

Update

California State University, Fresno

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Fresno State research scientist Florence Cassel Sharmasarkar (right) works with industry partner Shawn Ashkan (center) to record crop data. At left is student technician Diganta Adhikari. Second from right is CIT soil scientist Dave Goorahoo, a project co-investigator.

CO₂ applications evaluated in commercial strawberry fields

Advances in agricultural technology in California continue to spawn new language terminology

to describe processes that were only fleeting thoughts a few years ago.

One of the newest words – Carbogation™ – describes a process being tested for a second year by irrigation researchers at Fresno State’s Center for Irrigation Technology (CIT). Research scientists Florence Cassel Sharmasarkar and Dave Goorahoo are leading a study of field application of carbon dioxide (CO₂) to strawberry plants using conventional drip irrigation equipment.

CO₂ gas exists as approximately 0.03 percent of the earth’s natural atmosphere. Humans exhale it as a by-product of our breathing process, and

plants “inhale” it for their metabolism.

“In the photosynthetic process, plants use the sun’s energy to produce carbohydrate molecules (sugar) from water and CO₂, releasing O₂ as a by-product,” Cassel explained. Laboratory experiments have shown that increased CO₂ application to plants causes faster growth and increased yields. The problem agricultural producers have faced is making it work in the field.

“CO₂ is expensive to obtain and transport. You have to have a place to store it and equipment to apply it,” Cassel said.

Trials funded by a private company in 2002 featured CO₂ application on tomatoes using above-ground drip irrigation lines. A specially-designed manifold injected the CO₂ into the

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Motor vehicle safety program gets funding boost

Farm worker transportation safety will continue to be a priority for the Center for Agricultural Business (CAB) this coming year.

Based on the positive reactions of the agricultural industry to a pilot program initiated last year, CAB safety program leaders applied for and received additional grant funding to expand the “Farm Worker Motor Vehicle Safety Education Project” this year. CAB program development specialist Kimberly Naffziger is directing the effort.

Project objectives are to reduce the number of motor vehicle crashes, fatalities and injuries suffered by farm workers and other rural residents. One phase of the effort has been to publish and distribute Spanish-language fliers encouraging safe driving habits.

During the first year of the program, Spanish-speaking farm worker populations in Fresno and Tulare counties were targeted. Additional funding, provided by

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Forest study may provide keys to fire suppression techniques

Conifer forests in northwestern Mexico have not undergone systematic fire suppression treatments nor logging, making them unique

in western North America. These forests provide excellent opportunities for analysis of forest structures such as tree densities and regeneration patterns. Such information can be beneficial in the development of guidelines for managing California's mixed conifer forests.

Professor Samantha Gill of California Polytechnic State University, San Luis Obispo, and Scott Stephens of



Above: Panorama of the Sierra San Pedro Martir in Baja California. Left: Research technician uses an increment borer to determine tree age.

the University of California, Berkeley, recently completed an analysis of the Sierra San Pedro Martir, a Jeffrey pine mixed-conifer forest located in Baja California, Mexico. Through analysis of fire scar data, they found that the fire return interval of the forest was less than 15 years. Overall, 105 fire dates were identi-

fied from 1,034 fire scars in 105 specimens. Fires were recorded between 1521 and 1980, and superposed epoch analysis determined that moderate and large fires occurred in significantly dry years during this time.

One aspect of this project included comparing this forest area to the San Rosa Mountains just across the U.S. border in Southern California. Both forest types are similar, but the forests of the San Rosa Mountains have had

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CO₂: Conventional drip lines used for application

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lines when water was not being applied. The gas was injected under pressure and seeped out the emitters as water would.

CO₂ application in the field is determined by climatic parameters, Cassel said. Air temperature, as well as wind speed and direction, must be appropriate for the gas to disperse and "settle" around the plants.

The first season of field trials on tomatoes, conducted at CIT, provided "very encouraging" results to the company that sponsored the research, Cassel said. Compared to tomatoes grown using conventional methods, plants treated by Carbogation™ showed a weight increase of 65 percent, total fruit number increase of 25 percent, marketable fruit number increase of 98 percent, and a total marketable harvest weight increase of 120 percent – more than double conventional yield.

