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AGROECOLOGY
& SUSTAINABLE
FOOD SYSTEMS

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The CENTER for AGROECOLOGY & SUSTAINABLE FOOD SYSTEMS

FALL/WINTER 2004 | VOL. 22, NO. 2

USDA Grant Funds Research with Central Coast Organic Farmers

With organic agriculture poised to represent 10 to 20 percent of California cropland by 2024, the federal government has tapped UC Santa Cruz to lead a research program that will give organic farmers the same kind of boost the university has given conventional farmers for decades.

The U.S. Department of Agriculture has awarded UCSC's Environmental Studies Department a \$571,000 grant over four years to bolster scientific knowledge about organic systems and to strengthen the Central Coast network of organic farmers and agricultural researchers. Researchers and staff from the Center for Agroecology and Sustainable Food Systems (the Center) will play key roles in this effort.

In collaboration with farmers, agroecology researchers at UCSC have pioneered organic production methods for strawberries and other important regional crops. This project will build on those successes and prepare the organic industry for continued rapid growth by developing baseline nutrient management tools and addressing stubborn challenges, such as soil pathogens and pest management.

"Conventional farmers have decades worth of research to draw on, while organic growers have very little scientific data to rely on," said environmental studies professor Carol Shennan, the Center's director and one of four UCSC leaders of the project.

"Organic production is a complex system that integrates soil fertility, crop rotation, water management, and pest and disease control. It requires a systems approach, but agricultural research has historically tended to focus on narrow, single-issue problems."

GRANT BOLSTERS COORDINATED RESEARCH PROGRAM

The grant will fund a series of coordinated experiments at multiple locations in the Monterey Bay region designed to give farmers hands-on information. The results will be dispersed throughout the farming community with the help of organizations such as California Certified Organic Farmers, the Organic Farming Research Foundation, the Community

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Strawberry production is a focus of UCSC researchers and farmers who've teamed up on a USDA-funded study of organic farming systems.

“OUR JOB IS TO TAKE [THE FARMERS’] PROBLEMS AND DO THE RESEARCH THEY NEED TO SOLVE THOSE PROBLEMS,” SAID STEVE GLIESSMAN.

Alliance with Family Farmers, and the Agriculture and Land-Based Training Association. UCSC’s research team will be made up of Shennan, environmental studies professor Stephen Gliessman, research associate Joji Muramoto, and entomologist Sean Swezey, the Center for Agroecology and Sustainable Food System’s associate director.

“Over the years, we’ve done research that farmers want, and they’ve had a role in directing it,” said Gliessman, the Alfred E. Heller Professor of Agroecology. “Our job is to take their problems and do the research they need to solve those problems.”

Gliessman recalls the skepticism that greeted early collaborations. “When we started this work 17 years ago with Jim Cochran of Swanton Berry Farms, people said, ‘You’re crazy. You aren’t going to grow strawberries organically.’ Now, the USDA is saying, ‘This is important. It has to be done.’ It’s the farmers who took the risk.”

Cochran will be joined by other experienced, innovative organic growers who will participate in the study, including Daniel Schmida of Sandpiper Farms and Steve Pedersen of High Ground Organics. Landowner Robert Stephens has also set aside a portion of his acreage at Elkhorn Ranch for use in the study. In addition, research will be conducted on the 25-acre UCSC Farm. Representatives from UC Cooperative Extension offices in Santa Cruz, Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura Counties will participate, as well as a scientist from the USDA’s Agricultural Research Station in Salinas and an agricultural economist from UC Davis.

The grant will enable researchers to take ongoing studies to a new level and test the limits of monoculture farming, said Gliessman. “We want to redesign the system to better resist disease,” he said. “It may turn out to look very different from what we’re used to. You probably won’t see acre after acre of organic strawberries. You may see a patchwork of strawberries and other crops, because monoculture brings problems. We need to build on the strengths of diversity.”

STUDIES TO EXAMINE MULTIPLE ISSUES

By conducting replicated trials on organic farms, researchers will assess the effects of crop rotations and different fertility, disease, and pest management strategies on yields, soil quality, weeds, pests, and soil pathogens.

Experiments will focus on –

- Testing biological alternatives to methyl bromide to suppress *Verticillium dahliae*, a soil pathogen that poses the greatest threat for organic strawberry production in the

Finding practical ways to suppress soil-borne diseases, control pests, and manage nutrients efficiently in organic strawberry systems are major goals of the integrated research efforts.



Joji Muramoto

state. Anaerobic decomposition of cover crop residues and biofumigation with Brassicas will be evaluated. Given the upcoming ban on methyl bromide, such experiments may be of value to conventional farmers, as well.

This part of the study will include testing a technique pioneered in the Netherlands to control a number of soilborne diseases. Blocks of both a cover crop mix and mustard (*Brassica juncea*) will be incorporated into the soil, then covered with a tarp as the crops decompose. Following the tarping, researchers will measure levels of *V. dahliae* in the soil to assess this technique’s potential for disease suppression.

- Developing tools to help organic farmers monitor changes in soil nutrient levels, or “what goes in and what comes out,” as Shennan put it. Researchers will analyze the nutrient value of soil amendments, including cover crops, commercial composts, and fish emulsion fertilizer, and document what nutrients are removed when the crop is harvested. They will also develop plant tissue nitrogen tests so farmers can assess how well their fertility management is working, said Shennan. Building a database of their findings will give farmers a powerful resource to draw on that will supplement their own soil tests, she said.

This issue is especially timely on the Central Coast, where non-point source pollution of waterways is subject to intense public and regulatory scrutiny. Demonstrating organic practices that help minimize leaching and runoff will be important for the region’s growers. The fertility management work will build on several years of water monitoring data

“THE SCOPE OF THE PROJECT REFLECTS THE IMPORTANCE OF ORGANIC AGRICULTURE IN THE ECONOMY AND UCSC’S ROLE SUPPORTING ORGANIC FARMERS,” SAID CAROL SHENNAN.

collected by researchers from the Center for Agroecology and Sustainable Food Systems as part of the Central Coast project (see “Center scientist endorses nitrogen management efforts,” page 8 of this issue).

- Applicability of three models to simulate how management changes could impact crop harvests, soil nitrogen availability, and the movement of nutrients under a range of weather conditions and for different types of soils. If any model works well for predicting farming outcomes in this area, it could be used to help farmers make decisions about crop rotations, cover crop use, and management of fertility inputs, said Shennan.

- Use of organic pest control to combat pests that prey on strawberries. Vacuum devices and an alfalfa trap crop will be tested against the western tarnished plant bug (WTPB, *Lygus hesperus*), and researchers will evaluate the movement and effectiveness of beneficial insects introduced into or near the trap crop vegetation. Researchers will also assess the value of native-plant hedgerows in attracting beneficial insects that prey on crop predators.

This work will expand on research efforts showing that alfalfa can be an effective trap crop for WTPB and can be managed to reduce energy use associated with crop vacuuming, as well as enhance populations of beneficial insects. For results from an earlier phase of this study, see “Trap crops show potential to reduce pest damage, save time and energy in organic strawberry production,” *The Cultivar*, Vol. 22 No. 1, Spring/Summer 2004.

Results from the various studies will be passed on to growers via a combination of meetings, trainings, field days, listening sessions, focus groups, and other exchange opportunities designed to promote feedback between researchers and growers.

ORGANIC AG GROWING ON CENTRAL COAST

The scope of the project reflects the importance of organic agriculture in the economy and UCSC’s role supporting organic farmers, said Shennan. The Central Coast is well-known for its high concentration of organic farms, and many



Jennifer McNulty

UCSC researchers, from left, Sean Swezey, Stephen Gliessman, Joji Muramoto, and Carol Shennan are collaborating with organic farmers, including Jim Cochran of Swanton Berry Farms.

producers have benefited from partnerships with UCSC researchers and UC Cooperative Extension specialists.

In Santa Cruz and Monterey Counties, more than \$140 million, or 6 percent, of the region’s \$2 billion vegetable production in 2001 was certified organic, according to Shennan, and the two counties generated more than \$400 million gross value in strawberries. The California organic agriculture industry has grown quickly, producing sales of \$340 million in 2003, according to the California Department of Agriculture Organic Program. The state produces nearly half of the total organic vegetables certified in the United States; strawberries are the most lucrative organic commodity in the state on a per acre basis, valued at \$17.5 million.

“Organic farmers face the same production challenges as conventional growers, but the research community has overlooked their needs,” said Shennan. “With one of the oldest university-based organic research and training programs in the world and one of the pioneering academic programs in agroecology, UCSC is in a good position to help fill in the gaps of scientific knowledge.”

– JENNIFER MCNULTY

from the director



Our fall/winter issue crept into your mailbox behind schedule in part because we've been busy with an array of projects that have been keeping the Center staff on the run.

One of those projects is the culmination of a two-year effort to create a follow-up to the popular organic farming and gardening training manual that we produced in January 2003. Our new training resource, *Teaching Direct Marketing and Small Farm Viability: Resources for Instructors* offers lecture outlines, student exercises, and other resources to help teach the skills growers need to make their farm or market garden operation economically viable (page 7).

Patricia Allen, the Center's social issues specialist and associate director, also completed a major project this fall. Her new book, *Together at the Table: Sustainability and Sustainance in the American Agrifood System*, documents the significant changes brought about by the sustainable agriculture and food systems movement, while cautioning that much more needs to be done in order to create a truly sustainable food system (page 9).

We've also produced a new title in the Center's *Research Briefs* series, summarizing a study of Central Coast consumers' interest in various food system issues. Center researchers Phil Howard and Jan Perez discovered some interesting trends in focus groups and through a mail survey as consumers had a chance to offer feedback on food system issues that concern them, and to rate some of the environmental and ethical criteria they would support through their shopping choices (page 5).

