

SUSTAINABLE AGRICULTURE



Reports of the decline of Mark Twain's "Celebrated Jumping Frog" have not been exaggerated

by Robert L. Bugg, UC SAREP



photo by Gary Nafis, CaliforniaHerps.com

TOP: Northern red-legged frog. LEFT: Potawot kids club observes frogs, tadpoles.

9:30 PM, a warm night in late June, amid the rangelands and stock ponds of Los Vaqueros Reservoir and Watershed, Contra Costa County. Coyotes sing from the hill crest to the west, as dusk fades to darkness. We plunge into a pond; tules shift and rustle about us, dark, undulant waters closing about our waders. We wear strong headlamps strapped to our foreheads. An illumined glimpse into the depths (the forbidding, foreboding four-foot depths) reveals backswimmers (Notonectidae) and water boatmen (Corixidae) galore. Plus larval California tiger salamanders (*Ambystoma californiense*) and adult and larval waterbeetles. But what kind of water beetles? Dytiscidae? Hydrophilidae? They're big and ferocious looking. What a mistake, not taking that aquatic entomology class: I would at least know what was eating me.

Becoming accustomed to this aquatic environment, we start to pick up eye-shine, reflectance from the visual apparatus of other creatures. Fishing spiders (*Dolomedes* sp.)

perched on the water, supported by surface tension. Western toad (*Bufo boreas*). Garter snake (*Thamnophis* sp.). And, sitting amid the floating leaves of the tule beds, lots, lots of California red-legged frogs (*Rana draytonii*). Big, muscular, and fast. Several very large ones look like they are wearing red vests. Blinded by the light, they are catchable, sort of (I was 3-for-6). It occurs to me that the species might have long since been extinct if raccoons wore headlamps.

So this is the celebrated jumping frog of Calaveras County. Celebrated, that is, by **Samuel Langhorne Clemens** (Mark Twain), and barely hanging on in one pond in that Sierran foothill locale. The geographic range of the California red-legged frog extends from northern Baja California up to southern Mendocino County, with some fragmented populations in the Sierra Nevada foothills. Formerly, the range was more continuous and included parts of the Central Valley, but about 75 percent of this area has been lost, due to

See FROG on p.2

photo by Eric Johnson

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Ongoing red-legged frog studies at UC Davis

Ann Chang is a Ph.D. student at UC Davis in H. Bradley Shaffer's lab. Chang's dissertation project involves identifying the boundaries of the hybrid zone between the two species of red-legged frogs, most of which appears to be in artificial ponds. Then, Chang plans to look for mechanisms that promote hybridization between these species, which may be related to human-induced habitat heterogeneity. Some studies of frog hybridization in Europe and North America suggest that hybridization may be most prevalent where habitat is suboptimal for both parental species, and there is ongoing debate as to whether hybridization is beneficial or harmful for species persistence.

Further reading on frog hybridization

Anholt, B.R., S.Negovetic, C. Rauter, and C. Som. 2005. Predator complement determines the relative success of tadpoles of the *Rana esculenta* complex. *Evolutionary Ecology Research* 7(5):733-741.

Chang, Ann. 2007. Web page: www2.eve.ucdavis.edu/shafferlab/chang.htm

Parris, M.J. 2004. Hybrid response to pathogen infection in interspecific crosses between two amphibian species (Anura: Ranidae). *Evolutionary Ecology Research* 6(3):457-471.

Plenet, S., P. Joly, F. Hervant, E. Fromon, and O. Grolet. 2005. Are hybridogenetic complexes structured by habitat in water frogs? *Journal Of Evolutionary Biology* 18(6):1575-1586.

agriculture, urbanization, and introduced predators. The species is now nearly extinct in Southern California and the Central Valley.

Thanks to the efforts of the Contra Costa Water District, this threatened amphibian has found a firm, if slimy, toehold amid the rangeland ponds of Alameda and Contra Costa counties. The Los Vaqueros site is operated under a mitigation agreement, and many of the ponds are designed and managed with California red-legged frog specifically in mind. Each pond has shallow sections for basking and deeper sections (minimum four feet) to allow the larvae and frogs to more easily escape predators. Ponds also have diverse vegetation, with tule beds, bulrushes, and sedges on the edges and adjoining willow thickets. Some ponds are partially fenced off to limit access by cattle, allowing dense vegetation in and around part of the pond, but in the cattle-accessible portion providing the strong sunlight that favor fast metamorphosis. Not to mention, raw cattle manure is probably a plus, because it supports growth of algae and possibly other plants on which the tadpoles feed. Back in the Pleistocene, more than 10,000 years ago but the wink of an eye in evolutionary time, huge herds of huge animals would have visited the banks of California's lakes and slow-moving streams, making large, unlaundered deposits. Even in historic times, there were huge herds of deer, antelope, and elk that probably did the same duties. Both California red-legged frog and California tiger salamander thrive in nutrient-rich waters.

