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From the Director

Fine-tuning Agricultural Systems

In the past I have discussed the need for more system-level research, because farmers manage complex systems; I think that this need still exists. However, there is also a clear need for investigations into key components of these complex production systems. This sort of investigation may be the key to solving many of our production related problems in California. There are numerous production systems where component research is the key to solving particular problems.

For example, **Russell Lester** is a walnut grower in Winters, California, who like many other orchardists in the state is relying mainly on no-till management of cover crops to meet his trees' nitrogen needs. This general approach is seeing increasing use in California orchards, and both plant tissue analyses and production from most of these orchards suggest adequate nitrogen. Yet we know few particulars about nitrogen cycling in such systems. There have been no studies conducted to evaluate the possible benefits from cover crop-derived nitrogen in California almond or walnut orchards. Component research in such orchard systems could address how cover crop species selection, soil type, irrigation system, moving technique, and decomposer organisms influence nitrogen dynamics. Thus, critical component research could help Russell Lester and many other orchardists fine-tune and optimize their management. Component and systems research methods are potentially complementary, and whether one or the other is more appropriate depends on the question at hand. In both cases systems thinking will be involved, but in the case of component research the focus of the work is on the component.

Ecological orchardists have identified many other key research priorities, issues that they perceive as representing limiting factors in production. Last winter in Ventura, at the California Farm Conference, orchardists **Glenn Anderson**, **Ray Eck** and **Fred Smeds** sat down and discussed some of these issues with **Bob Bugg** of the UC SAREP staff. The priorities in critical component research that they came up with included biological and cultural control of key almond and stone fruit pathogens, such as brown rot; issues of soil health and nutrient cycling; management of wild solitary bees that pollinate almonds; effects of ecological management on bloom date, nutritive value and flavor of almonds; management of California gray field ant (*Formica aerata*) and the wasp *Goniozus legneri* as natural enemies of pests; alternative post-harvest sterilization techniques (e.g. freezing or CO₂ treatment); and selective (soft) control measures for the pest ants, including southern fire ant (*Solenopsis xyloni*) and pavement ant (*Tetramorium caespitum*).

In fact, many issues in sustainable production cut across commodity

boundaries, pointing up the possibility of cooperative funding of critical component research by several commodity organizations. Perhaps commodity boards and public funding agencies (such as UC SAREP) should explore joint funding approaches to get these issues addressed.

Our public and technical advisory committees have discussed the merit of having SAREP and commodity groups jointly sponsor such work. Such an approach would support commodity programs that are attempting to move forward on some of their tough production problems. This work would also give us new insights into how components can change the way systems function. We at UC SAREP are now exploring opportunities for these sorts of collaboration.

Bill Liebhardt, director, University of California Sustainable Agriculture Research and Education Program.

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Briefly Noted

Compiled by David Campbell, SAREP

California SAWG's First Statewide Meeting

Supported by funding from SAREP, the California Sustainable Agriculture Working Group (SAWG) held its first statewide meeting on October 8-9 in Modesto. The meeting brought together 67 individuals representing a broad range of groups, including farmers, legislative and

agency staff, research and extension staff, non-profit representatives, and grassroots activists for anti-hunger and labor concerns. Plenary sessions addressed sustainable agriculture in the 21st century, the Campaign for Sustainable Agriculture and the 1995 Farm Bill, production and policy alternatives for reducing pesticide use, and the links between sustainable agriculture and community food security. Alliances were formed among the diverse participants, and plans were made for SAWG activities. The California SWAG, one of five regional SAWGs around the nation, is designed as an institutional vehicle for advancing the common interests of the diverse constituencies involved in sustainable agriculture. For more information, contact **Kai Siedenburg**, SAWG Project Coordinator, P.O. Box 1599, Santa Cruz, CA 95061; (408) 458-5304.

Rise in Migrancy Among California Farmworkers

A recent Department of Labor report based on National Agricultural Workers Survey finds that almost half (47 percent) of all California agricultural workers migrate to find seasonal jobs. The finding is based on interviews completed between January 1989 and June 1991. That figure is up from the 39 percent migrancy rate found in a 1983 survey. The study found that most migrant workers travel from their hometowns to a particular work site, then return when the job is done. These "shuttle" migrants outnumber circular migrants—those who follow the crops from place to place on a seasonal route—by almost three to one. Four out of five shuttle migrants travel between a foreign country (mostly Mexico) and the United States. The study suggests that most migrants seek a lifestyle of stable long-term agricultural employment, but few find it due to the structure of farm labor demand which emphasizes temporary jobs, encourages subcontracting for labor management, and recruits workers in a manner that results in a chronic oversupply of labor. To obtain the report, *Migrant Farmworkers: Pursuing Security in an Unstable Labor Market*, contact **Ruth Samardick**, USDOL, Office of the Secretary for Policy, Room S-2015, 200 Constitution Avenue, N.W., Washington, DC 20010; (202) 219-6461. A related SAREP publication, *How to Stabilize Your Farm Work Force (and Increase Profits, Productivity, and Personal Satisfaction)* is now available (see P.10).

EPA, USDA Agree to Develop Pesticide Alternatives

On August 15 '1994, the U.S. Environmental Protection Agency (EPA) and U.S. Department of Food and Agriculture (USDA) announced an agreement to coordinate regulatory actions against high-risk pesticides with efforts to search for safer alternatives. According to the agreement, EPA and USDA will identify cases where producers will face a lack of pest management tools due to regulatory action. USDA would then work with both the agriculture and research communities to identify and develop alternative pest control methods. This will be done in part through a competitive grants program within a research and technology transfer program. To start the new process, EPA has recently listed 36 pesticides to be phased out under the terms of an out-of-court settlement of a lawsuit brought by the Natural Resources Defense Council (NRDC). Among the pesticides and their uses are alachlor, used on soybeans and peanuts; benomyl, a fungicide used on apples, citrus, grapes, rice and tomatoes; captan, used on grapes, plums, and tomatoes; mancozeb, used on cereal grains and grapes; and dicofol, used on fruits and tomatoes. For more information, contact **Al Heier**, US-EPA, (202) 260-4374; Tom Amontree, USDA, (202) 720 4623; or **Jennifer Curtis**, NRDC, (415) 777-0220.

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SAREP Offices Move

After years of being split into offices at two locations, SAREP staff members will be together at the new UC Division of Agriculture and Natural Resources (DANR) building on Hopkins Road in the far west section of the UC Davis campus. We will be sharing the building with the UC Small Farm Center, the Genetic Resources Conservation Program, and the offices of the directors of DANR's North Region and the North Central Region. The move is scheduled to be completed by the time this newsletter is mailed.

Please note that SAREP staff members formerly identified with the Information Group now do not need that designation as part of their address. We're all together. Those staff members who were housed off-campus will have new, on campus telephone numbers. The program address and FAX number and all telephone numbers and e-mail addresses are listed below. We expect the move to go smoothly, however, there may be some telephone confusion in the first several weeks. Please call the main program telephone number if there are problems with other lines, especially the new "754-" numbers. We appreciate your patience, and are looking forward to serving you more efficiently at our new site!

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* Kristen Kelleher , public information representative for the USDA Sustainable Agriculture Research and Education program/Agriculture in Concert with the Environment (SARE/ACE) for the Western Region, will share office space with SAREP. (3)	(916)752-5987	kkelleher@ucdavis.edu

* indicates part-time employee

(1) 50 percent funded by USDA

(2) funded by California Energy Commission

(3) funded by USDA/US-EPA

Agricultural Animals and California's Water

by [Lyra Halprin](#), SAREP

[Editor's Note: This is the first part of a two-part article on the Oct. 20, 1994 conference "Animal Agriculture Impacts on Water Quality in California, which reported the results of a year-long study of the same name undertaken by the UC Davis Animal Agriculture Research Center and the UC Agricultural Issues Center (AIC). Proceedings will be available from AIC in January 1995.]

