Florida Citrus Production Trends 2001-02 Through 2010-11

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Executive Summary

- The 2000 commercial citrus tree inventory indicates that Florida's orange tree population increased to a record 87.2 million, while the grapefruit tree population decreased to 12.7 million, down 16.2% from the record level in 1994. Florida citrus tree densities are continuing to trend upward, with the average number of orange trees per acre increasing from 93 in 1986 to 131 in 2000, and the average number of grapefruit trees per acre increasing from 82 to 107 over the same period.

- The production estimates in this report are for potential production, as opposed to utilized production. The potential production estimates assume no fruit abandonment.

- Potential production in upcoming years was estimated by applying average historical yields per acre to projected acres, by age.

- The citrus tristeza virus and the brown citrus aphid, which is an efficient vector in spreading this disease, are present in Florida. This situation may result in a sharp increase in tree losses in upcoming years. Trees on sour orange rootstock are vulnerable to tristeza, and, in upcoming years, tristeza may kill most of the trees on this rootstock. An estimated 14% of Florida's orange trees and 42% of the grapefruit trees are on sour orange rootstock.

- Potential production estimates for oranges, grapefruit and specialty are summarized below.

Item/ Season	Planting Assumption	Assumed Tree Losses To Tristeza			
		No Losses	Losses Phased in Over Next 8 Years	Losses Phased in Over Next 12 Years	Losses Phased in Over Next 16 Years
		million boxes			
Oranges					
2001-02		252	237	244	246
2004-05	Average	264	227	234	242
2010-11		282	250	249	249
Grapefruit					
2001-02		51	44	47	49
2004-05	Replacement	51	34	37	41
2010-11		51	50	48	46
Specialty			(Repl.)	(Avg.)	
2001-02		–	12.0	12.0	–
2004-05	Replacement Average	–	11.7	11.4	–
2010-11		–	11.2	9.7	–

- Based on experiences in the Indian River region, tristeza may spread faster to orange trees than to grapefruit trees, and a large part of the tree losses to tristeza may occur over the next eight years for oranges and the next twelve years for grapefruit.

- At its height, tristeza could reduce orange production by roughly 35 to 40 million boxes. Based on an eight-year phase-in of tristeza, potential orange production would decrease from 237 million boxes in 2001-02 to 227 million boxes in 2004-05, and then increase to 250 million boxes in 2010-11.

- Likewise, at its height tristeza could reduce grapefruit production by roughly 12 to 17 million boxes. Based on a twelve-year phase-in of tristeza, potential grapefruit production would decrease from 47 million boxes in 2001-02 to 36 million boxes in 2005-06, and then increase to 48 million boxes in 2010-11.

- Potential specialty citrus production is projected to decrease from 12 million boxes in 2001-02 to 10 or 11 million boxes in 2010-11, depending on planting rate assumptions.

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Florida Citrus Production Trends 2001-02 Through 2010-11*

Introduction

This report presents production estimates for Florida round oranges, grapefruit and specialty citrus for the 2001-02 through 2010-11 seasons. The estimates are based on the Florida Agricultural Statistics Service (FASS) biennial commercial tree inventory for 2000. The biennial inventory reports numbers of trees and acres by age for different varieties of citrus. These data are combined with FASS yield data on boxes of fruit per tree by age to estimate yields per acre, and future production is estimated by applying the estimated yields to projected acreage, by age[1].

The production estimates in this report are estimates of potential production, as opposed to utilized production reported by FASS. Potential production is the fruit that could be utilized assuming favorable citrus prices, while utilized production is the amount of fruit actually entering certified fresh and processing

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* By Mark G. Brown, research economist, Florida Department of Citrus, Gainesville, Florida, with an analysis of grapefruit based on a survey of Indian River grapefruit trees on sour orange rootstock by Ed Stover, assistant professor, Indian River Research and Education Center, Institute of Food and Agricultural Sciences, University of Florida.

[1] This method has been referred to as the acre method in past reports. Another method to project production is the tree method which applies average boxes of fruit per tree to projected trees, by age. The acre method was selected over the tree method because recently observed yields per acre, used in projecting production, were expected to more accurately reflect potential future yields than recently observed yields per tree. Increasing tree densities may negatively impact tree yields in upcoming years, making estimation of these yields and tree-based production projections problematic. Yields per acre were assumed to more fully reflect the impact of increasing tree densities. High tree densities have occurred in some of the younger age categories, and the observed acre yields for these age categories reflect the change in this factor. Older age category acre yields are assumed to be constrained by limited space and availability of sunshine, water and nutrients in the soil; historical yields are assumed to reflect these yields.

channels, as well as noncertified channels. Some fruit may be abandoned rather than utilized when grower prices are below harvest and post-harvest costs.[2]

Overview of the 2000 Commercial Tree Inventory

The 2000 commercial tree inventory shows Florida's total citrus acreage decreased 1.5% from 845.3 thousand acres in 1998 to 832.3 thousand acres in 2000 (Table 1). The number of citrus trees decreased slightly by .4% from 107.1 million in 1998 to106.7 million in 2000. The trend toward denser plantings continued with the average trees per acre at 128.2 in 2000. Acreage and tree inventory data for round oranges, grapefruit and specialty citrus are shown in Tables 2, 3 and 4, respectively.

The 2000 FASS commercial tree inventory indicates that the population of bearing and nonbearing round-orange trees increased to a record 87.2 million in 2000, up 2.1% over the previous inventory. As indicated in Table 5, the orange tree population in 2000 was older than in the last decade, with 61.7% of the round-orange trees being greater than eight years old, versus about 30% to 50% from 1990 through 1998 (49.8% in 1998, 38.6% in 1996, 34.4% in 1994, 34.8% in 1992, and 40% in 1990). In 2000, 16.9% or about 14.7 million of the round-orange trees were five years old or less; an additional 21.4% or 18.7 million trees were between six and eight years old. Despite the increase in the age of the orange tree population in 2000, further maturation of the population with normal attrition would likely increase Florida's orange production potential in the upcoming years.

According to the 2000 FASS commercial tree inventory, the total number of bearing and nonbearing grapefruit trees decreased 2.3% from 13 million in 1999 to 12.7 million in 2000. The grapefruit tree

[2] FASS reported abandonment of 3 million, 6 million and 6 million boxes of grapefruit in 1995-96, 1996-97 and 1998-99, respectively.

population has decreased by 16.2% since its high point of 15.1 million in 1996, reflecting the low returns grapefruit growers have experienced (grapefruit on-tree prices decreased from about the $5.60 to $6.60 per box range in the early 1990's to under $2.00 per box from1995-96 to1997-98; in 1998-99 and 1999-00, the on-tree price was up to $2.36 per box and $3.98 per box, respectively, but in 2000-01, the price is expected to be down). The grapefruit tree population continues to age with 67.5% of the trees being greater than eight years old in 2000, versus 47.1% in 1996 (Table 6). The age distribution for grapefruit trees by variety and by Indian River versus Interior regions is shown in Table 7.

