

Fall 1995

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From the Director

Two Experts Welcome Chaos

"Chaos defines my farm. I allow natural grasses to go wild. I see new six-legged creatures migrating into my fields, which now look like green pastures. I watch with paranoid panic, wanting to believe all will be fine while terrified I may lose the crop and even the farm. I need a lesson on managing chaos."

- David Mas Masumoto, in *Epitaph for a Peach* (Harper Collins, 1995)

California farmers like **Mas Masumoto** are vividly aware of the issues that **Tom Peters** addressed in his book, *Thriving on Chaos* (Knopf, 1987): international competition, accelerating technology, changing consumer tastes and other forces demand flexible management like never before. Peters advocates that we learn to *thrive on* chaos rather than merely learn to cope with it: "the winners of tomorrow will deal *proactively* with chaos, will look at the chaos as a source of market advantage, not as a problem to be gotten around."

Enhancing our sustainability in agriculture is, in many ways, an attempt to build in flexibility that works with, rather than resists, rapid change. Two exciting new projects, funded under our Biologically Integrated Farming Systems (BIFS) program (see p. 10), illustrate this approach. They look for ways to enhance the buffering that occurs in biologicallybased systems, rather than merely treating immediate problems and symptoms. They are based upon participatory teams, in which the farmers, scientists and consultants are equal partners in research and education, very similar to Peter's concept of selfmanaging teams.

In his more recent book, *The Pursuit of WOW!* (Random House, 1994), Peters responds to criticisms of selfmanaging teams. "Experts say the shift to selfmanaged teams takes years of training and preparation. Really? Whats a family but a selfmanaged team?" Perhaps that similarity is why Masumoto's book, subtitled *Four Seasons on My Family Farm*, is such an enjoyable illustration of many of Peters' management themes. For example, Masumoto's description of his efforts to instruct his pruning crew, only to admit that "These men have pruned more than I have...so now we exchange a few comments, they nod, and then they disregard my model," demonstrates perfectly Peters' maxims about the value of supervisors empowering frontline workers.

As Masumoto notes, "Most good farmers I know are ... tending to their trees and vines as best they can, comfortable with their work, and confident that the final product will be fine. Whether they know it or not, seasoned farmers are already experts at chaos."

Those of us who work for the University of California or other public or

private organizations that support the agricultural community may take comfort in the fact both an internationally respected management expert and a successful farmer agree it is not possible or always desirable to have all the answers. Masumoto and Peters, unlikely soul mates, know from experience it may be better to have a flexible system of management in place so that the vagaries of life and land can be received with enthusiasm.

-Jill Shore Auburn, associate director, University of California Sustainable Agriculture Research and Education Program.

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Farming Practices Survey

by Jill Shore Auburn, UC SAREP

Since 1992, participants at most educational meetings sponsored by UC SAREP have been surveyed about their farming practices and experiences. Many of the questions are similar or identical to those asked in 1990 by **Jim Grieshop** and **Arnaz Raj**, reported in *California Agriculture*, 46(2):4-7 (March/April 1992). The results reported here are from 374 responses received at 18 meetings in 1992 through 1994. The meetings addressed diverse commodities (e.g. apples, rice, vegetables, grapes, cotton) and topics (e.g. cover cropping, wildlife enhancement) and were held all over the state by UC farm advisors, private non-profit organizations, and others. Due to this diversity from meeting to meeting and year to year, results are reported here for all three years combined rather than separately for each year, since year-to-year differences may be a result of changing topics and audiences as much as changing times. As with Grieshop and Raj's earlier study, the results should not be interpreted as representative of the state's farming population as a whole, since respondents are self-selected as a result of attending a meeting and returning a survey. Nevertheless, they show some interesting patterns.

Survey respondents were primarily farmers (55 percent) farm managers (22 percent), or pest control advisors or other consultants (17 percent). A small number were farm suppliers (4 percent) or UC farm advisors (1 percent). Twelve percent were "other" such as students or educators. (Respondents checked all that applied, so percentages add to more than 100 percent.) The average number of acres farmed (or managed or consulted upon) was nearly 2,000. Most respondents were male (88 percent) and non-Hispanic White (84 percent); 7 percent were Hispanic, 6 percent of Asian/Pacific Island heritage, and 1 percent each Black, Native American and "Other."

When asked about specific production and marketing practices, many respondents reported substantial use of many tactics that are often associated with sustainable agriculture. (See Table 1).

Table 1. Sustainable agriculture practices most widely used.

<i>Practice</i>	<i>% of Respondents</i>
Tillage for weed control	76
Soil/tissue testing	74
green manures	71
Monitoring soil moisture or plant water stress	56

Pest-resistant varieties	55
Provide/improve habitat for predators	55
Avoid synthetic pesticides	51
Direct marketing	51

In addition, one-fifth or more of respondents planned to: use compost (purchased or produced on-farm); provide most nutrients from cover crop, compost, or manure; reduce tillage; release beneficials; use pheromones; use microbial pesticides; improve habitat for predators; and avoid synthetic pesticides.

We asked people to place themselves on Grieshop and Raj's seven-point continuum between "High Conventional" and "High Ecological" where *High Conventional* was defined as "the effective use of new and traditional technologies and practices, chemicals, and natural resources; centralized arrangements and agricultural practices for effective management and production; and primary reliance on resources and practices that maintain desired level of production." *High Ecological* was defined as "high concern for environment; very judicious use of inputs; minimal reliance on man-made resources; reduced use of chemicals; and increased conservation of soil, water, and energy." People were asked to place a mark on this scale for three points in time: today, five years ago, and five years from now. The average response was somewhat toward ecological for "today" (3.3 where 1=High Ecological and 7=High Conventional), versus somewhat toward conventional for "five years ago" (4.9). Approximately two-thirds predicted future change toward the ecological end of the continuum in the next five years; nearly all the remaining third predicted no future change, rather than a change toward conventional. The average future score predicted was 2.3.

Whether they had moved left or right on the continuum, we asked respondents to describe the effects on their farms. Results are reported for two contrasting groups of respondents: 1) those that reported no previous change on the continuum, or a change toward conventional (n=97, "more conventional"), and 2) those that reported more than average change (more than 1.5 points) toward ecological (n=149, "more ecological").

The results reported by the two groups are more striking for their similarities than their differences (Table 2): yields have most often held steady or increased and production costs have most often increased, for both groups. The distributions of experiences for net profits are also similar for the two groups, as are the results for disease, nematode, and weed problems. Those who had shifted more toward ecological management reported more decreases in insect problems, and more increases in labor needs. Management complexity and risk rose for both groups, but so did personal satisfaction from farming.

These figures report perceived results on a qualitative scale, rather than actual field measurements of the effects of farming practices.

According to this survey, those farmers who have switched to a more

ecological system compare favorably to those using conventional systems.

Table 2. Perceived effects on the farm of movement along continuum to "More Conventional" vs. "More Ecological."

	Greatly Increased	Increased	No Change	Decreased	Greatly Decreased
(Percent Responding)					
Crop Yields					
More Conv.	15	33	45	5	2
More Ecol.	8	31	46	16	0
Production costs					
More Conv.	5	48	25	20	3
More Ecol.	5	54	25	16	1
Net profits					
More Conv.	5	37	27	27	5
More Ecol.	3	33	35	26	3
Insect pest problems					
More Conv.	2	23	49	26	0
More Ecol.	3	16	31	47	3
Disease or nematode problems					
More Conv.	3	18	53	26	0
More Ecol.	1	22	48	27	2
Weed problems					
More Conv.	5	38	33	23	3
More Ecol.	9	39	28	22	2
Labor needs					
More Conv.	16	34	32	18	0
More Ecol.	7	61	19	13	1
Complexity of management decisions					
More Conv.	28	49	21	3	0
More Ecol.	24	59	11	6	1
Financial risk or uncertainty					

More Conv.	26	28	33	13	0
More Ecol.	13	55	26	6	0
Personal satisfaction with farming					
More Conv.	15	60	15	10	0
More Ecol.	35	44	14	6	2

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USDA Sustainable Agriculture Professional Development Program

by [David Chaney](#), UC SAREP

A new USDA program for professional education in sustainable agriculture was initiated in 1994. Funding was made available under the 1990 Farm Bill (Title XVI, Subtitle B, Chapter 3) for each state to develop a statewide strategic plan for professional development, targeting Cooperative Extension (CE) advisors, Natural Resources Conservation Service (NRCS) field staff, and other agricultural consultants (see "Western Sustainable Ag Training Program Underway," Sustainable Agriculture, Vol. 7, No. 1). SAREP coordinated this activity in California.