Based on those findings, Cassel sought additional financial support to expand the trials. Funding was made available by the Governor's "Buy California Initiative," the California Department of Food and Agriculture and the U.S. Department of Agriculture through the California State University Agricultural Research Initiative program.

With the help of a cooperating

grower in the Oxnard, California area, trials are being conducted this year in commercial strawberry fields. Production features the use of subsurface drip lines for irrigation and above-ground lines for CO₂ application.

Carbogation™ may provide significant positive economic impacts for agriculture and the environment, Cassel noted. Because federal and state regulations restrict factory emissions of CO₂ and other chemicals, many factories have collection systems and therefore need to dispose of CO₂.

"This technique could utilize carbon emissions by recycling CO₂ and, at the same time, provide more food," Cassel said. "This research has local and global applications if testing and verification prove economically successful."

Project results will be disseminated through CIT later this year.



Custom-made manifold injects CO₂ gas into drip lines for application on strawberry plants.

Center for Agricultural Business

Chinese supermarkets present export opportunity

CAB director Paggi serves on U.S. delegation visiting Asian business leaders

As part of an ongoing research program on Chinese agricultural market opportunities and challenges, the Center for Agricultural Business (CAB) participated in the recent international forum, "Supermarket and Agricultural Development – Challenges and Opportunities," held in Shanghai, China.

CAB was one of many event supporters, some of which included the U.S. Department of Agriculture, Michigan State University, and the Chinese Academy of Agricultural Sciences. More than 250 representatives of the agricultural industry, government and academic institutions in China and from around the world attended the conference.

CAB Director Dr. Mechel S. Paggi was among the speakers. He gave a presentation on the implications of supermarket development in China on U.S.-China trade. This and other Power-Point presentations, along with papers addressing trade issues, are available on CAB's website at cati.csufresno.edu/cab.

"Increasing incomes of residents in Shanghai, Beijing and other large urban centers are giving rise to an increased demand for the high-quality consumer food goods that California agricultural producers specialize in," Paggi said.



CAB Director Mickey Paggi discusses trade opportunities with Chinese business leaders during a recent trade conference in Shanghai.

"The rapid rise of the number of supermarkets in China, the global nature of their supply chains and the need for dependable year-round supplies combine to lead to increased marketing opportunities for many of California's specialty crops like fruits and nuts."

Paggi recalled a group tour of a local supermarket in the Shanghai suburbs, where he saw California-grown fresh oranges prominently displayed among a robust assortment of other fresh fruits from around the world.

The continued development of supermarkets in Asia, Latin America and elsewhere, combined with increasing industry concentration, will result in

the global trade of fresh and processed agricultural products being handled by fewer and larger firms, Paggi noted. The CAB research program in global food markets is designed to help California producers and agribusiness firms better understand how they can successfully compete in this dynamic market, he said.

Safety: Three new counties to be targeted

from Page 1

the California State University Agricultural Research Initiative (ARI), will support expanded education efforts to Madera, Kern and Kings counties.

"The current project will develop additional outreach materials identified in the pilot program," Naffziger reported.

"And it will continue to establish networking opportunities with grower and farm worker organizations throughout the state to create awareness of the need for motor vehicle safety."

For more information on the project, call CAB at 559-278-4405 or visit the CAB website at cati.csufresno.edu/cab.

Upcoming events

July 20 – Safety Breakfast Meeting, "What Employers Should Know About Workers' Compensation Reform (SB899-Poochigian)" in Salinas, California. Call 559-278-4405.

July 27 – Safety Breakfast Meeting, "What Employers Should Know About Workers' Compensation Reform (SB899-Poochigian)" in Calistoga, California. Call 559-278-4405.

Aug. 17 – Farm Labor Contractor Education Institute class in Bakersfield, California. Call 559-278-4405.

Sept. 14 – Farm Labor Contractor Education Institute class in Stockton, California. Call 559-278-4405.

Oct. 6 – Farm Labor Contractor Education Institute class in Fresno. Call 559-278-4405.

