The total 1.22 million budded nursery trees should be adequate to set about 10,000 acres at current populations of 121 trees per acre.

Rootstocks. Sour orange accounts for 98.5% of available rootstocks, although a few trees are being budded onto 'Carrizo' citrange and 'Swingle' citrumelo. It is significant that a large proportion of the rootstocks are container-grown, indicating that Texas citrus nurseries are quickly moving toward acceptance of the many advantages afforded by growing trees in containers inside heatable structures.

The 1.25 million rootstock seedlings should yield about 1.0 million budded trees for 1986 planting, both as new orchards and resets. At the current average population of 121 trees per acre, there should be enough trees to plant about 8,000 acres by the end of 1986.

Rootstock seed. The citrus canker quarantine in Florida and the freeze loss of Texas rootstock seed-producing trees permit the estimation of future rootstock numbers, inasmuch as virtually all seed in 1985 were imported under a permit system. Some 1,075 quarts of seed were imported from Florida.

These seed should generate about 1.4 million budded trees through mid-1987, assuming 2,200 seed per quart and 60% plantable trees. Consequently, enough trees should develop to plant another 11,000 acres at current spacings.

Potential acreage. Combining budded trees, rootstocks and seed potentials indicate about 3.6 million nursery trees available to plant approximately 29,000 net acres of citrus by mid-1987. These trees would increase the total acreage of Texas citrus to about 59,000 acres within 2 years. However, adjustments must be made for certain factors which will negatively affect total acreage.

There has been considerable discussion of higher density plantings, but there is no reliable evidence as to the number of acres or trees which will be replanted at closer spacings. Some existing orchards have been interset with new trees, as growers attempt to obtain some fruit production from their freeze-damaged trees while the intersets that will become the new orchard are maturing. Too, some growers are resetting 2 or more trees in spaces where 1 or more trees were removed.

Moreover, numerous trees in existing orchards continue to die and some orchards present during the inventory have since been removed. Industry sources guess that as many as 5,000 or more additional net acres of trees have been lost since the inventory.

A significant number of nursery trees will be marketed for residential planting throughout South Texas, but there is no reliable estimate of that quantity. Finally, nursery production has been reported to be off due to lower than normal seed germination and lower budding success.

Consequently, it is possible that the 1987 Texas citrus inventory will be closer to 50,000 acres than to 59,000. These uncertainties, however, in combination with the industry's need for more accurate data, are responsible for the decision by the Texas Crop and Livestock Reporting Service to update the inventory of Texas citrus nurseries to July 1986.

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ECONOMIC FACTORS AFFECTING POSTFREEZE PRODUCTION DECISIONS IN THE FLORIDA CITRUS INDUSTRY

RONALD P. MURARO
University of Florida, IFAS
Citrus Research and Education Center
700 Experiment Station Road
Lake Alfred, Florida 33850
AND
GARY F. FAIRCHILD
Food and Resource Economics Department, IFAS
University of Florida
Gainesville, Florida 32611

Abstract. **As a result of the Dec. 1983 and Jan. 1985 freezes, Florida's citrus industry is in a state of flux. Increased competition in the orange juice market and erosion of the U.S. tariff on citrus juices will necessitate increased efficiency in order to compete with other supply sources. Central to production decisions is the relative efficiency of Florida versus other supply sources. In addition, recent freezes have caused growers to question the relative advantages of production in northern and southern locations. The long-run aspect of investment in citrus necessitates the development of future estimates of relative production costs for the competing regions in the state. This paper discusses the relative costs of production, provides detailed budgets, and identifies some of the important risk factors associated with production in the two areas.**

The Florida citrus industry sustained a record 4 freezes in 5 years between 1980-81 and 1984-85. Since 1982, total Florida citrus acreage has been reduced by 24% from 845,300 to 642,900 acres. The Florida Crop and Livestock Reporting Service (FCLRS) 1984 commercial citrus inventory, as updated in 1985, also indicates that there are 11.2 million fewer orange trees than in 1982, a reduction of 20.9%. Comparisons for the same time period reveal that there are 900,000 fewer grapefruit trees, an 8.3% decrease.

Prior to recent freezes, Florida generally supplied about 85-90% of the orange juice marketed in the United States. However, as a result of freeze damage there have

been higher prices and sharply reduced orange juice supplies. In the past four seasons, Florida has supplied about two-thirds of the U.S. orange juice market.

