Fall 1994 (v6n4)

In This Issue:

Technical Reviews:

Fall 1994 (v6n4)

From the Director

Lessons from Down Under

Twenty-five years ago astronauts were able to land on the moon because the lunar mission had become a national vision. Society has not had a vision of a most important human activity-agriculture. As a society, we need to consider how we would like agriculture to be practiced and the rural landscape to look in the future.

On my recent sabbatical leave to Australia , I drove and flew over the Northern Territory, an area one-sixth of Australia's land mass, but with only 180,000 people. The Northern Territory has 26 cattle stations or large cattle ranches. There are about three or four major towns in total. The rest of the land area is mostly unpopulated "bush land."

As I looked out at the Northern Territory, I couldn't help noticing the contrast with much of the farmland in the United States. In the Midwest, Northeast and many places in California, the landscape is dotted with rural communities and surrounded by many small to medium-sized family farms. I wondered if the industrialization of agriculture might lead to the demise of this rural landscape. Industrialization tends to lead toward fewer and larger farms and fewer rural communities-a landscape more similar to that of the Northern Territory. Is this what we want?

Society needs to address the issue of where agriculture is headed, and how the landscape might look, based on different scenarios. During the last century, many new agricultural technologies and policies led to increased production but also resulted in depleting the rural landscape and moving people off of farms. Some think this should continue in the name of "progress," and others think this may not be in our best interest.

The future of agriculture and its effect on the rural landscape is a major question, not just for people in agriculture, but for society as a whole. It is also a major question that land grant universities need to address. While we have become very adept at looking at the small pieces, we need to consider the effects of our research on the larger picture as well. In this issue of *Sustainable Agriculture*, we include several articles that do look at the big picture. **Monica Moore's** article (see page 4) describes the Pesticide Action Network's study of pesticide use reduction plans in several European countries and how they might contribute to the transition to more sustainable agricultural practices in California. Input was gathered from a broad range of people in agriculture to develop a draft pesticide use reduction program for the state of California. Further work is now being done to assess incentives and funding mechanisms associated with the plan. The development of a pesticide use reduction plan as an explicit policy goal is one way of contributing to a vision of sustainable agriculture in California.

David Campbell's article (see page 12) reviews two recent government reports that describe the potential picture of California's future agriculture. One describes the rapid population growth and loss of prime farmland expected over the next several decades. The other predicts the effects of the resulting urban development on total water resources and their distribution. According to these reports, agriculture, one of California's largest industries, will likely get smaller share. In response to these reports, a vision of a more sustainable, resource-conserving agriculture that is connected with nearby communities looks promising, as Campbell points out.

We in the land grant universities need to solicit input from a broad cross-section of society to inform our research and education priorities. By doing so, we are articulating a vision of where we do want to be regarding the future of California agriculture.-Bill *Liebhardt, director, UC Sustainable Agriculture Research and Education Program.*

[Back | Search | Feedback]

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 competitive grant awards. 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 1994 are listed below.

Public Advisory Committee

Mark Chandler is the executive director of the Lodi-Woodbridge Winegrape Commission. A member of a San Joaquin Valley farm family (grapes/tree fruit), and a former winemaker for a British Columbia winery, he is interested in the large-scale adoption of IPM and sustainable practices by mainstream agriculture, and in creating markets for sustainable raised products. He is interested in the ag/urban interface as it relates to Sustainability, and is a steering committee member of the California Alliance for Sustainable Agriculture, a coalition funded by the Kellogg Foundation's Integrated Farming Systems Initiative to move the state toward more sustainable food and agriculture systems.

Gail Gant is a consultant with Weddle, Hansen and Assoc. Inc., a private environmental and agricultural consulting firm based in Placerville. Specializing in winegrapes and pomefruit, with clients in five counties around the Sacramento area, she is strongly committed to the implementation of integrated pest management.

Craig Underwood farms in Ventura County, where he raises lemons, avocados and specialty vegetables (baby beets, baby carrots, mesclun salad mix, bi-color corn), operates two roadside stands and a pick-your-own orchard in a family farming operation. Committed to sustainable farming practices and soil health, he makes and uses compost, and is interested in cover crops and insectaries in orchards and vegetable fields.

Technical Advisory Committee

Marc Buchanan is an assistant professor of soil science in the Environmental Studies Board at UC Santa Cruz. His areas of expertise include soil fertility, organic matter management, compost management and plant nutrition. He is particularly interested in consumer awareness of agricultural issues, and in water recycling, agricultural education, on-farm

issues, and environmentally and economically efficient vegetable and fruit production.

Donald Klingborg, DVM, is assistant dean for the Office of Public Programs, School of Veterinary Medicine, UC Davis. He is responsible for continuing education, animal welfare and professional, alumni, and public relations. Additionally, he is director of the Veterinary Medicine Cooperative Extension Unit, where he directs outreach activities, relations with commodity groups and governmental liaison. He is interested in residue avoidance and food safety.

Continuing PAC/TAC

Public Advisory Committee: Glenn Anderson, Larry Carmean, Peter Cooey, Jennifer Curtis, Frank Dawley, Sibella Kraus, Bryce Lundberg, Marta Salinas, and Betty Van Dyke.

Technical Advisory Committee: Marita Cantwell, Ben Faber, Holly George McCann, Richard Harris, Donna Hirschfelt, Nicelma J. King, Don Nielsen, Jim Oltjen, Ellen Rilla, and Carol Shennan.

Biographies of continuing PAC/TAC members appeared in the Summer 1992 (Vol. 4, No. 1) and the Summer 1993 (Vol. 5, No. 3) issues of *Sustainable Agriculture.*

Briefly Noted

Compiled by David Campbell, SAREP

Cover Crop Fights Nematodes In Wyoming Sugarbeets

Researchers in Wyoming are finding that a cover crop of nematode-resistant European fodder radish is an effective control for cyst nematodes in sugarbeets. Nematodes were down 57 percent compared to an untreated control, and the following sugarbeets yielded over 30 percent more than in plots treated with aldicarb. The five-ton yield increase more than paid for the cost of the radish cover crop. The cover crop also helps protect the soil from wind erosion. Researchers plan to test whether the economics of the system can be further improved by letting sheep graze the radish cover in fall and then test to see if nematodes are still controlled the following season. For a copy of *SARE/ACE 1994 Project Highlights,* which briefly describes this and other projects, contact Kristen Kelleher, SARE/ACE Communications, University of California, Davis, CA 95616.

