TEXAS A&M UNIVERSITY COMMERCE

Huanglongbing and the Citrus Industry: Applied Economic Analyses.

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Materials Innovation for Sustainable Agriculture (MISA)
Center of Excellence Conference
University of Central Florida, Live Oak Event Center, Orlando, FL
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Outline

1. Overview
    - ✓ Education
    - ✓ Research
    - ✓ Projects
2. Potential Economic Approaches
    - ✓ Present value of total damage cost
    - ✓ Profitability
    - ✓ Benefit/cost analysis
    - ✓ Marketability
3. Concluding Remarks

Education

- ***Ph.D., Agricultural & Applied Economics***

  Texas Tech University, December 2009
- ***M.S., Statistics***

  Texas Tech University, August 2008
- ***M.S., Agricultural & Applied Economics***

  Texas Tech University, May 2004
- ***B.B.A., Finance and Management***

  Ave Maria College, December 2001

Relevant Research

- **Fresh Fruit** Imports.
- **Fresh Tomato** Trade among NAFTA Countries
- **Fresh Tomatoes** in the Dallas-Fort Worth Grocery Market.
- **Feeder Cattle** Auction Prices in Northeast Texas
- **Fresh Vegetables** in Dallas-Ft. Worth
- Fresh Tomato Consumption in Northeast Texas
- The Economics of Foliar Fungicide Applications in Winter **Wheat** in Northeast Texas
- Huanglongbing and the California **Citrus** Industry: A Cost Comparison of Do Nothing vs. Do Something Management Practices
- Mexican **Meat** Demand at the Table Cut Level
- The **Dairy** Industry's Derived Demand for Feed Grains and Its Effect on the Cottonseed Market
- European Union **Cotton** Demand

Projects

- NIFA Center of Excellence: Multifunctional Surface/Sub-Surface/Systemic Therapeutic (CoE:MS3T) Technology for HLB Management. Funded by Specialty Crop Research Initiative (SCRI), National Institute of Food and Agriculture (NIFAS), United States Department of Agriculture (USDA) (with Principal Investigator Swadeshmukul Santra, and collaborators Evan G Johnson, James H. Graham, Jose Lopez, Karin Chumbimuni-Torres, Laurene Tetard, Leonardo De La Fuente, Nicole Labbe, and Woo Hyoung Lee), $1,975,000. [2016-2017].
- Northeast Texas Initiative for Cooperative Development (NTICD). Funded by the Small Socially-Disadvantaged Producer Grant (SSDPG), Rural Business-Cooperative Service, Rural Development, United States Department of Agriculture (with Project Director Jose A. Lopez and collaborators Jim Heitholt, Robert Williams, and Curtis Jones), $175,000. [2013].
- Breaking Barriers for Beginning Hispanic Farmers and Ranchers. Funded by Beginning Farmer and Rancher Development Program (BFRDP), National Institute of Food and Agriculture (NIFA), United States Department of Agriculture (USDA) (with Project Director Bob Williams, and Collaborators Jose A. Lopez, Curtis Jones, and Mario Villarino), $674,768. [2010-2013].
- Alliance to Achieve and Maintain Competitiveness in Logistics within NAFTA through Strategic Leadership (LOGIS). Funded by the Fund for the Improvement of Postsecondary Education (FIPSE), North American Mobility Program in Higher Education, US Department of Education (with Project Director Jennifer Oyler and collaborators), $190,000. [2010-2014].

