by an on tree basis, either box or bulk, with the processors paying the costs of picking and hauling. Similar sales are made to independent buyers, middlemen called bird dogs in the district, who maintain their own picking crew. Consignment sales, agreements between individual growers with packers and processors, are yet another method for the grower to market his fruit. Other sales are made within cooperative organizations, and, naturally, the several processing corporations with grove land handle their own fruit.

There is a great deal of frenzied activity by the bird dogs whenever a freeze is expected in The Ridge and Highlands. Many of these independent buyers make on tree purchases throughout the district speculating that a loss in one section will be more than offset by a higher price for fruit in another section of the district which will escape frost damage. Then, too, if the freeze is not damaging at all the buyer has at least made a purchase of fruit for what is usually cheaper than the going market price. On the other hand, the grower in this transaction has sold his fruit and made a profit whether his crop freezes or not, although the gain is usually smaller than under normal circumstances; however, it is the buyer who has taken the risk.

Harvesting is the only remaining work in the grove that must be accomplished by hand. The fruit picking itself is done as piece work per box, not by hour or day. Citrus fruit is picked from the ground, and since the trees are not intensively pruned, from ladders, as well. Oranges are either pulled from the stem or cut from the stem with clippers. Clippers are used by some fresh fruit packers to avoid breaking the rind where it is attached to the stem. Other packers that do not demand the use of clippers feel that the benefit to be derived from the use of clippers is offset by clipper damage to the fruit. Grapefruit are more easily separated from the stem and hence are usually merely pulled. The opposite condition and practice is true of the tangerine.

The picker places the fruit in a sack, which is suspended from his shoulder by a strap. The picker empties the fruit into the box, a field crate, when his sack is full. A field crate will hold about ninety pounds of oranges or grapefruit. An experienced picker can harvest about eighty boxes of oranges or 120 boxes of grapefruit in a day. The field boxes are loaded on a truck and then transported to a processing plant, either a fresh fruit packing house, a cannery, or a concentrate plant. Transportation to the processing plant by bulk rather than box is gaining in importance in the district as another innovation in the handling of citrus fruit.

CHAPTER X

CITRUS FRUIT UTILIZATION

The citrus fruit produced in The Ridge and Highlands today is marketed in an ever increasing variety of forms. The citrus production of the district from its inception to the 1930's was oriented toward only the fresh fruit market. The fresh fruit market continued as the major interest in The Ridge and Highlands even with the introduction of processing, mainly single strength juices and fruit sections, in the thirties. Processing at that time was regarded solely as a means of utilizing the surplus crop and rendering greater returns to the citrus growers. The better fruit still entered the fresh market channels; the culls, fruit which was offsized or had a blemished peel, could be disposed of in the processing industries. Other processed forms of citrus fruits, frozen concentrated juices, pasteurized concentrated juices, chilled juices, fresh citrus salad, and beverage bases, have been added through the years. Also, several by-products, stock feeds, citrus molasses, citrus peel oil, ethyl alcohol, wines, marmalade, and citrus seed oil, can be included in the list.

The processing of frozen concentrates, introduced in the 1950's, brought about the most significant, all encompassing changes in the utilization phase of the citrus industry. Frozen concentrates, first envisioned as simply another method in disposing of a portion of the increasing citrus fruit surplus, now consume a major part of the total citrus crop in The Ridge and Highlands. In addition, the frozen

concentrate industry demands and receives the bulk of the higher quality fruit produced in the district. The result has been a decline in the use of citrus fruit in the fresh form, both relatively and absolutely, until presently fresh fruit shipments account for less than one third of the total citrus production. This recent development in processing citrus fruits is more pronounced in the utilization of oranges than grapefruit. Sixty-two per cent of the oranges produced in the district are processed into frozen concentrate with only 20 per cent entering fresh fruit channels; the other 18 per cent of the orange crop is processed into another of the several forms. By comparison, only 15 per cent of the grapefruit is utilized in the frozen concentrate industry, yet other processed forms account for 40 per cent of the grapefruit crop. Still, fresh grapefruit remains the major single market form, utilizing 45 per cent of the total production in the district.[1]

I. REGULATORY AGENCIES

There are regulatory bodies in the state of Florida which influence the operations of the fresh fruit packers and the citrus processors in The Ridge and Highlands. These agencies are the Growers

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[1]Florida State Department of Agriculture, Annual Agricultural Statistical Summary: 1958-59 Season (Jacksonville, Florida: Florida State Marketing Bureau, 1959), p. 45.

Administrative and Shippers Advisory Committees, operating under the Federal Marketing Agreement Act, and the Florida Citrus Commission, a state agency.

The Growers Administrative and Shippers Advisory Committees each consist of eight members, growers and shippers respectively, who are appointed by the United States Secretary of Agriculture. The committee is charged with the regulation of grades and sizes of fruit which enters interstate commerce. The objective of their inspections is to prevent the shipment of low grades and off-size citrus fruits through interstate channels.

The Florida Citrus Commission, in operation since 1935, consists of twelve grower members, five of whom must have connections with processors, concentrators, and shippers. The duties of the Florida Citrus Commission are somewhat more complex than those of the federal committees. Varied aspects of the citrus industry which fall under the regulartory supervision of the Florida Citrus Commission include the maturity tests and grade standards for citrus fruits, the use of artificial coloring, the use and filling of containers, the registration and use of labels, the tests for fruit damaged by a freeze, the tests during processing, and the licensing of citrus dealers. The commission formulates these rules and regulations; the Florida State Department of Agriculture enforces them. The regulartory program in its entirety assures the consumer of a wholesome product of uniform quality, which, in turn, assures the citrus industry of Florida a continuing market. In

addition to the promulgation of rules and regulations, the Florida Citrus Commission is responsible for the collection of excise taxes on citrus fruit grown in Florida, the conduction of an advertising campaign, and the conduction of the citrus research program.[2]

II. MATURITY TESTS

One of the first steps taken in the fresh fruit packinghouse or in any of the several types of citrus processing plants is the fruit maturity test. The maturity testing of the citrus fruit is administered in the district by federal-state inspectors of the Citrus and Vegetable Inspection, Florida Department of Agriculture. The individual plant provides the facilities for the test. The minimum legal quality standards for the maturity of citrus fruit as set forth in the Florida Citrus Code are based on the following five factors: (1) the color break, (2) the volume of juice, (3) the total soluble solids, (4) the acid content, and (5) the ratio of total soluble solids to acid content. Except for the color break test, which requires at least fifty fruits, an official sample consists of either ten oranges, five grapefruit, or fifteen tangerines. In practice, the processors use a larger sample, about one-half box per load of fruit, because they need more exact information on the internal quality.

