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UC and USDA support California agriculture

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In fiscal year 2002, the United States Department of Agriculture awarded the University of California \$49 million. UC received \$34 million for research contracts and grants. An additional \$15 million in USDA funds for research and Cooperative Extension support was administered through the UC division of Agriculture and Natural Resources.

USDA provides the core funding for UC's agricultural research. These USDA research dollars allow UC to attract research funding from other sources including the state of California, other federal funding agencies, and from growers and commodity groups.

Some USDA programs award research funding by using formulas based on rural population statistics. Other USDA programs, like the National Research Initiative, base their grants on a competitive peer-review process. UC is ranked first among all university systems in earning grants from the National Research Initiative.

UC's agricultural research, education and extension partnership with the federal government dates back to 1868. In that year, the California state Legislature approved the terms of the Morrill Land-Grant College Act, which provided federal support for states to establish public universities offering an education in agriculture and the mechanic arts.

The UC division of Agriculture and Natural Resources spans the entire state with three colleges of agriculture (UC Berkeley, UC Davis, and UC Riverside), a school of veterinary medicine (UC Davis), nine research and extension centers, more than 50 Cooperative Extension county offices, and a Natural Reserve System with 34 wildlands sites.

Cooperative Extension advisers, based in local communities, bring innovations and science-based information from UC campuses to farmers, ranchers and consumers across the state. Today, California is the nation's leading agricultural state, producing more than 350 crops and commodities and generating nearly \$28 billion in cash receipts (13 percent of the national total in 2001).

UC scientists and advisers are essential in defending California against invasive species and pests. Major efforts are under way to combat the threats to California's agricultural and natural resources from the glassy-winged sharpshooter and Pierce's disease, sudden oak death, and other pests and diseases. UC researchers also are engaged in studies to understand the spread of the West Nile virus and its potentially devastating impact on public health.

Current USDA secretary Ann M. Veneman earned her bachelor's degree from UC Davis, a master's degree from UC Berkeley, and a law degree from the UC Hastings College of Law.

UC is proud to work with the secretary and the department to help USDA fulfill its mission of enhancing the quality of life for all Americans by supporting the nation's agricultural sector.

Fighting childhood obesity

Our children are growing up too fast. Health problems that once affected the middle aged are now found in teenagers and even preteens. Type II diabetes, high blood pressure and high cholesterol are more and more common in children.

The culprit is obesity. Obesity is epidemic among adults, but the epidemic is even worse among children. In the last few decades, the incidence of obesity in adults has doubled, but among children it has tripled. About one-quarter of children are already overweight or at-risk.

At the UC Berkeley Center for Weight and Health, nutritionist and Cooperative Extension specialist Patricia Crawford is combating childhood obesity with funding from the USDA. Her work at the center is a good example of how extension specialists grapple with problems in urban America.

“If we had tried to create an environment to deliberately encourage children to gain weight, we could have not done a better job,” says Crawford. “In many neighborhoods, children can’t run and play – there are few sidewalks and parks, and it is unsafe for them to play unsupervised.” Children are confined to their homes, playing computer games or watching television.

Working with center co-directors Sharon Fleming and Joanne Ikeda, Crawford and the center’s staff have produced a training kit to help communities tackle the problem of childhood obesity. The kit suggests that communities should use a variety of approaches, since the problem is



Lori Ellen Brown of the Center for Weight and Health measures a boy's body fat and bone density. The substitution of soft drinks for low- and non-fat dairy products leaves many adolescents, particularly young women, without enough bone calcium.



complex with many causes.

Strategies include encouraging school districts to change policies and increase physical education requirements, encouraging the sale of bottled water, fruit juice or milk (instead of soda) and developing fact sheets for parents that contain fun, inexpensive ideas for family oriented activities.

“Dieting or restricting children’s access to food does not work,” says Crawford. “What is required is a change in the child’s environment and that requires involvement by the family and the community.”

Crawford and the center have also collaborated with state agencies to evaluate an initiative to prevent obesity among children in California. The center will conduct pilot testing of a strategy to reduce TV viewing among children in select communities.

Television watching is one of the highest-risk behaviors for weight gain in children. Over one-quarter of children reported averaging four or more hours of television viewing per day.

Says Crawford, “Television is a triple whammy. First, it is sedentary. Second, children tend to eat while they

watch. Finally, over 40 percent of commercials during prime time children’s programming are for snacks and fast food.”

