Economic Analysis of Incentives to Plant Citrus Trees in Florida

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Abstract

New citrus tree plantings in Florida have been less than 50% of tree mortality/removal rates as indicated by the rate of decline in the Florida commercial citrus tree inventory. The significant decline in tree inventory in recent years, largely due to the citrus disease known as Huanglongbing (HLB) (*Candidatus liberibacter* spp.), remains a critical factor contributing to the sharp decline in citrus production in Florida. Concerns over significantly higher costs of production and the uncertainty associated with the spread of HLB have prompted industry leaders and governmental agencies to develop strategic incentives to promote reinvestment in planting new citrus trees to producers. The Florida citrus industry continues to provide significant economic contributions to the State of Florida and its local communities. Fostering reinvestment in citrus groves, at this time, remains a critical component to preserving and increasing the economic benefits back to the State, and ensuring the survival of the industry in the long-run. Industry programs have been proposed to encourage new plantings of early and midseason oranges, Valencia oranges, and grapefruit in Florida. Several existing citrus tree replanting programs are evaluated using net present value methods to analyze the outcome of the investment.

Key Words: Citrus, new tree investment, net present value, Huanglongbing

Introduction[1]

The Florida citrus industry, which has been the leading producer of citrus in the United States for several decades, is facing a crisis. Citrus crops have declined precipitously over the past 12 years due to a combination of factors, most notably those associated with pests and diseases. One particular disease known as Huanglongbing (HLB), also called citrus greening, is the latest and strongest threat to the industry. Total Florida citrus acreage has declined by more than 20 percent since HLB was first discovered in 2005 from 621,373 acres in the 2005-06 season to 501,396 acres at the end of the 2014-15 season.[2] The rate of fruit drop is at more than twice the rate for all varieties of citrus than was recorded a decade ago. Fruit yields are at an all-time low. Abandoned citrus acreage, estimated at more than 130,000 acres in 2015, serves as a safe haven for Asian citrus psyllid (*Diaphorina citri* 'Kuwayama'), the vector for spreading HLB. Citrus production in Florida has drastically declined over a few short seasons, and is at its lowest point in more than 50 years. The U.S. Department of Agriculture (USDA) estimate for the 2015–16 orange crop is 81.5 million boxes, down from the near record 242 million boxes produced in 2003–04 (National Agricultural Statistics Service Florida Field Office Citrus July forecast (NASS, 2016a)). It is also down substantially from the post hurricane crop of 170.2 million boxes produced in 2007–08. The NASS estimate for the 2015–16 grapefruit crop is 10.85 million, down from 40.9 million boxes produced in the 2003–04 season.

The reduced crop forecast reflects a number of factors, including lower per tree fruit yields. Figures 1 and 2 illustrate the average weighted fruit yields per tree over time for orange

[1] The authors wish to acknowledge Robert Norberg for laying the foundation for this analysis in 2014. Helpful comments were provided by Dr. Ariel Singerman, Assistant Professor and Extension Economist, Citrus Research and Education Center, University of Florida and by Dr. Carlos Trejo-Pech, Post-doctoral associate, Food and Resource Economics Department, University of Florida.

[2] Preliminary Commercial Citrus Inventory (September 2015) USDA, National Agricultural Statistics Service.

and grapefruit production, respectively. Early/midseason and late season orange yields have decline by 33 and 27 percent, respectively, since 2011-12 season. White and red/pink grapefruit season orange yields have declined by 31 and 26 percent, respectively, since 2011-12 season. Another crucial component for long-term viability of the citrus industry, new tree plantings have lagged considerably during a pivotal time in the industry even with higher grower prices associated with smaller crops. New plantings have been running at less than 50 percent of the level needed to sustain the existing tree inventory. Figure 4 compares citrus tree loss against new tree plantings over the last ten years. An analysis of production trends and their impact on the long-term output of the industry revealed a striking decrease in new citrus plantings that are apparently a consequence of reduced yields, higher grove maintenance costs, and increased uncertainty associated with Huanglongbing (Spreen and Zansler, 2015).

At the same time, the Florida citrus industry continues to provide significant economic contributions to the State and local communities. The infrastructure of the Florida citrus industry is well-established in key agricultural areas of Florida. Economic activities of the industry include agricultural production of citrus across 30 counties of central and south Florida, fresh fruit grading, packing and shipping to domestic and international markets, orange, grapefruit, and specialty citrus processing for juice extraction, and juice packaging for bulk, industrial, and retail distribution (Hodges, et al 2014). The economic impacts of the Florida citrus industry were evaluated for FY 2014-15 season and compared to an 80 million box orange crop scenario for the 2015-16 season (Hodges and Spreen, 2015). A summary of the results found that total output or revenue impact of the industry for the 2014-15 season was "projected at $9.882 billion, including $3.900 billion from citrus fruit production, $5.685 billion from citrus juice and byproducts manufacturing, and $296 million from fresh citrus marketing margins. Employment impacts of

the citrus industry in the 2014-15 season are projected at 56,446 fulltime and part-time jobs, while value added contributions to Gross Domestic Product (GDP) are estimated at $4.999 billion, and labor income impacts (employee wages, salaries, benefits, business owner income) are estimated at $3.055 billion."

The purpose of this paper is to examine the economic viability of new citrus tree plantings of several programs designed to encourage new tree plantings. Each of the programs evaluated, some of which have already been implemented, are described and analyzed under common assumptions regarding new tree costs, grove maintenance costs, and per tree yields.

In this paper, new investment in both processed orange and fresh market grapefruit production is analyzed. The decline in grapefruit production exceeds the decline in orange production on a percentage basis. There has also been a steep decline in other fresh market varieties such as Navel oranges and both early- and late-season tangerines. Although explicit results for the other fresh market varieties are not shown, the grapefruit analysis could be easily extended to specialty varieties.

The Investment Model

Investment in citrus trees requires multi-year financial planning to analyze the profitability of the investment in the long-run. The standard approach to analyze such an investment is the calculation of the net present value (NPV) of the investment (Kay and Edwards, 1999, p. 320).

> "The net present value method is a preferred method of evaluation, because it does consider the time value of money as well as the

size of the stream of cash flows over the entire life of the investment. It is also called the *discounted cash flow* method."