Vaya con BIOS!

Three Biologically Integrated Orchard Systems (BIOS) projects have been funded by the US Environmental Protection Agency (EPA), and a fourth is now underway with no outside support. In BIOS growers and their pest control advisers work closely with an experienced management team to implement practices that reduce their use of pesticides and/or synthetic fertilizers. BIOS is a project of the. Community Alliance with Family Farmers in collaboration with SAREP, UC farm advisors, the Soil Conservation Service and others. BIOS projects currently funded by EPA include almonds in Merced County (second year; 26 growers), almonds in Stanislaus County (first year; 2030 growers), and walnuts in Yolo and Solano Counties (first year; 15-20 growers). **Ben Faber**, farm advisor in Ventura County, has initiated a citrus BIOS project with no outside funding; it has received overwhelming support from growers.

Pesticide Use Increases by 20 Percent in 1992

After declining 12 percent between 1990 and 1991, agricultural pesticide use in California rose sharply during 1992, according to figures from the California Department of Pesticide Regulation. Pesticides used in agriculture totaled 170.2 million pounds in 1992, up from 142.2 million pounds reported in 199 1. In 1990, the first year for which records were available, pesticide use was 163.1 million pounds. Large fluctuations in pesticide use from year to year are not unusual, due to variations in climate and pest invasions. As they had been in 199 1, the top five crops by amount of pesticide use were

table grapes, processed grapes, almonds, cotton, and sugar beets. Sulfur, used on both conventional and organic farms, is the most widely used chemical in the state (61.8 million pounds). Following sulfur in order of total reported use are methyl bromide (1 9 million pounds), petroleum oil (19 million pounds), metam-sodium (8.6 million pounds), and sodium chlorate (4 million pounds). The 1992 *Summary of Pesticide Use Report Data* is available in two volumes, indexed by chemical or by commodity. To receive a copy send $25 for each volume to: Cashier, California Department of Pesticide Regulation, 1020 N Street, Sacramento, CA 95814.

Mevinphos Withdrawn from U.S. Market

In June 1994, the Amvac Chemical Corporation of Los Angeles voluntarily withdrew the pesticide mevinphos (brand name Phosdrin) from the U.S. market. The company's action was prompted by planned state and federal EPA actions to ban the product due to repeated incidents of farmworker poisonings. Mevinphos is a broadspectrum organophosphate used on 22 crops such as strawberries, lemons, broccoli, spinach and lettuce. Because U.S. law does not prohibit pesticides banned in this country from being sold overseas, Amvac plans to continue production of Mevinphos for export. For more information, contact: **Joshua First,** US EPA, 401 M St. SW, Washington, DC 20460, (703) 308-8032.

Kellogg Foundation Expands Integrated Farming Systems Initiative

The W.K. Kellogg Foundation has announced a second round of nine demonstration projects aimed at encouraging more integrated and resource-efficient farming systems. These projects join nine others funded during 1993, including the California Alliance for Sustainable Agriculture (CASA). Each of the 18 funded projects represents a unique collaboration among non-profit organizations and university programs. Organizations in the Western Region funded during the second phase of the initiative include: Marketing and Production Alliance for Sustainable Agriculture, Oregon State University (Corvallis, Oregon); and Washington State University (Pullman, Washington). For more information on Kellogg projects contact Jon Miller, (616) 968-161 1. Information on CASA can be obtained from Project Coordinator Kerstin Ohlander,(408)459-4786.

Fall 1994 (v6n4)

Pesticide Use Reduction: an Emerging Trend in State Policy

by Monica Moore, Pesticide Action Network North America Regional Center

In 1992, the Pesticide Action Network North America Regional Center (PANNA) began considering how its study of national pesticide use reduction (PUR) plans in several European countries could contribute to the ongoing transition to more sustainable agricultural practices in California. At the time, pesticide use reduction as an explicit policy goal was not widely discussed in the state. PANNA recognized that the historic lack of an overall state pest management policy and consistent regulatory framework created obstacles to investments in new, more ecologically and economically sound farm technologies and enterprises. Experiences in a number of European countries suggested that a comprehensive pesticide use reduction plan would help address many of these uncertainties. This article summarizes the activities of PANNA's California Pesticide Use Reduction Project to date.

State Pesticide Use Reduction Plan

In 1993, with a grant from the University of California Sustainable Agriculture Research and Education Program (UC SAREP), PANNA undertook a consultative process to develop an outline for a preliminary pesticide use reduction plan for the state of California. To begin the project, investigators identified persons knowledgeable about aspects of pesticide use reduction potential in California. Forty-six project cooperators agreed to participate in a process to assess the utility and optimal design of a state PUR plan. Cooperators were selected to provide input from sectors likely to be affected by the adoption of pesticide use reduction policies, including farmers (organic, transitional and conventional growers), farmworkers and farmworker advocates, regulatory and other government agency officials, health workers, pest control advisors, pest control operators, extension workers, and citizen group representatives.

A summary of the European PUR plans was produced and circulated to cooperators, who were asked to provide written feedback on the appropriateness of specific policy tools in a California context; relevant policies they noted as absent from European plans; and PUR-related policies that were already in place in California. These comments were gathered into a questionnaire format and distributed to cooperators to obtain more specific commentary on policy proposals of fellow cooperators and adapted from various European plans.