On another food-related note, our community support group, the Friends of the UCSC Farm & Garden, produced its third cookbook project in late fall. The new cookbook, *Fresh from the Farm & Garden: Seasonal Recipes for Busy Cooks*, was spearheaded by a member of our Community Supported Agriculture (CSA) program who assembled over 100 pages of recipes, crop information, and cooking tips for making the most of fresh produce from your favorite source, be it a CSA farm, the farmers' market, your own garden, or the local produce store (page 12).

Our research efforts received a major boost this fall in the form of a USDA grant that will help support a variety of projects with growers on the Central Coast. Agroecology researcher Joji Muramoto put together this successful competitive grant effort described in this issue's cover article.

This issue also hints at the bounty of summer to come with an article by Alan Chadwick Garden manager Orin Martin on choosing and growing peaches, nectarines, and

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The Center for Agroecology & Sustainable Food Systems is located at the University of California, Santa Cruz. Through our research and educational efforts we seek to increase understanding of the social, economic, political, and ethical foundations of agricultural sustainability; to establish the ecological and agronomic basis for sustainable production systems; and to demonstrate and facilitate the use of information critical to the adoption of these systems.

The Cultivar is published twice yearly. Current and back issues are available. Editor: Martha Brown.

On the UCSC campus, the Center manages the 25-acre Farm and 2-acre Alan Chadwick Garden, both open daily to the public. For more information about the Center and its activities, please contact us at:

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other stone fruit in the backyard or small-scale orchard (see page 13). Enjoy!

– DR. CAROL SHENNAN

Center Survey Finds Consumers Want to Know More About Their Food, Favor Eco-labeling System

Most consumers feel that they don't know enough about how their food is grown and processed, how it reaches them, or what's involved in food marketing. They'd like to see a system of eco-labels that would provide information on such criteria as whether the workers receive a living wage, whether the animals were treated humanely, and whether the food was locally grown.

These are some of the conclusions of a study by social issues researchers Phil Howard and Jan Perez of the Center for Agroecology and Sustainable Food Systems. The study asked consumers what aspects of food production, processing, transportation, and retailing they were most interested in knowing more about, and how they wanted to get that information.

"Our goal was to give consumers a voice they might not have, and the first step was to find out what they want to know," said Howard, a second-year postdoctoral researcher. "Food retailers, processors, and growers should all start looking closely at these issues because people are interested in supporting them through their purchases."

In 2004 Howard and Perez conducted five focus groups and mailed a 26-question survey to 1,000 randomly selected households in San Mateo, Santa Clara, Santa Cruz, San Benito, and Monterey Counties; the survey response rate was 48 percent.¹ The study was funded by a U.S. Department of Agriculture (USDA) grant to foster sustainable agriculture on the Central Coast as part of the Center's Central Coast Research Project.

FOOD SYSTEM INTERESTS IDENTIFIED

Eight food system-related topics were identified as themes that interested the focus groups; these topics were then presented in the written survey. Not surprisingly, the scores indicated that survey respondents were most interested in safety and nutrition; nearly all respondents ranked these topics near the top of a scale from 1 to 10 (Table 1). A number of surveys have consistently shown these to be important concerns, even for those with few other food-related interests.^{2,3} One focus group participant highlighted this fact when stating, "Who knows what the heck is in half the stuff we buy, I mean I don't ... Frankly, I don't care as long as it doesn't get me sick."

This was a minority view, however, as most focus group participants also had a number of concerns beyond their personal health. The survey results supported this broader concern. Treatment of animals involved in food production,



Jon Kersey

Consumers are particularly interested in food safety and nutrition, according to focus groups conducted as part of the study.

environmental impacts, and working conditions all received an average score of greater than 7.

In the focus groups, the treatment of animals elicited the most emotion. Several participants had toured slaughterhouses and said this experience had a lasting effect on them. Others had changed their consumption habits after learning of the way some animals are treated, such as veal calves. For some people the interest in animal welfare may also overlap with personal health concerns. For example, a focus group participant discussing the inhumane aspects of confinement animal production asked, "then are you eating growth hormone and ... or whatever you're putting in them, and what does that do? I mean, in the long run you know, what's that doing to you?"

On the issue of environmental impacts, focus group participants most frequently expressed concerns related to

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Table 1. Level of interest in food system-related topic. Score of 10 equals great amount of interest, 1 equals none at all.

	Mean	Standard Deviation
Safety	9.4	1.4
Nutrition	8.9	1.7
Treatment of animals	7.4	2.7
Environmental impacts	7.3	2.4
Working conditions	7.2	2.6
Wages	6.7	2.7
Influence of large corporations	6.6	2.9
How far food travels	5.8	3.1

pesticides and genetic engineering. Some participants were also concerned about irradiation and the impacts of food packaging or food waste. Several participants noted that environmental impacts were much more important to them when compared to other concerns about the food system.

On the topic of working conditions and wages, focus group participants were interested in the treatment of farm workers, such as the backbreaking labor performed for very low pay, and the exploitation of migrant workers. Workers involved in other aspects of the food system, such as processing or retail, were not discussed as frequently. When asked specifically to list criteria they would like to see improved for workers involved in the food system, focus group participants mentioned higher wages, protection from pesticide exposure, health care, education, adequate food, limited working hours, and adequate housing.

The influence of large corporations had an average score of 6.6. This theme emerged in all of the focus groups, though it was much more strongly held by some individuals. One participant said, “The huge conglomerates that are controlling agriculture really, really bother me,” and others named specific multinational food processors and chemical companies whose motives they distrusted. Some participants blamed these corporations for the low prices that farmers receive for their products and the loss of family farms.

How far food travels was the lowest-ranked topic on the survey, with a score of 5.8. Focus group participants had various reasons for their interest in this topic, involving economic, food safety, or environmental concerns. Most focus group participants wanted to know the country of origin of their food. “I guess I’d like to know [where fruits and vegetables are from] because I’d like to know are we producing our food or are we actually reaching out into other countries?” said one participant. Some participants wanted to support the U.S. economy, while others went further and expressed interest in supporting their local economies. Another stated reason for wanting this information was concern about the safety of imported food, such as the presence of pesticides banned in the U.S. or contamination with microbial diseases. Finally, some participants wanted to know how much fossil fuel was consumed in transporting their food.

Of 60 survey respondents who identified additional topics in a write-in section, 22% had reservations about genetically engineered food, and 15% wanted more information on pesticides. Other interests identified by more than one respondent were freshness, where food was grown, and the fate of food waste.

RANKING INFORMATION SOURCES AND PRODUCTION STANDARDS

Howard and Perez also wanted to know the formats that people would choose to obtain more information about their food, and asked members of the focus groups which ones they preferred. More than 80 percent of survey respondents endorsed the idea of food labels as a source of the information they’re seeking, said Howard. Citing the growing popularity of seals or logos that signify food meets certain

standards, such as the USDA’s “organic” food label, survey respondents were asked to rank five potential “eco-labels,” defined as follows –

- Humane**—meat, dairy products, or eggs from animals that haven’t been treated cruelly
- Locally grown**—grown within 50 miles of point of purchase
- Living wage**—provides above-poverty wages to workers involved in producing the food
- U. S. grown**—grown in the United States
- Small-scale**—supports small farms or businesses

The researchers asked respondents to imagine a product that was identical except for two of the five standards, and to choose the one that they preferred (e.g., locally grown OR humane). All possible combinations were presented in a series of pairs. The result was a ranking of all five standards for each respondent. The researchers learned from pre-testing the survey that these decisions were very difficult for most people. Many respondents said they would prefer food that represented all of these standards.

Respondents were most enthusiastic about the idea of a “humane” label, with more than 30 percent citing it as their first choice, followed by locally grown (22 percent), living wage (16.5 percent), U.S. grown (5.9 percent), and small-scale (5.2 percent).

The researchers also noted correlations between certain consumer characteristics and their ranking of standards. For instance, women, younger people, and people that frequently purchase organic products were all more likely to rank the “humane” criteria highest. Older people and households with children tended to rank “local” as their most preferred standard. And higher-income households and Hispanic households ranked “living wage” first in their list of criteria.

SUPPORT TO GUARANTEE LIVING WAGE

In a separate question, consumers showed a strong willingness to pay a “price premium” for strawberries that would guarantee a living wage and safe working conditions for farm workers. Eighty-four percent of respondents said they were willing to pay a 5 cent—or 3 percent—price premium on a \$1.50 pint of strawberries for the assurance the standards were being met. The median price premium people were willing to pay was \$1.06 per pint, or 71 percent above the regular price. Given that strawberry pickers typically earn 10.5 to 12.5 cents per pint, a 5-cent-per-pint price premium could fund a 40 percent increase in piece rate pay, said Howard.

“People being surveyed tend to express a greater willingness to pay than they actually support in the marketplace, but these results show the potential level of support for a price premium,” said Howard.

IMPLICATIONS FOR PRODUCERS, MARKETERS

The survey results indicate that growers, processors, and retailers could do a better job of providing their customers with information on the way that food is produced,

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New Teaching Guide on Direct Marketing and Small Farm Viability Skills

For farmers, growing food is just the first step—making the farm or market garden an economic success requires another suite of skills, including finding land, planning what crops to grow, marketing the crops, and managing income and expenses.

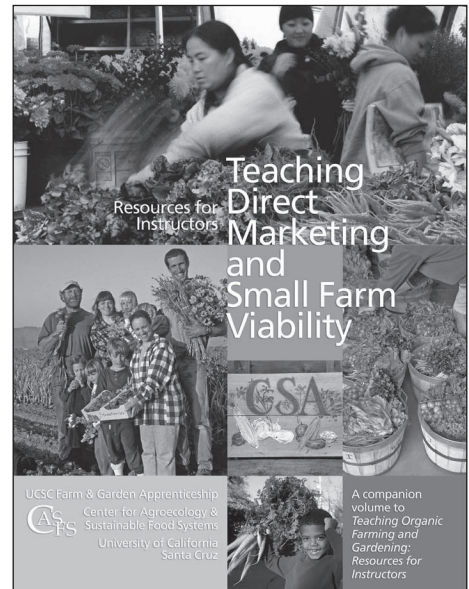
Geared toward a broad audience of agricultural educators, *Teaching Direct Marketing and Small Farm Viability: Resources for Instructors* covers a variety of topics with the goal of improving the skills it takes to make a small farming operation economically viable, and to give students a background in such topics as business planning and land tenure options. The training manual is designed for –

- Post-secondary instructors at the community, state college, and university levels
 - Agricultural Extension personnel
 - Apprenticeship programs and other farm-training programs
 - Farmers with interns
 - Urban farms, community gardens, and food projects with direct-marketing outlets

This instructor's resource features class and field demonstration outlines, trainee exercises, and resource materials, with a focus on Community Supported Agriculture. It can be used in a classroom setting or adapted for other training formats, such as short courses, conferences, and field days.