The 2000 inventory indicates that the number of specialty citrus (Temples, tangelos and tangerines) acres and trees decreased by 6.6% and 6.4%, respectively, over the last two years. This is the second census in a row that the specialty tree population has declined (from 1996 to 1998, the number of trees and acres decreased by 4.7% and 3.1%, respectively). The 2000 specialty tree population has matured but 48.7% of the trees are still less than nine years old (Table 8).

Methodology

The production estimates discussed in this report are based on projecting the acreage in 25 tree-age categories in the upcoming ten seasons. Separate projections were made for early and midseason oranges, late oranges, white seedless grapefruit[3], red and pink seedless grapefruit, Temples, tangelos and tangerines.

The Florida production projections for oranges and grapefruit were based on projections for four regions to take into account variation across regions in potential acreage loss and planting rates, as well as yields. Acreage losses due to the citrus tristeza virus are expected to vary substantially by region. The four

[3] A small amount of seedy grapefruit is included with white seedless grapefruit.

regions used in modeling production were the South, West, Indian River and the North and Central[4]. These regions are roughly the same as those for which FASS reports yields per tree.

Planting Assumptions

The projections are dependent on assumed future acreage-planting rates. Planting levels for the period from 1997 through 1999 are shown in Table 9. Orange planting levels are up somewhat from previous levels, while grapefruit and specialty planting levels are down (the trends in orange and grapefruit planting levels are reflected by the percentages of trees that are less than two years old in Tables 5 and 6). Over the projection period, alternative planting assumptions are considered—recent season average levels, twice and half the average levels, and replacement levels[5]. For the replacement planting assumption, acreage planting levels in the upcoming years are assumed to equal corresponding losses.

Tree/Acre Loss Assumptions

The citrus tristeza virus and the brown citrus aphid, which is an efficient vector in spreading this disease, are present in Florida. This situation may result in a sharp increase in tree losses in upcoming years. Trees on sour orange rootstock are vulnerable to tristeza, and, in upcoming years, tristeza has the potential to kill most of the trees on this rootstock. Based on data from the Bureau of Citrus Budwood Registration

[4] The regions included the following counties—South: Charlotte, Collier, Glades, Hendry, Lee and Okeechobee; West: DeSoto, Hardee, Hillsborough, Manatee, and Sarasota; Indian River: Indian River, St. Lucie, Martin, Palm Beach, Brevard, Volusia, and Flagler (parts of some counties are not included, as defined by FASS); North and Central: all other counties.

[5] Major factors influencing planting levels are citrus prices and grower returns, which depend on supplies and demands for Florida and competitive citrus products.

and a survey of grapefruit in the Indian River Region[6], an estimated 14% of the orange trees or about 12 million trees, and an estimated 42% of the grapefruit trees or about 5.3 million trees were on sour orange rootstock in 2000 (Table 10). Most of the trees on sour orange rootstock were planted in the 1980's and earlier (Exhibit 1), so that the surviving trees on this rootstock are in the most productive stage of their lives, and loss of these trees to tristeza would be expected to have a significant impact on total production.

Three scenarios were assumed in losing acreage to tristeza (Table 11)—nearly all acreage with trees on sour orange rootstock are lost during (1) the next eight years, (2) the next twelve years, and (3) the next sixteen years[7]. Based on experiences in the Indian River region, tristeza may spread faster to orange trees than to grapefruit trees, and a large part of the expected tree losses to tristeza may occur over the next eight years for oranges and the next twelve years for grapefruit. The initial incident of tristeza was assumed to be highest in the South and West; the North and Central region was assumed to have the lowest incident while the Indian River region was assumed to have a somewhat higher but relatively low incident.

Other factors in addition to tristeza are also expected to result in acreage losses. Non-tristeza, acreage-loss rates were assumed based on loss rates implied by the commercial tree censuses (Table 12). From 1998 to 2000, the State average annual acreage-loss rate for oranges was 2.7%. The historical acreage-loss rates tend to increase with the age of the trees on the acreage. This tendency is assumed to continue over the projection period, i.e., the orange projections are based on acreage-loss rates which increase with age.

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[6] The survey was conducted by Ed Stover, assistant professor, Indian River Research and Education Center, Institute of Food and Agricultural Sciences, University of Florida.

[7] A logistic function was used to model the loss rate for acreage with trees on sour orange rootstock. This function allows the loss rate for this acreage to increase relatively quickly in the first years when tristeza is spreading; then the loss rate levels off as the disease spreads to most of the trees.

With low grower returns for grapefruit, grapefruit-loss rates have increased substantially. From 1998 to 2000, the annual average grapefruit acreage-loss rates were 9.6 % in the Interior region and 5.5% in the Indian River region, versus 2.8% in the Interior region and 2.4% in the Indian River region over the 1994 to 1996 period. Although grapefruit on-tree prices were up in 1999-00, on-tree prices in 2000-01 are expected to decrease sharply, and the high, non-tristeza, loss- rate trend that occurred from 1996 to 2000 is assumed to continue in 2000-01. For 2001-2002 and thereafter, the non-tristeza, loss rates for grapefruit are assumed to follow the 1994 to 1996 loss rates, based on the expectation of relatively small grapefruit crops and improved on-tree prices in the future. As for oranges, these grapefruit loss rates were assumed to increase with age of the acreage.

For oranges and grapefruit, the assumed loss rates vary by region. For the specialty citrus production projections, which were made at the State level, the loss rates were assumed to be flat at recent levels, across the age of the acreage.

Yield Assumptions: Projection Methodologies Based on Trees Versus Acres

Production estimates were made for each of the four regions defined above, and State estimates were obtained by summing the region estimates. For each region, the production estimates were made by multiplying the projected number of acres in each specific age category by the yield or number of boxes per acre for that age category and summing the results across age categories. Average yields per acre by age were used in making these estimates. The averages were based on yield data reported by FASS for 1993-94 through 1999-00, excluding the 1998-99 season which experienced yields well below normal due to El Nino related weather. That is, normal yields are assumed over the projection period.

The FASS reports tree yields, as opposed to acre yields. A summary of the reported tree yield data is shown in Table 13. The acre yields used in this report were obtained by multiplying the tree yields (boxes per tree) by the tree densities (trees per acre), by age.