Often, the internal rate of return (IRR) is used as an application of the NPV calculation. Stated simply, IRR is the discount factor associated with an NPV of zero over a fixed planning horizon (Kay and Edwards, 1999, p. 321). In this analysis, a 20-year investment horizon is used. Under current production practices, trees reach their maximum yield at ages ranging from 10 to 15 years. Unless affected by HLB, tree life in Florida can extend well beyond 30 years, although some rootstocks are susceptible to another disease known as blight (also called decline) which begins to affect tree productivity at approximate age 15[3]. The formula for NPV is

$$NPV = \sum_{0}^{20} \frac{R_t}{(1+r)^n}$$

where R_t is the net return realized in year t and r is the discount factor.

R_t is negative for the first several years, as a citrus tree normally does not produce a marketable crop until its fourth year of life. Therefore, R_0 is the cost of new grove establishment including the cost of new trees, labor associated with planting, cost of irrigation equipment (irrigations lines and emitters), and other land preparation costs plus the cost of grove care in the first year after planting. In this analysis, it is assumed that the land being planted was previously used for citrus production therefore water availability (either surface or ground) is in place. Additional land preparation is also not included such as the preparation of beds and ditches for drainage.

Incentives to Encourage New Citrus Investment

[3] The effect of blight is not considered here.

Industry impetus to encourage new plantings has been proactive in recent years. Several organizations have developed programs intended to stimulate new grove investment. The varying structures of these programs emphasize that there is not a one size fits all approach to grove reinvestment. The incentives are intended to yield results for growers and processors alike. As such, criteria across programs would assuredly vary by expected outcomes for all stakeholders included. These programs are discussed in this section.

Profitability of new grove investment is affected by several factors, but the most important factors are productivity (fruit yields), fruit prices, initial cost of the investment, and length of time needed to recover investment costs through depreciation. The current programs that have been developed deal with all of these factors except productivity. Declining yields associated with HLB are the primary factor driving reduced new grove investment.

Expedited Depreciation

Expedited depreciation for income tax purposes allows for earlier deduction of the cost of new investment earlier in the life of the grove. Under present IRS rules, the cost of new grove establishment cannot be depreciated until fruit income is realized. This means that if a new grove is planted in early 2016, all planting costs plus grove care costs from 2016, 2017, and 2018 are tallied. Assuming a marketable crop is produced in 2019, a 10-year straight-line depreciation schedule is initiated on the total capital costs incurred in the 2016 through 2018 period. Thus, not until 2028, or 13 years after planting, are costs finally recaptured for tax purposes. Expedited depreciation is the basis of a proposal of a recently bill introduced by Rep. Buchanan (R-Fla.) (Bouffard, 2015). Under the proposed legislation, instead of accumulating new grove establishment costs and grove maintenance costs during the non-bearing portion of grove life, for tax purposes, the costs would be "immediately expensed" or written off in the year incurred. As

such, the ability to recapture costs associated with new grove development occurs much earlier in the planning horizon.

A modification of this approach, known as bonus depreciation, has been allowed by the IRS in the 2014 and 2015 tax years. Under bonus depreciation, 50 percent of the cost of new trees can be expensed in the year in which they are planted. All other costs, labor associated with new planting, irrigation equipment, land prep, and grove maintenance until fruit income is realized, is treated the same as current rules.

Long-Term Escalating Price Floor

In 2012, Minute Maid, one of the largest juice marketing brands and owned by Coca-Cola, offered growers a long-term contract in which growers were asked to make a 20-year commitment for new grove plantings only. The contract established a price floor of $1.90 per pound solid for early-mid fruit and $2.10 per pound solid for Valencia oranges for years 1 through 10[4], increasing to $2.00 per pound solid for early-mid oranges and $2.20 per pound solid for Valencia oranges in years 11-15, and increasing to $2.10 and $2.30 for early-mid and Valencia oranges, respectively in years 16 through 20.

The price paid is subject to a rise tied to the FDOC post estimate fruit price[5] and a price ceiling of $2.30 per pound solid for early-mid oranges and $2.50 per pound solid for Valencia oranges in years 1-10. This price increases by $.10 per pound solid in years 11-15 and increases

[4] The first 10 years of bearing fruit. The non-bearing period is not considered in the price schedule.
[5] Also known referred to the acronym DOCPER in the proposal. The FDOC audited Post Estimate Fruit Price provides the weighted average fruit price and boxes processed each week for contracts negotiated following the initial release of the USDA crop estimate for the season, with a known price the week of delivery regardless of where the fruit was processed (buyer's plant or under a toll processing agreement with another plant).

again by $.10 per pound solid in years 16 through 20. This program hereafter is called the "long-term escalating price floor" plan.

New Grove Investment Incentives

Two programs evaluated in this study were designed to reduce the cost of new grove development. One program is funded through the United States Department of Agriculture (USDA), and is known as the Tree Assistance Program (TAP). The other program is sponsored by Florida's Natural, one of the major processing companies in the state that operates as a grower-owned cooperative and is located in Lake Wales, FL. This program is open to cooperative members only.

The TAP is a program administered through the Farm Services Administration (FSA) and provides financial assistance to those growers willing to invest in new grove development. FSA in Florida has offices located throughout the state, but its main office is in Gainesville, Fla. The current TAP program, offered to citrus growers, reimburses growers for replanting trees/acreage lost to the effects of HLB. This program reimburses a portion of the cost of the trees, planting costs, and land preparation costs.

There are a number of eligibility provisions and payment constraints that limit widespread use of this program. In general, this program is beneficial for small- to medium-sized growers. To qualify, the average adjusted gross income of the individual or entity cannot exceed $900,000. In addition, a grower must demonstrate that they have incurred tree losses of at least 18% on a particular block due to HLB.

The TAP program received 1830 applications from 668 participant individual/entities with an average payment per application/notice of loss of over $13,000 each through Apr. 2016. The current number of applications covers close to one million trees worth of reimbursements.

Strengthening and refining this program could make a substantial difference to the tree planting trajectory in Florida so that program reaches the FSA goal of 6 million trees planted by 30 Sept. 2018 when the current U.S. Farm Bill will expire. The FSA has improved its efforts recently to increase participation in the TAP program.

