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From the Director

Why We Study Organic Agriculture

Many times we are asked why we at the UC Sustainable Agriculture Research and Education Program focus our efforts in particular areas, especially organic agriculture. My answer almost always is that we do what we do because the legislation that created SAREP is very precise. The legislation clearly states that we should "promote more research and education on sustainable agricultural practices such as organic methods, biological control and integrated pest managements, and including the analysis of economic factors influencing the long term sustainability of California agriculture." It requires that we "consider interactions among soil, plant, water, air, animals, tillage, machinery, labor, energy and transportation to enhance agricultural efficiency, public health, and resource conservation."

If we go back 100 to 150 years, all agriculture was organic. Even 50 years ago, most farming would have been considered organic. It is only since World War II that what is presently called "conventional" agriculture began to emerge. In fact, we may already be in the post-conventional phase. Agriculture, as practiced now is represented by a broad spectrum of practices, from organic to conventional.

Should conventional agriculture be researched? Should organic agriculture be researched? Yes, they both should, because they both represent very different ideas about how a major human activity should be conducted. Any idea or other practice may have merit and provide useful options, and therefore, may be worthy of study. Universities are places where many philosophies, ideas, and practices should be allowed to flourish. We need a wide pool of options to solve contemporary problems.

I know that the examination of alternative agricultural practices is not popular with some

people, but if that was always the case, we would still be a hunting-gathering society. **Thomas Kuhn,** in his book *The Structure of Scientific Revolutions*, notes that often when a new model or paradigm becomes dominant, as did conventional agriculture, most scientists focus on work that refines that model. They ask questions that are appropriate to that model and will avoid questions that do not fit. In a sense, a cerebral monoculture is developed. We are all socialized to believe the values attributed to the dominant model.

Anything that is different will have an uphill struggle. The prejudice or bias against organic agriculture is understandable because it is different from the current standard, conventional agriculture, and we are comfortable with what we know. However, if we step back and look at alternative agricultural paradigms as sources of complementary or new solutions to present-day problems, then we will have done ourselves a favor by broadening our

options.

An example of this is the case of a California conventional farmer and his family who are making the transition to reduced pesticide use on their 4,000 acres. The farmer told me that they have learned to be better farmers in their conventional operation by trying to farm a portion of their land organically. This is because they had to become better observers and managers to farm the organic portion. They have been able to reduce pesticide use on the entire operation by about 65 percent over a five-year period. By opening themselves up to other possibilities, they benefitted. The very process of trying to change is a wonderful learning experience. That lesson is a good one in today's society.-*Bill Liebhardt, director; UC Sustainable Agriculture Research and Education Program.*

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English/Spanish Sustainable Ag Documents

by Gall Feenstra, SAREP

English abstracts of approximately 100 Spanish language documents on sustainable agriculture are now available from the UC Sustainable Agriculture Research and Education Program (SAREP). Abstracts in Spanish will be available in the fall. The documents, appropriate for entry-level Hispanic farmers and those who advise them, describe a variety of sustainable farming and marketing practices including: soil and water conservation practices, appropriate technologies for small-scale producers, methods for reducing the use of pesticides, methods for employing biological controls, and strategies for marketing organically grown crops. Each abstract includes the author, title, source and cost (for ordering purposes), year, a brief summary of the contents (often with chapter headings), comments about who the publication is intended to reach and the context within which it was written, educational level of the intended audience, and key words. An index of key words and topics is included with each set of abstracts. The abstracts have been reviewed for relevancy and usefulness by farm advisors and nonprofit organizations working with Hispanic farmers and farmworkers. They will be widely distributed to farm advisors and others who work with Hispanic farmers and farmworkers in California. For information on obtaining a set of abstracts, please contact UC SAREP at (916) 752-7556. Donations are appreciated.

Four Libraries

As funding becomes available, SAREP hopes to establish four regional library sites in California to house the original Spanish documents and make them more accessible to farm advisors and others who work with Hispanic farmers. These four regional sites will include: the Small Farm Center in Davis, Cooperative Extension offices in San Diego and Fresno counties and the Rural Development Center in Salinas. These regional centers will be clearinghouses for the information and requests pertaining to sustainable farming for small-scale Hispanic farmers. Additional Spanish information on sustainable agriculture will be collected at the regional centers as it becomes available. Local planning groups made up of Hispanic farmers and farmworkers as well as university consultants and farm advisors will determine the most effective mechanisms for getting the sustainable agriculture information to Hispanic farmers in each region.

Briefly Noted

Compiled by David Campbell, SAREP

Clinton Budget Deletes Funding for Organic Food Programs

The Fiscal Year 1994 budget submitted to Congress in April by the Clinton Administration was a major disappointment for advocates of organic agriculture. It failed to include any funding for USDA's implementation of the Organic Food Act or for continuing the work of the National Organic Standards Board. This contrasts with the budget submitted by the Bush Administration a year ago, which proposed full funding for the program. Organic food supporters must now try to convince members of Congress to add funding for organic agriculture into the 1994 budget. For more information contact **Roger Blobaum,** Organic Foods Production Association of North America, 907 North Tower, 1331 Pennsylvania Ave., N.W., Washington, D.C.

20004.

USDA Links "White Lupin" to Sustainable Agriculture

USDA researchers have identified white lupin, a grain-legume developed in the 1950s, as having the potential to aid sustainable agriculture in the 1990s. The key is white lupin's nitrogen-fixing ability. In rotation with other crops, white lupin can restore nitrogen to depleted soils, avoiding the need for nitrogen fertilizer. It can also be used to increase the fiber content of many foods, including pasta and cereals. See "New Food," *Nutrition Week,* March 19, 1993, page 7.

Promoting Food Stamp Use at Farmers' Markets

After three years of demonstration projects, the Farmers' Market Nutrition Program (FMNP) became a permanent federal program in August 1992. The program provides participants in the Food Program for Women, Infants and Children (WIC) with $10 to $20 in farmers' market coupons in addition to their regular benefits. The aim of the program is twofold: 1) to provide clients with access to affordable, highly nutritious food, and 2) to help provide farmers with a boost from additional customers. The Food and Nutrition Service (FNS), which oversees the program at the federal level, estimates that 450,000 people will be served by the program in 1993. Farmers' participation as vendors in the program is often easier than they believe. To receive a guide on the program, send $5 to *Food Stamp and Farmers' Market Promotion Manual,* Hartford Food System, 509 Wethersfield Ave., Hartford,

CT 06114; or call (203)296-9325.

National Dialogue on Sustainable Agriculture

Representatives of more than 100 different grass roots organizations met in Washington, D.C. in late February to launch a national campaign to promote sustainable agriculture in the 1995 Farm Bill. Present were groups from a range of perspectives, including advocates of rural development, animal rights, traditional farm policy, consumers and the environment. Committees formed at the meeting will produce policy recommendations which will then be debated by local members of the various organizations. This grass roots input will lead to a national conference set for spring 1994 at which a platform will be adopted to form the basis for lobbying efforts. During the policy formulation phase, researchers will be enlisted to buttress recommendations with detailed analysis.

U.S. Begins Long-Term Study of Farm Family Health

Three national agencies are launching a project to monitor the health of farmers, farmworkers, and their families, in what will be the largest agriculture-related health study ever undertaken in the U.S. Collaborating on the 10-year project are the Environmental Protection Agency (EPA), National Cancer Institute (NCI), and the National Institute of Environmental Health Sciences (NIEHS). The project will follow two groups of farm families, one in Iowa, and one in North Carolina. In all, more than 100,000 people will be monitored, including male and female farmers, farmers' spouses, agricultural pesticide applicators, and their children. For more information, contact the Office of Cancer Communication, National Cancer Institute, Building 31, Room 10A24, 3000 Rockville Pike, Bethesda, MD 20892; or call (301) 496-4000.

Magnet High School for Agriculture and Environmental Sciences

Beginning in the fall of 1992, Pioneer High School in San Jose, California became a magnet school specializing in agriculture and environmental sciences. It is the only school of its kind west of the Rockies, reflecting both the growing agricultural literacy movement and the new reform movement in high school education. The curriculum approaches the study of agriculture within a broader concern for the way humans interact with the environment. It also takes into account the changing nature of the food system, given that much of the growth in agricultural employment is now in technical or marketing areas, rather than in production. For more information, see **Sibella Kraus's** article "Pioneer Spirit" in *California Farmer*, April 1993, p.34.