It should be noted that the projections in this report indicate production trends, and actual production levels in any given season could deviate substantially from these trends based on yield variation alone. Yield variability for early and midseason, and Valencia oranges since the last major freeze in 1989-90 is indicated in Table 14. Weighted average yields (yields by age category weighted by category tree population shares) by variety for each season were calculated using 2000 tree census data to construct the weights (2000 weights, as opposed to season specific weights, were applied to each season's yields so that changes over time in yields and tree population shares would not be confounded). Exhibits 2 and 3 show the patterns over time in these yields and suggest that future yield variation could be significant. Standard deviations for the weighted average yields over this period were .42 boxes for early and midseason oranges, and .33 boxes for Valencia oranges; dividing these standard deviations by their means indicate yields for early and midseason oranges, and Valencia oranges varied on average from their means by 10.9% and 12.4%, respectively.

Yields are expected to depend, in part, on tree density which has been increasing over time, as shown in Tables 1 through 4. Since the mid 1980's, tree densities have noticeably increased. On average, 134 orange trees were planted per acre in the last three years, 1997 through 1999, as reported in the 2000 commercial tree inventory; on the other hand, tree density of the oldest acreage (pre-1956) averages 92 trees per acre.

In the future, older-age-category densities may increase. For example, in 1999-00, the round-orange tree density for the five-year-old category (year set was 1994) was 146 trees per acre, compared

to 120 trees per acre in the sixteen-year-old category (year set was 1983). Five-year-old trees in 1999-00 will become sixteen-year-old trees by the end of the projection period in 2010-11. Hence, assuming the average density in this cohort is maintained over time, the density in the sixteen-year-old age category would increase from 120 trees per acre in 1999-00 to 146 trees per acre in 2010-11.

For young acreage, increasing tree densities are expected to increase yields per acre. However, since older acreage presently has relatively low tree densities, we can only assume how older-age-category yields per acre might be affected as young-high-density acreage matures into old acreage. In terms of tree yields, we do not know how boxes per tree may be affected by dense planting levels, as trees mature and compete for space. As highly dense acreage ages, some trees may be removed to allow the remaining trees more space to grow, or yields per tree may simply be less than historically observed. The likelihood of yields per tree decreasing with increasing tree density is supported by data in Table 14 and Exhibits 2 and 3. The correlation between yields and tree densities for early and midseason and Valencia oranges are negative and statistically significant.

In this study, yields per acre were assumed to more fully reflect the impact of increasing tree densities than yields per tree. The estimated acre yields for the younger age categories capture, to an extent, the impact of increasing tree densities, as these age categories have experienced increasing densities over the years for which the yields were estimated. Older-age-category acre yields are assumed to be constrained by the limited space in which trees must compete for sunshine, water and nutrients in the soil. Historical acre yields for the older age categories are assumed to reflect the yield potential for these age categories in upcoming years.

It should also be noted that abandonment of grapefruit in 1995-96, 1996-97 and 1997-98 negatively impacted grapefruit boxes of fruit per tree reported by FASS for those seasons. For each age

category, FASS boxes of fruit per tree were calculated as that age category's utilized production divided by the number of trees in that age category, including trees that yielded abandoned fruit. Hence, estimates of grapefruit production based on mean FASS yields for recent years may understate potential production. To correct for this problem, reported grapefruit yields for the three seasons when abandonment occurred were adjusted upward by multiplying the reported yields times the ratio of potential production (utilized production plus reported abandonment by FASS) to utilized production. Separate adjustments were made for white and colored seedless grapefruit yields.

Round-Orange and Grapefruit Production Estimates

Potential production estimates for oranges and grapefruit were made based on a number of different loss and planting assumptions, with an emphasis on the potential impact of tristeza. Table 15 shows estimates of potential orange production for four tristeza assumptions—(1) no losses due to tristeza occur, (2) tristeza kills virtually all trees on sour orange rootstock over the next eight years, (3) tristeza kills virtually all trees on sour orange rootstock over the next twelve years, and (4) tristeza kills virtually all trees on sour orange rootstock over the next sixteen years.

Assuming tristeza is phased in over the next eight years, potential orange production is estimated to decrease from 237 million boxes in 2001-02 to 227 million boxes in 2004-05; afterwards, production would increase reaching 250 million boxes in 2010-11, assuming average planting levels (Table 15). Comparing this projection to the projection assuming no tristeza indicates that tristeza could reduce potential orange production by 15 to 38 million boxes. If tristeza is phased in over the next twelve (sixteen) years the low point in orange production is estimated to occur in 2005-06 (2005-06 through 2007-08) at 233 (240) million boxes.

Confidence intervals for these estimates indicate the potential variation in production. For example, the 95% confidence interval for the orange production estimates under the eight-year tristeza phase-in assumption ranged from ±11% to ±12% of the reported projections, based on (normal) yield variation alone; if the 1998-99 El Nino influenced yields were included in the analysis, estimated orange production would decline by about 7 to 8 million boxes and the confidence interval would more than double.

Potential grapefruit production is estimated to decrease from 47 million boxes in 2001-02 to 36 million boxes in 2005-06; afterwards, production would increase reaching 48 million boxes in 2010-11, assuming tristeza is phased in over the next twelve years and replacement planting levels occur (Table 16). Comparing this projection to the projection assuming no tristeza indicates that tristeza could reduce potential grapefruit production by 4 million boxes in 2001-02 to 14 million boxes in 2005-06, with the difference closing to 3 million boxes by 2010-11. If tristeza is phased in over the next eight (sixteen) years the low point in grapefruit production is estimated to occur in 2003-04 and 2004-05 (2006-07) at 34 (38) million boxes.

The 95% confidence interval for the grapefruit production estimates under the twelve-year tristeza phase-in assumption ranged from ±8% to ±18% of the reported projections, based on (normal) yield variation alone.

Sensitivity of the orange and grapefruit production projections to planting assumptions is shown in Table 17. This analysis is based on the assumptions that tristeza is phased in over the next eight years for oranges and the next twelve years for grapefruit. For oranges, replacement planting levels are not greatly different from average planting levels, and the production estimates for these two planting assumptions are somewhat similar. If the average planting level were doubled (cut in half), the production estimate in 2010-11 increases (decreases) by 44 (22) million boxes. In contrast to the orange situation, the average and

twice-the-average planting levels for grapefruit are much lower than the replacement levels, so that unless growers plant more than they have in recent years, grapefruit production could decline by even more than previously noted (Tables 16).

Orange and Grapefruit Production Estimates by Variety

Oranges

Based on tristeza losses being phased in over the next eight years, potential early and midseason orange production is projected to decrease from 135 million boxes in 2001-02 to 126 million boxes in 2004-05, and then increase to 132 million boxes by 2010-11 (Table 18). Potential late-orange production is projected to increase from 102 million boxes to 118 million boxes over the ten-year projection period, with a slight decrease in production in the next few seasons. In 2001-02, early and midseason oranges and late oranges are estimated to account for 57% and 43% of round-orange production, respectively; by 2010-11, these shares are estimated to change to 53% for early and midseason oranges and 47% for late oranges.