A draft pesticide use reduction program for the state of California was developed directly from cooperator responses to the questionnaire. Policies receiving a plurality or a majority of positive responses were included in the draft plan. This draft plan was sent to cooperators, with a complete

compilation of responses to the questionnaire. Next, a series of cooperator meetings in Sacramento, Merced, and San Francisco were convened to discuss and solicit in-person comments on the draft plan. The meetings were structured to allow the groups to focus on what cooperators identified as the most problematic aspects of the draft plan, as well as policies considered most promising for achieving real reductions in pesticide use in California. Resulting discussions identified a number of components that seemed fundamental to a successful state pesticide use reduction policy. PANNA also found that most project cooperators were in agreement on the feasibility of introducing the following policies in the California context.

Key Policy Components

- Establish a numerical use reduction goal that is voluntary and ambitious. PANNA proposes a target of at least a 50% reduction of pesticide use in the state by the year 2000, with 1992 set as the base year against which to measure reduction.
- Establish specific reduction strategies by sector. This process must include the participation of affected communities and interested parties, including farmers, environmentalists, farmworkers, consumer organizations, structural pest control operators, health workers, pest control advisors and extension workers
- Phase out high-hazard pesticides according to specific criteria based on impacts to human health and the environment.
- Increase funding for alternative agriculture research and extension, specifically through competitive grants programs. Priority should be placed on farmer-identified research problems, and emphasize on-farm, systems research. The role of the extension service should be clearly defined to emphasize the provision of technical assistance regarding alternative production methods.
- Develop a program of financial incentives for growers in transition to alternative agricultural practices.
- Develop a pesticide fee-based mechanism for funding both research and extension on alternatives and financial incentive programs. An additional fee should be levied on high-hazard pesticides to discourage use and encourage phase-out.

These and other project findings were written up and circulated to cooperators, as well as a broader list of policy makers, agricultural and farmers organizations, extension agents, regulatory officials and non-profit organizations.

Financial Incentives and Funding Mechanisms

In 1994, UC SAREP provided additional funding for follow-up research, development and discussion of specific policy options in two PUR related areas: financial incentives that encourage transition to alternative pest management practices, and funding mechanisms for the implementation of a state pesticide use reduction strategy. A draft document is now being finalized that examines the potential of a variety of financial incentives to promote adoption of alternative pest management, and how specific incentives might be structured with respect to three crop production systems (cotton, strawberries, and oranges). Crop budget data and direct interviews with farmers, farm advisors and independent pest control advisors were used to identify and develop the incentives studied. The document also examines possible fee and tax structures as a means to recover basic pesticide regulatory costs, social and environmental damages of pesticide use, farm-based transition needs, and expanded research and extension services promoting alternatives to pesticides.

The incentives and funding mechanisms discussion paper will be sent to an expanded list of cooperators for written comment. From these responses, a set of policy recommendations will be developed and recirculated. Meetings with project cooperators are scheduled in September (in the Southern San Joaquin

Valley) and November (in the Northern San Joaquin Valley). Following an analysis of written feedback and responses obtained from these consultations, a set of policy recommendations will be prepared, with a record of cooperator concerns not resolved by the final recommendations. Finally, the revised set of policy options and discussion paper will be published and circulated among the group participants, policy makers and other interested people.

For more information, project publications, or to offer comments on the 1994 Pesticide Use Reduction Incentives and Funding Mechanisms discussion document, contact. Monica Moore or Angus Wright (principle investigators)or Doreen Stabinsky (project staff) at Pesticide Action Network North America Regional Center, 116 New Montgomery St. Room 810, San Francisco, CA 94105, Tel: (415) 541-9140 Fax:(415)541-9253 Email: panna@igc.apc.org. Related project publications:

Pesticide Use Reduction Policies in Europe. Pesticide Action Network North America Regional Center. March 1993.

Pesticide Use Reduction in the State of California: A Synthesis Report. Pesticide Action Network North America Regional Center. August 1993. A summary of 1993 project results also appeared in Volume 3, Number 4 of Global Pesticide Campaigner, PANNA's quarterly Journal.

Resources

Organic Farmers' Survey

1993 National organic Farmers' Survey by the organic farming Research Foundation (OFRF) is now available for $5 From OFRF, P.O. Box 440, Santa Cruz, CA 95061; or contact **Bob Scowcroft** at (408) 426-6606.

Livestock Newsletter

The Grazer's Gazette, a quarterly newsletter about livestock, pastures and rangeland, is available from the University of California Cooperative Extension, Mendocino/Lake Counties. To subscribe, send checks or money orders payable to UC Regents for $5.00 to: **John M. Harper**, Livestock/ Natural Resources Advisor, Mendocino/Lake Counties, Ag. Center/Courthouse, Ukiah, CA 95482p (707) 463-4495.

Citrus Groundwater Publication

Protecting Groundwater Quality in Citrus Production, 38 pages, 1994, by **Chuck Ingels**, SAREP. This book details the seriousness of the groundwater contamination problem in California, how chemicals move from farms to groundwater, and the history of nitrogen and weed management in the state's citrus industry. It presents diverse management strategies for both protecting groundwater and maintaining yields and fruit quality. Practices discussed include wellhead protection and creative techniques for managing nitrogen, weeds and irrigation. The book also provides the most thorough coverage available about cover cropping in citrus. It examines the limitations of cover cropping and suggests strategies that can be used to overcome these drawbacks. To order the book, send check or money order for $5.00, payable to UC Regents, to ANR Publications, University of California, 6701 San Pablo Avenue, Oakland, CA 94608-1239, (5 10) 642-2431.

Cover Crop Workgroup Report

Abstracts of research reports from the first meeting of the UC Cover Crops Workgroup are now available. The 20-page collection includes information from twenty researchers about their projects in annual and perennial cropping systems, plant nutrition, water infiltration, pest management, cover cropping systems and management, and education. To receive a copy, send checks or money orders for $ 5.00, payable to UC Regents, to: SAREP (CC Workgroup), University of California, Davis, CA 95616. To receive the abstracts free through electronic mail or for questions, contact: **Chuck Ingels**, perennial cropping systems analyst/CC Workgroup Chair, SAREP, University of California, Davis, CA 95616, (916) 75 7-3276; fax: (916) 75 73281; e-mail: caingels@ucdavis.edu.