How does livestock affect California's water? The state's animal industry is large dairy, beef, poultry, sheep and hog operations brought in more than \$5.25 billion in 1993, at least one-quarter of California's agriculture marketing receipts. State and federal agencies regulate the industry to protect water supplies, and yet there is a lack of research based, site-specific information on animals and water. These issues prompted the UC Davis Animal Agriculture Research Center and the UC Agricultural Issues Center to jointly sponsor a year-long research study on the relationship between animals and the state's water. More than 60 UC scientists from 16 departments and 14 Cooperative Extension offices, farmers and environmental groups as well as representatives from ten state and federal agencies contributed to the study, results of which were presented at the "Animal Agriculture Impacts on Water Quality in California" conference in Sacramento.

Keynote speaker **Paul Johnson**, chief of the USDA's Natural Resource Conservation Service (formerly the Soil Conservation Service), noted that because 75 percent of the land in the U.S. is private, water conservation must begin with those who live there. He said partnerships and coordinated research with state and federal agencies, the University of California, Cooperative Extension and the farm press will be necessary to protect water. A former farmer and a member of the Iowa House of Representatives, Johnson was instrumental in the passage of the Iowa Groundwater Protection Act of 1987, which emphasizes research, education and voluntary approaches to water quality.

Barbara Schneeman, dean of UCD's College of Agriculture and Environmental Sciences, noted that California's productive animal agriculture industry understandably generates a large quantity of by-products. "These aren't necessarily always negative, but they need to be dealt with," she said, referring to the 500 million tons of manure produced daily by the state's more than 300 million animals.

Where the Gaps Are

Schneeman said that researchers for the animal/water study were "charged to

determine what information exists, how reliable it is, and identify where gaps in the information exist." She noted that livestock operations are larger and more concentrated here than in other states, there is less rain, more feed is imported and urban pressures are intense. Limited water has produced concern over its quality and quantity, "particularly in the midst of our eight-year drought," Schneeman said.

She pointed out that dramatic animal management changes have taken place in the state in the last 45 years. She said that the number and character of the state's dairy operations alone is very different, shifting from 20,000 small dairy operations in 1950 to only 2,400 in 1991, each averaging more than 500 head, with many much larger.

As she introduced the first of four research teams that worked on specific animal agriculture issues, she reiterated that accurate information was the primary goal of the study. "Everyone needs to be aware of what is really happening out there, and we need to tell others," she said.

Each team leader's report was followed by a panel response that included farmers and ranchers, water scientists, regulatory agency officials, and audience participation.

The first research team report was presented by **James Oltjen**, an animal management systems specialist in the UCD animal science department, who discussed potential sources of water contamination from grazing and confined animal operations. He noted that in California's varied climate zones and topography, site-specific factors are key. Potential pollutants of most concern are animal manure, production water, storm water runoff, dead animals, dust, silage, bedding, waste products, medicine, chemicals, sediment and soil disturbance. He said detailed information is needed to better understand animal agriculture's contribution to water pollution, and to look at the way manure can be a positive resource as it is recycled for fertilizer, energy production and feed.

Cattle, Poultry, Hogs and Fish

Oltjen said feedlots in California maintain 375,000 head of beef cattle. Each 1000 lb. animal produces approximately 58 pounds of total manure each day (8.5 lbs/solids). The approximately 1.22 million dairy cows in the state (average size 1300 lbs) each produce approximately 1.22 pounds of total manure daily (approximately 15/lb. solids). In the poultry industry, 233 million broilers produce 2.25 pounds each of dry manure during their short lifetimes, which totals 530 million pounds of manure dry matter per year. The 26 million egg layers produce approximately 636 million pounds per year of manure dry matter, while the 23.6 million California turkeys produce 298 million pounds of manure dry matter annually.

Oltjen also gave statistics for hogs and fish produced in the state. California hog growers raise 275,000 swine each year, less than one percent of the nation's pork. (The state's consumers eat more than 10 percent of all U.S. pork.) One thousand pounds of live-weight pig (several animals) produces 84 pounds of manure per day (11 lbs solids). (Not mentioned at the conference, but noted in the study, is information about horse manure. An average horse weighing one thousand pounds is expected to produce 51 pounds of manure

per day, including 15 pounds of total solids. There are about one million horses in California.)

Aquaculture, an agriculture industry that contributes about \$30 million per year to the state, has highly regulated discharge water "Low concentration of waste in aquaculture water makes it ideal for other applications such as agricultural irrigation," Oltjen said.

Farmer Response

Responders included dairy farmer **Richard Michel**, who discussed the importance of manure-handling use plans for producers that extend from one to five years.

"No one is more concerned about water quality than the dairy farmer," Michel said. "He or she drinks the water, the employees drink the water, the animals drink the water. Poor quality water means poor crops, sick animals, and soon to-be-out-of-business. "

Michel said producers know it isn't possible to pile manure up forever in one place and not expect a consequence. He said, however, that dairy farmers generally see manure not as a potential problem, but as an asset. "We seem to be moving toward sustainable and organic farming practices," he said. "This manure is a great asset. We use it (on our own fields) to help offset the cost and use of commercial fertilizer."

"Let's keep in mind the potential contamination of water from animal operations," Michel said. "We have to acknowledge that the possible contamination also comes from other sources." He noted that when water is tested, it is not possible to determine which nitrates or metals come from animals, and which come from vineyards or orchards and commercial fertilizers.

Michel said further studies of potential contamination problems "could be justified by the university working with dairy associations in specific areas of the state to make long-term analysis."

"We want long-term studies," he said. "The university can work with Extension service people and farm advisors, who already have a relationship with farmers. University researchers can provide information gathering and testing. Above all, let's avoid an additional bureaucracy that would entail extensive and frequent reports and new fees from the farmer."

Lonnie Wass, a senior water resources control engineer in the Central Valley Regional Water Quality Control Board in Fresno noted that he has seen permit requests for large dairy operations increase, including one now under consideration for a three-phased dairy farm of more than 10,000 cows. "That's the size of a city in terms of waste production," he said. "We need to be careful in evaluating the permits to make sure we're not impairing the beneficial uses of surface or ground water in the region."

Sherman Swanson, a riparian scientist at the University of Nevada, Reno said that understanding cattle grazing behavior can help researchers figure out what to do to maintain stream environments.

Human Health Impacts

Kenneth Tanji, UCD professor of hydrologic science in the land, air and water resources department, reported on his team's research on the impacts on human health and agriculture and natural systems. He said that nitrate maps of California water wells only show deeper wells, and do not include the many shallow, private wells throughout the state. Tanji stressed that the impacts of animal wastes may be felt on-site as well as off-site; there is not enough research now to know exactly where animal wastes go. He said nitrogen from manure and urine can be converted to nitrate, the most mobile nitrogen form. Water and land management practices contribute to the possibility of nitrates migrating. He said it may take "decades of travel time" for the nitrate to migrate to aquifers. The Chino Basin area of Southern California, which started increasing its animal population in the 1930s, began showing signs of high nitrates in well water in the 1960s, he said. The area has frequently been used as an example of concentrated animal waste and groundwater contamination. Tanji noted the need for increased environmental monitoring and the use of models to improve waste management practices. "We need to better define the problem to evaluate the effectiveness of management alternatives," he said.

Ralph Jurgens, of New Era Farm Services, responded to Tanji's report and talked about how he uses manure to produce composted fertilizer. He said there are 600 dairies within 20 miles of his Tulare County office. He stressed the systems approach to composting what comes out of dairy farms, and using the products on other farms. "Manure, if handled properly, is not a waste product and does have a value," Jurgens said. "We compost this material and sell it as a composted soil amendment and as a fertilizer." Jurgens' operation serves more than 500 growers throughout the state, representing 490,000 acres.

Bruce Macler, regional toxicologist for the U.S. EPA office in San Francisco, said his work has showed him the truth in the sayings "everything is connected to everything; everything has to go somewhere; and there is no such thing as a free lunch." He pointed out that sedimentation released into streams by grazing animals is like sandpaper, and takes the stream bed with it. Animal wastes released into streams encourage the growth of algae, and toxic ammonia becomes part of the water stream. Growing alfalfa for animal feed brings the problems of subsidized water use and pesticides into the picture. He noted that human health concerns include contaminated wells, the problems of recreational exposure by people using rivers and lakes, and airborne dust contaminated with pathogens. He pointed out that pollution by microbials like giardia contribute to human health problems. "The identified outbreaks that occur from waterborne disease in the U.S. are small relative to the estimated 3 to 5 million endemic waterborne illnesses that occur each year," he said. In terms of animal wastes, Macler said that EPA is concerned with bacteria and protozoa contaminating streams and groundwater.