Grapefruit

Based on tristeza losses being phased in over the next twelve years and replacement planting levels, potential white seedless grapefruit production is projected to decrease from 18 million boxes in 2001-02 to13 million boxes in 2005-06, and then increase to 19 million boxes in 2010-11 (Table 18). Potential red seedless grapefruit production is projected to decrease from 29 million boxes in 2001-02 to 23 million boxes per year from 2004-05 through 2005-06, and then increase to 29 million boxes in 2010-11. Grapefruit production projections for the Indian River versus Interior regions are provided in Table 19.

Specialty Citrus Production Estimates

Specialty citrus production was projected using estimated equations which relate historical production to acres, by age. Potential specialty citrus production is estimated to decrease from 12 million boxes in 2001-02 to 11.2 million boxes in 2010-11, based on replacement planting levels (Table 20). Replacement planting levels are higher than the average planting levels for the past three seasons, and if average planting levels are assumed specialty citrus production would decrease to an estimated 9.7 million boxes in 2010-11.

Potential tangerine production is estimated to be relatively flat at around 7 million boxes over the next ten years, assuming replacement planting levels; production is estimated to decrease by 1.3 million boxes over this period if the average planting level were to occur. Temple production is estimated to range from 1.4 to 1.8 million boxes over the projection period, while tangelo production is estimated to range from 2.3 to 2.9 million boxes.

Summary

In the upcoming ten years, tristeza could have a significant impact on Florida citrus production. Both orange and grapefruit production could decline in the next several years, depending on the incidence of tristeza. Potential orange production could decrease from 237 million boxes in 2001-02 to 227 million boxes in 2003-04, assuming tristeza is phased in over the next eight years. Likewise, potential grapefruit production could decrease from 47 million boxes in 2001-02 to 36 million boxes in 2005-06, assuming tristeza is phased in over twelve years. The extent that orange and grapefruit production might decline depends on the rate at which tristeza spreads—if tristeza spreads slower the decreases in production will

be smaller and occur further out in time. Potential specialty production is estimated to decrease from 12 million boxes to 10 or 11 million boxes, depending on the planting assumption.

TABLES

Table 1. Florida citrus acreage and tree numbers by commercial inventory, 1966 to 2000.

Year of Inventory	Number of Acres	Percent Change from Previous Acre Inventory	Number of Trees	Percent Change from Previous Tree Inventory	Tree Density
	- thousand -	- % -	- million -	- % -	- trees/acre -
1966	858.1	--	66.4	--	77.4
1968	931.2	8.5	74.4	12.0	79.9
1970	941.5	1.1	76.7	3.1	81.5
1972	878.0	-6.7	72.1	-6.0	82.1
1974	864.1	-1.6	71.3	-1.1	82.5
1976	852.4	-1.4	70.5	-1.1	82.7
1978	831.2	-2.5	69.1	-2.0	83.1
1980	845.3	1.7	70.7	2.3	83.6
1982	847.9	8.5	71.6	1.3	84.4
1984	761.4	-10.2	66.0	-7.8	86.7
1986	624.5	-18.0	57.5	-12.9	92.1
1988	697.9	11.8	69.3	20.5	99.3
1990	732.8	5.0	78.9	13.9	107.7
1992	791.3	8.0	92.0	16.6	116.3
1994	853.7	7.9	103.7	12.7	121.5
1996	857.7	.5	107.1	3.2	124.9
1998	845.3	-1.4	107.1	NC	126.7
2000	832.3	-1.5	106.7	-.4	128.2

SOURCE: Florida Agricultural Statistics Service, *Commercial Citrus Inventory*, various issues.

Table 2. Florida round-orange acreage and tree numbers by commercial inventory, 1966 to 2000.

Year of Inventory	Number of Acres	Percent Change from Previous Acre Inventory	Number of Trees	Percent Change from Previous Tree Inventory	Tree Density
	- thousand -	- % -	- million -	- % -	- trees/acre -
1966	695.8	--	53.8	--	77.3
1968	713.4	2.5	56.6	5.2	79.3
1970	715.8	.3	57.8	2.1	80.7
1972	659.4	-7.9	53.7	-7.0	81.4
1974	642.4	-2.6	52.5	-2.3	81.7
1976	628.6	-2.1	51.6	-1.8	82.1
1978	616.0	-2.0	50.8	-1.5	82.5
1980	627.2	1.8	52.0	2.2	82.9
1982	636.9	1.5	53.5	2.9	84.0
1984	574.0	-9.9	49.9	-6.8	86.9
1986	466.3	-18.8	43.5	-12.9	93.3
1988	536.7	15.1	54.5	25.5	101.5
1990	564.8	5.2	62.6	14.9	110.8
1992	608.6	7.8	72.8	16.3	119.6
1994	653.4	7.4	81.6	12.1	124.9
1996	656.6	.5	84.2	3.1	128.2
1998	658.4	.3	85.4	1.5	129.8
2000	665.5	1.1	87.2	2.1	131.0

SOURCE: Florida Agricultural Statistics Service, *Commercial Citrus Inventory,* various issues.

Table 3. Florida grapefruit acreage and tree numbers by commercial inventory, 1966 to 2000.

Year of Inventory	Number of Acres	Percent Change from Previous Acre Inventory	Number of Trees	Percent Change from Previous Tree Inventory	Tree Density
	- thousand -	- % -	- million -	- % -	- trees/acre -
1966	103.2	--	7.10	--	68.8
1968	119.9	16.2	8.50	19.7	70.9
1970	124.1	3.5	8.92	4.9	71.9
1972	124.1	NC	9.01	.9	72.6
1974	130.3	5.0	9.65	7.0	74.1
1976	137.9	5.8	10.40	7.8	75.4
1978	136.3	-1.2	10.41	1.3	76.4
1980	139.9	2.6	10.77	3.4	77.0
1982	139.9	NC	10.83	.6	77.4
1984	134.7	-3.7	10.58	-2.3	78.5
1986	117.8	-12.5	9.62	-9.1	81.7
1988	119.6	1.5	10.08	4.7	84.3
1990	125.3	4.8	11.19	11.0	89.3
1992	135.2	7.9	13.12	17.2	97.0
1994	146.9	8.7	15.00	14.3	102.1
1996	144.4	-1.7	15.12	.8	104.7
1998	132.8	-8.0	14.08	-6.9	106.0
1999	121.3	-8.7	12.96	-7.9	106.9
2000	118.1	-2.6	12.67	-2.3	107.2

SOURCE: Florida Agricultural Statistics Service, *Commercial Citrus Inventory*, various issues.

Table 4. Florida specialty citrus[a] acreage and tree numbers by commercial inventory, 1970 to 2000.

