Potential economic consequences from huanglongbing (aka citrus greening disease) in California commercial citrus: Results for Navel orange production

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Issue

In the late 18th century, a citrus die-back began to take hold in India (Gottwald et al. 2007). Around the same time, farmers in southern China experienced a similar disease they referred to as huanglongbing (HLB) (da Graça and Korsten 2004). The bacterium *Candidatus* Liberibacter asiaticus (*C*Las), the causal agent for HLB, infects a tree's phloem, suffocating the roots, causing the tree to die. Once HLB infects a tree, it quickly spreads throughout the tree (Farnsworth et al. 2014). Even if a tree survives initial infection, much of its fruit does not fully ripen, leading some to refer to HLB as citrus greening disease. The fruit of an infected tree becomes inedible and the cost for treating an endemic grove is high, as spraying for the Asian citrus pysllid (ACP), the primary vector for *C*Las, and removal of infected trees and those near them are likely needed. Since its discovery in Asia, HLB has spread to more than 40 countries across Asia, Africa, and the Americas (Bové 2006).

In 1998, a grove in Florida was infected with ACP and within seven years HLB was detected in southern Florida. Its spread throughout Florida resulted in an estimated $4.5 billion cost to the Florida economy between 2007 and 2011 (Alvarez et al. 2016; Farnsworth et al. 2014; Hodges and Spreen 2012) and decreased production by an estimated 8 million tons per year between 2004 and 2020 (Simnett and Kramer 2020). To illustrate the magnitude of these losses, we note that Florida's 2022 citrus value and production are approximately $585 million and 2.03 million tons, respectively (USDA-NASS 2022).

In 2008, ACP was detected in residential trees in San Diego County, California and are now established throughout southern California in both residential and commercial citrus groves (Byrne et al. 2018; Hoddle 2012). To date, HLB has been detected in 6,190 residential trees in California.[1] There have also been two detections of *C*las-positive ACP in commercial grove in San Diego and Riverside Counties in southern California (CPDPP 2020; CPDPP 2022). However, no commercial citrus tree in California have yet to test positive for HLB.

Because of the likelihood of HLB reaching California's commercial citrus industry, the California citrus industry, California Department of Food and Agriculture (CDFA), and the United States Department of Agriculture (USDA) have developed a response to avoid repeating the experience in

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[1] Reported as of 08/25/2023 at https://maps.cdfa.ca.gov/WeeklyACPMaps/HLBWeb/HLB_Treatments.pdf

Florida. That response entails a better understanding of the rate of transmission and spread of the disease, identification of effective management practices, and outreach and incentives to improve the rate of farmer adoption of those practices and needed cooperation to adequately address HLB. With no known control for HLB to date, the only effective management of disease spread is vector control, removal of infected trees, and quarantines; necessitating the need for monitoring, reporting, and area-wide cooperation between growers. Estimating the rate of spread entails assessing the biology, geography, and population dynamics of the ACP (Gottwald et al. 2014). However, vector control to mitigate the risk and severity of infection will require a coupling between the bio-physical conditions of disease spread with grower response rates. Considering the biophysical and human dimensions of disease spread will help us better understand, and communicate, when and where possible outbreaks of the disease may occur and more accurately assess a grower's risk of infection. By analyzing the current production and economic value of citrus produced in California, we can identify where HLB may have the most severe impact on the state's citrus industry.

Study Methods

In this note, we evaluate the threat HLB poses for the production of California Navel oranges using data from the United States Department of Agriculture National Agricultural Statistics Service (USDA NASS), and California Department of Food and Agriculture (CDFA) ACP and HLB weekly report and risk-based survey results.[2,3] We compare where Navel oranges are produced in California with where ACP and HLB have been identified and pose a significant risk to citrus to determine the potential consequences from HLB spreading into California commercial Navel orange groves. We also evaluate potential HLB impacts in California on the US production of navel oranges as California contributes significantly to the US citrus market. Graphical analyses were performed using R (R Core Team 2021) with the stargazer (Hlavac 2022) and tidyverse (Wickham et al. 2019) R packages. The map was created using ArcGISPro.

