

Economic Impact of Eutypa on the California Wine Grape Industry
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The purpose of this report is to estimate the economic impact of Eutypa which is one of the most common canker diseases of grapevines in California. It is caused by the fungal pathogen *Eutypa lata* which requires wind driven rain to disperse the ascospores to relatively fresh pruning wounds where infection takes place. Once infected and without remedial action, the grapevine declines in production over a period of years to its death. The disease occurs on a worldwide basis and is present in virtually every region and variety of grapes grown in California. Growers have managed around Eutypa. The economic loss from Eutypa has not been quantified on a statewide basis. This report estimates the total impact at the producer level from the effects of Eutypa and will serve as a base for evaluating potential methods of dealing with the disease.

The California wine grape industry is valued at \$1.7 billion in 1999 at the producer level.¹ The value of wine grapes at the producer level has grown nearly 15 percent per year over the last 10 years. In terms of gallons of production, California ranks fourth in the world behind France, Italy, and Spain. In addition, exports of California wines have grown at an impressive rate of over 10 percent since 1995 and now rank third in state exports among commodities at \$505.7 million (1998 value).²

The full economic impact of the wine industry on California amounts to \$33 billion.³ This total includes revenues to the wine industry and allied industries, direct, indirect, and induced economic benefits. It also provides employment for 145,000 people in California. As an industry, it has a significant impact on the California state economy. The wine grape industry, as all of California agriculture is faced with increasing challenges to its economic viability. A rapidly increasing population is providing increasing pressure on the wine industry's resource base of land, water, and air. In addition, increased environmental standards and regulation have removed chemical tools that the industry has relied on to combat various pests and diseases as well as the introduction of exotic pests such as the Glassy Winged Sharpshooter which has increased the probability of Pierce's Disease into California vineyards.

One disease infecting grapevines is Eutypa, a fungal disease that infects grapevines through pruning wounds and is the primary vineyard disease in the state. Another similar disease is Bot Canker which acts like Eutypa. The two diseases are commonly confused, but their impacts are essentially the same. For purposes of this paper, the two will be treated as one. The disease affects grapevines by diminishing their vigor and eventually, without remedy, leads to the death of the vine. There is not a good control of the disease. A fungicide can be used after pruning, but is limited in its effectiveness. The major control is to prune out the infected parts of the vine to keep it from spreading to other parts. Other alternatives are to completely topwork the vine every 8 to 10 years, replant dead vines with new plants, or to completely replant the vineyard. All alternatives impose a major cost on the vineyard owner.

¹ Source: California Agricultural Statistics Service, Grape Crush Report.

² Source: California Department of Food and Agriculture.

³ Source: Economic Impact of California Wine, an MKF Research Report, sponsored by the Wine Institute and California Association of Wine Grape Growers, January, 2000.

Eutypa will vary in its impact depending on grapevine variety, location, pruning method, and age.⁴ Age is a particularly important factor. Eutypa usually does not appear until vines have reached 10 years of age; and the probability of infection appears to increase as vines get older. In estimating the impact of Eutypa on the California wine grape industry, these factors must be taken into account as well as assumptions on the rate at which vineyards are infected and the rate at which the infection spreads. There are four major impacts that Eutypa will have. These include loss in yield, increased cost of preventive maintenance through the chemical treatment of pruning wounds, increased cost of additional pruning of diseased parts of the vine, topworking and replanting dead vines, and decreased life of the vineyard.⁵ The economic impact of these factors need to be estimated in evaluating the overall economic impact of Eutypa on the California wine grape industry. A previous study, which was made as part of a Section 18, Emergency Use of NECTEC-P by the Lodi Woodbridge Winegrape Commission in 1998, estimated losses to their growers of \$170 million per year and as high as \$1 billion per year statewide (annual grower returns statewide is \$1.7 billion).⁶

Structure of California Wine Industry.

Tons crushed, grower returns per ton, and gross grower return for 1999 are detailed in Table 1.