Organic Cost Studies

Two new studies entitled *Production Practices and Sample Costs to Produce Organic Apples for the Fresh Market-Central Coast, 1993-1994, and Production Practices and Sample Costs to Produce Organic Apples for the Fresh Market-North Coast, 19931994,* are now available from UC Cooperative Extension. The studies were funded by the United States Department of Agriculture National Agricultural Pesticide Impact Assessment Program (NAPIAP) and by UC SAREP. Contact: Department of Agricultural Economics, University of California, Davis, CA 95616; (916) 7529376. The studies are also available in selected Cooperative Extension offices.

Also recently published is the Giannini Foundation Information Series No. 94-2, *Cultural Practices and Sample Costs for Organic Vegetable Production on the Central Coast of California.* This publication is available for $10.00 (checks or money orders payable to UC Regents) from the Division of Agriculture and Natural Resources, ANR Publications, University of California, 6 701 San Pablo Avenue, Oakland, CA 94608-1239; (510) 6422431. This study replaces the publication that was previously available from UC Cooperative Extension entitled *Production Practices and Sample Costs for a Diversified Organic Vegetable Operation in the Central Coast.* It has been slightly modified and condensed, with the regulations for organic commodities section updated.

Drip Irrigation and Fertigation Video

Drip Irrigation and Nitrogen Fertigation Management of Vegetable Crops, is the second in a series of new videos produced by CDFA's Fertilizer Research and Education Program (FREP) to help growers improve their fertilizer and water management to increase profitability, decrease potential groundwater contamination, and conserve water. The video, created by University of California Extension Specialist **Tim Hartz**, provides the viewer with in-depth information on crop nitrogen demands, irrigation scheduling, efficient fertigation programs and uses of fertility and soil moisture monitoring techniques.

Also available is a video on *Best Management Practices (BMP's) for Nitrogen and Water Use.* This video defines and illustrates BMP's and technologies to reduce nitrate contamination for several crops, and discusses nitrate sensitive areas in California. Both videos include reference booklets and can be purchased for $20.00. To obtain a copy, contact: **Debbie Scott** or **Casey Walsh Cady**, FREP, California Department of Food and Agriculture, 1220 N St., Sacramento, CA 95814,(916) 653-5340 or (916) 654-0574.

Farming near the City

MetroFarm, 576 pages, 1994, by **Michael Olson**. This book offers farmers a comprehensive guide for how to earn a substantial income on a small parcel of land in a metropolitan area. Written for both experienced growers and novices, the book presents information about technologies used by space-intensive farmers from around the world. Chapters discuss how to develop a

production and marketing strategy under many different circumstances-full-time or part-time farming; renting land or owning it; growing small fruits on prairie bench lands, ornamentals in city neighborhoods, flowers in steep, wooded hillsides or vegetables in city greenbelts. In addition to more than 252 charts, illustrations and photos from around the world, the book also includes 50 practical exercises and 5 chapter-length conversations with growers. Available for $29.95 (California residents add 7.25% sales tax), shipping and handling $4.00 per book, from: agAccess, 603 Fourth St., Davis, CA 95616p (916) 756-7188.

Ecological Horticulture Apprenticeship

The Agroecology Program and the University of California Extension offer a 6-month residential Apprenticeship in Ecological Horticulture, April 10-October 13,1995 at the Farm and Gardens, UC Santa Cruz. The Apprenticeship emphasizes hands-on learning with instruction in organic horticultural methods (soil fertility, cultivation, composting, propagation, irrigation, greenhouse management), cultivator requirements (vegetables, herbs, flowers, fruits), pest and disease considerations and marketing. Both garden and field-scale production are included. Application deadline is November 1, 1994. Tuition: $2,200. There will be an attempt to procure funds for two scholarships to minority/systematically disadvantaged individuals. Contact: **Al Johnson**, Apprenticeship Coordinator, Agroecology Program, University of California, Santa Cruz, CA 95064, (408) 459-2321.

Sustainable Agriculture Video

Sustainability.- The Quiet Revolution, a 45-minute educational video (VHS) that government agencies, extension, high school and postsecondary educators can use to promote or stimulate discussion about sustainable agriculture. Seven farm families discuss how they've shaped their operations to be more profitable, socially responsible and environmentally friendly. Produced by the Minnesota Extension Service. To order, send a check or money order for $45.00 payable to University of Minnesota, to: Distribution Center, Room 20, Coffey Hall, 1420 Eckles Avenue, University of Minnesota, St. Paul, @ 55108-6069. Credit card orders taken at (612) 625-8713.

SAREP Publications

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

Sources of Funding

Fertilizer Research Awards

A Request for Proposals will be out in mid-January 1995 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 **Jacques Franco** or **Debbie Scott** at CDFA, (916) 654-0547; e-mail: jrfranco@ucdavis.edu.

Organic Research Grants

The Organic Farming Research Foundation is offering funds for organic farming methods research, dissemination of research results to organic farmers and growers interested in making the transition to organic production 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. 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. Proposals are considered twice a year; the next round of proposals must be received by January 31, 199S. 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.

Funding Resource Note:

Funding-seekers may want to investigate *Environmental Grantmaking Foundations* 1993 Directory (October 1993), published by Environmental Data Research Institute, 1655 Elmwood Ave., Suite 225, Rochester, NY 14620; tel: (800) 7241857; fax: (716) 473-0968. The 600-page directory, with information on 417 grantmaking foundations, is available for $55 plus $5 shipping and handling.

Fall 1994 (v6n4)

Decomposition and nitrogen mineralization in natural and agroecosystems: the contribution of soil animals.

H.A. Verhoef and L. Brussaard

Biogeochemistry 11:175-211. 1990

This review (105 references) discusses the contribution of soil microfauna to nitrogen mineralization. The article contains six major sections: 1) A functional classification of the soil fauna based on their role in the decomposition process. 2) Findings from studies of natural and agricultural ecosystems. 3) Interactions between various soil fauna. 4) The effects of abiotic factors on faunal decomposition. 5) Effects of other environmental disruptions on soil fauna. 6) Areas for further research.