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[2]Camp, <u>op. cit.</u>, pp. 194-195.

The color requirement varies seasonally and from one type of utilization to another. For example, from August 1 to November 15 the color break, the orange or yellow coloring in the rind, must be at least 50 per cent in all varieties of oranges except the Parson Brown, for both fresh fruit and cannery fruit. All varieties need only have a 25 per cent color break from November 16 through November 30. The remainder of the citrus year fruit intended for the processors is not required to have a color break, but fruit utilized by the fresh packer still must have the minimum of 25 per cent break in color.

The amount of juice, the soluble solids, and acid are calculated from the juice test sample. Then a ratio of soluble solids to acid is figured. The amount of juice in the sample is measured and the figure converted into gallons per standard packed box.[3] Most mature oranges will yield forty-five to fifty-two pounds, or five to six gallons of juice per box. The minimum requirement for natural colored fresh and processed oranges is four and one-half gallons per box. The soluble solids in citrus fruits consist chiefly of the sugar (85 per cent) with smaller amounts of citric acid, vitamin A, vitamin C, essential oils, glucosides, and other compounds also present. These soluble constituents are measured with a Brix hydrometer, an instrument which actually measures specific gravity, yet is calibrated to read in degrees Brix. The amount of degrees Brix is converted into a percentage figure

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[3]A standard packed box contains one and three-fifths bushels or ninety pounds of oranges, eighty-five pounds of grapefruit.

of total soluble solids. The minimum legal requirement for per cent total soluble solids varies from nine in the early season to eight in the late season. Processed fruit must contain 8.5 per cent during the late season. The total acid in the juice is calculated by an alkali test. The minimum requirement is 0.4 per cent. The acid requirement is dropped after December 1 for processed fruits. The minimum requirement of the ratio of soluble solids to acid is eight to one for a sample with 12 per cent soluble solids. Other ratio requirements are calculated on a sliding scale; a decrease of 0.1 per cent in solids requires an increase of 0.05 per cent in ratio of solids to acid.[4]

Today, the total amount of soluble solids in citrus fruit is a prime consideration in the processing market. Most concentrate plants buy their fruit on a pound-solids basis rather than by the box. Oranges of the highest possible internal quality are utilized particularly in the frozen concentrate industry, and a relatively high amount of soluble solids is a good indicator of quality. The flavor, aroma, and especially the yield of juice from the citrus fruit is directly proportional to the amount of solids. A grower producing for a concentrate plant is no longer concerned merely with boxes per acre, but rather juice and pounds of solids per acre.

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[4]M. J. Soule, Jr. and F. P. Lawrence, What Every Citrus Grower Should Know--Maturity Tests for Fresh Fruit, University of Florida, Agricultural Extension Service, Circular No. 191 [n.n.], 1959, pp. 1-18; M. J. Soule, Jr. and F. P. Lawrence, Testing Oranges for Processing, University of Florida, Agricultural Extension Service, Circular No. 184 [n.n.], 1958, pp. 1-8.

III. FRESH FRUIT AND PROCESSING INDUSTRIES

Number and Location

The fresh fruit packing houses, the canneries, and the frozen concentrate plants are the major industries of citrus fruit utilization in The Ridge and Highlands. In Florida more than one-half of the plant facilities engaged in each of these pursuits are found in this central district of the state. Ninety-nine of the one hundred eighty-eight packing houses, twenty-two of the forty canneries, and sixteen of the twenty-five frozen concentrate plants of Florida are located in The Ridge and Highlands (Figure 37).[5] The fresh fruit packing houses are still greatest in number although the majority of the citrus crop is processed in one form or another.

Packing houses and processing plants have common characteristics in site location. The typical facility is located on a railroad siding, and either on a major highway or with easy proximate access to a major highway (Figure 38). Most plants are located on the margins of the towns, or at least their original location was on the periphery. In many cases the urban sprawl has since encompassed the plant.

Fresh Fruit Operations

Citrus fruit is first weighed and a sample taken for the maturity test when it is brought by truck to the packing house from the

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[5]Florida Fruit Digest Company, The Florida Fruit and Vegetable Directory: 1961 Season (Jacksonville, Florida: Julius Leitzer and A. Bilgore, Publishers, 1961), pp. 5-106.