U.S. orange juice imports, primarily from Brazil, have become a major factor in recent seasons, increasing 5-fold since 1980. U.S. imports have generally filled the supply void caused by the devastating freezes in Florida. Furthermore, the U.S. fixed-rate import tariff on citrus juice imports has been eroded due to higher prices, as well as federal government policies such as the Caribbean Basin Initiative. The combination of Florida's decreased production, increased Brazilian imports, increased chilled orange juice sales, higher prices, and Brazil's lower production costs has enabled foreign competition to gain a solid foothold in the U.S. orange juice market.

Florida orange production is forecast to increase during the next decade to approximately the 190-200 million-box level by the 1995-96 season. During this same period, Brazilian orange production is forecast to increase from the current level of 190-220 million boxes to nearly 300 million boxes. Based on long-term demand forecasts for orange juice in the U.S. market, there is projected to be an excess supply of orange juice in the next decade. This situation will likely result in downward price pressure. Projected grapefruit production increases and long-term demand for grapefruit products suggest similar downward price pressure in the grapefruit sector.

Projected supply-demand imbalances, lower prices, and increased competition create a situation in which the Florida citrus grower must carefully evaluate post-freeze planting and production decisions. Florida citrus growers must become as efficient as possible in order to compete successfully with other supply sources. Central to the post-freeze decision facing Florida citrus growers is the question of the relative advantages of production in the northern and southern locations in the state. The remainder of this paper focuses on a comparative analysis of citrus investments in North Central and South Florida.

Florida's Citrus Regions

The 2 freezes, Dec. 1983 and Jan. 1985, resulted in the loss of 200,000 acres of bearing citrus in North Central Florida. Prior to these freezes, this area produced approximately 20% of all the citrus grown in Florida. The deep sandy soils along with the high rolling terrain enable the citrus groves in North Central Florida to be among the most productive in the world. Although water enhances yields in the Northern region, water has not been a critical limiting factor for high levels of production.

With the loss of the citrus acreage due to repeated freezes, there has been increased interest in expanding citrus plantings in the relatively frost-free Southern region. South Florida's warmer climate allows for a longer growing season, enabling citrus trees to become productive more quickly. However, South Florida soils are less desirable for citrus culture and require special management to expand tree root depth by control of water movement. Irrigation is a necessity for growing productive citrus in the Southern region. Environmental concerns about the quality of excess water being discharged from citrus properties has resulted in additional cost, and loss of plantable acreage, due to required construction of water retention areas. Also, Florida's Southern region is rapidly increasing in urban population which may restrict the future available water supply for agricultural use.

Comparative Investment Analysis

Using cash flow budget analysis, citrus investments in South Florida and North Central Florida were compared. 'Hamlin' orange was the variety selected since this variety will probably predominate in the northern citrus replantings and is also extensively planted in South Florida. The 2 grove descriptions used in the 15-year budget analysis are presented in Table 1. Due to land preparation, installation of irrigation systems, and the availability of citrus trees, the analysis assumes that the citrus trees would not be planted until year 2.

Land preparation requirements differ for the two production regions. Clearing of land, ditching, canals, water retention areas, and soil beds must be developed before citrus can be planted in South Florida. In North Central Florida, removal of trees and leveling are the land preparation requirements. Of the total available acreage, an average of 75% of the land is plantable in South Florida whereas in North Florida at least 95% of land can be planted.

The cost of land is estimated to be $1,750 per acre for South Florida and $2,000 per acre for North Central Florida. The analysis assumes that the irrigation systems will be equipped for supplemental liquid fertilization. Land preparation costs are estimated to be $1,300 per acre for South Florida and $300 per acre for North Central Florida. Installation of drip irrigation systems predominate in South Florida. North Central Florida irrigation systems will probably be microsprinkler due to better moisture distribution on the deep sandy soils and for the potential frost protection. The per acre cost of the irrigation systems is estimated at $900 and $1,350 for the drip and microsprinkler, respectively. On a per planted acre basis, the total initial capital investment is estimated to be $4,967 and $3,771 for South Florida and North Central Florida, respectively.

Table 1. Grove description used in investment analysis.