Year of Inventory	Number of Acres	Percent Change from Previous Acre Inventory	Number of Trees	Percent Change from Previous Tree Inventory	Tree Density
	- acres -	- % -	- million -	- % -	- trees/acre -
1970	82,767	--	7.6	--	91.48
1972	77,042	-6.9	7.1	-5.8	92.60
1974	74,446	-3.4	7.0	-2.1	93.84
1976	67,485	-9.4	6.2	-10.9	92.24
1978	62,723	-7.1	5.8	-7.1	92.23
1980	60,360	-3.8	5.6	-3.9	92.07
1982	55,163	-8.6	5.1	-8.8	91.88
1984	34,619	-37.2	3.2	-37.7	91.17
1986	30,155	-12.9	2.9	-7.7	96.60
1988	30,284	.4	3.0	4.1	100.09
1990	33,347	10.1	3.7	21.1	110.04
1992	37,507	12.5	4.6	24.0	121.36
1994	45,768	22.0	5.9	30.4	129.69
1996	50,950	11.3	7.0	17.1	136.40
1998	48,556	-4.7	6.7	-3.1	138.70
2000	45,355	-6.6	6.3	-6.4	139.00

[a]Temples, tangelos and tangerines; fallglo tangerines not included prior to 1996.

SOURCE: Florida Agricultural Statistics Service, *Commercial Citrus Inventory*, various issues.

Table 5. Age distribution of Florida round-orange trees by year of inventory.

Year	Tree Age						Total Trees	Bearing Trees
	#2	3-5	6-8	9-13	14-23	$24		
	----------% ----------						---- thousand ----	
1970	9.1	20.6	17.6	14.8	13.4	24.4	57,801.5	49,404.2
1972	5.5	11.1	20.2	22.0	14.1	27.0	53,731.1	49,786.5
1974	4.0	5.9	16.9	27.8	16.9	28.4	52,521.7	49,466.9
1976	4.0	4.8	7.5	29.7	24.1	29.8	51,595.3	48,373.8
1978	5.2	4.5	4.7	23.4	31.5	30.6	50,843.2	47,454.5
1980	7.2	4.7	3.8	13.0	39.1	32.2	51,977.8	47,366.3
1982	12.0	5.1	3.7	7.2	40.2	31.8	53,504.7	46,078.5
1984	17.5	7.1	4.5	5.8	35.2	29.9	49,884.7	39,777.7
1986	20.0	12.4	6.1	7.1	28.7	25.7	43,461.4	32,708.0
1988	30.7	13.9	7.8	5.7	17.7	24.1	54,536.6	35,537.3
1990	35.1	14.3	10.7	6.7	10.0	23.3	62,613.4	40,666.0
1992	31.9	23.4	9.9	8.4	6.7	19.7	72,826.3	49,577.1
1994	24.4	24.6	16.7	11.0	6.5	16.9	81,614.4	61,707.7
1996	10.5	26.9	24.0	14.7	8.2	15.7	84,155.4	72,286.6
1998	8.0	15.5	26.7	23.0	11.5	15.3	85,430.6	78,586.5
2000	9.7	7.2	21.4	33.7	13.6	14.4	87,200.1	78,721.0

SOURCE: Florida Agricultural Statistics Service, *Commercial Citrus Inventory*, various issues.

Table 6. Age distribution of Florida grapefruit trees by year of inventory.

Year	Tree Age						Total Trees	Bearing Trees
	#2	3-5	6-8	9-13	14-23	$24		
	----------% ----------						----- thousand -----	
1970	15.1	21.7	4.2	3.9	14.1	41.1	8,925.4	6,746.5
1972	6.9	21.9	14.0	5.5	10.6	41.1	9,012.7	8,032.1
1974	11.5	8.2	25.1	7.6	8.1	39.4	9,647.2	8,362.6
1976	13.9	7.9	13.3	20.8	6.8	37.2	10,398.1	8,598.9
1978	8.5	13.8	6.8	28.9	7.1	34.9	10,412.5	8,969.7
1980	8.9	10.5	10.7	21.6	15.8	32.5	10,768.7	9,586.2
1982	7.5	7.4	12.8	12.6	29.1	30.6	10,833.2	9,753.9
1984	11.4	6.7	7.5	15.7	32.1	26.7	10,582.9	9,192.8
1986	9.7	7.8	7.9	17.0	35.7	22.0	9,624.0	8,367.7
1988	11.0	9.7	6.5	13.8	38.3	20.7	10,081.2	8,654.7
1990	21.8	6.2	8.0	9.1	31.4	23.5	11,193.2	8,748.5
1992	27.2	14.0	5.5	8.6	19.1	25.6	13,119.2	9,556.9
1994	23.3	21.3	7.6	8.3	16.0	23.5	15,004.0	11,514.1
1996	9.8	25.3	17.8	8.2	15.3	23.6	15,116.9	13,632.8
1998	4.3	16.7	24.6	13.8	14.8	25.8	14,079.1	13,469.6
2000	3.7	6.2	22.7	27.2	13.6	26.7	12,668.6	12,204.1

SOURCE: Florida Agricultural Statistics Service, *Commercial Citrus Inventory*, various issues.

Table 7. Age distribution of Florida grapefruit trees by marketing district and variety, 2000 inventory.

District/Variety	Tree Age						Total Trees
	#2	3-5	6-8	9-13	14-23	$24	
	---------- %[a] ----------						- thousand -
Indian River							
White Seedless[b]	5.0	9.8	14.1	22.4	4.9	43.7	3,350.5
Red and Pink Seedless	2.9	5.4	18.9	28.4	23.1	21.5	5,362.9
TOTAL	**3.7**	**7.1**	**17.1**	**25.9**	**16.1**	**30.0**	**8,713.4**
Interior							
White Seedless[b]	1.8	5.2	21.6	24.8	6.6	40.0	1,393.3
Red and Pink Seedless	4.5	3.6	42.3	32.6	8.8	8.2	2,561.9
TOTAL	**3.5**	**4.1**	**35.0**	**29.9**	**8.0**	**19.4**	**3,955.2**

[a]Percentages may not total 100 due to rounding.

[b]Includes seedy grapefruit.

SOURCE: Florida Agricultural Statistics Service, *2000 Commercial Citrus Inventory*.

Table 8. Age distribution of Florida specialty citrus trees by variety, 2000 inventory.

Variety	Tree Age						Total Trees
	#2	3-5	6-8	9-13	14-23	$24	
	----------%----------						- thousand -
Temples	5.5	9.9	8.3	14.8	5.7	55.9	686.5
Tangelos	2.8	6.5	24.3	35.3	5.2	25.8	1,421.8
Tangerines	6.0	11.0	40.9	31.7	5.1	5.4	4,195.0
TOTAL	**5.2**	**9.9**	**33.6**	**30.7**	**5.2**	**15.5**	**6,303.3**

SOURCE: Florida Agricultural Statistics Service, *2000 Commercial Citrus Inventory*.