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Collaborators on the new training manual included Center staff and experts in business planning, produce marketing, direct marketing techniques, and land tenure issues.

Teaching Direct Marketing and Small Farm Viability: Resources for Instructors is designed to be placed in a 1-inch, 3-ring binder so that sections can be easily removed and copied for class use. It is available from the Center for Agroecology and Sustainable Food Systems for \$25.00 (tax and binder included), plus \$4.00 for shipping within the U.S. Please contact TrainingManual@ucsc.edu to inquire about overseas shipping costs.

To order, send a check made payable to **UC Regents** to: CASFS, 1156 High St., Santa Cruz, CA 95064, attn: Direct Marketing Manual. Please be sure to include your mailing address, or copy and fill out the form below to send with your check. If you have questions about the resource guide, or questions about ordering, please send email to TrainingManual@ucsc.edu.

Teaching Direct Marketing and Small Farm Viability: Resources for Instructors is also available for free download in PDF format from the Center's web site (www.ucsc.edu/casfs). The CASFS web site makes many of our publications available online, including our first training manual, the 600-page *Teaching Organic Farming and Gardening: Resources for Instructors*.

Funding for development of this publication was provided by the True North Foundation, the Foundation for Sustainability and Innovation, and the Organic Farming Research Foundation.

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Center Scientist Endorses Nitrogen Management Efforts

As a soil scientist with the Center for Agroecology and Sustainable Food Systems (the Center), Marc Los Huertos helps farmers on the Central Coast manage nitrogen levels to maximize harvests and minimize pollution.

Los Huertos is also part of a growing global effort to address the problem of farm-generated nitrogen pollution. Just back from the Third International Nitrogen Conference in Nanjing, China, Los Huertos has a sobering message for farmers: “China is ramping up agricultural production, and strong international environmental regulations could be what saves U.S. farming from a formidable competitor,” said Los Huertos, who manages the Center’s research program on water quality monitoring in a number of Central Coast watersheds.

“I saw hundreds of miles of greenhouses,” Los Huertos said of a three-week tour of the Chinese countryside that followed the Nanjing conference. “If they can figure out how to get their produce here fast enough, the Chinese could outcompete U.S. farmers in no time at all.”

Convinced that U.S. farmers have a huge stake in regulations that would force global competitors to clean up their act, too, Los Huertos is eager to increase public understanding of agriculture-related nitrogen pollution.

“My job is to prepare farmers for policies that might affect them, whether at the state, federal, or international level, so I went to China to get a sense of the international movement,” said Los Huertos.

HIGH NITROGEN LEVELS PRODUCE MULTIPLE IMPACTS

Nitrogen accumulation reduces biodiversity, acidifies soil and water, degrades coastal environments, reduces forest productivity, contributes to the greenhouse effect, and depletes the ozone. “Reactive nitrogen is so high in the developed world that we’re polluting ourselves out of clean air, drinking water, and biodiversity,” he said.

Although essential to life, nitrogen must be converted from a gas to a reactive form to be usable by most organisms, including plants. The accumulation of reactive nitrogen in the environment is largely a result of the conversion of enormous quantities of nitrogen into fertilizers that are used in the production of food and fiber. Reactive nitrogen is also a by-product of fossil fuel combustion for transportation and energy production.

A significant portion of nitrogen in fertilizer is never taken up by plants and instead runs off, contributing to the “cascade” of atmospheric and aquatic nitrogen accumulating

in many regions of the world—even as most of Africa and parts of South America and Asia suffer from a deficiency of reactive nitrogen in the soil.

In Nanjing, about 800 conference participants approved the “Nanjing Declaration on Nitrogen Management,” which urges the United Nations Environment Program to promote understanding of the nitrogen cycle, assess consequences of its disturbance, provide policy advice and early-warning information, and promote international cooperation.

With Center director Carol Shennan and researchers Claire Phillips and Alex Fields, Los Huertos monitors nitrogen in several important waterways along the Central Coast, including the Pajaro River and around the Elkhorn Slough, one of the largest remaining tidal wetlands in California. Nitrogen levels in Central Coast agricultural watersheds have steadily increased since the 1950s, when levels of <1 ppm were typical, according to state records compiled by Los Huertos. Today, Los Huertos regularly documents levels of 10 ppm in May and 20 ppm in the fall in the Pajaro River. Drinking water standards allow for a maximum of 10 ppm.

Unlike some coastal areas where fertilizer runoff has wiped out marine life, Monterey Bay circulates the ocean water and flushes nutrients through the ecosystem. This mixing and upwelling make it difficult for scientists to assess how nitrogen runoff affects the bay, but it certainly has a role in the freshwater streams, according to Los Huertos.

“We know we have excess nitrogen on the Central Coast, and farmers and the state and federal government are struggling with finding ways to control polluted runoff,” said Los Huertos.

In other coastal areas, runoff from nitrate-based fertilizers has had devastating consequences. In the Gulf of Mexico, a 5,000-square-mile area from the mouth of the Mississippi River almost to the Texas border is overrun with nitrates each summer, triggering an algae bloom that severely reduces oxygen levels until late September.

NEW PROGRAMS TO ADDRESS NITROGEN RUNOFF

Researchers, including Los Huertos, have been working with government regulators to address the problem. The debate centers on whether to take a “carrot or stick” approach, observed Los Huertos.

California is considering a permit-like approach that would encourage farmers to take “short courses” to learn about nitrogen pollution, to adopt a water-quality protection plan, or to monitor their farm’s discharge—or pay someone else to monitor it.

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New Book Examines Progress and Pitfalls in Developing a Sustainable Food System

Factory farm pollution, mad cow disease, pesticide contamination, trade wars, the obesity crisis—it often seems like the only news coming out of the U.S. food system is bad news.

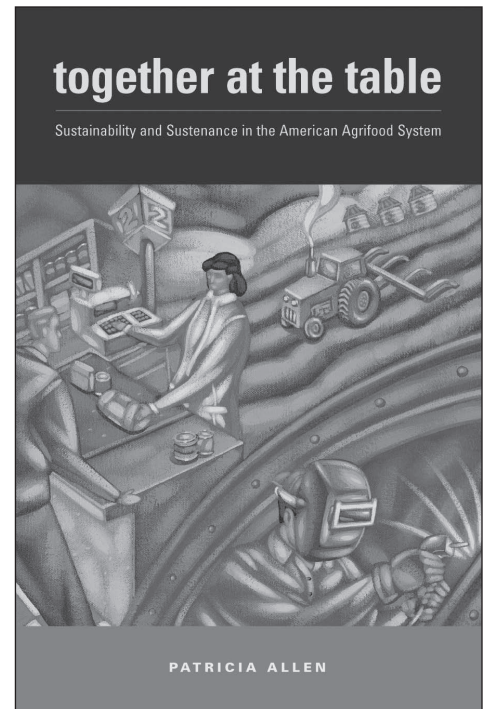
Patricia Allen begs to differ. Her new book, *Together at the Table: Sustainability and Sustenance in the American Agrifood System*, argues that “People have been working for years to solve environmental and social problems in the food system, and consumers have many more choices as a result of those efforts. From the fields to the table, our food production and delivery system is being transformed.”

Allen, who directs the social science research program for the Center for Agroecology and Sustainable Food Systems, wrote the book in part to document the incredible progress in the sustainable food system movement. “It’s pretty impressive when you put it all together,” she said. Among the highlights she points to are –

- the growth of organic farming
- the popularity of farmers’ markets
- the increase in community supported agriculture (CSA), in which consumers invest in a farm for a share of its bounty
- the vitality of urban agriculture and community garden programs
- the proliferation of university research programs focused on sustainable food systems
- the introduction of farm-to-school programs that supply schools with fresh fruits and vegetables

As “alternative food movements” have gained momentum, they have helped transform institutions from the U.S. Department of Agriculture to the University of California, argues Allen. She notes that, “Universities across the country have sustainable agriculture programs, and the USDA has programs that were unheard of 20 years ago.”

In her book, Allen examines the shortcomings of the current conventional agriculture system, and the ways that alternative agrifood movements are addressing problems such as environmental degradation and lack of food security. She analyzes the interactions of alternative movements with mainstream institutions such as the USDA and land-grant agricultural research system, describing the way their research agendas and methods are beginning to change. She addresses the importance of building broad-based alliances for developing alternative agrifood systems, and some of the emerging connections between groups working for environmental change and those concerned with social issues.



Allen also documents some of the problems with the current efforts to reform the conventional agricultural system. She points out the way that, in an effort to avoid controversy or upset the status quo, alternative ideals such as social justice may be watered down or slighted within traditional institutions such as academia or extension programs. Allen warns that some of the problems of the dominant agrifood system are being repeated within the movement toward a more environmentally sound and socially just system, and suggests ways to avoid such repetition. She also critiques the drive toward food-system localization as a strategy for the sustainable agrifood system movement, noting for instance the enormous differences in wealth and resources from one community to another.

Allen is particularly concerned by what she sees as two major problems in the movement to develop a more sustainable agriculture and food system: the lack of a coherent vision, and the paucity of attention being paid to social justice issues.