	South Florida	North Central Florida
Plantable acreage	75%	95%
Initial capital investment per planted acre	$4,967	$3,771
Land per planted acre	$2,333 ($1,750/acre ÷ 0.75)	$2,105 ($2,000/acre ÷ 0.95)
Land preparation per planted acre	$1,734 ($1,300/acre ÷ 0.75)	$316 ($300/acre ÷ 0.95)
Irrigation with fertigation and well per planted acre	$900 (drip)	$1,350 (microsprinkler)
Trees planted per acre	140	140
Tree replacement (trees lost) per year	4	3
Base price year 1 (lb. solids)	$1.10	$1.10
Base pick and haul cost (box)	$1.50	$1.50
Annual adjustment to normal expected yield:		
Potential fruit loss due to freezes	0	6.0%
Potential fruit increase due to growing conditions	+9.5%	0

Table 2. Estimated yields of 'Hamlin' orange used in budget analysis.

Tree age (yr)	Pound Solids per box (lb.)	Yield (Boxes/tree)		
		Normal expected	Estimated	
			South Florida[z]	North Central Florida[y]
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	4.25	0.50	0.55	0.47
4	4.50	0.90	0.99	0.85
5	4.75	1.50	1.64	1.41
6	5.00	2.50	2.74	2.35
7	5.25	3.30	3.61	3.10
8	5.50	4.25	4.65	4.00
9	5.50	4.75	5.20	4.47
10	5.50	5.00	5.48	4.70
11	5.50	5.25	5.75	4.94
12	5.50	5.25	5.75	4.94
13	5.50	5.25	5.75	4.94
14	5.50	5.25	5.75	4.94
15	5.50	5.25	5.75	4.94

[z]Average 9.5% more than normal expected yield (Table 1).
[y]Average 6% less than normal expected yield (Table 1).

Both production areas are assumed to have a planting density of 140 trees per acre. To allow for a normal attrition of citrus trees, an annual reset tree (replacement tree) rate was incorporated into the analysis. The annual per acre tree loss was assumed to be 4 trees (3%) and 3 trees (2%) for South Florida and North Florida, respectively.

Neither costs nor fruit prices were inflated over the 15-year analysis period. A constant delivered-in-price of $1.10 per pound solids and pick and haul costs of $1.50 per box were used in the analysis.

The normal expected fruit yields (Table 2) were based on field research trials of variety and rootstock combinations and yield data from the Florida Department of Agriculture. The fruit yields were adjusted to reflect the two production regions. Analyzing past historical freezes, excluding the recent freezes, the frequency that a freeze would occur was estimated to be once every five years. Analyzing the decrease in fruit production resulting from freezes not causing severe tree damage, it was estimated that 30% of a crop in the North Central Florida region could be lost if a freeze occurred. Replicating the possible freeze frequency along with the potential fruit loss percentage to account for a potential freeze in each year of the 15-year analysis, resulted in an overall 6% annual expected reduction in yield for the North Central Florida region.

South Florida historically has shown an average per tree yield advantage of 15.5% above North Central Florida for tree ages 5-14 years but a 25.3% average per tree yield disadvantage for tree ages 15-25 years. However, the 15.5% yield advantage also includes any decreased fruit yield due to freezes in North Central Florida. Therefore, the net average percentage yield advantage for South Florida was estimated to be 9.5% (15.5% less 6.0%).

No consideration of the effects that federal tax laws would have on an investment decision was analyzed. Also, capital costs such as interest and principle payments and leverage financing were not included in budget analysis.

Economic Analysis

Table 3 presents the costs per tree for solid-set and reset trees through the first four years after planting. Except for the first year costs, the total annual per tree cost for each production region is approximately the same. A $2.00 cost per tree is incurred in Year 1 for an insulated tree wrap in North Central Florida. Other cost differences are a somewhat higher cost for irrigation in North Central Florida, and higher costs of spraying, herbiciding, and cultivation/mowing in South Florida.

The reset costs represents the additional cost incurred to maintain a replacement tree in the citrus grove. The assumption is that each year another tree will be planted. Thus, year 4 represents the accumulated costs for resets which are 1, 2, 3, and 4 years of age. After four years, the analysis assumes that the reset will not need any additional grove care above that provided by the normal grove care program.

Table 3. Annual grove care costs per tree for solidset and reset trees from year of planting.