Farming Systems Comparison Project

by David Chaney SAREP

To facilitate the transition to sustainable agriculture, farmers need accurate information about the benefits, costs and risks associated with "conventional" and "alternative" systems. To generate this information, research must eventually be conducted at the whole-farm level. By broadening the boundaries of investigation, researchers are able to critically evaluate the success of farming practices and their effects on the environment, as well as the special requirements for adapting these practices to farms in various locations. A SAREP-funded research project comparing conventional, low-input and organic farming systems is an excellent example of this research.

The goal of this research project is to describe and quantify the environmental and economic consequences of the transition from conventional to low-input and organic farming systems typical of the southern Sacramento Valley. The research team is multidisciplinary (members listed at the end of the article), and participating farmers and farm advisor play a key role in guiding the management decisions applied to the various production systems. The project was initiated in 1989, and is located on 28 acres at the UC Davis Agronomy Farm.

Rotations and Experimental Design

The main experiment occupies about 20 acres and compares four cropping systems: 1) a conventional two-year rotation; 2) a conventional four-year rotation; 3) a low-input four-year rotation; and 4) an organic four-year rotation. The four systems are arranged in plots with four replicates of each system. All the cropping systems include processing tomatoes, a high-value commodity grown on approximately 310,000 acres in California (1990 data). Other cash crops grown include wheat, safflower, field corn, and beans. In addition, winter-spring cover crops are grown in the low-input and organic systems. The specific rotations used in the different management systems are shown in Table 1.

Table 1. Summary of Crop Rotations Used in Four Management Systems.

	Year 1		Year 2		Year 3		Year 4	
Management	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**	**Fall**	**Spring**
System								
Conventional	fallow	tomato	wheat		fallow	tomato	wheat	

(2 yr)								
Conventional (4 yr)	fallow	tomato	fallow	safflower	fallow	corn	wheat	beans
Low-Input	cover[1]	tomato	cover	safflower	cover	corn	oat+vetch	beans
Organic	cover	tomato	cover	safflower	cover	corn	oat+vetch	beans

[1] Cover crops used have included vetch, oats, and cowpeas, solely or in mixtures. Other species are currently being evaluated.

Both conventional systems are managed using practices typical for the southern Sacramento Valley. The two-year conventional system is practiced by farmers when short-term profit must be maximized. The low-input system includes a winter cover crop prior to planting of tomatoes, safflower, corn and beans. While trying to reduce dependency on non-renewable resources, synthetic fertilizers or pesticides may be used in the low-input system to maintain the profitability of the operation. The organic system is managed according to the certification requirements of California Certified Organic Farmers (CCOF); only approved fertilizers and pesticides are used. "Best farmer" management practices are used in all systems. For example, insect and disease management decisions for all systems are based on periodic monitoring of pest levels and no pesticides are applied until economic threshold levels are exceeded.

A companion research area of eight acres is being used to test alternative grain and cover crop legumes that could be used as cash crops, as winter and summer cover crops, or in intercropping systems in California. Along with this effort, investigators are evaluating various kinds of agricultural equipment for use in reduced tillage operations and innovative cover crop management.

Preliminary Observations

Data collected during the first four years of the experiment include measurements of: crop growth, yield and quality; soil biology; soil fertility; soil organic matter levels; soil water infiltration rates; weed biomass; disease levels; pest and beneficial insect populations; and economic performance. From these data, researchers have been able to make some preliminary observations about the performance of the various cropping systems.

Soil fertility and weed management have been identified as the most important factors limiting yields in the organic and low-input systems. Researchers have altered production practices to address these constraints. Organic and low-input tomatoes, for example, are now transplanted instead of direct-seeded. This practice gives tomatoes a head-start in competing against weeds and allows for the use of more efficient mechanical cultivation techniques. Supplemental manure fertilizers have also improved yields in the organic and low-input systems.

Other problems thus far have not been a major constraint for any of the production systems. However, the soil-borne pathogen *Verticillium dahliae has* been consistently higher in the conventional two-year system than in the

others. Researchers will be collecting additional data to determine whether or not the disease organism will actually decrease tomato yields in this rotation.

Organic matter added through cover cropping and manuring has resulted in small increases in soil organic matter levels in the organic and low-input plots. This increase seems to be improving soil physical structure as shown by trends toward increased water infiltration rates.

Preliminary results suggest that similar crop yields may be obtained when "best farmer" management practices are used in each of the different systems. Similar yields, however, do not necessarily translate into similar profits. Year-to-year variations in production costs for each system, and the modest price premiums offered for organically grown commodities should also be considered. During the 1991 growing season, for example, gross returns, per acre operating costs, and net returns above total costs were all highest in the conventional two-year rotation (all crops combined). The 1992 season, by contrast, showed that the organic system had the highest figures in each of these same categories. Results of this study support what other studies have found: The transition period (as evidenced by the performance of the low-input system) carries significant risk: There are no price premiums for "transitional commodities," costs of production may be high, growers are generally on the steep part of the learning curve, and the new production system can be ecologically unstable for a time. Recommendations for minimizing this risk is a key objective as experimentation and analysis continue.

Specific Research Objectives

Differences between the four cropping systems and the relationships among various parameters observed during the first four years of the experiment have suggested a number of more specific research questions to pursue. These are listed below under the general headings of soil, pests, and economics:

Soil

- How do seasonal changes in nitrogen availability differ among the various farming systems?
- What is the role of microbial biomass in regulating seasonal nitrate pool levels?
- How do microbivorous nematodes affect nutrient cycling?
- Can soil microbial parameters be used as indices of soil health?
- How will differences in soil organic matter levels and water infiltration rates affect the volume of soil explored by roots and the water balance of crops?

Pests

- Will soil-borne pathogens limit yields of tomatoes under the intensive 2-year tomato-wheat rotation?
- What levels of weed pressure can be tolerated in the different systems without loss of yield?

Economics

- How do the costs of cover cropping and manuring compare to those of applying chemical fertilizer?
- What are the cost differences and relative efficacy of conventional and alternative weed management strategies?

Funding Sources

In addition to funding from SAREP ($50,000/yr through FY 1991/92, $12,500 FY 1992/93), this project is supported by the USDA Sustainable Agriculture Research and Education program and the HJ. Heinz Foundation.

For more information, contact **Steve Temple,** Agronomy and Range Science, University of California, Davis, CA 95616, (916) 752-8216 or **Tom Lanini,** Botany Extension, University of California, Davis, (916) 752-0612.

A Comparison of conventional, Low-Input and Organic Farming Systems: The Transition Phase and Long-Term Viability

Investigators (all at UC Davis): **Steve Temple**, agronomy and range science; **Howard Ferris**, nematology; **Karen Klonsky**, agricultural economics Extension; **Tom Laini**, botany Extension; **James J. Marois**, plant pathology; **Frank Zalom**, entomology; **Carol Shennan**, vegetable crops; **Bob Miller**, DANR Analytical lab; **Kate Scow**, land, air and water resources; **Larry Schwank**l, land, air and water Extension.

Cooperators: **Tony Turkovich**, farmer, Winters, Yolo County; **Ed Sills**, farmer, Pleasant Grove, Sutter County; **Bruce Rominger**, farmer, Winters, Yolo County; **Jim Durst**, farmer, Esparto, Yolo County; **Tom Kearney** and **Gene Miyao**, UC Cooperative Extension farm advisors, Yolo County.

Other: **Don Stewart**, crop production manager; **Diana Friedman**, research manager; **Tomaz Ripoli,** visiting professor; **Miriam Volat**, student assistant. E

Farming Comparison Project Field Day

A field day of the farming systems comparison project is scheduled at the UC Davis Agronomy Research Farm July 8. Researchers will present results from the first five years of the extensive study.

Farmers, farm advisors, researchers, students, and the general public are invited to join a team of agronomists, soil scientists, entomologists, irrigation specialists, economists, and other UC researchers as they discuss what to expect during a shift to low-input or organic farming practices and conduct field tours of the 28-acre experiment site. Results from a current intensive soil study of microbial and nematode dynamics and contribution to nitrogen mineralization will be featured this year. Equipment and lab demonstrations will also be presented.