Brett Matzke, the Sierra Nevada manager of California Trout, Inc. presented one environmental organization's view of the water problems related to animals. He noted that 39 subspecies of salmon and 40 species of other fish "are in trouble." Sport fishing brings in \$1.7 billion to California coffers each year, Matzke said, not including fishing license fees which contribute an

additional \$40 million per year. He expressed concern about the 39 million acres of California land that is grazed, calling grazing the "number one culprit in damaging trout species. " He agreed that partnerships are "an excellent way to get rid of stereotypes' among the groups affected by regulation.

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SAREP Funds New Projects

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Thirty-four research and education projects have been granted a total of \$149,681 by UC SAREP in its 1994/95 funding cycle, according to **Bill Liebhardt**, SAREP director. New projects were chosen in four different areas: economics and public policy, production, meetings, and graduate student awards. A brief description of the projects, principal investigators and amounts awarded for the first year follows.

Economics and Public Policy Projects

(5 projects; \$51,298)

- **Robert Gottlieb**, Urban Planning, UCLA, "Expanding Direct Marketing Opportunities for Community Food Security and to Reduce Pesticide Use": \$10,615. This project will develop and evaluate new marketing arrangements that link farmers selling at farmers' markets with poor and low-income urban consumers. A pilot project will focus on the Gardena farmers' market, located in a mixed low- and middle-income neighborhood in southwest Los Angeles.
- **Sharon K. Junge, Roger Ingram, and Garth Veerkamp**, Placer County Cooperative Extension Office, "Reason for the Season: Increasing Sustainable Practices Among Consumers": \$12,000. This project will create a regional food guide to educate consumers on the benefits of purchasing locally produced, processed and distributed food that is geared to seasonal availability. Baseline data will be collected on food production, distribution and consumption in Placer County in order to evaluate the food system's impact on nutrition, environment, energy consumption, and local economic development.
- **Jered Lawson**, in cooperation with the Community Alliance with Family Farmers, "Sharing the Costs of Land Tenure and Stewardship: A Profile of a Family and Community's Efforts to Preserve their Agricultural Land and their Sustainable Farming Practices": \$5,000. The project will create a manual describing "shared equity," an innovative model for maintaining ag land in sustainable production. In the model developed by **Steve** and **Gloria Decater** at Live Power Community Farm in Covelo, the farmer owns the productive agricultural value of the land, and a non-profit organization owns the land's additional speculative or market value.

- **Peter Lehman**, Humboldt State University, "Arcata Farm and Education Project": \$8,683. This continuing project is a student-operated, community supported farm designed to serve as a sustainable agriculture education facility for students of all ages, local farmers, and community members. The farm serves as a teaching facility for Humboldt State classes, as a community supported agriculture site, and its staff engages in extensive outreach to the local area.
- **Don Villarejo**, California Institute for Rural Studies, "Viability of Small and Medium Scale Farms in California: Case Study of Fresno and Monterey Counties": \$ 15,000. This project will determine current farm turnover-both farmers going out of business and farmers entering business-in Monterey and Fresno counties, two key agricultural areas. The impacts of farm size, commodities, and ethnicity on farm survival will be assessed.

Production Projects (9 projects; \$7S,986)

- **Karen Klonsky**, Agricultural Economics, UC Davis, "BIOS Economic Impact Study: Quantifying the Transition to Sustainable Production": \$9,194. The impacts on income and expenses will be determined for farms enrolled in the Merced County almond Biologically Integrated Orchard Systems (BIOS) program. This project will also evaluate the economic viability of the BIOS production method over a three-year transition period.
- **Bruce Jaffee**, Nematology, UC Davis, "Suppression of Plant-Parasitic Nematodes in Conventional and Organic Farming Systems": \$5,155. Soils from conventional and organic farming systems will be examined for their ability to suppress plant-parasitic nematodes. The project will be conducted at the Sustainable Agriculture Farming Systems Project at UC Davis.
- **Steven Koike**, Monterey County farm advisor, "Determination of the Effect of Cover Crops on Lettuce Drop Disease: Year Two": \$3,640. This is the third year of a study that will identify cover or rotation crops that reduce lettuce drop disease. Additionally, the study will determine the effect of manure and yard waste compost on populations of the lettuce drop pathogen.
- **Steve Temple**, Agronomy and Range Science, UC Davis, "A Comparison of Conventional, Low Input and Organic Farming Systems: The Transition Phase and Long Term Viability": \$12,253. [The Sustainable Agriculture Farming Systems Project](#) at UC Davis is in its seventh year. It is comparing four farming systems with different levels of dependence on external resources over a 12-year period.
- **Richard Smith**, San Benito County farm advisor, "Nitrogen Fertility Monitoring in Organic and Conventional Vegetable Systems": \$2,744. In organic farming systems, "quick tests" for nitrate in plant and soil analyses may not be a good indicator of crop nitrogen status. This study will evaluate quick tests on two organic and two conventional onion farms.

- **Krishna Subbarao**, assistant plant pathologist, Cooperative Extension Specialist, UC Davis, "Subsurface Drip Irrigation for Soilborne Disease Management in Lettuce": \$11,000. The use of subsurface drip irrigation in vegetable production can improve the efficiency of water use and reduce nitrate leaching. This project will evaluate the effects of subsurface drip and furrow irrigations on lettuce diseases.
- **Ford Denison**, Agronomy and Range Science, UC Davis, "Rotation Length and Organic Transitions": \$10,000. An additional four-year organic rotation will be added to the SAREP funded 100-year long-term farmland research experiment at UC Davis. The project will evaluate two-year and four-year rotation length and will assess the contributions of soil quality and human factors in the transition to organic farming.
- **Kent Daane**, Kearney Agricultural Center, Parlier, "Effects of Cover Crops, Time of Cover Crop Plowdown and Trellis System on Spiders and Other Predators of the Variegated Leafhopper (*Erythroneura variabilis*)": \$12,500. This project, in its third and final year, is evaluating the effects of various cover cropping practices on spiders and variegated leafhoppers in raisin and table grape vineyards.
- **Phil Phillips**, South Coast area IPM advisor, Ventura County, "The Impact of Dust Deposits on Insectary Reared and Released Parasites in Transitional and Organic Citrus Orchards Using Perennial vs. Annual, Tilled Cover Crops": \$9,500. Ventura County citrus growers spend large amounts of money releasing parasites for control of California red scale and black scale, but foliar dust may interfere with biological control. This study will examine the effects of both ambient dust and dust generated by orchard operations on two key parasites.

Graduate Student Awards (5 projects; \$7,973)

- **Heinrich Schweizer**, Entomology, UC Davis, "Identification of non-pesticidal mortality factors of *Scirtothrips citri* Moulton which might be enhanced by cultural manipulations in order to reduce economic damage": \$2,000.
- **Robert Venette**, Nematology, UC Davis, "Soil Bacteria: Carbon and Nitrogen Ratios, Attractiveness to Bacterial-Feeding Nematodes, and Potential Role in Terrestrial Nitrogen Cycles": \$1,000.
- **Brian Correiar**, Plant Protection and Pest Management, UC Davis, "Determination of Sampling Methods and Effectiveness of Variable rates of Trifluralin for Layby Weed Control in Tomatoes": \$1,250.
- **Jennifer Katcher**, Pomology, UC Davis, "Reducing Nitrogen Fertilization and Irrigation May Improve Almond Trees' Defense Against Hull Rot Infection": \$2,000.
- **Colehour Arden**, Applied Behavioral Sciences, UC Davis, "Effects and Prospects of Direct Marketing on Sustainability - Survey of Farmer Perspectives": \$1,723.