Our planning process centered around three focus groups, which took place in November and December of 1994 in Merced, Riverside and Davis. The purposes of these meetings were to better define the educational needs and interests of the target audiences, and identify the methods and strategies that would be most successful in meeting those needs. More than 60 individuals participated in the focus groups including CE advisors and county directors from each of CE's four regions, NRCS field staff, farmers, and representatives of several UC programs, government agencies and non-profit organizations involved in sustainable agriculture education.

Since the target audiences for the Chapter 3 program are initially CE and the NRCS, the participation of advisors and field staff from these organizations was especially important. The plan builds on the considerable expertise and ongoing work of California's CE and NRCS personnel in extending information about sustainable agriculture, and aims to enhance their work with farms, ranches and communities across the state.

Much of the discussion that took place during the planning meetings focused on enriching the educational efforts that are already underway and strengthening the programs of the many organizations and groups in California involved in sustainable agriculture education. In summary, the planning groups recommended a three-part approach that:

- builds on existing educational programs
- provides focused programs and farm tours on high priority topics and issues
- strengthens extension teams and networks addressing related problems and issues.

These components and the assessment of educational needs and interests of the target audiences are described in detail in the planning document which is available from SAREP. With the completion of this plan and its submission to the Western Region USDA-SARE program, individuals or groups from California will be better positioned to compete for funds that will help enrich

educational and professional development activities.

For more information about the statewide plan contact [David Chaney](#), SAREP, University of California, Davis, CA 95616, Tel: (916)754-8551; e-mail: dechaney@ucdavis.edu. For information about funding opportunities in this area, please see *Sources of Funding*, page 19, "USDA Western Region SARE/ACE Grants."

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Ecological Apprenticeship at UCSC

The Center for Agroecology and the University of California Extension offer a six month residential Apprenticeship in Ecological Horticulture April 15 to October 11, 1996 at the Farm and Garden at UC Santa Cruz. The apprenticeship emphasizes hands-on learning with instruction in organic horticultural methods (soil fertility, cultivation, composting, propagation, irrigation, greenhouse management), cultivar requirements (vegetables, herbs, flowers, fruits), pest and disease considerations, and marketing. Both garden and field-scale production are included. Application deadline is November 1; tuition is \$2,200. A few whole and partial tuition waivers are available for minorities and economically disadvantaged individuals. For more information, contact: Apprenticeship Information, Center for Agroecology, University of California, 1156 High Street, Santa Cruz, CA 95064; Tel: (408) 4592321.

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RCDs Total Resource Management Outreach

by Stephanie McGovern, California Association of Resource Conservation Districts

In January of 1994, the California Association of Resource Conservation Districts received a \$1.7 million Challenge Grant from the U.S. Bureau of Reclamation to perform a three-year Total Resource Management Outreach Project. This ongoing project, called Farmers for Agricultural Resource Management (FARM), combines aspects of on-farm management at approximately 30 demonstration farms in five regions throughout California. A site manager has been chosen in each region to oversee the farms in the area. Some of the resources that will be integrated include agronomy, biology, drainage, energy, water and farm management. The goals of the project are to demonstrate total resource management on farms and to disseminate the results to California farmers and their non-agricultural neighbors.

Growers who practice TRM consider the connectivity of resources and their impacts on many aspects of the farming operation. These total resource managers put seemingly external factors such as soil health, biodiversity, ecology, air quality and water quality on a similar priority as more direct aspects of farm profitability such as pest management costs, crop yield and crop quality. Total resource managers tend to examine the far reaching cause and effect of different farming practices, and therefore often exhibit somewhat of an experimental approach to parts of the farming operation.

"This project is allowing farmers to test innovative practices and document what works and what doesn't. The grant helps pay for a team of specialists who analyze the innovations and reduce the risk to the grower's livelihood. These pioneer farmers are building a future model that encourages others to use sustainable and environmentally friendly farming practices," says **Julie Spezia**, executive director, California Association of Resource Conservation Districts.

The demonstration activities are designed to consider many different aspects of resource management through an iterative process of assessment, recommendation, implementation and evaluation. The cooperating districts were given flexibility to recruit growers and design their specific project approach within the given broad guidelines. Below is a summary of each district's activities:

Cachuma Resource Conservation District (CRCD)

The CRCD, located in San Luis Obispo and Santa Barbara counties, is the most recent cooperator to join the FARM Project. The RCD encompasses a service area of almost two million acres in San Luis Obispo, Santa Barbara

and Kern counties. The region is extremely diverse in climate, topography, agriculture, recreational opportunities and socioeconomic structure.

This diversity is best reflected in five major ecological zones. These zones range from arid regions in the interior through the mountains and foothills, to a Mediterranean-like climate in the coastal regions. Topography ranges from sea level to 6,828 feet. Precipitation is largely in the form of rain, but snowfall is common at the higher elevations. Rainfall ranges from five inches in Cuyama Valley to over 40 inches in the mountains. The diversity in growing conditions supports a wide range of crops and horticultural products. Major crops include avocados, lemons, strawberries, winegrapes, apples, broccoli, lettuce, cauliflower, carrots, beans, flower and vegetable seed and cut flowers. All of the major crops are irrigated. Collectively there are about 125,000 acres of irrigated cropland.

In the CRCDD service area the most critical resource issues are water quality and quantity, soil erosion and the resultant sedimentation, and urban/agricultural interface problems. In addressing these concerns there are numerous environmental and human resource issues which must also be considered. Sensitive plants, animals, and their habitats must be taken into account, and farm management practices must be closely monitored for their effect on air and water quality.

The CRCDD has an existing Mobile Lab team which provides traditional hydraulic evaluations and scheduling assistance for irrigators. It has also developed a software program which enables growers to automate irrigation scheduling. In addition, the team also includes an analysis of certain chemical properties in the water source, and recommends management changes when they are required. The CRCDD will soon start a joint venture project with the UC Cooperative Extension to measure nitrate-nitrogen bound in organic material incorporated into the soil under intensive farming conditions. The CRCDD also maintains one of the most effective soil erosion control programs in the state.

Kings River Conservation District (KRCDD)

There is nothing in the world quite like the Kings River. The magnificent mountain country in which the river begins is among the Earth's most rugged and spectacular. What water from the Kings has created on the land is equally remarkable, a garden of nearly 1.1 million acres which today is one of the most fertile and productive agricultural regions in the world. It is a living lesson in the value of water in a land of little rain. No resource is more precious to the hundreds of thousands of people who live and work in portions of Fresno, Kings and Tulare counties watered by the Kings.

Today faced with enormous population growth and increased environmental concerns, entirely new challenges are confronting the Kings River's diverse interests. KRCDD is striving to integrate all of the target resources on its demonstration farms. To date, it has extended the greatest effort in water management, energy management, agronomy, integrated pest management, and biology.

"The goal of the project is to demonstrate and publicize solutions to farming problems that are practical, economical and healthy to the environment and

farming over the long haul," says **John Weddington**, KRCD's project manager.

KRCD is currently working with four family-owned farms that range in size from 28 to several hundred acres and include table grapes, citrus, almonds and stonefruits. The growers were chosen based on their interest in the objectives of the program and their seemingly progressive natures. All four cooperating growers aspire to reduce dependence on fossil fuel and agricultural chemicals, but approach their aspirations in different ways. Some of the practices implemented to date include irrigation scheduling, pump rehabilitation, cover crops, IPM monitoring and releases, and installation of owl boxes.

Pond Shafter Wasco Resource Conservation District (PSWRCD)

The PSWRCD is notable for its successful Mobile Irrigation Laboratory program, which has been providing irrigation management support to growers in Kern County for several years. More recently Kern County growers have been confronted with reduced water supplies, increased water prices and intense pressure from regulatory agencies to alter chemical use and avoid impacts to endangered species habitat. Because many farming changes have been thrust upon area growers, PSWRCD has advanced delicately in its pursuit of integrated resource management by focusing on the growers' primary resource concerns and constantly looking for opportunities to introduce other technologies.