Nov. 4 – 23rd Annual Agribusiness Management Conference in Fresno. 559-278-4405.

Center for Irrigation Technology

Irrigation methods eyed

Comparison study of four methods indicates surface and subsurface drip provide greatest efficiency

A three-year study comparing different irrigation methods for young peach trees has shown that surface and subsurface drip systems were the most efficient in delivering water to tree roots.

Conducted by research scientist David Bryla of the U.S. Department of Agriculture, in cooperation with the Center for Irrigation Technology (CIT) and the California State University Agricultural Research Initiative (ARI), the study compared four irrigation methods – furrow, microjet, surface drip, and subsurface drip – in an orchard in the central San Joaquin Valley east of Fresno, California.

Furrow irrigation is the most common method used by peach growers. However, many growers and irrigation consultants are convinced that newer, more high-tech systems such as drip and microsprayer are more water efficient and better for the trees.

Bryla's research addressed the issue by comparing the four above-mentioned methods on young peach trees in a new orchard located at the USDA's Agricultural Research Service station in Parlier. Blocks of trees were designated for each treatment. All treatments received the same amount of water based on evapotranspiration measurements made from

other well-watered peach trees grown in a weighing lysimeter.

Over three seasons, from 1999 to 2001, measurements were taken of tree growth and pruning weights, and in the last year yield was also measured.

"Overall, trees irrigated by surface and subsurface drip outperformed trees irrigated by other methods during the first three years following planting," Bryla reported in a recent article published by *HortScience* (Vol. 38, October 2003). Trees irrigated by micro-sprayers were the lowest performers.

In trees irrigated at 100 percent ETC, trunk cross-sectional areas averaged 55 and 52 square centimeters for the drip and furrow treatments, respectively, by the end of year three. Trees under the microjet treatments were significantly behind, with cross-sectional areas averaging only 42 square centimeters.

Harvest data following the third season of treatments also favored the drip systems, Bryla reported.

In general, trees irrigated by microjets had fewer and smaller fruit at harvest, and consequently had significantly lower



Furrow irrigation (above) and microjet sprayers (left) were compared with surface and subsurface drip systems in a study on young peach trees.

yields, according to contrast comparisons, than trees irrigated by drip or subsurface drip, Bryla reported. Yields of furrow-irrigated trees were intermediate.

One key advantage of drip systems is the ability to deliver water continuously, which not only enhances tree growth, but fruit production, Bryla noted.

"Trees don't experience water stress between irrigations, therefore we see increased fruit development," he said.

The low performance of the microjets was only somewhat surprising, since in a young orchard the lack of shade is known to increase evaporation from a jet spray.

More project details can be found in the complete final report, titled "Irrigation Management Practices for Improving Water and Nutrient Use Efficiency and Crop Productivity in Peach," located on the ARI website at ari.calstate.edu.

Additional research using the same treatments on the maturing trees is continuing with support from the USDA and ARI, Bryla said.

Upcoming events

July 13 – Agricultural Pumping Efficiency Program 101 chemigation and pump efficiency seminars, 9 a.m. to noon in Salinas, California. Call Bill Green, (559) 278-2066, for details.

July 22 – Agricultural Pumping Efficiency Program Farm Bureau Media Night to promote conservation and agricultural business, 6 to 8 p.m. at the Fresno Equipment Co. Call Theresa Sebasto, (559) 278-2066, for details.

July 29 – Agricultural Pumping Efficiency Program Groundwater Protection Seminar, 9 a.m. to noon in Watsonville, California. Call Bill Green, (559) 278-2066, for details.

Aug. 10 – Agricultural Pumping Efficiency Program Golf and Turf Management Seminar, 8:30 a.m. to noon at the SoCal Edison AgTAC in Tulare, California. Call Bill Green at (559) 278-2066 for details.

Viticulture and Enology Research Center

Cabernet trials focus on canopy management

When it comes to fine wines, Napa and Sonoma are two California valleys whose names alone suggest the highest standards of character and flavor.

This year a research team at Fresno State's Viticulture and Enology Research Center (VERC) is searching for ways to add a new name – San Joaquin – to the list of valleys that ensures a high-quality product. The project, led by VERC Director Robert Wample, is focused on Cabernet Sauvignon grapes.