Meeting Grants (15 meetings; \$14,424)

- **David Pratt**, farm advisor, Napa, Solano & Yolo Counties, "The California Grazing Academy": \$1,000.
- **Sheila Gaertner**, farm advisor, Tehama and Glenn Counties, "Oak Woodland Management in the Northern Sacramento Valley": \$ 1,000.
- **Miles Merwin**, International Tree Crops Institute USA Inc., "Agroforestry Technology Course": \$1,000.
- **Stephanie Larson**, farm advisor, Sonoma and Marin counties, "Demonstrating Improved Rangeland Management for Improving Water Quality": \$1,000.
- **Mariposa Guido**, Committee for Sustainable Agriculture, "New Challenges in Production Techniques: Sustainable Agriculture Meeting and Farm Tour Series": \$1,000 for each of five meetings: Citrus and Strawberries in Ventura; Livestock and Vegetables on the North Coast; and Landscaping in Sacramento.
- **Michael Smith**, farm advisor, San Luis Obispo County, "Thistle Management in California": \$1,000.
- **Jeff Mitchell**, Vegetable Crops, UC Davis, "Development of Comparative Cropping Systems Research Projects in the Central San Joaquin Valley: Farmer/Scientist Focus Sessions to Identify Research Priorities and Appropriate Cropping Systems Research Options": \$424.
- **Jill Klein**, Community Alliance with Family Farmers, "The Lighthouse Farm Network Educational Events": \$1,000 for each of four meetings.

Western Sustainable Ag Training Program Underway

by Kristen Kelleher, Western U.S. USDA SARE/ACE

The U.S. Department of Agriculture's Sustainable Agriculture Research and Education (SARE) program in the Western U.S. recently awarded nearly a half million dollars in educational grants to several universities and non-profit organizations. The purpose of the grants is to kick off a federally-legislated "train the trainers" effort to instruct Extension Service and Natural Resource Conservation Service (formerly Soil Conservation Service) personnel and others in sustainable agriculture concepts and practices. The Western region SARE program is coordinated by soil scientist **V. Philip Rasmussen** and hosted by Utah State University.

"We've hit the ground running this year with a handful of solid, ground-breaking training projects," says Rasmussen. "The SARE regional leadership worked closely with selected training project leaders to make sure that every state and territory in the West would have access to at least one educational effort."

"One goal of this grants program is to train Extension advisors and other professionals, but the end users are really farmers and ranchers," says **A.J. Dye**, USDA program leader for this \$2.96 million national effort.

Rasmussen also announced that **Jill Shore Auburn**, UC SAREP associate director, will act as training coordinator. Auburn will organize the annual educational grants cycle and link training projects with similar state, federal and private outreach efforts.

Auburn was a founding member of the Sustainable Agriculture Network (SAN), a national information-gathering and electronic networking initiative of the national SARE program and has been involved in sustainable agriculture for 15 years. Auburn completed her doctorate at the University of California, Davis.

The competitive research grants portion of SARE, known as Chapter 1, has been funded since 1988. The new training effort, most often called Chapter 3, received funding for the first time in the 1994 federal fiscal year. Both grants programs are administered by USDA's newly-combined Cooperative State Research, Education and Extension Service (formerly the separate Cooperative State Research Service and the Extension Service).

Grant Awards and Selection

Western SARE Chapter 3 grant awards include:

- \$ 78,000 for a four-state "Pacific Northwest Sustainable Agricultural Systems Training Program" involving Oregon, Washington, Alaska and Idaho to be coordinated by **John Luna** of Oregon State University.
- \$75,000 for a one-year training program utilizing satellite-down linking and teleconferencing led by **Joe Hiller** of the University of Wyoming and **Dennis Lamm** of Colorado State University, which will focus on rangeland livestock production and dryland farming. It will be targeted to eight states: Colorado, Wyoming, Utah, Southern Idaho, Montana, Northern New Mexico, Northern Arizona and Nevada.
- \$89,000 for a one-year program coordinated by **Po-Yung Lai** of the University of Hawaii for extension personnel in Hawaii, American Samoa, Guam, Micronesia and the Northern Mariana Islands.
- \$71,000 for a University of California, Davis, program led by **Steve Temple** that will use a long-term, SARE- and UC SAREP-funded sustainable agriculture farming systems research project as a "living laboratory" for workshops and other educational efforts. Extension leaders in California, Oregon, Washington, Nevada, Utah, New Mexico, Arizona and other Western states will be encouraged to participate.
- \$91,000 for a training program coordinated by Nancy Matheson of the Montana-based nonprofit Alternative Energy Resources Organization that will include educational events and materials built upon research and results of "farm and ranch improvement clubs" (farmer-led small groups who conduct on farm research and demonstration projects). The program will be geared for extension personnel in Montana, Washington, Idaho, Wyoming and Utah.
- \$5,620 to **Jerome Osentowski** and **Sandy Cruz** of the nonprofit Central Rocky Mountain Permaculture Institute in Colorado to produce a pamphlet on permaculture, or "permanent agriculture" systems.

The selection process for the first round of grant awards and a regional training coordinator was conducted simultaneously and directed by the program's Administrative Council. Regional recommendations were then approved by the USDA.

New Calls for Proposals Released

In one of her first duties as training coordinator, Auburn recently initiated the Chapter 3 grants cycle for the current federal fiscal year. A Call for Proposals for educational and professional development training projects was released in the fall of 1994; proposals were due January 10, 1995.

State-by-State Strategic Planning

According to Auburn, in addition to awarded grants, every state Extension Service has been given financial support to develop educational strategies for training their personnel in sustainable agriculture. The federal Extension Service has directed state offices to bring together a variety of players to work on the plans. It is actively encouraging strategies that take advantage of

existing resources and encourages long-term dialogue within the extended agricultural community.

"It's a terrific opportunity for Extension and land-grant universities to work with farm advocates, educators and private industry outside the federal system on a vital task: sharing the latest scientific research and technologies related to sustainable agriculture," says Auburn.

In California, statewide planning is being coordinated by UC SAREP Director and State Extension Sustainable Agriculture Leader Bill Liebhardt (see "SAREP Coordinates Statewide Planning", p.9). To find out the extension leader in other states, contact that state's Cooperative Extension Service or Auburn at (916) 757-3278.

About SARE

The national SARE initiative is directed regionally by four independent policy-making councils: West, North Central, Northeast and Southern United States. In cooperation with the federal SARE office and the USDA Cooperative State Research, Education and Extension Service, these regional committees of scientists, farmers and administrators represent a variety of institutions, agencies, organizations and interests that provide regional perspective and leadership to all research, educational and training efforts.

Utah State University is host to the SARE program in the thirteen-state Western region, which includes Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming and the Island Protectorates.

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SAREP Coordinates Statewide Planning

As part of the new Chapter 3 program of the 1990 Farm Bill (authorized in 1994), funding has been made liable for each state to develop a statewide strategic plan for professional training in sustainable agriculture, SAREP Director and State Extension Sustainable Agriculture Leader **Bill Liebhardt**, and [David Chaney](#), SAREP information analyst, are coordinating this effort in California.

As mentioned in the 1990 Farm Bill legislation, the target audiences for this "train the trainers" program are Cooperative Extension advisors, Natural Resources Conservation Service field staff, and others involved in extending sustainable agriculture information to farmers and ranchers.

To launch the planning effort in California, three focus groups were held this past November and December in Merced, Riverside and Davis to explore various options for training. Attending the focus groups were representatives from the target groups mentioned above, plus farmers and non-profit organizations involved in sustainable agriculture. A planning committee will be meeting over the next few months to sift through the feedback obtained at these focus group sessions, and to draft a prospectus for professional, in-service training for California. For more information contact Liebhardt at (916) 752-2379

Year-Round Farm Employment Publication

A new publication from UC SAREP shows farmers how to diversify their operations to keep employees busy throughout the year. *How to stabilize your work force (and Increase Profits, Productivity, and Personal Satisfaction)* brings together the strategies, benefits and challenges encountered by farmers who keep workers employed year-round. Funded by SAREP and authored by two agricultural economists, a UC Cooperative Extension director, and two farm advisors, the 44-page handbook includes information gleaned from extensive interviews with 35 California farmers.

The authors tried to identify the underlying principles that make some farmers' systems work. Activities used most often include crop diversification and rotation, staggered planting, labor sharing with other farmers, selective mechanization, saving work for the off-season and value-added activities like wreath or jam-making. "These farmers do this both to level out the peaks and valleys of seasonal employment and to increase profitability," said **Gary Johnston**, director of UC Cooperative Extension in San Joaquin County.