"We want to look at all aspects of farming and offer our growers some expert recommendations on how to improve the overall efficiency of their farm," says **Brian Hockett**, PSWRCD's project manager.

The almond producers in the PSWRCD program include a 300 acre family farm, a 2,100 acre partnership and a 15,000 acre corporation. Each of the four sites has a different irrigation method, including two types of micro-

sprinklers, border strip and undertree impact sprinklers.

Over the three-year time span, workshops will be held for other farmers to learn results from the study. A public outreach program will also be implemented in order to inform urban residents of the value of maximizing resources in agriculture.

West Stanislaus Resource Conservation District (WSRCD)

The West Stanislaus RCD and its cooperators on over 30 farms are incorporating ways to support and improve California's Central Valley. Irrigation of this area has transformed the environment of a once semi-arid valley into a thriving agricultural garden.

"Water not only enables growers to cultivate many crops, it also supports the economy of many agriculture-related industries and provides the general population with an abundance of economical, high quality food and fiber," states **Keith Azevedo**, project manager from the WSRCD.

Unfortunately, the primary source of sediment reaching the San Joaquin River comes from eroded soil on furrow irrigated cropland. Much of this sediment comes from the West Stanislaus Area. Often this sediment is polluted with agricultural chemicals that could impair domestic, industrial, recreation and fish and wildlife water uses. The contaminated water can be toxic to animals and humans alike. Based on 16 years of past efforts, the focus of the WSRCD has been to improve the quality of surface runoff entering the San Joaquin River.

Given the reduced availability of water, mandates to reduce nutrient and pesticide use, urban expansion into agricultural areas and interest to improve wildlife habitat, the WSRCD and many cooperators will demonstrate new techniques of using existing practices to manage water, energy, chemical and biological resources within a profitable farm setting.

Yolo County Resource Conservation District (YCRCD)

The YCRCD has been active for several years in a variety of projects, the most notable of which involve increasing levels of biodiversity in agricultural settings. Its cooperators have introduced native grasses to roadsides, field edges and canal banks, which also serve as habitat for beneficial insects. They have installed irrigation and runoff detention ponds which provide plant and animal habitat, and they have helped introduce new rice production practices that increase waterfowl habitat and reduce agricultural burning.

The primary focus of YCRD's program is the integration of resources, with special attention being paid to biological and farm management resources. The influence of previous efforts to increase biodiversity are evident in many of the practices that are being considered such as cover crops, tailwater ponds and release of beneficial insects.

"We are trying to show growers how to handle a wide range of conservation questions rather than simply addressing water or erosion," says **Rich Engel**, YCRCD's project manager. "Our model farm program will show producers how they can set up their practices to preserve all resources like soils, energy,

water and air while farming their operations efficiently, reducing pesticide use and preserving wildlife habitat."

In addition to their current work on demonstration farms, the YCRCF FARM team is also focusing on developing an integrated resource method that will outlive the current FARM project. By refining the NRCS model for local conditions, the District is attempting to develop a streamlined way of assessing, recommending, implementing and reassessing sustainable agricultural practices.

The seven selected farms include a vineyard, walnut orchard, hay operation (alfalfa and oats), two cattle operations and two field crop operations (tomatoes, wheat, corn, etc.). Farm sizes range from a relatively small orchard to 9,000 acres of rangeland. In addition to the wide variety of crops, the selected growers also represent a variety of farming approaches, from fairly conventional to a grower that is considering conversion to organic status.

"We will not be looking strictly at the management of conventional resources, but at the attitude of the farmer and whether he or she is inclined to continue to risk capital on these practices after the program ends. There is a lot of pressure on farmers to have fields that look good to their neighbors. We'll be asking how these growers feel about seeing a few weeds out there," Engel says.

For further information regarding the FARM project please contact Stephanie McGovern at (916) 447-7237.

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SAREP Awards BIFS Grants to San Joaquin Valley Growers, Scientists

by [Lyra Halprin](#), UC SAREP

San Joaquin Valley winegrape and row crop growers are teaming up with University of California scientists in two pilot projects to showcase innovative farming practices that reduce pesticide use and improve soil quality.

The Lodi-Woodbridge Winegrape Commission (LWWC) and a group of farmers and researchers in the San Joaquin Valley's Westside have each been awarded money to demonstrate "biologically integrated farming systems" (BIFS) on local farms and share that information with other growers. The Commission has been allocated \$100,000 to use local vineyards as "classrooms" for area growers and to sponsor educational meetings on innovative farming practices. The Westside group has been awarded \$86,000 to conduct row crop comparison studies and to share information on biologically integrated farming practices with district growers. Authorization for the projects comes from the Legislature's Assembly Bill 3383, which was signed into law last year. Funding for the awards is provided jointly by the U.S. Environmental Protection Agency and the California Department of Pesticide Regulation. The program is administered by UC SAREP.

"We are delighted to award these grants to two voluntary researcher-farmer groups who have come together to deal with common agricultural problems and reduce pesticide use," said UC SAREP Director **Bill Liebhardt**. "Other projects similar to BIFS have shown us that using a team approach coupling innovative farmers with scientists is much more effective than regulations in helping other growers adopt biologically integrated farming practices."

Maintain Yields

These farmers are integrating biological and cultural control of pests into their production systems; providing on-farm habitats for beneficial insects, mites and spiders; and emphasizing soil-building practices such as cover crops to provide all or part of the nitrogen needed by crops. The intended result, according to Liebhardt, is that biologically integrated farming systems will enable farmers to maintain yields and quality while greatly reducing their reliance on agrichemicals, including pesticides and synthetic fertilizers.

BIFS is designed around a team approach to farm management, using farmers, consultants, University of California farm advisors and researchers, and independent pest-control advisers. Both projects use successful working farms to demonstrate agricultural operations that have reduced pesticide use in high-value crops. Other area farmers have agreed to participate by adapting the methods demonstrated to sections of their own farms and then

monitoring and comparing results with "conventional" plots.

Cooperative Venture

"The model of participatory extension and research in our project is based on the premise that useful outcomes occur when parties share goals and opportunities," said **Jeff Mitchell**, a UC Cooperative Extension vegetable crops specialist and project leader on the Westside project. "The 13 farmer members of our group are enthusiastic about this program because they want workable alternatives to pesticides and methods to improve soil quality, and they feel that UC researchers bring credibility to the on-farm demonstrations. Our researchers feel that they will benefit from direct involvement with farmers, which will allow them to develop new and relevant problem-solving research opportunities."

Mark Chandler, the LWWC executive director and administrator of the Commission's BIFS grant, notes that the Lodi-area coalition of researchers and farmers is excited to be involved in a project that will expand integrated pest management practices. "Conventional agriculture is looking for that 'shining example' of a district-wide, commodity-based IPM program that demonstrates 'how it's done,'" he said. "With this grant we hope to be that example."

The winegrape project is based on biologically integrated farming methods that the Commission has been promoting since 1992. At that time it began an integrated pest management program to promote effective and rapid adoption of sustainable winegrape production practices and to promote economic development in San Joaquin County by cultivating a market niche for winegrapes produced with more environmentally sensitive viticulture practices. According to Chandler, the BIFS grant will help the Commission accomplish its goal of extending adoption of sustainable practices throughout the region.

The two model farms involved in the winegrape project are the 120-acre Cabernet Sauvignon vineyard owned by Lange Twins Farm, and Kautz Farm's 30-acre Zinfandel vineyard, both of which have documented substantial reductions in pesticide use in the last five years. Both farms have tracked the use of compost, cover crops, beneficial insects and other farming practices.

Team Monitoring

The farmers who have signed up to participate in the winegrape project will be evaluated by the BIFS team at the onset of the project and will be monitored seasonally. The Commission will conduct ongoing side-by-side comparisons of yields and pesticide use between the BIFS-farmed blocks and conventionally farmed blocks on the farms of cooperating growers. The results of the comparisons will be made available with other project data at monthly grower meetings and field days and at smaller neighborhood grower meetings.

The Westside project is designed to facilitate information exchange among area farmers, consultants and researchers on soil-building practices and options for reduced reliance on agrichemicals. The project will monitor and

evaluate on-farm demonstrations of these practices, determine the extent to which IPM practices are used in row crops on the Westside and identify problems preventing further adoption. It will also provide community demonstrations of technologies while making use of participatory research teams to develop and refine additional information. The project will provide technical assistance to farmers and their consultants, and intensive pest management monitoring of fields enrolled in the project.

