Robert Mondavi Institute
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The Costs of Pierce's Disease in the California Winegrape Industry

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1. Introduction

Pierce's Disease (PD), caused by a strain of the bacteria *Xylella fastidiosa (Xf),* was first reported in the 1880s. *Xylella* blocks the xylem, or water-conducting system of a grapevine, leading to vine death, usually between one and five years after the plant becomes diseased. This disease threatens an industry with a farm value of production exceeding $3 billion per year. It imposes significant annual costs on the industry through losses of vines and the cost of efforts to mitigate the damage. Further significant costs are borne by the broader community in providing public programs that aim to contain the problem and develop longer-term solutions, and by the citrus, nursery, and grape industries in complying with those programs.

Until recently, PD was regarded as just one of many chronic diseases in the winegrape industry, always present and occasionally worse than usual. This was so when the only insect vectors for the disease were native sharpshooters. Major concerns about PD grew after a devastating outbreak in the Temecula Valley in southern California in the late 1990s, spread by a new non-native vector, the glassy-winged sharpshooter (*Homalodisca vitripennis*, GWSS). In response to these concerns, extensive programs were created to manage PD/GWSS in southern California, and to prevent the spread of the GWSS into other areas, especially into the highly-valued Napa and Sonoma Valleys, but also the contiguous southern San Joaquin Valley from which a large share of the total volume of California wine is produced, along with table and raisin grapes.

Since the inception of these programs in the late 1990s, tens of millions dollars of public and private funds have been spent each year to prevent the spread of sharpshooters and PD, and mitigate its effects. In this paper, we quantify the costs of these efforts to prevent and contain the spread of PD/GWSS and the costs of losing vines to PD.

2. Pierce's Disease and its Vectors

PD has caused vine death almost from the very beginning of the wine industry in California, as discussed and documented by Olmstead and Rhode (2008).[1] In 1857 the Los Angeles Vineyard Society settled in the Santa Ana Valley with initial funds of $100,000. The settlement produced its first vintage in 1860, yielding about 2,000 gallons of wine. Production increased rapidly and attracted further investment and growth. By 1883, the region was home to fifty wineries, approximately 10,000 acres of vines, and annual production of about 1.2 million gallons of wine. Within a few years of 1883, however, most of the vines had inexplicably died. Farmers unsuccessfully tried altering their methods of farming, including spraying, dusting, and pruning to combat vine death. The disease spread to neighboring areas and contributed to the eventual demise of commercial grape culture in southern California.

In May 1889 the United States Department of Agriculture (USDA) dispatched Newton B. Pierce, to Santa Ana to determine the cause of vine death. After extensive research, in 1891 Pierce concluded that the disease was unknown, and that it was probably caused by a microorganism, for which a cure was not available. Pierce's conclusion closed investigations into the disease for almost 50 years.

The causal agent that mysteriously killed the grape vines in Santa Ana, presently referred to as Pierce's Disease, and its insect vectors were not identified until recently. It is now known that the bacterium *Xylella fastidiosa* causes PD, and is spread by a variety of leafhopper insects, called sharpshooters. Sharpshooters obtain nutrients by feeding on plant fluids in the water-conducting tissues of a plant (xylem). Their feeding alone does

[1] The discussion in this paragraph and the next draws extensively on Olmstead and Rhode (2008).

not usually inflict significant plant damage, although in some cases the sharpshooter feeding causes significant water loss in citrus trees. However, when a sharpshooter feeds on a PD-infected plant, the bacteria can become attached to its mouthparts. Over time, the bacteria colonize the insect's foregut, and can be spread to other plants as it feeds, thus vectoring PD (University of California Integrated Pest Management, 2008).

Several sharpshooters are native to California. Among these, the blue-green sharpshooter (*Graphocephala atropunctata*, BGSS) has been present in the Napa Valley for over 100 years. Riparian areas provide the main breeding habitat for BGSSs, although irrigated landscaped areas can also host breeding populations(Pierce's Disease/Riparian Habitat Workgroup, 2000). The BGSSs migrate out of riparian areas in the spring and into vineyards where they can vector PD. BGSSs have a limited flight range; they do not fly far from where they hatch (University of California Integrated Pest Management, 2008).[2]

The glassy-winged sharpshooter (*Homalodisca vitripennis*, GWSS) was inadvertently introduced to southern California in the early 1990s; its native habitat is in the southeastern United States and Northern Mexico ((Purcell and Almeida, 2010). It is likely that the insect first arrived in southern California as an egg mass in ornamental or agricultural plant foliage. The GWSS can live in many habitats, including agricultural crops, urban landscapes, native woodland, and riparian vegetation. The GWSS has a strong preference for citrus groves as a host; however specific hosts can vary

[2] Green sharpshooters and red-headed sharpshooters also pose a threat to California vineyards, but significantly less than the BGSS. Green sharpshooters prefer dairy pastures, permanent grasses, and continuously irrigated areas, and subsist mainly on watergrass, bermudagrass, Italian rye, perennial rye, and fescue. Red-headed sharpshooters almost exclusively breed and feed in areas where bermudagrass grows. Vineyards are incidental hosts of these two grass-feeding sharpshooters (University of California Integrated Pest Management, 2008).

significantly to include woody ornamentals (shrubs and trees), and annual and perennial herbaceous plants. The GWSS also has the ability to fly a quarter mile or more without stopping, making it a highly mobile threat. In southern California and the San Joaquin Valley, the GWSS has at least two generations per year (University of California Integrated Pest Management, 2008).

3. Regional Profiles of Winegrape Production and Pierce's Disease

California production of grapes of all types was valued at approximately $3.2 billion in 2010, of which winegrapes accounted for nearly $2.1 billion or 74% of the total (California Department of Food and Agriculture, 2010a). In this study, we focus on the impact of PD on the winegrape industry, which accounts for the majority of grape acreage and value in California (Table 1) and an even greater share of the costs of PD.