At Los Vaqueros, the main reservoir harbors abundant fish and few frogs. But many of the ponds lack fish and are allowed to dry or are drained at least every two years.

This reduces reproduction by the introduced bullfrog (*Rana catesbeiana*), a potent competitor and predator of California red-legged frog. Bullfrog larvae require about a year before metamorphosis, whereas California red-legged frog larvae complete development in about six months. Fine-mesh fencing near the property boundaries is used to reduce colonization by bullfrog, and staff also routinely hunt and shoot bullfrogs that colonize the area. Bullfrog is distinguishable by its lack of a dorsolateral skin fold, making this task easier.

Galen Rathbun of the California Academy of Sciences (www.calacademy.org/research/bmammals/grathbun.html) and **Norman Scott**, formerly of the U.S. Geological Survey, are two biologists who have jumped into California red-legged frog conservation. Since 1992, they have collaborated and have consulted on projects ranging from rangelands to golf courses, to sewage treatment ponds, to toxic waste sites. At a June 2006 workshop hosted by the Natural Resource Conservation Service and held in Livermore and at nearby Los Vaqueros, the two shared scientific findings and personal experiences regarding the biology—especially the behavior—of *Rana draytonii*, and how this bears on conservation and restoration efforts.

Rathbun and Scott point out that the frog uses upland as well as aquatic habitat, including stock ponds and spring boxes, which are new features of the landscape and are potentially big assets in conserving the species. This frog is a creature of habit, programmed to return to its breeding ponds in straight lines, perhaps orienting based on geomagnetism, by night sky features, by memory, or some combination. The instinct for direct homing makes the frog vulnerable to human-erected barriers, including fences and roads.



Frog egg masses.

photo by Eric Johnson

The California red-legged frog has a close relative, the northern red-legged frog (*Rana aurora*) that is slightly smaller and that has a more northerly range; the two species were recently split on the basis of genomic studies conducted at UC Davis (Shaffer et al. 2004). The northern red-legged frog occurs from about the town of Elk in Mendocino County, north to southern British Columbia. There is about a five-mile zone of overlap in southern Mendocino County, where both species share the same ponds. Only northern red-legged frog occurs north of Big River, and only California red-legged frog occurs south of Mills Creek. Egg masses of California red-legged frog float, whereas those of northern red-legged frog sink, perhaps conferring some resistance to freezes, which are more likely in the north.

Arcata in April, a warm spring night near Potawot Health Village, by the little footbridge. Down in the tules, what's all that chuckling about? Northern red-legged frog, in the mood to mate. The mating call is softer than you would expect from a fairly large frog; in fact, it can be drowned out by the call of the much smaller Pacific tree frog (*Hyla regilla* = Pacific chorus frog, *Pseudacris regilla*). By mid-morning the next day, northern red-legged frogs are literally piled up on logs, basking in the spring sun, as well as, maybe, the amphibious afterglow. This gregarious species is abundant on the Potawot wetland and meadow restoration site, in the suburbs near the Mad River and large conventional farms.

United Indian Health Services purchased the property in late 1997, and developed a health clinic with extensive adjoining organic gardens and restored meadow, uplands, and wetlands. As staff ecologist **Eric Johnson** notes, restoration started in 1998, prior to design of the main buildings. Aerial photos, historical literature, and old maps guided the restoration efforts, which began with the excavation of old swales, and the high-quality organic soils were moved to the sites of future organic gardens. The underlying clay subsoils hold water well, and ponds are now supplied by storm-water run-off from parking lots and buildings by a gravity-feed swale system, plus overflow from Janes Creek. There are now meadows and thickets, managed using

techniques calculated to preserve amphibians and other fauna, including high mowing of the grasses. Native mammals on site include longtailed weasel, fox, skunk, and raccoon. Western toad (*Bufo boreas*) and western pond turtle (*Actinemys marmorata*), both native, are recent arrivals at Potawot.