The farms used in the Westside project include O'Neill Farms, a 7,200-acre diversified row crop operation near Five Points, and **John Diener's** 4,500-acre farming operation between Five Points and Huron. Side-by-side comparisons between conventionally managed and biologically-based production systems will be established on the 13 cooperator farms. A common Westside crop rotation of tomatoes/cotton/onions-garlic will be followed at most sites.

Both BIFS pilot projects are funded for one year. Contingent upon demonstrated progress, the projects will be eligible for renewed funding for two additional years.

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Social capital and sustainability: Agriculture and communities in the Great Plains and Corn Belt.

Cornelia Butler Flora

Journal Paper No. J16309, Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa (Project No. 3281). 1995

Evidence is mounting that the benefits of sustainable agriculture are not merely environmental and do not stop at the farm gate, but also improve community wellbeing. Documenting these social and economic changes is becoming easier as greater numbers of farmers, often concentrated in particular places, are adopting sustainable production and marketing practices. At the same time, social scientists in a variety of fields are discovering the unique importance for community development of "social capital," defined as "features of social organization, such as networks, norms and trust, that facilitate coordination and cooperation for mutual benefit." (Putnam, 1993) New methods for measuring social capital at the community level are making it possible for researchers to compare social relationships in communities where sustainable agriculture is practiced widely with those in communities surrounded by industrial agriculture. A long line of sociological research has linked industrial agriculture with community decline. The question today is: Can sustainable agriculture reverse this trend

Cornelia Butler Flora, currently a rural sociologist at Iowa State University, has been a leading scholar in this field for many years. In this article Flora reports the results of a five-year study of four Midwest communities. She wanted to know if sustainable agriculture contributes to community social capital by enhancing the community's ability to identify problems, consider alternatives, and make needed adjustments after solutions are first implemented; or, alternatively, if it detracts from healthy community development by creating isolated subgroups who distrust each other.

Methodology

Flora selected her four communities from a recently published study funded by the Northwest Area Foundation (1995). Researchers in that study developed an index to classify farms as either "sustainable" or "conventional." The index consisted of three criteria: 1) reduction in the use of purchased chemicals and fertilizers, 2) use of ecological practices such as natural fertilizers, more complex crop rotations, and diversified crop and livestock production, and 3) commitment to these practices as a long-term goal reflected in the farmer's values. Those who scored highest on the index were classified as "sustainable" and those who scored lowest as "conventional." The authors of the Northwest Area Foundation study were careful to note that the farmers labeled "sustainable" were not sustainable in

any absolute sense, but only in relation to other farmers surveyed. Likewise, those labeled as "conventional" were only relatively less sustainable than others on the index. The "conventional" label was only applied to those who scored at the low extreme of the index, thus allowing comparisons between two groups with polar opposite practices and values.

For her study, Flora selected two communities identified in the Foundation study as having a critical mass of "sustainable" farmers and matched each of these with a community of similar size, agricultural potential, and distance from major population centers and highways whose farmers were identified as "conventional." Between 1989 and 1994, each of the four was studied using the techniques of community ethnography, a way of operationalizing a variety of measures of social infrastructure and providing a description of a community's institutions and setting. Among the specific techniques used were content analysis of local newspapers, analysis of census data, field visits, interviews with community leaders, windshield surveys to determine social class indicators, and simply hanging out in cafes, stores and other businesses talking with owners, patrons and employees. Each of the four communities had a population under 2,000.

The agricultural economies of the two pairs of communities were slightly different. Communities in one pair were located in alluvial plains, and consisted primarily of locally owned dairy and row crop operations of moderate size. Communities in the second pair were located in glaciated areas with less rainfall, and featured cattle production and small grains. Flora notes that in the sustainable farming communities, levels of community cohesion and cooperation were low when the study began in 1989, as indicated primarily by the absence of functioning civic organizations and lowachieving town governments.

Findings and Conclusions

Over the course of the fiveyear study little change in community cohesion or effectiveness was noted in the two communities featuring conventional agriculture. By contrast, both communities where sustainable agriculture was more widely practiced experienced significant increases in their ability to mobilize community resources for development (Table 1). Flora found that a significant factor in the renewal was a shift that redefined sustainable farmers as community resources rather than sources of embarrassment. In one town, the local sustainable agriculture organization became an important part of the community fabric, sponsoring a variety of communitywide events. This in turn helped to spark a revival in city government, and ultimately to the creation of a highly successful community development plan with state backing.

The other community formed an economic development task force, which invested in an organic seed cleaning facility for local farmers to replace a business that had left the community. A small input supply and machinery repair shop in the town developed a field implement particularly useful for sustainable farmers and began to market this product by mail order.

Interpreting these and related findings, Flora believes that "movement toward sustainable agriculture through local sustainable farming organizations in a community is associated with, although not necessarily determinant of, an

increase in a community's social capital" (p. 16). A critical factor is the problemsolving mindset that is integral to sustainable farming, the ability to adapt to local conditions while striving toward economic, environmental and social goals. As Flora puts it, "community citizens and farmers both begin to see that their action, collective for communities and individual or household for farms, can make a difference in achieving goals" (p. 16). The farmer and the community no longer define themselves as victims of big government or outside industry, but begin to distinguish choices they can make to enhance economic security and environmental quality. According to Flora, "...a pattern of problem solving guided by norms of mutual trust and reciprocity is encouraged by the sustainable agriculture movement and the various organizations that give social expression to that movement, and that this is what helps to nurture and build social capital within small, agriculturally dependent rural communities" (p. 2).

Reviewer's Comments

Flora's study demonstrates that the somewhat nebulous concept of "social capital" can be successfully operationalized and linked to sustainable agriculture. While her data alone cannot prove the thesis that sustainable agriculture benefits community development by increasing social capital, it opens up a fertile new area for empirical investigation. Given the obvious dissimilarities between the isolated, small communities Flora studies and California's rural communities (typically larger and with greater proximity to urban centers), her work cannot be taken as an exact blueprint for testing the social capital thesis here. It is unlikely that one could find communities in California where boundaries are discrete enough and farming practices so clearly distinguishable, to enable the sort of community comparisons she has employed.

On the other hand, California is a ripe setting for studying how the proliferation of grower information networks, local marketing groups, farmland preservation coalitions, and other sustainable agriculture organizations at the local, regional and statewide levels are developing social capital that is benefiting the state and its communities. As in the Midwest, new levels of trust, cooperation, and an empowering problemsolving focus are creating both a heightened subjective sense of belonging and tangible economic gains. We need studies that articulate the impact of changing production and marketing techniques on community social and economic organization, including support networks, community values, and levels of trust and cohesion. Flora's study is one useful example, as is a recent Cornell study of farmers' markets which found that the social capital created by pursuing sustainable agriculture often serves as an incubator for creating new businesses that benefit the entire community (Lyson et al., 1995). The growth of this type of research is a welcome sign that the socioeconomic dynamics of sustainable agriculture are beginning to get the attention they deserve from social scientists.

Table 1. Indicators of development of social capital in communities identified as having a sustainable agriculture emphasis.

Symbolic Structure

- formation of a new community development organization
- increased discussion of sustainable agriculture in coffee shops
- two new businesses geared to local agriculture, one for seed cleaning and one manufacturing a special farm implement
- city government revived
- broad input into a community betterment plan
- newcomers gained access to important elected and appointed positions
- sustainable agriculture organization promotes a variety of communitywide events

Resource Mobilization Capacity

- increased number of volunteers and participation in local government and organizations
- plan developed to revitalize main street
- improvements in police and fire protection
- town's Economic Development Corporation revived and a community visioning process begun
- a local building restored and moved to a park in the state capital

Networks

- increased ties between local farmers and the state sustainable agriculture network
- more cooperation between organizations on planning and conducting community activities
- mothers participating in the WIC program (Women, Infants and Children) become more active in school, church and community activities
- newcomers asked into leadership positions in a planned and effective way
- Chamber of Commerce revitalized and casts a wide net for memberships
- community development efforts aided by visits and discussions with communities that had undertaken similar projects
- several new singing groups formed

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North Coast apple scab trials 1993/1994, organic and conventional materials comparison.