On a field adjacent to the farming trials, visitors will be able to view a comparison of novel tillage instruments.

Pre-registration for the $15 field day is required and includes lunch and an information packet. Presentations and tours will take place from 8 a.m. until 3 p.m. PCA credit is available. Checks should be made out to UC Regents and sent to Field Days, SAFSP Department of Agronomy and Range Science, University of California, Davis, CA 95616. For mote information contact **Diana Friedman** at the above address or call her at (916) 752-2023; FAX (916) 752-4361.

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New PAC/TAC Members join SAREP

UC SAREP is required by the California Legislature's 1986 Sustainable Agriculture Research and Education Act to have both public and technical advisory committees to advise the university on program goals and make recommendations on the award of competitive grants. The Public Advisory Committee (PAC) includes individuals actively involved in agricultural production, as well as representatives from government, public organizations, and institutions of higher education. The Technical Advisory Committee (TAC) is made up of university wide faculty and staff with knowledge and experience related to sustainable agriculture and makes recommendations about the scientific merit of grant applications. Each PAC or TAC member serves for three years. New members in 1993 are listed below.

Public Advisory Committee

LARRY CARMEAN provides pest management consulting services, with an emphasis on integrated pest management, for fruit and nut growers in the San Joaquin Valley.

PETER COOEY is the chief consultant to the Assembly Committee on Agriculture of the California State Legislature. He is particularly interested in developing sustainable agriculture policies that are attractive to mainstream agriculture, and in maximizing the public's understanding of the role agriculture plays in the economic and social fabric of California society.

JENNIFER CURTIS is a senior research associate at the National Resources Defense Council in the Pesticide Project. Her areas of expertise include scientific and policy analysis of pesticides in food and drinking water and alternative agriculture. She is the author of the NRDC's 1991 *Harvest of Hope: The Potential for Alternative Agriculture to Reduce Pesticide Use.*

FRANK DAWLEY is a ranch manager for Big Bluff Ranch in Red Bluff. Careful beef cattle management is the cornerstone of his watershed management plan.

DEBORAH DURST is a farm partner in Yolo County, where she and her husband raise dried beans, small grains, canning tomatoes, fresh market melons, sunflowers and sugar beets on 600 acres, 450 of which are farmed organically. Her main interest is in sustainability, "both in the way we care for the soil, and the way we work with our employees."

MARTA SALINAS is a farmworker and farm labor and community organizer from Orcutt in Santa Barbara County. She has spent her life involved with farm labor and environmental justice issues in California, Oregon, Idaho and Arizona. She is interested in sustainable agriculture as it

can provide a safe environment for "those who toil the earth." She is also particularly interested in medical benefits for the poor and those who work in the fields.

Technical Advisory Committee

BEN FABER is a farm advisor in Ventura and Santa Barbara counties where he studies soil and water-related topics. He works primarily with avocados and other subtropical crops. His current research involves water requirements of lemon and avocados, and the effects of sources and qualities of mulches on plant growth and disease suppression. He is interested in diverting organic materials from landfills to agriculture.

HOLLY GEORGE McCANN is the Cooperative Extension county director and livestock/youth development advisor in Plumas and Sierra counties. She is interested in integrated resource/multiple use land management and holistic resource management, as well as economic diversification for communities in timber- and cattle-dependent resource areas.

DUNCAN A. McMARTIN is acting director and an Extension Specialist at the Veterinary Medicine Extension Unit at UC Davis. His specialty is the diagnosis and prevention of infectious diseases in agricultural animals, especially poultry production systems. He initiated an Extension program in animal welfare for agricultural animals in 1988.

DON NIELSEN is a professor of soil and water science in the Department of Land, Air and Water Resources at UC Davis. A past president of the American Society of Agronomy and an internationally known soil scientist, he specializes in monitoring water and other materials within and below the root zone of plants and assessing the spatial variability of water-conducting properties of field soils. He is interested in developing on-farm monitoring projects using geostatistical analysis, a way of describing the effects of farming practices as they vary across farm fields.

ELLEN RILLA is a Cooperative Extension county director in Sonoma and Marin counties. She specializes in working with local community groups and decision-makers to solve local critical issues in public policy. Her research on agricultural literacy in California's public schools has spawned local ag education materials, including a $50,000 grant from the Marin Community Foundation to develop bilingual teacher resources.

CAROL SHENNAN is an associate professor of vegetable crops at UC Davis. Her research focuses on nutrient cycling and soil management in vegetable production systems, and she has done much work with cover crops. Her interests include on-farm and long-term systems research approaches and their importance for the development of sustainable agricultural systems.

Continuing PAC/TAC

Public Advisory Committee: Glenn Anderson, Vashek Cervinka, Sibella Kraus, Bryce Lundberg, Molly Penherth, Judith Redmond and Betty Van Dyke.

Technical Advisory Committee: Marita Cantwell, George Goldman, Richard Harris/John LeBlanc, Donna Hirschfelt, Nicelma J. King, Deborah Letourneau, Carol Lovatt, Jackelyn Lundy, Michael McKenry, Jim Oltjen, Howard Rosenherg and Lupe Sandoval.

Biographies of continuing PAC/TAC members appeared in the Summer 1992 (Volume 4, Number 4) and Fall 1991 (Volume 4, Number 1) issues of *Sustainable Agriculture News.*

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USDA's Sustainable Ag Conference Call

by Jill Auburn, SAREP

The U.S. Department of Agriculture's Sustainable Agriculture Initiative Team held its third quarterly telephone conference call on May 5, 1992. The conference calls are designed to share information between the USDA staff in Washington and people in the states.

Jim Bushnell, the leader of the team from the Extension Service, described the $3 million earmarked for new sustainable agriculture activities in the President's budget for the USDA. Both Bushnell and **Ferd Hoefner**, Washington representative for a coalition of sustainable agriculture nonprofit organizations, expressed hope that the final figure might be even higher. The funds are expected to be used for Chapters 2 (Integrated Management Systems) and/or 3 (Education and Training) of the sustainable agriculture section of the l990 Farm Bill, each of which is authorized for up to $20 million in funding but has received no funding to date.

George Bird, Cooperative State Research Service director of the national Sustainable Agriculture Research and Education (SARE) program (Chapter 1 of the same Farm Bill), reported that the $6.725 million that the program currently receives leverages approximately $l5 million more in matching funds from grant recipients. The National Sustainable Agriculture Advisory Council (NSAAC), appointed to advise the USDA on sustainable agriculture, was scheduled to hold its first meeting June 9-11 in Omaha, Nebraska. Administrative changes in the program include a change in the host institution for the Southern region SARE program from Louisiana State University to a new (as yet unannounced) site, and the appointment of a new director as Bird returns to his nematology position at Michigan State University in September. Despite the end of his two-year term as director, Bird will maintain his involvement in sustainable agriculture with CSRS. Of particular interest is the review of "sustainable agriculture relevancy" of research beyond the SARE program (e.g. research conducted by the Agricultural Research Service; research funded by the National Research Initiative), stimulated by **Senator Thomas Daschle's** hearings last September.

Jim Bushnell reported on the draft guidelines being developed for the administration of Chapters 2 and 3, if they are funded. Chapter 3 includes regional training centers for training extension workers and other agricultural professionals, competitive grants for educational programs, and technical guides and handbooks. The training center funds would not be for "mortar & bricks," he emphasized, but would involve faculty from universities and nonprofit organizations throughout each region. Farmers and ranchers would be involved as teachers, and their farms might be satellite centers for the training. The ad-hoc group developing the guidelines will be seeking input over the coming months.

The conference call concluded with brief reports from the participants in various states. **Teresa Maurer** of Appropriate Technology Transfer for Rural Areas (ATTRA, a non-profit information center in Fayetteville, Arkansas) said that they are seeking nominations for the second version of the SAN Directory of Expertise (see *Resources,* page 9);contact ATTRA at 1-8O0-346-9140 for more information. **Chuck Francis** of the University of Nebraska described a binder of information available at cost ($35) from the recent four-state (MI, IA, KS, NE) training on integrated resource management, and other forthcoming publications. **Bill Given** of the University of Georgia described the recent Southern region meeting at Callaway Gardens (a tabloid summary and proceedings are planned), and **David Granatstein** of Washington State University announced plans for an October 2-26 meeting addressing issues of systems research and education. **Greg Gajewski** of the Economic Research Service described a data template they have developed for researchers to compile information for their national model of the economic, environmental, and social effects of sustainable agriculture.