The result is a park-like expanse with meandering swales and trails, full of wildlife, walkers, and joggers. Anything but the prim and prissy “greenbelt” that typifies modern developments, Potawot, with its frog-friendly features, could serve as a template for suburban planners. The site is used for educational

programs, including a Potawot-based youth group called La Chomp Chay (“little frogs” in the Yurok language) Kids Club. Johnson reminisced that one midday in May, the La Chomp Chay kids were strolling back to the parking lot from a class held in the organic garden, but they all stalled out at the little footbridge. Why? There, on view in a one-foot-deep swale, were about 50 northern red-legged frogs amid the water parsley, bulrushes, and sedges. There were also numerous tadpoles and egg masses. Just try dragging kids away from a spectacle like that.

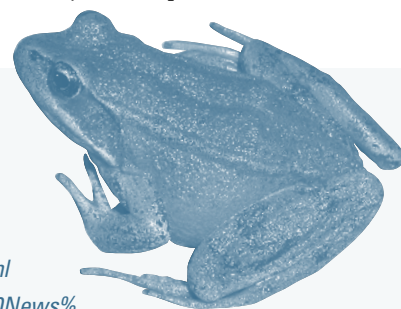


photo by Alan D. Barron

Further Reading

California Red-Legged Frog

californiaherps.com/frogs/pages/r.a.draxtonii.html

fws.gov/sacramento/ea/news_releases/2002%20News%20Releases/SFWO%202002%20News%20Releases/CA_Red-leggedfrog_FPlan.htm

Proctor, Keith, Terry Huff, Karen Sweet, and Ivana Noell. Frog Farming In Alameda County: Overcoming Barriers, Creating Opportunities. Alameda County Resource Conservation District/USDA Natural Resources Conservation Service, Livermore, CA.

Shaffer, H. Bradley, G. M. Fellers, S. Randal Voss, J. C. Olive and Gregory B. Pauly. 2004. Species boundaries, phylogeography and conservation genetics of the red-legged frog (*Rana aurora/draxtonii*) complex. *Molecular Ecology* 13(9): 2667-2677

Northern Red-Legged Frog

californiaherps.com/frogs/pages/r.a.aurora.html

Los Vaqueros Watershed

ccwater.com/losvaqueros/

pbase.com/sthuman/vaqueros

Potawot

www.fs.fed.us/r5/newslog/january2002/roundup/potawot.html

http://familydocs.org/practiceprofiles/8/content_medicine.htm

Amphibian Conservation on Farms

Bugg, R.L. and P.C. Trenham. 2003. Agriculture affects amphibians (Part 1): Climate change, landscape-scale dynamics, hydrology, mineral enrichment of water. *Sustainable Agriculture* (newsletter of UC SAREP), Spring 2003 15(1):12-15. sarep.ucdavis.edu/newsltr/v15n1/sa-6.html

Bugg, R.L. and P.C. Trenham. 2003. Agriculture affects amphibians (Part 2): pesticides, fungi, algae, higher plants, fauna, management recommendations. *Sustainable Agriculture* (newsletter of UC SAREP), Fall 2003 15(2):8-11. sarep.ucdavis.edu/newsltr/v15n2/sa-7.htm

Full circle

As I begin my new position at the University of California, I find myself saying that I feel like I've been preparing my whole career for a job like this.

In January I officially began work as the inaugural W.K. Kellogg Endowed Chair in Sustainable Food Systems at the UC Davis campus, and as director of UC ANR's statewide Sustainable Agriculture Research and Education Program (SAREP) and director of UCD's Agricultural Sustainability Institute (ASI). Whew!

It's a complex job, certainly, but in many ways it is a healthy move for me and my family. I've just spent six years in Nairobi, Kenya as global coordinator of the ASB Partnership for the Tropical Forest Margins, which is hosted by the World Agroforestry Center. I loved my work, and my family and I love Kenya, but it was time to come back to the U.S., and back to my roots.