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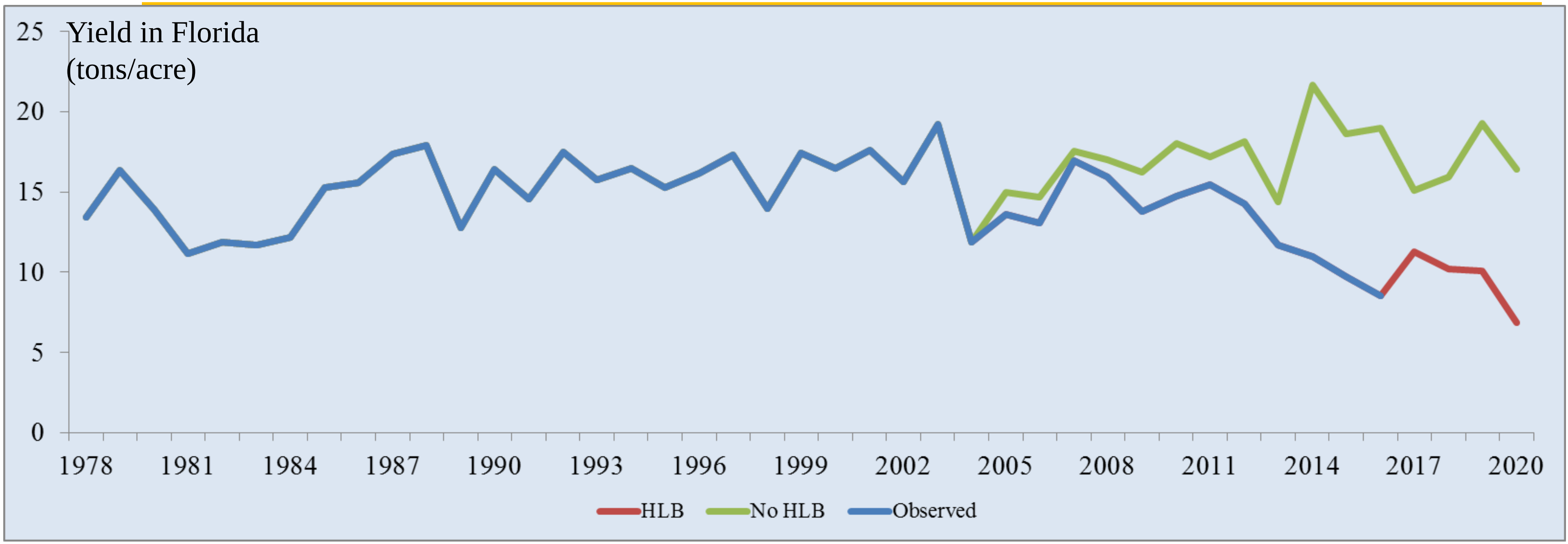
Potential Economic Analyses

- Economic analyses allow you to answer questions such as:
  - What is the economic impact (in dollar terms) that HLB has had to the Florida citrus industry?
  - Does it pay off to invest in the proposed MS3T technology? Can I make a profit?
  - Is the MS3T technology a good investment?