California's winegrape production is regionally diverse, with substantial variation in the cultural methods used, yield per acre, and value per ton, and variation also in the susceptibility of the vineyard to damage from PD and the prevalence of different species of sharpshooters. Reflecting this diversity, data on winegrape production are available for a total of 17 crush districts. For the purposes of the present analysis, we have divided California into six distinct regions that differ in terms of economic aspects of winegrape production and susceptibility to PD. These regions are described in Table 1 and Figure 1. Regional details on the value of production of winegrapes, average price, yield, and bearing acres are given in Table 2.

a. Southern California

Southern California is the smallest producing region: in 2010, it accounted for less than 1 percent of crush value and volume ($4.74 million and 4,000 tons), but it has been a hot spot for PD and the GWSS since 1999. In 1999 vineyards in the Temecula Valley, in Riverside County, began suffering great losses from PD after the non-native GWSS had entered the area and began vectoring the disease with devastating speed. By the end of August 1999, over 300 acres of grapevines had Pierce's Disease, and by 2002 the statewide vineyard acreage lost to PD exceeded 1,100 acres (California Department of Agriculture, 2009).

The GWSS is a highly mobile and adaptable threat to the grape industry. Its rapid population growth in the winter substantially increases the ability of the GWSS to vector PD in vineyards (University of California Integrated Pest Management, 2008). Although efforts to limit the size of the GWSS population in Temecula and mitigate its effects have been largely successful in many ways, the GWSS still remains a major threat in the eyes of many vineyard owners and policymakers.[3] The GWSS exists in other parts of southern California, but has not become well established except in Temecula.

b. Napa-Sonoma

In 2010 the Napa-Sonoma region produced approximately 10 percent of total crush volume but 35 percent of total value of California winegrapes (National Agricultural Statistics Service, 2011). PD, vectored by the BGSS, causes significant chronic losses in this region, especially in vineyards adjacent to riparian areas where the

[3] Conversely, some stakeholders in the area say they are not as concerned with the threat, given that effective materials (such as Imidicloprid) are available to prevent population growth and spread. What is less clear is whether these individuals would become more concerned if the current program were withdrawn under which the government arranges for Imidacloprid to be applied in neighboring citrus groves, and pays for the cost of doing so.

BGSS does most of its feeding; here, effective pesticides are lacking because of the regional climate and dominant soil types. Some growers have undertaken extensive riparian revegetation efforts to remove host plants (often non-native) of the BGSS and replace them with native non-host plants, but this process is quite costly and complicated. Extensive programs have been established to prevent the spread of the GWSS into northern California vineyards.

c. Coastal

The other Coastal Valleys together comprise the second-largest winegrape region in California, producing about 18 percent of total volume, and 28 percent of crush revenue in 2010. This has been the fastest growing winegrape region in California over the past 10 to 15 years, with acreage nearly doubling from 66,000 acres in 1997 to 125,000 acres in 2010 (National Agricultural Statistics Service, 1995–2012). PD is present in these areas, but with very low prevalence. Presently, native sharpshooters such as the Blue-Green and Willow Sharpshooters are the primary vectors of PD. Small hotspots of PD exist in parts of San Luis Obispo, Santa Barbara, Ventura, and Mendocino counties, but the damage has not been extensive enough to warrant taking precautionary measures to stop PD spread. Growers tend to avoid planting vineyards in the hotspots.

d. San Joaquin Valley South

In 2010, the southern portion of the San Joaquin Valley produced approximately half of California's wine crush volume, and about 22 percent of the wine crush value. In addition to winegrapes, the Southern San Joaquin Valley produces nearly all of California's raisin and table grapes. PD pressure in the Southern San Joaquin Valley is not as severe as in either the Napa Valley or Temecula. Nevertheless, great measures are being undertaken to prevent PD outbreaks in the area and to prevent the northward migration of the GWSS, particularly in view of the close proximity to Temecula with its abundant GWSS population.

d. San Joaquin Valley North

In 2010, the Northern portion of the San Joaquin Valley produced about 20 percent of crush volume, 14 percent of California's winegrape crush value. Here, PD pressure is relatively low, partly because of the programs and policy that have worked to prevent the northward migration of the GWSS.

e. Northern California

Northern California and the Sierra Foothills account for a small share of California winegrape production—about 2 percent of the total crush volume and about 1.6 percent of the total crush value. The region has had minor instances of PD and no cases of GWSS. It is widely held that GWSS would not sustain a population over the winter because of the cold temperatures.

4. Programs

Since the PD/GWSS outbreak in Temecula in 1999-2000, several programs have been initiated to help prevent the spread of GWSS and mitigate losses to PD in California.

a. Research

In 2006 the University of California Pierce's Disease Research Grants Program was established with funding from the USDA Cooperative State Research, Education, and Extension Service, to allocate funds to research aimed at preventing the spread of PD and GWSS. Each year the federal government has allocated $1–2 million to the UC PD Research Grants Program for research. Total spending under this program in FY 2009-10 was $1.86 million but since 2010-11, funding has ceased.

b. Pierce's Disease Control Program

The largest and most influential PD-related program in California is the Pierce's Disease Control Program (PDCP). It is a partnership that includes the California Department of Food and Agriculture (CDFA), county agricultural commissioners, the USDA, the University of California and California State Universities, other state and local agencies, industry, and agricultural organizations throughout California. The program aims to slow or stop the spread of GWSS while other short- and long-term solutions to PD are developed. In FY 2009-10, the PDCP spent approximately $18.6 million on efforts to prevent the spread of GWSS from infested to non-infested areas, surveying and detection, response to outbreaks or GWSS infestations, and outreach.

c. Local Government and Private Efforts

Napa County funds activities for prevention of PD, as well as other diseases and pests, in conjunction with the Napa County Winegrape and Disease Control District Board. Vineyard growers in Napa County are required to pay an assessment (of $8.22 per acre in FY 2010-11—Napa County Agricultural Commissioner's Office, 2010), which Napa County is required by law to match. The funds acquired are applied to inspection, detection, and prevention of and education about PD and GWSS, as well as detection and control of the Vine Mealybug (Napa County, 2009). In FY 2009-10, Napa County collected approximately $193,000 using this assessment.