Functional Classifications

Three classifications are discussed in this section: size, habitat, and food. Size (measured in body width) is often used since it broadly reflects the scale at which the various fauna affect soil processes. The size distinctions and species found in each group are:

- Microfauna (2m - l00m). Includes nematodes and protozoa.
- Mesofauna **(**100m - 2 mm). Includes collembola, mites, enchytraeids and others.
- Macrofauna (2mm - 20mm). Includes millipedes, woodlice, fly larvae, beetles, snails and earthworms.

Habitat classifications are usually based on the depth in the soil profile at which the animal lives. Earthworm species, for example, are identified as either epigeal (surface-active), endogeic (subsurface) or anecic (active between the surface and subsurface layers). Similar stratifications have been described for certain types of spiders and collembola.
The third classification, food, is largely based on the trophic relationships between different groups of soil animals. According to the authors, this classification is more complex than either size or habitat, but it is more useful for evaluating the effect of different soil-dwelling species on decomposition and mineralization.

Contribution to Nitrogen Mineralization

Studies from forest and grassland ecosystems indicate that soil fauna are responsible for about 30 percent of total net nitrogen mineralization. In one study of a forest system estimates ranged from 10 to 49 percent, depending on the assimilation efficiency factor used in the calculations. The grassland

study showed that amoebae and nematodes together accounted for over 83 percent of the nitrogen mineralized by all fauna. Another study conducted in an agricultural system estimated that soil fauna contributed 25 percent to net nitrogen mineralization. This is in close agreement with studies from the natural systems, especially considering the variation in faunal activity resulting from environmental and management factors.

Population Dynamics

The amount of nitrogen contributed by the soil fauna is closely correlated with their population densities. These numbers can fluctuate considerably even over short periods of time, and reveal a complex set of interactions amongst the various groups of fauna. Paradoxically, according to several studies, the rate of organic matter decomposition appears to proceed independent of these changes in faunal populations. How can this paradox be explained? According to the authors, "…total organism biomass, including bacterial and fungal biomass [flora and fauna], may be a poor indicator of biological activity. Rather than pointing to the low importance of the fauna at the observed level of microbial biomass, this may instead indicate that the microbial biomass is kept at a low level by microbial grazers. In their turn, the grazers may not build up a large biomass, but instead be consumed by predators. Hence it appears that in a variety of ecosystems, microbial grazers and their predators [soil fauna] significantly contribute to the mineralization of nitrogen, despite their often low biomass."

Abiotic Factors

Soil moisture and temperature are the key environmental variables influencing the activity of soil fauna. Several studies have shown an important phenomenon where moisture stress is concerned. While bacterial and fungal decomposition are slowed down (and ultimately cease) with increasing moisture stress, the process of nitrogen mineralization is continued to some extent where soil micro- and meso-fauna are active.

Management Factors

It is generally accepted that adding nutrients to a nutrient deficient system increases the rate of organic matter decomposition. This phenomenon has been observed in numerous studies. However, many examples exist in which addition of nitrogen to nitrogen-deficient systems slows down decomposition, especially where high lignin organic material is concerned. The authors' explanation for this is that nitrogen and other fertilizers can negatively influence particular groups of organisms, particularly microbes. Any shift in microbial composition can have a negative effect on the soil fauna as well. As a result, decomposition and mineralization rate may decrease.

Harvesting (particularly in annual cropping systems) and incorporation of crop residue also have a strong influence on mineralization, mainly because of the rapid dying-off of roots and the addition of large amounts of carbon to the soil system. Few studies, however, have analyzed the specific effect of harvesting and residue incorporation on soil fauna and the associated effect on nitrogen dynamics. It is likely that the fungi and their predators play a key role in the mineralization process, but the specific groups involved have not

been quantitatively studied.

Further Research

The authors explore three important lines for future research: 1) further development of models that help us describe, predict and manage the contribution of the soil biota to nutrient turnover in soil; 2) the ability of the soil fauna in managed systems to make nutrients available when plants need them; and 3) more detailed study of the interactions between functional groups of soil fauna to better understand the process of organic matter decomposition.

For more information write to: H. Verhoef, Dept. of Ecology and Ecotoxicology, Free University, De Boelelaan 108 7,1081 HV Amsterdam, The Netherlands.

(DEC.326)

Contributed by David Chaney

Fall 1994 (v6n4)

The role of soil microfauna in plant-disease suppression.

Elroy A. Curl

CRC Critical Reviews in Plant Sciences 7(3):175-196. 1988

The role soil microfauna play in the cycling of nutrients in ecosystems has been recognized for many years (see previous article, Verhoef and Brussaard, 1990). This review article (123 references) broadens our view of the soil community by examining the impact soil microfauna have on plant diseases.

The concept of suppressive soils was described by Baker and Cook (1 9 74) in their first book on the biological control of plant pathogens. This treatise described suppressiveness as the ability of a soil to prevent, truncate or delay the development of a disease even though favorable environmental conditions exist. Further research has attempted to explain the actual mechanisms of disease suppression. These studies have looked at the influences of various microbial antagonists, soil fungistasis (inhibition of fungal growth), and physical and chemical properties of soils. Investigations into the role of soil fauna in this process are relatively new.

From the start, this article argues that the effect of soil fauna on plant growth must be examined in the context of the whole microbiotic community. The author, therefore, puts considerable effort into describing the members of this community, both flora and fauna, that dwell in the rhizosphere. A brief section highlights the soil microflora: bacteria, actinomycetes, and the fungi. More detail is provided on the microfauna. This diverse group includes the protozoa, nematodes, and some arthropods, primarily mites and springtails (collembola).

Organic Matter Decomposition

In keeping with its holistic emphasis, the article examines the relationship between flora and fauna in organic matter decomposition and nutrient cycling before looking narrowly at plant disease. The author reminds us that as nematodes and protozoans feed upon microbial populations, they consequently will affect organic matter decomposition. It is likely that such feeding ultimately liberates nutrients immobilized in microbial cells or reduces competition between microorganisms so that mineralization is actually accelerated. " These activities not only influence the general nutrition, health, and vigor of higher plants (which relates to disease susceptibility), but also determine t e competitive behavior of root-infecting fungi and their microbial antagonists." These indirect and direct impacts are important ones for further study.