Although “socially just” is now included in most definitions of sustainable agriculture, along with “environmentally sound” and “economically viable,” Allen believes such issues as living wages, gender inequities, and land tenure are still receiving short shrift. Until such issues are seriously addressed, she argues, a truly sustainable agriculture will continue to elude us.

Lack of a coherent message is also a handicap. “One of the major things I try to do in this book is to focus on the way people are thinking about and portraying issues in the sustainable agrifood movement. When you have a social movement that doesn’t have a lot of access to traditional power or resources, your main tool is your ability to frame an issue and convince people of its importance. I feel like the

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sustainable food movement has not yet done a good enough job of that,” said Allen.

Within the movement itself, people are doing all kinds of activities—from running community gardens, promoting locally grown foods, and supporting family farmers, to creating food security councils. According to Allen, “Most people working in these areas recognize that they’re working on a small part of a much bigger issue. For the movement to become strong and vigorous, there needs to be a coherent, well-articulated platform that bring people together, even though they’re doing different projects. They need to be meeting the needs of a wide range of people so that people can feel that this movement is for and about them.”

Allen addresses this point in the book’s closing chapter, “Working Toward Sustainability and Sustainance,” where she writes –

“An articulated vision of a sustainable and food secure society would help engage and unite diverse constituents for an alternative agrifood movement. This is crucial because one of the fundamental requirements of a social movement is a problem statement and a way of expressing that problem—a clear discourse.”

With a clear message in place, Allen sees the potential for the alternative agrifood movement to catalyze even larger movements for social and environmental justice—movements in which everyone can play a role.

“Participation in the movements need not mean becoming a full-time activist, researcher, or producer. People can participate effectively as consumers by changing their own perceptions and practices . . . Participation in everyday forms of resistance, like choosing foods grown without pesticides, may seem small in comparison to the enormity of the problem, but they can have significant effects.”

Together at the Table is part celebration, part cautionary tale, and in the end, a call to action for people working in the alternative agrifood arena to come together and create a democratic social movement with a well-articulated message. “At this point,” writes Allen, “the contemporary American food and agriculture system sustains neither humans nor the environment. Agricultural policy and administrative agencies in their current forms are unlikely to develop effective solutions to problems of poverty, poor health, and environmental degradation.” The alternative agrifood movement has made great strides toward addressing these problems, but must go further to create a truly sustainable system.

Together at the Table is geared toward those teaching about agriculture and food system issues, as well as policy makers, activists, and others interested in the transformation of the U.S. agriculture and food system. The 260-page, hardback book is available for \$45.00 from Penn State University Press (www.psupress.org), Amazon (www.amazon.com), and other on-line booksellers. Review copies for course adoption can be ordered at a discount; see www.psupress.org/ordering/order_exams.html for information on ordering examination copies.

– MARTHA BROWN, JENNIFER McNULTY

Research

Updates

Impact of Aphids on Organic Broccoli Production Examined

The cabbage aphid (*Brevicoryne brassicae*) is the primary pest of broccoli in Monterey County. Aphids’ ability to contaminate a broccoli head has sometimes led to zero-tolerance spray thresholds in conventional broccoli production (meaning that growers will spray at the first sign of an aphid infestation on a developing broccoli head), thereby causing ecological harm.

Minimizing or eliminating sprays for aphids requires knowing more about how they affect broccoli production, and how alternative controls such as natural enemies can affect aphid populations. Diego Nieto, a researcher with the Center, spent two field seasons examining aphid dynamics in an organic broccoli system to determine the way that factors such as the time of the cropping season when aphids arrived, the location of the aphid colony on the plant, and the abundance of natural enemies influenced the broccoli harvest. The study is part of Nieto’s masters’ degree research at San Jose State University.

Nieto found that cabbage aphids predominantly colonized the outer leaves of a broccoli plant. These colonies, however, did not significantly influence broccoli harvest. In each of the study’s two field seasons, only aphids located at the center of the plant were correlated with head infestation, making the head unmarketable. Aphid arrival time into a field was strongly correlated with eventual harvest, with early arriving aphids being less likely to infest a head. This was in part due to higher numbers of natural enemies, particularly the larvae of syrphid wasps (Syrphidae), which developed in response to the presence of aphids early in the season.

Because natural enemies such as the syrphid wasp were able to control aphids arriving early in the season and had a positive effect on the harvest, Nieto recommends that future research on alternative controls for aphids focus on management practices that encourage the early establishment of natural enemies. Such practices might include the use of non-crop vegetation, such as insectary plantings, which might provide natural enemies with a secondary aphid species as a food source before cabbage aphids are established in a broccoli field. Alternately, the pollen and nectar resources provided by such micro-habitats might also attract beneficial insects before a crop has become colonized by aphids.

Nieto also notes that it would be advantageous to integrate spray policies in conventionally managed systems that

recognize aphid location on the plant as an important contributor to broccoli harvest, rather than utilizing a presence-absence or zero-tolerance threshold once heading has begun.

Nieto's advisors for the research include Jeffrey Honda and Shannon Bros of San Jose State's Department of Biological Sciences, Bill Settle of the United Nation's Food and Agriculture Organization, Center director Carol Shennan, and Rachel O'Malley of San Jose State's Environmental Studies Department.

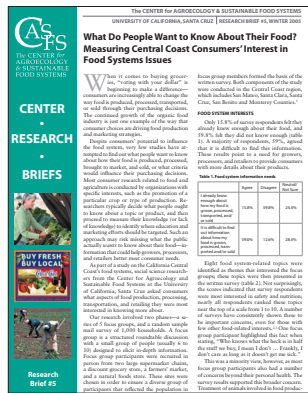
New Research Brief Summarizes Study of Consumer Interest in Food System Issues

The latest title in the Center's Research Brief series summarizes a study of consumers' interests in and concerns about how their food is produced, processed, transported, and distributed (see related article, page 5). Research Brief #5, *What Do People Want to Know About Their Food? Measuring Central Coast Consumers' Interest in Food Systems Issues*, is based on focus groups and a written survey mailed to 1,000 consumers in Monterey, San Benito, San Mateo, Santa Clara, and Santa Cruz counties.

Written by post-doctoral researcher Phil Howard, the research brief summarizes findings on such topics as whether consumers feel they have adequate information about their food, how they'd like to get that information, and what social or ecological criteria are most important to them when making purchasing decisions. Research Brief #5 is available free from the Center or can be downloaded as a PDF from the Center's web site (www.ucsc.edu/casfs). To request a copy, call 831.459-3240 or send email to jonitann@ucsc.edu.

Blueberry Variety Trial Shows Early Promise

A blueberry variety trial initiated last winter at the UCSC Farm is well on its way to producing a bumper crop. According to farm manager Jim Leap, "All the plant varieties are doing really well so far—people who know about blueberries and have seen the trial have said the plants look great." Leap is working with Aziz Baameur, Small Farm Program Advisor for Santa Clara County's UC Cooperative Extension (UCCE) office, and Mark Bolda, UCCE's central coast Strawberry and Caneberry Advisor on this trial comparing 17 varieties of highbush blueberries grown with organic management practices.



Blueberries are traditionally grown in colder climates, where the plants become dormant in winter. Finding varieties that perform well under Central Coast conditions is one of the trial's main goals. So far, it's brought some surprises. "The varieties with the highest chill requirements [northern highbush varieties requiring a relatively long period of cold temperatures to produce fruit] are dormant this winter, while those with low chill requirements [southern highbush varieties] never entered dormancy and are wanting to make fruit year round," said Leap. "I was expecting just the opposite to happen."

In order to create the acidic conditions that blueberries prefer, Leap added the per-acre equivalent of two tons of sulfur along with redwood mulch to the trial site's soil prior to planting last January. A mix of peat moss and raspberry pomace was placed in the planting holes for additional acidity, and the plants were mulched with more redwood chips to a depth of over three inches.

These efforts increased the soil's acidity from its original pH of 5.9 to its current level of 5.1. In addition, organic matter levels rose from 2.5 to 3.5, and the CEC [a measure of nutrient availability] increased from 8 to 11. "We've created a nice environment," said Leap, who also noted that "it's a lot of work." Still, the rewards can be high—a successful blueberry crop can generate \$30,000 to \$50,000 per acre, making it a potentially lucrative cash crop for small-scale organic producers.

Leap anticipates the first harvest this summer, one and a half years after the plants were put in. He would encourage growers to wait longer before their first commercial harvest—at least two and a half years—but acknowledged that the research team is anxious to evaluate the fruit quality of the different varieties. "We're also planning a field day at the site for growers sometime this coming summer," said Leap. If you're interested in attending a field day, contact Aziz Baameur at azbaameur@ucdavis.edu, or 408.282-3127 to be informed about upcoming programs.

USDA-Funded Symphylan Study Continues

The centipede-like garden symphylan (GS) presents a vexing challenge for organic and conventional growers alike. Measuring less than a 1/4-long, these mobile soil dwellers feed on the roots of developing plants, weakening or killing stands of both seedlings and developed crops, and potentially increasing their susceptibility to soilborne diseases. Conventional growers currently rely on organophosphate (OP) insecticides to control GS populations. However, the EPA is considering removing OPs from use due to their impacts on human health and the environment.

Because garden symphyllans also feed on decomposing organic material, they often flourish in well-managed soils with high levels of organic matter. Although there is no approved material for organic control, anecdotal evidence has demonstrated that symphylan populations are suppressed

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in areas where potatoes are grown. This observation holds promise for using potatoes in crop rotations to limit symphytan damage, and in isolating the potato compound that affects symphytans.

Based on this observation, a field study is currently underway to test the suppressive effects of potatoes in controlled, replicated trials at the Center's organically managed UC Santa Cruz farm and at four other sites (2 organic and 2 conventional) in California and Oregon. The work is part of a study coordinated by Jon Umble of Oregon State University and funded by a grant from the USDA's Western Sustainable Agriculture Research and Education Program.

Umble and UCSC Farm manager Jim Leap established three replicates of three treatments: potatoes only, potatoes intercropped with corn (which is known to be a good host for symphytans), and corn only. Similar plots were established at the four other study sites in order to examine potato's effect on GS in different soil and climate conditions.

