



The CENTER for
AGROECOLOGY
& SUSTAINABLE
FOOD SYSTEMS

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The CENTER for AGROECOLOGY & SUSTAINABLE FOOD SYSTEMS

UNIVERSITY OF CALIFORNIA, SANTA CRUZ

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Center Researchers Lead USDA-funded Study of Farm-to-Institution Programs

Growers with small- and medium-sized farms have been struggling financially in the U.S. for a long time. It's not because these farms aren't productive, rather that they've been squeezed out of the market by changes in processing and retailing. According to a USDA study, "The combination of increased concentration among food processing companies, loss of competitive markets, and reduction of government pricing stabilization tools has made farmers, and small farmers in particular, increasing vulnerable. Farmers find themselves with less and less control over their economic security," (USDA 2004).

To remain in business, many small- and medium-sized operations have turned to alternative markets, such as farmers' markets and community supported agriculture (CSA) projects, where they have a comparative advantage relative to large-scale growers. Although these markets have kept many growers in business, there is a limit to these easily saturated direct markets as a viable strategy for a large group of farmers.

If traditional wholesale and retail markets are closed to small- and medium-sized growers, and direct markets are becoming saturated, is there anywhere such growers can sell their produce and make a profit? For many, the most promising market outlet may be the institutional food sector.

NEW PROJECT EXAMINES DEMAND, DISTRIBUTION MODELS

Beginning this fall, researchers from the Center for Agroecology and Sustainable Food Systems (CASFS) will head up a collaborative, 2-year study to analyze the viability of institutional markets for small- and medium-scale growers, particularly those farming organically or using other environmentally sustainable farming methods. Such institutions include universities and colleges, hospitals, and correctional facilities. Funded by a \$400,000 grant from the US Department of Agriculture's Cooperative State Research, Education and Extension Service (CSREES), the research group will examine both the potential market for these growers, and the extent to which alternative distribution models help return profit to the farmers.



UCSC campus dining halls now feature produce from the UCSC Farm & Garden (shown here at the twice-weekly "market cart" stand) and from other farms that form the Monterey Bay Organic Farmers Consortium, an example of the burgeoning farm-to-institution movement.

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“These farm-to-institution programs could be a lifeline for small- to mid-scale farmers struggling to stay afloat, and would improve the eating habits of millions of Americans, from young schoolchildren to elderly hospital patients,” says project director Patricia Allen, CASFS associate director.

If institutional food buyers embrace sustainably produced goods, including organic and fair-trade crops and products, the environmental gains could be enormous, says Allen. “Due to the size of the institutional food market, farm-to-institution programs could catalyze a fundamental transformation in the way the nation produces and distributes food,” she says.

Farm-to-institution programs are sprouting up around the country, and the institutional demand for fresh, sustainably produced food is growing nationwide. The project, “Increasing Value-Added Profits for Small and Medium-scale Growers: The Institutional Market,” is the first large-scale assessment of the nation’s appetite for food-to-institution programs. It encompasses a national survey of college students’ food preferences, a survey of the priorities of institutional food buyers in California, and an evaluation of distribution models that could be developed to get more fresh, locally grown food into institutions, including universities, colleges and hospitals.

Allen will be joined on the project by codirector Shermain Hardesty, Cooperative Extension specialist in the Department of Agricultural and Resource Economics at UC Davis; Jan Perez, associate specialist, and Gwendolyn Keith, project assistant, at CASFS; and Gail Feenstra, food systems analyst, Jeri Ohmart, food systems program representative, and Tracy Perkins, Community Development graduate student, with the UC Sustainable Agriculture Research and Education Program (SAREP). Additionally, staff at the Community Alliance with Family Farmers (CAFF) will collaborate on the project, including program director Anya Fernald, program manager Kristen Schroer, and Marisol Asselta, coordinator of CAFF’s Central Coast “Buy Fresh, Buy Local” campaign.

“Very little is known about the distribution of local produce from small and mid-sized farms to institutions,” says Feenstra. “We want to find out what works and share this information with the farmers. They’re the ones who are disappearing from the landscape the fastest, and we believe they’re the ones best positioned to take advantage of the institutional markets we are targeting.”

