2006 Pierce's Disease Research Symposium
By Cliff Ohmart

In December of each year, starting in 2001, the California Department of Food and Agriculture (CDFA) convenes a Pierce's Disease (PD) Research Symposium where many of the researchers being funded by PD grant programs present the latest results of their work and a symposium proceedings is published containing abstracts of all of the currently funded projects. Over two thirds of the funding comes for a grower assessment based on the value of California grapes and the rest from the University of California (UC) PD Research Grants Program. The 2006 PD Research Symposium was held on November 28 and 29 in San Diego and I will present a snapshot of what occurred there.

First a brief review of the problem. PD is a disease caused by the bacteria *Xylella fastidiosa* (Xf) which has been in California for at least 100 years and may be native to the region. Xf lives in the xylem or water conducting vessels in host plants. Disease occurs when Xf colonies build up in these vessels, interfering with water transport. However, there is also evidence that Xf somehow causes cell death in leaves and shoots unrelated to water relations. Originally PD problems in California were caused by blue green sharpshooters transmitting Xf from other plant hosts, particularly in riparian areas, to nearby grape vines resulting in PD-killed vines. Blue green sharpshooters do not like winegrapes all that much so PD tended to be a problem only on vineyard edges adjacent to riparian areas. This all changed with the accidental introduction of Glassy-winged Sharpshooter (GWSS) into southern California. GWSS is a very strong flier which likes grapes and all sorts of other plants and, as demonstrated in Temecula vineyards, spreads Xf from grapevine to grapevine, causing very high PD incidence and vine death throughout the vineyard. There is no known control for PD. In areas of Texas and Florida where GWSS and Xf are native it is impossible to grow European winegrape varieties.

There are currently well over 60 research projects underway by scientists from many institutions and it is impossible to adequately summarize them here. I will make some overall observations on the progress in general areas of research and highlight a few projects to inspire you to find out more about the projects and researchers by visiting the CDFA website and perusing the symposium proceedings[1].

GWSS Biology, Ecology and Management

The basic biology of GWSS, such as preferred host plants, where and when it lays its eggs, number of generations per year, and numerical abundance throughout the year have all been pretty well established before 2006. Much of it has been published in scientific journals and summarized in PD Symposia of past years which are also available at the CDFA website[1]. However important ecological information still needs to be collected, some of which was presented at the 2006 Symposium. For example, since GWSS survives through the winter as an adult and does not go into diapause (i.e. a resting stage)

[1] http://www.cdfa.ca.gov/phpps/pdcp/ResearchSymposium/gw2006symp.htm

it must feed to survive. Researchers hypothesize that if winter temperatures are cold enough to prevent adults from feeding they would literally die of starvation and the insect would never gain a strong foothold in these areas. A team led by Dr. Marshall Johnson at the University of California Riverside defined the environmental constraints that influence the survival of GWSS through the winter and have created a map of California indicating where GWSS is likely to do well during the winter, where it cannot survive, and where it will struggle.

Another important area where work remains to be done is determining economic thresholds for GWSS in specific situations, such as in citrus orchards or vineyards. There are currently no scientifically validated treatment thresholds for GWSS.

Since the start of the PD research programs a significant amount of research money has been invested in studying the biological control of GWSS. Scientists have traveled to the native range of GWSS looking for promising biological control agents, the taxonomy of many of these agents has been sorted out, parasites have been collected and brought to California for careful study and release, and studies are being done to identify key predators of GWSS in California. It appears the most promising biological control agents are several species of small wasps in the genus *Gonatocerus* which parasitize the eggs of GWSS. Dr. Mark Hoddle and colleagues at the University of California Riverside have done a tremendous amount of work on biology and ecology of these parasites as well as their effectiveness in control GWSS numbers.

There is a feeling among many of the scientists working in the area of biological control of GWSS that most of the essential work has been done and that parasites will likely have their biggest impact on populations of GWSS in urban settings. In agricultural settings it is unlikely that biological control agents can keep GWSS numbers low enough to prevent spread of PD. However, some scientists disagree, thinking that GWSS can also play a crucial role in the management of PD in agricultural settings. Moreover, there are some areas where important work remains to be done. For example, parasitism of GWSS eggs by *Gonotocerus* is low in the spring generation but much higher in the summer/fall generation. It is hypothesized that if parasitism in the spring could be increased significantly it may provide enough overall control of GWSS to be effective in reducing PD incidence.