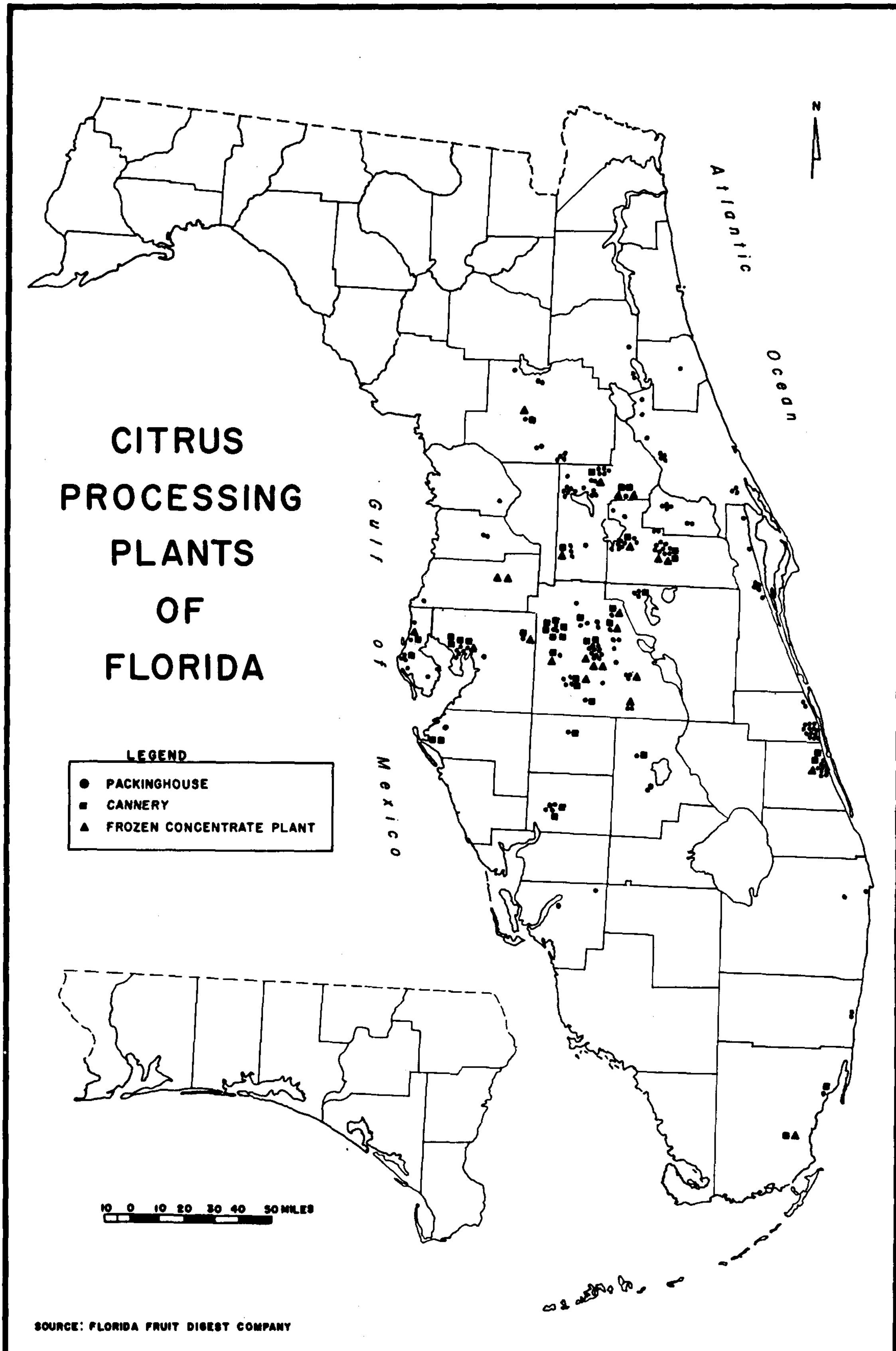

Figure 37. Citrus Processing Plants of Florida.

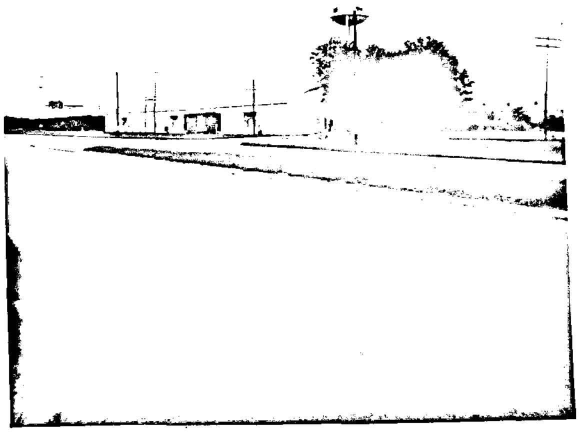

Figure 38. Processing Plant.

Figure 38. Processing Plant.

grove (Figure 39). After the fruit is weighed the boxes are unloaded by hand truck; bulk fruit is unloaded into large bins. If it is early in the season the fruit is taken to degreening rooms, if not, the fruit is taken directly to the packing house conveyor line.

The degreening process is necessary early in the season owing to the fact that oranges will retain their green coloring, although the orange color is present, yet masked by the green, until sufficent cold weather has occurred to bleach out the chlorophyl pigment and allow only the orange pigments to show. Degreening is sometimes necessary in the spring and summer, because ripe Valencias will regreen on the tree if there is a sustained period of warm, humid weather. In the degreening process box fruit is stacked in a room and held for twenty-four to seventy hours, depending upon the amount of greeness, while ethylene gas is introduced and circulated throughout the room by fans. Bulk fruit is similarly treated in bins. The ethylene gas bleaches out the green. The degreening process is necessary only because the market demand is for an orange colored orange. The green fruit is ripe, and the degreening has absolutely no effect on the quality of the fruit.

The fruit once in the packing house proper is continually on the move as it is carried by a system of conveyor belts. The fruit is dumped on the conveyor belt by hand or machine; the belt carries the fruit onto a roller conveyor which allows the leaves and trash carried from the groves to drop through. It then passes through a presizer which separates out the culls. The culls are carried by an elevator to a bin for processed fruit.

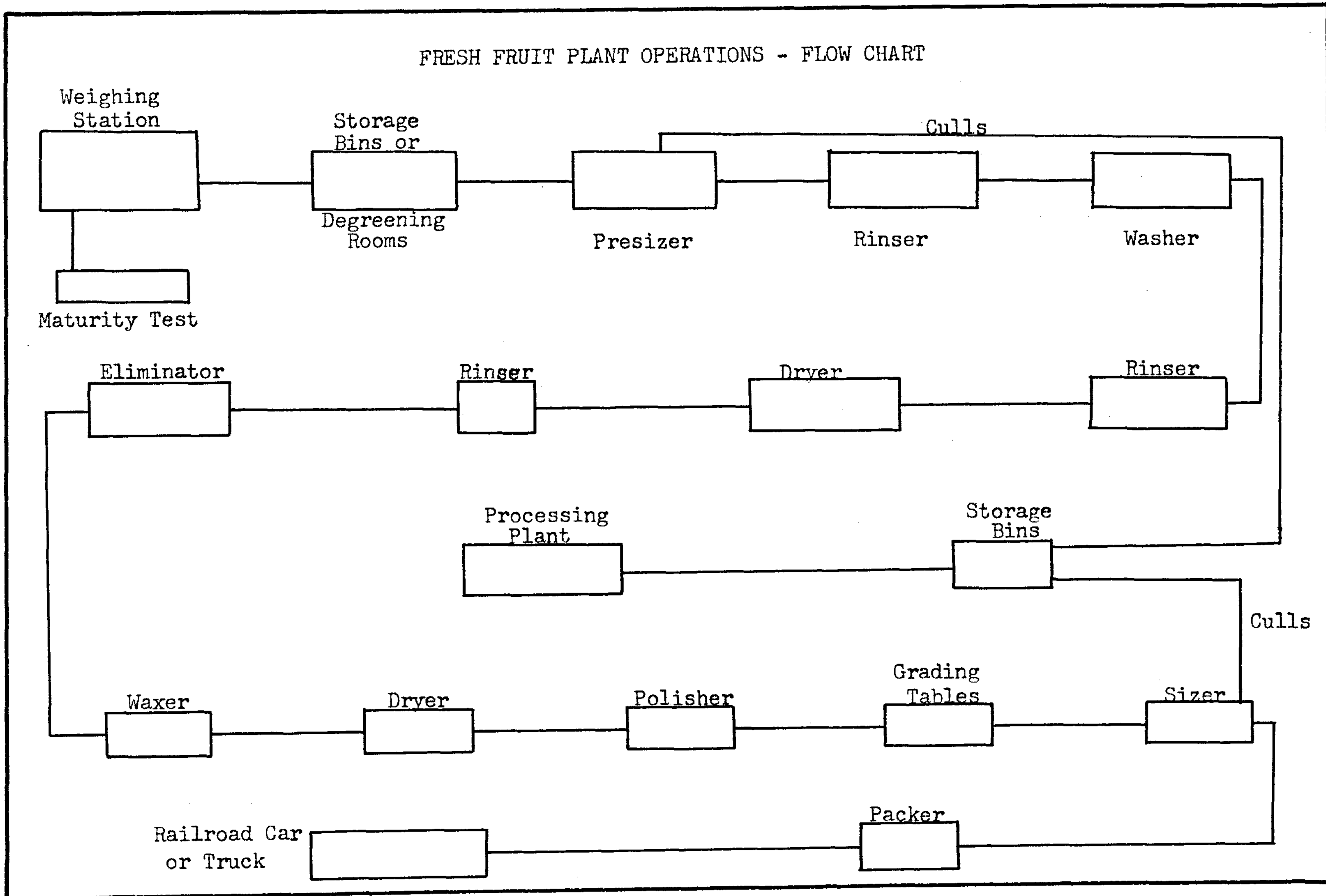

Figure 39. Fresh Fruit Plant Operations, Flow Chart.

