FALL 2004 - VOL. 8, ISSUE 3

CORF news

FLORICULTURE EDUCATION FROM THE KEE KITAYAMA RESEARCH FOUNDATION

Potential for Partnerships Between Local Agriculture and the Biotechnology Industry

by Valerie J. Mellano, UC Cooperative Extension, San Diego

The biotechnology industry is growing and maturing to the point where there are now countless genetically altered products marketed worldwide. According to a recent report, San Diego County is home to over 450 biotechnology-related companies. It is considered to be the leading metropolitan area for life science and biotechnology.* Much of the research and development of biotech products is conducted in plant materials, whether the end product is agriculturally related or not. Although San Diego County has a very active and productive agricultural industry, most of the plant-related research and development by the local biotech companies is not conducted in San Diego County, but rather in the Midwest and South, usually due to specific ties that an individual researchers within the biotech companies may have. During a recent sabbatical leave, I conducted a study to determine the potential for a linkage between local agricultural producers and the biotechnology industry, possibly providing economic opportunities for both groups.

During the course of the study, I conducted interviews with members of the agricultural and biotechnology industries. I interviewed 27 growers of various commodities, and members of the allied industry. Most of these individuals had previously expressed an interest in having some involvement with the local biotechnology industry. In addition, representatives of 10 local biotechnology companies were also interviewed. General questions were asked of each group, designed to gain

Potential for Partnerships cont. on page 2

A Rose by Any Other Name is Still a Rose?

Some Things You Might Want To Know About Biotechnology

by Peggy G. Lemaux, UC Cooperative Extension, Berkeley

Two rose bushes may look identical, that is until they flower. Then one bursts forth with spectacular melon-colored blossoms with a sweet fruity fragrance while its near identical twin has deep scarlet flowers with a hint of musk. In fact, hundreds of varieties of roses are grown in backyard gardens to the delight of all.

The uniqueness is due in part to the genetic information in the cells of the rose plant, which determines color and scent. That information is arranged in

A Rose by Any Other Name cont. on page 3

Genetic Manipulation

A Powerful Tool for Sustainable Production of Ornamentals

by Michael Reid, UC Cooperative Extension, Davis

Sustainable agriculture is often extolled as a tool for reducing inputs and eliminating environmental consequences of agricultural production. While these are important goals, we must remember that economic sustainability is just as vital. If we cannot make a reasonable return on our investments in production and marketing of agricultural commodities, we're forced either to quit or to adopt production techniques that reduce costs and techniques that are often detrimental to ecological sustainability.

Some consider 'organic' production as being synonymous with sustainabil-

Genetic Manipulation cont. on page 4

Editor's Note:

This issue of CORF News focuses on biotechnology in agriculture. You hear about it in the news, you vote for it or against it, and you might be scared of it or think great things of it. But what is it? We have 3 feature articles that help you understand what biotechnology is and how it might relate to your horticulture business.

After seventeen years of serving San Mateo County, Farm Advisor Ann King has left her post there and has moved to a new position at UC Davis. She will be missed in the County, and her CORF News Regional Report will be missed too. So instead of a San Mateo County Report, for the next few issues we plan to have a Regional Report from various other Farm Advisors located around California. We will give a different perspective of flower and nursery production from a different part of California in each issue. This issue Farm Advisor Mary Bianchi writes about San Luis Obispo County.

-Steve Tjosvold, Editor, CORF News

IN THIS ISSUE

Features

Potential for Partnerships _____ 1,2,4

A Rose by Any Other Name _____ 1,3

Genetic Manipulation _____ 1,4,10

Regional Reports

San Cruz & Monterey Counties _____ 6
Management of *Phytophthora ramorum*

Ventura & Santa Barbara Counties ___ 7
Ag Waiver Process in Ventura County

San Luis Obispo County _____ 8
The New Conditional Waiver for Irrigated Agriculture

San Diego County _____ 9,11
Preplant Soil Treatments Critical for Economic Production of Field-Grown Ranunculus

Other Interests

Science to Grower _____ 10
Does Mulching Alter Gene Expression in Crops?

Get Cultured _____ 12, 13
Copper Ionization and its Applications

Campus News & Research Updates __ 14
Genome & Biomedical Sciences

2005 CORF Program Calendar _____ 15

Sponsors _____ 16

Potential for Partnerships cont. from page 1

information on their education, agricultural and scientific background, their overall level of knowledge of the other industry, particularly on a local level, and their level of interest in partnering with the other industry. Questions concerning what they believed they could contribute to make a potential agricultural/biotechnology partnership a success were also asked.

Agriculture/Allied Industry Interviews:

Members of the agriculture/allied industry group were asked specific questions in addition to those noted in the previous paragraph regarding:

1) Level of knowledge and experience with biotechnology.
2) Knowledge of the local biotechnology industry, including any specific interactions with local companies.
3) On-farm facilities, equipment and expertise that the growers could provide.
4) Potential compensation-what are your time and facilities worth?
5) Potential for vandalism and the levels of security required to produce genetically altered plants.
6) Any philosophical objections to biotechnology.

Results of my grower interviews (See Table 1), indicated that most growers had college level education in science (22/27) but only one of 27 individuals interviewed had any hands-on experience with biotechnology. Several others (8/27) were fairly up to date with regards to the current and potential technology, but did not have individual experience dealing with local biotechnology. All growers underestimated the size of the local biotechnology industry, and most estimated it to include about 40 companies, or 10% of the actual number. None of the growers had accurate information about the level of security required (varies depending on the product, but is generally minimal), but were not concerned about meeting the security requirements once informed of them. None of the growers interviewed had philosophical differences with the idea of biotechnology, and were also not concerned about potential vandalism found in other locations, since San Diego County has generally accepted biotechnology and its products. Only one grower indicated that she would not be interested in a potential partnership at this time because all of her facilities (greenhouses) were in maximum use and there was no additional space.

As far as compensation was concerned, suggestions ranged from rates similar to leasing greenhouse space, to a consultant fee and stock options. It was noted that most of the growers greatly underrated the value of their expertise, and were willing to charge little or nothing for their own personal assistance in the growing operation. It was also noted that while most of the growers felt uneasy placing a high value on their services, they did not realize the large dollar figures that are required to develop a genetically altered product and the prices paid by the biotechnology companies for other services.

Table 1. Selected Grower Responses to Agriculture/Biotechnology Partnership Interview Questions

Agriculture/Allied Industry: Selected Responses	% of those interviewed
1. Had some college-level science education	81%
2. Had hands-on biotechnology experience	4%
3. Had current information on security requirements for handling/growing engineered plant materials	0%
4. Had current information on technology and potential of biotechnology	30%
5. Had current information on the size/impact of the local biotechnology industry	0%
6. Expressed interest in developing a partnership with local biotechnology industry	100%

Biotechnology Industry Interviews:

Members of the biotechnology industry were asked for information on the following topics:

1) Level and experience with production agriculture.
2) Specific knowledge of agriculture in the San Diego area.
3) Current arrangements for field or greenhouse studies.
4) Types of facilities and expertise needed for production.
5) Expected levels of compensation for grower cooperators.