INSTITUTIONS REPRESENT ENORMOUS DEMAND POTENTIAL

The institutional food market offers a new and potentially major opportunity for small- and medium-scale farmers, both economically and environmentally. Institutions are the second largest sector of the U.S. food service market, topped only by eating and drinking businesses such as fast food operations and full service restaurants. Within the institutional sector, \$29.3 billion was spent for food at schools and colleges, and \$40 billion at other institutions, such as hospitals, corporate cafeterias, prisons, military exchanges

and clubs, and airlines in 2004. In California alone, there are over 21,000 education and health care institutions that provide meals daily.

Schools, colleges, hospitals, and other institutions nationwide have already shown interest in purchasing fresh, sustainably-produced food from small- and medium-sized farms (e.g., see update on UC’s farm-to-college effort, page 9 of this issue). Hundreds of institutions have begun to offer locally produced, often organically grown food. According to Kristen Markley of the Community Food Security Coalition (CFSC), approximately 105 colleges and universities surveyed by the CFSC are spending an estimated \$23.5 million on products from local farms—the tip of the potential iceberg of demand for such products.

In California alone, there are 147 4-year colleges and universities, all of which operate food service programs for their students. Currently, about 25 of these institutions obtain some food products from local producers. Thus it is likely that significant unmet demand exists for such products and that the profitability and long-term viability of small and medium-sized producers can be improved by meeting this demand.

“The institutional foods market has been largely untapped by small- and mid-sized farmers,” says Allen. “If institutional contracts incorporate sustainability criteria, a huge market could be transformed with an incentive-based approach, rather than through regulation.” Such criteria could include wage and benefits requirements for food-system workers and reducing the use of toxic pesticides, she adds.

The research project discussed here will work toward that goal of transformation by assessing market potential, identifying barriers for both institutional buyers and growers in tapping that potential, and analyzing the true returns to growers involved in food-to-institution programs—and how such returns might be enhanced.

PROJECT TO ASSESS CONSUMER PREFERENCES AND BUYERS’ PRACTICES

The new research project will include a national survey of college and university students’ demand for food from small- and medium-sized farms with sustainability criteria (including such criteria as organic, locally grown, and socially just). The survey will also assess the students’ willingness to pay more for meals that meet certain criteria, such as distance (e.g., local, U.S., imported), farm scale, price, and environmental certification.

“The results of this survey will help us identify how interested students are in these particular criteria, and how much more they would be willing to pay for them. Farm-to-college advocates can use this information to help establish and define new programs,” says Perez.

UC Davis agricultural economist Shermain Hardesty will analyze the produce-buying practices and preferences at California’s colleges and universities, focusing especially on the influence of various “transaction costs” on buyers’ choice of produce suppliers. These include information costs,

such as those of identifying suitable suppliers, obtaining price information, and preparing vendor approvals; negotiation costs, such as preparing purchase orders and receiving product deliveries; and monitoring costs, including ensuring the produce delivered is of acceptable quality, and processing payments. Current research shows that such transaction costs are the primary obstacle to increasing the involvement of small- and medium-sized growers in farm-to-school programs (Community Food Security and Center for Food and Justice 2004; Kalb 2004; Markley 2002).

“The survey of buyers for food service operations at California’s universities and colleges will enable us to assess their produce preferences and purchasing practices,” says Hardesty. “If the transaction costs significantly affect their decisions to purchase from small- and medium-sized producers, then we’ll need to recommend alternative systems that reduce these transaction costs.”

The analysis of food service buyers’ practices will also include measuring the current volume of produce purchased by California’s colleges and universities from small- and medium-sized producers, as well as from larger businesses; the level of interest in purchasing more produce from small and medium-scale producers; and buyers’ willingness to pay more for produce certified as organic or sustainably produced. In order to identify potential obstacles, researchers will ask buyers about changes that would increase their purchases from local producers, such as improved product quality, on-time deliveries, and expanded product offerings from a single vendor.

IDENTIFYING THE BEST FARM-TO-INSTITUTION OPTIONS

On the distribution side, researchers at UC SAREP will assess the potential profitability of farm-to-institution programs, explore ways that farmers can tap these markets, and identify methods to facilitate food distribution so that institutions can meet their food demands without having to contract individually with multiple growers. The researchers will also analyze the true return to growers currently involved in food-to-institution programs—and how such returns might be enhanced.