	South Florida				North Central Florida			
	Year				Year			
	1	2	3	4	1	2	3	4
Solidset planted trees	Dollars							
Drip/microsprinkler irrigation	0.50	0.50	0.50	0.50	0.70	0.70	0.70	0.70
Fertilize tree	0.30	0.45	0.50	0.55	0.30	0.45	0.50	0.55
Supplemental fertilization thru irrigation	0.25	0.30	0.35	0.40	0.25	0.30	0.35	0.40
Spray	0.40	0.45	0.55	0.60	0.36	0.41	0.48	0.56
Insulated tree wrap	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00
Sprouting (labor)	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Herbicide	0.40	0.40	0.40	0.40	0.35	0.35	0.35	0.35
Ridomil/Aliette	0.45	0.45	0.45	0.00	0.45	0.45	0.45	0.00
Cultivation/mowing	0.30	0.30	0.30	0.30	0.25	0.25	0.25	0.25
Miscellaneous	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Total cost per year	2.95	3.20	3.40	3.10	5.01	3.26	3.43	3.16
Reset trees (year 4 equals cost of trees 1 through 4 years old)	2.95	6.15	9.55	12.65	5.01	8.27	11.70	14.86
Cost of planting trees	5.85[z]	–	–	–	5.85[z]	–	–	–

[z]Tree cost (bare root) = $4.20; stake, plant, and water tree = $1.65.

Table 4. Estimated grove care costs per acre for a mature citrus grove.[z]

Grove practice	South Florida	North Central Florida
	Dollars	
Cultivation & herbicide	112.79	98.08
Spraying	159.19	144.72
Fertilization	109.95	97.30
Hedging	18.78	18.78
Irrigation	71.47	101.87
Miscellaneous	23.61	23.04
Supervision & overhead	49.58	48.38
Total grove care cost per acre	545.37	532.17

[z]Does not include a cost for property taxes, tree removal and reset trees.

The estimated grove care costs for a mature producing 'Hamlin' citrus grove is shown in Table 4. The differences in costs are the higher cost for cultivation/mowing, herbiciding, and spraying for South Florida and the higher irrigation costs for North Central Florida. Miscellaneous costs is estimated to be 5% of all the costs listed above while the supervision and overhead costs is 10% of all the above listed costs. Total estimated cost per acre, not including property taxes, tree removal, and reset costs, is $545.37 and $532.17 for South Florida and North Central Florida, respectively.

Fig. 1 presents the total boxes per acre for the two citrus production regions. Beginning in the third year after planting (year 4 of the analysis), the two grove situations begin bearing and continually increase in production until year 12 of the analysis where total yield becomes constant. The yield in boxes per acre from year 12 is 674 and 607 for South Florida and North Central Florida, respectively. As can be seen from Fig. 2, total pound solids per acre from year 12 is 3,704 and 3,338 for South Florida and North Central Florida, respectively. These yields reflect the anticipated differences in per tree yield shown in Table 2.

Tables 5 and 6 present cash budget analysis for South Florida and North Central Florida, respectively. Total accumulative cash outlay peaks at year 5 for both production areas with a high of $7,065 per acre and $6,259 per acre for South Florida and North Central Florida, respectively. For both production regions, a positive net annual cash flow is expected to begin in Year 6 and a positive accumulative net cash flow will begin in Year 11. Figs. 3, 4, and 5 present the budget analysis in graphic form.

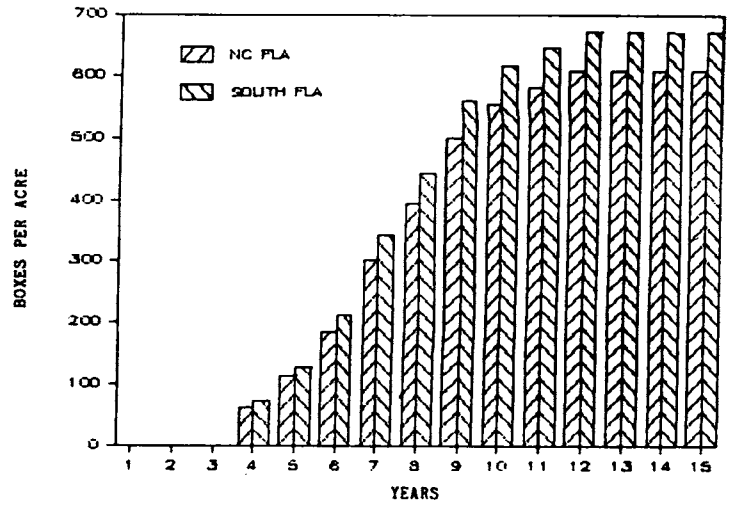

Fig. 1. Estimated box yield per acre for 'Hamlin' oranges in North Central and South Florida (box = 1¾ bushels).