Table 1. Major Categories of Wine Grape Crush

Class/Variety	Tons Crushed	Percent of Total	Grower Return/Ton	Gross Grower Return	Percent of Total
Raisin Type	419,362.4	13.2	200.32	84,066,676	5.0
Table Type	149,269.4	4.7	187.15	27,935,768	1.7
White Wine	1,195,073.2	37.5	518.32	619,430,341	37.1
Red Wine	1,421,757.7	44.6	648.71	922,308,438	55.2
Total	3,185,462.7	100.0	524.83	1,671,826,839	100.0
Variety					
Thompson	403,005.1	12.6	200.66	80,867,003	4.8
Chardonay	458,273.0	14.4	995.66	456,284,095	27.3
Chenin Blanc	139,360.7	4.4	242.41	33,782,427	2.0
Fr. Colombard	396,500.5	12.4	198.37	78,653,804	4.7
Sauv. Blanc	529,34.1	1.7	800.10	42,352,573	2.5
Barbera	104,539.5	3.3	267.18	27,930,864	1.7
Cabernet Sauv.	255,731.6	8.0	1,063.60	271,996,130	16.3
Carignane	571,66.7	1.8	342.33	19,569,876	1.2

⁴ Source: Scientific literature and discussions with University of California Farm Advisors and vineyard managers.

⁵ This conclusion is reinforced through an Australian study, "Eutypa Dieback: Current Status and Future Directions", Mette Creaser and Trevor Wicks, published in Grape Grower and Winemaker, Annual Technical Issue 2000, South Australian Research and Development Institute.

⁶ This figure was reported in an article authored by Ted Rieger, "Lodi Growers Apply to Use NECTEC for Eutypa, Review PM Problems for 1998", Vineyard and Winery Management, Jan/Feb, 1999. The economic estimates are attributed to Reed Smith, Regulatory Consultant, Oakdale.

Grenache	956,33.6	3.0	201.94	19,312,249	1.2
Merlot	239,567.1	7.5	993.55	238,021,892	14.2
Pinot Noir	366,53.4	1.2	1,721.85	63,111,657	3.8
Rubired	102,426.6	3.2	403.25	41,303,526	2.5
Ruby Cabernet	601,26.0	1.9	318.76	19,165,764	1.2
Syrah	44,099.0	1.4	729.58	32,173,748	1.9
Zinfandel	324,397.1	10.2	494.23	160,326,779	9.6
Total	2,770,414.0	87.0		1,584,852,389	94.8
District					
1.	58,647.6	1.8	1,454.56	85,306,453	4.8
2.	15,168.0	0.5	1,205.95	18,291,850	1.0
3.	142,477.0	4.5	1,880.89	267,983,565	15.0
4.	103,526.4	3.2	2,142.55	221,810,488	12.4
5.	13,615.4	0.4	1,061.83	14,457,240	0.8
6.	20,472.7	0.6	1,269.59	25,991,935	1.5
7.	115,385.9	3.6	1,347.88	155,526,347	8.7
8.	90,428.0	2.8	1,324.59	119,780,025	6.7
9.	44,957.2	1.4	552.25	24,827,614	1.4
10.	13,539.2	0.4	1,005.31	13,611,093	0.8
11.	437,174.7	13.7	570.16	249,259,527	13.9
12.	293,486.8	9.2	356.05	104,495,975	5.8
13.	1,253,716.1	39.4	247.39	310,156,826	17.3
14.	518,728.5	16.3	266.54	138,261,894	7.7
15.	1,246.3	0.04	599.16	746,733	0.0
16.	7,418.5	0.2	830.10	6,158,097	0.3
17.	55,474.4	1.7	622.94	34,557,223	1.9
Total	3,185,462.7			1,791,222,884	100.0

Source: Final Grape Crush Report, 1999 Crop, California Department of Food and Agriculture, Sacramento, March 10, 2000.