One of the things that people resonate with is the fact that I grew up on a farm in the Central Valley. It is now 20 acres in Orangevale (northeast of Sacramento), but it has been larger. My father's family came from Sweden and the Dalmatian Coast of Croatia many years ago, and purchased the original farm in 1898. At its largest, the farm was 300+ acres of rice, orchards and a duck club, which helped pay the bills for many years. My parents still live in my maternal grandmother's house on the remaining 20-acre diversified farm, where they raise fruit.

When I was growing up, we sold some of our crops to canneries and to grocery chains; now my



New SAREP and ASI director Tom Tomich (right) with his father, Thomas C. Tomich at the family farmstand.

dad likes to say "the market comes to the farm," as long-time customers and many new patrons come to the farm to buy fresh cherries, apricots, peaches, plums and other fruit. My father still enjoys working with young people, and area families arrange far in advance to have their children work with him on the farm. And, each winter he offers orchard pruning workshops on the farm.

I am happy to be here. After undergraduate work at UC Davis, a doctorate in food systems research at Stanford, 10 years as a Harvard faculty member, and 12 years in international agricultural research with the World Agroforestry Center, I see my new job as a wonderful opportunity to help develop the scientific foundations for sustainability in my home state.

To me, sustainability means a healthy bottom line for farmers, thriving rural communities, wholesome and nutritious food, and a healthy environment.

Right now is an exciting time of "imagining": imagining a statewide sustainable agriculture program and an Agricultural Sustainability Institute that will anticipate the big issues

and set the agenda for research, education and action. I see colleagues working together on an agenda driven by the concerns and aspirations of stakeholders representing the diversity of California, and supporting public discussion of big issues.

I believe that through our united efforts, we can integrate science and action, as our understanding of all dimensions of agricultural sustainability develops—in plant and animal science, the environment and natural resources, economics and social concerns.

I look forward to working with you, and hearing your hopes and concerns. Together, we can imagine what agricultural sustainability can and will be in California.

I'm glad I'm back home to be part of agriculture's future.

—Tom Tomich, director, University of California Sustainable Agriculture Research and Education Program, and director, UC Davis Agricultural Sustainability Institute

Online sustainable agriculture course for ag professionals

by David Chaney, UC SAREP

A new online course for agricultural professionals provides a comprehensive introduction to sustainable agriculture and what it means for farmers, ranchers and communities across the U.S.

The course, *Sustainable Agriculture: Basic Principles and Concept Overview*, is part of a larger continuing education program developed by the national USDA Sustainable Agriculture Research and Education (SARE) program. This program is designed primarily for Cooperative Extension and Natural Resource Conservation Service (NRCS) personnel, particularly new staff members, and will also be of interest to other agricultural, natural resource and community development professionals. It emphasizes core concepts and a basic understanding of sustainable agriculture, its goals and its relevance to farming and ranching operations – large or small.

Sustainable Agriculture: Basic Principles and Concept Overview is the first in a series of five online courses to be presented over the next three years. When completed, the series will include the following courses:

- Sustainable Agriculture: Basic Principles and Concept Overview (available now)
- Agroecology
- Strategic Farm/Ranch Planning and Marketing
- Participatory Research and Education Skills
- Program Planning Skills and Professional Development

The new online course is presented in an interactive, Web-based format that includes a variety of activities, real-life examples and extensive links to other Web sites that offer information, resources, and assistance. After completing the course, participants will be able to work more effectively with clients, and further develop research and extension programs that improve farming and ranching systems. A major advantage of the course is that it is self-guided and self-paced so that

students can complete it on their own schedule.

Sustainable Agriculture: Basic Principles and Concept Overview is available free of charge via the Cooperative Extension Curriculum Project Web campus (cecp-online.org), which provides the course management features and technical infrastructure. The site allows development and cataloging of course content and multimedia elements, is designed for maximum sharing of these learning resources across states, and will be integrated with the larger e-Extension (extension.org) effort.

In keeping with a 1994 congressional mandate requiring SARE and Extension to train all new agents in sustainable agriculture, SARE is encouraging Extension, NRCS and other agricultural professionals to take the course and share the information with

colleagues. To access the course, participants should start at the SARE National Continuing Education Program portal (<http://www.sare.org/coreinfo/ceprogram.htm>), where they can find out more about SARE professional development activities and instructions on accessing the course at the online campus.