In addition, in October 2001, the PD/GWSS Board was established, as a result of the California winegrape industry lobbying for the self-assessment to fast-track research efforts. The Board established a Statewide Winegrape Assessment (SWA), ranging from $0.75 per $1,000 to $3 per $1,000 of harvested winegrape value, which supports research (California Department of Food and Agriculture, 2010). In FY 2009-10, the Board collected $2.8 million using the SWA.

d. Regulatory Programs

The CDFA collaborated with nursery and grape industry members to establish the Nursery Stock Approved Treatment Protocol (NSATP), applied to shipments of nursery stock from infested areas to non-infested areas in California. A nursery in an infested area must comply with several steps.

5. Costs Associated with the Pierce's Disease Programs

Since 1999, when PD became a major problem for the greater Temecula area, through 2010, a combination of industry, federal, state and local governments have spent nearly $544 million dollars on PD/GWSS programs (Table 3). In FY 2009-10 the total government cost was just over $34 million, of which $30.1 million was federal, $3.7 million was state and $193,000 was local government expenditures (California Department of Food and Agriculture, 2010b). Figure 2 summarizes government expenditure and its allocation for Pierce's Disease, and Figure 3 summarizes privately funded expenditure and its allocation. In what follows we describe the details of these expenditures, as well as costs incurred by industry in compliance with the PDCP and by growers through the losses of vines to PD.

a. Federal Government Funding

Between 2000 and 2010, the federal government has contributed approximately $303 million, or 74% of the total funding for PD-related programs. In FY 2009-10, the federal government spent approximately $30 million on PD-related programs (Figure 2). APHIS received approximately $23 million and allocated the funds as follows: $13.7 million to the CDFA PDCP, $1.57 million to the Texas PD Program, $410,000 to the USDA California and Western Regions (supports PD programs outside California), and a combined total of $2.4 million to Kern, Tulare, Riverside, and Fresno Counties, and the balance of $5 million supported APHIS overhead expenses. The Agricultural Research Service (ARS) and NIFA received approximately $7.1 million. The UC PD Research Grants Program received $1.86 million, and the balance of $5.28 million funded USDA ARS programs and overhead expenses (Al-Khatib, 2011).[4]

b. State and Local Government Funding

Between 1999 (i.e., since the Temecula PD outbreak) through 2010, state and local governments have contributed funds of nearly $65 million, or 16% of the total funding, for PD-related and programs. In FY 2009-10, the CDFA contributed approximately $3.7 million to the PDCP, which had total funding of nearly $18.6 million of which it spent $6.2 million on expenses, and $12.1 million on county payments (California Department of Food and Agriculture, 2010b).[5] These two components support the program's four main elements: containment, survey and detection, rapid

[4] The UC PD Research Grants Program manages research proposal submissions, reviews processes, and allocates funds to projects, with an ad-hoc panel that determines which projects will be funded. In 2009-10 the Program spent approximately $1.76 million on research projects. The balance of funding, approximately $105,000, was spent on general overhead and management costs, which included salaries, benefits, supplies and travel expenses to the Annual PD Research Symposium.

[5] Industry funding accounted for a very small share of the PDCP, approximately $160,000, which equates to less than 1 percent of total program funding.

response, and outreach. The state of California also contributes in-kind services (e.g., scientific consultation, promulgation of regulations, environmental compliance, pesticide registrations, diagnostics, legal review, mapping, and so on) worth $250,000 annually to program operations and $24,000 to research (Table 3). Napa County takes additional precautionary measures to combat GWSS and PD using funds acquired from the state and a countywide assessment fee, as well as county funds. In 2009-10 the county matched the assessment of $193,378, which was spent on local inspection, detection, prevention and education of PD, GWSS, and the vine mealybug (California Department of Food and Agriculture, 2010b).

c. Industry Funding

The California grape industry contributed approximately $41 million, or 10% of direct funding for PD activities between 1999 and 2010 (Table 3), mostly through the PD/GWSS Board. Between 2001 and 2010, the CDFA PD/GWSS Board collected approximately $37.3 million, of which it spent approximately $21 million on 106 research projects and four field trials, as well as another $2 million on reviewing and guidance of research efforts (California Department of Food and Agriculture, 2010c).

The annual amounts have varied. In FY 2009-10, the industry contributed approximately $3.1 million, sourced and allocated as shown in Figure 3. In FY 2009-10 the Statewide Winegrape Assessment (SWA) raised over $2.8 million for research and related activities (see Figure 3). Napa County charges an assessment in addition to the SWA. The fee presently covers preventive measures for a multitude of insects in the Napa Valley, but specifically, contributed $179,727 FY 2009-10 to the prevention of PD (see Figure 3). Similarly, table grape growers are charged an assessment. The

Consolidated Central Valley Table Grape and Pest Disease Control District manages the funds acquired by the assessment. In FY 2009-10, the table grape assessment collected approximately $735,000. Of the total assessment, the Consolidated Central Valley Table Grape and Pest Disease Control District contributed about 15% (or approximately $119,000) to GWSS- or PD-related projects (Stewart-Leslie, 2011), allocated as shown in Figure 3.

d. Other Contributions

In-kind services, such as the participation by state employees on state and local task forces, and boards (including costs of transportation, consultation, benefits, overhead expenses, and insurance), contributed an estimated $524,000 annually (Table 3), with approximately half of that amount coming from state sources and the rest coming from a combination of the University of California and industry (California Department of Food and Agriculture, 2010b).

e. Nursery Compliance Costs

Approximately 70% of California's 12,000 licensed nurseries are located in GWSS-infested areas and those that choose to ship from infested to non-infested areas are required to take certain precautions to avoid the spread of the GWSS. Complying with CDFA-approved shipping protocols can be very expensive for nursery operators. Many nurseries have adapted their businesses to save on the costs of having to comply with shipping protocols when shipping from infested to non-infested areas. Some nurseries have opened facilities in non-infested areas while others have minimized, if not eliminated, all shipping to non-infested areas.