As predicted, GS population levels correlated directly with the cropping system: they were highest in the corn crop, lowest in the potato crop, and intermediate in the corn/potato intercrop. According to Umble, these results provide strong evidence that GS populations do decrease in potatoes, and that this effect is fairly consistent over variable conditions.

This spring, Leap will incorporate the winter cover crop planted on the study site and then directly sow broccoli, known to be an excellent host for symphytans. According to Leap, the broccoli will serve as an "indicator crop"—weakened or dying plants will indicate plots where GS populations are highest, while healthy stands will likely correlate with low GS numbers. The researchers will also sample for symphytans to confirm these indications.

Ongoing work on the trial includes lab tests to determine which compounds in potatoes affect symphytans, and when the observed decrease in GS numbers occurs during an 8-week study period. Umble hopes that results from these studies will give insights into the mechanisms of the effects being observed in the field, and eventually offer growers an option for preventing GS damage.

ES Student Wins American Society of Agronomy Award

Jodi Winemiller, an undergraduate student in UCSC's Environmental Studies Department, received the California Chapter of the American Society of Agronomy's 2004–2005 scholarship. The \$1,000 scholarship will support Winemiller's senior thesis research.

Winemiller is evaluating two methods to estimate rates of biological nitrogen fixation in winter legume cover crops grown in the Central Coast region. Developing more precise estimates of nitrogen fixation is critical to generating nitrogen budgets that can be used to find out if a farmer is adding too much or too little nitrogen during a crop rotation cycle. In this way farmers can avoid adding excessive amounts of nitrogen that could be lost to the environment (see related article, page 9).

Center Notes

Friends' New Cookbook Features Seasonal Recipes



Fresh from the Farm & Garden: Seasonal Recipes for Busy Cooks is the Friends of the Farm & Garden's latest venture in cookbook publishing. This third cookbook project undertaken by the Friends includes more than 100 pages of easy-to-make recipes

featuring fresh produce, as well as crop information and cooking tips. Beautifully illustrated by Dov Bock, the cookbook is available for \$20.00 (includes shipping and handling). Proceeds support the public education and scholarship work of the Friends of the UCSC Farm & Garden, the community support group of the Center for Agroecology and Sustainable Food Systems.

To order your copy of the cookbook, send a check for \$20.00 made payable to UC Regents to: Friends of the Farm & Garden, 1156 High St., Santa Cruz, CA 95064, attn: Cookbook. For more information, contact 831.459-3240 or jonitann@ucsc.edu.

New Book Examines Organic Agriculture in California

A new book by Center faculty affiliate Julie Guthman of UCSC's Community Studies Department questions some of the assumptions about organic agriculture as it examines the industry's growth in California. "Organic farming is seen as an answer to the crisis in our food system, but organic agriculture in California has evolved in some peculiar ways that effectively limit the number of acres that are in organic cultivation," said Guthman, author of *Agrarian Dreams: The Paradox of Organic Farming in California* (Berkeley: University of California Press, 2004).

A strong proponent of many of the ideals associated with organic agriculture, Guthman nevertheless believes the fastest-growing segment of farming today warrants scrutiny. Many experts expect as much as twenty percent of California cropland will be in organic production by 2024.

Among her findings, Guthman paints an unromantic picture of agriculture in California. “Historically, small-scale family farms have never been the norm in California,” she said. The state’s agrarian tradition has been shaped by land values that reflect and support a form of high-intensity, specialty-crop, year-round farming unlike anything else in the United States, said Guthman, who describes it as a “treadmill running on overdrive.”

“Land values in California correlate to the value of crops that are grown and the intensification of farming practices, so farmers are under incredible pressure to get more crop value per acre,” said Guthman. “Because organic adds value, it has the potential to further inflate land costs, which ironically undermines the goal of growing in less-intensive ways.”

Guthman’s prescription for addressing the shortcomings of the current organic agriculture system starts with “revisiting the roads less traveled,” including banning pesticides, creating government subsidies for sustainable farming, eliminating subsidies for conventional agriculture, and revising immigration policies to support farmworkers.

Center’s First Training Manual Lauded

Published in January 2003, the Center’s first training manual, *Teaching Organic Farming and Gardening: Resources for Instructors* continues to attract widespread interest and positive feedback. Now used worldwide, this 600-page resource covers organic farming and gardening skills and concepts, applied soil science for growers, and social and environmental issues in agriculture.

A review by Charles Francis, Professor of Agronomy at the University of Nebraska, appeared in the December 2004 issue of the North American Colleges and Teachers of Agriculture Journal (Vol. 48, No. 4). In his review, Francis wrote –

“We have found *Teaching Organic Farming and Gardening: Resources for Instructors* to be an exceptional resource that is practical and well organized. When we initiated a course in organic farming and gardening in our university the two key resources we provided to students were the web sites for this manual and for ATTRA [Appropriate Technology Transfer for Rural Areas] . . . I urge anyone who is considering offering organic farming as a formal course or a practical training activity to visit the web site of the Center for Agroecology & Sustainable Food Systems at UC Santa Cruz to review this material.”

Teaching Organic Farming and Gardening: Resources for Instructors can be downloaded free from the Center’s web site (www.ucsc.edu/casfs) or ordered for \$45.00 (includes domestic shipping and tax) by sending a check made payable to UC Regents to CASFS, 1156 High St., Santa Cruz, CA 95064, attn: Training Manual. For further information and to inquire about overseas shipping costs, please call 831.459-3240 or send email to jonitann@ucsc.edu. For information on the Center’s newest training manual, *Teaching Direct Marketing and Small Farm Viability: Resources for Instructors*, see page 7 in this issue.

Grants Fund New Greenhouse Facilities, Organic Training Efforts

The Center has received a grant of \$6,985 from the Stanley Smith Horticultural Trust to fund construction of new mist house facilities for asexual plant propagation at the Center’s Farm and Alan Chadwick Garden sites. The new mist houses will include polycarbonate growing tables, biotherm heating systems, hot water heaters, and mist/benchttop watering systems with auto controllers. These facilities will be used to teach apprentices and undergraduates the skills involved in propagating plants from cuttings.

One challenge of asexual propagation using organic techniques is how to stimulate root growth without the synthetic rooting hormones used in conventional operations, and how to prevent mildew and other fungal growth without using synthetic fungicides. The Stanley Smith Horticultural Trust grant will fund a trial of non-synthetic alternatives to both rooting hormone compounds and fungicides for mist house use.

Synthetic rooting hormones are not allowed under the USDA National Organic Program for the production of organic nursery stock. Currently all the Farm and Garden’s cuttings are rooted (with varying degrees of success) without the use of rooting hormone.

Garden managers Orin Martin and Christof Bernau plan to research available alternatives such as willow extract, kelp, and others. With assistance from the Center’s research staff, they will set up and monitor trials of several of these alternatives. Martin and Bernau also plan to trial a non-synthetic alternative to fungicides for the mist house, a commercially-available biological product called Root Shield.

Grant writer Ann Lindsey also made a successful appeal to the Gaia Fund, which is providing \$5,000 toward core support of the Center’s organic farming and gardening Apprenticeship training program in 2005. The Apprenticeship also received a \$25,000 grant from an anonymous foundation to provide core salary support for the program in 2005.

Center Publications Fund Seeks Readers’ Support

The combination of rising paper and printing costs, and a tight California state budget means that keeping *The Cultivar*, *Center Research Briefs*, *For the Gardener* information sheets, and other Center publications free for our readers both in the U.S. and around the world is an ever-growing challenge.

If you find these resources valuable and would like to contribute to our publications fund, we welcome your financial support. Donations can be made by check made payable to UC Regents and sent to: CASFS, 1156 High Street, Santa Cruz, CA 95064, attn: Publications Donation. We appreciate your interest and support.

Survey of Consumer Interest

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processed, transported, and sold. They should recognize safety and nutrition as consumers' top concerns, but they should also devote attention to ethical issues, particularly the humane treatment of animals, environmental impacts, and social justice issues. Because respondents identified labels as their preferred source of information, eco-labels may be an appropriate way to address these matters.

A majority of respondents indicated a willingness to pay more for strawberries that embodied a living wage and safe working conditions, even at price premiums up to 71% higher. The rapid growth of organic food sales, as well as sales of fair trade products from other countries, suggests that promoting the ethical values (such as a living wage) represented in food will continue to be a promising marketing strategy.

Consumers who are interested in ethical aspects of the food system should recognize that their purchasing decisions can influence the way their food is grown, processed, and distributed. Unfortunately, there are currently few avenues for individual consumers to let producers and retailers know about their concerns.

"You can talk to a store manager and hope to influence their decisions about what to stock or not stock. You can try to write to the company, but for the 10 corporations that sell over 50% of the food and drink in this country, they're probably not going to be very responsive to one person," said Howard.

Groups such as the Organic Consumers Association (www.organicconsumers.org) offer a way for individuals to make their voices heard through such mechanisms as letter-writing campaigns and other lobbying efforts on a variety of topics. "For example, OCA was a partner in the coalition that successfully campaigned to encourage Trader Joe's to eliminate genetically engineered ingredients from their store-brand products," said Howard.

Shoppers can also seek out and support existing eco-labels, such as "Organic," "Humane Husbandry," "Free Farmed," "Buy Fresh, Buy Local," or the "Black Eagle" label, which identifies produce from farms that have contracts with the United Farm Workers Union, indicating "decent wages, benefits, and working conditions."⁴ For consumers seeking information on eco-labels, Consumer Reports has an excellent web site (www.eco-labels.org) that evaluates the wide variety of labels now being used on both fresh and processed food, body products, and household products. The web site currently includes information on 137 different labels and general claims, such as "cruelty free."

