Evidence-based criteria for reducing the delimitation radius around *C*las-positive trees in Southern California

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Summary: This report proposes that the delimitation radius for tree surveys around an HLB+ tree be reduced from 400m to 300m. This change is suggested based on the geographic distribution of all trees confirmed to be positive for huanglongbing ("HLB+") by March 2020, based on a methodology previously used by the CPDPC to make operational decisions. This will increase program efficiency and conserve valuable CDFA resources by applying them to areas most likely to contain infection. We suggest any labor saved from this change be redirected to other Committee priorities that will be necessary to understand the further spread of HLB, such as sampling specific sentinel trees over time and/or more closely monitoring dooryard/commercial border zones.

Background: In the summer of 2018, an analysis of CDFA survey data presented to the CPDPC by Dr. Tim Gottwald revealed that the majority of detectably diseased trees were within 350m of another diseased tree; at the time, the radius for surveying around an HLB+ tree was 800m. The CPDPC used this information as the primary scientific evidence to change the delimitation radius from 800m to 400m. This change has not been revisited since 2018, though several changes in spatial disease dynamics have occurred since then, and statewide resources dedicated to HLB management are best reviewed frequently to identify potential efficiency gains. There exists, therefore, both a scientific and economic need to revisit the current survey protocols to determine if they remain efficient and appropriate for the current spatial reality of HLB.

Evidence: The *cumulative distribution function with distance* is, simply put, a method to classify the proportion of observations as the distance between them increases. When applied to HLB+ trees, it can be used to determine the proportion of all positive trees in terms of the distance to their nearest positive neighbor. Using this methodology, 95% of all positive trees in Southern California were within 230m of another HLB+ tree, based on data available through March 13, 2020 (Figure 1); this number has stayed relatively stable for at least the last year.

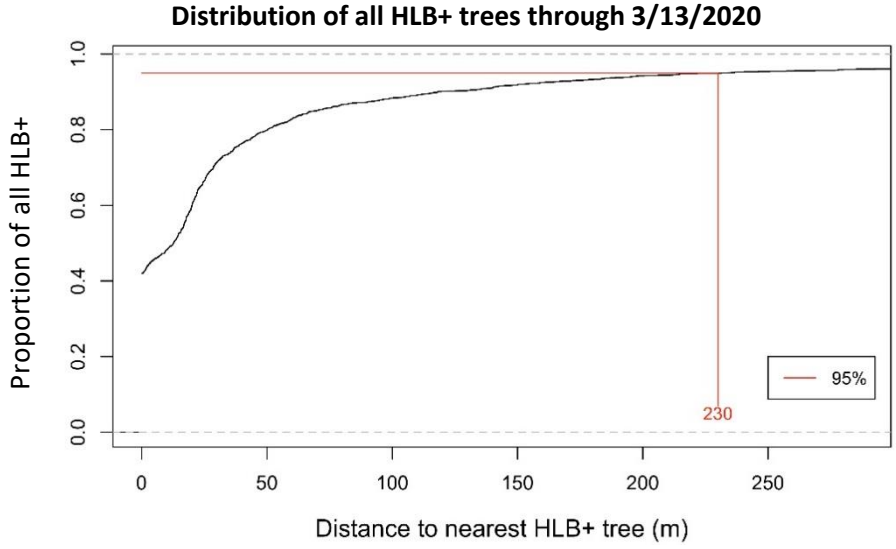

Figure 1: *The cumulative distribution function for all HLB+ trees detected in Southern California, indicating that 95% of trees are within 230 m of another HLB+ tree.*

To validate this conclusion and account for possible differences caused by coincidental date of detection of positive trees, the detection order of the HLB+ tree location data was randomized 500 times. For each of these new sequences of detections, the first 95% of the data were then reanalyzed (because 100% of the data would always produce the same cumulative distribution as the unrandomized data). This analysis allows us to examine whether we would come to the same conclusion about the spatial separation of infected trees if the sampling programs had happened to find the trees in a different order. The distance needed to find 95% of all positive trees stayed between 210 and 270m in all randomizations, and the maximum distance needed to detect 95% of HLB+ trees never exceeded 270m in all 500 randomized tests.

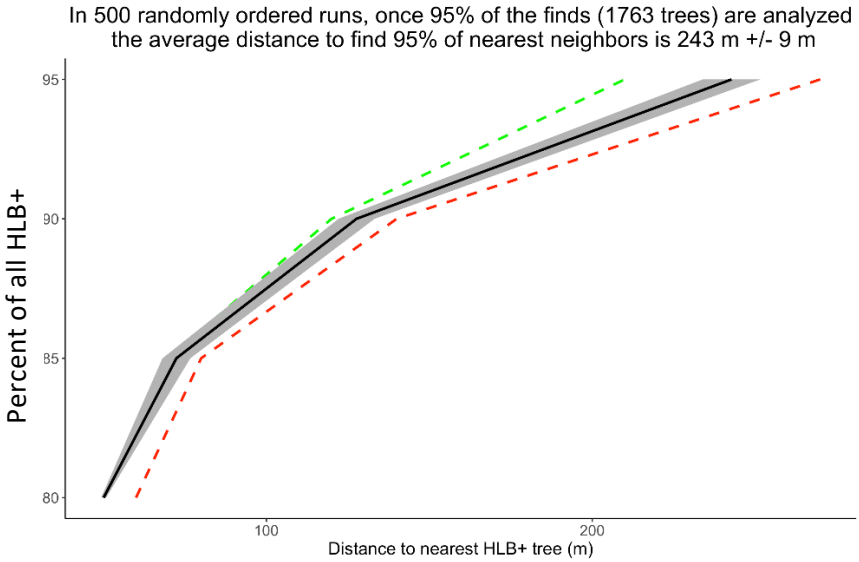

Figure 2: *The average radius around each HLB+ tree (black line) needed to encompass the indicated proportion of all HLB+ trees over 500 randomizations of the data, and the standard error (grey shading). Maximum and minimum distances produced from all randomizations are shown in green and red (respectively).*

Conclusions and Considerations: As in 2018, it appears that a case can be made to reduce the delimitation radius, in this case from 400 m to 300 m. If the committee wants to add a margin of comfort to the mathematical results, as was done previously, there is still a potential to reduce resource expenditure (Table 1). However, the Committee may want to consider the possibility that insecticide applications associated with delimitation may be contributing to locally reducing ACP populations around known sources of *C*Las, thereby helping to slow down disease spread. Unfortunately, there is currently almost no direct evidence available to quantitatively evaluate the question. Consequently, we recommend that the Committee consider the possibility of reducing the delimitation radius for tree survey and removal activities while concurrently maintaining a larger radius within which voluntary pesticide applications are continued.

Table 1. *The consequences of reducing the delimitation zone around HLB+ trees in terms of reduced area to cover (compared to 400m) and the percent of detected HLB+ trees for each radius.*

Radius (m)	Area ($km^{2)}$	Reduction in area/workload	Detected Infection
400	0.50	-	97.5%
350	0.39	23%	96.9%
300	0.28	44%	96.0%
270	0.23	54%	95.6%
250	0.18	61%	95%