Our cost estimates reflect explicit costs borne by the industry for those nurseries that comply with the NSATP, those that are located in infested areas, and those that are in infested areas but are declared “free-from.” Our estimates do not include foregone business, nor expenses incurred in changing business models to comply with the approved treatment protocol.[6] We estimated costs using information available from limited sources and extrapolated to the whole industry, which is diverse and fragmented. Specifically, using data on costs provided to us by a small number of nurseries that comply with the NSATP, combined with informal advice on the likely range of costs for other nurseries, we were able to estimate a compliance cost to the nursery industry as a whole of approximately $6.8 million in 2010 (Table 3).

Since the implementation of the Nursery Stock Approved Treatment Protocol and Glassy-Winged Sharpshooter Nursery Shipping Protocol in 2003, and modifications in 2008, shipments with GWSSs detected dropped from 149 in 2001 (57,600 total shipments) to 6 in 2010 (50,600 total shipments). Of the shipments with GWSSs, over 90% of the rejections were for the presence of egg masses.

In very rare instances, a nursery may choose not to comply with CAC protocol. This will result in a notice of proposed action (NOPA). After receiving a NOPA, a nursery may be subject to a fine—typically less than $1,000, but potentially much higher (Morris, 2010).

f. Citrus Compliance

As a winter breeding ground for the GWSSs, citrus groves play an important role in determining GWSS population sizes. The CDFA estimates that the California citrus industry spends approximately $3.5 million annually on programs and activities to mitigate the spread of the GWSS (California Department of Food and Agriculture,

[6] Examples may include changing product mix, additional management costs, and lost orders because of problems with scheduling inspections.

2010b). The citrus industry has improved its effectiveness in containing the spread of the GWSS through programs funded and established by the CDFA. As a result of the programs, the acreage of citrus treated for GWSSs has declined substantially. In 2003 Kern County treated just over 20,000 acres and Tulare County treated nearly 40,000 acres. In 2009, Kern County treated nearly 5,000 acres and Tulare County treated about 9,500 acres.

6. Costs Borne by Growers: The Value of Vines Lost to Pierce's Disease

California grape growers bear the greatest cost from Pierce's Disease. We estimate that an average of $56.3 million is lost each year because vines die from PD. This value is a lower-bound estimate of total cost because it does not include costs of preventive measures taken by growers against sharpshooters, including revegetation of riparian areas and pesticide use, or losses from land left idle. This section describes our estimates of costs incurred by growers as a result of vines dying from Pierce's Disease.

Table 4 presents a sample calculation for District 4 of costs from loss of vines to PD. If a vine contracts Pierce's Disease in Year 0, we assume it is removed and replanted in the following year (Year 1). We utilized UC Davis Cost and Return Studies for information on the costs of establishing a new vineyard; column (1) gives establishment costs for each year before the vine becomes commercially bearing, which include costs of stump removal, planting the new vine, pruning, and training. Year 1 has the highest per-vine establishment costs because that is when the new vine itself must be purchased and planted. Column (2) gives the yield of the new vine, until it reaches its maximum in year 5.[7] Operating costs begin in year 3, once the vine becomes commercially bearing; these include costs of pruning, application of fertilizer and pesticides, and harvesting. The net revenue per acre (column 4) is the average price per ton of grapes crushed multiplied by yield in tons per acre, minus operating costs. We calculated the gross revenue per ton of winegrapes as the volume-weighted average revenue per ton across all varieties in 2010, for a given crush district. Column (5), the net revenue per vine, is the result of dividing column 4 by 1,555, the number of vines per acre for District 4. Column (6) gives the foregone net revenue per acre—i.e., the revenue that would have been received if all vines were healthy—the maximum yield per acre multiplied by the price per ton, minus operating costs. Column (7) translates these costs into their per-vine equivalent by dividing (6) by 1,555. Column (8), the value of the net loss per vine that is removed because of PD in a given year, is the forgone net revenue from a mature vine in column (7) plus the establishment costs per vine, minus the net revenue once vines become bearing. Lastly, column (9) gives the value of the loss per vine over time discounted to the present using a 5% real discount rate, and the total cost is the sum of the discounted annual losses per vine.

Table 5 shows the bearing acreage and corresponding costs to growers of wine, raisin and table grapes, by region, over a range of incidence of Pierce's Disease, for which the most-likely estimates imply an annual loss of $56.3 million by California grape growers. We utilized expert opinion to define the range and most likely PD incidence rates since hard data are not available; the value of lost vines ranges from $14 million (low PD incidence) to $165 million (high PD incidence) per year. The largest share of

[7] For the other districts and varieties, the maximum yield is achieved between years 4 and 7. In District 4, the yield in year 4 was estimated as the average yield between year 3 and year 5 because year-4 yield was not explicitly stated in the Cost and Returns studies.

losses comes from winegrapes, followed by table and then raisin grapes. Of the winegrape regions, Napa-Sonoma (Districts 3 and 4) is the hardest hit, losing an estimated $33 million per year, making up more than half of the total losses to growers.

Table 6 shows district-specific losses. District 4 (Napa County) has the highest annual losses, at over $22 million, because it has a relatively high rate of Pierce's Disease (0.75 percent) and the highest average price for grapes in the state, such that the opportunity cost of losses is higher than other areas. The same is true, but to a lesser extent, for District 3 (Sonoma and Marin Counties).