A second new grove investment program was analyzed. In 2013, Florida's Natural, one of three major OJ brands and the largest citrus cooperative in Florida, put forth a program that combined elements of the Minute Maid and USDA-TAP programs. Under the Florida's Natural program, growers are given an interest free loan of $10 per tree for each tree planted in a new development[6]. Growers then are asked for a 13-year commitment, three years for the non-bearing portion and 10 years of bearing life. Each year that fruit delivery is made, one-tenth of the loan is written off (or forgiven) which is treated as taxable income. After 10 years of fruit delivery, the entire loan is forgiven. To date, Florida's Natural executives indicate that 100 percent of their goal of one million new trees has been subscribed, but not all trees have been planted as of the 2015–16 season. This approach is referred to hereafter as "supported investment."

It should be noted that the supported investment program did not preclude a grower also applying to the TAP program. It is not known how many, if any, growers actually applied and received assistance from both programs.

Analysis of Processed Oranges

Each of the five programs outlined are analyzed using an internal rate of return analysis and compared against a baseline. Early-mid and Valencia oranges are analyzed separately. The new grove investment is assumed to occur on land previously used for citrus so

[6] Therefore, money needed for resets in an existing grove is not eligible.

that land preparation charges are assumed to $400 per acre and the cost of new irrigation are assumed to be $1000 per acre. Therefore, the presence of a well or other water source is assumed. New trees cost $7.50 each and planting costs are $3.00 per tree, totaling $10.50 per tree. Grove maintenance costs are assumed to be $1100 per acre in year 1, $1600 per acre in year 2, and $1800 per acre in year 3. Under 2013 IRS rules, total investment costs are $8363 per acre assuming a tree density of 225 trees per acre[7]. These costs are based upon estimates provided by Singerman (2015a) combined with an informal survey of growers and extension agents.

Per tree fruit and juice yields are those used by Spreen and Zansler (2015) in their 2015 projection for future citrus production in Florida and represent yields from the 2014–15 season. Per tree fruit yields by age are shown in Table 1. These figures were computed by the authors using the 2013–14 per tree yields published by National Agricultural Statistics Service Florida Field Office (NASS, 2016b) and updated to reflect the actual 2014–15 crop. Yields for early and midseason and 'Valencia' oranges reflect the central region as defined by NASS (2016b); the red grapefruit yields are the Indian River yields. The Indian River region accounts for a large proportion of grapefruit produced in Florida.

The age categories used in Table 1 required further explanation. NASS (2016b) publishes per tree yields in age category ranges: ages 4 through 6 years, ages 7 through 13 years, ages 14 through 23 years, and ages 24 years and older. Under current production practices, per tree yields begin to level off around 12–14 years of age. Since this analysis covers the first 20 years of tree life, per tree fruit yields from ages 1 through 20 years are shown in Table 1.

[7] The costs used are based upon an informal survey of growers and extension specialists.

Many new plantings are at higher tree densities. Therefore a density of 300 trees per acre is also analyzed. Higher tree densities increase the cost of new grove investment since more trees are required. It is not clear the effect of higher densities on grove maintenance costs; here it is assumed that a density of 300 trees per acre increases grove maintenance costs by $100 per acre compared to 225 trees per acre in years 1, 2, and 3. Grove maintenance is assumed to be $2100 per acre for trees ages four and older at 225 trees per acre and $2200 per acre at a density of 300 trees per acre.[8] Pick and haul charges are assumed to $2.75 per box for early-mids and $2.85 per box for Valencias (Singerman, 2015a).

It should be noted that there are two concerns regarding the assumptions on caretaking costs. First, grove maintenance costs for trees ages 4 through 6 may be overstated. Second, the effect of increasing tree density from 225 to 300 trees/acre may increase caretaking costs by an amount different from $100 per acre.

With smaller crops, recent fruit prices have been close to the price floor of the Coca-Cola/Minute Maid 20-year contract. To provide some contrast, in the baseline scenario, fruit prices are assumed to be $1.80 per pound solid for early-mids and $2.00 per pound solid for Valencia oranges. A 20-year planning horizon is evaluated given the supported investment program requires 13 years and the floor price in the Coca-Cola/Minute Maid contract does not escalate until year 11.

Results and Discussion for Processed Oranges

The baseline results are summarized in Table 1. Estimated IRR is shown for each of four combinations of tree density (225 and 300 trees per acre and variety—early-mids and Valencia

[8] There are two concerns. First, grove maintenance costs for trees ages four through six may be overstated. Second, the effect of increasing tree density from 225 to 300 trees per acre may increase caretaking costs by an amount different from $100 per acre.

oranges). The IRR for both varieties improve with higher tree densities. At tree density of 225 trees per acre, both varieties report an IRR of 3.59 percent for early-mids and an IRR of 3.12 percent for Valencia oranges. At 300 trees per acre, estimated IRR is higher, 7.68 percent for early-mids and 6.95 percent for Valencias. Despite the positive estimated returns at higher tree densities, returns are still projected well below the level most investors would deem to be acceptable. These results confirm why the industry has seen low levels of new grove development. The primary reasons that low IRR are estimated is a combination of the recent decline in yields and increased grove maintenance costs. Both of these factors are a consequence of HLB, and can be mitigated with scientific advancements.

Both expedited and bonus depreciation are designed to promote new grove investment as means to stimulate new plantings. The estimated results, as shown in Table 2 (expedited depreciation) and Table 3 (bonus depreciation), indicate that both programs provide some increase in estimated IRR, especially at the higher tree density. For both approaches, the same pattern as observed for the baseline results, namely higher IRR, is associated with high per acre tree densities. The estimated IRR under both plans, however, is higher compared to the baseline. Expedited depreciation for early-mid oranges planted at 300 trees per acre show an estimated IRR of 9.16 percent compared to 7.68 percent at the baseline. Valencia oranges under expedited depreciation show a comparable advantage compared to the baseline at 300 trees per acre.

Similarly, estimated results of the Coca-Cola/Minute Maid escalating price floor approach showed elevated estimated IRR. Under all four scenarios considered, the escalating price floor plan showed estimated IRR that are approximately two percentage points higher across varieties and densities. At a tree density of 225 trees per acre, estimated IRR was 5.73 percent for early-mids and 4.93 percent for Valencias. A tree density of 300 trees per acre gave

an estimated IRR of 9.47 percent for early-mids ad 8.47 percent for Valencia oranges. The estimated IRR associated with 300 trees per acre are more aligned with what an investor would expect from investing in new grove plantings.