Paul Vossen and Doug Gubler

Adapted from Plant Protection Quarterly 5(2):17. 1995.

Editor's note: This article is adapted from the UC Plant Protection Quarterly, Volume 5, Number 2. It describes experiments conducted in 1993 and 1994. Vossen reports that similar results were obtained for the 1995 season. The full summary of data is too large to include here; contact the author for detailed results.

Apple scab, *Venturia inaequalis*, is a serious fungal disease on apples in the North Coast region of California. It is particularly severe during early spring when leaves, flowers, and fruit are developing. If not adequately controlled, especially in rainy years, scab can cause almost total destruction of an apple crop and defoliation of trees. Growers typically apply conventional fungicides at seven to ten day intervals, starting at the green tip stage, to prevent infection of susceptible tissue. There are many fungicides that provide temporary protection against apple scab and some provide a short term curative action (kickback) on leaves that have already become infected.

Some modern fungicides offer more than 10 days of protection, over 96 hours of kickback activity, and a minimum of phytotoxicity. They can be used after fruit formation without causing fruit russetting, a chemical burn of the fruit skin. Prior to their development, liquid lime sulfur was a commonly used fungicide. It provides approximately five days of protection, 36 to 72 hours of kickback activity, but is risky to use after fruit formation because it can burn foliage and fruit if applied during warm weather. Liquid lime sulfur and other alternative materials are currently staging a resurgence because of their status as products that can be used in an "organic" production system.

Food safety and environmental protection are two very important issues to today's consumer. Therefore, the use of conventional pesticides has come under increased scrutiny and the use of alternatives under increased demand. Many North Coast apple growers are trying to produce apples organically to take advantage of higher market prices brought about by demand for environmentally sensitive fruit production methods. Apple scab has limited the ability of these growers to produce organically grown apples economically due to yields losses when scab causes flower drop and lower prices for blemished, misshapen, and smaller fruit.

Materials which are legally classified as "organic" by the state health and safety code and Organic Food Act of 1990 were tested in these experiments and include fixed coppers (Kocide & COCS), wettable micronized sulfur (Thiolux), lime sulfurs (Liquid Lime Sulfur & Orthorix), mineral oils (Hytech

& Stylet), insecticidal soap (MPede) and nutritional supplements (Stoma Feast and Compost Tea).

Many growers have used several of these materials to control apple scab, but without direct comparisons. Fixed coppers have never been used much because they can cause fruit russetting. The various sulfur materials have been used for years. Oils and insecticidal soaps have been effective in controlling powdery mildew on some plants and in controlling some insect pests. Stoma Feast is a multimineral supplement in a gelatinous base and when combined with fixed copper and sulfur, it is claimed to enhance their effectiveness. Compost tea is made by bubbling air for 21 days through a mixture of water and finished compost made from dairy manure. Brewer's yeast is added to the liquid 24 hours prior to use. It looks like thinned-down molasses with an agreeable organic odor. Compost tea presumably coats leaves with antagonistic fungi and bacteria and/or provides a nutritional stimulation to leaves, flowers, and fruit and thus prevents apple scab infection.

The conventional fungicides Captan, Ziram, Funginex, Benlate, and Topsin have been used for scab control for many years. These, plus two relatively new materials, Rally and Rubigan, control scab but cannot be used in an organic system. Fluazinam is a nonregistered new product for control of apple scab. Benlate and Topsin have not been used for several years because resistance has developed by the fungus, and thus they were not included in this trial.

The experiments tested the efficacy of currently available organic chemicals in comparison to several conventional fungicides. Four different orchards were selected, each with a history of severe apple scab infection.

Overall Comparisons

After two years of experiments and several years of observations, we have come to a number of conclusions about organic materials for control of apple scab.

Lime sulfur is difficult to work with, especially out of large drums. It controls scab moderately well in the early part of the season but not as well as Thiolux or fixed coppers. When used after fruit formation it causes russetting on fruit even at a lower rate (1 gallon per 100 gallons of water). It can be used to eradicate or give kickback control of infections within 36 to 72 hours of the infection period.

Orthorix is very similar to lime sulfur but somewhat easier to work with. It is used at a much lower rate since it is formulated with a surfactant. It has the same tendency to russet fruit.

Thiolux, one of the micronized sulfurs, is easy to work with but requires large quantities per acre (12 to 25 pounds). It performed well in all trials with three to five well-timed applications. Starting at the high rate and finishing at the lower rate when fruit is formed, it did not cause fruit russetting.

Kocide performed well in controlling scab infection on fruit and leaves and is very easy to work with. At higher rates (4 pounds per acre and above), it caused severe fruit russetting. At 0.5 pounds per acre, it controlled scab

without severe fruit russetting. It also could be combined with Stylet oil or Thiolux and used at a lower rate without fruit russetting and perhaps enhancing control. Registration is pending in California. COCS performed similar to Kocide in all experiments.

Stylet Oil and Hytech Oil showed some efficacy in controlling apple scab. Stylet oil was more effective in combination with one of the fixed coppers. Both were somewhat difficult to work with since they were heavy liquids used at fairly high rates.

MPede, an insecticidal soap, showed some ability to prevent scab infection, and was similar to the mineral oils.

Stoma Feast tended to congeal in the mixing process and plug the sprayer filter, thereby altering spray nozzle emissions. Its effectiveness in enhancing control is not known at this time.

Compost Tea was not effective in preventing scab infection and in some cases appeared to enhance apple scab.

Timing of spring spray applications is a very important factor in apple scab control since the fungicides used offer only temporary protection or limited kickback activity. New tissue that is generated by the tree during this rapid growth phase must be covered with fungicide to prevent crop loss.

Most of the conventional fungicides used in these trials did an excellent job in preventing apple scab infection. Several of the organic materials have now been documented as potential alternatives by also providing excellent control of scab. These materials can be used for the purpose of lowering the environmental impact of more toxic fungicides, to reduce the threat of resistance when alternated with conventional fungicides, and to conform to organic certification laws.

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(CIAPP.019)

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Best management practices for wheat: A guide to profitable and environmentally sound production.

Steve Watson (ed.)

National Association of Wheat Growers, Washington, DC. 1994

The premise of this new handbook for wheat growers is that the majority of farmers in the U.S. are trustworthy stewards of the country's agricultural resources. It features both tried and true methods of farming as well as innovative practices that respond to many of the environmental concerns raised during the past decade, particularly those related to soil and water quality. Steve Watson, of Kansas State University is the editor. John Hickman (John Deere), Jeff Jacobsen (Montana State University), and Drew Lyon (University of Nebraska) are principal authors.

The first half of the book is devoted to the principles of soil erosion and water quality protection. It addresses the ecological limitations that many wheat farmers face (i.e., sloped lands, erodible soils, drought, and/or flooding) as well as the biological and chemical aspects of nutrient and pesticide movement in soils. This section provides important scientific background for developing appropriate crop management practices. The principles are presented in a manner that will be easily understood by a general audience.

The second half of the book presents practical applications of these principles. The authors describe 39 different "best management practices" (BMPs) being implemented around the country. The BMPs outlined in this book are shown in Figure 1. The authors divide them into two categories: Management BMPs which generally involve decisions about the use of existing resources and equipment, and Conservation BMPs which involve structural changes in the farming operation as well as management decisions.

Not all BMPs will work for every farm or in every part of the country, so growers are encouraged to judge for themselves whether or not a particular practice is appropriate for their situation. The final section of the handbook helps growers do this. Several figures provide a graphical link between the BMPs and the principles of erosion and water quality described in the first section. Additional charts give growers the opportunity to describe their own resource setting and the impact of various BMPs on the potential problem areas. Examples are provided to help growers through the process.

Lastly, the handbook offers some guidelines for the economic analysis of a particular BMP. While the basic economic principle of calculating additional costs and additional returns holds for each BMP, how that principle is applied can vary depending on the changes that are made in the farm system. Four types of economic analyses are described to address these differences: 1)

changes in input usage or modest changes in crop management; 2) changes in crop mix and rotation; 3) changes in tillage practices; 4) changes in or addition of structures.

Best Management Practices for Wheat is available for \$5.00 plus shipping and handling from the National Association of Wheat Growers Foundation, 415 Second Street, NE, Suite 300, Washington, DC 200024993. (202) 5477800.