6. Conclusion

Aggregating the costs of vine losses and industry assessments paid by grape growers, compliance costs for nursery owners and citrus growers, and expenditures by government entities, the estimated cost of PD in California is approximately $105 million per year. The total cost comprises (1) $48.2 million in funded Pierce's Disease activities undertaken by various government agencies, the nursery and citrus industries, and the University of California system, as shown in Table 3, and (2) $56.3 million in costs of lost production and vine replacement, borne by grape growers, as shown in Table 5. These figures do not include any of the substantial cost of preventive measures against the spread of GWSSs and BGSSs within vineyards undertaken by growers, and thus can be considered a lower bound for total PD costs.[8]

[8] A more complete examination of the costs of the disease to growers would include costs of preventive measures, but techniques vary greatly and the costs are not easily quantifiable. In the North Coast, prevention techniques include various forms of riparian revegetation, green fencing, and pesticide application, while in southern California, insecticide application is by far the most common and effective tool in controlling populations.

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Figure 1: Map of California Winegrape Production Regions

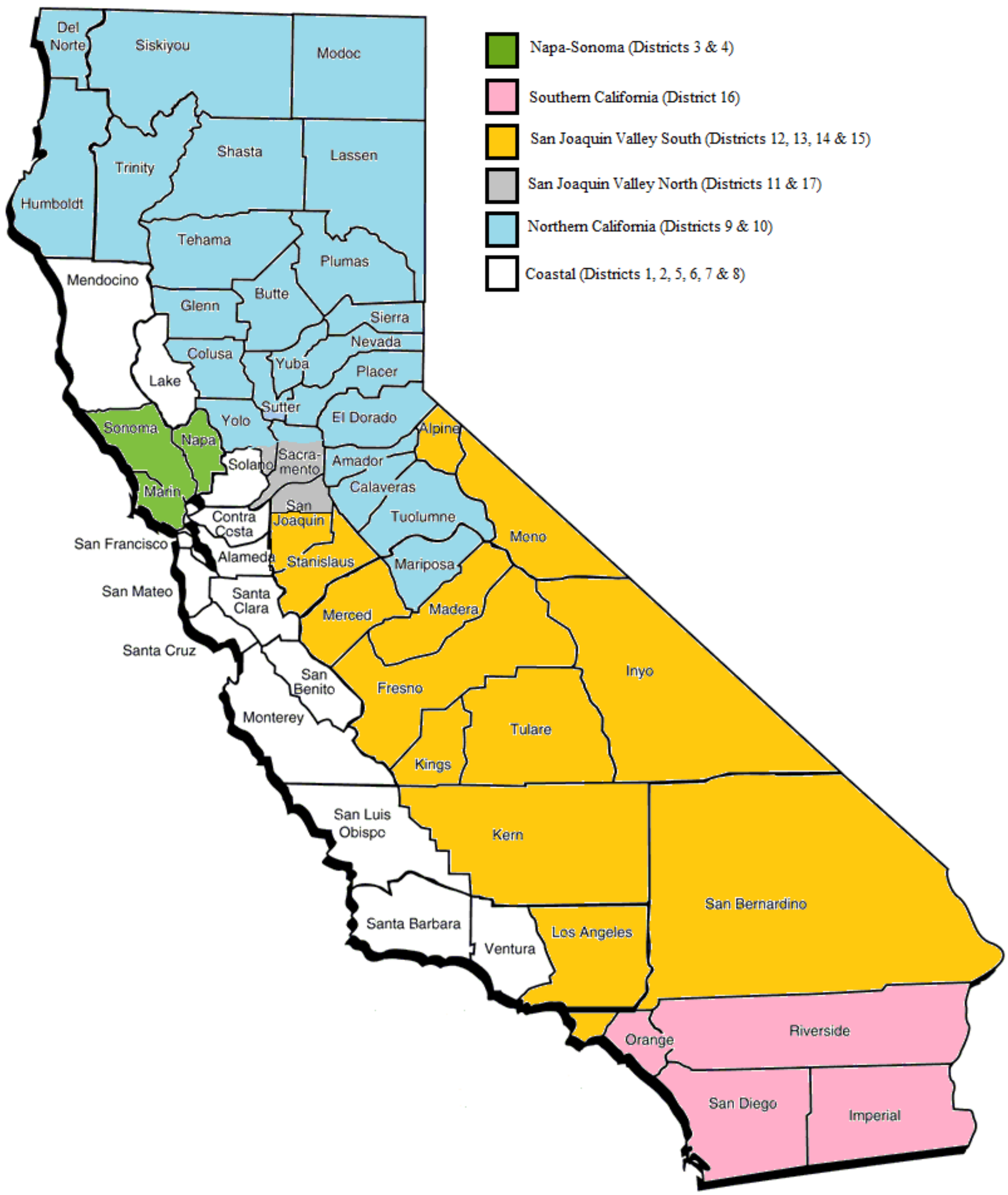
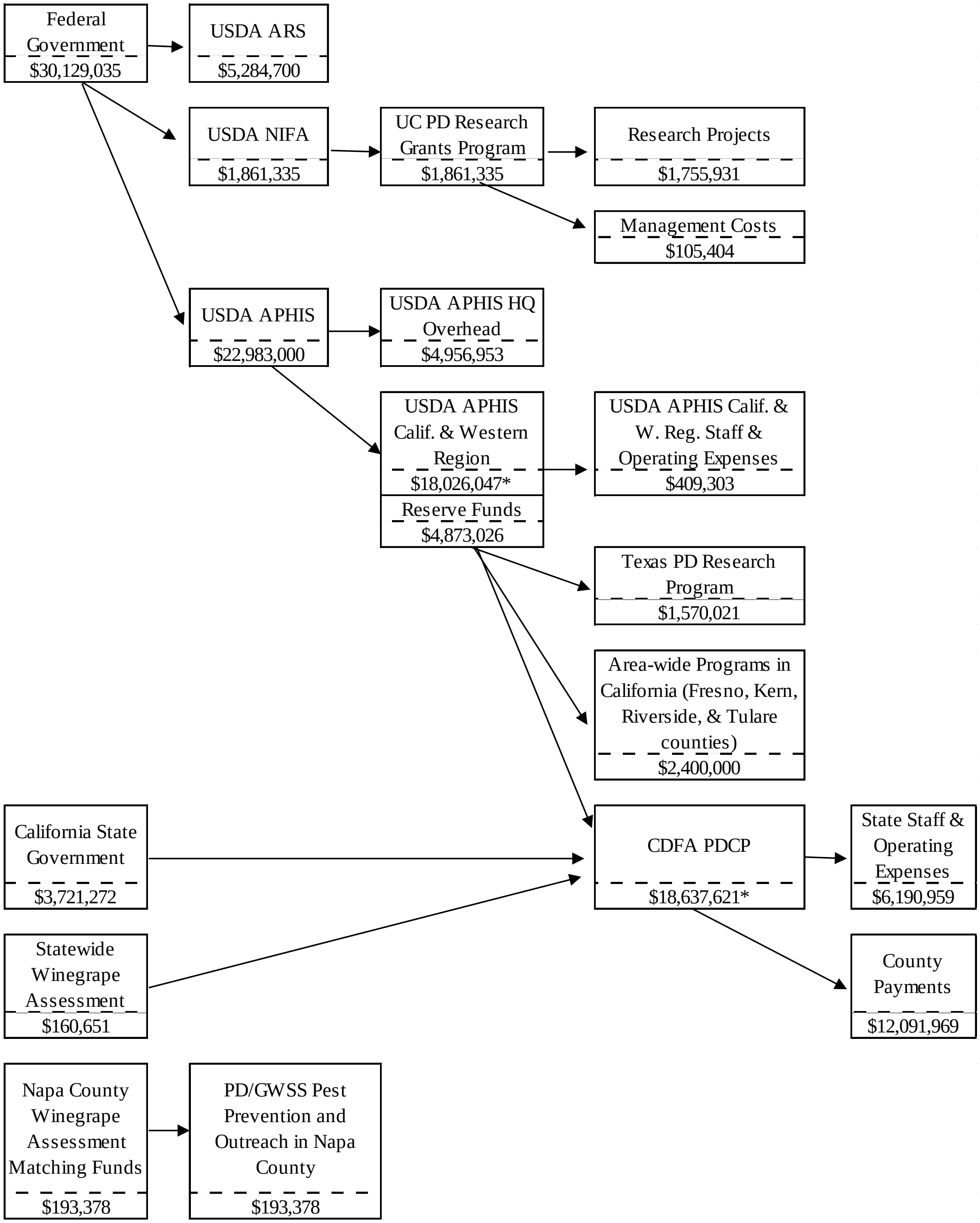