The research team will interview growers, cooperative representatives, distributors, and food service directors and managers who are involved in various distribution models to analyze the strengths and weaknesses of various farm-to-institution arrangements, focusing on identifying the factors that generate the highest net revenues to farmers and meet food service buyers’ needs.

By identifying the arrangement that are working best for both buyers and growers, the researchers hope to generate recommendations and give growers ideas for lowering their



Kathy Bruce

A UC Davis dining hall display describes local farms and crops as part of a farm-to-college event. Assessing college students’ interest in supporting purchases from local, organic farms will form part of the research effort on farm-to-institution programs.

transaction costs in order to become more attractive suppliers, thus increasing their sales to institutions. They also hope that buyers can use the information to more effectively work with local growers and distributors and to advocate for making any institutional policy changes needed to increase their supply of produce from small and medium-size farms. Ultimately, they hope to see increased institutional demand for local produce grown using environmentally sustainable farming methods.

“These farm-to-institution programs have captured the imaginations of businesses and activists alike,” says Allen. “They have the potential to transform the way much of the nation eats.”

– MARTHA BROWN, JENNIFER McNULTY

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from the director



Several articles in this issue of the newsletter offer examples of the way that members of the Center for Agroecology and Sustainable Food Systems address timely topics on both a theoretical and practical level.

Our cover story discusses a new USDA-funded study to examine the burgeoning farm-to-institution movement. Working with their colleagues from UC Davis and the Community Alliance with Family Farmers, Center researchers are studying the demand for sustainably grown food in universities; the challenges that institutional buyers meet in bringing more locally grown food from small- and medium-scale farms into their food service programs; and the benefits to farmers of such programs. Ultimately, this study hopes to provide both buyers and growers with ideas and information on how to improve farm-to-institution efforts.

A related story (page 9) looks at the latest developments in the farm-to-college effort at UC Santa Cruz and throughout the UC system. Center members are key players in working to develop system-wide policies that would bring more sustainably grown produce and other products to UC's students, staff and faculty, while at the same time providing students with unique educational opportunities.

Our latest Research Brief (discussed on page 8) examines the potential conflict between food safety issues and environmental concerns. In the wake of recent illnesses traced to spinach, proposed food safety policies may compromise environmental improvements by requiring growers to remove non-crop vegetation from around their fields to discourage the presence of wildlife—often the same vegetation that can improve biodiversity and decrease pollution from agricultural chemicals. The crux of the conflict is the possibly misplaced concern by the food industry about wildlife as a source and vector for *Escherichia coli* 0157:H7; we hope that this new Research Brief will help inform a balanced discussion regarding potential regulatory changes in farming practices.

For those who would rather “grow their own,” the article by Chadwick Garden manager Orin Martin (page 13) offers tips for cultivating spinach, beets, and chard in the backyard garden—an example of the practical organic gardening information that we continue to generate.

I also wanted to let readers know that I'll be starting a year-long sabbatical beginning in January 2007. Associate director Dr. Patricia Allen, who heads the social issues program for CASFS, will serve as acting director in my absence. Best to you all for the coming year.

- DR. CAROL SHENNAN

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the Cultivar

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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.

On the UCSC campus, CASFS manages the 3-acre Alan Chadwick Garden and 25-acre UCSC Farm. Both sites are open to the public daily from 8 am – 6 pm year round.

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Center Researchers Fine-Tune Water Quality Monitoring Efforts on Central Coast

From its headwaters in the coastal mountains near San Felipe Lake, the Pajaro River and its major tributaries flow through some of California's most productive agricultural land before emptying into the Monterey Bay. But this productivity comes at a cost: as it winds toward the coast, the river picks up enough nitrogen, phosphorus, fecal coliform bacteria, pesticides, and sediments to qualify as "impaired" under state clean water standards.

This problem isn't new. High concentrations of nutrients, specifically nitrate-nitrogen and ortho-phosphorus, have been documented in the Pajaro River for over 50 years (SJSU 1994). This pollution is thought to come primarily from "non-point" sources, i.e., unregulated discharges from urban and agricultural land uses. Potential sources of both nitrate and phosphorus include fertilizers, livestock waste, and septic systems. Nitrate also travels easily through the soil, carried by rain or irrigation water into groundwater supplies where it can travel laterally and reappear in surface waters.