Johnston's co-authors include **Suzanne Vaupel** and **Melissa Cadet**, Sacramento agricultural economist; **Franz Kegel**, farm advisor emeritus, San Joaquin County; and **Gregory Billikopf**, area farm advisor for Merced.

"No easy formula for year-round cropping systems can be given, due to different climatic regions, soils, markets, costs, risks and local conditions," Vaupel said.

She noted, however, that one of the benefits of the benefits of successful systems is generally lower unemployment insurance and worker compensation rates. "A steady work force is more likely to be familiar with the farm operation and equipment and therefore is less likely to be injured," she said. Although this theory is not always true, the three farmers interviewed most extensively had workers' compensation rates well below 100 (the average for the industry), and two of the rates were in the 50s, meaning that they are paying half the usual rate for the particular agricultural activity.

The handbook is available from UC SAREP, University of California, Davis, CA 95616; (916) 752-7556. The cost is \$6, with checks or money orders payable to "UC Regents."

Agriculture and the Community

by [Gail Feenstra](#), SAREP

One of the most critical issues facing California agriculture is its interaction with nearby communities and cities. Regions across the state are being forced to come to terms with how agriculture can be preserved in the face of increasing market, development and population pressures. Realizing that addressing these issues would need to be a community process, a coalition was formed in Santa Cruz County in the fall of 1991 with funding from SAREP. The goal of the Agriculture and Community Project (Ag Comm) coalition was to examine "the historical, existing and future status of agriculture in Santa Cruz County..." and to "collaborate with the Santa Cruz Community to identify and explore critical issues to ensure the long-term viability of agriculture."

Principal investigators **Steve Gliessman** of UC Santa Cruz's Center for Agroecology and Sustainable Food Systems, and **Jim Pepper**, Environmental Studies Program at the same campus, organized and directed the initial nine-member planning committee representing community interests including agriculture/production, agriculture/food processing, nutrition/food safety, development, environment/land use, health/housing, and government. After meeting for a year (May 1992-May 1993), the planning committee had defined topics which provided the foundation for specific areas of research and became the basis of the agenda for a community wide forum held November 20, 1993 in Aptos. At this forum, participants examined ways in which the entire community is connected to agriculture and explored strategies to broaden and strengthen this connection. Local residents were particularly interested in community education, encouraging the community to buy locally grown foods and finding common ground between urban and agricultural interests.

General Plan Law

Concurrently, the planning committee's work led to directed research by the Ag Comm staff about land use, farmland preservation and farmworker housing. Additional information was provided by student thesis research reviewing farmworker housing and farmland preservation policies in Santa Cruz County. Exploration of policy options included research on agriculture elements that have been drafted or approved under General Plan law in 11 different counties in California. When agriculture is elevated to "element" status under a county's General Plan, it gains equity with other recognized elements such as land use, open space, and housing when planning decisions are made. As a result of their work on land preservation, the Agricultural Policy Advisory Commission to the Board of Supervisors asked the Ag Comm group to advise them on issues such as agriculture at the urban edge. Should the Board of Supervisors and the County Planning Department decide

to pursue an agricultural element, work on General Plan elements will be compiled along with recommendations for proceeding.

In the fall of 1994, the continuing interest in land preservation policies led the Ag Comm group to conduct a "mobile workshop" or bus tour for local agriculture leaders, planning officials and policy makers on "Preserving Agricultural Land on the Edge: Ag Land Preservation Techniques." Tour participants visited selected sites and heard speakers in Marin and Sonoma counties, both of which have innovative agriculture preservation policies. Participants learned about particular tools designed to preserve ag land and which might be applied in Santa Cruz County. A workbook with articles describing the tools and techniques for preserving ag land produced for this mobile workshop and is available for purchase from the Ag Comm Project (contact project assistant **Kerstin Ohlander**, 408/459-3524).

Land Forum

A second public forum took place in November 1994, and focused on land preservation issues in Santa Cruz, Monterey, and San Benito counties. This forum, "Community and Agriculture: Understanding the Concerns of a Changing Region," assessed resource and land use conflicts at the urban edge. Keynote speaker was **Elizabeth Scott Graham** from American Farmland Trust. A panel of farmers discussed their concerns about urban growth and farmland preservation. A "tools and techniques" workshop addressed policy, education and housing issues and their connection with agriculture at the urban edge. Finally, participants were able to explore concerns and potential solutions in county workshops.

In addition to land use issues, the Ag Comm project also received a grant from the California Alliance for Sustainable Agriculture (CASA) to profile Central Coast farmers and understand their contributions to the local economy and regional food system. The project's objective is to understand the similarities among farms involved in the Lighthouse Farm Campaign, and organic and conventional growers in terms of their concerns, where they go for assistance and what their information needs are. The data gathered from approximately 60 interviews is being analyzed. Results will be available in the spring of 1995. For more information about this project, contact **Rachel Bornfeld** at (408) 459-3524.

The Ag Comm project is an example of how a small amount of seed money can initiate a process that continues the discussion, research and exploration of solutions to the agricultural issues most important to that community. According to Kerstin Ohlander, however, this process takes a lot of time, patience and listening. This project's success has been due in part to working with all elements of the agricultural community and cooperating in areas where there is common agreement. Instead of competing for scarce resources, Ag Comm has focused on ways to form linkages. Further cooperation with local agricultural organizations, government agencies, farmers and citizens will strengthen these links within the county and provide an opportunity for the community to work together.

Rural development, biorefineries and the carbohydrate economy.

David Morris and Irshad Ahmend

Institute for Local self-reliance. 1993

This provocative 12-page report describes an emerging "carbohydrate economy" in which plants are used not only for food, feed, paper and lumber, but as raw material for fuels and basic industrial materials. At the heart of this economy are locally-based biorefineries which process plant materials-creating new markets for farmers and boosting economic development in rural communities. The report suggests a new strategy for wedding many goals at the heart of agricultural Sustainability, including the economic viability of small to medium-scale farms, resource conservation, and a more resilient rural economy linked to farming.

Drawing on government reports, university research, and recent business experience, the authors describe two recent developments that are making possible the carbohydrate economy. Technological advances in the material sciences make it possible to create high quality, low cost fuels and industrial chemicals from plant matter. At the same time, political regulations on fossil fuels have stiffened and raised their cost. As a result, biofuels or biochemicals are beginning to be competitive in cost with mineral-derived fuels and chemicals.

For example, the cost of producing detergent enzymes, a partial substitute for phosphates, has dropped by more than 70 percent, while over half of the nation's states have enacted regulations limiting or banning the use of phosphates in detergents. Ethanol, perhaps the most widely recognized biofuel, now can be produced for about \$ 1. 10 per gallon and competes well with gasoline additives like MTBE (methyl tertiary butyl ether) required by the Clean Air Act. Biomass generated electricity is becoming competitive with coal, particularly because of expensive pollution control technologies required on new coal-fired power plants. New emission standards for volatile organic compounds are spurring the substitution of vegetable oils for mineral oils in inks and paints.

While virgin plant material will be the key feedstock of the carbohydrate economy, agricultural wastes will also play an important initial role. By raising the cost of disposal, environmental regulations make it increasingly attractive to recover agricultural wastes. The authors estimate that some 350 million tons of agricultural wastes are currently taken from fields and available for processing. These waste materials include items such as cotton processing wastes, rice straw, wheat straw, wood and pulp mill wastes, and cheese whey from dairies. Agricultural waste-to-energy and chemical facilities are beginning to emerge, including the first whey-to-ethanol plants

such as the one in Tulare, California.

Because plant matter is expensive to transport, it makes sense for bioprocessing facilities to be modest in scale and located near their raw material suppliers. Based on experience to date, the authors estimate that an average size biorefinery might consume 100,000-300,000 tons of plant matter per year. By recovering agricultural wastes, and increasing the acreage of new carbohydrate crops, the nation might easily produce 200 million tons of plant matter, enough to supply 700-2,000 new biorefineries. The higher estimate would allow for one such facility in every rural county in the nation.