Present Value of Total Damage Cost

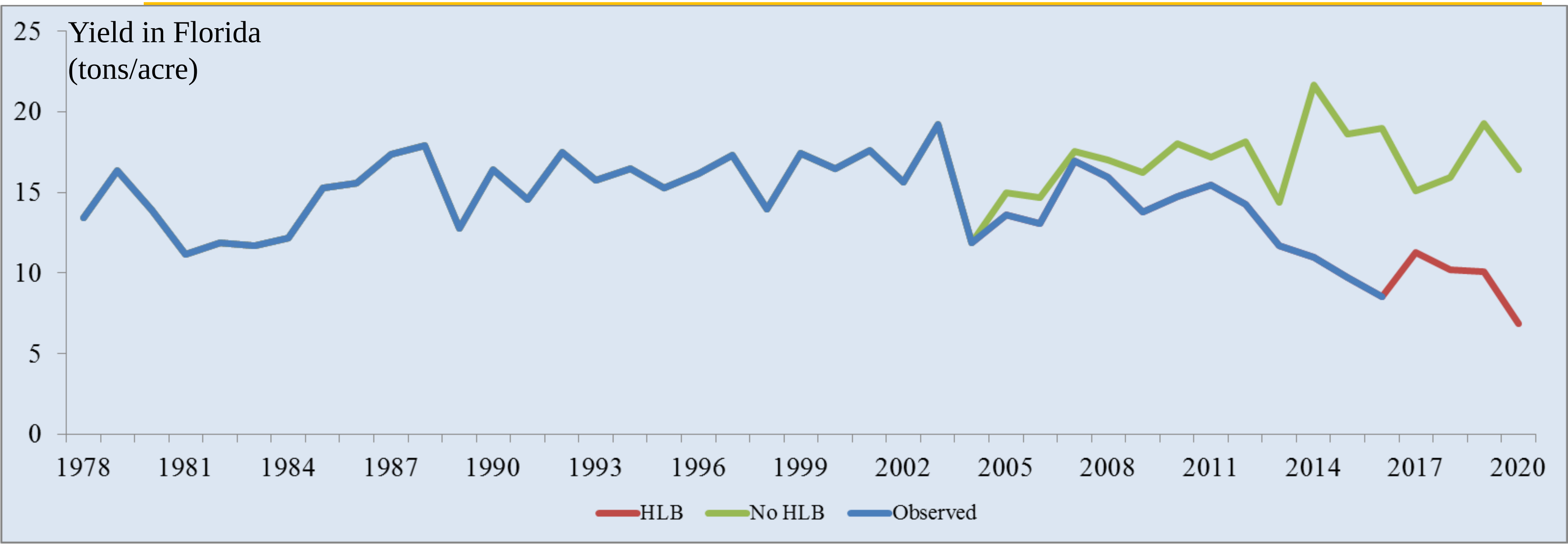
- This approach requires estimating the total production loss ($/acre) in year *t* and then calculating the present value of the total damage cost ($/acre) over a period of time, say 20 years.
- If nothing is done to manage HLB, the total damage costs ($/acre) from HLB ($D_t$) in year *t* equals the total production loss ($/acre) from HLB in year *t* (TL_t).
- If something is done to manage HLB, the total damage costs ($/acre) from HLB ($D_t$) is the sum of the total loss in production value per acre (TL_t) plus the additional costs associated with limiting HLB spread per acre (AC_t).
- For additional information, refer to Lopez and Durborow (2014).

Trend Analysis of Citrus Production in Florida



- Up to year 2005, the blue line depicts the actual yield before HLB.
- From 2005 to 2015, the blue line depicts the actual yield after HLB.
- The red line shows predicted yield from 2016 to 2020.
- The green line illustrates what the yield would be if HLB had not arrived to Florida.