While most of the several dozen participants in the May call were from universities, the quarterly conference calls are open to any and all participants on a first-come, first-serve basis. The dates and telephone number to call, along with other timely information and dialogue about sustainable agriculture, are shared through the computer electronic mail group "sanet-mg," accessible via the Internet computer network and the many commercial and nonprofit networks that connect to it (e.g. Compuserve, MCI-Mail, Econet, America On-Line, etc.) The e-mail group is sponsored by the national Sustainable Agriculture Network (SAN) chaired by UC SAREP's **Jill Auburn,** and staffed by **Gabriel Hegyes** at the National Agricultural Library. For more information about SAN, contact Auburn (within California) at (916) 757-3278 (Internet: jsauburn@ucdavis.edu) or Hegyes (outside California) at (301) 504-6425 (Internet:ghegyes@nalusda.gov). Audio cassette tapes of the most recent conference call are available from **Charles Morgan**, USDA extension Service, South Building, Room 3335, Washington, DC 20250-09OO, (202) 690-3656.

Resources

Soil Management Proceedings

Proceedings: Sustainable Soil Management Symposium, April 22, 1993, UC Davis. 90 pages. Co-sponsored by UC SAREP and the UC Small Farm Program, the symposium addressed the rationale and methods for improving soil quality through periodic additions of organic matter. Two research projects comparing conventional and alternative production systems were also presented. The proceedings includes articles submitted by symposium speakers as well as selected articles from peer-reviewed journals. To receive a copy, send a check for $10 payable to UC Regents to SAREP University of California, Davis, CA 95616.

Organic Cost Studies

Cost-of-production studies for organic vegetables, wine grapes, almonds and rice funded in part by UC SAREP are available from UC Cooperative Extension. The most recent publication is the 100-page booklet *Production Practices and Sample Costs for a Diversified Organic Vegetable Operation in the Central Coast.* It includes an overview of production practices, cover crops, crop rotation and diversification, pest management, marketing and regulations for organic crop production, and budgets for 15 vegetable crops and two cover crops grown on the Central Coast. The studies were coordinated by researcher **Laura Tourte** and involved UC Davis Extension economist **Karen Klonsky,** SAREP annual cropping systems analyst **David Chaney** and perennial cropping systems analyst **Chuck Ingels,** agricultural economics researcher **Pete Livingston** and several UC Cooperative Extension farm advisors. Two different studies each are available for wine grapes (with a cover crop or with resident vegetation), rice (aerial seeding versus non-tillage seed drilling), and almonds (flood irrigation versus sprinkler Irrigation). Up to three of the studies may be requested at no charge. For more than three studies, a $1 charge will apply. The diversified vegetable study is $4. Contact: Department of Agricultural Economics, University of California, Davis, CA 95616; (916) 752-9376. The publications are also available in selected Cooperative Extension offices.

Sustainable Ag Video

Sustaining America's Agriculture: High Tech and Horse Sense, 1992, produced by USDA Soil Conservation Service and US Environmental Protection Agency in cooperation with Winrock International. The 29-minute video describes how farmers and ranchers minimize environmental impacts while maximizing production. Narrated by actor and farmer **Raymond Burr**, the video profiles successful farmers and ranchers including a

citrus/vegetable farmer in Florida, a cattle feeder with customized farm equipment, and a farmer who uses terraces, cover crops, and contour farming. To order, send $10 check or money order to NACD, P0 Box 855, League City, TX 77574-0855; or call (800) 825-5547. The video is also available on loan from conservation district offices, EPA regional offices and SCS state offices.

Sustainable Ag "Yellow Pages," "Showcase," Cover Crops Handbook

Sustainable Agriculture Directory of Expertise-1993, 300 pages. Lists hundreds of people and groups with information on building soil health, pest-control, diversifying cash flow and other topics. Produced by the Sustainable Agriculture Network (SAN), a project of USDA's Sustainable Agriculture Research and Education program, the directory's seven indexes are organized by state, person, organization, enterprise, expertise, product/service, or management method. Contains 717 entries. $14.95.

Showcase of Sustainable Agriculture Information and Educational Materials is also available from SAN. It's a 79-page booklet with names, addresses and summaries of publications, videos and other materials from 65 universities, government, business and non-profit organizations that have displayed materials at four "share fairs" of sustainable agriculture information since 1991. $4.95.

Managing Cover Crops Profitably, a 124-page handbook for farmers on more than 40 legumes, grasses and legume-grass mixtures that can be used to build soil and cut chemical costs, is also available from SAN. $9.95.

For any SAN publication, send check or money order payable to Sustainable Agriculture Publications, Hills Building, Room 12, University of Vermont, Burlington, VT 05405. Prices include postage/handling. Payment must accompany order.

USDA SARE Program Overview

*1993 National Overview***,** *USDA Sustainable Agriculture Research and Education program,* a 4-page leaflet, is available from regional SARE offices. The newsletter details accomplishments and goals of the national sustainable agriculture program (formerly the LISA program) and highlights successful projects across the country. To receive a free copy, write to the SARE communications contact in your region: West, **Kristen Kelleher,** USDA SARE program, 258 Hunt Hall, University of California, Davis, CA 95616; North Central, **Lisa Jas.**, 207 Agriculture Hall, University of Nebraska, Lincoln, NE 68583-0704; South, **Diana Jerkins,** 107 Conner Hall, University of Georgia, Athens, GA 30602; Northeast, **Beth Holtzman,** Plant & Soil Science Dept., University of Vermont, Burlington, VT 05405.

Sources of Funding

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 systems, and education of the public about organic farming issues. Projects should involve farmers in both design and execution, and take place on working farms whenever possible and appropriate. Proposals of $3,000-$5,000 are encouraged. Most projects will be less than $10,000. Matching funds from other sources and/or in-kind contributions from cooperators are encouraged but not required. Proposals are considered twice a year. Proposals received by July 31, 1993 will be awarded by November 30, 1993. To receive copies of grant application procedures and the "OFRF Research and Education Priorities" which describes target areas, write Grants Program, Organic Farming Research Foundation, P.O. Box 440, Santa Cruz, CA 95061 or call (408) 426-6606.

Stewardship Incentive Program

Federal Stewardship Incentive Program (SIP) funding of up to $10,000 per land owner per year is available to private individuals, groups, associations, corporations, Indian tribes or other legal private entities who own rural lands with existing tree cover or woody vegetation or land suitable for growing such vegetation. The Food, Agriculture, Conservation and Trade Act of 1990 authorizes the SIP to offer cost-sharing assistance to improve management of nonindustrial private forest lands. Landowners must maintain and protect SIP-funded practices for a minimum of ten years. Eligible landowners must have an approved Forest Stewardship Plan and own up to 1,000 acres of qualifying land. (Authorizations must be obtained for exceptions of up to 5,000 acres.) Existing management plans can be modified to meet guidelines. Specific SIP practices approved for cost-share assistance include management plan development, reforestation, forest and agroforest improvement, windbreak and hedgerow establishment and maintenance, soil and water protection and improvement, riparian and wetland protection and improvement, fisheries habitat enhancement, wildlife habitat enhancement, and forest recreation enhancement. For more information contact a state forester, Agricultural Stabilization and Conservation Service office, County Extension office, or Soil Conservation office.

Field Research Money

University Research Expeditions Program (UREP) provides funds and field assistance to University of California researchers worldwide. Applicants need

not qualify for principal investigator (P1) status. Support is provided by selected members of the public who subsidize research costs through tax-deductible donations and contribute their own skills and time as short-term field assistants. UREP funds can be used for short or long-term field research, as seed money for new research, to extend continuing projects, supplement other grants and support graduate students or additional staff. Proposal deadlines: October 1,1993 (for projects during June 1994-Oct. 1994). For more information, contact University Research Expeditions Program, Desk D06, University of California, Berkeley, Ca 94720, (510) 642-6586, FAX (510) 642-6792.