Over the past 6 years, researchers from the Center for Agroecology and Sustainable Food Systems (CASFS) have worked to identify and monitor the sources of nitrate and phosphorus in the 1,300-square-mile Pajaro River watershed. In a program initiated by CASFS director Carol Shennan in 2000, a research team led by Marc Los Huertos has established a series of monitoring stations throughout the watershed to measure nutrient levels and to link water quality with land use practices.

Recently, CASFS researchers have stepped up their monitoring efforts as part of the Conditional Waiver of Waste Discharge Requirements. Known as the "conditional ag waiver," this program was implemented in July of 2004 on the Central Coast by the state Regional Water Quality Control Board (RWQCB) to regulate the discharge of nutrients, pesticides, and other wastes from irrigated lands. It applies to all irrigated lands used for producing commercial crops that discharge wastes into the Pajaro River.

The Agricultural Waiver requires growers to take a water quality short course where they learn about Best Management Practices (BMPs) such as source control, detention basins, vegetative buffer strips, and erosion controls aimed at improving water quality. The program places a great responsibility on farmers to improve water quality and requires systematic water quality monitoring to ensure the effectiveness of the waiver program and the adequacy of waiver conditions. Changes in water quality are being monitored by CASFS and other Central Coast groups both on a watershed-wide scale and at individual farms.



The Pajaro River floodplain and surrounding agricultural land (courtesy of <http://www.pajarowatershed.com>).

FARMERS CHALLENGED TO REDUCE NITRATE AND ORTHO-PHOSPHATE LEVELS

At high concentrations nitrate can cause health problems for humans (such as methemoglobinemia, or "blue baby syndrome") and livestock, as nitrate interferes with the blood's ability to transport oxygen; but the most widespread effects of nutrient pollution in surface water are excessive plant and algae growth. When plants and algae die and decay, oxygen levels in the water are depleted (a process termed eutrophication) and can become sufficiently low to kill other organisms, including fish. Algae blooms also reduce the aesthetic value of waterways and can cause odor problems. Blooms of cyanobacteria can also be toxic to many organisms, including cattle, horses, dogs, and humans, and the production of neurotoxins has been linked to increased phosphorus levels.

As part of state and federal efforts to protect and restore water quality, the Central Coast RWQCB has set a preliminary target of 0.12mg/L for maximum ortho-phosphate concentrations in the Pajaro River. This numeric value is based on the lowest concentrations that have been observed in waterways of the Pajaro watershed with excessive plant or algae growth. At minimum, the nitrate nitrogen concentrations in the Pajaro River should not exceed the drinking water standard of 10mg/L, since municipal/ domestic water supply is one of the designated beneficial uses for the Pajaro River.

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NUTRIENT LEVELS IN PAJARO RIVER TRIBUTARIES

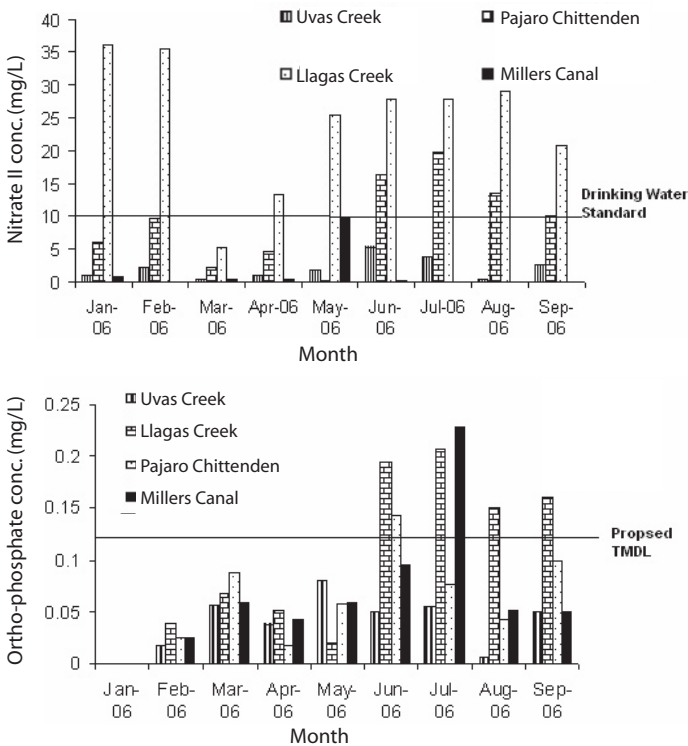
As part of the conditional waiver monitoring effort, a team of CASFS researchers is monitoring tributaries of the Pajaro River that directly receive non-point source run-off from agricultural lands. Funded by a special USDA grant (2006–2007), this monitoring is important for determining water quality trends over time in the watershed as well as linking water quality with land use.