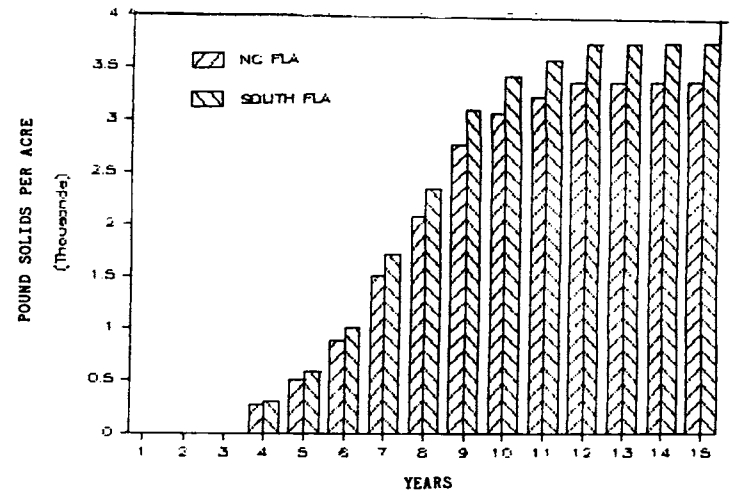

Fig. 2. Estimated pound solids yield per acre for 'Hamlin' oranges in North Central and South Florida.

The annual net operating income and annual net cash flows were discounted for both budget analysis. A 10.0% discount rate was assessed in the analysis. This is considered a safe rate of return for long-term certificate of deposit investments. The discounted annual operating income was $1,117 per acre ($4,655 per acre less $3,538 per

Table 5. Cash budget analysis for establishing a 'Hamlin' orange grove in South Florida[z].

	Dollars per acre for year														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Adjusted gross revenue	0	0	0	229	443	782	1365	1893	2545	2814	2944	3068	3068	3068	3068
Operating expenses															
Cost to remove trees or brush	0	0	6	6	9	9	12	12	18	18	18	18	18	18	18
Grove care costs	0	0	0	0	0	432	432	469	490	490	518	518	518	545	545
Young tree care—resets	0	0	12	25	38	51	51	51	51	51	51	51	51	51	51
Young tree care—solidset	0	413	435	449	397	0	0	0	0	0	0	0	0	0	0
Plant reset/solidset trees	0	819	23	23	23	23	23	23	23	23	23	23	23	23	23
Property taxes	15	17	18	20	22	24	27	29	32	35	39	43	47	52	57
Total operating expense	15	1249	495	523	489	539	544	584	614	618	649	653	657	689	694
Net annual operating income	−15	−1249	−495	−293	−47	243	820	1309	1931	2196	2295	2415	2411	2379	2374
Less: initial capital investment	4967	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual net cash flow	−4982	−1249	−495	−293	−47	243	820	1309	1931	2196	2295	2415	2411	2379	2374
Accumulative net cash flow	−4982	−6230	−6725	−7018	−7065	−6822	−6002	−4692	−2762	−565	1730	4145	6556	8935	11309

[z]Discounted annual net operating income @ 10% rate is $4655. Discounted annual cash flow @ 10% rate is $140. Internal rate of return is 10.26%.

Table 6. Cash budget analysis for establishing a 'Hamlin' orange grove in North Central Florida[z].

	Dollars per acre for year														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Adjusted gross revenue	0	0	0	200	387	687	1208	1683	2275	2523	2644	2761	2761	2761	2761
Operating expenses															
Cost to remove trees or brush	0	0	5	5	7	7	9	9	13	13	13	13	13	13	13
Grove care costs	0	0	0	0	0	427	427	460	482	482	507	507	507	532	532
Young tree care—resets	0	0	15	25	35	45	45	45	45	45	45	45	45	45	45
Young tree care—solidset	0	701	447	460	414	0	0	0	0	0	0	0	0	0	0
Plant reset/solidset trees	0	819	18	18	18	18	18	18	18	18	18	18	18	18	18
Property taxes	15	17	18	20	22	24	27	29	32	35	39	43	47	52	57
Total operating expense	15	1537	502	526	495	520	525	561	590	593	622	626	630	660	665
Annual net operating income	−15	−1537	−502	−326	−108	167	683	1122	1685	1930	2022	2136	2131	2102	2096
Less: initial capital investment	3771	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Annual net cash flow	−3786	−1537	−502	−326	−108	167	683	1122	1685	1930	2022	2136	2131	2102	2096
Accumulative net cash flow	−3786	−5323	−5825	−6151	−6259	−6092	−5409	−4287	−2602	−672	1350	3485	5617	7719	9815

[z]Discounted annual net operating income @ 10% rate is $3538. Discounted annual cash flow @ 10% rate is $110. Internal rate of return is 10.24%.