The desirable sized fruit continues on to either a water tank or a roller conveyor with a series of overhead sprays. Either of these water units remove the loose dust, spray residue, or other accumulation from the rind of the fruit. The fruit moves from the wetting or soaking into a washer, which consists of rotating cylindrical brushes. The fruit is subsequently soaped, scrubbed, and rinsed as it is moved along by the rotating brushes. As the fruit leaves the washer, it runs through an eliminator, rotating cylindrical brass rolls, which removes excess moisture from the fruit. Grapefruit moves directly to the waxer and dryer, but oranges may first pass through an application of orange-red dye. The dying intensifies the orange color of the orange, and is used solely on fruit which is to be shipped to a market that desires color-added fruit. Oranges are rinsed and run over an eliminator as they leave the dying unit.

Waxing is usually done at some time after the fruit leaves the eliminator and before it reaches the grading tables. The most common practice is to apply the wax as the fruit leaves the eliminator. The application of wax is usually applied by overhead jet atomizers similar to paint sprayers. The most common wax emulsions used contain paraffin and carnauba waxes emulsified in water. The waxes perform two important functions. One, they give the fruit a polish. Two, they replace the natural waxes which are removed in the washing operation. The artificial fruit waxes serve to reduce the rate of moisture loss from the fruit, and in doing so help to maintain the fruit in better condition as it moves from the packing house finally to the consumer.

Upon leaving the waxers the fruit enters the dryers. The most often used dryers consist either of roller conveyors in a tunnel, into which warm air is blown, or rotary brushes with horsehair bristles, plus overhead fans. The fruit moves from the dryer to the polisher, which is constructed quite similar to the brush dryer only the fans are omitted. From the polisher the fruit is carried by conveyor belt to the grading table. Oranges which have been dyed pass through a machine which stamps "color added" on them, either between the polishing application and the grading table, or after the grading has been done.

Grading is accomplished by hand usually by experienced women. The grading is based solely on the external appearance of the fruit. The graders remove fruit from the line which has sustained wind, melanose, rust mite, scale, or mechanical injury. The acceptable fruit moves on to the sizers; the culls are placed on a cannery conveyor belt which moves them to a loading bin.

The sizers separate the fruit according to diameter; the sizes being determined by the number required to fill the standard one and three-fifths bushel box. The diameters of oranges range from approximately two and four-sixteenths inches to three and eleven-sixteenths inches; the sizes range from 324 to 96. For example, it requires 200 (size) oranges of three inch diameter to fill a standard box.

The fruit finally moves by size to the packer. Most of the citrus fruit today is packed in either wirebound wooden crates which contain the standard one and three fifths bushels, one-half box cartons,

or one-half box crates. Some pre-packaging is done in small five and eight pound cotton mesh or polyethylene bags, and even these are placed in cartons for shipment.

The boxes or cartons are sealed after the fruit is packed, and the packer stamps the grade and size on the box. The containers are then moved to a refrigerated railroad car or truck by hand truck. In many packing houses the fruit is precooled down to about forty degrees in special insulated rooms prior to shipment.[6]

Processing Operations

Canned single strength juices, canned fruit sections, and canned frozen concentrated juices are the most important citrus products of the processing industries in the district. The mid season Pineapple and the late season Valencia are the two preferred orange varieties in the canning industries owing to the fact that their juice retains the orange color and flavor when processed; the seedier varieties of grapefruit such as the Duncan are similarly preferred. The primary demand of the processing industries is for citrus fruit with a relatively high ratio of solids to acid.

Many of the initial steps taken in the canning of single strength juices are similar to those of the fresh fruit packing industry (Figure 40). The fruit is weighed, unloaded, and graded, only the grading in this case is done solely to remove unwholesome fruit. A

