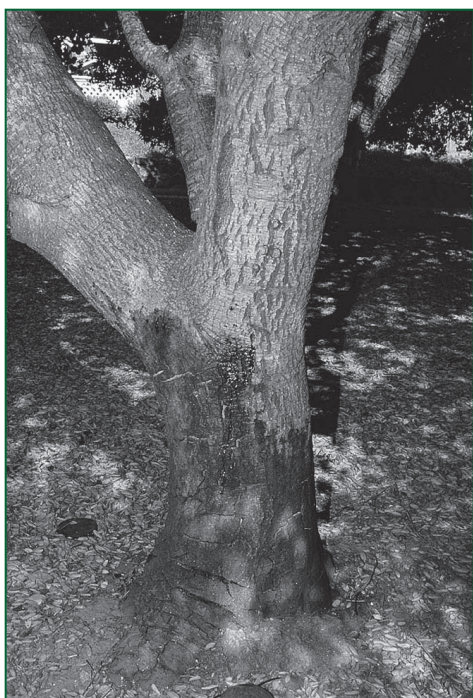


Estimating the Costs of Sudden Oak Death: Results of a Survey of California Nurseries

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Unique nursery-level survey data are used to quantify pest management costs for California firms impacted by *Phytophthora ramorum* (Sudden Oak Death). We find that nurseries have not shifted production away from host plants, but rather are incurring additional costs to limit their exposure. Despite widespread media attention, estimated management costs have actually been quite low—constituting less than three percent of annual production expenses.



Sudden Oak Death (SOD) forest disease, has led to the death of tens of thousands of oak trees in California and Oregon. The environmental impacts of SOD may be profound because of the critical role that oaks play in many coastal ecosystems.

Photo courtesy of UC Regents

Since 1995 an emergent fungus-like pathogen *Phytophthora ramorum*, the causal agent of the Sudden Oak Death (SOD) forest disease, has led to the death of tens of thousands of oak trees in California and Oregon (California Oak Mortality Task Force, <http://nature.berkeley.edu/comtf>). The environmental impacts of SOD may be profound because of the critical role that oaks play in many coastal ecosystems. However, control of *P. ramorum* in natural environments remains elusive. As a result, management costs in the wild, in the areas of tree removal, green-waste disposal, and fire-risk management, are ongoing and often difficult to empirically evaluate.

Recent publicity and regulatory policy have increasingly focused on management challenges that *P. ramorum* represents for the nursery industry. The pathogen can be spread naturally via rain-splash or wind-driven rain, and artificially via shipment of popular ornamental host plants such as rhododendron, camellia, and viburnum. Nursery shipping channels are perhaps the most likely means by which SOD could spread to areas outside of the western United States. Consequently, efforts to prevent the artificial spread are imposing new expenses on a high-value industry in a state where agricultural costs of production are already high.

To date, import restrictions on California nursery products have been avoided through the use of California Department of Food and Agriculture (CDFA)-endorsed SOD-compliance agreements, which legally obligate firms to maintain detailed tracking records and submit to frequent on-site inspection. In return, the agreement certifies the sale of host product that: (i) is produced within

a quarantined county (California counties that are under quarantine for SOD: Humboldt, Mendocino, Lake, Sonoma, Napa, Solano, Marin, Contra Costa, Alameda, San Francisco, San Mateo, Santa Clara, Santa Cruz, and Monterey) and transported/sold outside of a quarantined county, or (ii) is produced anywhere in California and transported/sold outside of the state.

At the nursery-level, a SOD infestation can have disastrous short- and long-run implications for financial viability. In response to the 2004 detection of *P. ramorum* at wholesale nurseries in Southern California, over one million nursery plants were destroyed and nursery imports from California were halted by several states. At the time, revenue losses due to extended import restrictions for California producers were estimated to be \$100 million. However, costs due to ongoing management and regulatory compliance efforts, as distinct from shocks associated with import restrictions (which were quickly lifted), have not been quantified.