Classes of grapes used in the annual wine crush are white wine types, red wine types, raisin types (mostly Thompson Seedless), and table types. White wine and red wine types account for over 80 percent of the crush, and nearly 90 percent of the gross producer value. In addition, their grower return per ton amounts to 2.5 to 3 times the value over the raisin and table types. In terms of varieties, the 15 listed in Table 1 account for over 85 percent of the tons crushed and 95 percent of the gross grower returns. The top five varieties in terms of tons crushed (Chardonnay, Thompson Seedless, French Colombard, Zinfandel, and Cabernet Sauvignon) account for nearly 60 percent of the crush, and 63 percent of the gross value. However, the top five varieties in terms of gross grower return (Chardonnay, Cabernet Sauvignon, Merlot, Zinfandel, and Thompson Seedless) account for over 70 percent of the total gross value. The leading districts in terms of tons crushed are the San Joaquin and Sacramento Valley ones (11,12, 13, 14), while in terms of gross grower return, the districts growing the higher value grapes, Sonoma (3) and Napa (4) rank with the Valley districts. Table 1 illustrates that while wine grapes are grown in a huge geographic area and encompasses many varieties, tons crushed and gross returns are dominated by a handful of districts and varieties. This information and data will be instrumental in estimating the impact of Eutypa.

Economic Model.

The economic model that will be used to estimate the impact on the industry is a modified Welfare Equilibrium Model which measures the total change in producer and consumer welfare from shifts in market equilibrium. This model is best demonstrated and explained in Appendix 1.

Based on the model being used in this study, estimates of net revenues in vineyards infected with Eutypa and vineyards without Eutypa need to be made. In order to undertake these estimates, information is needed on the difference in vineyards with Eutypa compared to those with no Eutypa. The current situation is one where, according to interviews, Eutypa is virtually present throughout California and encompasses decreased yields, increased vineyard management costs, and shortened life span of vineyards. These factors will be discussed in turn.

A key piece of research on yield losses was reported in an article by Munkvold, et al.⁷ In this article the authors identified and estimated the relationship between yield and disease severity. They also statistically estimated the relationship between yield and vineyard age for six Chenin Blanc and eight Barbera vineyards in Merced County with data spanning 1964 to 1990. The Chenin Blanc relationship is reflected by the formula $y = 1.37 + 3.65X - 0.151X^2$, where y = yield and X = age of vineyard. This formula demonstrates the destructive potential of Eutypa as some vineyards over 20 years old exhibited an 83 percent decline in yield compared with their peak years. These formulas are depicted in Figure 1.

According to the authors, “the decrease in yield that occurs after these vineyards reach approximately 12 years of age is associated with the period of rapid increase of Eutypa dieback. In Merced county Chenin Blanc vineyards, Eutypa dieback is rare until the vineyards reach 10-12 years of age. Between 12 and 20 years of age, disease increases each year, until nearly all vines are infected at 20 years”.

The authors then continued “Healthy vineyards generally experience increased yields up to 10 years of age and subsequently maintain a stable yield for several decades. This is demonstrated by the Barbera vineyards, which are rarely affected by Eutypa dieback”. The Barbera relationship between yield and age is reflected by the formula $y = 32.9(1 - \exp(-0.35X)) - 11.6$; where y = yield and X = vineyard age. The two formulas will be used in the estimation of economic differences between Eutypa infected vineyards and Eutypa free vineyards. However, before proceeding to this point, some discussion of increased vineyard management costs must be made.

⁷ Munkvold, G.P., J.A. Duthie, and J.J. Marois, “Reductions in Yield and Vegetative Growth of Grapevines Due to Eutypa Dieback”, *Phytopathology*, 84:2, 1994, pp. 186-92.