David Chaney, education coordinator for UC SAREP and the Western Region SARE representative, worked with a national team to develop the framework for the National Continuing Education Program, and to create this first course. He continues to work with the national SARE program on developing subsequent courses in the series. (See Sustainable Agriculture Winter/Spring 2006, Vol. 18, No.1.) For more information contact Chaney at dechaney@ucdavis.edu.

photo by Lyra Halprin



Extension professionals attend many courses and field days; the new USDA SARE program's online sustainable agriculture course offers another opportunity to update information and skills.

Goal: Sustainable food system in one generation

Roots of Change (ROC), the statewide University of California Sustainable Agriculture Research and Education Program (UC SAREP), and the new UC Davis Agricultural Sustainability Institute are hosting a meeting at UC Davis on March 13 to promote ROC's collaborative effort to create a sustainable food and farming system in California by the year 2030. The meeting will be one of seven taking place in California communities in February and March. The UC Davis event will take place Tuesday, March 13, at the Buehler Alumni & Visitors Center from 1–4 p.m.

Roots of Change Wheel. This visual representation of California food systems depicts the interdependent and connected nature of the many elements linked to food systems.

ROC is a collaborative effort involving business, government, non-governmental organizations, foundations, and individuals. Since 2002 ROC has developed a vision, a network of committed leaders, and proposed initiatives in a transformation strategy, with indicators for measuring progress (see www.rocfund.org).

ROC aims to generate and maximize impact over the next five years by creating venues and activities that unify food system leaders around the vision and a common campaign strategy, and then support those leaders and their organizations with tools, funding, and expertise to ensure effective implementation.

ROC is inviting producers, non-governmental organizations, business, universities, government, foundations and others to work together to devise plans and implement projects to reach a sustainable food system in one generation. This system-oriented effort will seek to improve the health of our communities, enact sound agricultural and food policy, create meaningful jobs, increase market opportunities, and effect positive change in the environment for California.

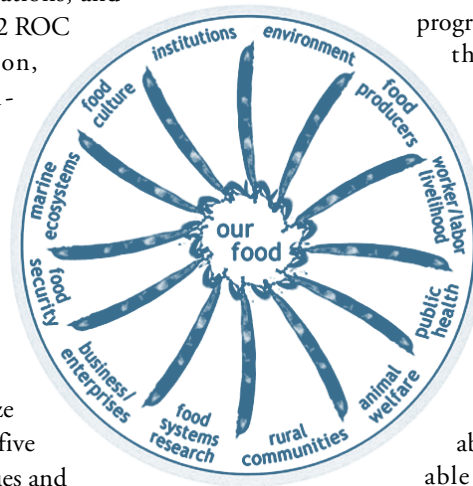
Gail Feenstra of UC SAREP was instrumental in developing the 76 indicators that will be used to track the progress of the initiative over the next two decades.

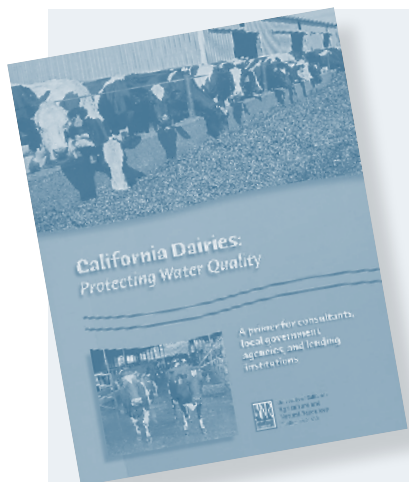
Feenstra's work is a major component of ROC's 2006 *New Mainstream* report, which proposed a vision and change agenda. Elements of this report provide the launch point for the next phase of ROC's work. It is available as a free, downloadable pdf at rocfund.org/.

The public is invited to attend the meeting to learn about:

- Proposed initiatives to achieve a sustainable food system
- How to help shape plans and implementation of projects
- ROC's role and proposed services
- How to receive ROC's requests for grant proposals
- How to apply for a 2007 ROC Planning Fellowship

For more information, contact **Nicole Mason** at Roots of Change (415) 391-0545 x11 or nicole@rocfund.org. To make a reservation for the March 13 meeting, please contact Mason by March 6.





New UC dairy water quality publication for lenders, ag consultants

by Lyra Halprin, UC SAREP

A new University of California publication outlines key management practices that protect surface and groundwater quality for the dairy industry. Milk is now California's No. 1 agricultural commodity with a farm-gate value of more than \$5 billion annually.

