I. Project Title: The Economics of Pierce's Disease in California

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III. Objectives:

1) Estimate the costs and benefits to wine grape, table grape and raisin growers, consumers and taxpayers from changes in the costs of grape production due to the establishment of the GWSS. The changes in production costs will be based on current best practices and will include chemical treatments, removal of infested vines, quarantine restrictions and public control programs. The increase costs of production affect newly infested producers directly because they bear the burden of paying the increased costs of production; however, consumers and producers are also affected through the market effects due the changes in the costs of production.

2) Estimate the costs and benefits of public policies to manage and contain the GWSS. The public control policies include public programs to treat the GWSS in citrus to prevent its spread into grape vineyards in the spring, and the associated containment program. An additional public policy to contain the spread of GWSS and, thus, the transmission of PD, is a state quarantine on the movement of nursery, citrus and other host crops out of infested regions.

3) Estimate the optimal check-off rate for the grape and other agricultural industries that benefit from the treatment of the GWSS on overwintering crops. The rate will take into account the costs and benefits to the grape growers in both infested areas and areas that benefit from the containment of the GWSS within infested areas, and the costs and benefits to growers of overwintering crops. The results of the first two objectives will be used as parameters in the model that estimates check-off rates.

Objectives 1 through 3 will be completed through the use of economic market models. Market models are used to estimate the losses to both producers and consumers when changes in the costs to grow and market a crop are significant enough to affect market prices, production and supply. These effects can be shown graphically. Figure 1 presents the market effects of the increased incidence of PD due to the establishment of the GWSS on the market for grapes (here defined as wine, table and raisin grapes) and the development of effective GWSS control methods. The market contains suppliers, who are willing to supply grapes and initially represented by supply curve S*. The supply curve is upward sloping because as prices increase growers will grow more grapes and supply more grapes to the market. The market also contains consumers who purchase grapes and are represented by the demand curve D. The curve is downward sloping because as prices decrease, consumers will want more grapes. The market is in equilibrium at point d. At point d, price is equal to P* and the quantity demanded by consumers, Q*, is exactly equal to the quantity supplied by producers.

At the initial equilibrium point there are some consumers who are willing to pay more than P* and some producers who could offer their products at a market price less than P* and still make a profit. The consumers who are willing to pay more may have more income than other consumers, or just a greater preference for grapes and grape products. The maximum amount that each consumer would be willing to pay for grapes is represented by the demand curve. The difference between what consumers are willing to pay and the actual price that they do pay is called consumer welfare. In Figure 1, consumer welfare is equal to area P*gd.

The producers who could profitably accept less than the market price are producing grapes at a lower cost than other producers. The minimum amount at which each producer would supply grapes to the market is represented by the supply curve. The difference between the price at which producers would offer their goods to market and the actual price they receive is called producer welfare. In Figure 1, producer welfare is equal to area P*ad.

The establishment of the GWSS in select counties in California initially causes the supply curve to shift up from S* to S'. For supply curve S' the new equilibrium point is f. At point f, the equilibrium price is P', and the equilibrium quantity is Q'. For example, this shift could represent the losses in the Temecula Valley as PD spread with the GWSS and diseased vines were removed. Over time, management of the GWSS improves and losses decrease. This causes the supply curve to shift from S' to S''. Thus, supply curve S'' represents the current situation with respect to the management of GWSS and PD. For supply curve S'', the new equilibrium point is e, price is P'' and market supply is Q''. For example, over time growers in the Temecula Valley learned that treating a vineyard with the Admire® formulation of imidacloprid can effectively reduce GWSS populations and the incidence of PD. While vineyards can now be replanted, the cost to produce grapes has increased above the pre-GWSS environment because growers must now incur the additional expense of applying Admire®.