A careful evaluation of premium wine-producing regions such as Australia, Italy, Spain and South Africa reveals weather patterns similar to the San Joaquin Valley, Wample noted in explaining his project. So producing quality wine grapes does not simply require the "right" weather, but effectively managing vine growth relative to climate and soil conditions of the area.

"The San Joaquin Valley has generally been considered too hot for premium wine grape production," he said. "However, within the past five years wine-makers in the San Joaquin Valley and faculty and students in the Viticulture and Enology Department at Fresno State have demonstrated that fruit from this region can yield premium and ultra-premium quality wines." Some of these wines have earned gold and silver medals



Research assistant David McGarry uses a soil probe to record moisture levels at one, two and three feet below the soil surface.

in national and international competitions, he noted.

A key to wine grape management is to prevent the leaf canopy from growing too vigorously, Wample said. An over-extended canopy siphons energy from fruit production and blocks the sunlight the berries need to enhance color and flavor.

"What we're trying to do is use irrigation treatments to control canopy characteristics," he said. Using surface and subsurface irrigation systems, the project will feature greatly reduced irrigation during the first part of the growing season, which will result in shortened shoots and a smaller canopy. The smaller canopy will allow more sunlight to penetrate and enhance the color of the berries.

In Napa and Sonoma some growers prune in the summer to allow for greater sunlight penetration to the berries. Wample hopes to achieve that result in the San Joaquin Valley through the deficit irrigation treatments, which would save on labor costs.

"Since we have less rainfall here, we have more control over irrigation treatments and thus over canopy growth," he said.

During last season and this one, Fresno State student research techni-

cians have been attending the trial vineyard weekly to oversee irrigation treatments and to measure shoot growth, plant water status, and stages of berry maturity. Following harvest, they will measure yields, berry size, sugar, Brix and titratable acidity. Finally, wine made from each season's crush will be evaluated.

"Ultimately it is the concentration of flavor and color that makes the wine better," Wample said. "Our question is, can we manage the grape canopy to enhance those characteristics?"

Results of the trial data, including wine sensory evaluations, will be analyzed later this year. Project funding was made available by the Governor's "Buy California Initiative," the California Department of Food and Agriculture and the U.S. Department of Agriculture through the California State University Agricultural Research Initiative program.

For more project details, visit the VERC website at cati.csufresno.edu/verc.



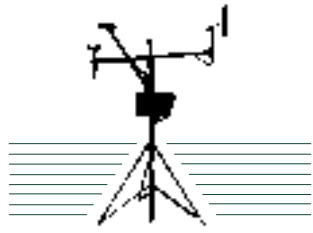
Student research assistant Brian Terrizzi uses a pressure device to measure leaf moisture.

Upcoming events

Aug. 10 – Grape Day 2004 at the Fresno State viticulture and enology facilities. Presentations will focus on current VERC research projects and industry issues. For details, call 559-278-2089.

Nov. 10 – American Vineyard Magazine Central Coast Grape Expo in Paso Robles, California. For details, visit <http://www.malcolmedia.com>.

JULY 2004



CIMIS

California
Irrigation
Management
Information
System

Reference Evapotranspiration: Definitions and Uses

Evapotranspiration (ET) is evaporation plus transpiration from a given surface. Reference evapotranspiration is ET from well-watered grass (ET_o) or alfalfa (ET_r) surfaces. CIMIS uses weather data measured over well-watered grass surfaces to calculate ET_o using the Modified Penman equation adjusted for local conditions. A user needs to calculate the actual ET for a specific crop (ET_c) using a crop factor known as crop coefficient (K_c). Tabulated values of K_c are available from different sources for most crops growing in California.

The primary use of CIMIS ET_o data is for planning, design, and operation of irrigation systems. In planning an irrigation system, one needs to know the total water demand and available supplies. CIMIS ET_o helps the planner to determine what the total demand will be and to design the system accordingly. Irrigation system design, in turn, involves

Visit the CIMIS home page at
<http://www.cimis.water.ca.gov>

determining the sizes of the different components for diverting, delivering, and applying water into the field.