[6]Camp, *op. cit.*, pp. 172-193; Enzor, *loc. cit.*

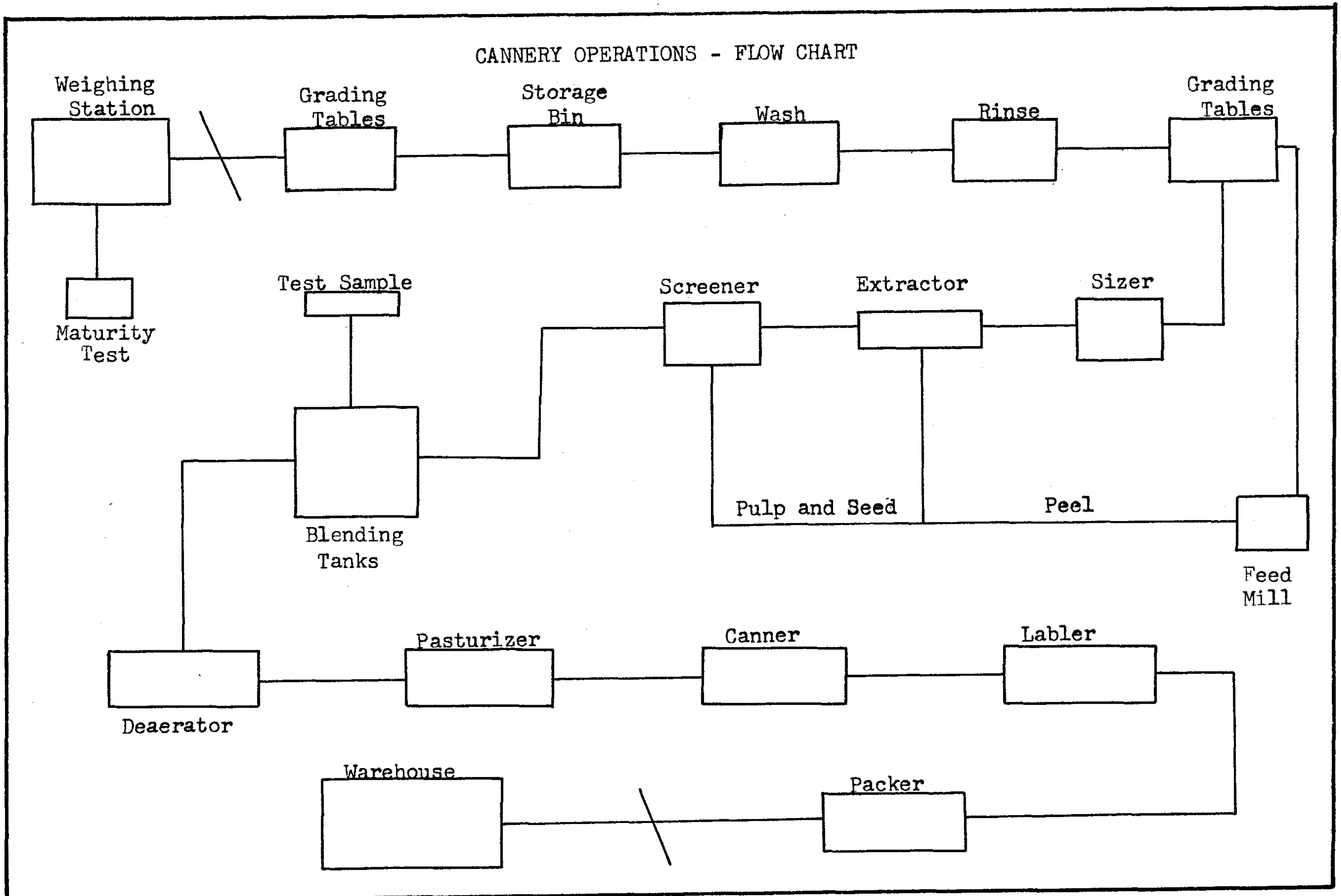

Figure 40. Cannery Operations, Flow Chart.

sample is taken to determine maturity, and the solids to acid ratio, information which is applied in the blending process. The fruit then is carried to elevated storage bins; fruit of identical brix ratio are stored in the same bin. An additional function of the bins is to provide a continuous supply of fruit for the processing operations. The fruit moves from the bins by conveyor through a wash and rinse unit, is graded again, and then runs through a sizer. It is here the similarity of the processing run to the fresh fruit packing operation ends.

The fruit moves by size to a mechanical juice extractor, which is preset to receive fruit of a given diameter. The juice first runs through a screener to remove the pulp and seeds, then it is carried on to the blending tanks. The seeds and pulp, plus the peel from the extractor, are carried out of the plant and then taken to a feed processing mill.

In the blending tanks the juice is tested for soluble solids, acid, and color. If the juice is to be sweetened the sugar is added at this point. After the blending is accomplished the juice is deaerated under vacuum to remove air incorporated during the processing. Deaeration insures the maximum preservation of flavor and vitamin C. The juice is then flash pasturized, about forty seconds, at a temperature of about 197^{o} F. The juice is quickly, automatically canned while hot, and the sealed cans are rapidly cooled to room temperature by water sprays. The cans are run through an automatic labeler, then packed and sealed in a

carton, and moved to the warehouse for storage.[7]

The initial steps taken, from the fruit unloading to the blending tanks, in the processing of frozen concentrates are identical to those of the single strength juice canning industries (Figure 40 and 41). In the concentrating process a small portion of the juice is set aside, called "cutback" in the industry, only to be used later. Most of the juice moves to the evaporators. The juice is evaporated in vacuum at temperatures ranging from 60° F. to 80° F. until a soluble solids content of approximately 55 per cent is attained. Cutback juice is then added to the brix until the soluble solids content in the concentrate is down to about 42 per cent.

The cutback method was discovered in 1944. Concentration of citrus juice had been scientifically possible for some time prior to this discovery, yet, owing to the fact that most of the aroma and flavor of the fruit are lost during the operation, this product had never been marketed. The addition of a small portion of the cutback fresh juice sufficiently restores the natural flavor so that the juice concentrate, when reconstituted, closely resembles fresh juice.[8] Some plants also cutback juice from the early season crop to be mixed with juice from the late season crop, and likewise some juice of the late season is held

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[7]United States Department of Agriculture, Chemistry and Technology of Citrus, Citrus Products, and Byproducts, Agriculture Handbook No. 98 (Washington: U. S. Government Printing Office, 1956), pp. 24-28.

[8]*Ibid.*, pp. 38-40.