"The state has fewer dairy farms than it did 20 years ago, but the average herd size has increased," said **Stu Pettygrove**, UC Cooperative Extension (UCCE) soils specialist, UC Davis, and co-author of the publication. "Dairy producers are faced with increasing scrutiny by environmental health and planning agencies. We're happy to be able to share practical approaches and technologies that work to protect water quality."

Pettygrove noted that wide-scale adoption of farming practices that protect the environment depends on awareness and support of agricultural businesses and regulatory agencies. The guide is aimed at lending institutions, consulting engineers and crop management companies that work with dairy producers, as well as regulatory bodies like county environmental health departments and the regional water quality control boards.

Each dairy is different, and production practices must be individually tailored, Pettygrove said. The guide identifies three kinds of dairies—those with irrigated cropland, those with non-irrigated pasture and hay fields, and those with limited cropland—and outlines a variety of management measures for each. It also summarizes four critical components that must be in place to protect water quality:

- All dairies must have sufficient cropland to receive recycled wastewater and manure for their land base
- There must be suitable storage for manure during periods of rain to keep nutrient runoff out of waterways

- There must be a distribution infrastructure and equipment to move manure nutrients to cropland
- There must be management procedures and recordkeeping to document that recycled manure is applied at appropriate rates and does not pollute water

"The process of upgrading an existing dairy facility to an 'ideal' dairy farm takes time," Pettygrove said. "We have compiled some of the specific measures taken by progressive dairy producers who have improved their nutrient management practices. There are a wide range of solutions to the challenges facing dairy farmers."

California Dairies: Protecting Water Quality was co-authored by **Patricia L. Ristow**, former postgraduate researcher at UC Davis; **Deanne M. Meyer**, UCCE livestock waste management specialist, UC Davis; **David Lewis**, watershed management advisor, UCCE Sonoma, Marin and Mendocino counties; **Nyles Peterson**, dairy advisor and county director, UCCE San Bernardino County; and **Janet C. Broome**, area plant pathologist, UCCE Sacramento, Yolo and Solano counties.

The 16-page guide was produced with funding from the California Department of Food and Agriculture's "Buy California" Initiative, the USDA, the US-EPA Clean Water Act, and the UC Sustainable Agriculture Research and Education Program (UC SAREP). It was developed through UC SAREP's Biologically Integrated Farming Systems program. A limited supply of free copies are available in Pettygrove's office through **Tiva Lasiter** at tlasiter@ucdavis.edu, or phone (530) 752-1130. The guide is ANR Publication 21630, and may also be ordered for \$10 (plus tax and shipping) by calling (800) 994-8849 or by logging onto anrcatalog.ucdavis.edu.

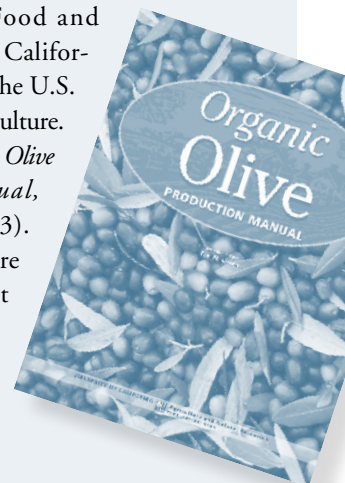
Organic Olive Production Manual

In response to growing demand for organic olive oil and an increasingly competitive market, University of California Cooperative Extension farm advisors and researchers have produced an organic olive production manual.

"Organic olive oil production could be a significant niche in California's agriculture industry," said **Paul Vossen**, UC Cooperative Extension farm advisor in Sonoma and Marin counties, lead author of the manual. "We're pleased to be able to offer this resource for growers."

Organic Olive Production Manual provides detailed information for growers on production issues, economics, pest control, harvest, the conversion process, and organic certification and registration. 112 pages, 45 photographs and 37 tables and figures. ANR Publication 3505. Technical Editor: **Paul Vossen**. Authors: **Paul Vossen**, **Alexandra Kicenik Devarenne**, **Joseph H. Connell**, **William H. Krueger**, **W. Thomas Lanini**, **Jeffrey A. Creque**, **Stephen R. Gliessman**, **David Chaney**, **Ray Green**, and **L. Ann Thrupp**. Publication coordinator: **Jeri Ohmart**. Cost: \$18. The manual may be ordered from the UC ANR Publications Web site at anrcatalog.ucdavis.edu

The manual was produced with funding from the California Department of Food and Agriculture's "Buy California" Initiative and the U.S. Department of Agriculture. It supplements the *Olive Production Manual, 2nd Edition*, (3353). Organic growers are advised to consult both publications as they develop and refine their production systems.