Figure 1. List of practices featured in Best Management Practices for Wheat

Management BMPs

- Crop rotation
- Volunteer wheat and barley control
- Set realistic yield goals
- Site specific management
- Soil testing and plantanalysis
- Nitrogen timing and rates
- Nitrification inhibitors and slow release nitrogen
- Fertigation, chemigation
- Manure management
- Nutrient placement methods
- Integrated pest management
- Tramlines
- Sprayer maintenance andcalibration
- Pesticide application timing
- Pesticide applicationmethods
- Pesticide selection and rate determination
- Soil, site evaluation
- Rotating chemicals with different modes of action
- Careful handling andmixing practices
- Irrigation management
- Harvest management
- Emergency tillage
- Buffer zones
- Riparian and wetland protection

Conservation BMPs

- Mulch till
- No till
- Field windbreaks
- Critical area planting
- Contour farming
- Field strip cropping
- Gradient terraces
- Storage, level terraces
- Grass waterways
- Vegetative filter strips
- Divided slopes
- Water control structures

- Water and sediment controlbasins
- Subsurface drainage
- Infiltration enhancement

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Cover crop biology: A minireview. Part I.

Robert L. Bugg

Article written for *Sustainable Agriculture Technical Reviews*. 1995

Introduction

Managing cover crops in orchards or vineyards depends in part on understanding their basic biology. This article, presented in two parts, reviews several aspects of cover crop biology. Part I looks at seeds, seedlings, rootzone biology, nutrient uptake, and the fate of cover crop derived nitrogen. Part II (to appear in the next issue of *Sustainable Agriculture*, Vol.8, No.1) will cover plant community dynamics and allelopathy. Most of the plant species discussed may be used as cover crops or as forage crops in rangeland settings. The issues raised have general applicability to a number of farming systems in California.

Seeds and Seedlings

Williams and Elliott (1960) studied dryland northern Californian populations of crimson clover (*Trifolium incarnatum*), rose clover (*T. hirtum*), and subterranean clover (*T. subterraneum*) with respect to: 1) amount of impermeable seed produced, 2) the rate at which seeds become permeable, and 3) factors causing breakdown of impermeability of rose clover. Crimson clover impermeability declined to a low level in the months after seed maturation. Subterranean clover followed a similar pattern, though slightly delayed. At one site under marine influence, subterranean clover retained a moderate proportion of impermeable seed into autumn. Rose clover maintained a large proportion of hard seed throughout the summer, autumn, and winter months. High temperatures at and slightly above the soil surface were demonstrated to cause breakdown of rose clover impermeability. Rose clover is able to persist better than crimson or subterranean clovers in most dryland northern Californian settings. This characteristic is probably in part due to its prolific production of impermeable seed.

According to Williams (1956), during establishment, the force produced by legume seedlings may be crucial in overcoming the weight of overlying soil and surface crusts. Using glass tubes containing vermiculite and glass rods of known mass, the force produced by seeds of crimson clover, rose clover, subterranean clover, and alfalfa was estimated. Mean forces exerted (in grams, +/- standard error of mean) were estimated as follows. Alfalfa (15.2 +/- 0.5), crimson clover (23.8 +/- 0.2), rose clover (24.1 +/- 0.5), subterranean clover (60.0 +/- 2.9). The force exerted by the seeds was highly correlated ($R=0.999$) with seed weight, but not so highly ($R=0.837$) with hydrolyzable carbohydrates, suggesting that other factors may be involved.

Williams (1963) later found that crimson clover varieties showed great

variability in the amount of force exerted by seedlings. '_Autauga' F.C. 32, 963 and Mississippi selection F.C. 32, 964 showed particularly great forces. These greatly exceeded those of rose clover, '_Caliverde' and '_Ranger' alfalfa, and '_Kenland' red clover. Forces exerted by crimson clover and alfalfa were highly dependent on temperature, with the maximum force attained for the former near 20 C, and for the latter between 25 and 30 C. These patterns suggest that plantings could be timed to correspond with sufficiently warm weather to achieve good emergence of seedlings.

RootZone Dynamics And Nutrient Uptake

Nitrogen

Schomberg and Weaver (1990) found that the addition of the equivalent of 31 kg per hectare of starter nitrogen did not reduce nitrogen fixation by arrowleaf clover, and substantially improved seedling vigor. Starter nitrogen can actually lead to improved nitrogen fixation by legumes.

In a threeyear field trial in Germany, Benkenstein et al. (1990) assessed uptake of nitrate (from sodium nitrate) and ammonium (from ammonium sulfate) by winter cereal rye (*Secale cereale* cv '_Janos') through the growing season, as a function of depth of placement in the soil (40, 60, and 80 cm beneath the surface). Sampling indicated that cereal rye plants absorbed 72 percent of the nitrate derived from the 40cm placement, and 18 percent of that derived from the 80cm placement.

In Germany, Raderschall and Gebhardt (1990) evaluated winter crops of rape (*Brassica napus*), barley (*Hordeum vulgare*), and Welsh ryegrass (*Lolium multiflorum*). These respectively accumulated in their aboveground structures 52.1, 36.2, and 22.9 kg of nitrogen per hectare following bell bean (cv '_Alfred').

Guiraud et al. (1990) conducted a lysimeter study in which a catch crop of annual ryegrass (*Lolium multiflorum*) reduced nitrate leaching from 124 kg of nitrogen per hectare to 40 kg of nitrogen per hectare. The percentages of fertilizer nitrogen (as a percentage of total nitrogen) in the water were 19 and 7 percent in covercropped and bare fallow plots, respectively. To a depth of 30 cm, 23 percent of labeled nitrogen was retained in organic form where ryegrass had been incorporated, versus 15 percent under bare fallow.

Jackson et al. (1993) evaluated several potential winterannual nitrogen catch crops for rotation with lettuce in the Salinas Valley of California sown in November and harvested the following March. Particularly promising in terms of nitrogen assimilation were white senf mustard (*Brassica hirta* cv '_Martigena' 200 kg of nitrogen per hectare), cereal rye (*Secale cereale* cv '_Merced' 129 kg of nitrogen per hectare), tansy phacelia (*Phacelia tanacetifolia* cv '_Phaci' 182 kg of nitrogen per hectare), white mustard (*Brassica alba* 205 kg of nitrogen per hectare), and oilseed radish (*Raphanus sativus* cv '_Renova' 161 kg of nitrogen per hectare). Annual ryegrass (*Lolium multiflorum* 85 kg of nitrogen per hectare) showed less capacity for nitrogen absorption when used in this temporal niche.

Phosphorus Uptake

Hoffland et al. (1989) grew rape (*Brassica napus* cv _Jetneuf') in agar plates and nutrient solution with or without phosphorus. Bromocresol purple was included as a pH indicator. Acidification, caused by exudation of citric and malic acids, occurred along a restricted zone about 1.5 cm in length, just behind root tips. Conditions were alkaline along the remainder of the root systems. Concentrations of citric and malic acids were generally lower for plants grown with sufficient phosphorus. Further work will be needed to test whether the acidification observed leads to solubilization of rock phosphate. Potassium, calcium, and nitrate were taken up about twice as rapidly by plants with sufficient phosphate than by plants grown in a phosphorusdeficient medium.

Gardner and Boundy (1983) found that wheat intercropped with white lupin (*Lupinus albus*) has access to a larger pool of phosphorus, manganese, and nitrogen than wheat grown in monoculture. The former two nutrients were probably mobilized by exudates from the lupin roots, then taken up by the closelyassociated wheat roots.

Based on pot experiments and a literature review, Paynter (1990) concluded that burr medic (*Medicago polymorpha*) and barrel medic (*Medicago truncatula*) are not as efficient at absorbing soil phosphorus as is subterranean clover (*Trifolium subterraneum*).

