

Potential economic consequences from Huanglongbing (aka citrus greening disease) in California commercial citrus: Results for lemon 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 huanglongbing (HLB) (da Graça and Korsten 2004). The bacterium *Candidatus Liberibacter asiaticus* (CLas), the presumptive 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 spray 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, the Asian citrus psyllid (ACP), the primary vector for HLB, was discovered in Florida 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). In 2008, ACPs were detected in San Diego County, California and are now established throughout southern California in both residential and commercial citrus trees (Byrne et al. 2018; Hoddle 2012). To date, HLB has been detected in 5,708 residential trees in California.¹ There have been two detections of CLas-positive ACP in commercial grove in southern California. However, no commercial citrus tree in California have tested 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

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¹Reported as of 07/14/2023 at https://maps.cdffa.ca.gov/WeeklyACPMaps/HLBWeb/HLB_Treatments.pdf

Department of Agriculture (USDA) have developed a response to avoid repeating the experience in Florida. That response will entail a better understanding of the rate of transmission and spread of the disease, effective management practices, the rate of farmer adoption of those practices, and needed rate of cooperation to adequately address HLB. With no known control for HLB to date, the only effective management of disease spread is vector control; 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 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 lemons 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 lemons are produced in California with where ACPs and HLB have been identified and pose a significant risk to citrus to determine the potential consequences from HLB spreading into California commercial citrus groves. We also evaluate potential HLB impacts in California on the US lemon production as California provides a large majority to the US fresh fruit market. For example, the US imported just over 104,000 tons of lemons for the fresh fruit market in 2022-23 market year⁴ while California produced nearly one millions tons of lemons for this market (see Figure 1). By identifying where the most citrus is grown, and tracking the spread of *CLas*-positive ACP, we can identify areas that are most at risk for infection. Using data from the USDA (USDA-NASS 2022), we visualized citrus production in the United States and California and conducted a spatial analysis of HLB in California and its potential impact on the lemon industry there. In this research note, we provide insights for lemon production. Graphical analyses were performed using R (R Core Team 2021) and the stargazer (Hlavac 2022), treemap (Tennekes 2021), and tidyverse (Wickham et al. 2019) R packages. The map was created using ArcGISPro.

Insights and Findings

The US commercial lemon supply appears vulnerable to the impacts of HLB. US lemons are primarily grown in southern California (see Figure 1 and Figure 2) and HLB has been found in residential citrus trees in neighborhoods in San Diego, San Bernardino, Riverside, Orange, and Los Angeles counties (CDFA Citrus Pest Disease Prevention Division 2023). If HLB were to spread to commercial groves in these counties, in particular, over \$145 million of annual production value (approximately 16% of total value for California lemons), spanning 11,100 bearing acres (19.4% of California’s commercial lemon acreage), is at risk based on the latest California County Agricultural Commissioner reports.⁵ Subsequent to other vulnerable counties, particularly Ventura County, \$361 million of annual production value would be at risk spanning 28,100 bearing acres (49%). As seen in Figures 1 and 2, over 95% of US lemon production occurs in southern California, with the remainder grown in Arizona (USDA-NASS 2022). While no HLB-positive citrus trees have been found in commercial groves in California, there have been two *CLas*-positive ACP found in commercial groves (CPDPP 2020; CPDPP 2022).

The establishment of ACP and the incidence of HLB in residential trees puts California’s lemon industry at a high risk, as *CLas*-positive ACP could easily migrate toward commercial groves and spread HLB there, although HLB quarantine areas and transport restrictions (tarping of transport vehicles) have been established. Additionally, as Arizona borders southern California, lemons grown there may also be susceptible to HLB. As shown in Table 1, 14.2 percent of the total production and

²https://maps.cdfa.ca.gov/WeeklyACPMaps/HLBWeb/HLB_Treatments.pdf

³<https://www.cdfa.ca.gov/citrus/docs/committee/2023/03082023SupportingMaterials.pdf>

⁴<https://www.ers.usda.gov/data-products/fruit-and-tree-nuts-data/data-by-commodity/>

⁵https://www.nass.usda.gov/Statistics_by_State/California/Publications/AgComm/index.php

15.8 percent of California’s lemon production value is found in counties that currently have at least one incidence of *CLas+* ACP (San Diego, Riverside). Based on the risk-survey assessment, coastal counties without such incidence (particularly Ventura, Santa Barbara and San Luis Obispo) face significant risk from HLB. These counties contain 35% of commercial lemon bearing acreage (20,170 acres) and generate approximately \$242 million in annual production value.

Figure 1: Fresh and processed lemons produced by state based on data from USDA NASS Quickstats (<https://quickstats.nass.usda.gov/>).