The role of microarthropods in mineralization is also discussed. Mites and collembola are known to fragment organic matter as they feed on soil microflora. This fragmentation to finer particles creates new surface areas for microbial colonization and consequently speeds the decomposition and mineralization processes.

Along with mineralization effects, this section of the article describes several other interesting features of the microbiotic community, including increased nitrogen fixation by nitrogen-fixing bacteria *(Azotobacter* spp.*)* where protozoa are present, and the behavior of bacterialand fungal-feeding nematodes.

Rhizosphere Effects

The rhizosphere is the soil zone surrounding and influenced by plant roots. To complete the picture of the microbiotic community, the author examines the specific characteristics of the rhizosphere that affect microflora and fauna. The primary influences in this zone are root exudates and the chemical and physical features of the root-soil interface. Root exudates and sloughed root cells in the rhizosphere provide a rich carbon source for microbes. As the microbial population increases, so does the activity of microbe-grazing fauna, leading eventually to the release of inorganic nitrogen and phosphorus.

Root exudates can also have a strong influence on soil pathogens. "The nutrients in exudates release dormant spores and sclerotia from the grip of soil fungistasis, a natural phenomenon imposed by chemical inhibitors and microbial competition for nutrients. Propagules fteed from fungistasis germinate and establish infection if they are not first consumed by mycophagous [fungus-eating] animals. Root exudates are also important in the activation of quiescent nematode stages and in the movement of plant parasitic forms to infection sites."

Specific Soil Fauna-Plant Disease Relationships

This analysis of the soil fauna and the author's description of the niche the fauna have in the rhizosphere are sufficient to indicate that soil fauna do regulate pathogen populations to some degree. Investigations since 1975 have given some detail to the actual mechanisms involved and highlight some interesting relationships. These are summarized in table 1.

Conclusions

The studies reviewed in this paper point to the fact that the soil microfauna play an important role in suppression of plant pathogens and represent a significant biological control potential. However, there has not been adequate field testing to verify if this biocontrol potential can be exploited in cropping systems. In addition, any evaluation of a candidate organism must include the possibility of adverse effects upon plants, animals, or the environment. A problem with the fungal-feeding amoebae, for example, maybe their effect on other beneficial organisms such as the mycorrhizal fungi. "In the final analysis, efforts to manipulate and exploit the friendly fauna populations for crop benefit must be compatible with microbial symbionts, and other plant-growth promoting rhizosphere organisms, and with fungi and bacteria that are

being promoted for biological control of diseases." This is clearly an area with great opportunities for further research.

For more information write to: E. Curl, Dept of Plant Pathology, Auburn University, Auburn, AL 36849.

(DEC.318)

Contributed by David Chaney

Table 1. Summary of biological control activities of soil micro-and meso- fauna.

Biocontrol Agent	**Action**
Amoebae	
At least 5 different species	Conidiall perforations and/or hyphal feeding on numerous species of fungi including *Cochliobolus sativus*, *Thielaviopsis basicola, Fusarium oxysporum F. sp. melonis, F. roseum, F. solani, Verticillium dahliae, Gaeumannomyces graminis, and Phytophthora cinnamomi.* Also may feed on bacteria, flagellates, blue green algae, diatoms, and nematodes.
Nematodes	
Numerous species from 7 genera	Feed on various species of *Rhizoctonia, Aternaria, Pyrenochaeta, Botrytis, Fusarium*, and *Agaricus.*
Microarthropods	
Mites	Fungal feeders, but probably play a minor role in disease suppression.
Collembola	Two species found to feed extensively on several plant pathogenic fungi including *Rhizoctonia solani*, and *Fusarium oxysporum*. Show marked preference for particular types of fungi.

Fall 1994 (v6n4)

Are modern fruit production systems sustainable?

I.A. Merwin and M. P Pritts

HortTechnology 3(2):128-136. 1993

This article presents an overview of some of the current issues affecting the sustainability of fruit production around the world. The authors note that "'sustainability' has emerged as a new paradigm by which fruit production systems and practices are judged." They define sustainable farming systems as those which conserve resources, provide adequate food and fiber, optimize crop output, and are profitable, supporting both the farmer and viable rural communities.

Fruit Production Systems

The authors examine three systems of fruit production: traditional fruit growing and gathering, traditional family farms, and modern fruit production systems. Traditional fruit growing and gathering appear to be a model of sustainability, using minimal external inputs and having endured for centuries. Some fruits, such as Brazil nuts, are still commercially harvested this way, and people in many parts of the world use traditional systems for subsistence. These systems, however, do not meet the food needs of increasing human populations and are being threatened by deforestation. Traditional family farming operations were common until the mid-1900s. These systems were often highly diversified, with fruit production being only one component. Modern production systems (whether on family farms or corporate farms) tend to be more capital-intensive and use more synthetic chemical inputs than in the past. Modern production systems are more profitable than the traditional systems, but the demands on today's farms are also greater. Trees must be early-bearing and fruit must pass the scrutiny of the marketplace. In important fruit-growing regions, the usual practice is to reestablish orchards continuously. However, replant problems often develop with successive plantings. According to the authors, "The ability to replant fruits successfully .. without extensive modification is itself a good test of the sustainability of prior production practices." With the phase-out of methyl bromide, for example, the sustainability of fruit production in some areas is questionable without effective substitutes.

Sustainability Issues in Fruit Production

Growing perennial fruit crops has many advantages in resource conservation, and some modem practices enhance agricultural sustainability. For example, tree roots, leaf litter, and cover crops improve soil quality, especially on hillsides. Fruit crops can also provide a relatively rich habitat for a diversity

of plant and animal species, which can aid in pest management. But fruit producers are also faced with a number of challenges.

Because fruit crops tend to be located on land of high value, they are often threatened by **urban and suburban sprawl.** California's Central Valley is currently a major battle ground for land and water. Unfortunately, many growers oppose protection of land from development in order to retain the option of selling the land for a high price. According to the authors, this is an example in which the farming system may be sustainable, but it is unable to withstand external socioeconomic pressures.