Annan and Amberger (1989) investigated the ability of buckwheat (*Fagopyrum esculentum*) to acquire phosphorus. The authors investigated phosphorus uptake, morphological features, and chemical changes in the rhizosphere. Root weight and length, and frequency of root hairs were higher when plants were grown under phosphorus deficiency. Phosphorus uptake rates were only moderate; concentrations of phosphorus in the shoot were high (1.8% of dry weight). Release of P from FePO₄ and glucose6phosphate was not due to a buildup of organic acids in the rhizosphere, but to high activities of acid phosphatase, an enzyme produced by buckwheat plants growing in low phosphorus conditions. The following parameters were regarded as important for buckwheat's phosphorus efficiency: 1) a finely divided root system of considerable length, with a high ratio of root surface to root or shoot length; 2) a high storage capacity for inorganic phosphorus, 3) an increased release of protons and FePO₄ or MnO₂ solubilizing substances by phosphorus deficient plants; 4) a favorable ratio of phosphorus uptake to root mass increase, especially at low phosphorus supply; and 5) a high activity of acid phosphatase in the rhizosphere and the capability to use phosphorus from organic sources.

Fate of Nitrogen Derived from Cover Crops

Sawatsky and Soper (1991) grew field peas using a splitroot procedure. The study suggested that at the time of harvest, 22 to 46 percent of the belowground nitrogen had been shed into the rhizosphere (root zone). Because this nitrogen "rhizodeposition" has not previously been assessed for annual legumes, nitrogen fixation may be underestimated by about 10 percent.

Fox et al. (1990) reported that in order for nitrogen mineralization to occur, nitrogen concentration of incorporated residue must exceed 15 to 25 grams per kg. However, little mineralization will occur if there are high

concentrations of lignin or polyphenols. These workers reported a study involving the decomposition of and nitrogen mineralization from residues of six kinds of legumes (alfalfa, round leaf cassia, leucaena, Fitzroy stylo, snail medic, and *Vigna trilobata*), in which the ratio of lignin+polyphenols to nitrogen content was a good predictor of nitrogen mineralization rate, whereas initial nitrogen concentration of residues was not. After 12 weeks, net nitrogen mineralized ranged from 11 percent from round leaf cassia to 47 percent for alfalfa.

In Terman's (1979) review of ammonia volatilization, he noted that crop utilization of nitrogen from surface-applied materials ranges from 30 to 70 percent and may average about 50 percent. Losses of ammonia (NH₃) increase with increase in the intensity of drying conditions (higher temperatures, more air movement, and lower humidity), with higher soil pH, with coarse-textured soils of low cation exchange capacity, and with lower initial soil moisture content. Losses are very low if various nitrogen sources are incorporated into the soil or are moved at once into the soil by rain or irrigation.

Janzen and McGinn (1991) reported three experiments evaluating ammonia volatilization from decomposing lentil residue (*Lens culinaris* Medik.). The first experiment showed that after 56 days, ammonia volatilization from residue left on the soil surface represented five percent of applied nitrogen. Incorporating the residue into the soil stopped nearly all NH₃ loss.

In Georgia, on gravelly clay loam and sandy clay loam soils, McVay et al. (1989) conducted a trial of no-till corn and sorghum production under various covercropping regimes. Hairy vetch and crimson clover grown as winter cover crops, respectively, replaced on the average 123 and 99 kg per hectare of fertilizer nitrogen. The corresponding aboveground nitrogen contents of cover crop herbage were 128 and 108 kg of nitrogen per hectare. These results suggest efficient cycling of nitrogen in a no-till system, with minimal losses due to volatilization of ammonia. Harper et al. (1995) reported that in Georgia for crimson clover preceding sorghum under no-till management, volatilization of ammonia was minimal: 323 kg of nitrogen per hectare accumulated in the crimson clover, and an estimated 0.25 kg of nitrogen per hectare (less than 0.1%) was lost by volatilization of NH₃.

By contrast, in the Northeast and the Midwest, cyclic wetting and drying may lead to the loss of from one-third to one-half of the nitrogen contained in surface-managed leguminous residues, regardless of the pH of the soil (Sarrantonio and Scott, 1988). Even if field conditions do not lead to substantial volatilization of ammonia, nitrogen availability to the target crop may be delayed in no-till systems, as suggested by Lemon et al. (1990) for berseem clover preceding grain sorghum in Burleson County, Texas.

Dr. William L. Hargrove of the University of Georgia has extensive experience in managing no-till cool-season annual legumes and in assessing their nitrogen contributions to warm-season annual field crops; he is also an authority on ammonia volatilization. In discussions with the author, Hargrove (personal communication, 1994) stated that ammonia volatilization should be minimal and nitrogen from cover crop residues should become available to trees if understory conditions remain relatively moist during the principal period that the clippings are decomposing. Shading and irrigation, of course,

would aid in maintaining the desired moist conditions. Hargrove further indicated that staggered mowing patterns, as often recommended in managing orchard cover crops, will further reduce volatilization by reducing the concentration of ammonia during any one period of decomposition. Rainfall in Georgia averages about four inches per month throughout the year; this corresponds well with the amounts of water applied to sprinklerirrigated almond orchards (91 cm [36 inches] over nine months), and is less than the amounts applied to walnut orchards (122 cm [48 inches] over seven to eight months).

Conclusion

In managing cover crops, many issues must be considered. Here, I have presented a selection of research results on cover crop ecology, emphasizing the dynamics of stand establishment and maintenance, and nutrient cycling. Our knowledge of cover crop ecology is still fragmentary, yet it is progressing rapidly. Thus, these and other results may ultimately be used to develop comprehensive views and management plans. For this to happen most efficiently, farmers, advisors, and scientists should discuss not only the scientific papers themselves, but also the applicability, adaptability, or nonapplicability of the findings within the context of particular farms, or even individual fields. Scientific data like those presented here take on their most important life when they enable farmers to fulfill their aims with minimal expenditure and environmental risk.

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Resources

Endangered Peaches & More

Epitaph for a Peach, by **David Mas Masumoto**, HarperCollins, 237 pages, 1995, \$20. Masumoto, a third generation California farmer, writes about his peach and grape farm in Fresno County, and about his choice to continue growing delicious Sun Crest peaches with limited shelf life. Rave reviews in the *New York Times Review of Books* and the *Atlantic Monthly* extol Masumoto's descriptions of the daily uncertainties of farmers. A cooperator on a UC SAREP project, Masumoto has long been a chronicler of the complexities of farm life. Available at bookstores.

Bioengineering & Sustainability

A Garden of Unearthly Delights: Bioengineering and the Future of Food, by **Robin Mather**, Dutton, 195 pages, 1995, \$23.95. Mather, the food editor of **The Detroit News**, details the way bioengineering could change the way we grow, eat and think about food. She shows consumers the link between farmers and their grocery baskets. Mather explains sustainable agriculture, compares genetically engineered tomatoes and farmers' market tomatoes, discusses the implications of dairy cows being treated with recombinant bovine growth hormone, and compares free range vs. supermarket chickens. Available at bookstores.

Edible Plants

A Taste of Nature: Edible Plants of the Southwest and How to Prepare Them, by **Kahanah Farnsworth**, Sunbelt Publications, 197 pages, \$10. This field guide to edible plants includes three sections on each plant. A drawing of each plant appears on the left side of the page, and on the right side are descriptions and information about it (uses, comparisons with other plants), and a recipe. To order, send checks or money orders for \$10, plus \$2 shipping and handling (add \$0.70 tax for California residents) to Kahanah Farnsworth, 14135 Ezra Lane, Poway, CA 92064; Tel: (619) 4864083.

Food Policy

Shifting the Burden, by **Laurie True, Ed Bolen** and **Wendi Gosliner**, 13 pages, 1995. Published by the California Food Policy Advocates, this report analyzes the impact of Congressional food block grant proposals on all 58 California counties. Statistics on participation, and data on the economic contributions of the federal food programs in each county are included. For a free copy of the report, which is available in individualized versions for every California county, contact California Food Policy Advocates, Tel:(415) 2910282.

Ag Coops

Two publications on agricultural cooperatives are available from the University of California Center for Cooperatives. *Starting an Agricultural Marketing Cooperative* (45 pages, 1994, \$10), includes market research and feasibility studies, as well as finance and cooperative incorporation information to guide new agricultural marketing cooperatives from conception to operation. Sample legal and accounting documents are included. *California Agricultural Cooperatives: Managers' Strategies and Attitudes Towards Finances and Risk*, by **Steven C. Blank** and **Robert Thompson** (30 pages, 1994, \$6), describes agriculture's changing risk environment, and details the practices of cooperatives in borrowing, lending and financial services. Both publications available from the Center for Cooperatives, University of California, Davis, CA 95616; Tel: (916) 7522408. Checks payable to UC Regents; \$3 postage and handling per order.