In the operation of irrigation systems, CIMIS ET_o is essential for irrigation scheduling purposes. A water budget method can be used to determine when to irrigate and how much water to apply. Applying the right amount of water at the right time saves water, money, energy, and manpower for systems that are over-irrigating. It also improves the quality of water by reducing contamination from pesticides, herbicides, and other chemicals. For systems that are under-irrigating, however, it increases the quantity and quality of crop yield and aesthetic values of landscapes.

CIMIS ET_o data can also be used in water balance analyses, stream runoff estimation, weather forecasting, water rights issues, and other related disciplines. For example, in designing water storage facilities such as reservoirs and ponds, estimates of evaporation losses from free water surfaces and transpiration losses from surrounding plants are required. Existing correlations between these losses and CIMIS ET_o can be used to quantify the losses.

These are just a few of the many uses of the CIMIS ET_o data. Although the number of CIMIS data users has been increasing steadily over the years, many irrigators are still not making use of this free resource. We believe the reason for this is lack of appropriate information. CIMIS is doing its best to educate as many users as possible through its outreach activities and different publications.

For more CIMIS information...

CIMIS information is published quarterly in the CATI *Update* newsletter. Articles are provided by the California Department of Water Resources, CIMIS program staff.

For more information about CIMIS or its programs, contact any of the following representatives at these offices:

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San Joaquin District
Steve Ewert
(559) 230-3334
sewert@water.ca.gov

Southern District
Sergio Fierro
(818) 543-4652
sergiof@water.ca.gov

If you are unable to reach a CIMIS representative near you, call the CIMIS Helpline at 1-800-922-4647.

Weekly ET_o Comparisons for Fresno

Fresno: 03/01/04 – 05/31/04

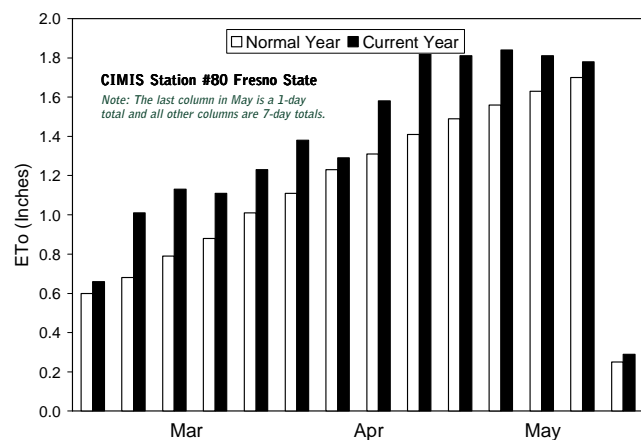


Chart shows ET_o variation from normal over last three months.

Research program addresses urban forestry issues

Effective tree and plant management can provide fire prevention, energy conservation benefits

The urban forest provides an important partnership between nature's forests and the human metropolis.

Trees growing in urban areas can contribute to fire suppression, flood management, pest management, energy conservation, economic investment and community enrichment.

Researchers from California State Polytechnic University, Pomona, have completed a project focused on creating a functional urban forestry program. The project, directed by Dean Wayne Bidlack of the College of Agriculture, proposed an Urban Forestry Research Center at Cal Poly Pomona that will research issues and problems of the urban metropolis that extends from Ventura County south to San Diego County and east to San Bernardino County, with the goal of using trees to help solve specific urban problems.

Program benefits would include cost savings in fire prevention and energy



Strategic management of urban forests will enhance scenery, reduce energy use and aid in fire prevention.

conservation, commercial use of the wood, and decreased property damage.

Specific program strategies include the use of fire management strategies that incorporate forms of damage control, use of fire-resistant landscapes to serve as recreational places, and conservation of energy based on harnessing the cooling power of trees within cities.

Project leaders initiated discussion among representatives of key agencies in Washington and California, including many of the state and regional players interested in urban forestry issues.

Researchers felt that the administration in Washington favored the proposal and is considering providing more financial support.