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Summer 1993 (v5n4)

Sustainability of Pacific Northwest horticultural producers.

Cordray, S. M., L.S. Ley, R.P Dick, and H. Murray

J. Production Agriculture 6(1):121-125. 1993

In an effort to determine how "sustainable" are western Oregon and Washington farmers, the authors of this paper conducted two telephone interviews of over 300 growers of potatoes, broccoli, sweet corn, raspberries, and strawberries. Numerous sources were used to identify the growers, who represented a wide range of farm sizes.

Initially, a single sustainability scale was to be used for the interviews, but it was determined that the variables separated into two distinct scales. The Input Change Scale was used to identify the changes in the use of chemical fertilizers and pesticides in the past five years. The Production Practices Scale assessed farmers' use of alternative production practices, including: integration of livestock in the farming operation, type of tillage, use of rotations, nitrogen budgeting, sources of nitrogen, nonchemical methods of pest control, and methods used to control erosion. The Production Practices Scale also examined farm characteristics, family structure, and participation in farm work, community involvement, and purchasing patterns.

The authors note that the two scales are not correlated with each other. That is, producers in this region who were reducing input use have different characteristics from those who were adopting a variety of alternative production practices.

According to the Input Change Scale, producers using fewer agricultural chemicals farmed fewer acres and had a higher percentage of family income earned off the farm than those whose use of chemicals had increased. The decreased chemical input group also had fewer employees, less investment in machinery, and lower incomes than the increased input group. Finally, the decreased chemical input group sold more produce at fresh market and bought slightly more inputs from local sources.

In contrast to the Input Change Scale, the Production Practices Scale indicated that growers having greater use of alternative production practices had larger farms, greater investments in machinery, and somewhat higher incomes than those using fewer alternative practices. Family members on the farms with higher levels of alternative practices were less likely to work off the farm, and the percentage of family income earned off the farm was lower.

The authors compared the influence of farm size and principal occupation of the operator on input use and production practice decisions. Similar trends were found for these variables:

- Full-time and large-scale producers (360 acres or more) were far more likely to increase their use of chemical fertilizers and pesticides than part-time and small-scale farmers (39 acres or less);

- Part-time and small-scale producers used limited primary tillage and noncommercial nitrogen sources more than large-scale and full-time producers who used cultivation or rotation for most weed control, nitrogen budgeting, and various ecological cropping and rotation patterns.

Conclusions

This research highlights the difficulties involved in characterizing the "sustainability" of a set of agricultural producers. It also points out the strong influence of structural factors such as farm size and the principal occupation of the farmer on the practices farmers use. According to the authors, the results of the study seem reasonable because small-scale producers can more easily reduce chemical use by substituting labor (e.g., hand-weeding) for chemicals; large-scale producers, on the other hand, usually have more resources (e.g., land and money) to test and use alternative practices.

Though for a limited set of horticultural producers, this research lends support to the argument that "policies for moving farmers in the direction of using more sustainable practices should take into account the structural factors that influence the adoption of such practices."

Table 1. Comparison of farms using fewer chemicals (Input Change Scale) and farms implementing more alternative practices (Production Practices Scale).

	Sustainability Measure	
	Fewer	**More Altern.**
Farm Characteristics	**Chemicals**	**Practices**
Farm size	Smaller	Larger
% income earned off-farm	Greater	Less
Farm income	Lower	Higher
Number of employees	Fewer	More
Investment in machinery	Less	More

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(CI-SUST.087)

Contributed by Chuck Ingels

Summer 1993 (v5n4)

Marketing fresh organic produce in Colorado supermarkets.

Sparling, Ed, Karen Wilken and John McKenzie

Final Report: Colorado Department of Agriculture/USDA, Federal State Marketing Improvement Program. 1992

Reviewer's Note: Understanding the barriers to marketing organic produce has been a constant challenge for the organic industry. Much research has been conducted about sustainable and organic production techniques, as well as consumer attitudes and demands for organic produce. Yet, little research has focused on why it has been so difficult to match supply and demand for organics, and how to move organic produce successfully through the distribution system. This study uncovers some of the structural and attitudinal barriers that have kept the market system from functioning as efficiently as it might for organic produce. Results of this study suggest possible actions for farmers, supermarket produce managers, corporate produce directors, government agencies, and others who want to increase the availability of organic produce in their communities.

Approach and Hypotheses

This study was begun in the Fall of 1990, in the wake of the daminozide (Alar) controversy, with the objective of identifying obstacles and possible remedies to marketing fresh organic produce in Colorado supermarkets.

The study hypothesized that there are three major limitations within the marketing system that may contribute to organics failing to thrive in supermarkets: high prices, low quality, and the decision-making structures within supermarket chains. All three hypotheses were studied simultaneously in one of Colorado's market areas: the northern front range encompassing the cities of Fort Collins, Boulder, Greeley, and Denver. The general approach of this study is unique in that it viewed the entire marketing system as a whole, from the point of production to the point of purchase.

Methodology

The three components of the marketing system-consumers, stores, and farmers-were studied using surveys and personal interviews.

Consumers' attitudes, perceptions and purchasing patterns were determined through a mail survey to 1500 Colorado families representative of the area. Responses to questions about acceptable price premiums were used to construct demand curves for five specific organic commodities: leaf lettuce, carrots, broccoli, russet potatoes, and apples. The demand curves were used

to generate the probability of respondents buying organic fresh produce at each price premium.

Conventional and organic produce were evaluated by an experienced inspector in retail stores in the study area. Information was recorded about the item's price, grade, and size. The inspector also noted the nature of the produce display, methods used for identifying organics at checkout, and quality/visual differences between organic and conventional produce.

Finally, interviews were conducted with store-level produce managers, corporate-level produce directors and farmers in the study area.

Results and Analysis

Consumer Survey. The consumer survey found that 26 percent of consumers purchased organic produce at least once every two to three months, and 5 percent bought it at least once a week. The main reasons people gave for buying organics were "concern about chemical residues" (30%), personal and family health (21%) and flavor (17%). Those who had not purchased organic produce in the last year said their main reasons were lack of availability (41%) and price

(34%).

When comparing organic and conventional produce, consumers rated organic better in four attributes: free of chemical residues, environmental impact, farm workers' health and safety and personal health. They rated conventional produce better for one attribute: price. About half of the respondents rated organic and conventional the same for: appearance, freshness (in store), keeping qualities, flavor and nutritional value. However, in another question, appearance and availability were weak points for organic produce.

The demand schedules constructed for each of the five commodities indicated that:

- about 50 percent of consumers were willing to pay more for organic produce when the price was only 8 percent higher than conventional produce;
- fewer than 25 percent of the consumers were willing to pay more when the premium jumped to 24 percent;
- only 3 percent of consumers were willing to pay more when the premium was 64 percent above conventional.

These results are consistent with the hypothesis that supermarket organic premiums are too high, since the average premium was above 60 percent for the organics inspected in this study. Premiums varied considerably between commodities (from a low of 25 percent for carrots to a high of 95 percent for lettuce) and by supermarket chain. Premiums were similar within any particular chain, suggesting that prices were determined by corporate policy, not at a store level. From this analysis, the investigators conclude that organic produce should not be priced at more than 33 percent above conventional.

Quality Comparisons. Reports of the produce inspector showed that organics rated better than conventional produce in 10 percent of the observations, and conventional was better than organic in 45 percent of the observations. Conventional and organics were rated similarly in 45 percent of the observations. While investigating the instances where organics were inferior, the study authors found a statistically significant relationship between negative attitudes of store produce managers and observed quality of produce. A specific cause and effect relationship between these two variables is identified (but not well- substantiated) in the report, i.e., the produce manager's attitude determined the quality of the organic produce section.

The study also showed that in-store handling affected the quality of the produce, and that separating organics into their own section decreases demand. The small number of stores that had success in selling organics mingled organics with regular produce. Most of the organic commodities studied were pre-bagged as part of the produce display, but this practice was also found to decrease demand.