The USDA-TAP provides growers with up-front advanced assistance for new grove development; however, adjustments to several components of the program would enhance participation and possible returns. The USDA-TAP program places significant limitations on program participation that is largely based upon farm size. To qualify, the average adjusted gross income of the individual or entity cannot exceed $900,000. At the same time, TAP is considered a grant with no re-payment provisions as long as the eligibility criteria are met. The level of support provided by the TAP program depends on the number of trees eradicated to make a new block eligible for a new solid-set planting with a total payment cap set at $125,000.

The TAP program received 1,830 applications from 668 participant individual/entities with an average payment per application/notice of loss of over $13,000 each through April 2016. The current number of applications covers close to one million trees worth of reimbursements. Strengthening and refining this program could make a substantial difference to the tree planting trajectory in Florida so that program reaches the FSA goal of six million trees planted by September 30, 2018 when the U.S. Farm Bill will expire. The USDA Farm Service Agency has improved outreach efforts recently to increase participation in TAP program. At the same time, FSA is bound by the limitations as currently outlined in the statute.

In this analysis, it is assumed that the old block is planted at 145 trees per acre (which has become the standard density in much of the 1990s and first decade of the 2000s) and at least 18 percent of the trees are infected to meet the eligibility criteria. The grower is compensated for 65 percent of the cost of replanting based upon the old density less an 18 percent deduction for the

infected trees. In the example here, approximately 118 healthy trees would need to be eradicated. The figure times $10.50 per tree (cost of new tree plus planting cost) times 0.65 gives a compensation of $811.49. The program also covers 50 percent of the land clearing costs which are assumed herein to be $400, so that total compensation for the tree density levels considered here is $811.49 plus $200 which equals $1011.49.

Similarly, the supported investment program is designed to provide the grower with up-front advanced assistance for new grove development. The supported investment plan has repayment provisions that are waived as long as the fruit from the new planting remains committed to guarantor. The level of the cash award under the supported investment program is higher than the TAP plan and varies based upon the density of the replanted grove. The cash awards from both programs are subject to income taxes although the timing of the tax burden differs. An additional benefit to the grower, and one that enhances the incentive to reinvest in replanting, is that eligible growers can participate in both programs.

Under the two planting densities considered, estimated IRR for the TAP is about one percentage point higher compared to the base although that advantage grows larger at 300 trees per acre. Under the supported investment plan, the increase in IRR is approximately two percentage points; early-mid oranges planted at 300 trees per acre have an estimated IRR of 11.11 percent.

Another scenario was considered under which it is assumed that per tree yields increase by 20 percent across both varieties and all tree age classes. These results are shown in Table 7 under the baseline scenario assumptions only. Increasing yield by 20 percent has a marked effect on estimated IRR increasing by more than three percentage points across all four scenarios. This result provides more evidence on two fronts: first, the negative impact of HLB on the economics

of new grove investment, and second, the need to implement solutions to HLB that would have modest benefits on tree productivity.

In summary, expedited depreciation provides relief to investors in Florida oranges. The positive increases in IRR shown by the estimates in Tables 2 and 3, especially when combined with other qualifying programs, support the implementation of these important programs for growers to enhance the overall IRR of any initiative. An escalating price floor approach offers assistance. Upfront cash awards for new grove development is an approach that also offers assistance, although the two programs analyzed are subject to limited participation. One thing to note is the price guarantee for the Coca-Cola/Minute Maid plan, although significantly higher in 2012 when the plan was first proposed, are not much higher than those observed in the last two seasons. Each of the programs evaluated yielded higher estimated IRR for the grower, especially at higher tree densities.

Analysis for Grapefruit

Analysis of new grove investment for grapefruit differs from processed oranges since a portion of the crop is sold in the fresh market. Grapefruit also show different yields. Fresh market grapefruit incur higher caretaking costs since external appearance is important; the threat of citrus canker (*Xanthomonas axonopodis* pv. *citri*) is also an issue. It is also unlikely that grapefruit will be planted at densities of 300 trees per acre[9], thus only densities of 150 and 225 trees per acre are considered.

[9] Although there is research at the Indian River Research and Education Center in which grapefruit are being grown in pots at densities substantially higher than 300 plants per acre, this analysis focused largely on current industry practices.

With respect to the five programs analyzed for processed oranges, all are applicable except the escalating price floor plan which is intended for processed oranges only. Therefore, an escalating price floor plan is not considered in this section.

Grove establishment costs are the same as those assumed in the processed orange analysis. Caretaking costs, however, are assumed to be $2200 per acre for a mature grove planted at 150 trees per acre and $2400 per acre at a tree density of 225 trees per acre. Per tree yields from the 2014-15 season for red seedless grapefruit are used. The analysis, however, could be easily modified to account for white seedless grapefruit grown for the fresh market in the Indian River area. In a similar manner, this framework could also be adapted for other fresh market varieties such as Navel oranges, early and late tangerines, as well as new mandarin varieties.

Caretaking cost in the first three years of tree life are assumed to be $1450, $1650, and $1850 per acre for years 1, 2, and 3, respectively, for groves planted at 150 trees per acre. These costs are assumed to be $1600, $1800, and $2000 per acre for the first three years for groves planted at 225 trees per acre. Packout (percent suitable for the fresh market) is assumed to be 65 percent. Pick and haul costs are $2.85 per box, fresh fruit packing costs are $5.36 per carton (Singerman, 2016b), and FOB fresh fruit prices is $12.00 per carton. The estimated elimination value is based juice yields ranging from four pound solids per box at age four up to 4.6 pound solids per box at age 10. The elimination charge is $1.42 per box (Singerman, 2015). Current delivered-in prices for processed red grapefruit are $1.88 per pound solid[10].

Results and Discussion for Grapefruit

[10] This is the season-to-date price reported by the Florida Department of Citrus.

The results from the baseline, expedited depreciation, bonus depreciation, USDA-TAP[11], and Florida's Natural scenarios are shown in Table 8. The first result of note is that across all scenarios, the estimated internal rate of return (IRR) is comparable for fresh market grapefruit compared to processed oranges. At a density of 150 trees per acre all of the estimated IRRs are negative except for the Florida's Natural plan which 0.12 percent. All of the estimated IRRs at densities of 225 trees per acre are positive ranging from 7.46 to 9.91 percent. These results are obtained using fruit yields from the Indian River area that are lower than the other regions of the state. Estimated IRR would be higher using yields from other production regions

For grapefruit, both bonus depreciation and expedited depreciation show some benefit in increasing IRR with the increase for accelerated depreciation being substantial at a density of 225 trees per acre. Both new planting assistance programs, USDA-TAP and Florida's Natural[12], provide increases in IRR compared to the baseline with the Florida's Natural plan giving an estimated IRR of 9.91 percent at a tree density of 225 trees per acre.