Responses to the questions were fairly consistent (see Table 2) among the biotechnology companies. None of the individuals interviewed had any production agriculture experience, but all had research experience, and had focused on microbiology or "growth chamber" scale plant production. In addition, none of those interviewed had any idea of the scope or magnitude of the agricultural industry in the San Diego area. Several (4/10) conducted field or greenhouse research and development work in remote areas. Most, (8/10), expressed interest in working with growers in the San Diego area, unless they had long established exclusive relationships or field stations in other parts of the country, (2/10), or if their plant or project type was not a good match for the local climate (1/10). All of the companies cited a need for field or greenhouse space and considerable grower expertise at some time during the research and development process, although it may not be continuous, possibly making a partnership more difficult. Four out of ten interviewed commented that it was difficult and expensive to construct greenhouse and other plant production facilities in San Diego County, particularly close to the location of most of the biotechnology companies (La Jolla/Sorrento Valley area). Current field and greenhouse arrangements included company-owned field stations in other parts of the country and arrangements with university field stations. Trips to visit the field sites are costly in both time and expenses, and it was noted that cooperation with local growers could alleviate that.

The biotechnology companies placed a higher value on the services and knowledge that a grower-cooperator could provide, much higher than the growers themselves placed on their services. While it was noted that each project would be

Potential for Partnerships cont. on page 4

recipes, or genes, made of chemical units. If alphabetic letters are used to represent each unit, 52 books of recipes, each with 1000 pages, would be needed to hold all of the information for a particular rose variety.

What if we wanted a new rose variety? If we used classical breeding, we would cross pollen (male cells) of one variety with eggs (female cells) of another and select a new, rose variety with the color and smell we wanted. What happens to the genetic information when you do that? Easy, you just combine them to make 104 books? No, genetic rules say only 52 books remain, so 50% of the recipes from each parent is kept; 50% is lost. Breeders can't control which recipes are kept, but just observe and choose the one closest to the one they want.

In the late 1800's, an English farmer, Henry Bennett, artificially pollinated Hybrid Perpetual and Tea roses and began to promote a new class of roses, called Hybrid Teas. From that time on rose breeding changed.

Roses have a wide spectrum of growth types, from massive ramblers to shrub roses from miniature types to tall bushy varieties. They also present a wide spectrum of colors – from fire engine red to peach pink, from creamy white to egg yolk yellow. But, despite efforts by rose breeders, amateurs and professionals, one color you won't see from breeding is blue! Why?

Flower color is due primarily to a plant's ability to make certain pigments. In different flowers there are two major pigments, flavonoids, which contribute yellows, reds and blues, and carotenoids, responsible for yellow to orange flowers. But roses lack a major component needed for flavonoids and so they can't make the blue pigment. In this case classical breeding is limited by a genetic deficiency in the rose species. And since you can't cross the species barrier with classical breeding, you can't cross a rose with a blue pansy to get a blue rose.

New methods exist that allow researchers to read the "books of genetic information" in an organism; this has been done for microbes, viruses, mouse, rat, human, and two plants. By doing this you can develop a genetic table of contents for the recipes or genes in a particular organism. Such a table of contents is being developed for roses and will be used to identify traits to, for example, protect against fungal and insect attack. Having this table of contents makes breeding easier since it is possible to link a recognizable physical part of the genome with the desired trait.

To develop a blue rose, a different approach to using the table of contents was used, called genetic engineering (GE). A single trait, encoded in a gene, is comparable to a half page recipe in the 52-thousand-page book. This can be cut out of a flower that has the blue pigment using the table of contents and then introduced into the rose to direct the plant to make the blue pigment. In early 2004, Japanese scientists successfully introduced a pansy gene into rose to create the first true, blue rose.

Whether you consider breeding and GE the same or different depends on your perspective. Both use the same cellular machinery to move genes around and both cause heritable genetic changes. So in that sense they are the same. But with classical breeding the change occurs inside the cell, while with GE it occurs in the laboratory. Also with breeding keeping a given gene is a random process, while specific genes are introduced with GE.

Perhaps the most fundamental difference is that gene exchange by breeding takes place most often between closely related plants, although gene exchange at a low frequency occurs across species barriers, like crossing rye with wheat to get *Triticale*. With genetic engineering the gene source can be the same crop, another crop or even different organisms, like bacteria or animals. Why? This is because genetic information in all living things is written in the same (chemical) language. In fact humans and plants share many (~40-60%) of the same genes.

So how many foods and horticultural crops today are genetically modified? It depends on the definition. If you mean how many have genetic changes, the answer would be all, including ones grown as organic. For example, ancient corn relatives did not look like modern corn; its seeds were too hard to open with your teeth and seed numbers were hundreds of times lower.

If you mean how many different commercial GE crops are on the market, the number would be very small. While many processed foods (except those labeled 100% organic) contain a GE ingredient, they come from a small number of large-acreage crops, corn, soy, cotton or canola. The only whole GE food on the market is a viral resistant papaya. There are no GE horticultural crops in commercial production in California, although small-scale field trials have been conducted under the guidance of the USDA's Animal and Plant Health Inspection Service (APHIS). In Australia, there are GE carnations being grown commercially – called Moonglow for its blue color that comes from petunia; it is also engineered to last longer by turning off an "aging gene". But these carnations only enter the U.S. in cut form.

So roses are roses? No, major and minor gene alterations in roses have occurred over time, both naturally and with human help. This has resulted in today's wonderful diversity of rose varieties – from ramblers to miniatures, from deep red Tea roses to brilliant yellow floribundas. These modifications occur through human intervention in gene exchange – either by classical breeding or genetic engineering. ❖

Peggy G. Lemaux
Department of Plant and Microbial Biology
University of California
111 Koshland Hall
Berkeley, CA 94720
Phone: (510) 642-1589
Fax: (510) 642-7356
Web Address: http://ucbiotech.org

Potential for Partnerships cont. from page 2

Table 2. Selected Biotechnology Representatives Responses to Agriculture/ Biotechnology Interview Questions

Biotechnology Industry Responses	% of those interviewed
1. Had some college-level science education	100%
2. Had hands-on production agriculture experience	0%
3. Had current knowledge on size/impact of local agricultural industry	0%
4. Had other field/greenhouse arrangements in other parts of the country	40%
5. Expressed interest in developing partnerships with local agricultural producers	80%
6. Intended to continue exclusively with remote field locations	20%

Grape vineyard. (Photo by Lynn Betts)

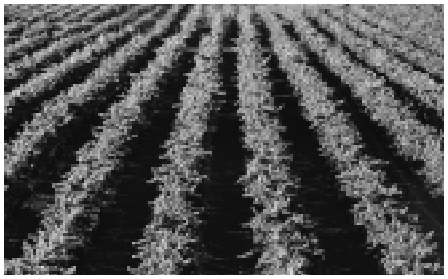
different and negotiated independently, the industry representatives assumed that there would be a grower fee charged, in addition to the square footage charge for greenhouse space. The level of involvement and knowledge of the growers would determine the compensation. Members of the biotech industry cited electrical capacity and sustainability, price of employee housing and business real estate, and traffic issues as major concerns in continuing in business in the San Diego area.