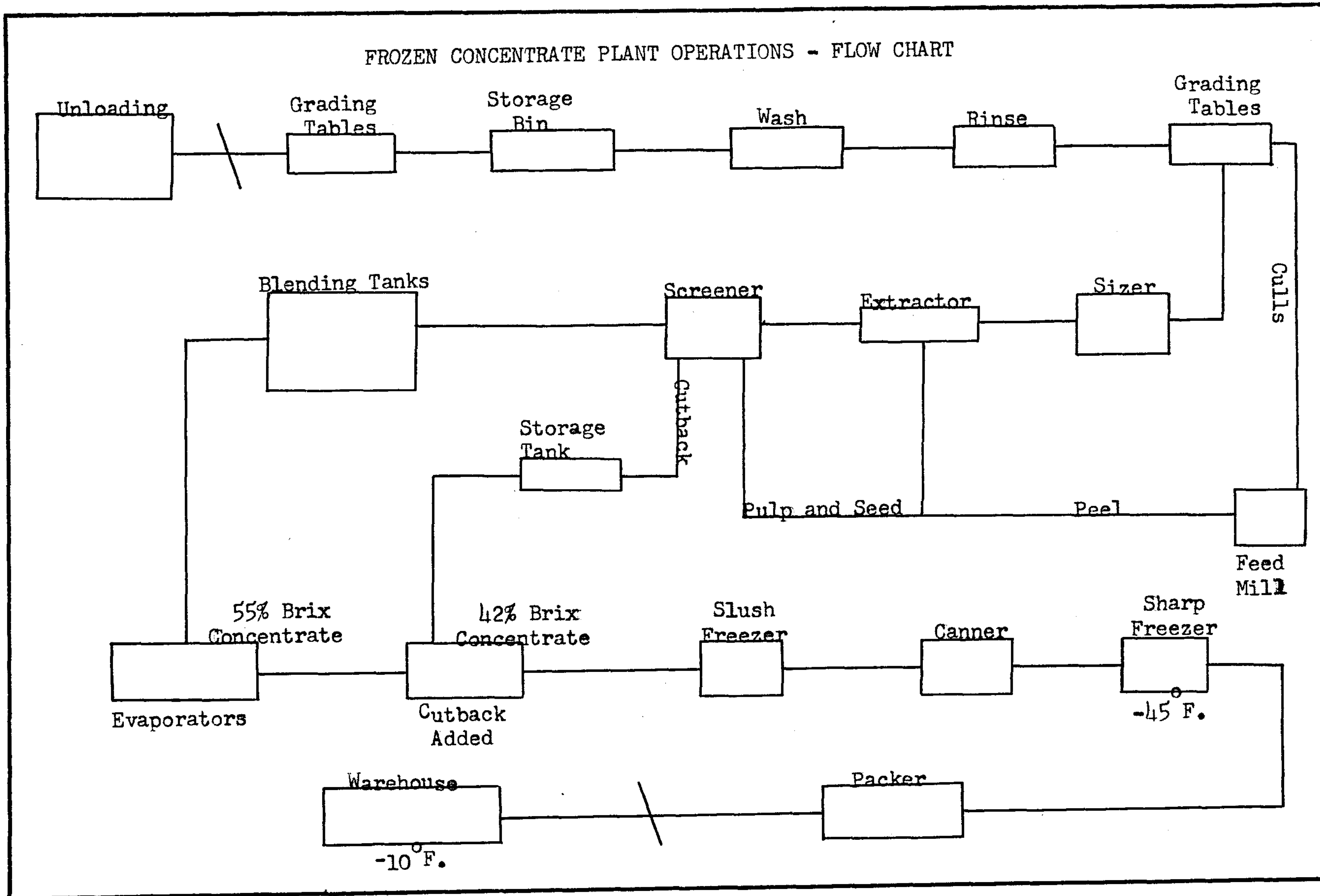

Figure 41. Frozen Concentrate Plant Operations, Flow Chart.

over to be mixed with that of the following early season. This cutback operation is employed to assure a uniform product throughout the year.[9]

The end product of the concentrate and cutback blend is finally slush frozen, canned and then sharp frozen in an air blast freezing tunnel at minus 45°F. The cans are then packaged in cartons and stored in a warehouse at minus 10°F.[10]

Other Processing Industries

The remainder of the citrus fruit processing industries in The Ridge and Highlands are minor in comparison to the primary market forms. However, these secondary outlets of fruit utilization represent ever increasing methods of product variation which have been adopted in the district in the effort to market the expanding citrus crop. The most important of these today in utilization are the canned sections of grapefruit. The combination of grapefruit and orange sections chilled in glass and marketed as citrus salad, is a most recent introduction which is gaining popularity in the markets.

The production of stock feed and citrus molasses, both products of the same operation, is one of the major by-products industries in The Ridge and Highlands. The feed mill performs an important function in disposing of the processing wastes, rind, pulp, and seeds, of the

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[9]Statement by Jerry Mize, plant production manager of the Birdseye concentrate plant, Florence Villa, Florida, Personal Interview.

[10]United States Department of Agriculture, op. cit., pp. 41-42.

juice and concentrate plants, in addition to its basic performance of producing cattle feeds.

The production of mixed alcoholic beverages by one processing plant in the district represents the most recent attempt in the continuing search for product variation. The two drinks which are canned are: (1) the Screwdriver, a mixture of distilled citrus alcohol and orange juice, and (2) the Bloody Mary, citrus alcohol and tomato juice. Oddly enough, a special act of the state legislature was necessary to allow the plant to produce these products, owing to the fact that the plant was located in a legally dry county at the time. Even now, these products cannot be marketed in the county of their production. The marketing of these products is still in the experimental stage, and confined primarily to the Atlantic coast cities of Florida.[11]

IV. MARKETING

The major markets for the citrus products of the fresh fruit and processing establishments of The Ridge and Highlands are located in the densely populated manufacturing belt of the northeastern United States. The southeastern states rank second as a market region for citrus products of the district. Canada is the major foreign market; other countries are relatively minor as market outlets. Often trade agreements are restrictive to the flow of citrus from the district to foreign areas. For example, England, at present, gives Israel

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[11] Enzor, loc. cit.

preferential treatment in the marketing of citrus products. Western Europe, in general, is not a market for the major form of citrus processed in The Ridge and Highlands, frozen concentrate, owing to the fact that the retail and wholesale establishments, as well as the consumers are not equipped with facilities which can store this product.[12]

Most of the fruit products are transported to market from The Ridge and Highlands by either truck or rail. Water transport as a method of shipping Florida citrus first declined in importance as this interior district of the state and rail lines throughout the state began to develop, until today the boat is of relative minor importance. The importance of citrus product movement by truck, particularly fresh fruit became dominate beginning in 1950.[13]

The type of transport facility used to move citrus fruit to market from The Ridge and Highlands is related to several factors. They include: (1) the type of facility available, (2) the type of sale, (3) the distance to market, and (4) the size of the market.

Trucks are more readily available to fresh fruit shippers when the volume of fruit is small in the early season and very late season owing to the minimum weight requirements of the railroads; the railroads are relatively more available during the peak of the season.

Railroads are most important in shipping fresh fruit that is sold at an auction market primarily owing to the fact that the auction

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[12] Ibid.

[13] Florida State Department of Agriculture, op. cit., pp. 8-14.

facilities are located in the railyards of the major terminal markets in Baltimore, Philadelphia, New York City, Boston, Cleveland, Detroit, Pittsburgh, Cincinnati, Chicago, and St. Louis. However, most fresh fruit now is sold on an f.o.b. basis, a direct sale by the shippers to the buyers in the market cities. The movement of these sales can be either by rail or truck.

The truck is the favored transport facility for citrus shipments of eight hundred miles or under; this would include all of the markets of the southeastern United States. Truck and rail transport compete in the areas from 800 to 1200 miles; this area includes the major auction markets of the northeastern United States. Within this general market region of the northeast the size of the market is related to the type of transport used. In the larger cities with an equally large volume to handle, plus the auction markets for fresh fruit, the railroads continue as the major carrier. In shipments to the smaller cities, where the volume of each market is small, and split deliveries are necessary the truck is preferred.[14]

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[14]Marvin A. Brooker and Kenneth M. Gilbraith, Factors Influencing the Method of Transportation Used in Marketing Fresh Florida Citrus, University of Florida, Agricultural Experiment Stations [n.p.], 1954, pp. 5-8.

CHAPTER XI

FUTURE PROSPECTS AND SUMMARY

I. FUTURE PROSPECTS

There are three possible courses The Ridge and Highlands could pursue in the future. The district could either continue to expand and retain its prominent position among world citrus areas, remain at the present level of production and decline relatively on the world scene, or decrease production and thereby decline absolutely. Naturally, the direction this citrus district will follow can be determined only in the final analysis of future developments in the area. However, there are some conflicting current developments which can provide an insight into the divergent courses the citrus district may follow. Factors which no doubt could negatively affect the citrus district include the threat of urban expansion into existing groves and the limited amount of virgin citrus land remaining in The Ridge and Highlands. On the other hand, the possible adaptation of citrus rootstocks to flatwoods soils and yield increases in existing groves are among recent experiments which could prove to be more positive in nature.