SOURCES OF FUNDING

SAREP offers grants to UCCE advisors and county directors

SAREP announces a Request for Proposals for one-year projects that address one of three agricultural sustainability issues:

- Analysis of energy costs in agriculture,
- Research on agricultural marketing strategies that promote environmentally sound and socially responsible practices, or
- Assessment of potential impacts of global climate change on California agriculture.

Funds are available to UC Cooperative Extension advisors and directors. Collaboration with other UC scientists, graduate students, government agencies, or non-profit organizations is strongly encouraged. Total funding available is approximately \$100,000; projects will be awarded up to \$25,000.

More information is available on SAREP's Web site at: sarep.ucdavis.edu/grants/request.htm. Proposals are due **April 11, 2007**.

Fertilizer Research Awards

The California Department of Food and Agriculture Fertilizer Research and Education Program (FREP) is accepting suggestions for projects to help improve the efficient use of fertilizer and minimize environmental impacts. Projects may focus on research or education/demonstration. Project suggestions due March 9; Request for Proposals released April 7, with proposals due June 1, 2007. For more information, contact **Ken Kitade**, CDFA/FREP, 1220 N St., Sacramento, CA 95814-5607; (916) 445-0444; kkitade@cdfa.ca.gov. **Web site:** cdfa.ca.gov/is/frep.

CALENDAR

* SAREP WEB CALENDAR AND ONLINE COURSE

SAREP offers a regularly updated sustainable agriculture calendar on our World Wide Web site at: www.sarep.ucdavis.edu (click "Calendar" on top menu bar). Please feel free to add sustainable agriculture events. In addition, we offer an online course for pest control advisors and others titled Ecological Pest Management. Up to 11 CE credits for California PCAs. See www.sarep.ucdavis.edu/courses/

* NATIONAL/INTERNATIONAL CALENDAR

The National Agricultural Library maintains a calendar as part of AgNIC at www.agnic.org. It links to more than 1,200 major national and international agricultural conferences.

MARCH

4 - 7 *California Farm Conference*, Monterey Bay Beach Resort, Monterey. State's premier gathering of small farmers, supporters. On-farm tours, workshops, networking. Information: california-farmconference.com

MAY

3 - 30 *Intensive Sustainable Farming Course*, Ecuador. 1-month intensive. Practical/theoretical, videos. Organic agriculture, permaculture, biodynamics, natural farming. Includes local activities: chocolate making, horse trekking, crafts. Courses run May, August, November. Contact: Rio Muchacho Organic Farm & Education Centre, Bolívar 902 y Arenas, Bahía de Caráquez, Ecuador. info@guacamayotours.com or info@ecopapel.org; www.riomuchacho.com.

JULY

11 - 14 *2nd National Conference on Facilitating Sustainable Agriculture Education*, Cornell University, Ithaca, New York. Steering Committee: students, faculty and staff from Cornell University, Delaware Valley College, Mercyhurst College, The Pennsylvania State University, The Rodale Institute, and UC Davis. Contact Kathi Colen Peck, kscp@turbonet.com.

SUSTAINABLE AGRICULTURE is a publication of the UC Sustainable Agriculture Research and Education Program (SAREP). SAREP provides leadership and support for scientific research and education to encourage farmers, farmworkers, and consumers in California to produce, distribute, process and consume food and fiber in a manner that is economically viable, sustains natural resources and biodiversity, and enhances the quality of life in the state's diverse communities for present and future generations. SUSTAINABLE AGRICULTURE is published three times yearly by SAREP staff from its UC Davis offices, with assistance from ReproGraphics, UC Davis. Mailing address is: UC Sustainable Agriculture Research & Education Program, University of California, One Shields Ave., Davis, CA 95616-8716. **Internet:** <http://www.sarep.ucdavis.edu> **Email:** sarep@ucdavis.edu, **Telephone:** (530) 752-7556, **Fax:** (530) 754-8550. Material in this publication may be reprinted with credit, except articles that have been reprinted from other publications.

Tom Tomich

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