Although it was established that there is a need for greenhouse and field facilities and grower expertise, there were a few drawbacks to long-term relationships noted by both groups. The biotechnology industry goes through changes, and often a smaller company is bought out by larger companies, altering their research agenda, or their location for doing business. This can interrupt partnership programs. In addition, it is not unusual for personnel in the biotech industry to move from one company to another, making long-term maintenance of relationships difficult. Some of the biotech firms indicated that they are "not quite there yet" with regard to product development, and do not yet require field or greenhouse facilities for their research and development. Both groups indicated that there was a lot of present and future potential for a match between agriculture and the local biotechnology industry, and that further information would be helpful for both sides.❖

Reference cited: DeVol, Ross, Perry Wong, Junghoon Ki, Armen Bedroussian and Rob Koepp.*
America's Biotech and Life Science Clusters: San Diego's Position and Economic Contributions. Deloitte and Touche, LLP, 2004.

Valerie J. Mellano
Environmental Issues Advisor
UC Cooperative Extension
5555 Overland Avenue, Suite 4101
San Diego, CA 92123-1219
Phone: (858) 571-4204
Fax: (858) 694-2849
e-mail: vjmellano@ucdavis.edu

Genetic Manipulation cont. from page 1



ity in agriculture, and organic production and marketing is the fastest growing sector in the industry. However, consideration of organic production practices suggests that they are far from being environmentally sustainable. For example, permitted pesticides include elemental sulfur, and Bordeaux mixture, a copper-containing fungicide that certainly contaminates the soil and the plant materials on which it is used. In 2002, California's grape growers applied 20,000 tons of sulfur for control of powdery mildew and grey mold, the largest use of a single pesticide in the state! Variable quality and safety, high input costs in terms of labor and approved chemicals, and small price margins for organic products suggest that true agricultural sustainability will have to be sought elsewhere.

In her accompanying article, Dr. Lemeux has clearly described our new capability to insert or delete a single gene (recipe) from the genome, the book of recipes that contains the code for all of plant growth and development. Sadly, a vocal lobby has waged a vigorous information and political campaign to convince the public that these amazing new techniques are not compatible with the desire for increasing sustainability of agriculture. Sad, because these tools provide elegant strategies to meet all the goals of sustainability – reduced inputs, minimal environmental impact, and enhanced productivity and profitability for the growers. Each year, more than 100 million acres of the nation's basic agricultural products – corn, soybean, and cotton – are genetically modified. Despite the widespread incorporation of the products of these farms into our food and fiber system, there has so far not been one documented case of illness or environmental degradation attributed to the use of GM crops. To the contrary, data show lowered costs of production and reduced worker illnesses resulting from minimizing exposure to toxic pesticides as well as improved soil quality through the use of benign herbicides and minimum-tillage techniques.

Truly sustainable agriculture will

Genetic Manipulation cont. on page 10

Management of *Phytophthora ramorum* in Commercial Ornamental Nurseries

by Steve Tjosvold, UC Cooperative Extension, Santa Cruz and Monterey

What should a commercial ornamental nursery do to prevent the introduction of *Phytophthora ramorum* (the causal agent of Sudden Oak Death)?

For most nurseries, this can be, in part, accomplished by careful inspection of new incoming host propagative material and stock. First, make sure incoming stock from infested counties are inspected by agricultural inspectors. Symptoms are not always readily apparent to inspectors on stock initially. So, a weekly, systematic, monitoring of stock by a trained scout in the nursery helps insure that the pathogen has not been introduced. Other practices that should be helpful include:

• All nursery personnel need to be aware of the issues and disease symptoms regarding this pathogen and should be ready to alert the nursery scout or other authority if characteristic symptoms are seen.

• Infected leaves often drop from plants. For high-risk incoming shipments, off- load the nursery stock in an area that can be cleaned of leafy debris. Sweep debris from the receiving area and delivery truck and bag for disposal. Loading and delivery areas should be as far from production areas as possible

• Maintain good shipping and receiving records to facilitate trace-backs and trace-forwards if contaminated stock is detected.

What about nurseries that are surrounded by native host trees and shrubs and in an immediate area where *Phytophthora ramorum* is found?

• Periodically inspect nearby native hosts for disease symptoms. Infected California bay laurel trees near the perimeter of nurseries may produce inoculum that can spread and cause infection of nearby host plants, so removal of these trees may be warranted.

• Rain runoff coming down slope from areas containing infected hosts may contain *P. ramorum*. Consider building berms to prevent water and soil movement into production areas from hillsides surrounding the nursery.

• Irrigation water pumped from streams and ponds in areas of infected native hosts may be contaminated with *P. ramorum*. Consider having this water periodically tested to detect *P. ramorum*. If it is found to be present, consider alternative irrigation sources, such as well water, or disinfection treatments.

Sporangium of *Phytophthora ramorum* (Photo by Matteo Garbelotto, UC Berkeley)

What other cultural practices that can be useful to reduce disease risk?

• Avoid irrigation practices where the foliage is wetted for prolonged periods. If sprinklers are used, irrigate in the morning to allow for thorough and quick drying of foliage.

• Monitor irrigation-water sources, other than well-water, for *P. ramorum*. Use disinfection systems if using recycled water.

• Wounded leaves (even tiny wounds or scratches) are much more susceptible to infection. Avoid handling host plants if they might be wounded when environmental conditions favor disease.

• Avoid soil or container soil contact with foliage or any splashing water from soil to foliage. Use raised benches, gravel or other means to elevate susceptible plants above soil. Transplants, even on gravel beds, appear to be very susceptible to disease due to the close proximity of foliage to soil, runoff water, or rain splash. Raised benches may be warranted for transplants.

• Propagate cuttings only from disease-free hosts.

• Use only new or disinfested containers and soil. Potting soil piles should be as far from infected native hosts or cull piles as possible and covered with clear polyethylene sheeting. Potting soil components should not be mixed on bare soil.

What about fungicides? Wouldn't fungicides control diseases of *Phytophthora ramorum* on ornamentals?

• If applications of fungicides are made to nursery stock they should be made as preventative treatments. Currently, even the most active fungicides do not stop the development of *P. ramorum* once foliar lesions are present. They need to be applied before environmental conditions favor pathogen infection, for example, before a period of rainy weather that would allow water to linger on leaf surfaces for many hours.