Produce Manager Interviews. Produce managers felt that consumers were most concerned about price, and somewhat less concerned about appearance and freshness. Out-of-store promotion and pricing were left to the corporate offices. Prices appeared to be inflexible and standardized by each supermarket chain. Stocking decisions were based primarily on what was available at the corporate warehouses. Several managers mentioned that the selection and quality of organics at warehouses was poor. Some managers said they could probably sell more organic produce if they could obtain it. Autonomy in procurements and pricing contributed to successful marketing of organics in supermarkets. Some stores had made arrangements with their warehouses that allowed them to order some produce directly from local farmers or suppliers.

Corporate-Level Interviews. Produce directors indicated that organics comprised a very small volume compared with conventional produce. They believed in the safety and healthfulness of the conventional food supply. Thus, they thought that promoting organics might imply that conventionally grown produce was in some way inferior. At the same time, they also saw in organics an opportunity to provide a product that the public apparently wanted. They acknowledged however, that in providing organics, they did not provide informational materials to their produce managers about organic food production. Although the same grading standards were used in purchasing organic and conventional produce, one director observed that the quality of the organic produce was compromised by time lags in the distribution chain, and the fact that only modest quantities were being distributed. Handling small quantities of slow-moving, perishable, organic produce is difficult for the warehouses.

Organic Farmer Interviews. Farmers indicated that they thought consumers purchased organics mainly due to personal health concerns, residue concerns and for better flavor. They felt that consumers needed and wanted more information about organic food production and that this information was an important point-of-purchase marketing tool. Constraints mentioned by farmers to marketing organic produce included: the lack of access to special equipment such as hydrocooling and storage, and the inability to use some post-harvest chemicals that retard spoilage. Farmers felt that distributors were

good outlets for their produce. Supermarkets have tremendous potential but first, corporate-level directors need to support organics, and second, price premiums need to be reduced substantially. Many saw an opportunity for expanding their sales through freezing and canning surplus produce.

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Summer 1993 (v5n4)

Managing cover crops to manage arthropod pests of orchards.

Bugg, Robert L. and Carol Waddington

Agriculture, Ecosystems and Environment 41. In press. 1993

Cover crops have various effects, both beneficial and deleterious, on orchard pest problems. Ideally, cover crops might be selected or managed so as to: 1) not harbor important pests; 2) divert generalist pests; 3) confuse specialist pests visually or olfactorally and thus reduce their colonization of orchard trees; 4) alter host-plant nutrition and thereby reduce pest success; 5) reduce dust and thereby reduce spider mite outbreaks; 6) change the microclimate and thereby reduce pest success; and 7) increase natural enemy abundance or efficiency, thereby increasing biological control of arthropod pests. This review article (65 references) examines various studies of cover crops for tree nuts, pome fruits, stone fruits, and citrus, with examples from the United States and Canada. Only the Californian cases are detailed in this summary.

Almond

Two ant species (Hymenoptera: Formicidae) are particularly damaging to almonds in central California: pavement ant *(Tetramorium caespitum* [L.]) and southern fire ant *(Solenopsis xyloni* McCook). These feed on nutmeats after the nuts have fallen to the ground, and in a study by Barnett et al. (1989) were especially damaging amid cover crops of soft chess *(Bromus mollis* L., cv 'Blando', Poaceae), strawberry clover *(Trifolium fragiferum* L., cv 'Sauna', Fabaceae), and resident weedy vegetation, as compared with residual herbicide. However, the same study showed that cover crops of soft chess, strawberry clover or resident vegetation accelerate the decomposition of unharvested almonds, which otherwise represent an overwintering niche for navel orangeworm *(Amyelois transitella* Walker, Lepidoptera: Pyralidae). Breakdown prompted by moisture in cover crops and by flail mowing greatly decreased the spring emergence of the moths. Thus, cover cropping may enhance the control of one pest while exacerbating others. This example illustrates the trade-offs implicit in different management options. An ongoing comparison of organic and conventional almond orchards by Lonnie Hendricks (1991) confirms that cover crops can be an important tool in managing arthropod pests and their natural enemies.

Walnut

Sluss (1967) found that convergent lady beetle *(Hippodamia convergens* Guerin-Meneville) and *Olla abdominalis* (Say) (now termed *0. v-nigrum* [Mulsant]) were the two most abundant Coccinellidae (Coleoptera) attacking walnut aphid *(Chromaphis juglandicola* [Kaltenbach], Homoptera:

Aphididae) in Persian walnut orchards of northern California. Sluss believed that ground cover (of unspecified composition) can assist biological control by convergent lady beetle because it harbors aphids (which serve as alternate prey) from late February through

April or May. If ground cover is disked or chopped too early, i.e., before walnut aphid is available as food, beetles will disperse from the orchards. Such disengagement of the predators may lead to subsequent eruptions of the aphid. Chopping of understory cover killed many lady beetles, but some (including pupae) survived. *Olla v-nigrum*, a principally arboreal lady beetle, tolerated lower threshold densities of walnut aphid than did convergent lady beetle (Sluss, 1967), and remained in trees during the late spring and early summer, when the latter species dispersed to other habitats.

Apple

In an unreplicated trial in northern California, Altieri and Schmidt (1985, 1986) found that over a two-year period, codling moth infested 36.1 percent of the apples in an organic apple orchard with a cover crop of bell beans *(Vicia faba* L.), whereas a nearby clean-cultivated organic orchard suffered a 45 percent fruit loss from this pest. Bell bean has extrafloral nectaries that attract beneficial insects.

Cherry

In California, mountain leafhopper *(Colladonus montanus* [Van Duzee], Homoptera: Cicadellidae) transmits a myco-plasma-like organism that causes buckskin disease (X-disease) of cherry. This leafhopper reproduces on cool-season *Medicago* spp. and *Trifolium* spp. (Fabaceae), which may harbor the pathogen (Purcell et al., 1987). Thus, there is circumstantial evidence that cover crops of these groups should be used only with care in cherry orchards. There are, however, no field studies showing increased damage to cherry trees with undersown leguminous covercrops (A. H. Purcell, pers. comm.). Apparently, the legume must survive at least a full year to be an effective reservoir of the pathogen, an atypical scenario for annual clovers and cool-season medics.

Citrus and Avocado

Various grasses produce windblown pollen, used as an alternate food by the predatory mite *Euseius tularensis* Congdon (Acari: Phytoseiidae) (Kennett et al., 1979). This species and others in the genus attack several pests of Californian citrus and avocado, including avocado brown mite *(Oligonychus punicae* [Hirst], Acari: Tetranychidae), citrus thrips *(Scirtothrips citri* Moulton, Thysanoptera: Thripidae), citrus red mite *(Panonychus citri* [McGregor], Acari: Tetranychidae), and scale crawlers (Homoptera: Diaspididae) (Congdon and McMurtry, 1985). This mite can subsist and reproduce on diets of various pollens (Zhimo and McMurtry, 1990). Deposition of windblown pollen during late winter and early spring has been shown to be particularly important in hastening the seasonal buildup of populations of these mites (Kennett et al., 1979). In California, pollens from wind-pollinated tree species (e.g., valley oak, *Quercus lobata* Nee', Fagaceae) are available as early as March (Munz, 1973), whereas annual and perennial

grasses produce pollen mainly during April and May. Pollens are attractive foods (Zhimo and McMurtry, 1990), and, if excessively abundant, might be expected to divert the predators from the target pests. Of the grass pollens thus far tested, none is a sufficient diet for E. *tularensis* to sustain peak reproductive rates for more than one generation. The thick exine coats of grass pollens may render them less suitable as foods than other pollens (e.g., apple pollen) (Ouyang et al., 1992).

Management Techniques

In California, legal and market pressures and the development of pesticide-resistant pests are motivating farmers to explore cover cropping as at least a partial alternative to insecticides and acaricides. Californian orchardists are exploring the use of cover crops to provide key resources for predators and parasites of orchard pests, and to arrest generalist pests, such as *Lygus* spp. and flower thrips *(Frankliniella* spp.).

The options being explored include the use of: 1) resident vegetation that harbors abundant beneficial arthropods; 2) alternate strip management of cover crops, including, planting, mowing, and tillage schemes designed to ensure temporal continuity of habitat for both beneficial and pest arthropods; 3) commercial "insectary mixes" of plants that are attractive to beneficial arthropods; 4) mowing and deposition of clippings as mulch to harbor generalist predators. The last-named option is poorly understood in orchard systems.