Limitations

One notable result is that across all varieties and incentive plans, higher tree densities gave higher estimated IRR. This result may show the need for growers to increase tree density in new plantings. It may also be a consequence of the assumptions made herein. Per tree yields used at a density of 300 trees per acre (for oranges) may overstate fruit production per acre, especially at older ages. This phenomenon is reminiscent of what occurred in the 1990s after the freezes of the 1980s and tree density was increased from 80-100 trees per acre to the now

[11] The assumed density of the infected grove is 130 trees per acre. Based upon an infection level of 18 percent, the estimated compensation would be $923.45.

[12] It should be noted that the Florida's Natural Plan, at the present time, does not include grapefruit. It is analyzed here for illustrative purposes only.

standard density of approximately 150 trees per acre. As those groves matured, it became apparent that per tree yields from groves at 80-100 trees per acre could not be extrapolated to higher density plantings. The results indicate that programs in which grove reinvestment includes higher density scenarios may provide more appealing results.

As a consequence of disease impacts, including HLB and citrus canker, per tree yields have declined substantially over the past several seasons so that extrapolation of these lower yields may not overstate tree productivity at higher densities.

Another issue is caretaking costs. Even though higher caretaking costs are assumed at higher tree density, the costs assumed herein may understate the actual increase in caretaking costs as tree population per acre increases. In such cases, returns may be overstated at higher tree densities.

Summary and Conclusions

In this paper, an analysis of several programs whose intent is to stimulate new plantings of citrus in Florida is presented. The five programs considered address different aspects of the tree planting decision. Present IRS regulations provide for what is called bonus depreciation of new plantings which allows immediate write-off of a portion of the cost of new trees. There is proposed legislation that would greatly alter the tax treatment of new plantings and allow all expenses related to new grove investment to be "expensed" in the year realized instead of depreciated over a 10-year period beginning when the first crop is harvest (generally year 4 after planting). The results of the analysis here are that both of these programs would provide benefits for both processed orange and fresh market grapefruit investment.

Another approach is a long-term fruit contract with an escalating price floor similar to the one proposed by Coca-Cola/Minute Maid in 2012. Analysis of this approach provided some increase in estimated IRR for processed oranges. The present plan is not applicable to fresh market grapefruit. The program allows for processors to set the price and allows for growers to plan for long-term reinvestment. The 2012 plan, however, calls for lower prices per pounds solids than have been realized during the 2015-16 season.

The third approach is a new grove investment assistance program. The USDA-TAP program provides funds to cover a portion of the cost of land preparation and compensation for trees lost. The Florida's Natural program provides a $10 per tree no interest loan for new grove development. The loan is forgiven over a 10-year period as long as the fruit remains with Florida's Natural. The Florida's Natural program provides a higher level of assistance compared to USDA-TAP and therefore shows higher IRR. Given the limits in the USDA-TAP programs, a smaller increase in estimated IRR was realized compared to the Florida's Natural plan across all varieties and tree densities analyzed.

The Florida citrus industry continues to provide significant economic contributions to the State of Florida and its local communities. Fostering reinvestment in citrus groves, at this time, remains a critical component to preserving and increasing the economic benefits back to the State, and ensuring the survival of the industry in the long-run. The established infrastructure devoted to activities surrounding the Florida citrus industry provide the basis for reinvestment incentives. Several programs were developed to promote reinvestment with each program highlighting the critical needs of individual grower groups.

References

Bouffard, K. 2015. Bill seeks to spur planting of new citrus groves. The Ledger, Lakeland, Fla., 16 Nov. 2015. http://www.theledger.com/article/20151116/news/151119589

FDOC Economic and Market Research Department. 2016. FDOC Processors statistics report 04.23.16. Fla. Dept. Citrus, Gainesville, Fla. http://fdocgrower.com

Kay, R.D. and W.M. Edwards. 1999. Farm management, 4th ed. McGraw-Hill, Boston, Mass.

Hodges, A.W., M. Rahamani, T.J. Stevens, and T. H. Spreen. "Economic Impacts of the Florida Citrus Industry in 2012-13." Economic Impact Analysis Program, University of Florida-IFAS, Food & Resource Economics, Gainesville, FL, December 2014.

Hodges, A.W. and T. H. Spreen. "Economic Contributions of the Florida Citrus Industry in 2014-15 and for 80 Million Boxes Orange Production." Economic Impact Analysis Program, University of Florida-IFAS, Food & Resource Economics, Gainesville, FL, June 2015.

National Agricultural Statistics Service Florida Field Office. 2015. Commercial citrus inventory primary report. U.S. Dept. Agr., Maitland, FL.

National Agricultural Statistics Service Florida Field Office. 2016a. Citrus July forecast. U.S. Dept. Agr., Maitland, FL.

National Agricultural Statistics Service Florida Field Office. 2016b. Florida citrus statistics 2014–15. U.S. Dept. Agr., Maitland, FL.