Another culprit is soft drinks. They contribute almost half of the sugar in teenagers’ diets, and consumption of sweetened beverages is another high-risk indicator for excess weight gain.

Soft drinks have replaced milk products in the diets of many teenagers, leading to calcium deficiencies. Nationally, only 10 percent of girls and 29 percent of boys consumed the recommended amount of dairy foods. Lack of bone calcium can lead to osteoporosis and other degenerative skeletal problems later in life.

Crawford and colleagues at UC Berkeley’s School of Public Health and Stanford University studied the diets of young women and measured their bone density. The study concluded that diet during adolescence is particularly important for optimal acquisition of peak bone mass.

“At the Center for Weight and Health, we believe children deserve to grow up healthy and active,” says Crawford. “We know how important it is for children’s well-being to promote lifelong patterns of healthy eating and exercise.”

The race to control sudden oak death



Two views of sudden oak death. On the left, a canker on a Tanoak caused by infection with *Phytophthora ramorum*, the fungus-like pathogen that causes sudden oak death. On the right, an oak tree with the same disease, showing the discolored sap that is characteristic of the disease in oaks.

For thousands of years, California's oak trees have thrived, and the lives of the oaks have grown intertwined with the lives and identities of the people of the state. Their acorns fed Native Americans and later the oaks lent their name to emerging towns and cities – Oakland, Thousand Oaks, Oak Grove. John Steinbeck's second novel, *To a God Unknown*, tells the story of an ancient California oak and the ensuing human tragedy that follows from its death.

We are in the midst of another tragedy for California's oak trees. Since 1995, tens of thousands of oaks have succumbed to a new disease, dubbed "sudden oak death." The disease is caused by a previously unknown fungus-like organism called *Phytophthora ramorum*. It was a relative of *Phytophthora* that caused the Irish potato famines in the 19th century. The ultimate impact of this new plant disease on California's forests and ecosystems is still unknown.

At UC Berkeley, forest pathologist and extension specialist Matteo Garbelotto is racing to find out how the disease spreads, and how to control it. "The American chestnut was destroyed by a blight in the early 1900s," says Garbelotto. "We are hoping California's oaks won't share the same fate."

Phytophthora attacks the cambium, the nutrient-carrying layer beneath the bark, growing there until the tree is strangled and dies. The pathogen was identified as the cause of the disease late in 2000, five years after trees in coastal counties began showing symptoms. Garbelotto's collaborator, David Rizzo, a UC Davis

plant pathologist, first cultured the new species. Meanwhile Garbelotto developed a genetic test for the pathogen using nested polymerase chain reaction (PCR), a technique that amplifies trace amounts of genetic material.

In a scientific speciality that usually works slowly and methodically, sudden oak death has caused an explosion of questions and activity. "For a scientist, this can be frustrating," says Garbelotto. "We never seem to have time to resolve one question before a dozen more pop up that also demand our attention. The questions grow faster than we can answer them."

To date, there is no practical way to treat sudden oak death. Experiments that treat infected trees with phosphoric acid, a chemical that has been effective against a related *Phytophthora* in Australia, have shown limited success. But this technique is too expensive and labor intensive to treat millions of trees in the wild.

One of the most puzzling questions is where the disease originated. The likely candidate is the Rhododendron, a common ornamental nursery plant that is routinely shipped

throughout the United States and Europe. Varieties of *Phytophthora ramorum* have been isolated from Rhododendrons in several European countries. However, the *Phytophthora* that is infecting European Rhododendrons seems to be genetically distinct from the Californian variety. The source of the epidemic here remains a mystery.

(continued on page 8)



UC Berkeley forest pathologist and USDA extension specialist Matteo Garbelotto discusses a tree infected with the pathogen that causes sudden oak death.

Breeding *Xylella* resistant grapes



UC Davis grape geneticist Andrew Walker points to damage caused by Pierce's disease.

In the 1870s, Anaheim was the grape growing capital of California. Wine, table and raisin grapevines covered forty thousand acres, and almost 50 wineries dotted the landscape. In the 1880s, something went wrong. Grapevines began to wither and die, no matter how much they were watered.

As the region's grape production collapsed, the United States Department of Agriculture brought in special agent Newton B. Pierce, an expert in bacterial diseases of plants. But neither Pierce nor anyone else could solve the puzzle, and the disease permanently destroyed Anaheim's commercial grape production. Although Pierce never did find the culprit, the malady was given his name.