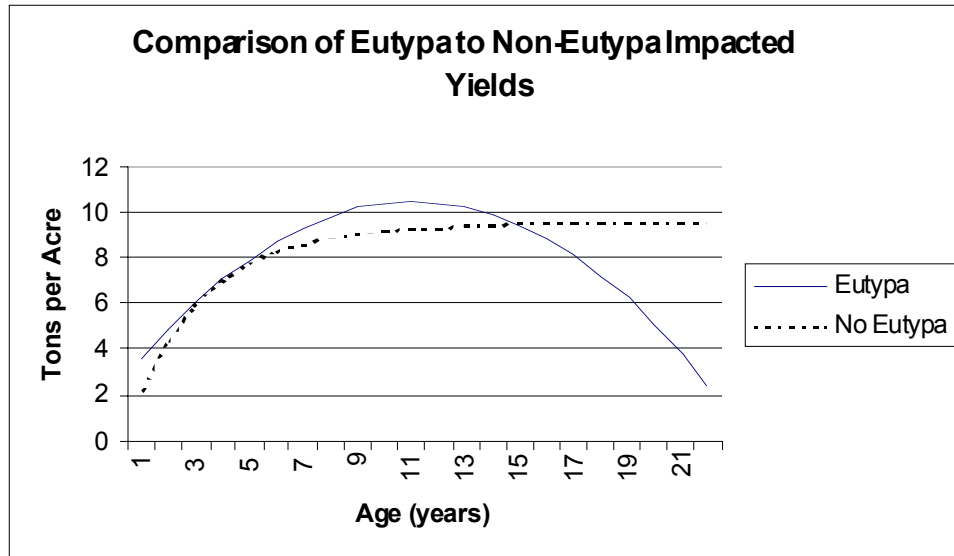


Figure 1.

The first increased cost identified was a preventive measure of painting or hand spraying large pruning wounds with a fungicide as soon as possible after pruning. However, this method is very labor intensive and expensive. The materials registered for use only last up to one week; four to six applications in the spring may be necessary. The second increased cost is the removal of infected wood from the vineyard. This alternative also involves retraining the resulting new growth from the pruned parts. The operation may involve only one cordon or arm on a vine to removal of most of the trunk and the training of new growth. This alternative is also highly labor intensive and costly.

A third alternative is to allow the disease to take its course and plan on replanting the vineyard every 20 years or less. Vineyards have an amortization period of 18 years or more to recover sunk capital costs when they are planted. The longer the life of the vineyard, the lower the amortization, or overhead costs, will be. A shortened vineyard life will only add increased costs to the grower and decrease net profits as well as build up of equity.

Estimation of Economic Impact.

In order to estimate the impact between Eutypa infected vineyards and Eutypa free ones, the formulas developed by Munkvold, et al, were converted to an index for a 22 year life of a vineyard. This index was then used to estimate the accumulated yields and revenues for different varieties by applying historical differences in yields and prices received by growers. Costs were estimated using University of California of California Farm Advisor sample cost estimates. Available Farm Advisor Cost Estimates are contained in Appendix 2. From these calculations, a net profit for a grower over the 22 year period was estimated for vineyards with Eutypa and Eutypa free vineyards. Estimates were made for the major grape varieties grown in California and by region. The varieties included Chardonnay, Chenin Blanc, French Colombard, Barbera, Cabernet Sauvignon, Grenache, Merlot, Zinfandel, and Thompson Seedless grapes. These varieties account for over 75 percent of the 1999 crush and over 80 percent of the 1999 gross grower return. Yields and average grower returns per ton used in the model are contained in Appendix 3. The results of these

calculations are contained in Table 2 for California. Overall, the loss in net income for wine grapes in California is estimated to be over \$260 million. Compared to the 1999 crop value at the producer level, this estimate amounts to nearly 16 percent of the gross producer revenue of \$1.672 billion.

In interpreting these estimates, caution should be used. The estimates are an upper bound. The explicit assumption made in these estimates is that the infection of Eutypa is uniform throughout varieties and districts. However, the actual infection rate of Eutypa will vary by variety and location. In addition, Eutypa is more prevalent in the later years of a vineyard's life than in earlier years. For example, most of the vines in Napa are relatively young due to a massive replanting of vineyards because of Phylloxera. Hence, the probability of incidence of Eutypa is significantly reduced until the vines reach 10 – 12 years of age. Also, producers can and do take steps to promote longevity in vineyard life. There are vineyards with vines aged 50 years and greater. The steps include treating pruning wounds with a reliable wound protectant such as Benomyl paint, late pruning, replanting of dead vines, and locating and removing diseased portions of vines and retraining the new growth. These good management practices involve increased costs which are beyond the scope of this study at this time due to data restrictions. However, a discussion of

Table 2. Estimated Changes in Net Income for Eutypa Infected Vineyards

<u>Variety</u>	<u>1999 Acres</u>	<u>Total Net Income Change</u>
Chardonay	80,998	70,114,299
Chenin Blanc	20,437	5,131,322
French Colombard	44,504	9,952,875
Barbera	11,595	4,014,073
Cabernet Sauvignon	39,988	29,831,048
Grenache	11,167	3,550,883
Merlot	36,506	36,678,673
Zinfandel	46,000	30,590,460
Other White/Red Wine Types	83,557	55,566,241
Total Wine Grape Type	374,752	245,429,873
Thompson-Wine	62,548	17,120,081
Other Wine (raisin & table)	6,285	1,720,172
Total All Wine	490,789	264,270,126
Estimated 1999 Gross Grower Return		1,671,826,389
Estimated Percent Loss		15.8%

Management Practices.