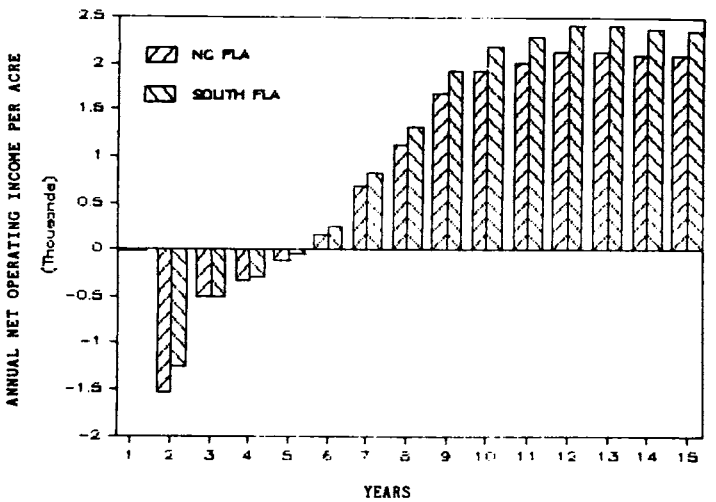

Fig. 3. Estimated annual net operating income per acre for 'Hamlin' orange grove in North Central and South Florida.

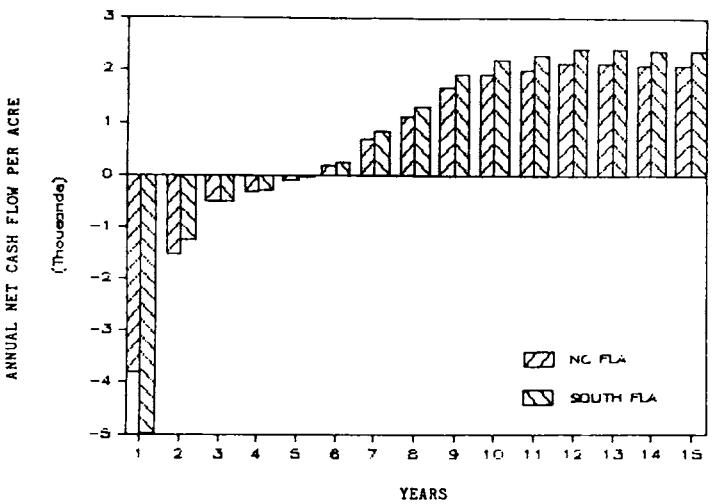

Fig. 4. Estimated annual net cash flow per acre for 'Hamlin' orange grove in North Central and South Florida.

acre) greater for South Florida than North Central Florida (Tables 5 and 6). Likewise, the discounted annual net cash flow for South Florida was $30 per acre ($140 per acre less $110 per acre) greater than North Central Florida (Tables 5 and 6).

Internal rate of return (IRR) is one of the most widely used measures of return on investment projects. The internal rate of return is a form of discounted cash flow analysis where cash flows are discounted at the interest rate at which they exactly equal the present value of the initial investment. The initial investment analysis was assumed to equal the first year annual net cash flow. Even with higher annual net cash flows in the later years of the analysis, the IRR rate for both production regions was approximately 10.25%. The higher initial investment cost and the larger annual net cash flow losses during the early years contributed to a lower IRR rate for South Florida.

The effects which an increase or decrease in annual costs have on the IRR rate is shown in Table 7. A 10% increase in annual costs would result in an approximate 0.9% and 0.8% decrease in IRR rate for South Florida and North Central Florida, respectively. A 10% decrease in annual costs would result in approximately an 0.8% increase in the IRR rate for both regions. Table 8 presents a comparison of discounted net operating income and annual net cash flow and IRR rates for North Central Florida with respect to different annual percent decrease in yields.