We know now that Pierce's disease is caused by *Xylella fastidiosa*, a bacteria that spread to California from the Southeastern U.S. The bacteria is harbored by several species of native plants in the North Coast wine country of Napa and Sonoma counties. In 1996, Napa growers estimate they lost \$24 million due to Pierce's disease.

Much like the human diseases bubonic plague and malaria, Pierce's

disease requires an insect vector to spread. The vector for the disease is a small leaf-hopping insect called a sharpshooter. These insects transmit the bacteria as they feed on the fluid-filled xylem, the vessels that transport water inside plants. An infection with *Xylella* causes the xylem to fill with a waxy residue, and the plant dehydrates and dies.

Fortunately for the North Coast wine industry, the local green and blue-green sharpshooters don't care much for grapes and instead prefer creekside habitats with their native plants and grasses. The habits of the local sharpshooters have helped keep the costs of Pierce's disease under control – for now.

Just as the bacteria that causes Pierce's disease migrated from the Southeastern U.S., so did a dangerous vector for the disease – the glassy-winged sharpshooter. Unlike the local varieties, this sharpshooter is a voracious feeder on grapes and will travel from plant to plant, spreading the fatal disease with each feeding.

An outbreak of glassy-winged sharpshooters in 1997 caused significant damage to the vineyards in the Temecula Valley, southeast of Los Angeles. More recently the insects have spread the disease to grapevines in Kern County near the southern end of the San Joaquin Valley.

USDA and UC researchers, along with scientists and inspectors from the California Department of Food and Agriculture and county agricultural commissioners, are working to confine the outbreaks to these two regions. They are keeping the glassy-winged sharpshooter out of California's premium wine growing regions to the north for as long as possible.

The only lasting solution is to breed grape varieties that are resistant to Pierce's disease. These may take years to cultivate but under UC Davis grape geneticist Andrew Walker, the work is under way.

"There are about 20 to 25 native species of North American grapes, and other than the Concord grape, most Americans have never tasted any of them," says Walker. "Fortunately, some of these native species have evolved resistance to Pierce's disease."

Using both classical breeding and modern gene-splicing techniques, Walker is creating hybrids that he hopes will maintain the disease resistance of the American varieties, yet will keep the flavor characteristics suitable for the table grape, raisin and wine industries.

Virtually all of the wine grape varieties are a single species, *Vitis vinifera*. Originally from central Asia, *vinifera* varieties are susceptible to Pierce's disease. On the other hand, American species including *V. shuttleworthii*,



The vivid but unhealthy coloration in this grape leaf is caused by the bacteria *Xylella fastidiosa*.

V. simpsonii, and *Muscadinia rotundifolia* all exhibit resistance. Walker is crossbreeding the varieties using classical methods.

Grapes crossbreed or hybridize

readily, but even under greenhouse conditions, a generation requires three years. After one generation, hybrids with desirable properties must be crossed back to *vinifera* species until a variety is produced with consistent resistance and flavor characteristics. While Walker estimates it may be another 20 years before disease-resistant commercial varieties of wine grapes are available, table and raisin hybrids may be available sooner.

The process of identifying genes for resistance to Pierce's disease can be shortened by using gene-mapping techniques similar to those used to map the human genome. Grapes have 38 small chromosomes, and gene-mapping work is just beginning. Walker and his colleagues have begun to build basic maps to help find the location of genes that confer resistance and to help identify better hybrids for breeding purposes.

Gene-splicing techniques are no panacea, Walker warns. "You can isolate a desirable gene from one grape species and splice it into the chromosome of another, but you really have very little control over where the new gene is placed in the chromosome, or how it is activated. In many ways, gene-splicing techniques involve as much trial-and-error as traditional breeding techniques."

Consumer acceptance is another area of concern. In the U.S., wines are identified by the variety of the grape used to produce them. In Europe, wines are identified by the region where the grapes are grown. If you go to a fine Parisian restaurant and ask for glass of Chardonnay, you are likely to get a blank look. An attentive waiter might suggest you try a white wine from the Burgundy region, since this wine is typically made with Chardonnay grapes.

In the U.S., a Chardonnay that has been crossed with a wild variety from Florida can no longer be called a Chardonnay. "Two decades from now," says Walker, "We may be in the business of creating whole new varietal classifications for new disease-resistant hybrids."