By substituting native plant matter for imported petroleum, a biorefinery-oriented economic development strategy can help meet key national security and environmental goals. It can also create thousands of new jobs in rural areas and raise the prices farmers receive for their crops. If the biorefineries were organized as producer cooperatives they could insure that the majority of revenues created remain in the area to help the local economy, rather than being siphoned out of the community by distant corporations. Finally, biorefineries could lead to spin-off businesses in the area of cultivation or processing, providing for the type of regional "clustering" that many economic experts believe will be critical to success in the new global economy.

Reviewer's Comments

The carbohydrate economy provides important new market possibilities for farmers, as well as a realistic, agriculturally based economic development tools for rural areas. In its admittedly limited applications to date, this development strategy is beginning to strengthen the interconnections between farmers and rural development planners, and provide an alternative to tourism as the key to developing rural economies.

As the authors point out, a national policy to encourage biorefinery development will need to be compatible with a continuing emphasis on environmentally sound production practices. If the new market for fuels displaced needed food production, or if farmers rushed to supply this new market by implementing practices that threatened soils or water supplies, the strategy will not realize its potential of being simultaneously environmentally benign and economically viable.

This report presents new possibilities for sustainable agriculture research. Appropriate plant types (that could be raw materials for biorefineries) need to be identified. These new crops must be introduced within the context of a whole production system, and attention must be given to how these crops could be grown in an environmentally sound manner.

Rural Development, Biorefineries and the Carbohydrate Economy is available from the Institute for Self-Reliance, 2425 18th NW, Washington, DC 20009-2096. Tel: (202) 232-4108.

Contributed by Dave Campbell

(DCC.007)

A no-tillage tomato production system using hairy vetch and subterranean Clover mulches.

Aref A. Abdul-Baki and John R. Teasdale

HortScience 28(2):106-108. 1993

This article describes a no-tillage vegetable production system that uses winter annual legumes as both cover crop and plant mulch. According to the authors, this production system is adapted to both large- and small-scale operations. It takes advantage of the benefits that legumes offer, and avoids the difficulties of spreading a mulch uniformly over a field.

The experiment was conducted at the Beltsville, Maryland Research Center. The researchers looked at the effects of the no-tillage system on yield and earliness of fresh market 'Sunny' tomato. Tomatoes following cover crops of hairy vetch and 'Mt. Barker' subterranean clover were compared to those grown under conventional tillage using black polyethylene mulch, Horto paper mulch, and no mulch.

In the cover crop treatments, beds were prepared immediately before sowing of the cover crops. Clover seed was planted on September 5 at a rate of 28 kg per ha; vetch seed was planted on September 18 at a rate of 53 kg per ha. The cover crops were not irrigated and were grown without any other treatment until they were mowed the following spring. In early May, after determinations were made of cover crop growth, the clover and vetch plots were mowed to about 4 cm above the soil surface using a high-speed flail mower. This operation chopped the plants and spread them uniformly over the beds. Five-week-old tomato seedlings were planted through the mulch layer on May 1 (early planting date) and May 8 (optimum planting date). A 7-cm hole was cut through the mulch using a tree planter and then tomatoes were transplanted by hand causing minimal disturbance to the mulch. Trickle irrigation lines were laid over the cut mulch surface 10 cm away from the plants and fixed in position with U- shaped wires. Tomatoes were planted in the comparative systems on the same two dates (May 1 and 8).

The poly mulch, paper mulch and bare soil treatments were irrigated weekly through the drip lines with a 9-6.6-24.9 NPK solution. Cover crop/mulch treatments were fertilized every other week using the same solution. Weeds were controlled as needed in all treatments using herbicides.

Table 1. Effect of mulch on total and early yield of 'Sunny' fresh-market tomato in the field at early and optimum planting dates.

Yield (tons per ha)			
Treatment	Planting Date	Total	Early a/

No mulch (control)	Early	55.0	9.71
	Optimum	51.8	6.65
Hairy Vetch	Early	121.1	9.49
	Optimum	137.2	5.36
Subterranean Clover	Early	85.7	1.93
	Optimum	95.7	1.41
Horto paper	Early	97.7	4.54
	Optimum	95.7	6.12
Black polyethylene	Early	99.9	16.9
	Optimum	114.8	23.63
LSD(0.05)		12.5	3.41
a/First four harvest at 5-day intervals			

The effect of the various treatments on tomato yield is shown in table 1. Total tomato yield in the hairy vetch mulch was more than double the yield of the control (nonmulched) plants, and significantly higher for both planting dates than yield from the black polyethylene-mulched plants. The authors attributed the success of the vetch over the clover treatment to its superior winter hardiness in the Beltsville area. "The clover stand was killed on top of beds in winter but produced 3.6 tons per ha of dry matter in the troughs between rows. In contrast, the hairy vetch stand was well established on the beds, and the plants were about 1 meter long at mowing time, with 3.8 tons per ha above ground dry matter."

In terms of earliness, black polyethylene mulch was superior to all other mulches in enhancing yield. The effects of black polyethylene mulch in warming soil and promoting plant growth have been well-established.

The authors suggest that the vetch mulch offers a number of benefits in this production system. First, mowing and spreading the cover crop provides a thick layer of mulch that reduces soil erosion and soil water evaporation, and that moderates soil temperature. The mulch also eliminates early weed competition (later weed emergence or cover crop regrowth can be controlled with postemergence herbicides.) The authors also conclude that the cover crop residue on the soil surface sustains nitrogen decomposition and release over a longer period than if the cover crop were plowed in.

Reviewer's Comments

The authors have produced a pamphlet for growers that describes this production system in more detail. The title is *Sustainable Production of Fresh-Market Tomatoes with Organic Mulches*, published by the United States Department of Agriculture, 1994, Farmers' Bulletin FB-2279. Contact Abdul-Baki for information about how to order the pamphlet (see address below).

Adapting the no-till mulch production system to California conditions will require careful management on the part of growers. Major considerations include: 1) the choice of cover crop; 2) the effect of the mulch on soil insect

pests; 3) the tendency of the mulch to keep the soil cool in the spring; 4) the time of mowing as it relates to conservation of soil water; and 5) the relative costs and benefits of other types 'of mulches.

For more information write to: A. Abdul-Baki, USDA-ARS, Vegetable Laboratory, Building 4, BARC- West, Beltsville, MD 20705.

(DEC.523)

Contributed by [David Chaney](#)

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Potential of adult carabids (Coleoptera: Carabidae) as predators of fifth-instar codling moth (Lepidoptera: Tortricidae) in apple orchards in California.

E. W Riddick and N.J. Mills

Environmental Entomology 23:1338-1345. 1994

Codling moth is a serious pest of several crops including apples, pears and walnuts. In semidwarf apple orchards, the smooth bark of the trees affords few pupation sites so codling moth typically pupates on the ground in leaf litter, or in the soil. This habit renders the larvae susceptible to predation by ground-dwelling predators, including carabid beetles. In apple orchards in Sonoma and Contra Costa counties of California, the investigators conducted observations on predators attacking fifth-instar codling moth tethered on the orchard floor. Tethering was by means of heavy-duty black cotton thread fastened either to a 9-cm disk of sandpaper or to an inverted petri dish of 9.5-cm diameter that was flush with the soil. Laboratory studies were also conducted on killing success, degree of carnivory, and consumption patterns.

Carabidae attacking tethered codling moth larvae in the field included *Agonum punctiforme* Say, *Calathus ruficollis* Dejean, *Harpalus pensylvanicus* DeGeer, and *Pterostichus (Hypherpes)* spp. In the **field**, predation rates were high during early June, but declined during later June and July. In the laboratory, 75 percent of the individuals tested of each of the following species were capable of killing fifth-instar codling moth: *Pterostichus lustrans* LeConte, *Pterostichus cursor* LeConte, *Pterostichus (Hypherpes)* spp., *Harpalus pensylvanicus* DeGeer, and *Anisodactylis californicus* Dejean. *Pterostichus* spp. were particularly effective predators.