• The regular and blanket use of fungicides will drive the mechanism that develops resistant pathogen strains. Fungicides with specific modes of action - as many *Phytophthora*-active fungicides are - will be especially vulnerable. Minimizing fungicide use, in any way, is the first priority to prevent resistant strains from developing. When fungicides are used, use different chemical classes- either in rotation or combining products in tank mixes. Fungicides active on *P. ramorum* may already be used in the nursery to control other foliar or soil-inhabiting *Phytophthora* species or related pathogens (such as downy mildews), and their use should be considered in planning the overall fungicide treatment strategy.

• Fungicides active on *Phytophthora* should not be applied to high-risk nursery stock or cuttings that will be monitored for *P. ramorum* infection because detection of symptoms may be delayed or masked.

Where can I get more information?

The Oak Mortality Task Force maintains a website, www.suddenoakdeath.org, where nursery-specific information is available. There you will find information on regulatory issues, disease chronology and images. A draft document "Nursery Guide for Diseases of *Phytophthora ramorum* on Ornamentals: Diagnosis and Management" by S.A. Tjosvold, K.R. Buermeyer, C. Bloomquist, and S. Frankel is available by download. It also contains information on the history of the disease and pathogen biology, as well as images to aid the detection of the disease on ornamentals.❖

Steve Tjosvold
UC Cooperative Extension
1432 Freedom Blvd.
Watsonville, CA 95076-2796
Phone: (831) 763-8040
Fax: (831) 763-8006
e-mail: satjosvold@ucdavis.edu

Ag Waiver Process in Ventura County

by Julie P. Newman, UC Cooperative Extension, Ventura and Santa Barbara

Nurseries that manage water runoff water may be categorized as "Low-Risk" under the proposed Conditional Waiver".

The Los Angeles Regional Water Quality Control Board (LARWQCB), which has jurisdiction for water quality in Ventura County, is creating a Conditional Waiver for Irrigated Lands. Our office first distributed a draft structure of the new Ag Policy to floriculture and nursery growers in Ventura County in November 2003. At that time, it appeared that growers who were participating in our Clean Water Program (CWP), funded by a Proposition 13 grant, were likely to satisfy the monitoring and educational requirements that the Board was proposing for a group waiver. Since then, the LARWQCB has developed a more specific document, and as a result of comments from all stakeholders, have modified the requirements.

The ornamental production industry could work with other farmers to satisfy all the slated requirements. The first step will be to formally apply as part of a group. The Ventura County Farm Bureau and various watershed groups are already working towards this effort.

Those electing to participate in our CWP will be able to meet most of the proposed monitoring requirements through March 2006. This is a huge benefit, as in addition to the monitoring, UCCE is already developing an approved monitoring plan, which nursery owners would otherwise have to obtain.

We are also collecting management practices used by nurseries in our CWP. This data will be pooled by watershed, maintaining nursery confidentiality. However, the level of confidentiality which will be required for the Waiver is yet to be determined. One proposal is that each operation maintains a copy of their management practices that would be available to the Regional Board staff upon request, in addition to records of pesticide and fertilizer applications.

If the requirements in the draft are implemented, UCCE will work to identify which nursery operations are "Low-Risk" dischargers. The criteria for the "Low-Risk" category have not yet been approved, but all of the following have been proposed by the Board: all irrigation is applied using water saving devices; there is no runoff, or only during storms; fertilizer volumes are documented to be no more than the N requirement shown by leaf/plant testing and a measure of available nutrients; no pesticides are used that are listed for the watershed on the most recent 303(d) list; pesticide application is *only via irrigation* and follows UC/NRCS IPM guidelines; irrigated land is at least 50-feet back from any water body or wetlands, or is separated from that waterbody by buffer strips; tile drains are not used, or the discharge is impounded/treated/documented to meet all regulation requirements. Nurseries with soil floors and container farms that manage and contain runoff may also be categorized as "Low-Risk." All other nurseries using fertilizers and pesticides will be assigned as "Typical" dischargers by the Regional Board and will have more intensive monitoring requirements. A nursery's classification may change over time if annual water quality reports support modification.

It is proposed and subject to approval by the LARWQCB that all operations participating in a group be monitored at least two or more times during a five-year period in both wet and dry weather. Each sample will be examined for chlorides, ammonia, nitrate/total nitrogen, aldrin, chlordane, DDT, DDD, dieldrin, endosulfan, toxaphene, choropyrifos, atrazine, diazinon, and other constituents. Groundwater monitoring may be required in the future. Additionally an annual group monitoring report and other reports are required.

The LARWQCB estimate that it will cost a 50-member group approximately $475 per member per year for sampling and water sample analysis. This would not include State fees, administrative costs, improvements, etc.

If growers do not wish to join any of the groups that will be formed to obtain a group waiver, they have the option of applying individually for a waiver. These nursery operations will also be assigned a risk category. Monitoring costs will be more expensive —the LARWQCB estimates about $4164/per year. This does not include labor, which will be costly because the individual will be responsible for all the plans and extensive reporting documentation. Most nurseries do not have in-house staff that can complete these requirements.

For groups and individuals, evidence of education is also required, which can be satisfied by attending UCCE water quality seminars, or other meetings approved by the LARWQCB.

For both group and individual waivers, a corrective action plan with time-specific management modifications is required when monitoring shows that regulatory limits are not attained.

I strongly recommend that nursery owners read the draft waiver and send comments to me or to the LARWQCB. We cannot avoid regulations to uphold water quality but we can work to ensure that there is a technical basis for proposed regulations, and that they can reasonably be addressed by our industry. Copies of the draft can be obtained by contacting Krissy Gilbert, UCCE Water Quality Coordinator, at 805/645-1463.❖

Julie P. Newman
UC Cooperative Extension
669 County Square Drive, Suite 100
Ventura, California, 93003-5401
Phone: (805) 645-1459
Fax: (805) 645-1474
e-mail: jpnewman@ucdavis.edu

The New Conditional Waiver for Irrigated Agriculture

What does it Mean for the Floriculture/Nursery Industry on the Central Coast?

by Mary Bianchi, UC Cooperative Extension, San Luis Obispo

Irrigated agriculture producers in the Central Coast, including the nursery industry, are expected to enroll in a new regulatory program by January 1, 2005. On July 9, 2004, the Central Coast Regional Water Quality Control Board adopted a new conditional waiver for discharges from irrigated lands. The Central Coast Regional Board territory extends from Half Moon Bay in San Mateo County to the Ventura County line with Santa Barbara County.

The California Water Code gives Regional Water Quality Control Boards (Regional Boards) the authority to regulate discharges of waste that could impact the waters of the state of California, through permits called "Waste Discharge Requirements". A discharge is any release of waste, such as fertilizer, pesticide or sediment, to a water of the state. Waters of the state include rivers, streams, lakes, bays and estuaries, and also groundwater. Regional Boards may also waive issuance of Waste Discharge Requirements for specific discharges or categories of discharges if it is in the public interest to do.