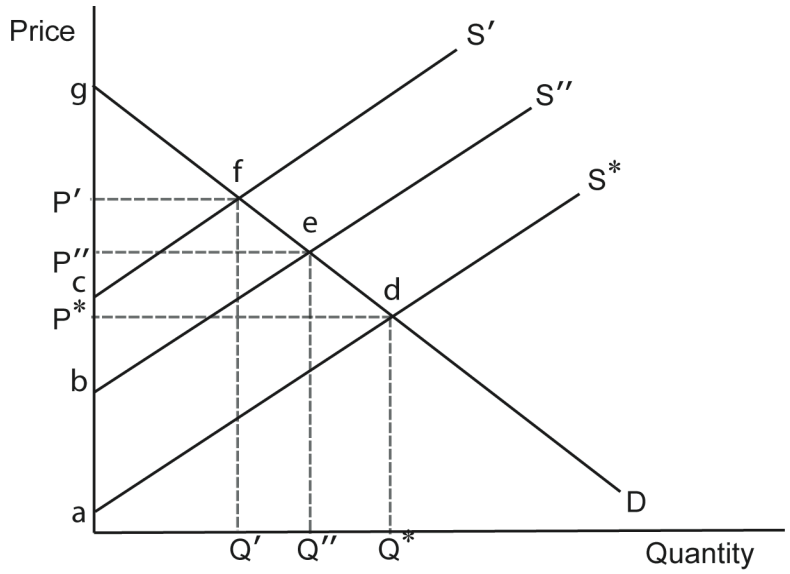

Figure 1. Market effects for grapes produced in GWSS infested counties.

For Objective 1, the losses to the different grape industries in California will be estimated assuming a shift in the supply curve from S to S''. The estimated losses to consumers and producers will be equal to area beda. For Objectives 2 and 3, the initial market equilibrium will reflect the current situation and practices in California. In Figure 1, this is at point e, where the demand curve, D, and supply curve, S'', intersect. It is assumed that should the public management of GWSS be discontinued, the supply curve would shift upward again. As an example, assume that the supply curve S'' shifts back up to S' if the public programs are discontinued. The estimated losses to producers and consumers would then be equal to area cfeb.

The graphical analysis above illustrates the situation in which all grape production in a specific region is affected. Within that region all growers are worse off due to higher costs, but losses to some degree are minimized through higher market prices. Consumers are worse off due to higher prices, and lower consumption. With regard to the case of PD in California, growers located in regions free of the GWSS, and growers in other states where the GWSS is native, will be better off due to the establishment and spread of GWSS in select counties of California. Growers without GWSS receive higher prices, but do not incur higher management costs due to control of GWSS. Additional costs accrue to taxpayers who bear the costs of the public management programs. An economic analysis needs to include all these effects. Due to the relative newness of the establishment of the GWSS, the scenarios estimated will include a sensitivity analysis that reflects the best estimates of the range of possible effects by scientists researching and managing the GWSS.

Once all costs and benefits of the establishment of the GWSS are estimated, and the costs and benefits of the public program to treat GWSS in citrus are estimated, the check-off rates that growers would need to pay in order to take over the citrus GWSS control program will be determined. Because research and the most effective means to complete the public control program is still being conducted, there is still a vital role public agencies have in reducing the short-term effects on producers and, especially, consumers, of commodities affected by *Xylella fastidiosa* and GWSS. In the long-run though, taxpayer financed control of the GWSS will probably not continue. Even though public funding will continue for the foreseeable future, this research project will put the economic evaluation tools into place if budgetary shortfalls at the state or federal level put pressure on policy makers to downsize the public program, and the industries affected by GWSS need to respond quickly.

IV. Summary of major research accomplishments and results for each objective:

Objectives 1 – 3 Data collection

For Objective 1 data are needed on the changes in the costs of production for affected growers due to the establishment of the GWSS in California. For Objectives 1 – 3 data are also needed on grape, citrus and nursery production, prices, revenues and trade data from 1998 through 2007 (the last year for which data are available); current costs of production; and elasticities (elasticities measure the percentage change in a quantity variable for a one percent change in a price variable – for example it could measure the percentage change in production for a one percent change in the farm price.)

Effects on crop production due to the establishment of the GWSS and the public control program.

Objective 1:

How the GWSS affects current production was determined through meetings held with UCCE farm advisors and growers to discuss how the establishment of the GWSS affected their pest control programs for grapes. The meetings were held in November and December 2008 in the southern San Joaquin Valley in November and December 2008. Production and price data for grapes were collected from the National Agricultural Statistics Service (See Appendix)

Economic Effects in the Southern San Joaquin Valley

A meeting was held with grape growers, and public agencies involved with the public control program to determine how the establishment of GWSS has affected different groups in this area. Three groups are affected by control of the GWSS in the southern San Joaquin Valley, grape growers, citrus growers and taxpayers. While there is currently a low incidence of PD in Kern and Fresno counties, the incidence can rapidly increase should GWSS not be controlled.