Howard believes that the fact that people want to know more about their food, yet individually do not have much voice in the food system, can be seen as an opportunity. Farms, cooperatives, and businesses involved in the food system can develop a way to give consumers input. For example, a subscription organic food delivery service in Denmark serves nearly 50,000 households.⁵ This "humongous CSA"

employs people in a "conversations department" to handle more than 6,500 phone calls and 10,000 e-mails a month. This has helped them to grow at a rate of 10,000 subscribers a year while rapidly adjusting to what consumers want. By being more responsive to their needs, farmers, cooperatives, and retailers have the potential to provide consumers with the information they're seeking and meet demands that are not being met by multinational corporations.

– PHIL HOWARD, JENNIFER McNULTY, MARTHA BROWN

¹Further details of this study are available online at www.ucsc.edu/casfs; see Center Research Brief #5, What Do People Want to Know About Their Food? Measuring Central Coast Consumers' Interest in Food Systems Issues.

²McBride, J. 1997. Food safety is major concern of shoppers. Washington DC: United States Department of Agriculture, Agricultural Research Service. September 17. www.ars.usda.gov/is/pr/1997/970917.htm

³Steptoe, A., T. Pollard, and J. Wardle. 1995. Development of a measure of the motives underlying the selection of food: the food choice questionnaire. *Appetite* 25:267-84.

⁴United Farm Workers, 2004. UFW Union Label of the Month. Keene, CA. www.ufw.org/ulmth.htm

⁵Gilman, Steve. 2004. "Thomas Harttung's Humongous CSA: Growing by 10,000 households per year." *New Farm*, January 30. http://www.newfarm.org/depts/talking_shop/0404/nofanys.html

Nitrogen Impacts

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Los Huertos described two intriguing programs he learned about at the Nanjing conference. A program run by American Farmland Trust in the corn belt rewards farmers who reduce their use of fertilizer by allowing them to bank the financial savings with a guarantee that if their yields drop, they'll get their money back. No one has made a withdrawal, noted Los Huertos.

"Farmers are afraid to cut back on fertilizer because they're afraid their harvests will drop, but some of what they apply ends up in our waterways," he said. "This program gives farmers a low-risk incentive to cut back, and they're seeing that it's OK. They realize excess fertilizer hasn't benefited their crops. They might as well have been pouring that money down the drain."

A more punitive program run by the Nebraska Resource Conservation District fines farmers who overfertilize and contaminate wells to the point that the water becomes undrinkable.

"Farming is a ruthless business, and you have to be smart to make it," noted Los Huertos. "Margins are tight, and the risks are high, but the most successful growers are innovators. We have to find ways to ease the transition for growers who have become accustomed to using fertilizer in excess of crop needs. And we need to find ways to reduce the amount of nitrate that reaches sensitive habitats and sources of drinking water."

– JENNIFER McNULTY

Choosing and Growing Stone Fruit

For many of us, biting into a juicy, tree-ripened peach marks a high point of summer. Here Orin Martin, manager of the Alan Chadwick Garden, offers his advice on choosing and growing peaches, nectarines, and other stone fruit in a backyard garden or small-scale orchard.

Prunus is a large, diverse genus in the Rosaceae family, commonly referred to as stone fruits. Principal commercial crops in this genus include peaches, nectarines, plums, prunes, pluots, apriums, apricots, cherries and almonds –

<i>Prunus persica</i>	Peach
<i>Prunus persica</i> var. <i>nectarina</i>	Nectarine
<i>Prunus domestica</i>	European or Prune Plum
<i>Prunus salicina</i>	Japanese Plum
<i>Prunus insititia</i>	Damons Plums
<i>Prunus italica</i>	Green Gage Plums
<i>Prunus avium</i>	Cherry (sweet)
<i>Prunus cerasus</i>	Sour Cherry
<i>Prunus armeniaca</i>	Apricot
<i>Prunus amygdalus</i>	Almond
<i>Prunus salicina</i> x <i>armeniaca</i>	Pluot and Aprium

The name stone fruit refers to the stone-like pit enclosing the seed. It is the soft, flavorful, juicy, aromatic (at full ripeness), mouthwatering combination of sugars and acids in fleeting succession that intrigues us as gardeners. The true “raison d’être” for these swollen ovary walls is merely to attract animals to eat them and disperse the seed to perpetuate the species. After much field testing and reflection, I would say of this evolutionary strategy — Well done, well done indeed!

The stone fruits are nonclimacteric fruits. *Climacteric* derives from the Greek root meaning “critical point,” or literally, “rung of a ladder.” It is therefore a major turning point or critical stage — in this case, pre-senescence or death. Climacteric fruits such as apples and pears, bananas, kiwis, and avocados can be picked mature but green, held under refrigeration, and will ripen and color on their own, or with the introduction of ethylene gas. These fruits store their sugars in the form of starches that are converted back to sugars by enzymes and by warm (65°–75° F) temperatures off the tree.

Nonclimacteric stone fruits don’t produce or respond to ethylene gas. They ripen gradually, and don’t store sugar as starch, but instead depend on their continued connection—via the conductive vascular tissue of the stem—to the

parent (i.e., the tree) for continued sweetening. They get no sweeter off the tree, though enzymes may promote their softening. Thus the quality of the fruit is dependent on the ripening that takes place on the tree. In fact, cold storage (< 50°F) retards natural pectin breakdown, causing stone fruits to become dry and mealy.

PEACHES AND NECTARINES

Prunus persica and *Prunus persica* variety *nectarina*

Peaches and nectarines hail from northwestern China (Xian—also home to the exquisite garlic variety of the same name). The specific name *persica* is a misnomer, probably attributed to its spread via trade caravans from China into Iraq and Iran and eventually to Europe. The fruit came to the Americas (Mexico and Florida) with the Spanish explorers in the 16th century on their conquering expeditions. It was then spread across the U.S. by Native Americans. The nectarine is genetically identical to the peach but with a recessive gene for pubescence (or as on-the-ground gardeners say, it lacks the fuzz gene). The nectarine is as old as the peach, with records of cultivation dating back to 2,000 BC. It is either a chance seedling or a whole tree mutation (bud sport).

Commercially, peaches and nectarines are grown at latitudes between 25°–45° North and South of the equator. Major peach growing regions include Chile, China, Northern Italy, Spain, Turkey, California, Southeastern U.S., New York, Pennsylvania, and Michigan. They can be grown closer to the equator than any other species of temperate zone deciduous fruits because of their tolerance for heat and humidity, and their low chill requirements for breaking dormancy.

The peach, often referred to in old pomology texts as the “Queen of Fruits,” ranks only behind the apple in worldwide production and economic worth. Their sweet flavor, aroma, and nectar set the bar very high (along with apricots) for sun-warmed tree-ripe perfection that evokes the essence of summer.

Peaches are the shortest-lived of all deciduous fruit trees, with an average life expectancy of only 20–40 years (apples and pears live > 80–100 years). Because the genetics of the peach are much less variable than any other fruit, the trees of almost every seedling bear edible fruit. There are also more cultivars (varieties) of peaches than any other fruit owing to the ease of obtaining quality seedlings from peach crosses.

Peaches and nectarines can be grouped into two basic flesh types—clingstone and freestone. Clingstones exhibit a

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firm-textured flesh that cannot be pulled off the stone (pit) and must be cut away with a knife. Because they hold their shape when cut or sliced, they are the logical candidates for canning, drying, or being used fresh, halved, or sliced. Free-stones are softer-fleshed varieties with higher juice content, and separate easily from the pit. They lend themselves to fresh eating.

Additionally, peach tastes can be linked to flesh color and “old school” vs. “new school” varieties. Old school varieties don’t color evenly or have as bright a sheen to their skin. They have a more balanced sugar/acid ratio contributing to a fuller old-timey peach flavor. They have a very limited shelf life, must be tree ripened to have full flavor, and bruise easily, giving rise to that old farmers’ market adage, “Real peaches don’t stack.”

These “old school” varieties include Suncrest, Elberta, Babcock, J.H. Hale, Red Haven, Le Grand, Rio Oso, Sun Grand, and Baby Crawford (see varietal descriptions, page 18). Because they are more difficult to grow they’re considered all but obsolete in today’s produce world. And because the fruit deteriorates rapidly (becomes mealy) in cold storage, the older varieties are a mere remembrance fading in the rear view mirror—a tribute to a time when there was a fierce loyalty to varietal brand names.

New school peach and nectarine varieties are all sugar and sweetness with very little acid. They have a rich pink/red hue to their skin, are firm fleshed, larger on average than the old varieties, and continue to ripen off the tree under refrigeration. They have a sublime, delicate flavor that is less peachy and more sugary. New school varieties include Arctic Supreme, Arctic Glo, White Lady, Sugar Lady, Snow Giant, and Arctic Jay (see page 19).

In general (old school or new school), white-fleshed varieties are sweeter than the more sugar/acid balanced, aromatic, yellow-fleshed varieties.

A separate category of peaches, including Peento, Donut, Saturn or Bagel peaches (see page 18), are synonyms for the smallest, sweetest, melting-fleshed peaches native to China. They are flat, small (2-3” across, 1” thick), and shaped like their name implies. They have a very short season and bruise more easily than any other type of peach.

Cultivation and Growing Tips

The peach is a vigorous (5–8 feet of extension growth) upright grower in the early years after planting. As it matures the tree’s habit morphs to a more naturally spreading form with moderate to weak vigor. Peach leaves cast dense shade, so it is important to train trees to allow sunlight to penetrate into the center of the tree. Remember, sunlight translates to color and emphatically to high sugar content.

The largest, best-quality peaches are produced on lateral one-year-old branches that hang on young, actively growing main scaffold branches (3–5 years old). With peaches, what you grew last year is what you’re eating this year. That is to say that a lateral branch will grow one year and simultaneously produce and express fruit buds. In year two these branches bear fruit. They should be shortened

to 12–18 inches long and fruit should be thinned to 6–8 inches apart. Because peach fruit buds contain only a solitary flower, they set a single fruit and unlike apples don’t need cluster thinning.