The conditional waiver applies to all irrigated lands in the Central Coast used for producing commercial crops, including, but not limited to, land planted to row, vineyard, field and tree crops, **commercial nurseries, nursery stock production and greenhouse operations with soil floors that are not currently operating under Waste Discharge Requirements**.

Water quality monitoring will be required to ensure the effectiveness of the waiver program. Growers have the option of performing individual monitoring or participating in a cooperative monitoring program. It is likely that cooperative monitoring will be the least costly alternative, and will satisfy requirements of the regulations.

All Central Coast producers are expected to complete 15 hours of farm water quality education before 2008, develop farm water quality management plans that address, at a minimum, irrigation management, nutrient management, pesticide management and erosion control, and begin implementing management practices identified in their plans.

Coastal strawberry field. (Photo by Lynn Betts)

The University of California Cooperative Extension, in cooperation with the Natural Resources Conservation Service, has developed the **Farm Water Quality Short Course**, designed to provide Central Coast producers with support for development of individual water quality management plans. The Short Course provides the required 15 hours of water quality education. Certificate hours for Pest Control Advisors are also available.

For more information on Farm Water Quality Planning Short Courses in your Central Coast County, visit http://waterquality.ucanr.org and click on the Farm Water Quality Planning link on the upper right corner. Farm Water Quality Short Courses currently scheduled through June 2005 are available under the Farm Water Quality Short Course Schedule link, or call Julie Fallon with the UCCE Farm Water Quality Project at (805) 788-2321 for more information or to register for a Course.❖

For additional information on the Conditional Waiver for Irrigated Lands, visit:

http://www.swrcb.ca.gov/rwqcb3/AGWaivers/documents/FAQ7-04forweb.pdf

Mary Bianchi
Horticulture Farm Advisor
UC Cooperative Extension
2156 Sierra Way, Suite C
San Luis Obispo, CA 93401
Phone: (805) 781-5949
Fax: (805) 781-4316
e-mail: mlbianchi@ucdavis.edu

Floriculture and Nursery Industry in San Luis Obispo County Supports Water Quality Planning Efforts

New regulatory programs for water quality protection are becoming a familiar topic for Central Coast producers. Water quality education and farm plan development are at the top of the local "to-do" list for compliance with these new regulations. The Farm Water Quality Project, a collaborative effort between the University of California Cooperative Extension and the USDA Natural Resources Conservation Service, has been delivering Farm Water Quality Short Courses to vegetable, strawberry, vineyard, and orchard producers.

With support from the Board and members of the Central Coast Greenhouse Growers Association in July 2004, we have adapted the materials and delivery of the Course to meet the needs of the greenhouse industry. The participants met for a 2 1/2 day course in July to develop individual water quality management plans for their operations. Below are some of the comments from the participants from program evaluations, reflecting the topics covered during the program:

What was the most helpful part of this session?

- "Defining watershed boundaries, topography, where our water goes, getting our plan started."
- "This session was a useful tool in awareness. I now have a much better idea of what our facility needs to improve on."
- "Irrigation tailwater management and erosion management awareness."
- "Different irrigation practices - waste water management and erosion control methods."
- "Sediment management, pesticide management (elimination of targeted pesticides - source control)."
- "It is an awareness as well as a lot of good contact information."
- "All information was clear and valuable - very well presented."

What was the best part of this course?

- "Field session - identifying current practices or lack of."

Preplant Soil Treatments Critical for Economic Production of Field-Grown Ranunculus – 2004 Trial Results

by Clyde L. Elmore, Husein A. Ajwa, C.A. Wilen, J.D. MacDonald and Karen L. Robb, UC Cooperative Extension

In the Flower Fields in Carlsbad, ranunculus is grown from seed to produce cut flowers and bulbs. This crop is planted in late fall; flowers are harvested in the spring and the bulbs are harvested in summer. This crop has been grown on the same location for decades. Primary pests are soil-borne diseases such as *Fusarium* and *Pythium* and weeds such as malva, clovers, common sow thistle, common groundsel and wartcress.

We have been conducting trials to evaluate the efficacy of selected soil treatments as replacements for methyl bromide for several years. Here we present a brief summary of some of the 2004 results.

Materials and Methods

The field was ripped, cultivated and bedded up into 42 inch beds with two drip irrigation lines. Sachets containing annual bluegrass (100 seeds/sachet) and yellow nutsedge nutlets (eight nutlets/sachet) were placed at 5 and 15 cm depth in the center of each treatment. Similarly, sachets containing known aliquots of *Fusarium oxysporum* f.sp. '*dahlia*' were buried at 15 and 30 cm depth in each treatment. Each bed was covered with a high density poly tarp. Fumigants were applied in 2 inches of water per acre. Preplant treatments consisted of eight beds of either iodomethane plus chloropicrin (33:67%) (Midas) at 200 lb/A, chloropicrin at 200 lb/A, 1,3-dichloropropene plus chloropicrin (Inline) at 200 lb/A and an untreated control. Each treatment was replicated four times. One week later, four of the eight beds (as a block in each treatment) was drip irrigated again with metam at 40 gal/A. One week after the last treatment, the poly was removed and the sachets were exhumed and returned to the laboratory for viability testing.

Flowers were harvested by hand in each of the plots in May and total harvest numbers per plot were calculated, then standardized to 200 feet of row. After the plants were dried down, the tops were cut and the bulbs were harvested for each plot. Again, the data presented is standardized to 200 feet of row.

Results

All treatments were effective at controlling *Fusarium oxysporum* f.sp. *dahlia* in sachets buried into the beds prior to treatment (Table 1).

Annual bluegrass seed buried in sachets in the treatments were also effectively controlled by all treatments except the untreated control (Table 2). Table 3 shows that all treatments had greater control of yellow nutsedge than the untreated control.

All treatments significantly increased the number of flower bunches

Table 1. Control of *Fusarium oxysporum* in sachets buried in treatments.

Treatment	% Control of *Fusarium* in sachets
Iodomethane/chloropicrin	100%
Iodomethane/chloropicrin plus metam*	100%
Chloropicrin	100%
Chloropicrin plus metam*	100%
1,3-dichloropropene/chloropicrin	100%
1,3-dichloropropene/chloropicrin plus metam*	100%
Untreated control	0.0%
Control plus metam*	100%

*Metam applied one week after the first series of treatments.

Table 2. Percent germination of annual bluegrass seed buried in sachets in treatments prior to planting ranunculus.