The first line of defense against the spread of PD by the GWSS is the public control program whereby citrus is treated during the winter months to prevent the build up of GWSS populations. To control for GWSS in citrus an application of Assail is made in the fall followed by an application of imidacloprid in the spring. Imidacloprid is applied at a rate of 32 fl oz an acre (2 lb ai/gal formulation) through the irrigation system. The control program is conducted on an area-wide basis to achieve longer-term reductions in GWSS populations. The control in citrus occurs about once every three years based on monitoring of GWSS populations. With the Citrus growers are reimbursed for their treatments of GWSS and participation in the public program is currently voluntary for the citrus grower.

The second line of defense against the spread of PD is to treat grape vines for GWSS. A majority of grape growers apply imidacloprid once annually to control GWSS and prevent the transmission of PD. Applications of Admire Pro are typically at the maximum rate of 14 fl oz an acre (4.6 lb ai/gal formulation) through the irrigation system. The cost of applying Admire Pro is currently about $50-$60 an acre. The patent for Admire expired in 2005. As a result the initial cost to control the GWSS was higher. Growers from the southern San Joaquin Valley will provide the costs for earlier treatments with Admire.

The treatments with imidacloprid also provide some cost savings as the GWSS also controls the variegated grape leafhopper, grape skeletonizer, and is a suppressant of the grape vine mealybug. The cost savings by growers is $62 an acre based on UCCE budgets, or about the same amount as the current costs to apply Admire Pro. No quarantine costs are incurred by grape growers as mature fruit destined for the fresh market is hand harvested and field packed.

Total costs of production for citrus growers are also affected by the public control program and quarantines against moving citrus out of infested areas. Treatments with imidacloprid may help suppress nematodes, citrus peelminer and California red scale. Better control of these insects can be achieved by applying an additional amount of imidacloprid when treating for GWSS; however, the grower is responsible for those costs. The citrus industry is affected by the interior quarantine and fruit from infested areas needs to be inspected and treated before leaving a quarantine area. Quarantine treatments involve fumigation using EverGreen (pyrethrum + piperonyl butoxidor). Turbocide has also been mentioned as a material that can be used as a fumigant. If GWSS are found in a grower's orange shipments, the grower bears the cost of treating for GWSS in his or her grove if the grower did not participate in the area wide program. This aspect of the public control program is believed to encourage greater participation by citrus growers in the control of GWSS.

Economic Effects in the Temecula Valley

In the Temecula Valley there is also a public program to control GWSS. In contrast to the program in the southern San Joaquin Valley, individual groves are treated following identification of an outbreak. Area wide coordination of treatments has been more difficult in the Temecula Valley. Many groves are being carved up into rural homesteads and cultural procedures are completed by farm management companies instead of a grower/owner. With a lower proportion of groves being treated in the Temecula Valley than in the southern San Joaquin Valley, GWSS pest pressure in greater in the Temecula Valley.

Private treatment of GWSS by grape growers in the Temecula Valley also consists of an annual treatment of Admire. However, because there is greater GWSS pest pressure, higher costs of production for grape growers in the Temecula Valley are being realized as the application of Admire is being supplemented with annual sprays of Danitol in some areas. For vineyards located near citrus groves about two applications of Danitol are needed a year. Growers in the Temecula Valley would also no longer be required to treat for the grape leafhopper or the grapeleaf skeletonizer. Based on UCCE budgets, grower costs to apply Danitol are about

The Temecula Valley has a drier climate than the San Joaquin Valley. In order for growers to apply Admire when it can do the most good, a separate irrigation may be required. Farm managers with whom meetings were held estimate that half the time they need to complete a separate irrigation in order to apply Admire. The extra irrigation costs are estimated to be $12.50 on average.

Market effects of GWSS control and PD to date.

These cost increases will be incorporated into the market model, and changes in prices, production and market supplies estimated for the wine, raisin and table grape industries. Those estimates will then be used to calculate the costs to producers and consumers from the establishment of GWSS in their areas. This analysis is expected to be completed by June 2009.