A significant threat to the sustainability of modern fruit production is its extensive **reliance** on **pesticides and fertilizers.** This reliance stems in part from consumer demand for blemish-free fruit. Other market and regulatory forces are discouraging agrichemical usage. The future of many pesticides in fruit production is questionable as a result of the increased cost of producing them, stricter regulations, and rapid development of biochemical resistance to pesticides. Fungicides may be hardest hit, as many will be banned with stricter enforcement of the "Delaney Clause." The loss of fungicides will likely favor fruit production in drier areas, such as in California. However, this concentration will require that water be available and that fossil fuels and transportation remain inexpensive to supply distant markets.

Lastly, **genetic resources** are critical to the long-term sustainability of fruit crops. Yet germplasm throughout the world is being threatened by human population pressures. Among the fruit crops considered most at risk are apple, avocado, coconut, mango, and pear. Because of market pressures, genetically improved cultivars often replace valuable landraces at the centers of origin for many crops, further eroding the genetic pool. Germplasm repositories and collections contain only a small fraction of the existing genetic diversity. For some fruits, the only truly effective way to conserve genetic resources is to protect large areas of land from development at the centers of origin. "Sustainable farming in any one country is thus intimately tied to the well-being of other countries, and acknowledging this fact is perhaps the biggest challenge facing the sustainable farming movement."

New Paradigms in Horticulture

A primary goal in modern fruit production has been to increase yields per unit of land and labor. The authors point out that this paradigm is giving way to a new one, i.e., reducing environmental impacts and the use of external inputs, even at the cost of reduced productivity. "The new agricultural paradigm is holistic, emphasizing process as well as product, and quality more than quantity." This shift coincides with a recognition that our low food and fiber prices have not accounted for the true costs in farming as a result of "hidden" government subsidies such as low energy costs.

Reviewer's Comments

Two of the issues discussed in this article are particularly relevant to California.

Water. Low annual rainfall (particularly in recent drought years), a growing urban and suburban population, and increasing recreational and

environmental demands mean that less water is available for irrigating crops. Up to this point, annual crop growers have borne the brunt of the water shortage by removing land from production. But some orchards, while remaining alive, have lost vigor and production from insufficient water or irregular watering schedules. In response, farmers are relying more on groundwater sources and are pumping it faster than it is being recharged, a clearly unsustainable practice. Technical developments (e.g., maximizing irrigation efficiency, low-volume irrigation systems) offer only a partial solution. Political action based on dialog among the various stakeholders is also needed. (See review of land and water use reports below.)

Pesticides. Pesticide use continues to be at the forefront of concerns expressed in the marketplace and through the legislative process. In addition, many pests have developed biochemical resistance to pesticides, leading some growers to implement "resistance management." With the problems surrounding agrichemicals, a logical approach is to continue to work toward the development of nonchemical alternatives, resistant cultivars, and more biologically integrated cropping systems.

For more information write to: Dept. of Fruit and Vegetable Science, Cornell University, Ithaca, NY 14853.

(CI-SUST.108)

Contributed by Chuck Ingels

Two reports highlight trends in land and water use.

Population Projections by Race/Ethnicity for California and its Counties 1990-2040.

California Department of Finance, Demographic Research Unit, Report 93P-1. 1993.

The California Water Plan Update. Vol. / and /1.

California Department of Water Resources, Draft Bulletin 160-93. 1993.

Two recent state reports raise disturbing questions about the sustainability of California agriculture in the face of population growth and water scarcity.

Population Projections by Race/Ethnicity for California and its Counties 1990-2040. The Demographic Research Unit of the California Department of Finance predicts that the state's population will reach 63 million by the year 2040, more than double the current 29 million. Prime agricultural land is particularly threatened by the concentration of new growth in the Central Valley, where the total population will triple to more than 15 million. Many of the state's most productive agricultural counties are slated to grow at more than double the 2.26 percent rate for the state as a whole.

Assuming current residential density patterns, a Central Valley population of 15 million would consume another 1 million acres of productive valley floor agricultural land, resulting in a potential loss to the agricultural economy of $1.267 billion dollars, measured in 1990 dollars. Indirect economic losses on non-farm industries would make this figure even higher.

The California Water Plan Update. Vol. I and II. Confirmation of this stark economic prospect for agriculture can be found in the new water budget developed by the California Department of Water Resources. For the first time, this budget admits that total demand for water will outstrip supplies by the year 2020. The question becomes, how will the limited water supply be distributed among agricultural, urban and environmental interests?

According to DWR, agriculture's share of the total water supply will **decrease** over the next 30 years, while urban and environmental uses will increase. The calculations use 1990 as the base year, and include water from all sources (i.e., including groundwater and rivers in addition to water projects), The 1990 figures show that agriculture uses about 42 percent of the state's water supplies (rather than the 80 percent figure more commonly cited which represents agriculture's share of developed water supplies from the state and federal water projects only). Net urban demand is 11 percent,

environmental demand 44 percent and miscellaneous uses 3 percent.

By 2020 agriculture's share of the total state water supply will drop from 42 percent to 38 percent, while the urban share increases from 11 percent to 16 percent (an increase of 57 percent over 1990 levels). Environmental demand, measured for the first time by DWR in this report, will remain at 44 percent. This category includes existing in-stream flow requirements, wild and scenic river flows, Bay-Delta protection requirements, fishery requirements, and supplies for managed freshwater wetlands.

For agriculture, these numbers suggest a decline in agricultural water use of approximately 1.9 million acre-feet in an average year. Where will this decline come from? According to the report, the bulk of the decrease in agricultural water use will come from a permanent retirement of 400,000 acres of agricultural land (by 2020) on which new urban development will take place. Another 45,000 acres of land with drainage problems due to selenium problems is also expected to be retired.

Reviewer's Comments

The evidence from these two reports evokes a disturbing picture for agriculture in California's Great Central Valley. Do we really want a future in which one can drive the highway 99 corridor from Sacramento to Fresno without any sense of being in an agricultural region? What changes will be required so that the predictions from these reports do not become a self-fulfilling prophecy?