Fruit Trees

Orchard Almanac: A Seasonal Guide to Healthy Fruit Trees, by **Steve Page** and **Joseph Smillie**, 176 pages, agAccess, \$16.95. New, revised edition is aimed at commercial orchardists and backyard fruit growers who want to grow healthy fruit trees using less pesticides. A strict organic approach, as well as integrated pest management techniques are detailed. Order from agAccess, Tel: (916) 7567177; Fax: (916) 7567188. Add \$4 shipping and \$1.22 tax for California residents.

Farm Bill

Agriculture and the Environment: Listening to the Grassroots, 48 pages, 1995, Soil and Water Conservation Society. This report provides a crosssection of citizen opinion in eight U.S. focus groups and identifies 12 issues to be addressed in the 1995 Farm Bill: commodity program reform; conservation compliance; farmland protection; private, nonindustrial forestland management; private property rights; reorganizing agricultural agencies; sustainable agriculture; water availability and use; water quality; wetlands conservation; and wildlife restoration. The report includes a forward by **Paul Johnson**, chief of the USDANatural Resources Conservation Service; an executive summary and a list of panel presenters. Copies re available from SWCS for \$15 (\$12 for SWCS members) plus \$3.50 shipping and handling. Send orders to Soil and Water Conservation Society, 7515 NE Ankeny Road, Ankeny, IA 500219764; Tel: (800) 8437645 or (515) 2892331; Fax: (515) 2891227.

Food Systems Newsletter

Community Food Security News is a newsletter produced by the Community Food Security Coalition, a coalition of sustainable agriculture, community gardening, farmers' markets, environmental and community development organizations. The newsletter disseminates information about the coalition's two main goals: developing 1995 Farm Bill legislation related to a community food system, and promoting local food security coalitions. For more information contact **Mark Winne**, Hartford Food System, 509 Wethersfield Ave., Hartford, CT 06114, Tel: (203) 2969325; hn283@handsnet.org; or **Andy Fisher**, Community Food Security Coalition, PO Box 209, Venice, CA 90294, Tel: (310) 8225410, asfisher@aol.com.

Sustainable Ag on the _Net

The USDA Sustainable Agriculture Research and Education program (SARE) established the Sustainable Agriculture Network (SAN), which produces publications and databases and also includes an electronic mail group called sanetmg. To subscribe to this free online network send the message subscribe sanetmg to the Internet address: almanac@ces.ncsu.edu. Almanac is the North Carolina Cooperative Extension Service's information server. It handles all mailing groups. Almanac also keeps an archive of articles that have been posted to sanetmg. To receive a catalog of archived articles, send the following command send sanetmg catalog to almanac@ces.ncsu.edu. If you have general questions about the mailing groups or Almanac, mail to almanachelp@ces.ncsu.edu. For more information about electronic resources or SAN's publications contact: SAN Coordinator, c/o Alternative Farming Systems Information Center, Room 304, NAL/ARS/USDA, 10301 Baltimore Blvd., Beltsville, MD 207052351; Tel: (301) 5046425; Fax: (301) 5046409; email: san@nalusda.gov.

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Sources of Funding

USDA Western Region SARE/ACE Grants

Note: There are **EARLY** release and due dates in the next granting cycle for four programs of the USDA-sponsored Western Region Sustainable Agriculture Research and Education (SARE) and Agriculture in Concert with the Environment (ACE) programs. Contact the Western Region SARE Host Institution, 1500 North East 800, Utah State University, Logan, UT 84322-2310; Tel: (801) 797-3537; Fax: (801) 797-4002, to be put on the mailing list for all Calls for Proposals or to ask questions about SARE (Chapter 1), ACE, or Farmer/Rancher Research Grants.

SARE and ACE research grants:

A Call for Proposals has been issued for SARE and ACE projects. The SARE program is funded through USDA Cooperative State Research, Education and Extension Service, under Chapter 1 of Title XVI of the Food, Agriculture, Conservation and Trade Act of 1990. Proposals funded through SARE should promote good stewardship of the nation's natural resources by providing site specific and profitable sustainable farming and ranching methods that strengthen agricultural competitiveness; maintain and enhance soil; conserve soil, water, energy, natural resources, and fish and wildlife habitat; protect the health of people and animals involved in agriculture and enhance the quality of life and employment in rural communities; and examine the regional, economic, social and environmental implications of the adoption of sustainable agriculture practices and systems. The ACE Program is funded jointly by the Pollution Prevention Office of EPA and the SARE program. ACE projects should promote the adoption of sustainable practices and reduce the misuse of nutrients and pesticides. ACE priority issues include irrigated agriculture, nutrient management, environmentally sound multiple land uses, and animal waste management. Funding may also be available for proposals that specifically reduce pesticide use in target crops. Funds have not yet been determined by Congress, but it is anticipated that there will be approximately \$1,000,000 for new SARE projects and approximately \$160,000-\$300,000 for new ACE projects. Proposals are due to the Western Region SARE office at Utah State University by **November 8, 1995**.

Farmer/Rancher Research grants:

Producers and producer groups residing in the Western U.S. will be eligible to compete for SARE Farmer/Rancher Research Grants. The Call for Proposals for those grants is expected to be released November 6, 1995. Grants will be made for projects that identify, evaluate and test sustainable agriculture practices and provide innovative solutions to local problems. Research proposals must be led by one or more producers, include a professional agricultural technical advisor and provide a plan for sharing information with others in the community. Proposals are due to the Western

Region SARE office at Utah State University by **January 17, 1996**.

Professional Development/In-Service Education Projects:

Proposals are sought for projects helping Cooperative Extension Service, Natural Resource Conservation Service, and other agricultural professionals within the Western Region to increase their understanding and proficiency in the area of sustainable agriculture. Projects must address education and professional development that will improve their ability to conduct education programs and activities in sustainable agriculture and to respond to inquiries from farmers, ranchers and the public regarding sustainable agriculture concepts and systems. Proposals are due **December 6, 1995** to **Jill Shore Auburn**, Western Regional Training Coordinator, University of California, Davis.

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. Matching funds and/or in-kind contributions are recommended. Proposals are considered twice a year; the next round of proposals must be received by **January 15, 1996**. To receive copies of grant application procedures and the OFRF Research and Education Priorities describing target areas, write Grants Program, Organic Farming Research Foundation, PO Box 440, Santa Cruz, CA 95061; Tel: (408) 426-6606.

Fertilizer Research Awards

A Request for Proposals will be out in mid-January 1996 from the California Department of Food and Agriculture's Fertilizer Research and Education Program. Funding will be available for projects directed toward the environmentally safe and agronomically sound use and handling of fertilizer materials. For details and to be put on the mailing list, contact **Casey Walsh-Cady** or **Debbie Scott** at CDFA, (916) 653-5340; e-mail: lwcady@ucdavis.edu.

Department of Pesticide Regulation

The California Department of Pesticide Regulation (DPR) is requesting proposals from California public and private entities to encourage the formation of groups interested in investigating and adopting innovative pest management practices that will lead to the development of reduced-risk pest management systems. The program intends to provide support for groups of innovators to work with university researchers, private industry, and consultants to set up demonstration projects of new IPM systems. A broad range of projects is encouraged, including those that involve a single-tactic approach that can be interrogated into a whole system. Pest management projects from the agricultural and non-agricultural sectors are invited. Equal consideration will be given to new projects or existing projects that wish to expand. Awards will range from \$10,000 to \$30,000 per year. Proposals are

due by 4:30 p.m., **November 30, 1995**. For information, contact Jenny Broome, Tel: (916) 324-4100; Fax: (916) 324-4088, e-mail: jbroome@cdpr.ca.gov; 1020 N Street, Room 161, Sacramento, CA 95814-5624. Please request either the one-page Request for Proposals general specifications or the full application package.

Funding Resource Note:

Funding-seekers may want to investigate Environmental Grantmaking Funding 1995 Directory (January 1995), published by Environmental Research Institute, 1655 Elmwood Ave., Suite 225, Rochester, NY 14620, tel: (800) 724-1857; fax: (716) 473-0968. The 700-page directory with information on 600 grantmaking foundations is available for \$70 plus \$5 shipping and handling.

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