Regardless of the scientific nature of the methods for producing new grape varieties, the ultimate test is a highly subjective one – taste. The most disease-resistant grape hybrid is of little commercial value if it doesn't taste good.

At the end of the growing season, Walker and his students harvest the dozens of varieties of hybrid grapes they have grown that season and have a grape-tasting party. "If a variety doesn't taste interesting, we pull it up and plant something else."



A refrigerator magnet urges Napa County residents to report any sightings of the glassy-winged sharpshooter.

UC experts help fight Pierce's disease

UC researchers and extension advisers play a major role in the fight against Pierce's disease. UC brings a remarkable breadth and depth of research to the battle, from basic laboratory research on the genetic variations of *Xylella fastidiosa*, to applied research in local fields to determine the most effective pesticide regimes for eliminating sharpshooters.

In addition to the research of Andrew Walker and others at UC Davis (see main story), scientists at the Berkeley and Riverside campuses – the other agricultural colleges at UC – also help keep the glassy-winged sharpshooter at bay. At the Cooperative Extension county offices, advisers work directly with farmers to implement the latest techniques based on UC research.

UC Berkeley entomologist Alexander Purcell has been studying and writing about Pierce's disease for 30 years. He was part of the team that first cultured *Xylella fastidiosa* and proved it caused Pierce's disease. Purcell has devised ways to reduce sharpshooter populations by managing the vegetation that harbors the pests. He is working with Brazilian researchers to sequence the genome of the *Xylella* bacteria.

UC Riverside researchers played a pivotal role in halting the outbreak of Pierce's disease in the Temecula area in 1997. Extension entomologist Nick Toscano devised pest management programs to reduce sharpshooter infestations with a minimum of insecticide and the least disruption to the environment. Bacteriologist Donald Cooksey is developing means of biological control of *Xylella* through creating benign mutant strains that can competitively displace pathogenic strains.

UC Cooperative Extension advisers work with growers, farmworkers, regulators and county agricultural commissioners to control sharpshooters. They also have taken the lead in developing on-site pest management programs for Southern California nurseries to prevent the spread of glassy-winged sharpshooters to other parts of the state in shipments of landscape and ornamental plants.

Seeking salt-tolerance genes



At the USDA salinity laboratory at UC Riverside, USDA researcher Clyde Wilson and graduate student Harkamal Walia test salinity levels. The barley plant on the right has been stunted by excessive salinity.

The world is running out of fresh water. Expanding populations will require more food, yet at the same time more people will compete with agriculture for both land and water. In the future, crops will have to grow with brackish water or in poorly-drained irrigated soils. The result will be the build-up of salt in the soil and the stunting of crops.

On several UC campuses, scientists are looking for ways to make plants more salt-tolerant. UC Davis researchers have spliced a gene from a cabbage relative into tomato plants, allowing the plants to shunt salt into cavities in the leaves. The fruit grows normally, even in extremely salty water.

At UC Riverside, plant geneticist Timothy Close is taking a different approach. Working with USDA researchers and a private company, he is developing new bioinformatics tools to unlock the natural genetic potential of the barley genome.

Barley is a good model plant for the cereals. It is closely related to wheat, rye and their wild cousins, yet barley's genome is simpler than those of the wheat varieties used for bread and pasta. If Close can understand the genetics of salt-tolerance in barley, he can apply that knowledge to wheat, rice, corn and the other grains that make up the bulk of the world's cereal consumption.

Working with Affymetrix, a San Francisco Bay Area biotechnology company, Close has helped develop a microarray, or "gene chip" for barley (see photo). "The germplasm of wild and cultivated barley naturally contains special forms of genes that could be used to improve salt-tolerance," says Close. "The microarray is a new tool that will help us recognize this genetic variation."

Close and colleagues collected genetic information on barley genes from laboratories in five countries and put it together in a database that included about 40,000 of the estimated 55,000 barley genes. Each gene contains the DNA blueprint for a protein used by the plant to grow.

Using techniques borrowed from the semiconductor industry, samples of the DNA from 22,000 barley genes were embedded on a microarray chip in 500,000 precisely defined spots. Each spot is only 18 thousandths of a millimeter square, yet each spot can be individually analyzed by a laser scanner.

Close uses the gene chip to detect which genes are responsible for salt-tolerance in barley. The barley genes contain instructions for tens of thousands of proteins. The trick is determining which genes contain the codes for the proteins the plants need to survive in salty conditions.