Reviewer's Note

This article explores the role of carabids in apple orchards, but ground beetles may also be active predators in walnut orchards. In walnuts, codling moth larvae overwinter under loose scales of bark or in trash on the ground near the trunk. Samples collected by [Robert Bugg](#) and John Dunley during July 1994 from organic walnut orchards near Winters, California, were sent to Riddick for identification. Table 1 shows the carabid species found in that sampling (Orchard 1). A collection made in late August at the edge of another organic walnut orchard near Winters yielded 22 specimens. These are also listed in table 1 (Orchard 2).

In addition to the paper reviewed here, other studies in both Europe and the U.S. are exploring the potential importance of ground beetles (Carabidae) as biological control agents. Several recent papers have looked at the ability of

ground beetles to control pests (codling moth and others) that pupate in the soil; other papers suggest possibilities for increasing their abundance in agronomic crops.

For more information write to: E.W. Riddick, Department of Entomology, Symons Hall, University of Maryland, College Park, MD 20742.

(DEC.522) *Contributed by Robert Bugg*

Table 1. Carabid species collected from two walnut orchards near Winters, California.	
Species	Number of Adult Individuals Collected
Orchard 1 (July, 1994)	
<i>Amara sp.</i>	2
<i>Agonum punctiforme</i>	14
<i>Agonum (varioatum?)</i>	3
<i>Calathus ruficollis</i>	2
<i>Harpalus pensylvanicus</i>	1
<i>Pterostichus cursor</i>	2
<i>Trechus obtusus</i>	3
Orchard 2 (August, 1994)	
<i>Amara spp. (2 species?)</i>	4
<i>Calathus ruficollis</i>	7
<i>Harpalus pensylvanicus</i>	9
<i>Harpalus sp.</i>	1
<i>Pterostichus (Hypherpes) algidus</i>	1

Participatory research in pest management: The impact of generalist predators on the peach twig borer in peaches.

J.W. Dlott, K. M. Daane, M.P. Jones and M. Peterson.

Adapted from Plant Protection Quarterly 4(3):1-5 1994

The inclusion of farmers in the agricultural research and extension process has emerged as a central theme in the development of more sustainable production systems. Though this call for farmer participation has become more widespread, few studies have documented the actual process whereby farmers participate with scientists in defining, implementing, and/or evaluating research. In 1991, we began just such a collaborative grower-scientist pest management research project. The objectives were to develop a research agenda in cooperation with peach growers, implement scientific studies that addressed questions raised by farmers, evaluate the effectiveness of this participatory approach in generating relevant information, and document the overall process. This paper reports on two of these objectives. First, we provide a brief description of the development of the research agenda. Second, we present the results from the on-farm studies.

Developing a Research Agenda

The research program was developed in collaboration with members of the non-profit organization California Clean Growers Association (CCGA) utilizing a methodology called participatory rural appraisal (PRA). PRA combines secondary data review, semi-structured interviews, observation of farm activities, and formal and informal group meetings to identify and evaluate specific needs (Dlott et al. 1994). From this work, we developed a research program for the 1990-91 season. Our focus was on the peach twig borer (PTB), *Anarsia lineatella*, which was identified by peach farmers as the key insect pest in their production systems. Farmers further expressed interest in understanding and improving biological and cultural controls of PTB that would work in conjunction with *Bacillus thuringiensis* (Bt) and pheromone confusion.

Following the 1991 field season, a focus group meeting was held with the 11-member CCGA Board of Directors, and four observers: three agricultural scientists with expertise in entomology, agronomy, and sustainable agriculture, and a meeting recorder who took notes as well as made an audio recording. The purpose of the meeting was to evaluate the project and then refine future research activities. The outcome of the meeting was a set of farmer-generated research questions, which included: 1) What beneficial insects are eating PTB? 2) How does weather affect PTB survival? 3) What is the feeding pattern of PTB?

In response to these questions, a series of predator exclusion experiments was conducted in 1992 and 1993. The experiments were designed to identify PTB mortality caused by generalist predators (e.g., ladybird beetles, green lacewings, ants, minute pirate bugs) and climatic conditions (referred to as "abiotic mortality"). The exclusion experiments focused on the impact of generalist predators because recent work by Daane et al. (1993) has shown that parasitoid activity on PTB is relatively low in Fresno and Tulare counties.

Materials and Methods

An experimental plot of 60 three-year-old 'Diamond Princess' peach trees was established in 1992 at a farm in Dinuba, California. A second field site consisting of 100 twelve-year old organically managed 'Flame crest' peach trees arranged 5 rows by 20 trees was established in 1993 at a farm in Kingsburg, California. Insect pest management at these sites included a dormant season oil application for the San Jose Scale (SJS), *Quadraspidiotus perniciosus*; pheromone confusion for the oriental fruit moth (OFM) *Grapholita molests*; and, at the Kingsburg site only, three applications of Bt at bloom for PTB. The plots received no applications of insecticides, fungicides, or fertilizers when experiments were underway. The orchard floors at both plots were covered by a mixture of planted cover-crops and endemic plant species.

In each plot, shoots with 3-S lateral shoots located in the top meter of trees were selected. Three treatments were established in a randomized complete block design. Then each shoot was infested with a single PTB larva coinciding with the natural emergence of larvae in the area. The three treatments were:

- 1) Full exclusion (shoot enclosed in an organdy cage): designed to remove the effect of predation.
- 2) Partial exclusion (shoot isolated by a barrier of Tanglefoot placed around the base of the terminal shoot): designed to remove the effect of predation by the ant *Forinica aerata*.
- 3) Open: designed to estimate the combined effects of predation and abiotic mortality.

Natural enemy species composition and relative abundance were measured by direct observation of open and partially excluded shoots. Generalist predators observed on shoots were tested in laboratory no-choice trials to determine if they fed on PTB larvae. Shoot attack rates, measured by the presence of one or more damaged shoots per larva, were determined by monitoring shoots for damage at 2-3 day intervals. On the last sampling date, shoots in all treatments were removed from trees and dissected in the field using a dissecting microscope. This confirmed previously recorded shoot damage, corrected for damage in earlier sampling, and allowed for the collection of surviving larvae. The stage of recovered larvae was noted. All experiments were terminated when larvae in the partial exclusion treatment were fourth and fifth instars.

Analysis of variance (ANOVA) was used to test for effect of treatment and

block on: 1) natural enemy relative abundance, 2) larval attack rate, and 3) larval survival. Treatment means for larval attack rate and survival were compared with Tukey's multiple comparison test ($P < 0.05$).

Results

Generalist Predator Abundance. Generalist predators observed in this study included: a predatory ant, *R aerata*, convergent lady beetle, green lacewing species, a minute pirate bug species, and two salticid spiders, *Sassicus virus* and *Thiodina* sp. All of the predaceous stages of the observed generalist predators fed on PTB larvae in laboratory nochoice trials. The species composition and relative abundance varied between successive PTB generations and farm sites. *E aerata* was the only predator observed on treatment shoots in all experiments, and only its densities were significantly higher in the open versus partial exclusion treatments. Relative abundance of all other generalist predators was not significantly different between these two treatments. This indicates that the Tanglefoot barrier significantly reduced predation pressure from *R aerata*.

Survival of PTB Larvae. Larval survival rates were significantly lower in the open treatment as compared to the partial and full exclusion treatments in experiments conducted in the overwintering generation 1992, overwintering generation 1993, and first generation 1993. *F. aerata* activity was significantly higher on open shoots accounting for the only significant difference in generalist predator abundance. These results provide direct evidence that PTB larval survival significantly increases when *R aerata* are excluded from foraging on shoots. The data also suggest that predation by *E aerata* is the reason for the differences in larval survival among treatments.

Larval survival during the second to fifth instars in the second generation (1993) also was significantly lower for both the partial exclusion and open treatments compared to the full exclusion treatment. PTB mortality in the partial exclusion treatment can be explained, in part, by the abundance of jumping spiders at this site. The Tanglefoot barrier did not significantly restrict their movement, as compared to the movement of *E aerata*.