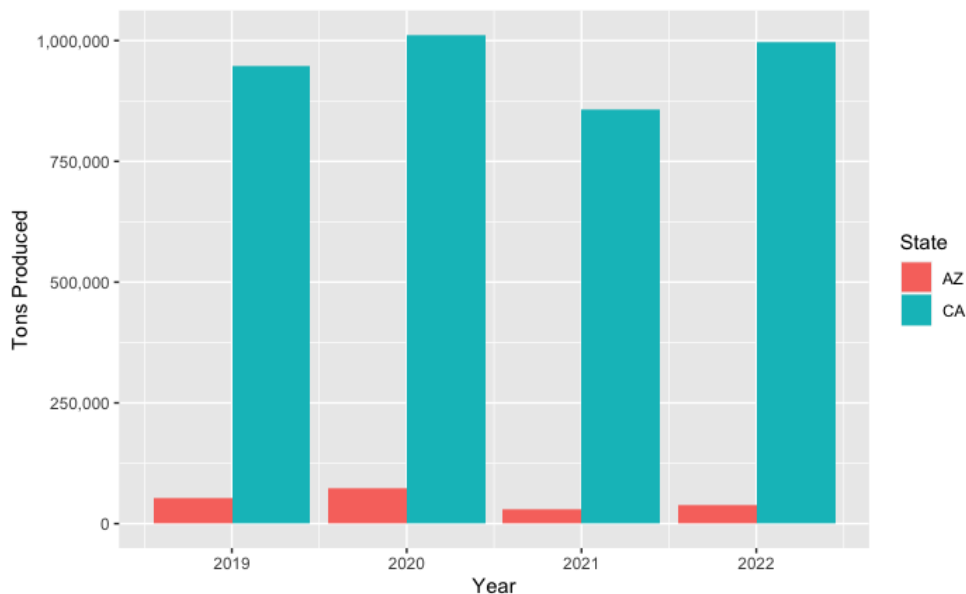
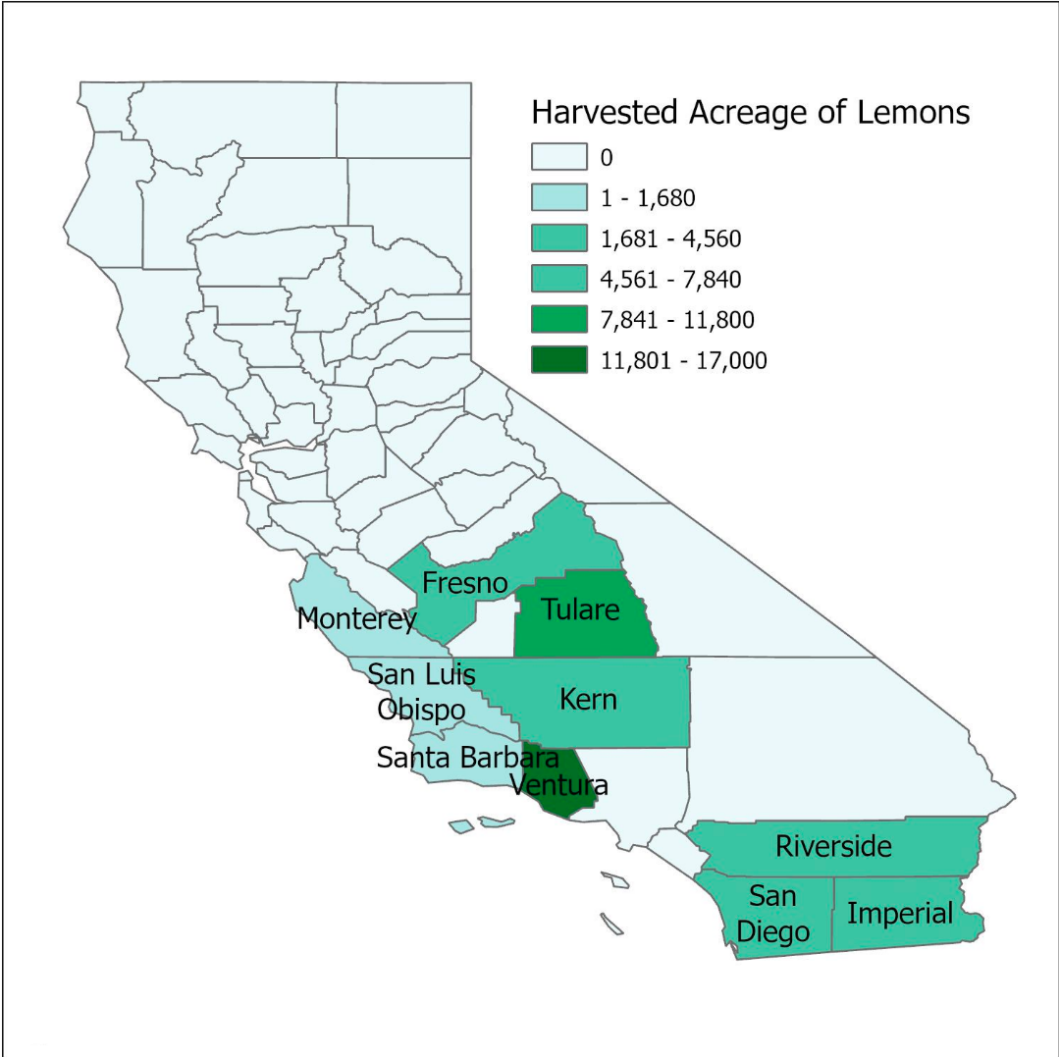


Table 1: Harvested acreage, production and total value of lemons in top ten California producing counties based on data from County Agricultural Commissioners’ Reports Crop Year 2019-2020 (https://www.nass.usda.gov/Statistics_by_State/California/Publications/AgComm/index.php).

County	Bearing Acres	Production (Tons)	Total Value (\$)
Ventura	17,000	342,000	216,190,000
Tulare	11,800	199,000	268,650,000
Riverside	7,840	71,700	65,891,000
Kern	4,560	87,400	96,007,000
Imperial	4,440	77,800	49,225,000
Fresno	3,920	80,300	79,497,000
San Diego	3,260	73,300	79,334,000
San Luis Obispo	1,680	28,800	16,803,000
Santa Barbara	1,490	25,200	9,333,000
Monterey	1,360	34,000	36,720,000
Total	57,350	1,019,500	917,650,000

Figure 2: Harvested acreage of lemons by California counties based on Data from County Agricultural Commissioners' Reports Crop Year 2019-2020 (https://www.nass.usda.gov/Statistics_by_State/California/Publications/AgComm/index.php).



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