It is apparent that California agriculture faces a precipitous decline unless a new covenant is forged between urban and agricultural interests. From the urban community, we need a commitment to rational planning processes that permanently protect prime agricultural soils and take growth management seriously. From the agricultural community, we need a transition to agricultural practices that preserve environmental quality and are compatible with sites on the fringes of residential areas.

Sustainable agriculture can play a critical role in helping agriculture make these needed changes. By enabling farmers to reduce chemical use (and still remain profitable), it can dramatically reduce agriculture's contribution to non-point source water pollution. This in turn will increase the supply of clean water available for urban and environmental uses. By reducing or eliminating chemical applications, and by improving soil quality, it can reduce agriculture's contribution of dust and chemicals to particulate pollution. Furthermore, farms that use fewer chemicals will be considered better neighbors to urban areas. This can help expand political support for agriculture among urban residents. The emphasis in sustainable agriculture on direct marketing, farmers' markets, composting businesses and other direct economic ties between local farmers and their communities can enhance this support.

Ultimately, the future of agriculture in California's Central Valley will require a new vision of the integral relationship between agriculture and community life. Perhaps the greatest contribution of sustainable agriculture to California's future is its attempt, however imperfect, to offer alternatives to the status quo for family farms, rural communities, farmworkers, consumers and others

involved in our food system. Out of a new dialogue between urban and rural California lies the promise that agriculture may yet have a healthy future in this state.

Population Projections by Race/Ethnicity for California and its Counties 1990-2040, is available from the California Department of Finance, Demographic Research Unit, 915 L Street, 8th Floor, Sacramento, CA 95814. Tel. (916) 445-3878

The California Water Plan Update is available from the California Department of Water Resources, 1416 9th Street, Sacramento, CA 95814. Tel. (916) 653-1097.

(DCC.006)

Contributed by Dave Campbell

Fall 1994 (v6n4)

1993 national organic farmers' survey.

Organic Farming Research Foundation. 1994

In 1993 the Organic Farming Research Foundation (OFRF) mailed an eight-page survey to every certified organic farmer in the United States that belonged to any of the fifty-four organic verification organizations and chapters that would share their lists with OFRF. Five hundred fifty surveys (20%) were returned from growers in 39 states.

The survey was designed and conducted by Erica Walz and Bob Scowcroft of OFRF, in consultation with a survey advisory committee comprising Jill Auburn, Associate Director, UC SAREP; Brian Baker, Technical Program Coordinator, CCOF; Faustino Munoz, UC Cooperative Extension, San Diego County; and Harry MacCormack, former Research and Education Director, Oregon Tilth.

Survey Results

Information Resources. Approximately SS percent of organic farmers consult newsletters and magazines for information; the same proportion obtain information from other farmers. A smaller but still significant portion of the respondents (greater than 50%) get information from catalogs and books, by attending meetings, and consulting suppliers, buyers, and extension advisors. Substantially fewer organic farmers use electronic media (TV, video, radio, audio and computer), but those who do may use them quite frequently (e.g., 27 times per year for radio; 12 times per year for computers).

Organic farmers rate other farmers the most useful source of information, followed closely by newsletters, magazines, and all types of meetings. Electronic media are considerably less useful as rated by all farmers in the survey, but those who report using them rate them about as high as some other people that they consult (suppliers, buyers, and extension advisors). About one- third of the farmers surveyed said that they felt that existing sources of information generally met their information needs on organic farming; about sixty percent said they did not, and a small percentage did not reply.

Organic Farming Research. Nearly one-third of the farmers surveyed have participated in on-farm organic farming research projects. The farmers provide the land most of the time, and define the problem for study and provide labor for the research more than half the time. They frequently provide financial support and materials and equipment (40-45% of the time), but less commonly (10-20% of the time) publish or distribute the research results. Over 80 percent of the farmers said that they would be interested in participating in on-farm organic research projects if the resources were

available.

Organic farmers' high priorities for research span a wide range of topics including consumer demand for organic products, the relationship of growing practices to crop quality and nutrition, and the relationship between plant nutrition and resistance to pests. Other high-priority topics include crop rotation, soil biology, public policy, marketing, cover crops, green manures, and habitat management and other approaches to pest control. Figure 1 shows what organic farmers consider to be their worst pests.

Figure 1.

Organic farmers' worst pests by number of responses (farmers surveyed could list up to three).

(Not Available)

Commodities and Markets. Most of the farmers surveyed (over 60%) grow vegetables. Herbs, tree fruit, field crops, root crops, vine fruit, or flowers are each grown by at least one fourth of the farmers. Greenhouse crops, beef cattle, and eggs are each grown by 10-20 percent of the farmers. Livestock are most frequently used as a fertilizer source for use on the farm, and somewhat less often as a primary or secondary source of income. The median number of commodities grown is between 6 and 10, although more than 20 percent of the farmers grow over 25 commodities.

Nearly half the farmers sell direct on-farm and nearly half sell to wholesalers. Farmers' markets, restaurants, and retail stores are also popular outlets (about one-third sell to each). Over two-thirds of the farmers marketed 76-100 percent of their produce as organic in 1992.

Demographics. Organic farms are family farms: 84 percent of respondents are sole proprietors or family partnerships. Nearly half of them made 25 percent or less of their 1992 net family income from farming, but nearly one-fourth made 76-100 percent of their 1992 net family income from farming. The median gross income from the farm in 1992 was $15,000 to $30, 000, but about one-fifth of the farms grossed $100,000 or more.

The respondents have been farming, on average, sixteen years, ten of them organically, and they average 46 years old. Three-fourths are male. Over two-thirds have completed college, and one-fifth hold graduate degrees, in everything from anthropology to zoology.

Complete results of this survey are available for $5.00 from OFRF, P.O. Box 440, Santa Cruz, CA 9SO61. Tel. (408) 426-6606.

(JSA.L *07)*

Contributed by Jill Auburn