A significant amount of research has also been done concerning controlling GWSS with insecticides, such as identifying the best materials to use to stop the spread of GWSS on nursery plants, the best materials to use in agricultural settings such as in citrus orchards and vineyards, and how to control GWSS on an area-wide basis. Much of this work has been done by entomologists at the University of California Riverside, such as Drs. Nick Toscano, Richard Redak, Matthew Blua and Frank Byrne in cooperation with the citrus, grape and nursery industries. As a result of this work very effective strategies have been developed and implemented to control GWSS in citrus and grapes as well as on nursery plants destined for shipment to non GWSS-infested counties.

Biology, Ecology and Management of Xylella fastidiosa

Great advances have been made in the knowledge of the biology and ecology of Xf as a result of the grower and UC-funded research projects on PD. Unfortunately, this has not yet resulted in the development of any commercially applicable management tactics for PD. This is not for the lack of trying. There are many extremely talented researchers doing some great science. It's just that studying a bacteria that lives in plant xylem and figuring a way to either keep it out of the plant or from not causing disease once it gets there is extremely challenging. Moreover, the fact that it is vectored by GWSS, a very active insect with a large host range, adds a whole other level of complexity.

Most scientists and many practitioners believe the only way to end up with an effective management program for PD is to understand the biology and ecology of Xf and how it causes PD in grape. By taking this approach it is hoped that one or more weak links in the life of Xf can be broken and the disease cycle stopped. Therefore, studies are being done in all aspects of Xf biology and ecology in not only the grape plant but also in GWSS. Moreover, with the rapid development of technologies for studying an organisms genome (its entire genetic material), the DNA of several strains of Xf has been completely sequenced. Researchers have been able to take these results and begin figuring out the role of specific genes in how Xf operates in the plant and GWSS and possible ways to disrupt processes critical to either Xf survival or its ability to cause PD. Another very valuable outcome of this genetic work is the development of quicker and cheaper ways to determine the presence of Xf in grape plants, including ones that can be used in the vineyard.

It is impossible to begin to cover all of the areas of research being done on Xf. Interested readers can go to the CDFA website listed above and review the abstracts of each project in the PD Research Symposium Proceedings. I will mention only a few here to wet your appetite.

One important area of work is being done by Dr. Steve Lindow and his colleagues at UC Berkeley. They discovered that Xf produces a chemical 'signal' that plays a role in Xf cell aggregation and therefore plugging of the grape xylem vessels. They hypothesize that if this signal can be disrupted, Xf may not end up causing PD in the grape vine. Their studies have advanced enough to where they are about to try applying a spray to the vine that would be absorbed into it and prevent Xf from aggregating and causing PD.

Another project, being done by Dr. George Bruening and his colleagues at UC Davis and USDA Agriculture Research Service, is focused on the development of a transgenic grape rootstock that produces a protein which is transported into the scion and interferes with Xf's ability to cause PD. As far as they know, no grape plant produces such a protein so genes that produce it need to be added to rootstock DNA using recombinant techniques.

Several projects have shown that there are many different genetic strains of Xf occuring in huge array of host plants from California to southern South America. It appears that in a 'natural' host a specific strain does not cause disease but lives scattered around the

xylem causing no problems. It is only when it arrives in a host it normally does not occur in that it may cause disease. Therefore researchers are trying to figure out why a particular strain causes a disease in a particular species of plant and what triggers it to do so.

Some of the most practical work on developing a control for PD is through conventional plant breeding. Resistance to PD occurs in some North American grape varieties. Dr. Andy Walker and colleagues at UC Davis are using conventional plant breeding to get these resistance factors into European grape varieties. The downside to this work is that it is a long process but they are able to use some of the latest genetic technologies to speed it up.

Conclusions

Unfortunately, despite all the research that has been done so far no control techniques for PD in grape have been developed. However, there are some very talented scientists doing some very valuable research and I think, for the most part, we are getting our money's worth. Having witnessed the PD program since it inception in 2001 I feel that researchers are getting to the point where many of the basic questions are being answered and we may be entering a phase where it is clearer where some control strategies may come from. While GWSS is easily managed with insecticides most realize this is not the ultimate answer for controlling PD. At this point in time it is very possible a control technique may involve either a transgenic rootstock, transgenic scion, a transgenic bacterium that acts as a biological control agent for Xf, or any combination of these things. As I discussed in my previous Vineyard Views column (citation?), it is time for the Wine Industry to come to grips with where they stand on GMOs in anticipation of these new control strategies.

As with any large research program communication among researchers and the end users of their research products is challenging. To help meet this challenge, CDFA has created an online forum at www.pdgwss.net to facilitate the interaction between all those who are connected in the ongoing battle against the PD/GWSS threat. From researchers in the lab, to winegrape growers in their vineyards, communications has and will continue to play a major role in finding a solution to this threat. Visit the online forum and get involved.