No HLB Solution



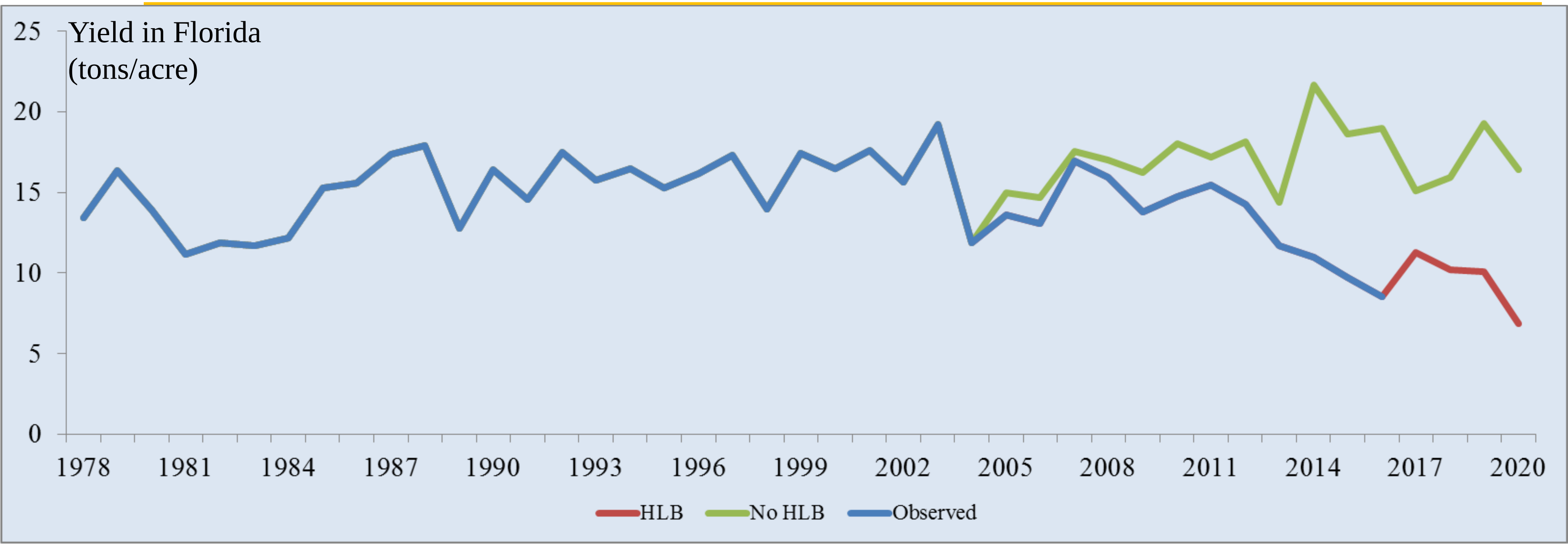
(1) $$TL_t = HP_t - HLBP_t$$

(2) $$PV_{Damage} = \sum_{t=1}^{T}(1+i)^{-t} \times TL_t$$

If no HLB solution, the total production loss ($/acre) from HLB in year *t* (TL_t) can be approximated by the difference in yield with and without HLB.

The present value of the total damage cost ($/acre) over a period of time estimates the economic impact (in dollar terms) that HLB has had to the Florida citrus industry during that period.

HLB Management



(3) $$D_t = TL_t + AC_t$$

(4) $$TL_t = HP_t - HLBP_t$$

(5) $$PV_{Damage} = \sum_{t=1}^{T}(1+i)^{-t} \times D_t$$

If something is done to manage HLB, the total damage costs ($/acre) from HLB ($D_t$) is the sum of the total loss in production value per acre (TL_t) plus the additional costs associated with limiting HLB spread per acre (AC_t).

The present value of the total damage cost ($/acre) over a period of time estimates the economic impact (in dollar terms) that HLB has had to the Florida citrus industry during that period.

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Profitability Analysis

- This approach estimates net returns ($/acre) from investing in a management strategy such as the proposed MS3T technology.

$$Rn = P * (Y_t - Y_c) - (C_m + C_a)$$

- P is fresh-orange price ($ per 75-pound carton),
- Y_t is the observed yield from treating with the MS3T technology (75-pound cartons per acre),
- Y_c is the observed yield from control group, such as untreated plots or plots treated with an alternative management strategy (75-pound cartons per acre),
- C_m is the cost of the MS3T technology ($/acre),
- C_a is the application cost of the MS3T technology ($/acre) such as labor.

Profitability Analysis

- The probability of treatment resulting in a yield difference larger than the estimated yield difference needed to offset the cost of the treatment is calculated from the observed yield difference between the treatment and control group and their observed standard deviation which is calculated from a pooled variance.
- The following probabilities are estimated.
- The probability that net returns from treatment will at least break even:

$$PT\,[Rn > (1+0)*(C_m + C_a)];$$

- The probability that net returns from treatment will be at least 25% greater than the investment on the treatment:

$$PT\,[Rn > (1+0.25)*(C_m + C_a)];$$

- The probability that net returns from treatment will be at least 50% larger than the investment on the treatment:

$$PT\,[Rn > (1+0.50)*(C_m + C_a)]$$

Profitability Analysis

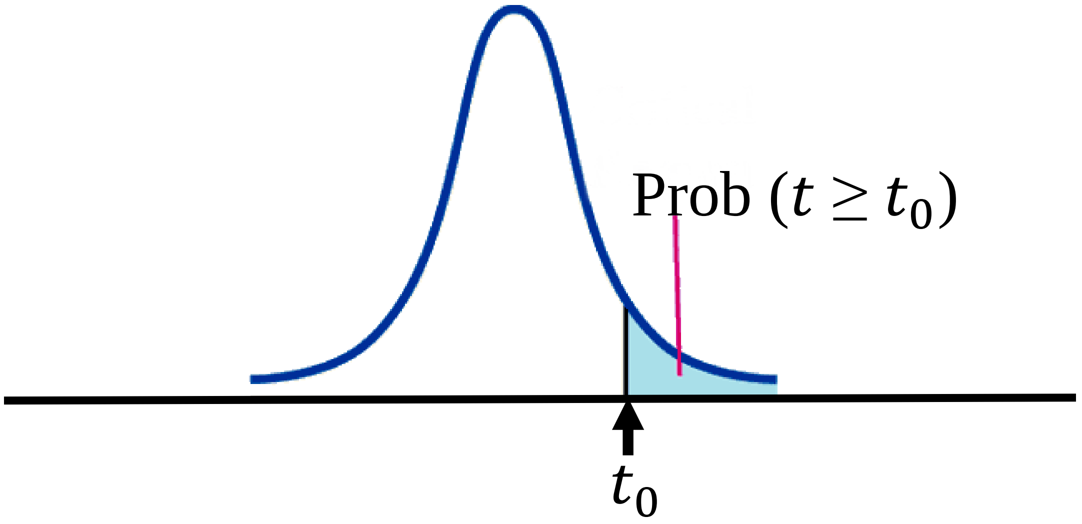
$$\text{PT} = 1 - \text{Prob}\ t\left[\frac{\beta_0 - \left(Y_f - Y_c\right)}{S_p\left(\frac{1}{n_t} + \frac{1}{n_c}\right)^{1/2}}, df_e\right]$$

- The yield difference needed to offset the cost of treatment is computed as:

$$\beta_0 = \frac{(1+ER_n)(C_m+C_a)}{P}$$

- This profitability analysis is conducted based on Bayesian inference.
- For additional information, refer to Lopez, Rojas, and Swart (2015).

Probability Net Returns from Treatment will at Least Break Even

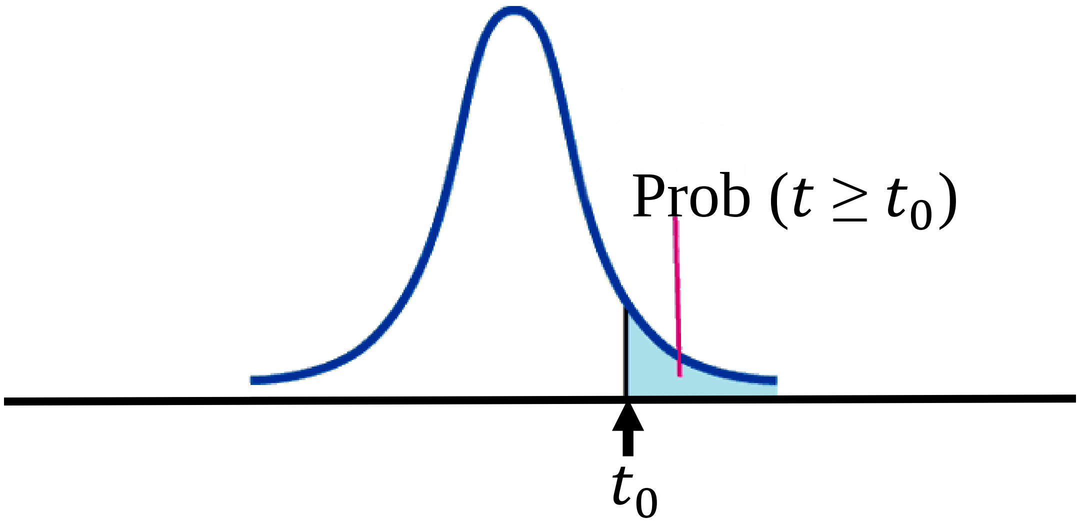


$$P[Rn > (C_m + C_a)] = P(t > t_0) = 1 - P(t < t_0)$$

$$t_0 = \frac{\frac{(C_m + C_a)}{P} - (Y_f - Y_c)}{S_p\left(\frac{1}{n_t} + \frac{1}{n_c}\right)^{1/2}}$$

The above probability estimates the probability that net returns from treatment will at least break even.