Strip Management

The understory vegetation in an orchard need not be managed uniformly. Different zones maybe treated differently; we term this "strip management," because the different treatments are usually applied linearly, and the different understory zones appear as bands or strips running through an orchard. Strip management of cover crops may entail: 1) sowing cover crops of different floristic composition in different strips; 2) mowing strips at different times; 3) tilling strips at different times; and 4) combinations of 1,2, and 3. Sowing of different mixes leads to stands with differing statures and phenologies, affording diverse resources to pest and beneficial arthropods. A complex of stands having differing floristic compositions could remain attractive to arthropods for longer periods of time. Paradoxically, mowing can be used either to kill or to rejuvenate a cover crop. Close mowing of annual cover crops in full flower may kill the cover crop. Plant species having indeterminate growth habits can be mowed relatively high and before peak blossoming to extend attractiveness to both beneficial and pest arthropods. High mowing preserves vegetative and flower buds and permits regrowth of many species. By contrast, tillage usually destroys cover crops.

Strip management can permit a grower to attain multiple goals and balance competing aims, such as reducing competition from the cover crop or liberating nutrients for the trees, while maintaining habitat or allowing cover crops to reseed. Byway of illustration, a walnut orchardist in northern California (R. Lester, Winters, California) mows or tills strips of woollypod vetch *(Vicia villosa* Roth ssp. *dasycarpa* Ten., cv 'Lana') and common vetch *(Vicia sativa* L.), while leaving alternating remnant strips to reseed the entire

alley. After seed of vetches has matured in May, flowering will resume if soil moisture is sufficient. Thus, arthropod habitat can be retained through time.

A prune grower (T. Turkovich, Winters, California) sowed alternating alleys to different mixtures. One set of alleys received a mixture of woollypod vetch, common vetch, and oat *(Avena sativa* L.). The other set of alleys was seeded to a mixture of crimson clover *(Trifolium incarnatum* L.), rose clover *(Trifolium hirtum* All.), subterranean clovers *(Trifolium subterraneum* L.), barrel medic *(Medicago truncatula* Gaertn., cv 'Jemmalong'), rattail fescue *(Vulpia myuros* L., cv 'Zorro'), and soft chess *(Bromus mollis* L., cv 'Blando'). At two-week intervals beginning in late June, every third alley is mowed high. Thus, maturation of seed is permitted, cover crop regrowth (1)y vetches only) is staggered, and resident warm-season vegetation gradually supplants the cool-season annual complexes. Beneficial insects, such as lady beetles, ants, and parasitic Hymenoptera persist in the understory under this regime (R.L. Bugg, pers. obs.). Outbreaks of two-spotted spider mite *(Tetranychus urticae* Koch, Acari: Tetranychidae) have been avoided since 1991, when this scheme was adopted. Prior to this, in the spring of 1990, cover crops were mowed closely throughout the orchard, and a spider mite outbreak ensued, necessitating an application of acaricide.

Insectary Mixes

Proprietary mixes of reputed "insectary crops" are now commercially available from several sources. Several of the plants in these mixes are known to attract beneficial arthropods of interest to orchardists; others have not been assessed formally. Few have been evaluated in critical experiments on orchard biological control. The authors suggested that most of the plants employed attract wide ranges of entomophagous arthropods, and that increasing numbers of farmers are using insectary cover crops.

Conclusions

Various cover crops harbor distinctive complexes of beneficial and pest arthropods, and diverse trophic relationships have been well documented in the literature. More study is required to determine: 1) whether cover cropping modifies orchard microclimate and target-crop nutritional status, thereby influencing pest dynamics; and 2) whether and how cover crop species composition, spatial interspersion of species, and management (irrigation, mowing, and tillage) affect build-up and movement of arthropods, and resultant pest damage to the target crop. Formal replicated trials are essential to evaluate these issues in the context of overall orchard management.

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(DEC.458)

Contributed by Robert Bugg

Summer 1993 (v5n4)

Crop rotation and intercropping strategies for weed management.

Liebman, Matt and Elizabeth Dyck

Ecological Applications 3(1) :92-122.1993

"Results of a literature survey [234 references] indicate that weed population density and biomass production may be markedly reduced using crop rotation (temporal diversification) and intercropping (spatial diversification) strategies. Crop rotation resulted in emerged weed densities in test crops that were lower in 21 cases, higher in 1 case, and equivalent in 5 cases in comparison to monoculture systems [see Table 1]. In 12 cases where weed seed density was reported, seed density in crop rotation was lower in 9 cases and equivalent in 3 cases when compared to monocultures of the component crops. In intercropping systems where a main crop was intersown with a "smother" crop species, weed biomass in the intercrop was lower in 47 cases and higher in 4 cases than in the main crop grown alone (as a sole crop); a variable response was observed in 3 cases. When intercrops were composed of two or more main crops, weed biomass in the intercrop was lower than in all of the component sole crops in 12 cases, intermediate between component sole crops in 10 cases, and higher than all sole crops in 2 cases. It is unclear why crop rotation studies have focused on weed density, whereas intercropping studies have focused on weed biomass.

"The success of rotation systems for weed suppression appears to be based on the use of crop sequences that create varying patterns of resource competition, allelopathic interference, soil disturbance, and mechanical damage to provide an unstable and frequently inhospitable environment that prevents the proliferation of a particular weed species. The relative importance and most effective combinations of these weed control tactics have not been adequately assessed. In addition, the weed-suppressive effects of other related factors, such as manipulation of soil fertility dynamics in rotation sequences, need to be examined.

"Intercrops may demonstrate weed control advantages over sole crops in two ways. First, greater crop yield and less weed growth may be achieved if intercrops are more effective than sole crops in usurping resources from weeds or suppressing weed growth through allelopathy. Alternatively, intercrops may provide yield advantages without suppressing weed growth below levels observed in component sole crops if intercrops use resources that are not exploitable by weeds or convert resources to harvestable material more efficiently than sole crops. Because of the difficulty of monitoring the use of multiple resources by intercrop/weed mixtures throughout the growing season, identification of specific mechanisms of weed suppression and yield enhancement in intercrop systems has so far proven elusive.

"Significant advances in the design and improvement of weed-suppressive crop rotation and intercropping systems most likely to occur if three important areas of research are addressed. First, there must be continued attention to the study of weed population dynamics and crop-weed interference in crop rotation and intercropping systems. More information is needed concerning the effects of diversification of cropping systems on weed seed longevity, weed seedling emergence, weed seed production and dormancy, agents of weed mortality, differential resource consumption by crops and weeds, and allelopathic interactions. Second, there needs to by systematic manipulation of specific components of rotation and intercropping systems to isolate and improve those elements (e.g., interrow cultivation, choice of crop genotype) or combinations of elements that may be especially important for weed control. Finally, the weed-related impacts of combining crop rotation and intercropping strategies should be assessed through careful study of extant, complex farming systems and the design and testing of new integrated approaches.

"Many aspects of crop rotation and intercropping are compatible with current farming practices and could become more accessible to farmers if government policies are restructured to reflect the true environmental costs of agricultural production."

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(RTN. 154)

Contributed by David Chaney

Table 1. Summary of research papers comparing weed control in crop rotations vs. Monocultures. Summarized in Liebman, M. and E. Dyck. 1993. Crop rotation and intercropping strategies for weed management. Ecological Applications 3(1):92-122.