	No Metam	No Metam	With Metam	With Metam
Treatment	**5 cm**	**15 cm**	**5 cm**	**15 cm**
Iodomethane/chloropicrin	0	0	0	0
Chloropicrin	0	0	0	0
1,3-dichloropropene/chloropicrin	0	0	0	0
Control	96	96	0	0

San Diego Regional Report cont. on page 11

Science to the Grower

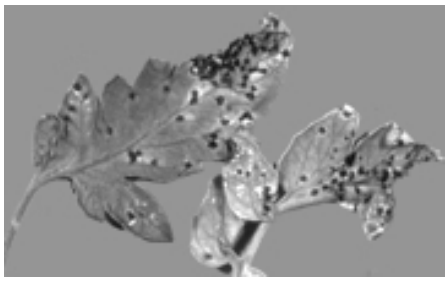
Does Mulching Alter Gene Expression in Crops?

by Richard Y. Evans,UC Cooperative Extension, Davis

Advocates of mulching tout it for weed suppression, water conservation, and soil stabilization. Cover crops, used as living mulches, are less likely to conserve water, but may contribute nutrients to the principal crop with which they are planted. Their benefits may be even greater for some crops, as shown by two recent reports.

Mills and others[1] conducted a three-year study of foliar disease incidence in tomatoes grown in beds with bare soil, composted manure, hairy vetch, or black plastic. Use of hairy vetch always resulted in less early blight and Septoria leaf spot than in the bare soil or compost plots, and black plastic was more effective than bare soil or compost in some years. In one year, use of vetch suppressed these diseases more than in the plots mulched with plastic. The authors described two ways in which the vetch and plastic reduced disease severity. They decreased the amount of soil that splashed onto tomato leaves, thereby reducing the spread of the disease inoculum. They also decreased the amount of time during which leaves were wet, thereby reducing the time during which disease infection could occur.

Kumar and others[2] showed that the hairy vetch cover crop affected the tomato crop in other ways. They grew tomatoes in raised beds with bare soil, black plastic mulch, or hairy vetch, and inoculated the tomatoes with early blight, Septoria leaf spot, and bacterial leaf spot. Disease severity increased steadily in the black plastic plots, but was completely suppressed in the vetch plots for 3 months. Tomato leaf senescence was also more rapid in the black plastic plots. Leaf samples from the plots were analyzed for expression of genes related to leaf senescence or disease tolerance. Compared with leaves from the black plastic plots, those from vetch plots had more



Small, uniform, brown spots caused by Septoria lycopersici on tomato leaves. Chlorosis is often associated with the spotting. (Photo by R.C. Lambe)

expression of genes required for photosynthesis, use of nitrogen and carbon, and power generation. Leaves from the vetch plots also had greater expression of genes associated with plant defense against diseases. How does hairy vetch cause this change in gene expression? That isn't so clear. The authors suggest that decomposition of the vetch causes a slow release of carbon and nitrogen compounds to the tomato plant, and that those compounds affect plant hormone signalling in the roots and leaves. However, the case they make is based on circumstantial evidence that Johnny Cochran could tear to shreds. What is clear is that mulches work.❖

[1] Mills DJ, Coffman CB, Teasdale JR, Everts KL, and Anderson JD. 2002. Factors associated with foliar disease of staked fresh market tomatoes grown under differing bed strategies. *Plant Disease* 86:356-361.

[2] Kumar V, Mills DJ, Anderson JD, and Mattoo AK. 2004. An alternative agricultural system is defined by a distinct expression profile of select gene transcripts and proteins. *Proceedings of the National Academy of Sciences* 101:10535-10540.

Richard Y. Evans
Extension Specialist
Department of Environmental Horticulture
University of California
Davis, CA 95616
Phone: (530) 752-6617
Fax: (530)752-1819
e-mail: ryevans@ucdavis.edu

Genetic Manipulation cont. from page 4

make use of the powerful new techniques that molecular biologists are developing to change plants so as to eliminate the need for chemical inputs, and to improve their profitability. Critics have legitimately pointed out some of the shortcomings of the early methods used to genetically engineer crops, including the use of bacterial resistance genes, and the danger of transfer of genes to wild populations through cross pollination. Scientists have already demonstrated techniques that will overcome these shortcomings, and we look forward to a future where inserting or modifying a gene will be as simple and safe as pollination is today. Space (and my limited imagination) does not permit discussion of all of the strategies that this approach can permit, but current research indicates possible directions. It is not too great a stretch of the imagination to think about sustainable production of cut flower roses in 20 years time. The plants will be grafted on a rootstock that is highly resistant to soil-borne diseases, insects and nematodes (engineered with resistance genes from wild rose species). The roots will have nodules (based on genes from other members of the rose family, or from members of the pea family) that allow the plants to fix their own nitrogen, and (using modified uptake genes from the rose plant itself) will be able take up phosphorus from the low concentrations of this mineral present in all soil solutions. The plants will be resistant to drought and salt stress, and their leaves will be engineered to resist the attack of foliar diseases and will discourage insect feeding while encouraging colonization by beneficial insects. The stems will be free of thorns, and the fragrant flowers, in all the colors of the rainbow, will be resistant to grey mold and ethylene and will last for two weeks in the vase.

For the growers, such plants will enable the production of high quality flowers with minimal chemical inputs and low environmental impacts. For society, such ornamentals will show the power, potential, and safety of the molecular approach to breeding for sustainability. The high cost of registering genetically modified edible crops makes it likely that it is in ornamentals, where registration is considerably less complex and expensive, that the benefits of modern biology will convincingly be demonstrated for horticulture.❖

Michael S. Reid
ANR Agricultural Productivity Program Leader
College of Agricultural & Environmental Sciences, Davis Campus
Environmental Horticulture, One Shields Avenue
Davis, CA 95616
Phone: (530)754-6751
Fax: (530)754-6753
e-mail: msreid@ucdavis.edu

San Diego Regional Report cont. from page 9

Table 3. Percent control of yellow nutsedge buried in sachets in treatments prior to planting ranunculus.

	No Metam	No Metam	With Metam	With Metam
Treatment	**5 cm**	**15 cm**	**5 cm**	**15 cm**
Iodomethane/chloropicrin	100	100	100	100
Chloropicrin	89.6	91.4	100	100
1,3-dichloropropene/chloropicrin	100	100	100	100
Control	18.8	15.9	100	100

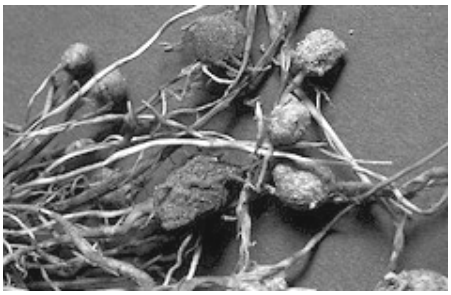


Table 4. Ranunculus flower bunches harvested following treatment with selected fumigants.

Treatment	Total Flower Bunches*
Control	74.7 a
Iodomethane/chloropicrin	215.0 b
Chloropicrin	205.4 b
1,3-dichloropropene/chloropicrin	224.8 b

*Means followed by the same letter are not statistically significantly different.

Table 5. Ranunculus flower bunches harvested from beds with or without a preplant Metam drip treatment.

Treatment	Total Flower Bunches*
With metam	198.6 a
Without metam	161.4 b

*Means followed by the same letter are not statistically significantly different.

harvested compared to the untreated plants (Table 4). The addition of metam one week following the initial treatments increased the number of flower bunches harvested compared to all treatments without the subsequent metam treatment (Table 5).