In 2005 we collected original survey data to obtain the first quantitative estimates of the ongoing management costs that SOD-control regulation imposes on California nurseries. Our unique survey data include relevant nursery-level measures that were previously unavailable, and permit acute identification of SOD-control regulatory effects. Behavioral signals derived solely from Agricultural Census data are likely to be overly noisy because there is no way to separate SOD-host producers from non-producers. Thus, our analysis provides an accurate measure of the nursery-level burden imposed by the emergence of *P. ramorum*, a crucial component of the total social costs of SOD, and will help policy

Table 1: Reported Changes for the Feasible Set of Pest Management Actions: Results from a Survey of California Wholesale Nurseries, July 2004 to January 2005

Activity	Percent of all nurseries that reported changes as a result of SOD	Percent increase in average cost of activity
Inventory management	63	10
Fungicide use	40	16
Irrigation or water treatment	7	3
Treatment of cut greens	3	3
Soil management	13	3
Green waste disposal	13	34
Insurance	0	--
Percent of acres devoted to host product	0	--

makers determine appropriate research/prevention investments to combat the (perhaps) more significant costs associated with the artificial spread of *P. ramorum* to areas outside of the current zones of infestation.

In contrast to what may be expected from published reports, our analysis suggests that aggregate management costs, exclusive of those incurred due to infestation, have actually been low and are estimated to be less than three percent of annual production expenses. Thus, while the effects of *P. ramorum* on California’s environment may be profound, private costs to the nursery industry so far have been limited.

Original Survey of Nursery Firms

We developed a survey instrument using insights gained from several meetings with nursery industry professionals to collect nursery-level data for our analysis. These professionals included CDFAs scientists, nursery-sector lobbyists, University of California Cooperative Extension Specialists, and California nurserymen from several different types of nurseries. The survey questions included topical nursery characteristics (e.g., “how many acres are devoted to growing nursery products/host products?”) and cost structure (e.g., “has there been an increase in the cost of your fungicide program specifically

due to SOD?”). However, the survey did not request information on actual costs or profit levels, due to concerns about non-response. The survey instrument is available from the authors upon request.

A complete list of California producers of host product is not available, so we identified potential survey participants as licensed nursery wholesalers that produce coniferous evergreens, broad leaved evergreens, deciduous shade trees, deciduous shrubs, or rose plants. All host plants fall into one of these categories, but there are likely firms that produce these categories of products but not hosts. Unfortunately, we cannot identify these producers. We further restricted this sample to nurseries that are strictly wholesalers and operate on at least five acres of land. The CDFAs Plant Health and Pest Prevention Services online directory of California licensed nurserymen provided detailed location information for 255 nurseries that fit our search criteria, but not telephone numbers.

To contact nurseries, we compiled an initial list of telephone numbers using the Google search engine, which produced phone numbers for 142 nurseries. An additional 44 telephone numbers were obtained through various other channels, including conversations with nurserymen and nursery-sector lobbyists. In total, we gathered numbers for 186 (of the 255) potential survey

participants, and then began contacting them to determine if they produce host product. Ultimately, we spoke with managers at 112 firms, of which 68 produced host product since 2002—the year SOD regulation began. Among these host producers, 45 managers participated in our survey, 30 of whom completed an extended version which identified the feasible set of pest-management activities relating to SOD.

Actual SOD Control Expenditures

Table 1 summarizes responses from the 30 extended surveys and indicates that fungicide and inventory management are the most likely responses to SOD control. Few nurseries are investing in improved irrigation/water treatment, treatment of cut greens, soil management, or green waste disposal. They do not report expanding insurance coverage either. A few firms do report high green waste disposal costs, but these are likely a consequence of infestation and associated stock destruction, rather than *ex ante* investments.