Proper thinning equals proper size and is especially critical on small-fruited varieties like Saturn types, Baby Crawford, and all nectarines (which tend to be smaller than peaches). In the third year, the lateral shoot will die out (or start to) and not bear any fruit. Or it will grow new wood that bears the following year, but is too far away from the main branch for either good mechanical support or continued flow of nutrients for size and taste.

In any given winter pruning session, approximately one-half the laterals should be stubbed to 1–3 buds or 1–3 inches to renew growth and bear the following year. Similarly, after laterals have fruited they should be stubbed back to renew the cycle. Since new growth is prioritized on peaches and nectarines, primary branches are pruned hard annually in the winter to encourage good extension growth and the induction of laterals. As a result, it is not unusual to prune 40–60% of the previous year’s total growth off a peach or nectarine (in contrast, pome fruits are pruned by 20–25% annually). Additionally the primary scaffold branches on an (open center) peach are completely renewed by stubbing them to their base every 5–7 years. This re-scaffolding is best achieved incrementally over a 3–5 year period. More markedly than with pome fruits, peaches slow down and lose vegetative vigor with age.

Almost all peach/nectarine varieties are self fruitful, that is they accept pollen from their own flowers and do not need pollen from another variety to set fruit. Notable exceptions are Elberta types and Hale cultivars.

Peach leaf curl (*Taphrina deformans*) is a leaf fungus that afflicts almost all peach and nectarine varieties in almost all growing regions. It is especially devastating in cool, coastal climates where trees can be completely defoliated in June during a bad year. Peach leaf curl infects the leaves and young shoots. It causes distorted, reddened, puckerred foliage and when severe can radically reduce annual production and deinvigorate the tree over the long term.

As with most pest and disease populations, the aim in controlling peach leaf curl is to aggressively prevent high spore pressure. It is difficult to work backward from high pressure to good control organically. The prescription for peach leaf curl is three annual sprays with copper or sulfur products. An easy-to-remember schedule aligns with three big American holidays: Thanksgiving (leaf drop), Christmas (full dormancy) and of course the Super Bowl (Feb. 1 – bud swell). Resistant peach varieties (and they are effectively resistant) include Frost, Avalon Pride, Mary Jane, and Q1-8. Extremely susceptible but great tasting (“aye, there’s the rub”) varieties include Babcock, Elberta, and the Saturn types.

Rootstocks

Compared to pome fruits, rootstock options are more limited with stone fruits. There are no truly dwarf (size



Open center tree form for stone fruit

controlling) stocks—the only choices are full-size and semi-dwarf. The principle attributes imparted to fruit trees via rootstocks are size control, disease/pest resistance, and fruiting efficiency.

Size Control – Full-size or standard stocks produce vigorous vegetative growth (especially in the early years). Trees on these stocks will top out at 20–30 feet tall. Semi-dwarfing stocks reduce tree size (15–20 feet).

Pest, Disease Resistance – The main issue with stone fruits is root susceptibility to nematodes (*Pratylenchus* spp.), which are multicellular, microscopic non-segmented roundworms. Nematodes sap tree roots of nutrients, reduce vigor, and lower fruit productivity. The rootstocks Nemaguard and Nemared impart resistance, especially with peaches and nectarines.

Fruiting Efficiency – Although not as dramatic as with pome fruits, stone fruit dwarfing rootstocks promote greater fruit production per area of tree canopy. The mechanisms for this are not fully understood, but the result is demonstrable.

PLUMS/PRUNES

While nearly all the land masses of the northern temperate zones (25°–45° N Latitude) have native species of plums, the cultivated plums can be divided into four species –

European or Domestica Plums – *Prunus domestica*

These are the plums of choice throughout Europe, more widely planted than apples and pears. In the Slavic countries Domestica plums exceed 50% of all acreage planted to fruit

trees. There is evidence of Domestica plums being grown in Europe prior to 2,000 years ago.

Commonly dubbed prune plums in the U.S., European plums offer a more diverse spectrum of colors, shapes, sizes, tastes, and uses than any other fruit. The fruit is small and oval-oblong—almost egg shaped. Skin colors are in the blue-purple range for prune types to yellow, orange, and red for dessert types. They thrive in areas with moderate summers (75°–100°F), low humidity and moderate winter chill. Major production areas worldwide include Western U.S., New York state, Italy, Chile, Turkey, Romania, Yugoslavia, France, Austria, and Germany.

The trees of European plums are upright and vigorous when young (much like the peach) and develop a pendant-weeping form and weak vigor when established. At 50–80 years they are fairly long-lived. The fruit buds are the longest lived of the stone fruits (5–8 years), so minimal renewal pruning is necessary. They tend to be a shorter tree than Japanese plums (10–15 feet). European plums also have a higher chill requirement to bloom and set fruit (500-900 hours) and bloom later than their *P. salicina* counterparts, and in some years avoid the pollination problems caused by erratic spring weather and rain. They are self unfruitful and thus need pollen from another variety to set fruit. The varieties Santa Rosa and Wickson are universal pollinators.

European plums are smaller and firm textured, with less juice than Japanese plums. They are also free stone. Because of their high sugar content they dry readily as prune plums. Fresh off the tree, European plums are a high quality dessert fruit and because of their low juice content and freestone nature, are excellent candidates for cooking in tarts and other recipes.

Greengage plums – *Prunus italica*

This species, known as the gage plums, originated in Turkey and was brought to Mediterranean Europe by the Romans. They all but disappeared (as did much of intellectual and artistic value) during the Dark Ages of Medieval Europe and were rediscovered in France in the 1700s. Sir William Gage introduced the gages to England in the 1720s and subsequently both lost the varietal labels and (not so modestly) named them after himself. The trees are weak to moderate in vigor and extremely narrow and upright. At their tree-ripe perfection in late July and August, the gages feature a green, yellow, or golden skin and a sugary sweet taste with slight tangy undertones that is arguably the most intensely rich-tasting fruit on the planet. True green gage plums are hard to find but worth the search.

Damson plums – *Prunus insititia*

In the U.S. this species is largely associated with the Damson plums, small spreading trees with small, oval, blue-skinned fruits and amber flesh. While some texts describe the taste as acid spicy/tart, the reality of it is they are wickedly phenolic and acrid fresh. However when made into jam or preserves they sweeten measurably. Their high pectin content gives the jams a creamy, spreadable texture. These trees need little pruning and no thinning.

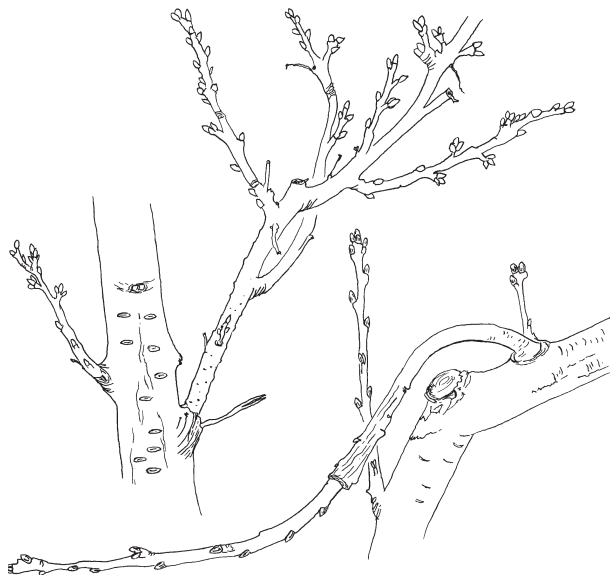
Japanese plums – *Prunus salicina*

This species originated in China 2,000 years ago, was introduced to Japan in the 1600s, and subsequently brought to the U.S. by horticulturists John Kelsey and Luther Burbank. Burbank used this stock to breed the Satsuma, the Santa Rosa plum, and countless other varieties that founded the California plum industry. The fruit is large and heart-shaped to conical. The skin color can range from golden yellow, orange-red, or blood red to purple and black. Flesh color usually reflects a variation on the skin color. The taste is slightly acid over sweet. They are best eaten fresh. The flesh is juicy and unlike European plums they are not freestone, two notable exceptions being Satsuma and its improvement, Mariposa. These two varieties also feature less acidity and thus can be dried, a prune plums.

Japanese plums bloom abundantly early in the season (late January through early March), and thus fruit earlier than European plums (late June through early August). They generally produce heavy crops; if even 1–2% of the blooms set fruit, thinning is required. They tolerate milder winters, that is to say they bloom and set fruit with less chill hours than European plums. The trees tend to be vigorous, rambunctious growers, often exceeding 10 feet a year on standard rootstocks. They are very upright growers with the exception of the Satsuma and Mariposa varieties, which again exhibit a prune plum-like growth habit. Their pollination needs are similar to European plums.

Cultivation and Growing Tips

Domestic plums should be pruned hard to stimulate continued vegetative growth throughout their life. As with peaches, when a plum branch (especially prune plums) goes flat it weakens and produces smaller and smaller fruit. Prune to an inward or upward facing bud to redirect flat growth upward.



Plum fruit wood (laterals): left, short, bushy twigs; right, long shoots

Emma Walden

Japanese plums should rarely be stimulated via heading cuts once established. Heading causes multiple (3–5) narrow-angled (mechanically weak), excessively vigorous regrowth. Pruning at maturation devolves to the occasional thinning cut and the renewal of the brushy lateral fruit-bearing growth. Japanese flower buds have a cluster of 3–5 blossoms that live for 3–5 years. In any given pruning session 20% (1 in 5) of these laterals should be stubbed back to 1–3 buds and regrown. They will fruit in the second year after renewal.

Thinning for Japanese and European plums should be one to a cluster every 4–6 inches. Oversetting results in a nutrient sink that inhibits bloom and fruiting the next year (alternate bearing). As with peaches they can and probably should be rescaffolded periodically (every 8–10 years).