Table 9. Average annual citrus plantings, by variety, 1997 through 1999.

Variety[a]	Plantings[b]	
	Trees	Acres
	- thousand -	- acres -
Oranges		
Early and Midseason	1,044	7,846
Late	1,771	13,194
TOTAL	**2,815**	**21,040**
Grapefruit		
Indian River		
White Seedless[c]	56	525
Red and Pink Seedless	52	464
Interior		
White Seedless[c]	8	86
Red and Pink Seedless	39	276
TOTAL	**155**	**1,351**
Specialty		
Temples	16	111
Tangelos	17	136
Tangerines	84	565
TOTAL	**110**	**757**

[a]Orange trees and acres listed as "unidentified" by the FASS were allocated between early and midseason oranges, late orange, Temples and tangelos in the same proportions as the identified proportions in calculating the averages. Grapefruit trees and acres listed as "unidentified" by the FASS were allocated between grapefruit varieties in the same proportions as the identified proportions in calculating the averages.

[b] Calculated as bearing trees or acres divided by 3 (years set: 1997, 1998 and 1999).

[c] Includes seedy.

Table 10. 1999-00 estimates of Florida orange and grapefruit trees on sour orange rootstock.

Region	Oranges			Grapefruit		
	Sour Orange Rootstock	Other Rootstocks	Total	Sour Orange Rootstock	Other Rootstocks	Total
	million trees					
South	2.9	28.2	31.1	.3	1.9	2.2
West	3.3	16.8	20.1	.1	.4	.5
Indian River	1.8	9.6	11.4	4.5	4.2	8.7
North and Central	4.0	20.6	24.6	.4	.9	1.3
State	**12.0**	**75.2**	**87.2**	**5.3**	**7.4**	**12.7**

Table 11. Loss rate assumptions for acreage with trees on sour orange rootstock.

Season	8-Year Phase-In			12-Year Phase-In			16-Year Phase-In		
	South and West	Indian River	North and Central	South and West	Indian River	North and Central	South and West	Indian River	North and Central
	----------%----------								
1999-00	10.1	4.1	1.6	5.9	3.1	1.6	4.3	2.6	1.6
2000-01	22.9	10.1	4.1	10.8	5.9	3.1	7.0	4.3	2.6
2001-02	43.9	22.9	10.1	19.2	10.8	5.9	11.2	7.0	4.3
2002-03	67.3	43.9	22.9	31.7	19.2	10.8	17.4	11.2	7.0
2003-04	84.4	67.3	43.9	47.6	31.7	19.2	26.0	17.4	11.2
2004-05	93.5	84.4	67.3	64.0	47.6	31.7	37.0	26.0	17.4
2005-06	97.4	93.5	84.4	77.6	64.0	47.6	49.5	37.0	26.0
2006-07	99.0	97.4	93.5	87.1	77.6	64.0	62.1	49.5	37.0
2007-08	99.6	99.0	97.4	93.0	87.1	77.6	73.2	62.1	49.5
2008-09	99.9	99.6	99.0	96.3	93.0	87.1	82.0	73.2	62.1
2009-10	99.9	99.9	99.6	98.1	96.3	93.0	88.4	82.0	73.2
2010-11	100.0	99.9	99.9	99.0	98.1	96.3	92.7	88.4	82.0

Table 12. Historical citrus tree- and acreage-loss rates, by variety.

Variety	Annual Loss Rate[a]					
	Trees			Acres		
	1994-96	1996-98	1998-00	1994-96	1996-98	1998-00
	----------%			----------%		
Oranges[b]						
Early and Midseason	1.2	1.9	2.3	2.2	2.3	2.7
Late	1.2	1.9	2.3	2.2	2.3	2.7
Grapefruit[c]						
Indian River						
White Seedless[d]	1.5	3.0	4.8	2.4	3.5	5.5
Red and Pink Seedless	1.5	3.0	4.8	2.4	3.5	5.5
Interior						
White Seedless[d]	2.3	7.4	9.3	2.8	7.9	9.6
Red and Pink Seedless	2.3	7.4	9.3	2.8	7.9	9.6
Specialty[e]						
Temples	3.2	4.9	4.8	3.9	5.7	5.3
Tangelos	4.3	5.2	5.6	4.7	5.6	5.6
Tangerines	2.1	4.1	5.6	3.0	4.5	5.5

[a]Based on 1994, 1996, 1998 and 2000 commercial citrus inventories.

[b]One loss rate for round oranges (early and midseason and late oranges) was estimated due to the unidentified (by variety) young round-orange trees.

[c]One loss rate for seedless grapefruit was estimated due to the unidentified (by variety) young grapefruit trees.

[d]Includes seedy for the 1998 to 2000 period.

[e]Loss rates based on bearing trees or acres due to unidentified nonbearing specialty citrus.

Table 13. Average yields by age of tree for 1993-94 through 1999-00, excluding 1998-99.

Variety	Age Category[a]				
	3-5	6-8	9-13	14-23	24+
	- - - - - - - - - - 1-3/5 bushel boxes per tree - - - - - - - - - -				
Oranges					
Early and Midseason	1.23	2.80	3.77	4.62	5.18
Valencia	1.12	2.15	2.53	3.42	4.30
Grapefruit					
State					
White Seedless	2.10	3.76	4.37	6.66	6.13
Red and Pink Seedless	2.00	3.32	4.56	4.98	5.31
Indian River					
White Seedless	1.81	3.53	4.09	5.77	5.65
Red and Pink Seedless	2.09	3.08	4.27	4.82	5.05

[a]Yields by age category were used to obtain linear interpolation yield estimates for ages, 3, 4, ..., 23, 24+ which were used in estimating the orange and grapefruit crop sizes.

SOURCE: Florida Agricultural Statistics Service.

Table 14. Historical yields by age of tree, by season.

Season	Early and Midseason		Valencia	
	Weighted Average[a]	Bearing Tree Density	Weighted Average[a]	Bearing Tree Density
	boxes/tree	trees/acre	boxes/tree	trees/acre
1990-91	4.23	105	3.07	104
1991-92	3.70	111	2.77	112
1992-93	4.45	115	3.11	116
1993-94	3.85	119	2.66	123
1994-95	3.96	121	2.84	125
1995-96	3.67	124	2.57	130
1996-97	3.86	123	2.68	129
1997-98	3.82	126	2.86	133
1998-99	2.92	126	1.93	134
1999-00	3.48	127	2.49	135
Mean	3.79		2.70	
Standard Deviation	0.42		0.33	
Coefficient of Variation[b]	10.9%		12.4%	
Correlation Coefficient[c]	-0.62		-0.66	

[a]Weights based on 2000 tree distribution, reported in the *Commercial Citrus Tree Inventory*, by FASS.

[b]Standard deviation divided by mean.