Additional funding was acquired for

Cal Poly Pomona's Barclay Hudson, special projects coordinator at the university's LandLab, to develop a forestry display at AGRIScapes, an on-campus center that promotes agricultural and environmental literacy.

Funding for the forestry project was provided by the California State University Agricultural Research Initiative (ARI). Additional support was provided by Cal Poly Pomona and the U.S. Forest Service.

To view and/or obtain a copy of the final report for this project, titled "Development of an Urban Forestry Research Center," visit the ARI website at ari.calstate.edu. Go to "Funded Projects" and click on the Research Focus Area: *Public Policy*.

CATI on the Web!

For timely information about CATI, its research projects or centers, or to view text of research publications, visit us at cati.csufresno.edu.

Center for Agricultural Business (CAB) – cati.csufresno.edu/cab

Center for Food Science and Nutrition Research (CFSNR) – cati.csufresno.edu/cfsnr

Center for Irrigation Technology (CIT) – cati.csufresno.edu/cit

Viticulture and Enology Research Center (VERC) – cati.csufresno.edu/verc

Agricultural Technology Information Network (ATI-Net) – cati.csufresno.edu/atinet

Forest: Data will aid in ecosystem support

from Page 2

nearly 100 years of fire suppression treatment while those of the Sierra San Pedro Martir have had none. It was found that there are significant differences in tree size, as well as in distribution and in the amount of regeneration present. This information is useful in examining the effects fire suppression had on forested ecosystems.

Funding and administrative support for the project was provided by the California State University Agricultural Research Initiative (ARI), administered

by the California Agricultural Technology Institute. Additional support was provided by UC Berkeley and the U.S. Department of Agriculture.

To view and/or obtain a complete copy of the final report for this project, titled "Fire History, Forest Structure and Early Land Uses in a Jeffrey Pine-Mixed Conifer Forest Under an Unmanaged Fire Regime," visit the ARI website at ari.calstate.edu. Go to "Funded Projects" and click on the Research Focus Area: *Natural Resources*.

Diet, flight studies may help in medfly control

Insects such as the Mediterranean fruit fly and the walnut husk fly make up a group of extremely harmful and invasive agricultural pests. Although populations in California are minimal at the present time, the state is at considerable risk for outbreak and eventual establishment of these pests. One eradication strategy for medflies – the release of sterile males – assists in preventing outbreaks.

As sterile male medflies are currently known to suffer from poor flight and survivorship abilities, researchers at California State University, Hayward and University of California, Riverside have completed a study exploring ways to improve the health and performance of sterile males. A research team led by CSU Hayward Professor Susan B. Opp studied sterile, mass-reared male medflies in field and laboratory settings to investigate the role of diet and dietary microorganisms in the flies' dispersal and survival.

The study found that, contrary to what has been reported in past literature, hydrolyzed yeast, typically referred to as a "protein source" for fruit flies, contains little actual protein and is more likely a source of nitrogen or amino acids.

It also found that the addition of



Left: Student research technician Joe Zermeno prepares a medfly for flight mill studies in the laboratory. Below: Individual cups hold a single medfly or walnut husk fly to determine survivorship under different feeding regimes.



bacteria and/or hydrolyzed yeast to the standard sucrose diet did not significantly improve lab or field survivorship of sterile males, nor did it improve laboratory flight capacity. However, a diet of sucrose plus hydrolyzed yeast, fed post-release, significantly improved survivorship.

Results showed that sucrose alone may not be a sufficient diet for flies to attain reproductive maturity, but they indicated that continuing to feed the standard pre-release diet of sucrose in agar may provide the greatest dispersal and survival ability for sterile medflies.

Funding and administrative support

for the project was provided by the California State University Agricultural Research Initiative (ARI), administered by the California Agricultural Technology Institute.

To view and/or obtain a complete copy of the final report for this project, titled "Improving Sterile Medflies to Protect California Agriculture," visit the ARI website at ari.calstate.edu. Go to "Funded Projects" and click on the Research Focus Area: *Biotechnology*.

In the event of incorrect address information or extra copies to your workplace, please return this address label by mail or fax with your requested changes. CATI fax number is (559) 278-4849.

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