Figures 1 and 2 show nutrient data collected for the major tributaries entering the Pajaro River, namely Llagas Creek, Millers Canal, and Uvas Creek, over the period January to September 2006. Water entering the Pajaro River from Llagas Creek had the highest nitrate concentrations, greatly exceeding the drinking water standard. Concentrations declined somewhat downstream of Chittenden, however, dilution of nitrate as the Pajaro River flows westward was not enough to bring concentrations below the target of 10mg/L except during winter periods of high water flow.

Phosphorus levels also exceeded the recommended limit of 0.12 mg/L during summer downstream of the aforementioned tributaries. The highest concentrations of phosphorus were recorded in Millers Canal in July 2006 at 0.24 mg/L—twice the recommended value. Phosphorus levels in Llagas and Uvas Creeks were below the target value except on one occasion in June 2006 when high levels were recorded in Llagas Creek.

NUTRIENT IMPACTS ON CHLOROPHYLL *a* LEVELS

While the data presented above give us a broad picture of water quality dynamics, there are too few samples to exam-



Figures 1 and 2. Nitrate (top) and ortho-phosphate (bottom) data collected under conditional ag waiver monitoring in the major tributaries entering the Pajaro River from January to September 2006.

ine relationships between elevated nutrient concentrations and excess algae and plant growth; we can only make very general statements about relationships between water quality and land use, since land use can change on a much finer scale or resolution than our sampling allows us to detect.

To address these problems, Los Huertos, Gerhard Epke, and Kevin Dinoto conducted an intensive sampling of one tributary, Millers Canal, over a two-day period. They canoed downstream from the headwaters at San Felipe Lake through Millers Canal, entering the Pajaro River downstream of the confluence with Llagas Creek, and continuing down the Pajaro past the confluence with Uvas Creek to Chittenden Gap. Samples were collected at regular intervals and transported to the Shennan Research Laboratory at UCSC, where Kristy Morris and other research team members analyzed them for nutrients (dissolved nitrate, ammonium and soluble reactive phosphorus; and total nitrogen and phosphorus) and phytoplankton (chlorophyll *a*).

Figure 3 shows that the highest concentrations of phosphorus, 0.5–0.7mg/L, were recorded in Millers Canal; these levels declined markedly from 0.5 mg/L to approximately 0.15 mg/L at the confluence of Millers Canal and the Pajaro River. Phosphorus levels remained relatively constant as the Pajaro River moved westward toward Monterey Bay; however, they typically always exceeded the 0.12mg/L standard recommended by the RWCQB. Furthermore, a consistent increase in the ammonia concentration from 0.05 mg/L to 0.4 mg/L was also observed moving downstream of San Felipe Lake through Millers Canal. Upon entering the Pajaro River these levels also decreased rapidly and remained below 0.02 mg/L.

Figure 4 shows that the nitrate-nitrogen levels in Millers Canal were consistently below 0.2 mg/L moving downstream and increased dramatically to 12 mg/L at the confluence of the Pajaro River. The nitrate-nitrogen concentrations of between 14–16 mg/L recorded downstream in the Pajaro River exceed the drinking water standard of 10 mg/L. Llagas Creek was previously identified as a major upstream source of nitrate-nitrogen to the Pajaro River and nitrate concentrations in the Pajaro River were also shown to increase again at the confluence of downstream tributaries, including Uvas Creek and San Juan Creek (which can be seen at the downstream location before Chittenden), indicating that these tributaries also provide a source of nitrate to the Pajaro River.