[c]Correlation coefficient between the weighted average yield and bearing tree density. Both correlation coefficients for early and midseason and Valencia oranges indicate statistically significant relationships at the .05 level.

Table 15. Orange production estimates.[a]

Season	With No Additional Losses Due to Tristeza		With Tristeza Losses Phased in Over Next 8 Years		With Tristeza Losses Phased in Over Next 12 Years		With Tristeza Losses Phased in Over Next 16 Years	
	Production	Acre Loss Rate[b]	Production	Acre Loss Rate[b]	Production	Acre Loss Rate[b]	Production	Acre Loss Rate[b]
	mil. boxes	- % -	mil. boxes	- % -	mil. boxes	- % -	mil. boxes	- % -
2001-02	252	-2.3	237	-5.4	244	-3.9	246	3.4
2002-03	256	-2.4	231	-5.7	241	-4.6	246	3.8
2003-04	260	-2.4	227	-5.0	237	-5.0	244	4.2
2004-05	264	-2.5	227	-3.9	234	-4.8	242	4.5
2005-06	268	-2.6	230	-2.9	233	-4.1	240	4.4
2006-07	272	-2.6	234	-2.5	235	-3.3	240	4.0
2007-08	274	-2.7	238	-2.5	238	-2.8	240	3.5
2008-09	278	-2.7	243	-2.6	242	-2.6	243	3.1
2009-10	280	-2.7	246	-2.6	246	-2.6	246	2.8
2010-11	282	-2.8	250	-2.7	249	-2.7	249	2.7

[a]Average yields and average plantings assumed.

[b] Loss rate due to normal attrition and tristeza.

Table 16. Grapefruit production estimates.[a]

Season	With No Additional Losses Due to Tristeza		With Tristeza Losses Phased in Over Next 8 Years		With Tristeza Losses Phased in Over Next 12 Years		With Tristeza Losses Phased in Over Next 16 Years	
	Production	Acre Loss Rate[b]	Production	Acre Loss Rate[b]	Production	Acre Loss Rate[b]	Production	Acre Loss Rate[b]
	mil. boxes	- % -	mil. boxes	- % -	mil. boxes	- % -	mil. boxes	- % -
2001-02	51	-2.4	44	-10.4	47	-6.4	49	-5.1
2002-03	51	-2.5	38	-13.3	44	-8.4	46	-6.2
2003-04	51	-2.5	34	-11.0	40	-9.9	44	-7.3
2004-05	51	-2.5	34	-5.5	37	-9.6	41	-8.2
2005-06	51	-2.6	37	-2.3	36	-7.0	39	-8.1
2006-07	51	-2.6	41	-1.7	38	-4.0	38	-6.8
2007-08	51	-2.6	44	-1.8	40	-2.3	39	-4.9
2008-09	51	-2.6	47	-1.9	44	-1.9	41	-3.2
2009-10	51	-2.7	48	-2.0	46	-1.9	43	-2.3
2010-11	51	-2.7	50	-2.1	48	-2.0	46	-2.1

[a]Average yields and replacement plantings assumed.

[b] Loss rate due to normal attrition and tristeza.

Table 17. Orange and grapefruit production projections for alternative planting assumptions.

Season	Planting Scenario							
	Orange[a]				Grapefruit[b]			
	Replace-ment	Average	Twice the Average	Half the Average	Replace-ment	Average	Twice the Average	Half the Average
	million boxes							
2001-02	237	237	237	237	47	47	47	47
2005-06	235	230	239	225	36	32	33	31
2010-11	265	250	294	228	48	30	33	28

[a]Assumes average yields and tristeza is phased in over next eight years.

[b]Assumes average yields and tristeza is phased in over next twelve years.

Table 18. Estimated round-orange and grapefruit production by variety.

Season	Oranges[a]			Grapefruit[b]		
	Early and Midseason	Late	Total	White Seedless[c]	Red and Pink Seedless	Total
	million boxes					
2001-02	135	102	237	18	29	47
2002-03	131	100	231	17	27	44
2003-04	127	100	227	15	25	40
2004-05	126	101	227	14	23	37
2005-06	127	103	230	13	23	36
2006-07	128	106	234	14	24	38
2007-08	129	109	238	15	25	40
2008-09	130	113	243	17	27	44
2009-10	131	115	246	18	28	46
2010-11	132	118	250	19	29	48

[a] Assumes average yields, average plantings and tristeza losses phased in over eight years.

[b] Assumes average yields, replacement plantings and tristeza losses phased in over 12 years. Non-tristeza loss rates for white seedless grapefruit were assumed to be higher than those for red seedless grapefruit, based on 1998-2000 loss rates; over the projection period, non-tristeza loss rates for white (red) seedless grapefruit averaged about 3.4% (2.0%); weighted average non-tristeza loss rates for white and red seedless grapefruit are shown in Table 16, the no tristeza scenario.

[c] Includes seedy grapefruit.

Table 19. Indian River versus Interior estimated grapefruit production, with tristeza losses phased in over next 12 years.[a]

Season	Indian River			Interior		
	White[b]	Red	Total	White[b]	Red	Total
	million boxes					
2001-02	11.2	17.9	29.1	7.2	11.1	18.3
2002-03	9.9	16.4	26.3	6.7	10.9	17.6
2003-04	8.7	14.5	23.2	6.4	10.6	17.0
2004-05	7.6	13.1	20.7	6.2	10.3	16.5
2005-06	7.4	12.5	19.9	6.1	10.1	16.2
2006-07	8.0	13.2	21.2	6.2	10.1	16.3
2007-08	9.2	14.5	23.7	6.3	10.4	16.7
2008-09	10.4	16.0	26.4	6.5	10.6	17.1
2009-10	11.4	17.2	28.6	6.7	10.7	17.4
2010-11	12.1	18.1	30.2	6.8	10.9	17.7

[a]Average yields and replacement plantings assumed. Non-tristeza loss rates for white seedless grapefruit were assumed to be higher than those for red seedless grapefruit, based on 1998-2000 loss rates; over the projection period, non-tristeza loss rates for white (red) seedless grapefruit averaged about 3.4% (2.0%); weighted average non-tristeza loss rates for white and red seedless grapefruit are shown in Table 16, the no tristeza scenario.

[b]Includes seedy grapefruit.