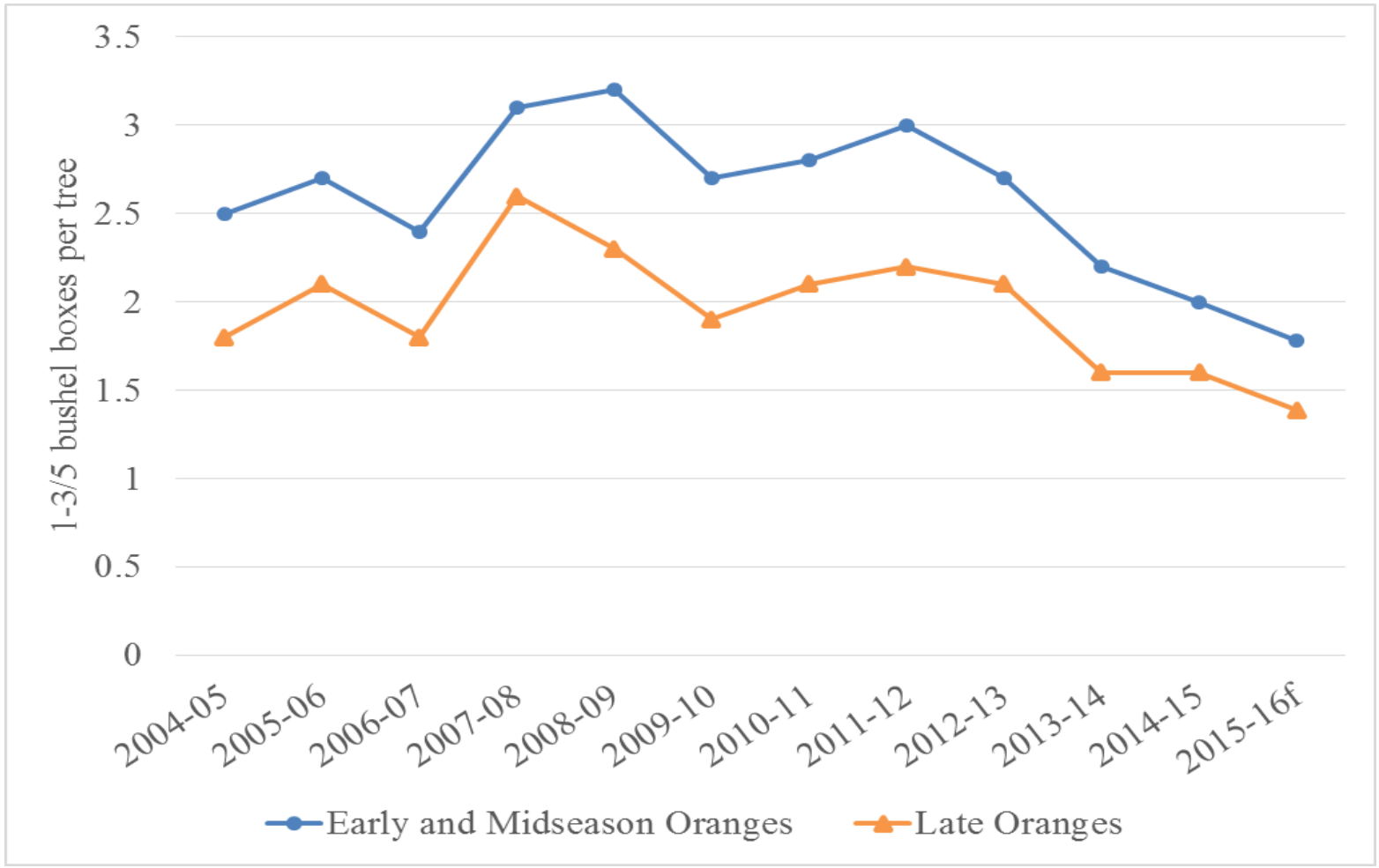
Singerman, A. 2015a. Cost of production for processed oranges in central Florida (Ridge), 2014/15. Electronic Data Information Source (EDIS) FE985. Citrus Res. Educ. Ctr., Univ. Fla., Lake Alfred, FL. <http://edis.ifas.ufl.edu/FE985>

Singerman, A. 2015b. 2014/15 average packing charges for Florida fresh citrus. Electronic Data Information Source (EDIS) FE989. Citrus Res. Educ. Ctr., Univ. Fla., Lake Alfred, FL <http://edis.ifas.ufl.edu/FE989>

Spreen, Thomas H., Jean-Paul Baldwin, and Stephen H. Futch. "The Economic Implications of *Huanglongbing* (HLB) on New Citrus Tree Plantings in Florida." *HortScience* 49(2014): 1052-5.

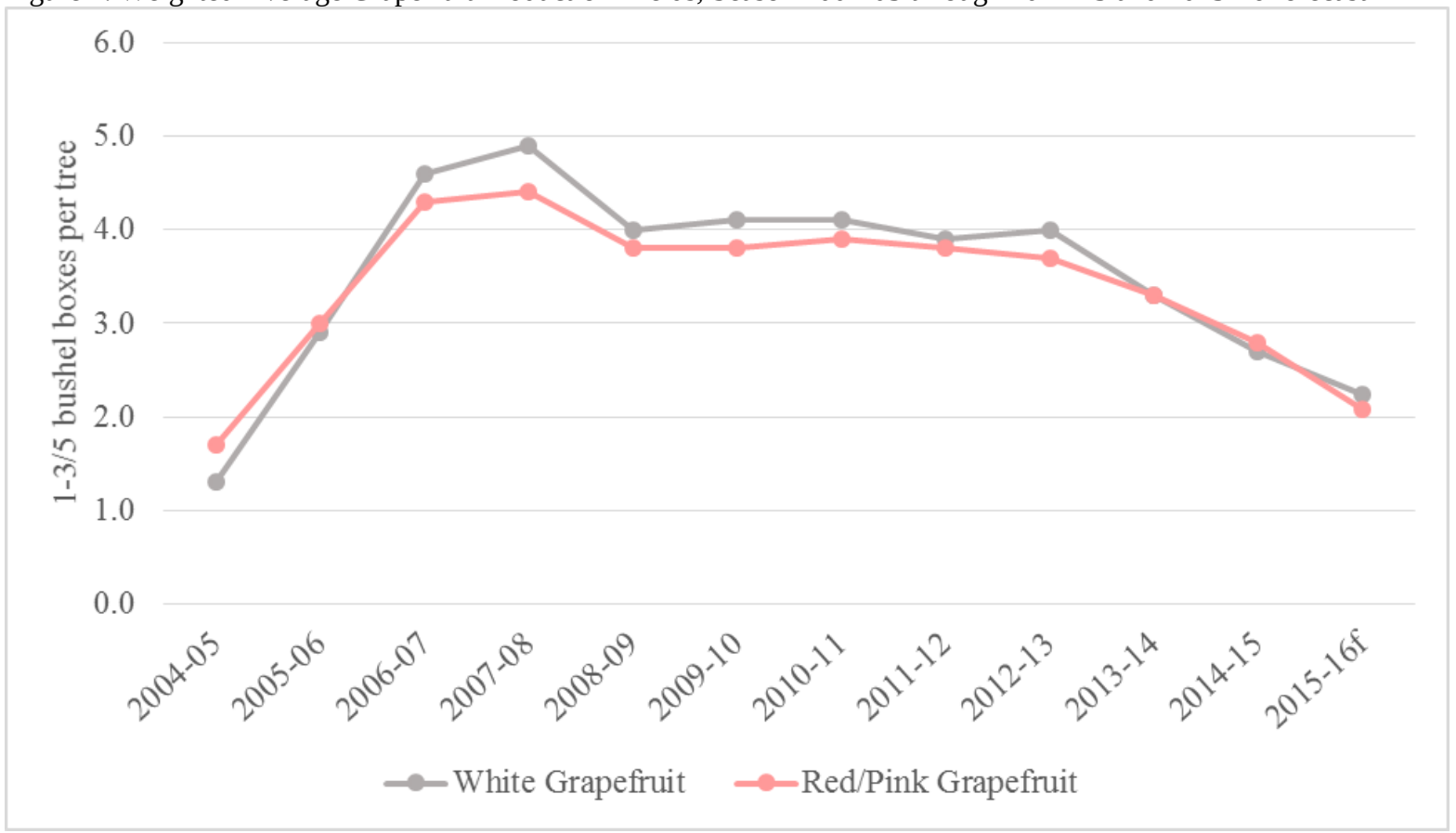
Spreen, Thomas H., and Marisa L. Zansler. "Florida Citrus Production Projections and Consumption Scenarios 2016-17 through 2025-26." Bartow, FL. Florida Department of Citrus, Economics and Market Research Department, October 2015. Available at (https://app.box.com/shared/3ztz0it923/1/76187684/41110905326/1).