Probability Net Returns from Treatment will be at Least 25% Greater than the Investment

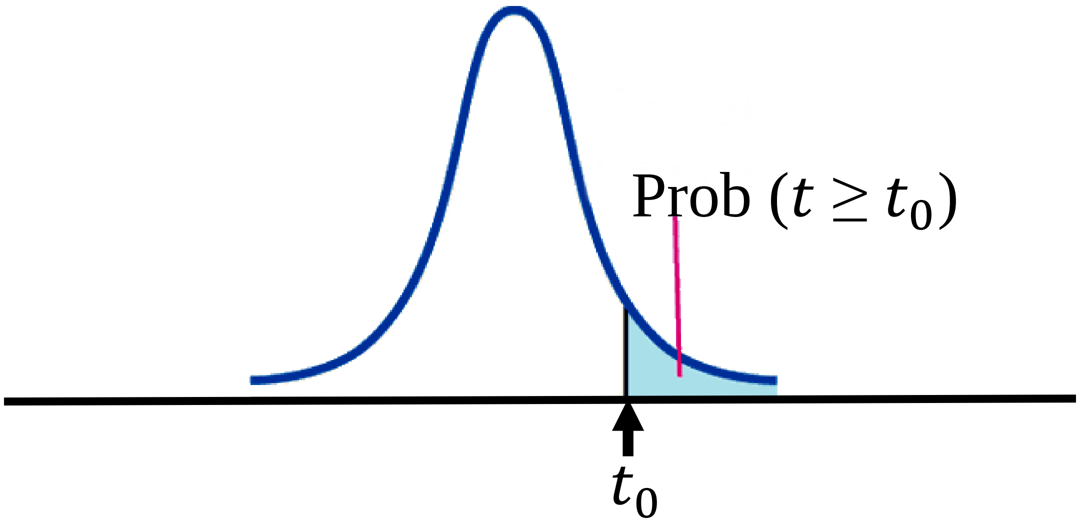


$$P[Rn > (1+0.25)*(C_m + C_a)] = P(t > t_0) = 1 - P(t < t_0)$$

$$t_0 = \frac{\frac{(1+0.25)*(C_m + C_a)}{P} - (Y_f - Y_c)}{S_p\left(\frac{1}{n_t} + \frac{1}{n_c}\right)^{1/2}}$$

The above probability estimates the probability that net returns from treatment will be at least 25% greater than the investment on the treatment.

Probability Net Returns from Treatment will be at Least 50% Greater than the Investment



$$P[Rn > (1+0.50)*(C_m + C_a)] = P(t > t_0) = 1 - P(t < t_0)$$

$$t_0 = \frac{\frac{(1+0.50)*(C_m + C_a)}{P} - (Y_f - Y_c)}{S_p \left(\frac{1}{n_t} + \frac{1}{n_c}\right)^{1/2}}$$

The above probability estimates the probability that net returns from treatment will be at least 50% larger than the investment on the treatment.

Other Factors to Consider

- The MS3T Technology is multifunctional allowing for a comprehensive management of HLB and other bacterial and fungal diseases.
- The MS3T Technology is expected to reduce application frequency.
- Integrated Pest Management Strategy

Copper Zinkicide MS3T

Copper MS3T Copper MS3T

MS3T MS3T Copper MS3T MS3T Copper

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Benefit/Cost Analysis

- This approach compares benefits and costs across time by either computing the ratio (benefit/cost analysis) or the difference (net present value analysis) of benefits and costs.

$$\frac{B}{C} = \frac{PV[B_0,\ldots, B_n]}{PV[C_0,\ldots, C_n]}$$

- The present value of streams of benefits ($B_0,\ldots, B_n$) and costs ($C_0,\ldots, C_n$) over a period of n years are:

$$PV[B_0, \ldots, B_n] = \sum_{i=1}^{n} \frac{B_i}{(1+r)^n}$$

$$PV[C_0, \ldots, C_n] = \sum_{i=1}^{n} \frac{C_i}{(1+r)^n}$$

- The more the benefits exceed the cost, the better the investment.