Objective 2

Taxpayers currently bear the costs of the public program and the state quarantine. These costs include the payments to citrus growers, some public treatment of nurseries in the Ventura area, management of the costs of the program, and inspection and monitoring costs of all quarantined materials. The entire program, including inspection and monitoring costs of the nursery industry is $22 million a year. The cost of the public program will be compared to the costs of GWSS control and PD outbreaks assuming no area wide management is undertaken.

The benefits of the program to growers with no GWSS infestations include preventing the spread of the GWSS north from the southern San Joaquin Valley and Ventura County. A meeting with CDFA and local managers of the area wide program in the southern San Joaquin Valley was held in January 2009. The result of the meeting was that should all portions of the public program be discontinued (i.e. both the quarantine and the area wide spraying) then the probability that GWSS can be contained and prevented from spreading is less than the current probability, even if private funding is secured for the area wide program. This is because even with a spray program, the quarantine would end. The quarantine serves not only to prevent the inadvertent transportation of the pest to new areas, but is also used to encourage citrus growers to comply with the public program in areas with GWSS infestations.

There are also benefits to lower costs of production for growers that already have GWSS infestations. Should the public program end, growers in areas that currently have GWSS infestations would have an additional increase in the costs of production, increases in monitoring and surveillance costs, or greater vine death. Consequently, one scenario for the benefit of the public program would be to evaluate it assuming that the incidence of PD would increase in both the San Joaquin Valley and the Temecula Valley. Additional scenarios are currently being developed. Once the benefits of the public program are estimated, the grower check-off rates needed to switch funding to a private program will be estimated.

The data on current production and prices will be the basis of the market analysis that will estimate the benefits of the public program for objective 2. Based on a meeting with growers in March 2009 it was apparent that the public program was considered the primary mechanism to prevent the spread of PD by the GWSS *within* their region. Should the public program end growers are concerned that rates of infection will return to the levels seen between 1998 and 2001. Discussions are continuing with growers regarding how their management practices would change should public funding end for the area wide program.

Objective 3

Objective 2 needs to be completed before objective 3 can be begun. Based on the meetings with growers and CDFA; however, a privately financed area wide program would not consist of beneficiaries of the public program merely taking over the cost. Additional actions will need to be considered to account for the risk of GWSS spread due to the end of the quarantine. The assessment rates will be determined by comparing the benefits of an area wide program to the cost to producers to control GWSS and PD outbreaks assuming no area wide management is undertaken.

V. Publications. No publications have been prepared.

VI. Presentations on research.

One presentation at the annual Pierce's Disease Symposium in San Diego in December has been completed.

VII. Research relevance statement.

This research contributes to solving the PD/GWSS problem in California by evaluating the economic impact of different management options on the control of the GWSS. This knowledge is important in developing cost effective solutions to the public and private management of this pest and disease.

VIII. Summary

The objectives of this study are to determine the costs to producers, consumers, and tax payers from the spread of GWSS and PD in California to date; to determine the benefits of the public area wide management program; and to determine the optimal rates growers would have to pay to finance area wide management of the GWSS should the public program end. Since the early 2000s a key component in effective management of GWSS in grapes has been a public control program of this pest in citrus while it overwinters in citrus trees. The program consists of treatments for GWSS by citrus growers, who are then reimbursed for their costs. By preventing populations from building up during the winter, GWSS populations are low when grape vines come out of dormancy,

and GWSS move from citrus and onto grape vines – a preferred host. The other component of the public program is a quarantine on the movement of nursery products and fresh fruit from infested counties.

The level of success that the public area wide program achieves in each region effects the economic impact of private GWSS treatment in grapes. In the southern San Joaquin Valley where most citrus growers are participating in the public program, grapes growers need only one application of the soil formulation of Admire to keep GWSS populations low enough to prevent the spread of PD. Because the application of Admire also controls other pests such as the grapeleaf skeletonizer, the grape leafhopper, and suppresses the vine mealy bug, the additional costs to control for GWSS are offset by cost savings associated with not having to treat for other pests. In the Temecula Valley where there is less participation by citrus growers in the voluntary public program grape growers are also having to complete additonal spray treatments to control GWSS. In addition, about half the time an extra irrigation is needed when the Admire is applied in order to achieve optimal control of the GWSS. Consequently, growers in the Temecula Valley have experienced a higher increase in their costs of production than growers in the San Joaquin Valley.