Figure 1. The average number of boxes of citrus harvested per tree are used to project future citrus production in Florida are disaggregated by tree age and citrus cultivar for the Florida 2014–15 season.



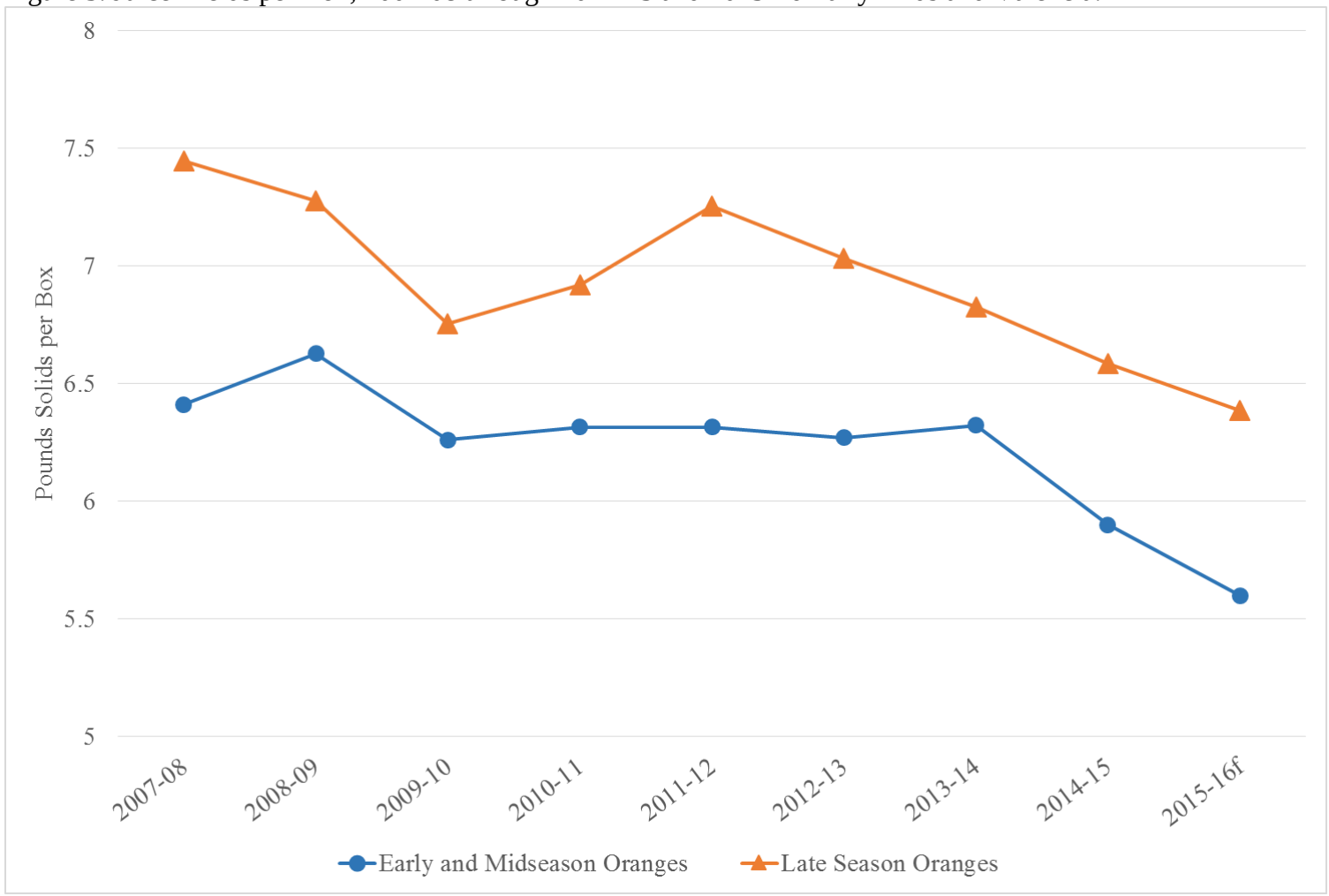
Source: Commercial Citrus Tree Inventory, USDA/NASS.