Bulb yield was also increased following preplant fumigant treatments (Table 6). All treatments yielded significantly more jumbo, 6's and 5's than the control treatment, although 1,3-dichloropropene/chloropicrin was not as good as the other fumigants in jumbo bulb yield. No significant differences between treatments and the controls were observed in numbers of 3 and 4 bulbs. Although there were more bulbs produced in plots that had been treated with metam than without metam (Table 7), there were no statistically significant differences between these two treatments.

Table 6. Mean number* of ranunculus bulbs, by grade, following preplant fumigation.

Treatment	Jumbo	6's	5's	4's	3's	Total Bulbs
Iodomethane/ chloropicrin	1408.5 a	2378.0 a	2893.0 a	1994.3 a	1331.2 a	10005.0 a
Chloropicrin	1369.0 a	2484.9 a	2824.2 a	2068.3 a	1330.7 a	10077.1 a
1,3-dichloropropene/ chloropicrin	1099.4 b	2159.1 a	2882.5 a	2344.0 a	1360.7 a	9845.8 a
Control	441.4 c	1024.5 b	1556.5 b	1547.2 a	662.8 a	5232.5 b

*Means followed by the same letter in the same column are not statistically significantly different.

Table 7. Mean number* of ranunculus bulbs by grade following treatment with or without metam.

Treatment	Jumbo	6's	5's	4's	3's	Total Bulbs
With metam	1154.5 a	2145.5 a	2665.4 a	2221.6 a	1215.0 a	9401.9 a
Without metam	1002.2 a	1877.7 a	2412.7 a	1755.4 a	1128.0 a	8175.7 a

*No statistically significant differences between treatments.

Clearly, at this site with considerable pest pressure, treatment with preplant fumigants significantly increased yields of flowers and bulbs. In fact, it probably would not be economically feasible to grow ranunculus for bulbs or cut flowers with preplant soil treatments at this site.❖

Karen L. Robb
UC Cooperative Extension
5555 Overland Avenue, Suite 4101
San Diego, CA 92123
Phone: (858) 694-2857
Fax: (858) 694-2849
e-mail: klrobb@ucdavis.edu

Get Cultured

Copper Ionization and its Applications in the Nursery Industry

by Donald J. Merhaut, UC Cooperative Extension, Riverside

History

The use of copper and silver ionization is a popular method of treating drinking water for pathogens. Historically, this method of water treatment gained popularity after the outbreak of *Legionella pneumophila,* the bacteria responsible for Legionaires' disease, which occurred at the 58th state convention of the American Legion in Philadelphia, Pennsylvania in 1976. Since then, many hospitals and other public facilities have incorporated various methods, such as copper and silver ionization to kill pathogens in drinking water. The concentration necessary for pathogen control is approximately 100 ppb for drinking water and 20 ppb to treat pool water. However, the use of copper ionization in the nursery industry is relatively new. In this article we will discuss the use of copper ionization in the nursery setting, presenting its attributes and limitations.

What is Copper Ionization?

Ionization works via inserting copper-coated ceramic electrodes into one point of the water system. An electric current passes through this electrode, releasing copper ions (Cu^{2+}). These positively-charged copper ions are attracted to negatively-charged particles, such as organic matter, silt and clay particles and to the membranes of bacteria, algae and mold. If copper binds to the organic matter, silt or clay, then the copper becomes chemically inactive. However, if the copper binds to the membranes of the organisms, the organisms die.

Copper in Agriculture

Copper is a heavy metal that has been traditionally used in agriculture as a bactericide on crops through applications of copper sulfate, which has been used alone or with other pesticides. In addition, copper is an essential plant nutrient, which is required at relatively low concentrations (0.002-0.003%) (20-30 ppm plant dry weight). In most nutrient formulations, especially micronutrient blends, copper is mixed into media at a rate of approximately 0.01-0.40 g/pot. For hydroponically-grown crops, copper is supplied at concentrations of approximately 0.05 ppm. Because of such relatively low requirements, any additional copper that is added to a plant system, either as a pesticide or fertilizer, should be monitored so that copper toxicity is avoided.

Copper Ionization in Nursery Production

Copper ionization has been used successfully in agricultural processes such as: (1) coolant pad water treatment to keep filters free of algae and (2) postharvest washing of fruits and vegetables. Information regarding copper ionization usage in irrigation water recycling systems is limited. In most copper ionization systems, recommendations are to maintain active copper ion concentrations at 0.50 to 1.5 ppm. Copper electrodes are inserted into the water system – preferably after the water has been filtered of debris and suspended clay and organic matter. The number of copper electrodes required will depend on the amount of water that needs to be treated, the cleanliness of the water (presence of organic matter and suspended clay) and the size of the electrodes. Some of the models currently available will treat about 200 gallons of water per minute. Additional electrodes will be required for higher flow rates.

ADVANTAGES

- *Operation costs* — moderate. Electrode replacement (up to $10,000) and the cost of electricity.
- *Installation costs* — low. Financial outputs are primarily for installation of copper coated electrodes and electrical source.
- *Chemicals* — some companies claim that no additional chemicals are required for pathogen control. However, others indicate that oxidizers such as chlorine will still be needed, but at lower concentrations.
- *Technical components* — few technical components or control systems.
- *Maintenance* — low (occasional replacement of copper electrodes.)
- *Pathogen removal* — pathogens such as bacteria and fungi will be killed.
- *Chemical effects* — copper ionization will not alter the pH of the effluent water.
- *Space* — requires no additional land for the construction of large treatment facilities.
- *Algae control* — the system will kill algae on water and on coolant pads.

Get Cultured cont. on page 13

Get Cultured cont. from page 12

DISADVANTAGES

- *Copper toxicity of water* — some ornamental crops are sensitive to the copper concentrations (0.5-1.5 ppm) that are recommended to effectively treat water. No data is available on copper accumulation with long-term usage of copper ionization in a closed recycling irrigation system.
- *Effectiveness reduced with dirty water* — since copper ions are positively charged, they will be attracted to and bind to negatively charged particles of organic matter and clay, making the copper ions inactive. Therefore, greater injection (release rates) of copper ions from electrodes will be needed to keep the copper ions at concentrations effective to kill pathogens.
- *Herbicide and pesticide removal* — does not remove other chemicals from the water.
- *Floating debris removal* — does not break down or remove floating debris.
- *Dissolved organic matter* — coloration due to dissolved organic matter and acids is not removed from the water.
- *Clay and silt removal* — clays and other soil particles are not effectively removed with copper ionization.
- *Copper accumulation in closed recycling systems* — copper will bind to organic matter and clay that settles out in reservoirs. Therefore, if this sludge is recycled back into the media, copper concentrations in the sludge could be toxic to some crops. Tests should be performed to check copper concentrations of the sludge and media before use on crops.