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Simulation Analyses

- Several simulation or sensitive analyses can be conducted.
- The economic impact to the Florida citrus industries can be simulated under likely citrus demand and price scenarios as more citrus produces adopt the web technology and citrus production increases.
- The profitability analysis can be simulated under various technology and application costs.
- Benefit and costs can also be simulated to incorporate yield and costs uncertainty.

Table 1. Cultural Costs of Production per Acre for Processed Oranges in Southwest Florida, 2015/16

Costs represent a mature grove (10+ years old) including resets	Number of Applications	Materials Cost per acre ($)	Application Cost per acre ($)	Total Cost per acre ($)
Cultural Costs				
Weed Management				
Mowing (Chemical & mechanical)	6	1.08	58.41	59.49
Herbicides	3	103.09	47.51	150.59
Total Weed Management Costs				210.09
Foliar Sprays				
Insecticides		183.95		
Fungicides 449.59		99.73		449.59
Nutritionals		165.91		
Application:				
Ground	5		133.11	133.11
Aerial	3		28.92	28.92
Total Foliar Sprays Costs				611.62

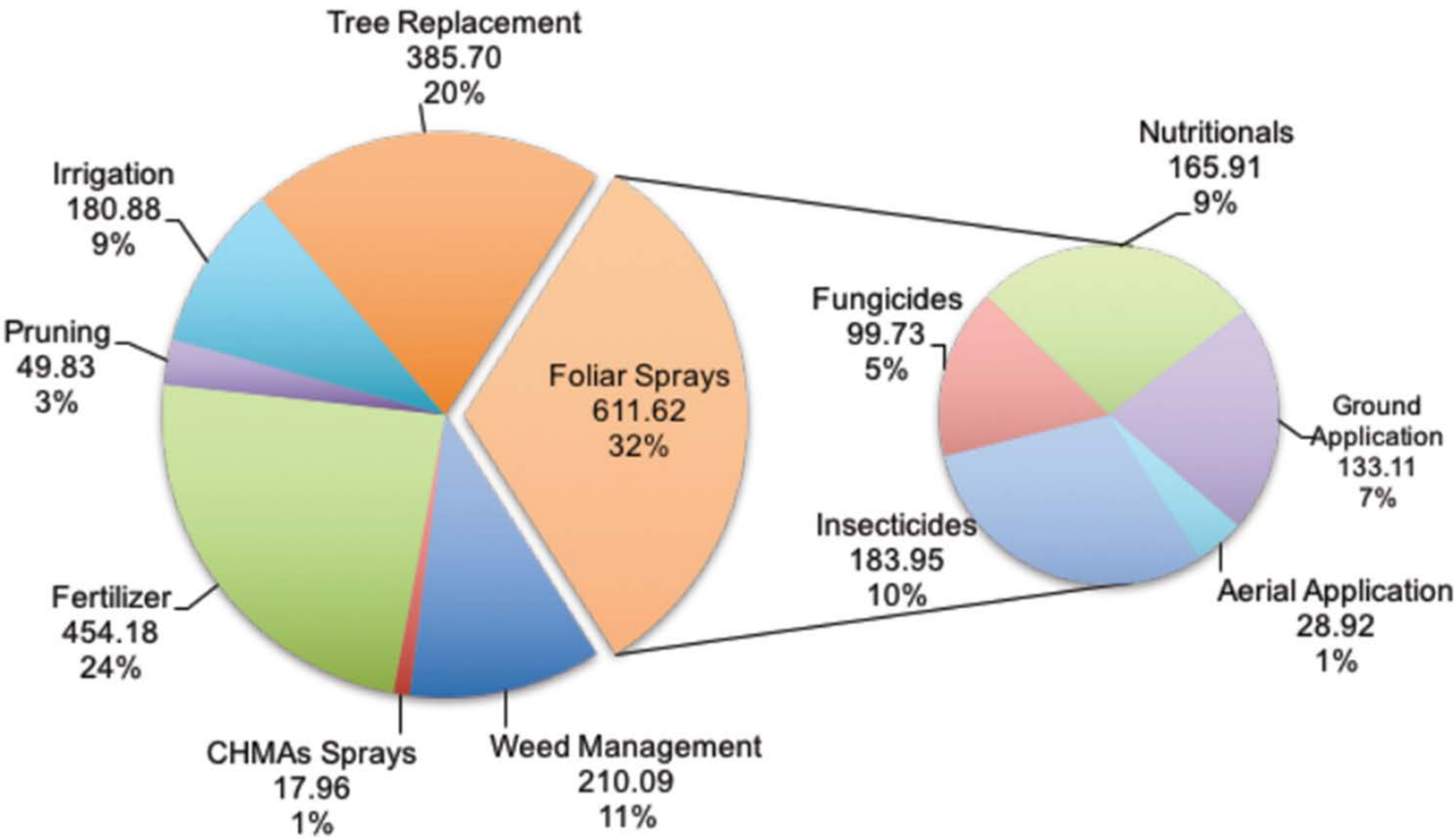
Source: Ariel Singerman, Assistant Professor and Extension Economist, University of Florida

