Trend Analysis of Citrus Production in Florida

Sona Grigoryan and Dr. Jose A. Lopez
School of Agriculture, Texas A&M University-Commerce

I. Abstract

Since 2005, the U.S. citrus industry has been suffering significant economic losses because of a bacterial disease known as Huanglongbing (HLB) or citrus greening. It affects the vascular system of citrus plants and eventually kills the trees. Traditional methods for managing HLB are often inefficient or not economically viable. Starting from 2004, the annual production of citrus fruits has been generally decreasing at an average rate of 8% per year; while the bearing acreage has also been decreasing since 1997 at an average rate of 3% per year. Prior HLB (during the 1997-2004 period), citrus productivity (measured in tons/acre) in Florida was increasing by 3.9% per year on average; while post HLB (after 2004), citrus productivity has been decreasing by 4% per year on average. This study employs an empirical trend analysis to estimate the per-acre yield of citrus plants in Florida as a function of time and a trend variable. The resulting model enables us to develop two scenarios and estimate the decline in productivity due to HLB.

II. Introduction

Worldwide annual production of citrus fruits accounts for over 92 million tons, covering nearly 18.7 million acres of area with average yields ranging from 5.3 to 6.7 tons/acre, and with the most intensive countries exhibiting average citrus yields of 11 to 11.5 tons/acre. Brazil produces a quarter of the world's citrus. The US is the second significant producer of citrus fruits, with the production of 7.77 million tons. The US biggest citrus producing states are Florida and California with production of 51% and 45% of total US production, respectively. The Florida citrus industry and its position in the global citrus market are being jeopardized by a bacterial disease known as citrus greening, or Huanglongbing (HLB). It is one of the most serious citrus diseases in the world, which attacks the vascular system of plants and eventually kills them. Since HLB was first reported in 2005 in Florida, citrus productivity has been decreasing by 4% per year on average. Despite the huge negative economic impact of the disease, traditional methods for managing HLB are often inefficient or not economically viable.

III. Approach

This study employs an empirical trend analysis to estimate the per-acre yield of citrus plants in Florida as a function of time and a trend variable.

Probabilistic forecast has two components:

A deterministic component estimates a point forecast as:

$$\hat{Y} = a + b_1 X + b_2 Z$$

A stochastic component is $\tilde{e}$ and is used as:

$$\tilde{Y} = \hat{Y} + \tilde{e}$$

This leads to the complete probabilistic forecast model as:

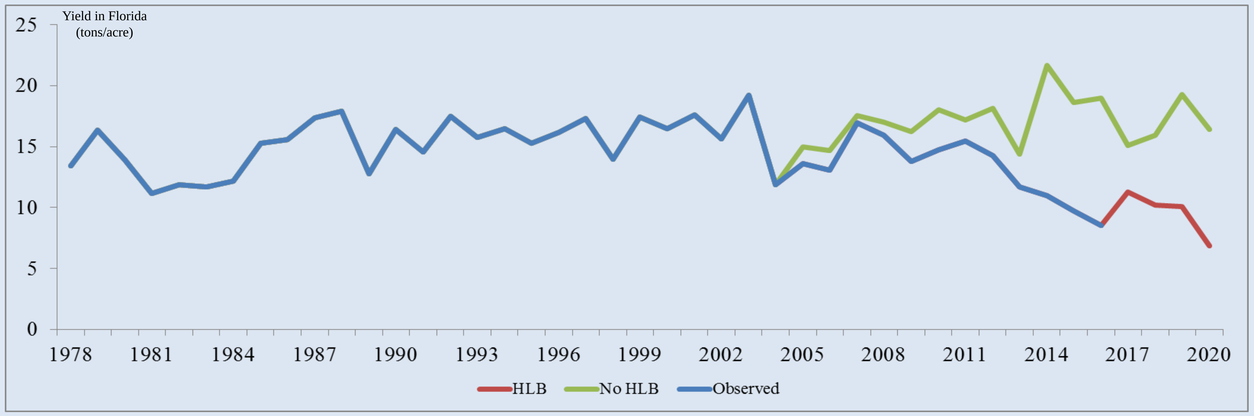
$$\mathbf{\tilde{Y} = a + b_1 X + b_2 Z + \tilde{e}}$$

where $\tilde{e}$ makes the deterministic forecast a probabilistic forecast.

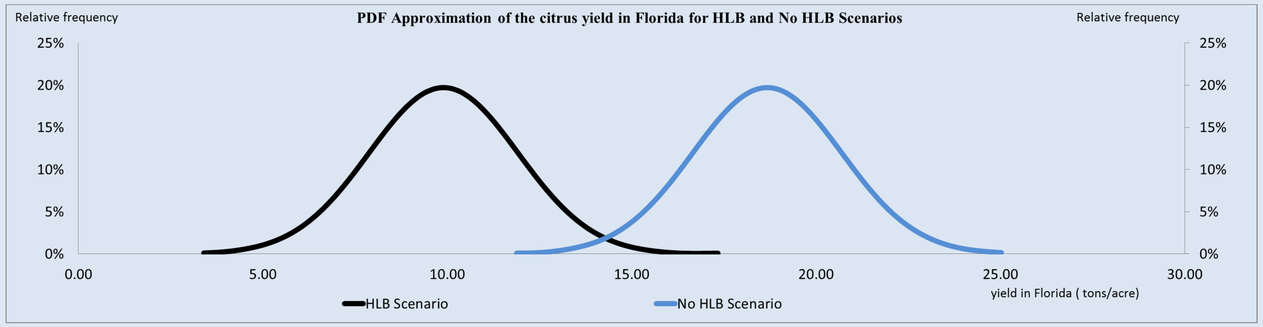
IV. Data

- This study analyzes data on bearing acreages (acres) and production (tons) for 38 years, from 1978 to 2016. The data are reported by the United States Department of Agriculture.
- Production was divided into acreages to get yield data for each year.
- A trend variable was added to the model.

V. Results



Up to year 2005, the blue line depicts the actual yield before HLB was found; the red line shows predicted yield from 2016 to 2020; and the green line illustrates what the yield would be if HLB had not arrived to Florida. The data starting from 2005 is stochastic and only represent two likely scenarios for what the Florida citrus industry could look like for the next three years with continued HLB or what it could have looked like had HLB not arrived to Florida.



The figures above show two PDF approximation scenarios, with and without HLB. According to the HLB scenario, 2.5% of the time the yield of citruses is expected to be less than or equal to 6.07 tons/acre while 2.5% of the time the yield of citruses is expected to be greater than or equal to 13.7 tons/acre. According to the No HLB scenario, 2.5% of the time the yield of citruses is expected to be less than or equal to 14.8 tons/acre while 2.5% of the time the yield of citruses is expected to be greater than or equal to 22.51 tons/acre.

VI. Conclusions

This empirical trend analysis estimates per-acre yield of citrus plants in Florida, enables us to develop two likely yield scenarios (with and without HLB), and estimates the decline in productivity due to HLB.