An important insight from Table 1 is that nurseries in our sample have not significantly shifted production away from host plants, which implies that pest-management investments are the primary means of mitigating SOD exposure. This finding is not an artifact of our sampling methodology; we over-sampled large nurseries and nurseries that have entered into a SOD-compliance agreement, which are the types of nurseries that are most likely aware of the impact that continued host production will have on future profit streams. In our full sample of 45 nurseries, 22 percent of the nurseries are located in a quarantined county and 58 percent have signed a SOD-compliance agreement. While Table 1 shows that almost 40 percent of firms report no changes in inventory management costs and 60 percent of firms report no changes in fungicide use, the standard deviation for both variables

is about double the mean value, so investment levels are high for some nurseries.

Discussion

The survey data indicate that nurseries have not shifted production away from host product in order to limit their exposure to a *P. ramorum* infestation. Rather, they are actively investing in fungicide and inventory management by monitoring host plants and surrounding areas for symptoms of SOD, as well as maintaining accurate shipping documentation for the purpose of effective tracebacks and traceforwards (Table 1). These additional expenditures translate into modestly increased production expenses at the nursery level on average.

Simple econometric analysis (using techniques to account for the fact that some types of firms may have systematically been included in our sample data) indicates that these additional costs, while relatively small, are not borne equally across nurseries. Not surprisingly, growers of host product are incurring higher fungicide and, especially, inventory management costs. Higher costs are also being incurred by nurseries located in counties where SOD spreads through natural channels as well as via product shipment. In practice this means that the relatively large nurseries in California, which are located outside of the quarantined counties, are incurring disproportionately lower costs.

The estimated increase in ongoing pest-management costs for the average nursery under the current regulatory regime is about \$13,500 per year. In the event that all California counties are quarantined (“full-quarantine” regime), the estimated cost increase for the average nursery is \$29,500 per year, more than double the current impact. The reason for the large increase across regulatory scenarios is that nurseries in the current quarantined counties are, on average, smaller and have a lower

percentage of host product; thus, by moving to the full-quarantine regime, the average nursery located in an infested area is both larger and produces a higher percentage of host product, both of which have a positive effect on cost increases.

Total impact for the average nursery under the current regulatory regime is quite small compared to annual production expenses. In 2002, the average nursery spent \$528,000 in total production expenses (2002 California Census of Agriculture), which implies that total impact under the current regulatory regime is only a 2.6 percent increase in production expenses. Under the full quarantine regime, total impact is only a 5.6 percent increase in production expenses. However, it is important to point out that these cost changes are ongoing at the nursery level, meaning that the new level of cost for each nursery will be sustained indefinitely. Moreover, additional costs would be incurred in the event of an infestation as a result of product destruction and lost sales.

These relatively modest aggregate costs are likely a result of the regulatory regime adopted by the CDFA, which has been effective in preventing import restrictions and has passed a key cost of SOD monitoring on to taxpayers. Critically, the costs of testing for SOD and maintaining certification for California export sales, including both labor and laboratory analysis, are borne by the CDFA.

Conclusion

Nurseries are actively investing in inventory management and fungicide in order to limit their exposure to SOD. Our analysis shows that few nurseries are actively investing in other pest-management actions, and that nurseries have not significantly shifted production away from host plants. This implies that nurseries view the investment in pest-management actions as

the primary means of combating a *P. ramorum* infestation at this time.

We use original survey data to identify actions that nurseries are taking in response to SOD and provide the first quantitative estimates of the costs that SOD-control regulation imposes on the California nursery sector. Our analysis suggests that additional costs are not borne equally; rather, costs are higher for nurseries in quarantined areas. This suggests that the largest industry players are not bearing proportional cost increases since they are not located in the currently designated infestation zones. In addition, we find that, despite widespread media speculation, estimated costs are quite low as they represent less than three percent of annual production expenses under the current regulatory regime.

In conclusion, while the effects of *P. ramorum* on California’s environment are likely profound, private costs to the nursery industry have been limited. This finding is largely a result of the current policy regime, as state regulators are actively funding a portion of pest-management expenses (on-site testing) and have designed a credible certification scheme which effectively limits the probability of market closure.

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For more information, the authors recommend:

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