Late Pruning. This management practice should not involve additional pruning costs unless higher labor costs are necessary due to a tight labor market in the spring when late pruning occurs. At this time, additional information is not available to make assumptions.

Treatment of Pruning Wounds. Treatment of Pruning Wounds. The University of California Pest Management Guidelines for Eutypa recommends that in addition to late pruning that large pruning wounds be painted or hand sprayed with a fungicide as soon as possible after pruning and before rain. The treatment recommended is Benomyl (0.2 lb. Per gallon of water) and cautions that reapplication is necessary after rainfall. Cost of Benomyl in a commercial product is reported to be \$18.00 per pound. An unpublished paper by A.N. Kasimatis et. al⁸ showed significant reductions in Eutypa infections. Also, effective was the reduction of dormant pruning cuts through spring shoot thinning. In estimating the cost of fungicide treatment of pruning wounds, discussions with vineyard operators indicated that one person per six pruners could cover a field. This ratio would result in a 17 percent increase in labor costs for each treatment. Another estimate from interviews indicates that one person with a backpack sprayer could cover an acre in three hours. This latter figure will be used in estimating the cost of applying a fungicide after pruning.

The following assumptions will be used: 1) three hours to spray each acre with a backpack sprayer; 2) 3.2 ounces of Benlate per gallon of water at a rate of application of 3.5 gallons per acre; 3) a labor wage of \$6.50 per hour (could be higher in some places like Napa and Sonoma); and 4) a Benate fungicide costing \$18.00 per pound. These assumptions yield a per acre cost of \$32.10 which corresponds to estimated costs resulting from interviews with vineyard managers. If it was assumed that the 490,789 acres of grapes used for wine are treated in the manner described, total cost to the industry would be \$15.8 million each application. Depending on the amount of rain encountered during the spring, recurring applications may have to be made up to four times resulting in a cost of \$63 million.

The practice of applying a fungicide after pruning is not universal throughout the industry, and it is not known how widespread the practice is. In order to provide a more accurate estimate of the impact of this practice on the industry, more information is needed on the extent to which this practice is followed and its effectiveness in reducing the infection of Eutypa and prolonging vineyard life.

Top-working. This practice involves pruning out parts of the vine infected by Eutypa and training new growth along a trellis or wire system. In addition, dead vines are replaced by either planting a new vine or rooting a runner from an adjacent vine. The costs of this practice will depend on the severity of infection in a vineyard. There are many vineyards in California that are significantly older than 20 years. However, no information exists on the age distribution of vineyards by variety or location. Data is needed from vineyards that through various management practices are able to mitigate the effects of Eutypa and extend vineyard life. In addition to identifying management practices, information is also needed on differences in yield and costs in order to estimate least cost practices.

Conclusions.

This report has demonstrated that significant costs are associated with Eutypa. The actual extent of these costs in the California wine grape industry is difficult to estimate in that there are significant data and information gaps. However, vineyard managers

⁸ A.N. Kasimatis, J.A. Wolpert, E.P. Vilas, P. Verdegall, and J.J. Kissler, "Late Pruning, Benomyl Application at Pruning, and Shoot Removal Treatments Reduce Incidence Of Eutypa Dieback in Chenin Blanc Grapevines", University of California, Unpublished Paper, 1988.

and producers have managed around Eutypa in order to maintain yields and prolong vineyard life. Costs estimated in this report have been extrapolated from a narrow base of scientific research. Additional economic estimates require that the data and information gaps be resolved.

Refinements to this study require the following steps:

1. A formal survey of the incidence of Eutypa by variety, pruning method, and location should be undertaken.
2. A detailed estimate of vineyard age by variety and location should be undertaken.
3. Estimates of vineyard management practices to prevent and treat Eutypa infected vineyards should be made, including costs and yields.
4. Samples of yields and costs in Eutypa infected vineyards and Eutypa free vineyards should be obtained for analysis.