Figure 2. Weighted Average Grapefruit Production Yields, Season 2004-05 through 2014-15 and 2015-16 forecast



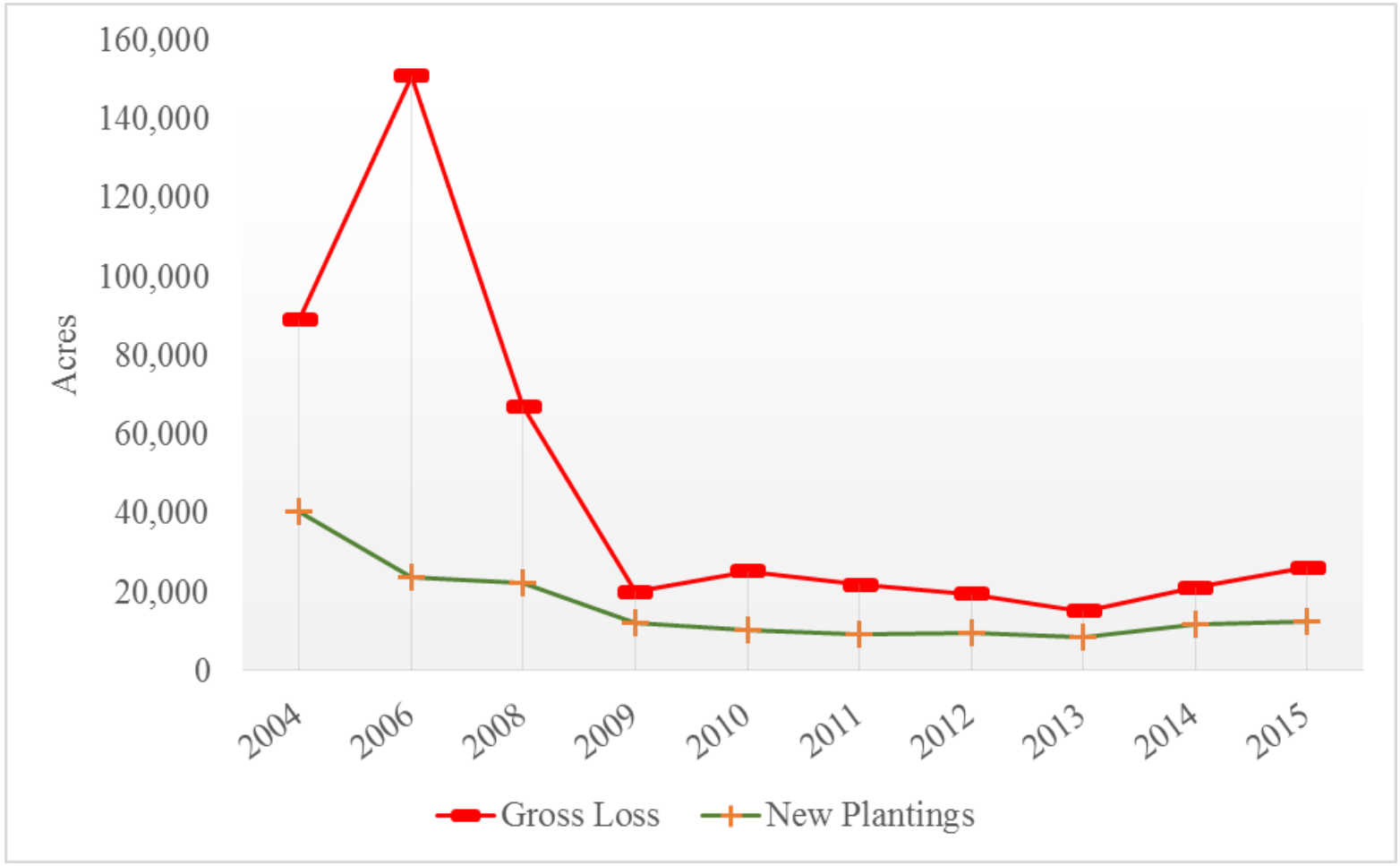
Source: Commercial Citrus Tree Inventory, USDA/NASS.

Figure 3. Juice Yields per Box, 2007-08 through 2014-15 and 2015-16 Early-Mids and Valencia.



Source: Florida Processors Statistics Database, Florida Department of Citrus.

Figure 4. Florida Citrus Tree Loss and New Plantings, 2004 through 2015.



Source: Commercial Citrus Tree Inventory, USDA/NASS.

Table 1. The average number of boxes of citrus harvested per tree are used to project future citrus production in Florida are disaggregated by tree age and citrus cultivar for the Florida 2014–15 season.

Tree age (years)	Early and midseason oranges Yield (90-lb (boxes/tree)[a]	'Valencia' oranges Yield (90-lb boxes/tree)[a]	Red grapefruit Yield (85-lb boxes/tree)[a]
1–3	0	0	0
4	0.35	0.2	0.7
5	0.65	0.35	0.9
6	0.9	0.5	1.1
7	1.1	0.7	1.3
8	1.3	0.9	1.5
9	1.5	1.1	1.7
10	1.7	1.3	1.9
11	1.85	1.5	2.1
12	2.0	1.7	2.3
13	2.1	1.8	2.5
14–20	2.1	1.8	2.7

1 lb = 0.4536 kg

Source: Spreen and Zansler (2015)

Table 2. Estimated internal rate of return (IRR) of baseline and alternative tree planting incentive programs for new plantings at various grove densities of processed early and midseason oranges, processed 'Valencia' oranges, and fresh-market red grapefruit.

	Early and midseason oranges		'Valencia' oranges		Red grapefruit	
	Grove density (trees/acre)					
	225	300	225	300	150	225
Program	IRR (%)					
Baseline	3.59	7.68	3.12	6.95	-0.78	7.46
Expedited depreciation	4.51	9.16	3.88	8.20	-0.5	9.12
Bonus depreciation	4.19	8.55	3.73	7.87	-0.79	7.57
Long-term escalating price floor	5.73	9.47	4.93	8.47	n/a	n/a
Tree assistance program	4.52	8.63	4.85	7.80	-0.25	8.21
Supported investment	5.61	11.11	4.89	9.94	0.12	9.91

Table 3. The estimated internal rate of return (IRR) of baseline scenario for processed oranges across citrus cultivars and tree densities is determined under a scenario where yields of fruit per tree are 20% higher.

	Grove density (trees/acre)	
Citrus variety	225	300
	IRR (%)	
Early and Midseason Oranges	7.15	10.85
'Valencia' Oranges	6.44	9.90

Table 8. Estimated Internal Rate of Return (IRR) for New Grapefruit Planting under Various Plans

Plan	Grove Density (trees per acre) (%)	
	150	225
Baseline	-0.78	7.46
Expedited Depreciation	-0.50	9.12
Bonus Depreciation	-0.79	7.57
USDA-TAP	-0.25	8.21
Florida's Natural	0.12	9.91