Conclusions

When used properly, copper ionization can be used in some nursery systems to control pathogens. However, the primary concern is that copper concentrations in closed recirculating systems should not increase to toxic levels. In a recent study, copper toxicity was documented for chrysanthemum (*Dendranthema*), miniature rose (*Rosa*), and geranium (*Pelargonium*) at 0.32 ppm, 0.15 and 0.50 ppm, respectively.❖

Copper Toxicity Symptoms:

Leaves: Reddish brown lesions, which coalesce in severe cases.

Roots: Stunting and death of root tips and an increased production of lateral roots. Under severe toxicity the entire root system will senesce.

When treating recycled waters, always check for effective control of pathogens, regardless of the treatment process being used. In the case of copper ionization, additional tests should be conducted to determine the copper levels in media and waters. Copper sensitivity tests should also be conducted on new plants that are suspected of being sensitive to the copper concentrations that are used in the growing system.

Donald J. Merhaut
Department of Botany & Plant Sciences
University of California
4118 Batchelor Hall
Riverside, CA 92521
Phone: (909) 827-7003
Fax: (909) 787-5717
e-mail: donald.merhaut@ucr.edu

Campus News & Research Updates

Submitted by Julie Newman, Farm Advisor, UCCE

Campus News

UC DAVIS.

The University of California, Davis, officially dedicated its new Genome and Biomedical Sciences Facility on October 13, 2004. The $95 million, 225,000-squarefoot building will foster cross-cutting, leading-edge research in genomics, bioinformatics, biomedical engineering, pharmacology and toxicology, and other areas.

"Discovery simply does not stop at disciplinary boundaries," said UC Davis Chancellor Larry Vanderhoef. "In fact, those interfaces are where creative new ideas are most likely to occur. Through its unique combination of scientists, this new facility will permit UC Davis to make very real strides in the understanding of biology and in the advancement of human health, agriculture and the environment. And it will contribute significantly to the region's growing life-sciences corridor."

Genomics is a new approach to biology that uses technology to study thousands of genes at the same time. Bioinformatics is the related science of using computers and math to understand the DNA code. Biomedical engineers bring a fresh physics - and math-based approach to biology. Together, these disciplines provide a new way to understand biology and advance medicine.

"The life sciences will benefit tremendously from the interdisciplinary approaches to critical questions that will be made possible through this facility. The opening of the building is both a culmination of a vision to bring together researchers across many disciplines and the beginning of an ambitious plan to add expertise that will complement our strengths in genomics, proteomics and metabolomics," said Phyllis Wise, dean of the division of biological sciences at UC Davis.

The building will house the UC Davis Genome Center, the Department of Biomedical Engineering and scientists from the UC Davis School of Medicine. The research by this unique combination of biologists, physicians and engineers ranges from studies of molecules and cellular biology up to whole organisms.

The Genome Center will house 17 faculty as well as provide core service facilities for genomics, proteomics and related areas to all scientists on campus. Its floor plan has open laboratories and shared spaces to encourage researchers from different backgrounds to mix and exchange ideas.

The Genome Center will serve as a "technology antenna" for genomics on campus by developing and maintaining state-of-the-art core service facilities, encouraging the growth of new research areas and teaching programs, said center director Richard Michelmore.

Michelmore, a professor of genetics at UC Davis, was appointed to lead the Genome Center in November 2003 and began recruitment of 15 new faculty members. The director's position is supported by an endowed chair in genomics sponsored by a $500,000 gift from Novozymes Inc., the world's largest manufacturer of industrial enzymes.

The center now has 11 faculty, nine of whom are new to campus. They have joint appointments in the Genome Center and departments in the biological and medical sciences, chemistry and the College of Engineering. Their research links biology with applied research in medicine, veterinary medicine and agriculture.

Michelmore describes genomics as a "global approach" to biology that impacts everything from DNA sequence analysis and modeling protein structure to metabolic profiling and population genetics. Research at the Genome Center will include plants, animals and microbes, reflecting the broad range of expertise at UC Davis.

Research Updates

Inoculum Production Model for Nematode-Destroying Fungi

Root-knot nematode

Becker, J.O.[1], P. Han[1], X. Chen[1], C.A. Wilen[2], and J.A. Downer[3]. [1]Department of Nematology, University of California, Riverside, CA 92521, [2]University of California Integrated Pest Management Program, Cooperative Extension San Diego County, 5555 Overland Avenue, San Diego, CA 92123; [3]University of California, Cooperative Extension Ventura County, 669 County Square Dr., Ventura, CA 93003.

Autoclavable mushroom spawn bags (Unicorn™) were evaluated for the production of nematode-destroying fungi. Micro-filters in the polypropylene bags allowed gas exchange without compromising the aseptic growing conditions. Strains of *Fusarium oxysporum* and *Pochonia chlamydosporia*, both parasites of several endophytoparasitic nematode species, were cultured in the spawn bags on sterile millet for two to four weeks. Both fungi rapidly colonized the substrate and sporulated as prolifically as in flask culture. Mixing and crumbling the inoculum into individual fungus-colonized millets was effortless because of the elasticity of the polypropylene bags. Dry inoculum was aseptically sealed and stored in the spawn bags without further transfer and minimum space requirements. Greenhouse trials with spawn bag-produced inoculum of *P. chlamydosporia* reduced both the root-knot nematode *(Meloidogyne incognita)* population and damage to various nursery crops.❖

J. Ole Becker
Department of Nematology
University of California
Riverside, CA 92521
Phone: (909)787-2185
Fax: (909)787-3719
e-mail: ole.becker@ucr.edu

2005 CORF Program Calendar

FEBRUARY	
TBD	Water Quality Management Somis
MAY	
11	Drip Irrigation Somis
24	Grower's School : Protea San Diego
JUNE	
2	Insect Diagnostics Ventura
7	Insect Diagnostics San Diego
9	Insect Diagnostics Watsonville
10	CORF Planning Meeting
JULY	
20	Impact/Overhead Irrigation II Somis
SEPTEMBER	
22	ABC's of Horticulture San Diego *(Spanish Only)*
27	ABC's of Horticulture Watsonville *(Spanish Only)*
OCTOBER	
5	Insect Symposium San Diego
NOVEMBER	
15	Disease Symposium Watsonville
DECEMBER	

CORF Wishes you a Happy Holiday Season!

CORF
Floriculture Education from the
Kee Kitayama Research Foundation

CORF News is published three times a year and is a publication of CORF, the California Ornamental Research Federation, a statewide partnership of growers, floriculture associations, allied industry, and researchers/educators whose mission is to identify and meet the research and educational needs of the California floriculture industry.

California Ornamental Research Federation
P.O. Box 318
Freedom, CA 95019-0318
Ph: (831) 724-1130
Fax: (831) 728-7337
www.corf.org

Address Service Requested

THANKS to these Sponsors of CORF Educational Programs

Sustaining Sponsors

Arvesta
Dow AgroSciences
Phyton (Source Tech Biologicals)