Findings

As seen in Figures 1 and 2, over half of US Navel orange production occurs in California (60.34% by weight), primarily in southern counties in the state, with the remainder grown in Florida (39.3% by weight) and Texas (0.34% by weight) (USDA-NASS 2022). If HLB were to spread to commercial groves in the California counties where residential trees have been infected (Riverside and San Bernardino Counties) and *C*Las-positive ACP have been discovered in commercial groves (Riverside and San Diego Counties), the most likely future scenario given the most recent CDFA risk survey results, a little more than $17.5 million of annual production value (approximately 1.1% of total value for California Navel oranges), spanning 2,148 bearing acres (1.6% of California's commercial Navel acreage), is at risk from HLB based on the latest California County Agricultural Commissioner reports shown in Table 1.[4]

In addition, coastal counties without HLB incidence (particular Ventura, Santa Barbara, and San Luis Obispo) also face significant risk from HLB as seen in the latest CDFA risk survey results. However, only Ventura County produces Navel oranges with 0.37% of commercial Navel orange bearing acreage, generating approximately $3.3 million of annual production value, spanning 498 bearing acres (0.37%). These results suggest that the US Navel orange supply faces limited additional risk beyond the effects of HLB in Florida.

Key Insight

- Although HLB has been found in residential citrus trees in neighborhoods in San Diego, San Bernardino, Riverside, Orange, and Los Angeles counties (CPDPP 2023) and two *C*Las-positive ACPs were found in commercial groves in San Diego and Riverside counties (CPDPP 2020; CPDPP 2022), the US commercial Navel orange supply currently appears to face limited additional risk from the impacts of HLB in California.

[2] https://maps.cdfa.ca.gov/WeeklyACPMaps/HLBWeb/HLB_Treatments.pdf
[3] https://www.cdfa.ca.gov/citrus/docs/committee/2023/03082023SupportingMaterials.pdf
[4] https://www.nass.usda.gov/Statistics_by_State/California/Publications/AgComm/index.php

- This insight relies on the facts that ACP have yet to establish a population in California's central valley (home to Tulare, Kern, and Fresno counties) where most (approximately 98.7% by weight) of California Navel oranges are grown. Moreover, ACP migration to commercial navel groves located in the central valley of California will be difficult given CDFA HLB quarantines, area-wide coordinated ACP insecticide spraying, and other measures such as tarping of transport vehicles that significantly limit ACP migration into and across the central valley.

Figure 1: Fresh and processed Navel oranges produced by state (Data source: https://quickstats.nass.usda.gov/)