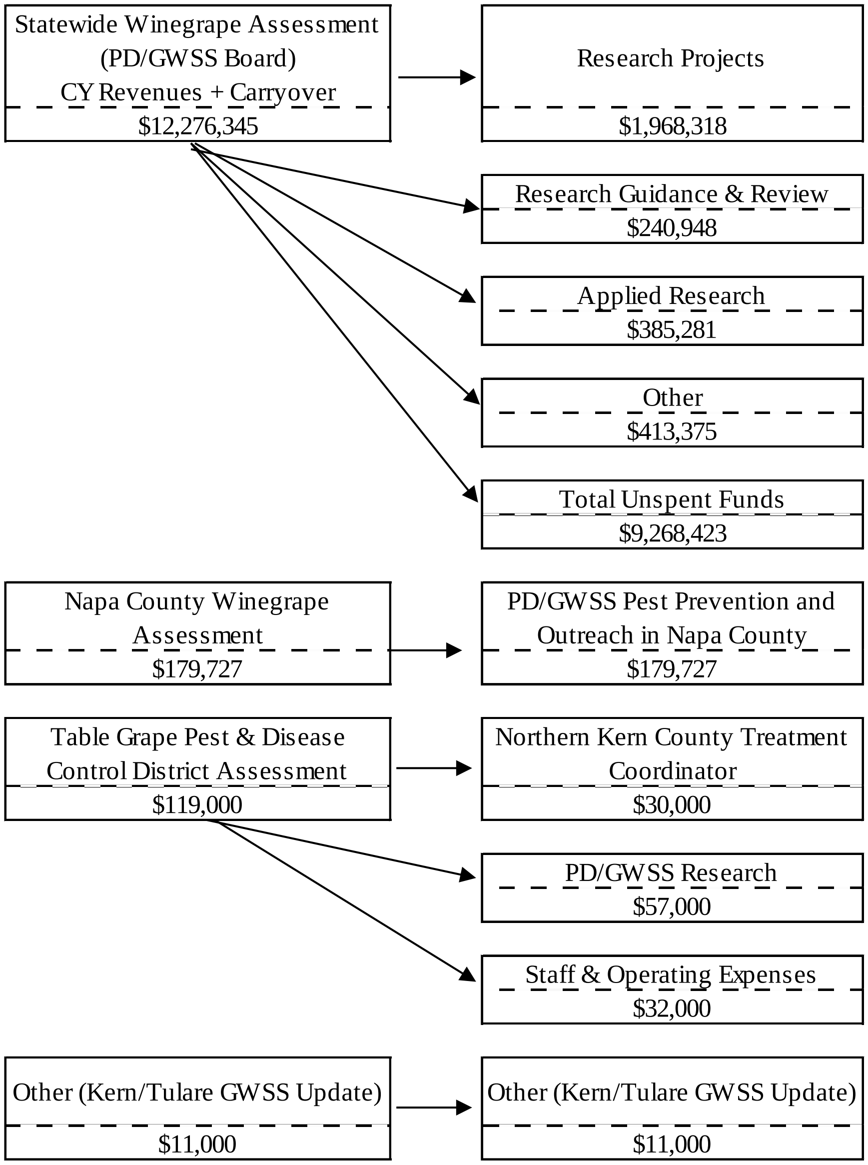
Figure 2. State and Federal Funding for PD Related Programs and Expenditures, 2009-10



Notes:
* Funding amount has a surplus or deficit value, resulting in funding not equaling the expenditure value.
All other values may have a surplus or deficit value, not presented in the figure.