Discussion

The predator exclusion experiments provide evidence that predation by *F aerata* significantly decreases PTB larval survival rates. The Tanglefoot barrier provided an effective means for segregating *F. aerata* from convergent lady beetles, green lacewings, and minute pirate bugs and the results indicate that these other generalist predators did not account for significant mortality of PTB larvae. In addition, larval survival rates were not significantly different between full and partial exclusion treatments. These results indicate that mortality due to generalist predators other than the ant, *E aerata*, was minimal. The data from these experiments was put into "life table analysis" and gave similar results, showing that predation by *R aerata* is the most important overall mortality factor for PTB larvae (Dlott, 1993).

Now that *F. aerata* has been identified as the most important TB predator, the question remains whether or not this predator can be manipulated to the growers' advantage. To answer this question we must consider the biology of

F. aerata. Some ant species aggregate to abundant food sources, such as extrafloral nectar, and once on the plants, also seek prey. *F. aerata* appears to exhibit such foraging behaviors on peaches in the Central Valley. However, *E. aerata* also exhibits other less desirable behavior, such as tending honey dew-producing scale and aphid insects. Shorey et al. (1993) reported that *F. aerata* tended several aphid species in plum trees in Tulare County. Aphid outbreaks appear to be more common in plums than in peaches, a phenomenon that may be linked to this ant-aphid relationship. Some varieties of plum are known to produce only small amounts of extrafloral nectar. Under these conditions, *R. aerata* may switch from foraging on nectar to "tending" aphids, leading to increases in aphid populations.

We are currently working with growers to determine which cultural practices can be used to "conserve" ant colonies. Several observations may be of interest. First, in peach orchards managed without in-season broad spectrum insecticides, two ant species are commonly found, *F. aerata* and the southern fire ant, *Solenopsis xyloni*, with *F. aerata* being the dominant species. Second, it appears that cover crops on the orchard floor may affect ant species composition and numbers by providing alternative food sources (e.g., herbivore prey, seeds or nectar) as well as changing the microclimate and soil texture. Finally, using selective management tactics, such as substituting Bt sprays at bloom for broad spectrum insecticides, are an important component in fostering biological control of PTB. We believe that a better understanding of how cultural practices increase or decrease population levels of ant species could lead to exciting new options in stone fruit integrated pest management.

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Contributed by Jeff Dlott

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Resources

Ag Labor Management Book

Labor Management in Ag.- Cultivating Personnel Productivity by **Gregory Encina Billikopf**, photos by **Jack Kelly Clark**, 170 pages, 1994. This book by a UC farm advisor who specializes in labor management, illustrated by a UC. DANR photographer, includes sections on employee selection, incentives, supervision, conflict management, and discipline. To order the book, send check or money order for \$ 1 0, payable to Stanislaus County Farm Advisors'Trust, to University of California, c/o G. Billikopf, 733 County Center 3, Modesto, CA 95355; Tel: (209) 525-6654; Fax: (209) 525-4969.

Organic Cost Studies

A new study entitled *Production Practices and Sample Costs for Organic Processing Tomatoes in the Sacramento Valley* is now available from UC Cooperative Extension. Funded by the National Agricultural Pesticide Impact Assessment Program of the U.S. Department of Agriculture and the Clarence E. Heller Charitable Foundation, the 24 page publication is \$ 1. It includes an overview of production practices, cover crops, crop rotation and diversification, and sample budgets. Also available are cost-of-production studies for organic vegetables, apples, wine grapes, almonds, rice and walnuts. The studies were coordinated by researcher **Laura Tourte** and involved UC Davis Extension economist **Karen Kionsky**, SAREP analysts **David Chaney** and **Chuck Ingels**, ag economics researcher **Pete Livingston**, UC farm advisors, and California growers. Contact: Department of Agricultural Economics, University of California, Davis, CA 95616; (916) 752-9376.

Resource Guide

The Showcase of Sustainable Agriculture Information and Educational Materials, third edition, 100 pages, 1994, Sustainable Agriculture Network (SAN). This new, expanded guide to organizations and their sustainable agriculture publications is arranged alphabetically by organization ' Each of the 400 entries includes information about the publisher, author, availability and price. To order, send a check or purchase order for \$4.95 to: Sustainable Agriculture Publications, Hills Bldg., University of Vermont, Burlington, VT 05405; Tel: (802)656-0471. For rush or bulk orders, call(802) 656-0471 or e-mail to: bholtzma@moose.uvm.edu)

Good Bug Book

Suppliers of Beneficial Organisms in North America, by **Charles D. Hunter**,

1994 edition, 30 pages, Department of Pesticide Regulation, Cal/EPA. This directory of sources of "good bugs" in the U.S., Canada and Mexico includes 120 beneficial organisms in 13 categories, including mites, nematodes, parasites and predators. Single-cell organisms such as bacteria, fungi, protozoans and viruses are not listed as they are registered pesticides under state and federal law and are widely available. Free, single copies are available from the Department of Pesticide Regulation, Environmental Monitoring and Pest Management Branch, Attn: Beneficial Organisms Booklet, 1020 N Street, Room 16 1, Sacramento, CA 95814-5604; phone: (916) 324-4100.

Sustainable forestry

Restoration Forestry: An International Guide to Sustainable Forestry Practices, edited by **Michael Pilarski**, 512 pages, Kivaki Press, \$21.95. This comprehensive source book on sustainable forestry includes 50 articles from professional foresters, ecologists and resources planners; reviews of forestry organizations, journals, restoration forestry model projects, books and universities offering forestry degrees; and an extensive index. Aimed at forestry professionals, restoration ecologists and classes focusing on ecological forestry, agroecology, and sustainable development, the book is a distillation of 15 years of work by Friends of the Trees Society. Contact: Friends of the Trees Society, P.O. Box 1064, Tonasket, WA 98855; tel/ fax: (509) 485-2705.

Community Ag Workbook

Food and Agriculture Workbook, 120 pages, 1991, Economic Renewal Program, Rocky Mountain Institute. Designed to help community leaders, economic development professionals and government staff involve local people in their search for the best ways to improve the local food supply and strengthen the agricultural economy, the workbook is organized around a four-step community workshop process. The workbook is \$ 1 5 and maybe ordered with VISA/Mastercard, checks or money orders payable to Rocky Mountain Institute, 1739 Snowmass Creek Rd., Snowmass, CO 81654-9199; Tel: (303) 927-3851; Fax: (303) 927-4178.

Subscription Farm Center

CSA West, a community supported agriculture (CSA) or subscription farm training and resource center has been formed at the University of California, Santa Cruz Farm and Garden. Its goal is to identify and help find solutions to the challenges of CSA participants, and will feature field days, workshops and a regional conference to promote information exchange. CSA West is a project of the Community Alliance with Family Farmers. Contact: Jered Lawson or Brandon Ross at (409) 459-3964.

SAREP Publications

For a complete list of SAREP publications, call (916) 752-7556 or send an electronic mail request to bbwetzl@ucdavis.edu.

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Sources of Funding

Fertilizer Research Awards

A Request for Proposals will be available in mid January from the California Department of Food and Agriculture's Fertilizer Research and Education Program. Funding will be available for projects related to the environmentally safe and agronomically sound use and handling of fertilizers. For details and to be put on the mailing list, contact Jacques Franco or Debbie Scott at CDFA, (916) 654-0547; e-mail: jrfranc@ucdavis.edu.

Organic Research Grants

The Organic Farming Research Foundation is offering funds for organic farming methods research, dissemination of research results to organic farmers and growers interested in making the transition to organic production, and consumer education on organic farming issues. Projects should involve farmers in design and execution, and take place on working farms when possible. Proposals of \$3,000-\$5,000 are encouraged. Most projects will be less than \$10,000. Matching funds and/or in-kind contributions are encouraged. Proposals are considered twice a year; the next round of proposals must be received by January 31, 1995. To receive copies of grant application procedures and the *OFRF Research and Education Priorities* describing target areas, write Grants Program, Organic Farming Research Foundation, P.O. Box 440, Santa Cruz, CA 95061; Tel: (408) 426-6606.

Funding Resource Note:

Funding-seekers may want to investigate *Environmental Grant making Funding 1995 Directory* (January 1995), published by Environmental Research Institute, 1655 Elmwood Ave., Suite 225, Rochester, NY 14620, tel: (800) 724-1857; fax: (716) 4730968. The 700-page directory with information on 600 grant making foundations is available for \$70 plus \$5 shipping and handling.