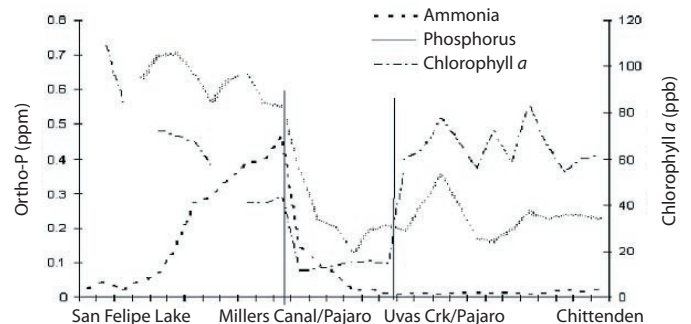


Figure 3. Ammonia, phosphorus, and chlorophyll *a* concentrations moving downstream from Millers Canal and entering the Pajaro River.

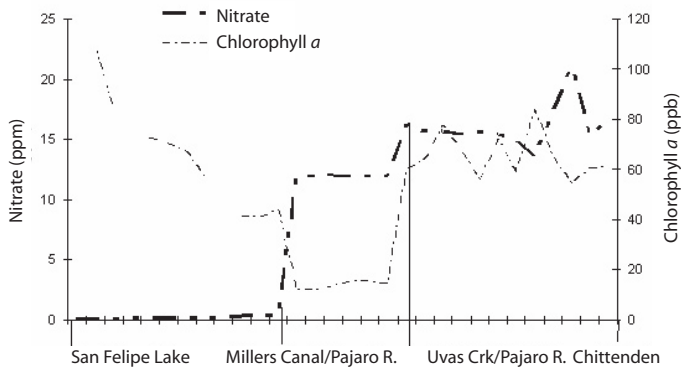


Figure 4. Nitrate and chlorophyll *a* concentrations moving downstream from Millers Canal and entering the Pajaro River.

Both chlorophyll *a* and phosphorus concentrations decreased moving downstream of San Felipe Lake through Millers Canal, suggesting that San Felipe Lake may be the source for both elevated levels of phosphorus and algae. The dilution of both phosphorous and chlorophyll *a* by the Pajaro River at the confluence dramatically decreased the concentrations of these pollutants. Chlorophyll *a* concentrations increased again downstream following the confluence of Uvas Creek, suggesting that Uvas Creek may also be a significant source of chlorophyll *a* flowing into the Pajaro River.

During this study a bloom of cyanobacteria (previously known as blue green algae) was detected in backwaters connected to the main channel of the Pajaro River. Samples were collected and sent to UC Davis for toxicological analysis, where it was identified as a species of heterocyst-forming bacteria. This species fixes atmospheric nitrogen, providing it with a potential competitive advantage in nitrogen-limited systems. Based on the N:P ratio in the water column, some general predictions can be made. For example, a ratio below 20 suggests that algae growth is limited by nitrogen availability; a value above 20 suggests that phosphorus may limit algae growth. Algae growth in San Felipe Lake and Millers Canal appears to be limited by the amount of available nitrogen (figure 5), which raises the question of whether San Felipe Lake and Millers Canal may be sources of the cyanobacteria causing the blooms in the Pajaro River backwaters. Further monitoring for the presence of cyanobacteria in San Felipe Lake and Millers Canal is needed to answer this question.

CONCLUSIONS

This study illustrates the value of “high resolution” sampling, namely taking multiple samples along a given stretch of river, rather than the more typical limited sampling with one or two samples used to describe long stretches of a waterway. Data from the high resolution sampling supports our previous work showing that in general agricultural lands are associated with elevated nutrient concentrations in the Pajaro River, but also shows that nutrient levels vary depending upon more specific land use practices. For example, the highest concentrations of ammonia and phosphorus were reported in Millers Canal, which enters the Pajaro River downstream of Llagas Creek, whereas nitrate levels were very low. Concentrations of ammonia were up

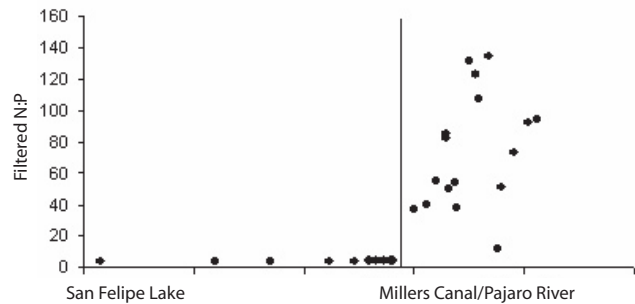


Figure 5. Ratio of nitrogen to phosphorus traveling downstream through Millers Canal and entering the Pajaro River.