Somewhat of a paradoxical dilemma confronts future attempts in areal expansion of groves in The Ridge and Highlands today; the growers are cognizant of preferred locations for plantings in relation to the geographic elements, yet these groveland sites are almost entirely planted to citrus groves, or either occupied by some type of

competitive land use. Thus, very little potential citrus land remains in The Ridge and Highlands proper.

In Polk County, the leading producing county of the district, most new plantings during the past few years have consisted either of a row or two of five to ten trees at the margins of existing groves, or of a plot of several trees on well-drained flat land protected by a wind machine (Figure 42). Many of the small acreages on hammock lands in Polk County have also been planted during the past decade. This type of planting activity applies to the other counties of the district with the possible exception of Lake County. The most extensive plantings of large acreages during the past few years have been in Lake County. In 1959, Lake County had approximately one million eight hundred thousand citrus trees that had not reached bearing age. However, much of this planting has been on relatively flat land in the highlands. Although the soils are suitable, most of these grove sites are marginal owing to the frost hazard. Lake, now Florida's second county in total citrus production, could possibly challenge the leadership of Polk County if the new plantings survive the test of time.

The freeze of December, 1962, the most damaging since the "Big Freeze," provided a somewhat extreme test for these new areas of planting. On the night of December 12-13, an advection freeze was experienced in the district with temperatures in the teens and low twenties. Owing to the strong winds accompanying the cold front high ground locations were as cold as low ground locations, and all methods

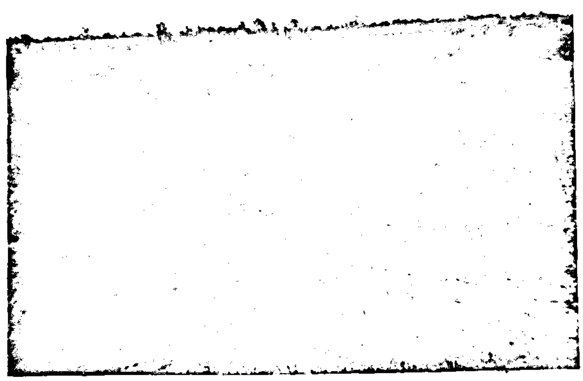

Figure 42. Wind Machine in Flat
Groveland.

Figure 42. Wind Machine in Flat Groveland.

of artificial frost protection were of little value. Fourteen million citrus trees were killed in Florida during this freeze. The majority of the trees that were killed in The Ridge and Highlands were located on the northern and western margins of the citrus district. Thus, most of the trees that died were the younger trees in the newer locations. Despite the almost universal losses in these areas the growers of the district evidently plan to replant as soon as possible. In the other sections of the district considerable damage was sustained by the bearing surface of the trees, so production will be much lower for several years. The groves of Highlands County, southern Polk County, and southwestern Orange County were the only ones of the district to escape tree damage.[1]

Orange County experienced an absolute decline in the total amount of production during the period from 1954 to 1959.[2] This decline in citrus production is almost entirely the result of urban expansion in the Orlando area on the northeastern margin of the citrus district. The contiguous urbanized area of Orlando today is about ten miles north-south and nine miles east-west at the maximum points of length and breadth.

Henry F. Swanson, Orange County Agricultural Agent, concerned about the urban sprawl into agricultural lands, directed a population

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[1]Mike Zotti, "Aftermath of the Freeze," The Tampa Tribune, Tampa, Florida, May 26, 1963, p. 1G.

[2]U. S. Department of Agriculture, 1959 Census of Agriculture, Vol. I, Part 29 (Washington: U. S. Government Printing Office, 1960) p. 238.

project of the Orlando urbanized area to the year 1975. His findings indicate that approximately 25,000 acres of the present 70,000 acres of citrus land in Orange County will be converted to some urban land use by that date. In addition, the Orlando urbanized area, extending along the major highways, will continue into citrus land in the neighboring counties of Seminole, Lake, and Osceola by the same year.[3]

Lakeland in Polk County on the western margin of the citrus district is experiencing the same problem, only on a smaller scale. The loss of groveland to urban uses is largely confined to the city limits and environs of Lakeland. Any decline in production in the Lakeland area has been compensated for by increases elsewhere in the county. Some remnants of groves can be seen in the dooryards of subdivisions there. Some other cities in The Ridge and Highlands are experiencing the urban sprawl into groveland, but only in a very minor way. The loss of citrus trees is confined primarily to the oldest groves of the area, mostly seedling groves.

If the present trends do continue the eastern and western margins of the district in the Orlando and Lakeland Highlands probably will further decrease in the number of citrus trees and in fruit production, and likewise in the immediate vicinity of the smaller cities as well. Fortunately so far as the citrus industry is concerned, urban functions are the only land uses which compete with citrus fruit growing for space in The Ridge and Highlands.

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[3]Statement by Henry F. Swanson, County Agricultural Agent of Orange County, Florida, Personal Interview.

The flatwoods, collectively, could prove to be the area of greatest potential for expansion in the citrus district. Also, an extension of large plantings into the flatwoods could more than compensate for the decreases resulting from urban growth in the highlands for many years to come. However, the inherent problems of the flatwoods, the poor drainage and the frost hazards, must be solved or at least adapted to before the lowlands can become of important consequence to the citrus growing industry. Presently, experiments are in progress by the agricultural scientists of the state in an effort to develop a rootstock which could be utilized in the flatwoods by the citrus growing industry.

Citrus trees have been grown successfully on the flatwoods in Hardee County, southwest of The Ridge and Highlands. The excessive soil water problem in Hardee is controlled by either open ditch or tile drainage, and minimum winter temperatures are somewhat warmer there than in the flatwoods to the north. Even in Hardee County the citrus plantings are necessarily restricted to the higher flatwoods soils, in which the underlying hardpan is not near the surface. Citrus trees planted on lower lying soils where the hardpan is relatively close to the surface usually develop well until the tap root reaches this hardpan layer; then the tree declines.[4]

Intensification in place, increasing yields in existing groves by scientific practices, is yet another method by which The Ridge and

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[4]Statement by J. C. Hayman, County Agricultural Agent of Hardee County, Florida, Personal Interview.

Highlands can continue to increase its stature among world citrus districts. The growers of the district have had a rising interest in increasing yields in the existing groves as the best groveland has become more and more scarse and more expensive to purchase.