Study	**Rotation**	**Test Crop**	**Emerged Weed Density in Rotation[1]**	**Test Crop Yield in Rotation**
Stewart and Pittman (1931)[2]	wheat/sugar beet	wheat	lower	higher
	potato/potato/pea/sugar beet/sugar beet/wheat	wheat	lower	higher
	wheat/red clover/potato/sugar beet/ field bean	wheat	lower	higher
	alfalfa (5 yrs)/potato/sugar beet/ pea/sugar beet/wheat	wheat	lower	higher
	potato/oats/maize/field bean	oats	lower	higher
	alfalfa (3 yrs)/oats/sugar beet/sugar beet/oats	oats	lower	higher
Dospekhov (1967)	fallow/winter rye/potato/oats+clover/clover/flax	winter rye	lower	unavailable

		potato	equal	unavailable
		oats	lower	unavailable
		clover	lower	unavailable
		flax	lower	unavailable
Austenson et al. (1970)	summer fallow/wheat	wheat	lower	higher[3]
	summer fallow/wheat/ wheat	wheat	lower	higher[3]
MacHoughton (1973)	maize/maize/soybean	maize	-l	higher
	maize/soybean/wheat	soybean	-l	higher
Dowler et al. (1974)	maize/peanut/cotton/soybean	maize	lower	equal
		peanut	equal	equal
		cotton	equal	equal
		soybean	lower	higher
Zawisiak (1980)[4]	sugar beet/field bean/spring barley	sugar beet	higher-e	unavailable
	winter rye/winter rape/winter wheat	field bean	lower-1	unavailable
		spring barley	lower-e	unavailable
		winter rye	lower-1	unavailable
		winter rape	lower-e	unavailable
		wheat	lower-1	unavailable
Covarelli and Tei	winter wheat/maize	maize	lower-1	unavailable
(1988)	maize/winter wheat/maize	maize	equal-1	unavailable
	winter wheat/maize/maize	maize	equal-1	unavailable
	winter wheat/winter wheat/maize	maize	lower-1	unavailable

[1] Where data were available, comparison of weed seed numbers are given as: -1 (lower), -e (equal)

[2] Actual weed numbers were not reported in this study. Comparisons between rotation and monoculture treatments were based on qualitative observations.

[3] Mean yield on cropped land area.

[4] Weed density data represent means of combined herbicide and nonherbicide treatments. However, no interactive effects between cropping system (monoculture vs. rotation) and weed control regime (herbicide vs. nonherbicide) were reported.

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Private interests, public responsibilities and the College of Agricultural and Life Sciences.

A report of The Biotechnology Project, Wisconsin Rural Development Center. 1993

A key concern for sustainable agriculture is the content of the land grant research agenda. Sustainable agriculture advocates ask: To what extent does this agenda serve the needs and interests of farmers, farmworkers and rural communities? To what extent does it serve the needs of academic researchers and corporations? And, most importantly, who controls the agenda?

This brief report addresses these questions within the context of the University of Wisconsin's College of Agricultural and Life Sciences. The authors sought to determine the extent to which grants from the biotechnology industry were shaping that college's research activities. While limited in scope, the study's methods and findings will interest those who are pursuing similar questions elsewhere, including California.

Methodology

Researchers from the Biotechnology Project of the Wisconsin Rural Development Center (a private non-profit group) conducted a thorough review of 39 research agreements between College of Agricultural and Life Sciences (CALS) faculty and various funding entities, both private and public. They focused their attention on 21 contracts with business entities that involved biotechnology research. The researchers asked whether university policies and practices impact the ability of CALS to perform its public function of setting and responding to the state's agricultural agenda.

The corporations entering contracts to fund the research projects include four biotechnology companies (Forgene, Advanced Genetic Sciences, Agracetus, Agrigenetics), one pharmaceutical firm (Unimed), seven chemical/pharmaceutical corporations (Eli Lilly, W.R. Grace, American Cyanamid, S.C. Johnson, Du Pont, Pitman Moore, International Minerals and Chemical), two food companies (Campbell Soup Company and Nutrasweet Company), a diversified household products company (Proctor and Gamble), and one commodity group (National Dairy Promotion and Research Board). The principal investigators represented the departments of bacteriology, biochemistry, horticulture, meat and animal science, plant pathology, dairy science and veterinary science. The projects ranged from six months to several years in length, and from $8,400 to $603,484 in funding. Total support for CALS research for the 21 contracts was $3,075,094.

Conclusions

The report finds that private industry support for biotechnology research alters the "terms, structure, and objectives" of CALS research. Industry money leverages public investments in salaries and infrastructure to pursue private ends. As the authors put it:

"Over 80% of the CALS research budget comes from public funds, both state and federal, while 12% comes from industry and commodity groups. State funds are used largely to pay salaries and other fixed costs. Relatively little remains for specific research projects. By funding a specific research project, industry sponsors, with relatively small amounts of discretionary spending, are able to obtain public facilities and publicly funded researchers for their private research agenda." (p.1)

A number of specific policies and procedures facilitate the subsidy to industry. For example, the investigators found that 13 of the 21 research contracts studied paid less than the university's federally audited overhead rate. Since that overhead rate represents the amount the university needs to break even in conducting the research, this means that taxpayer dollars are paying for the difference. While there might be legitimate public reasons to subsidize particular research projects, the researchers found "no set of criteria by which administrators are to judge the importance of projects." They add, "it is not immediately apparent why these 13 projects were sufficiently important to warrant over $300,000 of public subsidy."

The authors note that no mechanism exists for obtaining citizen input into this agenda-setting process. While ordinary taxpayers pay most of the costs of running the university, they have little say in deciding how researchers use their time. The report recommends that a university-industry relations committee be formed to decide and monitor what constitutes "fair and appropriate" contract provisions with industry. A significant portion of the membership of this committee would be from the public at large.

Other problems were uncovered by the WRDC study. In some instances, University of Wisconsin policies allowed university researchers to assign patent rights to corporate sponsors as a condition of receiving the grant. In other cases, industry support was predicated on agreements that restricted the free flow of information, especially where trade secrets or other proprietary information was used in carrying out the research. Also, many of the university's topflight researchers received lucrative consulting contracts with the industries that sponsor their research, raising questions about whose interests are being served and when.

The authors are concerned that these problems will grow more severe as research funds become scarcer. Rather than blaming the researchers, they conclude that University of Wisconsin policies do not sufficiently protect researchers from industry pressure to dictate the terms of research. They conclude: "The loose rules governing research contracts leave many researchers vulnerable to pressure from corporate sponsors who are free to withhold funding if their conditions are not met."

Reviewer's Comments

This report from Wisconsin raises issues that are becoming increasingly critical in California. As public support for the University of California

declines, and as industry seeks to spend less on in-house research, the practice of "technology transfer" from university to industry is being promoted as a mutually beneficial solution. Many of California's approximately 350 biotechnology companies already have established close links with universities. The UC system is actively considering new ways to promote technology transfer, including possible creation of an independent foundation to fund university research and development in return for the right to license new technology. According to a recent study, UC's systemwide Patent, Trademark and Copyright Office already expects to earn approximately $22 million yearly from licensing technologies discovered by UC researchers (Postlewait et al., 1993). Most of this money comes from biomedical research at UC San Francisco, but UC Davis ranks second among the campuses, generating royalties of approximately $2.5 million per year. Of this amount, $2 million comes from plant-related patents, an area where biotechnology appears poised to make major advancements in the near future.

For advocates of sustainable agriculture, the questions raised by these developments include the following: If land-grant universities increasingly define their mission as developing and transferring technology to commercial interests, what will happen to the broader goals and constituencies that land-grants were originally created to serve? Will industry interests, however valid, exclude from the agenda competing social interests? Will the effort to upgrade salaries and facilities in order to attract industry-funded research drain funds from research and extension services that directly aid farmers, farmworkers and rural communities?

The study by Postlewait et al. concludes that efforts to transfer biotechnology in agriculture will not be cost effective unless the personnel and resources of Cooperative Extension play a significant role. But they end their analysis on a cautionary note:

"By its very nature, biotechnology tends toward privatization. An overemphasis on the promise of biotechnology may mean that agricultural problems that can be effectively solved through cultural practices (e.g., crop rotation) may instead be addressed with high-tech product-oriented solutions. It is best if expertise in biotechnology comprises a component in the Cooperative Extension portfolio, but is not the only part." (p.16)

If the Wisconsin study is any indication, many land grant universities are currently ripe for just the sort of "overemphasis" these authors fear. Few have adequate mechanisms for insuring that the research and extension agenda are oriented toward the broad public good rather than primarily by commercial interests. Opinions on the proper role of various biotechnologies in the future of agriculture vary, and land grants must consider the interests of all of their constituents before moving forward. A detailed study of UC research policies and practices similar to that conducted in Wisconsin is certainly in order.

References

Postlewait, Alyssa, Douglas D. Parker and David Zilberman. 1993. The advent of biotechnology and technology transfer in agriculture. Technological Forecasting and Social Change 43:1-17.

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