Should the public program growers in the southern San Joaquin Valley are concerned that they will see PD levels increase to those observed in the Temecula Valley, even with additional spray treatments. This is because even with a spray program, the quarantine would end. The quarantine serves not only to prevent the inadvertent transportation of the pest to new areas, but is also used to encourage citrus growers to comply with the public program in areas with GWSS infestations. Consequently, one scenario for the benefit of the public program would be to evaluate it assuming that the incidence of PD would increase in both the San Joaquin Valley and the Temecula Valley. Additional scenarios are currently being developed. Once the benefits of the public program are estimated, the grower check-off rates needed to switch funding to a private program will be estimated.

IX. Status of funds: Approximately $9,000 has been spent. The funds have been used for the purchase of a computer, travel to the PD symposium in December, and partial salary for the months of January and February. Approximately $28,231 remains in the account.

X. Intellectual property. No intellectual property was produced during this research project.

References

U.S. Department of Agriculture. Various years. *Agricultural Statistics 1997 through 2008*. National Agricultural Statistics Service. http://www.usda.gov/nass/ pubs.

U.S. Department of Agriculture. 2008. *Fruit and Nut Situation and Outlook Yearbook.* Market and Trade Economics Division, Economic Research Service. www.ers.usda.gov/Publications/fts/Yearbook08/FTS2008.pdf

Appendix

Table 1. Price per ton data for California and the Rest of the U.S. (RUS) by market.

Region	Year	Fresh	Canned	Dried	Wine	Juice
California	2007	767		294	582	
	2006	898		277	582	
	2005	442		261	582	
	2004	716		320	549	
	2003	601		172	530	
	2002	616		152	535	
	2001	640		179	546	
	2000	565		157	567	
	1999	552		321	585	
	1998	484		276	574	
	1997	448		262	598	
	1996	650		281	536	
US	2007	n/a	n/a	n/a	n/a	n/a
	2006	987	303	241	562	n/a
	2005	570	n/a	218	543	148
	2004	765	300	303	504	170
	2003	689	280	125	489	204
	2002	686	270	92	474	214
	2001	690	270	137	562	278
	2000	647	270	129	511	262
	1999	660	270	292	530	261
	1998	631	270	265	510	267
	1997	607	268	219	503	254
	1996	725	267	255	457	227

Table 2. Grape production data for California and the Rest of the U.S. (RUS) by market.

		Utilized Grape Production (in 1,000 tons)					
Region	Year	Fresh	Canned	Dried	Wine	Juice	Total
California	2007	882	21	1,427	3,571	0	5,901
	2006	776	21	1,444	3,454	0	5,695
	2005	940	16	1,325	3,849	0	6,130
	2004	907	25	1,044	3,384	0	5,360
	2003	809	27	1,564	3,215	0	5,615
	2002	926	31	1,808	3,735	0	6,500
	2001	884	29	1,617	3,400	0	5,930
	2000	885	32	1,985	3,785	0	6,687
	1999	865	35	1,392	3,181	0	5,473
	1998	703	36	1,272	3,054	0	5,065
	1997	910	44	1,717	3,525	0	6,196
	1996	810	36	1,275	2,879	0	5,000
RUS	2007	6.2	0	0	244	577	828
	2006	5.6	0	0	246	388	640
	2005	7.4	0	0	219	615	842
	2004	6.6	0	0	197	397	601
	2003	14	0	0	246	449	709
	2002	11	0	2	211	418	642
	2001	15	0	5	200	370	590
	2000	19	0	8	177	424	628
	1999	20	0	8	164	503	695
	1998	20	0	10	144	354	527
	1997	30	0	2	142	462	637
	1996	27	0	11	128	362	529
US	2007	888	21	1,427	3,815	577	6,729
	2006	782	21	1,444	3,700	388	6,335
	2005	947	16	1,325	4,068	615	6,972
	2004	914	25	1,044	3,581	397	5,961
	2003	823	27	1,564	3,461	449	6,324
	2002	937	31	1,810	3,946	418	7,142
	2001	899	29	1,622	3,600	370	6,520
	2000	904	32	1,993	3,962	424	7,315
	1999	885	35	1,400	3,345	503	6,168
	1998	723	36	1,282	3,198	354	5,592
	1997	940	44	1,719	3,667	462	6,833
	1996	837	36	1,286	3,007	362	5,529