Table 20. Estimated specialty citrus production by variety.[a]

Season	Planting Assumptions							
	Replacement[b]				Average[c]			
	Temples	Tangelos	Tangerines	Total	Temples	Tangelos	Tangerines	Total
	million boxes							
2001-02	1.8	2.9	7.3	12.0	1.8	2.9	7.3	12.0
2002-03	1.8	2.8	7.4	12.0	1.8	2.8	7.4	12.0
2003-04	1.7	2.8	7.3	11.8	1.7	2.8	7.3	11.8
2004-05	1.7	2.8	7.2	11.7	1.6	2.7	7.1	11.4
2005-06	1.7	2.8	7.1	11.6	1.6	2.6	6.9	11.1
2006-07	1.6	2.7	7.0	11.3	1.6	2.6	6.7	10.9
2007-08	1.6	2.7	6.9	11.2	1.5	2.5	6.5	10.5
2008-09	1.6	2.7	6.9	11.2	1.5	2.4	6.3	10.2
2009-10	1.6	2.7	6.9	11.2	1.4	2.4	6.2	10.0
2010-11	1.6	2.7	6.9	11.2	1.4	2.3	6.0	9.7

[a]Acre-loss rate assumed to be 5% per year for all varieties.

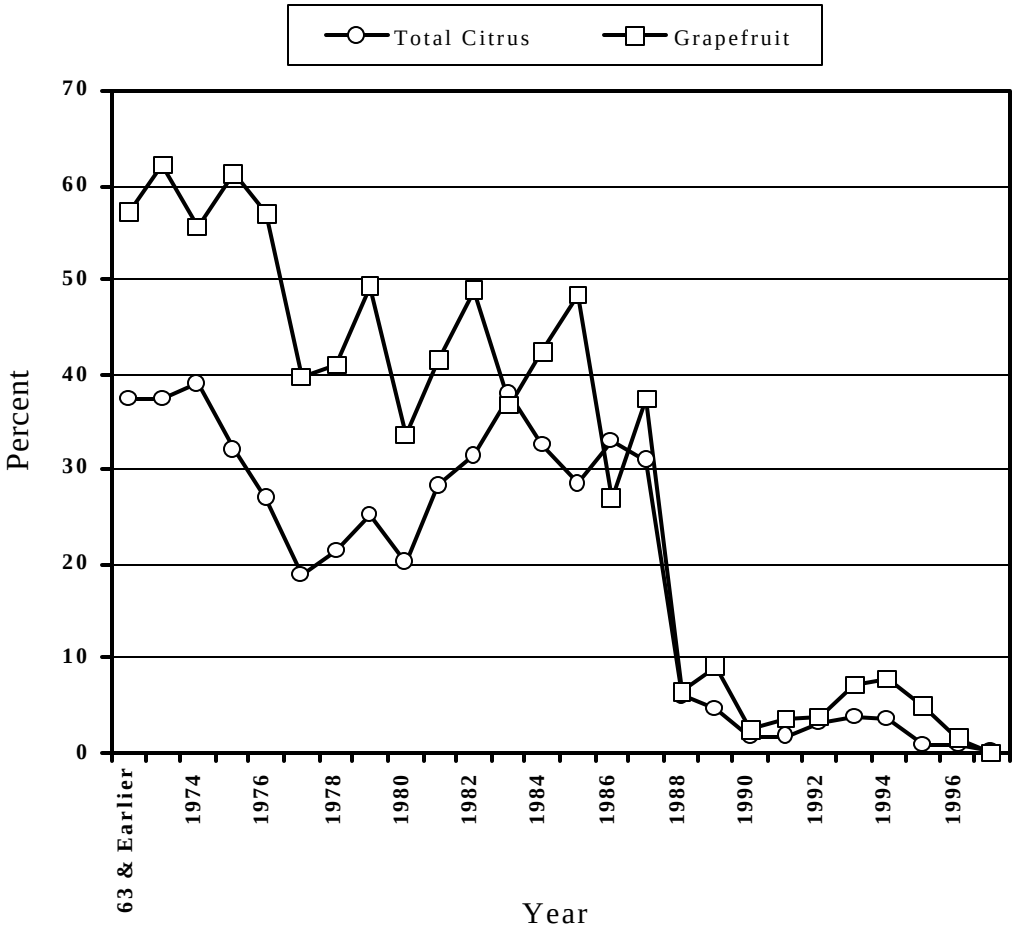
[b]Acre plantings are assumed to be equal to acre losses.

[c]Average acres planted from 1997 to 1999.

EXHIBITS

Exhibit 1

Percent of Nursery Trees on Sour Orange By Year Set



Source: Bureau of Budwood Registration.

Exhibit 2

Early & Midseason Yields and Tree Density

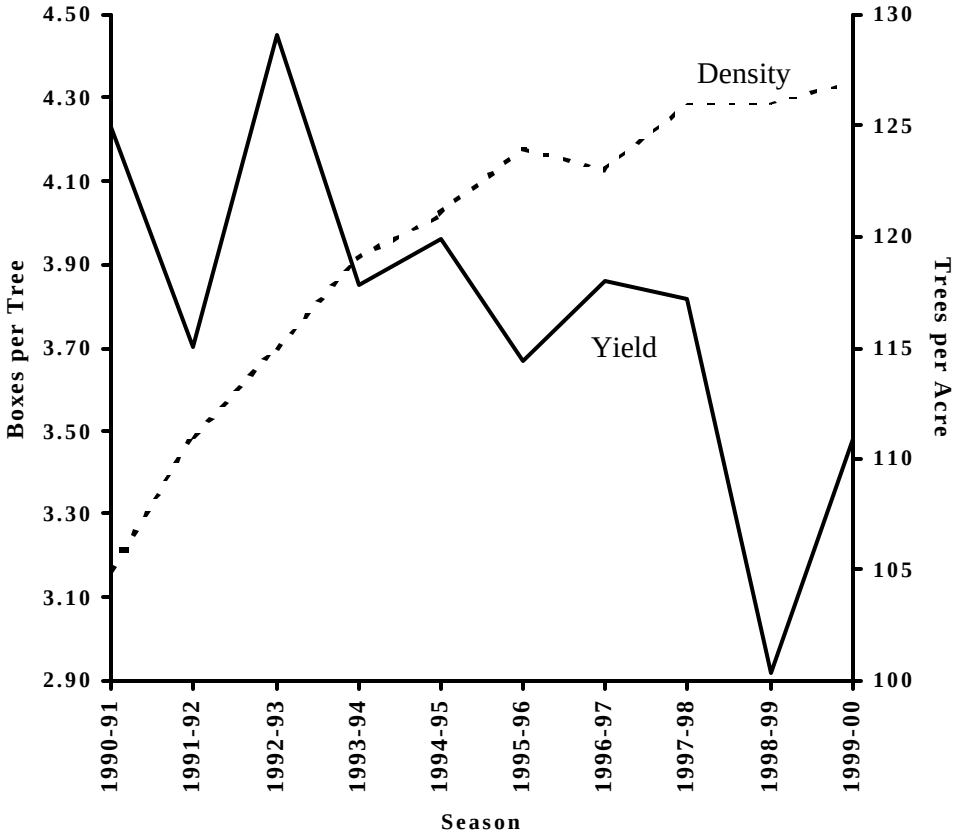


Exhibit 3

Valencia Yields and Tree Density