In the past various methods of spacing trees in the grove, which actually involves the number of trees per acre, have been employed in efforts to increase yields. The allowance of space in the grove for the use of cultivating and spraying equipment, important in the cost of operation, has been a major factor limiting the maximum number of trees per unit of land.

Current experiments in hedging could provide the growers with a method with which to increase yields per acre. Hedging was originally introduced, about 1950, to alleviate the problem of using heavy equipment in overcrowded groves, in which citrus trees had accidentally been spaced too closely together. Now some growers knowingly space citrus trees closer together with the intention of hedging as the grove reaches maturity.

The latest innovation in the effort to increase yields per acre is to plant trees closer together and to hedge the rows in both directions, making a square tree. Currently, about one half of the groves of The Ridge and Highlands are hedged.[5] As this practice continues to spread throughout the district, total production will, no doubt, continue to increase.

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[5]Statement by R. E. Norris, County Agricultural Agent of Lake County, Florida, Personal Interview.

II. SUMMARY

The Ridge and Highlands Citrus District of Florida has localized as the most intensive area of citrus fruit production in the United States. The production of citrus fruit annually amounts to approximately 55 per cent of the United States total. Economic prosperity within the district is dominated by the citrus industry although in the state of Florida citrus activities rank second to tourism in total value.

The grove landscape of the citrus district can be delineated in respect to several geographic phenomena. They include location in the karst region of central Florida: (1) to the south of the 60° F. isotherm of January, (2) above the 100 foot contour line in elevation, (3) in respect to slope and cold air drainage, plus proximity to lakes and swamps, and (4) on the infertile, well-drained upland soils of the Lakeland, Eustis, Orlando, and Blanton series. In addition, the extent of planting, especially on the excessively well-drained soils, is the result of the development and use of rootstocks, particularly the rough lemon stock, in combination with the intensive use of mineral fertilizers. Other factors related to the present degree of development of The Ridge and Highlands include: (1) the rise in demand for citrus fruit in the markets of the U. S., (2) the introduction of rapid rail transport and later truck transport into the district, (3) the introduction of the canning and frozen concentrate industries, and (4) the decline in other citrus producing areas of the U. S.

The location of the citrus district is similar to that of the other commercial citrus areas of the world. In this respect The Ridge and Highlands occurs as close to the major consuming regions as is climatically possible. However, owing to the non-periodic occurence of sub-freezing temperatures artificial methods of frost protection are occasionally necessary in order to sustain the district in its present location. Likewise, even though the district receives fifty inches of rainfall in the average year, irrigation is necessary to save a crop during an occasional drought.

The location of the district today is the result of a long evolutionary process in respect to climate and market accessibility. Commercial citrus production began in northeast Florida after the area became a U. S. territory. The commercial citrus areas of the time were linked to northern markets by water. Later, in the 1880's, the introduction of rail transport into central Florida witnessed an expansion into the peninsula of the citrus industry. The districts of the south, The Ridge and Highlands, the Tampa Bay, and the Indian River, were well on their way to become the major centers of citrus fruit production, when suddenly a series of bad freezes in the late 1890's accentuated this trend. The districts of central Florida suffered losses, yet the citrus area in northeast Florida was completely destroyed.

In a general way, the outline of The Ridge and Highlands was set by the turn of century. During the almost sixty-three years which have followed the growers of the district have been filling the suitable

blank spaces with citrus trees. At first, grove plantings were made from the empirical observations that black jack oak land was relatively frost free. Later, the advantages of planting in respect to slope and cold air drainage were scientifically realized, and thus became the basis for planting groves.

Unfortunately the better grove land as far as frost protection is concerned is the poorest in regard to fertility. Many changes in production technique were necessary before high yields of good quality fruit were realized in the district. The major contributing measures which rectified this situation were: (1) the introduction and use of root stocks, particularly the rough lemon for oranges, and (2) the use of commercial mineral fertilizers.

Mechanization is apparent today in all aspects of grove work in the district owing to the high costs of labor; only the harvesting is done by hand. The cultivation, fertilization, and spraying is accomplished by the use of heavy equipment. Although the prime consideration of the grower is yields of fruit per acre, the trees must be spaced so as to allow the heavy equipment to pass between the rows. As a consequence the average grove in the district contains fewer trees than do those in other world regions such as Spain. Older groves in the district in which trees were spaced too closely now employ the use of hedging machines to make a suitable passageway for the grove equipment.

The picking season extends from October to July; March is the peak month. The season witnesses a steady influx and out flow of migratory labor which is needed to harvest the majority of the citrus crop. The regular chores of cultivating, fertilizing, and spraying are accomplished by a small year-round labor force.

The small grower still reigns supreme in the district, although the trend is toward large holdings. The seemingly continuous landscape of The Ridge and Highlands is actually divided into numerous squares and rectangles of five, ten, and up to twenty acres on the average, based upon the U. S. Rectangular Survey System. The small grower most often is not dependent upon the grove for his livelihood. He usually works at a job which may or may not be related to the citrus industry. His grove is either tended by a private caretaker or by a cooperative caretaker. Although the grower is not dependent upon the grove directly, often his livelihood is indirectly dependent upon the economic posture of the citrus industry in general. The growers with larger landholdings most often are fresh fruit or fruit processing handlers as well.

The bulk of the citrus fruit produced in The Ridge and Highlands is marketed in processed rather than fresh form, as in the early days of the state's history. Frozen concentrated juice has become the "Cinderella" product of the 1950's and 1960's just as canned single strength juice was in the 1940's. These processed products, introduced originally as variations through which to market the surplus fruit crop of the district, have finally gained such wide, popular market acceptance that they have become the major interest of the citrus industry.

The Ridge and Highlands today faces a dilemma which similarly confronts other agricultural specialty regions of the United States. First, the better land, indeed even the marginal land, for citrus trees in the district is in production. Second, the urban sprawl threatens to erase some citrus groves from the district. This eradication of groves has already become of some consequence in the Orlando and Lakeland metropolitan areas, and in a minor way in and near every town in the district. Commonly, the urban spread has been into some of the better site locations for groves, that is, onto land with good water and air drainage. Fortunately, urban land use is the only type of land use which can economically compete with citrus growing.

The continuance of The Ridge and Highlands as a leading world producer of citrus products in the future depends upon several variables. Increased urbanization is the only apparent factor on the negative side of the ledger. Either climate or disease could produce grave consequences, as well. New techniques and others still in the experimental stage could possibly offset the losses of groveland to urban use. They include: (1) closer planting in combination with hedging, (2) the wider use of wind machines in protection of cold locations, and (3) the adaptation of rootstocks to flatwoods soils. Together these innovations could produce a greater intensification in the existing groves of the district along with an extension onto the flatlands within and surrounding the district.

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