to 20 times higher in Millers Canal compared to those in the Pajaro River, and phosphorus levels were nearly 4 times higher. We are now investigating the source of these high phosphorus concentrations. In contrast, the highest nitrate levels were found in the Pajaro River as a result of the flow of nitrate-rich water from Llagas Creek, which drains land that includes urban, light industry, and intensive row crop production areas. Higher resolution sampling along Llagas Creek would help to identify which land use is the major nitrate source. To draw firm conclusions, however, it is important that high resolution sampling be accompanied by similarly high resolution land use mapping, which we have yet to complete.

Control of non-point source pollution is difficult and complex, and requires coordination across watersheds as well as cooperation of land managers within a watershed. Understanding relationships between land use and nutrient levels in streams is critical to the interpretation of trends over time as a result of the conditional ag waiver program, since changes in other land uses may mask effects of best management practices. It is also important to understand relationships between groundwater and surface water transport of nutrients, as nutrients may leach through the soil into aquifers where they can move laterally and reemerge in surface waters downstream.

By increasing the sampling frequency within a stream reach we can better understand the changes in nutrient concentrations moving downstream, and better identify non-point sources of nutrients. This information will help local water quality agencies develop realistic goals and help growers and other land managers identify management options that enable them to meet water quality targets. Nonetheless, high resolution sampling is expensive, and clearly impractical to do on a large scale; rather, strategic lower resolution sampling needs to be done first to identify high priority waterways that are major sources of nutrients.

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New Research Brief Examines Farm and Food Security

This fall the Center produced a new title in its Research Briefs series. Research Brief #9, *Meeting Farm and Food Security Needs through Community Supported Agriculture and Farmers' Markets in California*, was written by CASFS associate director Patricia Allen, community studies assistant professor Julie Guthman, and environmental studies graduate student Amy Morris. The brief examines whether alternative food initiatives (AFIs) such as community supported agriculture (CSA) and farmers' markets can meet the food security needs of low-income consumers.

"Is it possible to simultaneously make fresh, nutritious food affordable to low-income people while providing a decent return to small-scale, sustainable farmers through farmers' markets and CSAs?" ask the authors. "The goal of our research . . . was to see how and to what extent California CSAs and farmers' markets are addressing food security in both concept and practice."

To address this question, the authors surveyed farmers' market and CSA managers throughout California. "We wanted to get the views of market and CSA managers because they best know the constraints under which their operations must function. In addition, their intentions, decisions, and efforts play a key role in the ways and degree to which food security is addressed in these institutions," write the authors.

Allen, Guthman, and Morris found that the vast majority of both farmers' market and CSA managers believe that these institutions should be paying attention to issues of food security, and that there was significant support for trying new strategies to reach low-income people. Eighty-three percent of CSAs and 87 percent of farmers' markets had attempted at least one strategy to attract low-income people.

Despite their efforts, the managers reported low rates of participation by low-income people in both CSAs and farmers' markets. The authors found a variety of both economic and structural constraints that limited participation by low-income consumers in these AFIs. In addition, small- and medium-scale growers who participate in CSAs and farmers' markets are often in tenuous economic positions themselves, and thus not able to lower prices in order to meet the needs of low-income shoppers. "Our data suggest that the biggest success in bringing in low-income people has been through the use of entitlements," write the authors, who conclude that AFIs are not and cannot be substitutes for state entitlements, such as food stamps and farmers' market vouchers, in meeting the food security needs of low-income people.

A more extensive report on this research appears in Guthman, J., A. Morris, and P. Allen, 2006, *Rural Sociology* 71(4).

Titles in the CASFS Research Brief series are available free of charge by contacting mtbrown@ucsc.edu, calling 831.459-3240, or accessing the briefs from the CASFS web site, www.ucsc.edu/casfs.

Potential Conflict between Food Safety and Environmental Protection Analyzed

A second title in the Center Research Briefs series was also produced this fall. Research Brief #10, *Food Safety versus Environmental Protection on the Central California Coast: Exploring the Science behind an Apparent Conflict*, was written by UCSC environmental studies graduate student Diana Stuart, CASFS director Carol Shennan, and CASFS senior editor Martha Brown.