Source: Developed by the authors using data from the CDFA PDCP, PD/GWSS Board and UC PD Research Grants Program.

Figure 3. Industry-Funded PD Related Programs and Expenditures, 2009-10



Notes:
Values may have a surplus or deficit value, not presented in the figure.

Source: Developed by the authors using data from the CDFA PDCP, PD/GWSS Board and Table Grape Pest& Disease Control District

Table 1. Definition of Winegrape Production Regions

Region	Crush Districts	Counties
Napa-Sonoma	3 & 4	Sonoma, Marin and Napa
Coastal	1, 2, 5, 6, 7 & 8	Mendocino, Lake, Solano, Alameda, Contra Costa, Santa Clara, San Francisco, San Mateo, Santa Cruz, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties
San Joaquin Valley North	11 & 17	San Joaquin (N. of HWY 4), Yolo (S. of I-80 from Solano County line to Junction of I-80 and HWY-50 and S. of HWY-50), and Sacramento (S. of HWY-50) Counties
San Joaquin Valley South	12, 13, 14 & 15	San Joaquin (S. of HWY 4), Stanislaus, Merced, Madera, Fresno, Alpine, Mono, Inyo, Kings, Tulare, and Kings Counties
Southern California	16	Orange, Riverside, San Diego, and Imperial Counties
Northern California	9 & 10	Yolo (N. of I-80 from Solano County line to Junction of I-80 and HWY-50 and N. of HWY-50), Sacramento (N. of HWY-50), Del Norte, Siskiyou, Modoc, Humboldt, Trinity, Shasta, Lassen, Tehama, Plumas, Glenn, Butte, Colusa, Sutter, Yuba, Sierra, Nevada, Placer, El Dorado, Amador, Calaveras, Tuolumne, and Mariposa Counties

Table 2. Details of Winegrape Production, by Region, 2010

Production Region	Value of Production	Weighted Average Price	Total Crush Volume	Bearing Area
	2010 $ (millions)	*2010 $/ton*	*Tons (thousands)*	*Acres*
Napa-Sonoma (Districts 3 & 4)	835	2526	331	100,424
Coastal (Districts 1, 2, 5, 6, 7 & 8)	670	1031	650	124,817
San Joaquin Valley North (11 & 17)	336	477	705	84,530
San Joaquin Valley South (Districts 12, 13, 14 & 15)	531	290	1,833	132,861
Southern California (District 16)	5	1192	4	1,012
Northern California (Districts 9 & 10)	39	588	66	13,274
Grand Total	**2416**	**673**	**3,589**	**456,918**

Table 3. Funding for Pierce's Disease Activities, by California State Fiscal Year, 1999-2000 to 2009-2010

Fiscal Year	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	Total
							$ '000					
Federal Government Funding												
USDA APHIS Funds for Temecula	360	-	-	-	-	-	-	-	-	-	-	360
USDA Allocation for APHIS & CDFA	-	-	8,500	17,500	22,119	23,003	24,079	24,079	23,013	23,175	22,983	188,451
CCC Emergency Funds	22,289	-	8,714	8,770	5,182	-	-	-	-	-	-	44,955
USDA ARS & CSREES Funds for Research	100	2,700	5,473	6,389	7,180	7,218	7,328	5,285	6,805	6,712	7,146	62,337
Grapevine Loss Assistance Program	-	7,140	-	-	-	-	-	-	-	-	-	7,140
Total	22,749	9,840	22,687	32,659	34,481	30,221	31,407	29,364	29,818	29,887	30,129	303,243
State and Local Government Funding												
AB 1232 Funds for Research	750	750	750	-	-	-	-	-	-	-	-	2,250
SB 671 Allocation	6,900	-	-	-	-	-	-	-	-	-	-	6,900
State Budget Act	-	6,900	8,288	6,401	6,408	4,408	4,341	4,500	4,549	4,089	3,721	53,605
UCR Greenhouse	-	-	375	-	-	-	-	-	-	-	-	375
City of Temecula	125	-	-	-	-	-	-	-	-	-	-	125
Riverside County	125	-	-	-	-	-	-	-	-	-	-	125
Napa County*	-	-	-	180	165	150	78	180	110	190	193	1,246
Total	7,900	7,650	9,413	6,581	6,573	4,558	4,419	4,680	4,659	4,279	3,915	64,626
Industry												
AVF Funds to Match AB 1232	250	250	250	-	-	-	-	-	-	-	-	750
Statewide Winegrape Ass*	-	-	6,163	3,927	3,777	4,109	5,593	4,945	3,539	2,411	2,815	37,278
Napa Cty Winegrape Ass*	-	-	-	180	165	150	78	180	110	190	193	1,246
Table Grape Pest Control District(s)***	-	-	-	-	-	-	399	440	448	480	119	1,886
Other	-	-	-	-	9	11	11	11	-	-	-	42
Total	250	250	6,413	4,107	3,950	4,270	6,081	5,576	4,097	3,082	3,127	41,202
Direct Funding Total	30,899	17,740	38,513	43,346	45,004	39,050	41,907	39,619	38,574	37,248	37,171	409,071

Table 3, cont'd

Fiscal Year	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	Total
							$ '000					
In-Kind Services												
State Program Operations	250	250	250	250	250	250	250	250	250	250	250	2,750
State Research	24	24	24	24	24	24	24	24	24	24	24	264
Total	274	274	274	274	274	274	274	274	274	274	274	3,014
Compliance Costs												
Nursery Industry	4,000	7,800	8,900	8,800	10,400	9,800	9,300	9,900	8,400	7,200	6,800	91,300
Citrus Industry	-	1,175	2,350	3,525	3,525	3,525	3,525	3,525	3,525	3,525	3,525	31,725
Grape Industry	-	605	605	605	605	605	300	100	-	-	-	3,425
Total	4,000	9,580	11,855	12,930	14,530	13,930	13,125	13,525	11,925	10,725	10,325	126,450
Other Contributions												
Industry & UC Participation on State Task Forces, Boards, etc.	150	210	210	210	210	210	210	210	210	210	210	2,250
Industry & UC Participation on Local Task Forces	50	68	68	68	34	34	34	34	34	34	34	489
UC In-Kind	250	250	250	250	250	250	250	250	250	250	250	2,750
Total	450	528	528	528	494	494	494	494	494	494	494	5,489
In-Kind Funding and Other	4,724	10,382	12,657	13,732	15,298	14,698	13,893	14,293	12,693	11,493	11,093	134,953
Grand Total	*35,623*	*28,122*	*51,169*	*57,078*	*60,302*	*53,747*	*55,800*	*53,912*	*51,266*	*48,740*	*48,264*	*544,024*