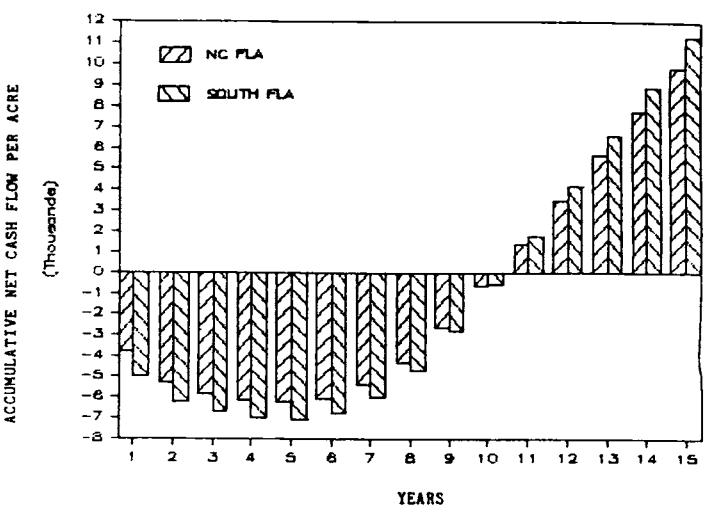

Fig. 5. Estimated accumulative net cash flow per acre for 'Hamlin' orange grove in North Central and South Florida.

Table 7. Effect of percentage change in annual costs to internal rate of return.

Annual change in cost (%)	Internal rate of return (%)	
	South Florida	North Central Florida
+10	9.48	9.30
0	10.25	10.24
−10	11.04	11.08

Table 8. Effect of percentage yield reduction due to freezes in North Central Florida.

Annual decrease in yield (%)	Discounted net operating income @ 10% rate ($)	Discounted annual net cash flow @ 10% rate ($)	Internal rate of return (%)
8	3,366	−63	9.87
6	3,538	110	10.24
4	3,710	282	10.60
2	3,883	454	10.95

Summary and Conclusions

Management skills and cost-efficient operations will be necessary for a successful citrus production in the future. Increased competition and potentially lower prices puts pressure on producers to make good decisions and maximize profits. This paper presents one method of evaluating investment decisions. There are several alternative methods available. Specific conditions, objectives and limitations of the individual firm's situation must be considered in both location and production decisions. The purpose of this paper has been to stimulate an increased awareness of the importance of management decisions to potential profits in the future.

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THE FUTURE OF THE FLORIDA ORANGE INDUSTRY

DAN L. GUNTER
Economic Research Department
Florida Department of Citrus
2121 McCarty Hall, University of Florida
Gainesville, FL 32611

GARY F. FAIRCHILD
IFAS, Food and Resource Economics Department
McCarty Hall, University of Florida
Gainesville, FL 32611

Abstract: **The Florida orange industry is in a state of change with respect to both production and marketing environments. The dynamics of the industry include shifts in orange juice demand, freeze-reduced Florida orange crops, and increased Brazilian and out-of-state competition. This report provides projections of orange juice supply and demand, and an assessment of the implications of the market trends for Florida's orange industry.**

Florida's orange industry has been popularly described as "in transition." This transition involves 3 major factors: growth and shifts in orange juice demand, the 4 freezes of this decade, and expansion of Brazilian orange production. Discovery of citrus canker in Florida nurseries in Aug. 1984 has contributed to the uncertainty regarding planting decisions.

Given the nature of citrus production, where a large investment of time and capital is required before any returns can be realized, formulation of expectations about the future is critical to development of business plans. The purpose of this report is to briefly describe how the abovementioned factors will impact on the welfare of the industry in the years ahead.

Per Capita Citrus Consumption

Florida's orange industry has benefited tremendously as a result of demand growth. Per capita consumption of citrus in the U.S. roughly doubled between 1940 and 1980 (Fig. 1). It increased from 62.5 lb. in 1940 up to 117.5 lb. in 1980 measured on a fresh weight equivalent basis. During the 40-year period there were also significant shifts in demand for processed versus fresh products which have benefited Florida's orange industry. Fresh citrus consumption declined by 50% during the 40-year period. Average fresh consumption was 52 lb. per capita in 1940 and 26 lb. per capita in 1980. Processed consumption increased by about nine-fold during the same time period. Processed consumption was about 10 lb. per capita in 1940 and 91 lb. per capita in 1980. Given Florida's orientation to production of juice type varieties, the state has realized significant gains from the expansion in demand for processed products.

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