The principal disease of plums (and all stone fruits) is brown rot, *Monilinia laxa* and *M. fructicola*. Airborne spores spread under warm (72°–82°F), humid and wet conditions. The parts of the tree affected by brown rot are –

Bloom—pollen abortion, browning, and withering

Twig—die back

Fruit—pre- and post-harvest, brown blotches, followed by buff gray-colored spores on the fruit surface, causing the fruit to soften and rot

Spores overwinter in the orchard on rotted fruit remaining on the tree (“mummies”) and on fallen leaves on the ground. Good orchard hygiene and annual dormant sprays of either copper or sulfur products are essential and highly effective. Like peaches, plums are non-climacteric fruits and do not respond optimally under refrigeration.

VARIETAL DESCRIPTIONS

Peach Varieties

Older (“old school”) peach varieties need to be carried to full maturation on the tree. They are ripe when the background color has no tinge of green and is expressing full yellow or white coloring. The foreground color of red and/or golden yellow may be more a function of varietal characteristics than ripeness. Tree-ripe peaches that have achieved full sweetness should be extremely, sublimely aromatic and yield slightly to the touch. Varieties of note (in order of ripening) –

Babcock and Giant Babcock—Medium and large fruit, skin mostly red. White flesh, sweet, juicy. Consistently heavy yields.

Avalon Pride—High flavor, yellow flesh, semi-freestone. Extremely resistant to peach-leaf curl.

Red Haven and Early Red Haven—The standard for assessing all early season varieties. Firm yellow flesh, pleasing smooth texture, red/golden skin. Good fresh eating and canning.

Saturn and Sweet Bagel—Shaped like a doughnut, melting sugary flesh, small fruit. Not particularly resistant to plain leaf curl. Sweet Bagel fruit is bigger and yellow fleshed.

Loring—Large yellow fruit with a striking red blush.

High flavor, good eating quality, also for canning.

Suncrest—The classic California peach as lauded in *Epitaph for a Peach*, by David Masumoto. Large, round fruit, highly aromatic, flavorful balance between acid and sugar—“old timey” flavor. Skin is 2/3 red, 1/3 yellow, colors unevenly, bruises easily.

Elberta, Fay Elberta, Late Elberta—Firm yellow fruit with golden hue and red blush. Sweet and holds reasonably well off the tree.

Rio Oso Gem—Heavy bearer of large, firm freestone fruit. Red skin, great taste, late maturation. Small tree. One of the best tasting varieties ever.

“New school” peach varieties all equal or surpass the superlatives good, better, best. These varieties break almost all the rules—they ripen before background color comes up, can be picked firm and will have high sugar content, and can be refrigerated and shipped long distances.

Arctic Supreme—White flesh, low fuzz, light sweet flavor even when firm. Red over creamy white skin, freestone.

Starfire Freestone—Staggered ripening over 2–3 weeks. Rich flavor, yellow flesh. Good in cool summer areas.

White Lady—Low acid, high sugar, melting flesh (white). Medium to large red-skinned, firm flesh, freestone.

European or Prune Plum Varieties

Italian Prune—Large, purple, heavy setting prune plum with a sweet freestone fruit with yellow-green flesh. Ripens in August.

Schoolhouse—Large oval yellow prune plum, ripens in mid August. A found seedling from Port Townsend, Washington.

Seneca—Large, sweet, red-skinned fruit with yellow flesh. An upright vigorous tree. Ripens in September.

Early Laxton—Pink-orange oblong freestone plum with yellow, firm flesh. Great for cooking. Introduced in England in 1916.

Kirke’s Blue—Large, round, dark-blue freestone fruit. Juicy yellow flesh with high flavor. Introduced in London in 1930.

Valor—Similar to Italian prune but with much larger fruit. Fruit has purple skin, yellow flesh, and is sweet with great flavor.

Coe’s Golden Drop—Oblong-shaped, golden-green fruit with golden flesh. Sweet and flavorful with an almost apricot-like taste. Ripens in October.

Japanese Plum Varieties

*Santa Rosa—Fruity bouquet aroma (on the tree!). Complex set of flavors — tart near skin, sweet with an intense almost overpowering scent/perfume in

the center and slightly tart again at the pit. Early season ripener (late June–July). Rapidly fading as California’s leading cultivar—40% of crop in 1960s, 4% now. Has been lamentably superceded by firm (almost rubbery) black-skinned varieties more suited to the racquet ball or squash court.

*Satsuma and Mariposa (an improved Satsuma)—Late season ripener (August) with meaty, firm flesh. Blood red, low juice content, almost freestone. One of the only Japanese types that can be halved and dried. Moderate vigor tree. Small pit.

**Both varieties bred by Luther Burbank.*

Laroda—Dark purple-skinned fruit with rich, juicy flavor and a red-amber flesh. Extended harvest, lasting 5-6 weeks after Santa Rosa plums.

Shiro—Mid-size, yellow fruit with a sweet, mild flavor. Harvest from late June – early July. Self fruitful.

Beauty—Beauty is better adapted and more productive in cool, wet, rainy springs than Santa Rosa. The flesh is red streaked and the skin red over yellow. Sweet and full of flavor.

Catalina—Large, black-skinned fruit with sweet, firm flesh that is a treat when eaten out of hand. Harvest from late July – early August.

Elephant Heart—Old-time favorite with a big, heart-shaped fruit. The sweet, rich flesh is firm textured and dark red in color. Harvest in September.

Hiroimi Red—Relatively new variety bred by Floyd Zaiger. Purple red skin and flesh, sweet juicy flavor.

Emerald Beauty—Intensely sweet, strikingly green-yellow flesh, freestone. Ripens from late August through late September, fruit hangs and sweetens on the tree. Crisp and crunchy too.

– ORIN MARTIN

References

Good Fruit Grower Magazine, 105 South 18th Street, Suite 217, Yakima, WA 98901. 800.487-9946. www.goodfruit.com

Masumoto, David Mas. *Epitaph for a Peach: Four Seasons on My Family Farm*. San Francisco: Harper Collins, 1995.

The ATTRA web site, www.attra.ncat.org, lists a number of organic growing guides for specific fruit crops. A current publications list is also available by calling 800.346-9140.

Santa Cruz area events

► **Seed Starting and Spring Garden Preparation**, Saturday, March 26, 10 am–1 pm, UCSC Farm. Garden manager Christof Bernau shares ideas on getting your garden growing. Tips on seed sowing, direct sowing, varietal selection, soil preparation, and more at this morning workshop. \$10 for Friends' members; \$15 non-members, payable the day of the workshop.

► **Introduction to Bee Keeping**, Saturday, April 16, 12 noon–3 pm, UCSC Farm. Join Albie Miles for a look into the life of the honeybee. If you're thinking about getting into bee keeping, this workshop will be a great introduction. \$5–\$10 for Friends' members (sliding scale); \$15 non-members, payable the day of the workshop.

► **Growing and Using Medicinal Herbs from the Garden**, Saturday, April 23, 10 am–1 pm, UCSC Farm. Learn about the abundance of herbs growing in local gardens. Darren Huckle, a Western/Chinese herbalist and licensed acupuncturist, will teach you about sources of medicinal plants, how to use garden herbs for health and wellness, and how to prepare planting beds and harvest herbs. \$15 for Friends' members; \$20 for non-members, payable the day of the workshop.

► **Spring Plant Sale**, Saturday, April 30, Sunday, May 1, 10 am–2 pm, Barn Theater Parking Lot, UCSC. The biggest and best collection of organically grown flower, herb and vegetable starts, perennials, grasses, and other landscape plants available in the region. Proceeds support the Farm & Garden Apprenticeship training program. Friends of the Farm & Garden will have pre-entry priority from 9 am - 10 am on Saturday.

► **Organic Rose Care**, Saturday, May 14, 10 am–12 noon, Alan Chadwick Garden, UCSC. Orin Martin presents a workshop on choosing and raising roses, and controlling pests and diseases using organic techniques. \$10–\$15 for Friends' members (sliding scale); \$15 for non-members, payable at the workshop.

► **Building Garden Structures**, Saturday, July 23, 9 am–1 pm, Louise Cain Gatehouse, UCSC Farm. Farmer and builder Thomas Wittman shares his knowledge and plans for gazebos, benches, trellises, garden sheds, and more at this workshop. Learn how to enhance your garden with wonderful hand-built structures. Includes plans for some basic garden structures. \$15 for Friends' members; \$25 for non-members, payable at the workshop.

► **Wildlands and Watering Cans**, June 21–25, June 28–July 2, July 12–16, 9 am–3 pm, UCSC Farm. These popular day camp sessions for kids 7–10 fill up fast. Call Life Lab at 831.459-2001 or www.lifelab.org for more info. Registration begins in April.

► **A Garden of Poetry and Music**, Saturday, June 25, 12 noon–2 pm. Alan Chadwick Garden, UCSC. Set aside time for an afternoon in the Chadwick Garden as we listen to the poems and tunes of the region's artists. Enjoy the Garden at its springtime best.

► **VI International Shortcourse on Agroecology 2005**, July 10–23, UC Santa Cruz. This year's short course focus: "Using Agroecology for Building Community Connections in Food Systems."

This year we have formed new strategic alliances to give the course a special focus on the interactions between human and ecological communities in food systems, from rural producers to urban consumers.

For updated information and questions on the course, please see www.agroecology.org/shortcourse.htm, email course@communityagroecology.net, or contact the course organizer, Sarah Levitan at 831.459-3619, 831.459-2867 (fax).

California

► **Heartland Festival**, Saturday, May 21, Stevinson. A celebration of food, farming, and healthy living in the Central Valley, presented by the Ecological Farming Association. Workshops, demonstrations, kids' activities, music, great food, and more! For information contact EFA at 831.763-2111, email info@eco-farm.org, or see www.eco-farm.org.

► **Growing a Community**, Wednesday and Thursday, May 11–12, Sacramento. Sponsored by the Great Valley Center, this conference includes exhibits, displays, and interactive workshops on a variety of topics including land use, agriculture, the environment, land conservation, community building, and much more. For information contact the Great Valley Center, 209.522-5103, email conference@greatvalley.org, or see www.greatvalley.org/conference.