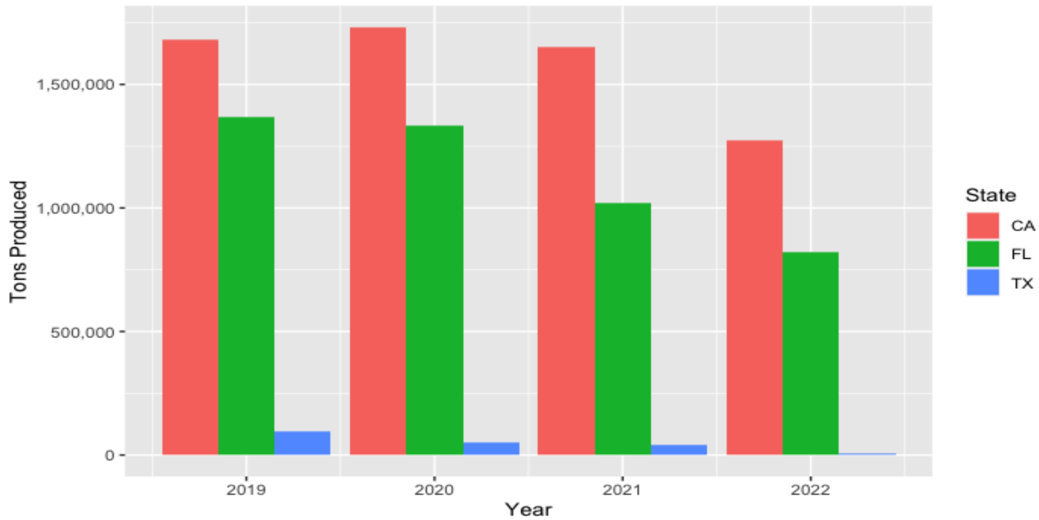
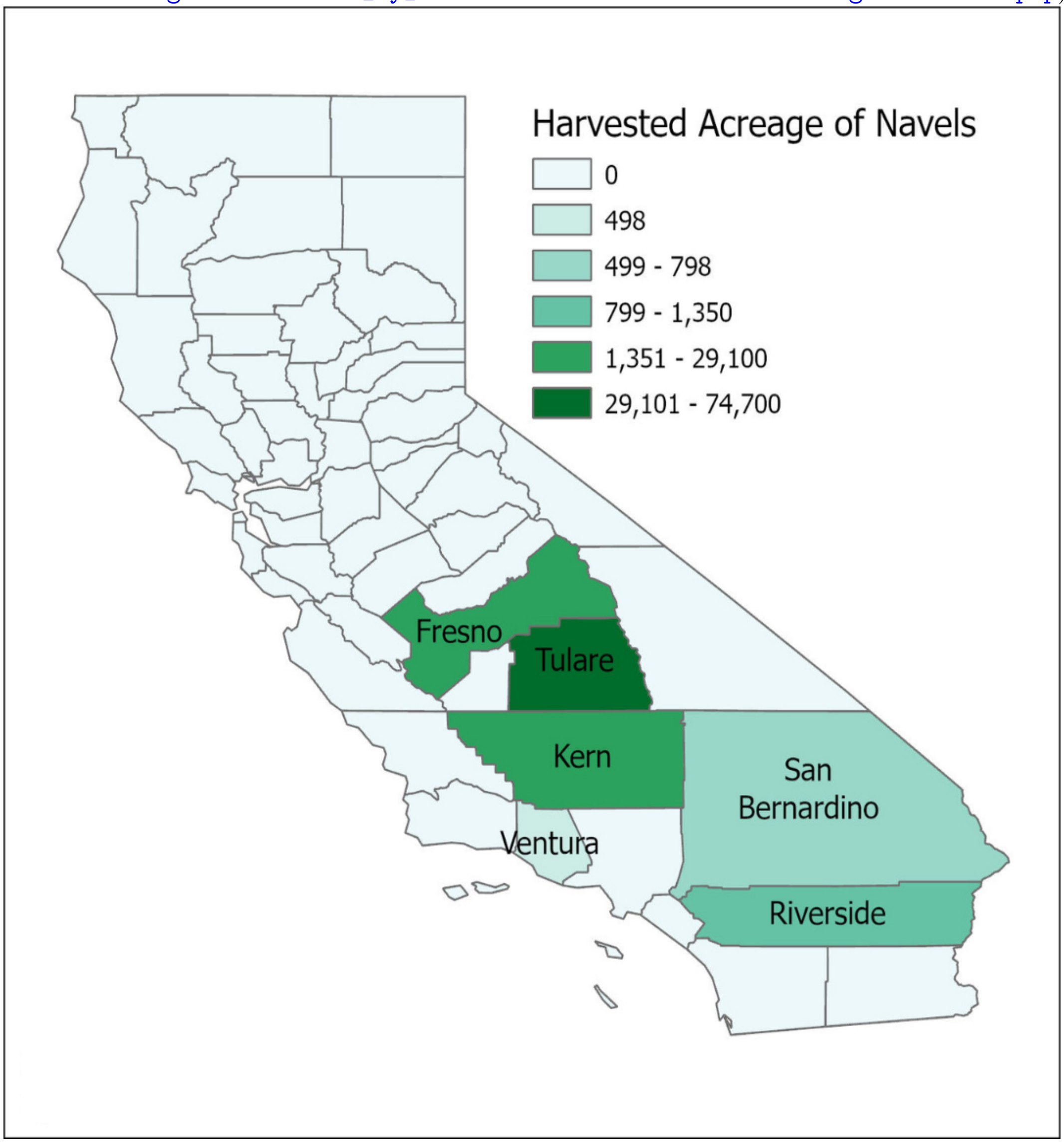


Table 1: Harvested acreage, production and total value of Navel oranges in 2020 in top California producing counties (Data source: https://www.nass.usda.gov/Statistics_by_State/California/Publications/AgComm/index.php).

County	Bearing Acres	Production (Tons)	Total Value ($)
Tulare	74,700	1,650,000	868,566,000
Kern	29,100	542,000	427,339,000
Fresno	27,500	475,000	282,653,000
Riverside	1,350	18,900	7,438,000
San Bernardino	798	6,830	10,152,000
Ventura	498	8,650	3,373,000
Total	133,946	2,701,380	1,599,521,000

Figure 2: Harvested acreage of Navel oranges by California counties in 2020 (Data source: https://www.nass.usda.gov/Statistics_by_State/California/Publications/AgComm/index.php).



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