At the USDA salinity laboratory on the Riverside campus, Close's student Harkamal Walia and USDA research scientist Clyde Wilson grow varieties of barley in saline conditions. From the salt-stressed plants Walia extracts samples of genetic material. These samples are rich in genetic codes for salt-tolerance proteins

used by the plant. When a sample is placed on the gene chip, it will react with some of the 22,000 barley genes on the chip. By noting which genes on the chip react with the plant's genetic material, Close and colleagues get vital clues about which of the genes are responsible for salt-tolerance.

Armed with this information, Close can more rapidly sort through the progeny produced by crossing different strains of barley and identify genotypes with salt-tolerance genes.

"As each barley variant is identified," says Close, "there is an opportunity to bring it into plant breeding programs so that new varieties can continue to be developed to help farmers all over the world grow healthier cereal crops in marginal conditions."



UC Riverside geneticist Timothy Close holds the barley gene chip he helped to develop.

Sustaining California agriculture

From the top of a hillside onion field at UC Santa Cruz, you can take in the sweeping view of Monterey Bay. The natural diversity of region is stunning, from rocky beaches where photographer Edward Weston composed his images, to the Watsonville strawberry fields where Cesar Chavez organized farmworkers.

Can these local farms, expanding towns and the Monterey Bay Marine Sanctuary continue to coexist in coming decades? Can agriculture continue to be both profitable and sustainable here? It is these questions that drew Cambridge-trained botanist Carol Shennan to this Santa Cruz hillside in 1997.

Shennan is the director of the UC Santa Cruz Center for Agroecology and Sustainable Food Systems. "Sustainable agriculture rests on the principle that farming must meet the demands of the present without compromising the future," says Shennan.

Although organic farming is a important component of sustainable agriculture, topsoil depletion, groundwater contamination, the decline of small farms and the neglect of farm laborers are also major concerns.

At the statewide level, the UC division of Agriculture and Natural Resources supports the Sustainable Agriculture Research and Education Program (SAREP). Based at UC Davis,

SAREP helps California farmers and ranchers develop low-input, organic and other sustainable production practices. The program promotes a "systems approach" to farming and has pioneered the introduction of environmentally compatible practices for growing walnuts, cotton, strawberries and other commodities through biologically integrated farming systems.

From its inception, the UC Santa Cruz agroecology center has offered its services to small- and medium-scale growers looking for ways to implement sustainable farming techniques. The center's farming systems and agroecology research and extension program develop comprehensive soil fertilizer management and pest control alternatives for regional crops.

Shennan's work at the center has begun to attract USDA funding, and she is involved in a multi-year study of the quality of water that flows into the marine sanctuary.

The main watersheds that flow into Monterey Bay drain 5450 square miles. Seventy-five percent of the land in the drainage area is used for agriculture and livestock production. At times, these rivers show excess levels of nutrients, sediments and pesticide contamination. Shennan and colleagues have been taking detailed measurements throughout the year to determine the patterns of contamination.

"Controlling this non-point source pollution is difficult. A single farm is not to blame. Rather, we work to document how certain farming practices throughout the region could help prevent this unnecessary runoff," says Shennan.

Shennan is concerned with possible sources of runoff from both standard

and organic farms. "We understand pretty well how commercial chemical nitrogen fertilizers can leach from the soil into groundwater, but we actually have little data on how organic fertilizers behave."

Shennan stresses that blaming farmers for these environmental problems is simplistic. Farmers are caught by economic forces, selling in markets where they have little control. They must often respond to demands of buyers that prevent them from practicing good soil conservation and fertilizer management.

Lower-income farmers, many who have come from Mexico, must rent and farm marginal steep land, where erosion can be severe. The combination of language barriers and lack of incentives to improve rented land can make optimal practices difficult to achieve.

Researchers at the center are studying the possibilities of community supported agriculture for Central Coast farmers. Under this plan, a farmer commits to growing food for a group of people, and the group supports the farmer by paying for their share of produce ahead of time, often at the beginning of the season. Members of community supported agriculture plans share both the risks and the bounty of farming.

At the national level, organic farmers in the Monterey Bay area count their congressman, Sam Farr, as a big supporter. Farr has sponsored legislation for strengthening organic labeling and has encouraged USDA funding for studies of organic and sustainable farming practices.

Shennan is spreading the word internationally as well. She recently toured the United Kingdom and the Netherlands, where she visited a number of other programs working on sustainable agriculture. Says Shennan, "It's exciting to learn about their efforts as well as to share the news of our center's work."