* For PD/GWSS activities

** Includes interest

*** Total Assessment, not 100% contributed to PD/GWSS activities.

The federal fiscal year runs from October 1 to September 30. The federal fiscal year is named as the year where most months occur (e.g. funds employed November 1, 2009 fall under federal fiscal year 2010). The state fiscal year runs from July 1 to June 30. The state fiscal year is named as both years (e.g. funds employed November 1, 2009 fall under state fiscal year only included the state fiscal year.

Figures include funding appropriated, collected, or allocated in that fiscal year, regardless of what fiscal year the funds were actually spent.

Source: CDFA PDCP Funding for Pierce's Disease Activities and own calculations.

Table 4. District 4 Sample Calculation of Costs of Vine Loss, 2010

	New Vine Planted in Year 1					Mature Vine		Net Loss	
Years after vine death	Establishment Cost	Yield	Operating Cost	Net Revenue		Foregone Net Revenue		Current Cost	Discounted Present Value
	(1)	(2)	(3)	(4)	(5)=(4)/1,555	(6)	(7)=(6)/1,555	(8) = (7)+(1)-(5)	(9)
	$/Vine	*Tons/Acre*	*$/Acre*	*$/Acre*	*$/Vine*	*$/Acre*	*$/Vine*	*$/Vine*	*$/Vine*
0	-	-	-	-	-	10,827	6.96	6.96	6.96
1	12.53	0.0	0	0	0	10,827	6.96	19.49	18.56
2	1.42	0.0	0	0	0	10,827	6.96	8.38	7.61
3	0.00	1.0	3,070	108	0.07	10,827	6.96	6.89	5.95
4	0.00	3.0	4,716	4,819	3.10	10,827	6.96	3.86	3.18
5	0.00	5.0	5,064	10,827	6.96	10,827	6.96	0.00	0.00
								Total Loss	**42.26**

Source: Authors' calculation based on (a) $3,374.55/ton, (b) 1,555 vines/acre, and (c) 5% discount rate, using data from UC Cost and Return Studies.

Table 5. Expected Cost of Vine Losses, by Grape Type and Region, 2010

Type and Region	Bearing Area	Value of Vines Lost to PD ($ millions)		
	Thousand Acres	*Low*	*High*	*Most Likely*
Winegrapes				
Napa-Sonoma (Districts 3 & 4)	100.4	13.0	92.6	33.3
Coastal (Districts 1, 2, 5, 6, 7 & 8)	124.8	0.0	29.0	6.5
San Joaquin Valley North (11 & 17)	84.5	0.0	4.2	2.1
San Joaquin Valley South (Districts 12, 13, 14 & 15)	132.9	0.0	12.6	4.4
Southern California (District 16)	1.0	0.2	1.2	0.6
Northern California (Districts 9 & 10)	13.3	0.0	1.5	0.2
Winegrapes Subtotal	456.9	13.2	141.1	47.0
Raisin Grapes				
San Joaquin Valley South (Districts 12, 13, 14 & 15)	200.2	0.0	6.6	3.0
Southern California (District 16)	1.1	0.1	0.3	0.1
Raisin Grapes Subtotal	201.4	0.1	6.9	3.1
Table Grapes				
San Joaquin Valley (Districts 12, 13, 14)	71.5	0.0	12.0	3.5
Southern California (Districts 15 & 16)	7.0	1.0	5.4	2.7
Table Grapes Subtotal	78.5	1.0	17.4	6.2
Grand Total	**736.8**	**14.3**	**165.5**	**56.3**

Source: UC Davis Cost and Return Studies and authors' calculations.

Table 6. Expected Cost of Vine Losses, Winegrapes, 2010

Crush District	Bearing Area	Planting Density	Yield	Grape Price	Cost per Vine	"Most Likely" Loss Rate	Total Cost
	Acres	*Vines/acre*	*Tons/acre*	*$/ton*	*$/vine*	*%*	*$ '000*
1	16,276	908	5.75	1,101	31.36	0.00	0
2	7,939	908	5.75	1,089	31.01	0.00	0
3	55,647	1,089	5.00	1,974	37.08	0.50	11,237
4	44,777	1,555	5.00	3,178	42.26	0.75	22,071
5	3,164	726	7.00	667	20.37	0.25	117
6	6,563	908	5.75	974	27.73	0.25	413
7	45,539	908	5.75	966	27.50	0.25	2,843
8	45,336	908	5.75	1,054	30.01	0.25	3,089
9	7,064	726	7.00	406	12.24	0.25	157
10	6,210	908	5.75	1,051	29.92	0.00	0
11	66,802	622	6.50	461	15.40	0.25	1,600
12	28,220	565	12.00	353	27.78	0.25	1,107
13	78,643	565	12.00	268	21.56	0.25	2,395
14	25,352	565	12.00	285	22.78	0.25	816
15	646	908	5.75	783	22.25	0.25	33
16	1,012	908	5.75	1,170	33.34	2.00	613
17	17,728	726	7.00	515	15.64	0.25	503
Total	**456,918**						**46,993**

Source: NASS, California Grape Acreage Reports, Various California Crush Reports, UC Davis Cost and Return Studies and authors' calculations.