Table 1. (Cont.)

Costs represent a mature grove (10+ years old) including resets	Number of Applications	Materials Cost per acre ($)	Application Cost per acre ($)	Total Cost per acre ($)
Fertilizer				
Ground/Dry Fertilizer	3	326.45	26.84	353.29
Fertigation/Liquid Fertilizer	6	73.12	27.76	100.89
Total Fertilizer Costs				454.18
Pruning				
Topping & Hedging	1		29.63	29.63
Chop/Mow Brush	1		20.20	20.20
Total Pruning Costs				49.83
Irrigation				
Irrigation System[1]				130.31
Fuel for pump				50.57
Total Irrigation Costs				180.88
Total Cultural Production Costs without Tree Replacement				**1524.55**
Tree Replacement (9 trees):				
Tree Removal (Clip-shear; use front-end loader)				60.66
Site Preparation and Plant Tree (includes reset trees)				96.84
Supplemental Fertilizer, Sprays, Sprout, etc. (Trees 1-3 years old)				228.20
Total Tree Replacement Costs				385.70
Total Cultural Costs with Tree Replacement				**1910.25**

Source: Ariel Singerman, Assistant Professor and Extension Economist, University of Florida

Figure 1. Cultural Costs of Production for Processed Oranges Grown in Southwest Florida, 2015/16



Source: Ariel Singerman, Assistant Professor and Extension Economist, University of Florida

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Concluding Remarks

- The PV of the total damage cost is useful for assessing the impact of a new management strategy to an industry.
  - It allows you to assess the cost savings/additions from a new management strategy.
- The profitability analysis is useful to assess whether the yield gain offsets the costs of a new management strategy.
  - It can be enhanced by conducting probabilities, such as the probability of breaking even.
- When benefits and costs can be quantified, the benefit/cost analysis can be used to assess whether or not support a management strategy
- Access to data is essential in conducting any economic analysis.

Thank You!

REFERENCES

Lopez, J.A., K. Rojas, and J. Swart. 2015. "The Economics of Foliar Fungicide Applications in Winter Wheat in Northeast Texas." *Crop Protection*, 67:35-42.

Lopez, J.A. and S. Durborow. 2014. "Huanglongbing and the California Citrus Industry: A Cost Comparison of Do Nothing vs. Do Something Management Practices." *Texas Journal of Agriculture and Natural Resources*, 27:51-68.