Director Carol Shennan of the UC Santa Cruz Center for Agroecology poses with the center's organic garden.

(continued from page 3)

One thing has become clear from the research. The early moniker for the disease, sudden oak death, is misleading on all counts. *Phytophthora* doesn't only attack oaks, and it doesn't always kill suddenly – or kill at all. Many other plants can harbor the fungus with only minor symptoms, acting as a reservoir for infection.

Twenty-six plants are now listed by the state Sudden Oak Death Task Force as affected by the pathogen, including Douglas fir, Coast redwood and California bay laurel. In these trees, the symptoms of the disease appear to be limited to the limbs and branches, and the infection doesn't kill.

The Tanoak, a close cousin of the oaks, is the most susceptible tree. In the coastal canyons of the Big Sur area south of Monterey, the Tanoaks have been decimated. Oaks seem to be less susceptible. So far the four oak types known to be infected with *Phytophthora* are the Coast live oak, the Canyon live oak, the California black oak and the Shreve oak. On Marin County's Mount Tamalpias, the infection is spotty, leaving a mix of healthy and dying trees. This may be due to genetic variation in the trees, or it may be due to the way the pathogen spreads, carried by splashes of rain.

For now sudden oak death seems to be confined to the coastal counties of northern California and southern Oregon. The organism is probably killed by high temperatures like

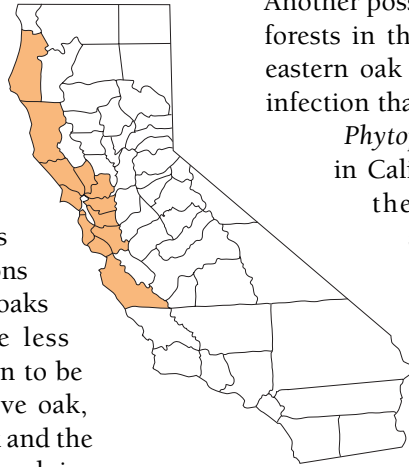
those occurring during a hot Central Valley summer. These findings give rise to the hope that sudden oak death will be confined to cool moist areas, allowing a healthy proportion of the state's oaks to survive.

There are reports that *Phytophthora* might be present in the Sierra foothills, but this has not yet been confirmed. Another possibility is that the disease could jump to oak forests in the eastern U.S. Tests have shown that the eastern oak varieties are even more susceptible to the infection than their western counterparts.

Phytophthora can drastically alter forest ecology in California. Although redwoods seem to resist the pathogen, it may make them more susceptible to other opportunistic infections – leading to a die-off of the world's tallest trees. And even if a few individual coastal oaks are resistant and can survive, it might take them decades to reestablish themselves – if they ever do.

Over the next century, the natural landscape of coastal California may change so drastically that not even John Steinbeck would recognize his beloved Salinas Valley.

"We're learning as much as we can as fast as we can," says Garbelotto, "to predict the changes *Phytophthora* will cause, and maybe to prevent those changes through better management of the land."



Sudden Oak Death has spread to 12 coastal counties.

UC Davis awarded major USDA grant to assure homeland security and food safety

A \$900,000 grant from USDA is funding the new Western Center for Plant Disease and Pest Surveillance and Detection at UC Davis. The center will protect against pests and diseases introduced accidentally or through acts of bioterrorism.

After the September 11 terrorist attacks, food safety and security have taken on new meaning. UC scientists and veterinarians, in partnership with UC Cooperative Extension advisers, industry and government, are working to secure agricultural production in California.

The new center will be coordinated by UC Davis's College of Agricultural and Environmental Sciences. The center will work with partners throughout the western United States to establish a network for detecting and diagnosing plant-health problems.

The newly established network will concentrate on linking researchers, databases

and information systems at diagnostic laboratories in the region to better track the health of crops and the progression of any disease or insect outbreak.

Nationally, a communications system will be established to provide early detection and diagnostic capabilities for plant disease and pest concerns. More timely diagnostic information will be provided to the agricultural agents and specialists who must address pest or disease problems at the local level.

This year's goal for all of the regional networks is to develop a prototype network demonstrating coordinated national capability to detect, identify and report possible bioterrorist attacks on agricultural and natural ecosystems.

Director of the new campus center and diagnostic network will be Richard Bostock, professor and chair of the UC Davis Department of Plant Pathology.

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