The brief examines whether potential changes in food safety regulations on farms could compromise current efforts to protect the environment—particularly water quality—from the impacts of farming operations.

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Jered Lawson



CSA managers use a variety of tactics to attract low-income consumers, including encouraging members to contribute toward the cost of subsidizing low-income shares.

UC Santa Cruz's Food Systems Working Group Helps Develop Statewide Farm-to-College Initiative

College campuses across the country are emerging as powerful sources of change as they link teaching, research, and campus engagement to focus on sustainable food systems. From local, organic, humane, and Fair Trade options in cafeterias, coffee shops, and restaurants to experiential programs and classes, campuses are offering students not only an opportunity to change their diet, but also the chance to learn about how their choices affect the larger food system. Efforts throughout the University of California's 10-campus system are transforming higher education's role in the food web, as well as the ways in which these institutions work with local and sustainable food providers.

Much of this transformation is based on work done by UC Santa Cruz's Food Systems Working Group (FSWG) to develop a more sustainable food system at UCSC (see "UCSC Makes the Farm-to-College Connection," *The Cultivar*, Vol. 24 #1). UCSC's purchasing guidelines, which target local, organic produce and other sustainably produced food, are now a model being used to develop similar guidelines for all of UC's campuses. UC Santa Cruz Executive Housing Director Sue Matthews and Center for Agroecology and Sustainable Food Systems staff member Tim Galarneau are now heading the statewide food service task force advising UC's Housing Directors in their efforts to bring sustainably produced food to campus communities.

STATEWIDE SUSTAINABILITY PROGRAMS TO INCORPORATE FOOD SYSTEM POLICIES

Students have been the driving force in steering the UC system toward more sustainable practices. In 2002, students with the statewide California Student Sustainability Coalition (CSSC) came together to express concern that none of UC's electricity came from renewable sources and to request a commitment to work together to change the UC system's energy dependence. Two years later, 16 percent of UC's energy needs came from alternative sources, making UC the largest university purchaser of renewable energy in the country.¹ Thanks to this student initiative, UC now has a statewide policy addressing green building, alternative energy, and sustainable transportation practices; implementation and evaluation of this policy are now underway.²

Although UC's "Policy on Green Building Design, Clean Energy Standards, and Sustainable Transportation Practices" targets reducing both greenhouse gas emissions and the footprint of the built environment, the policy didn't initially address food service purchases and their effect on energy use.



Tim Galarneau

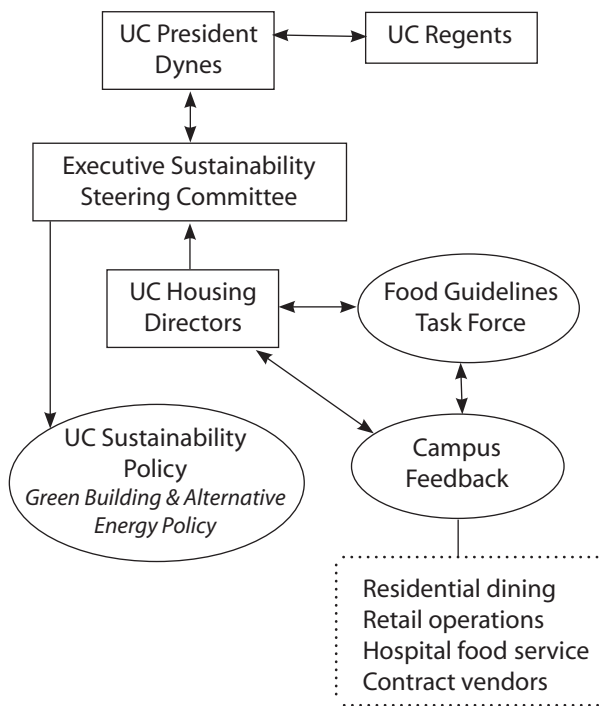
Merribeth Platt, budget analyst for UCSC's Dining Services, speaks at a dinner hosted by the Food Systems Working Group for UCSC chefs and farmers from the Monterey Bay Organic Farming Consortium, a group of growers that provides organic produce to campus cafeterias.

With the global food system identified as one of the single most important causes of increased greenhouse gas emissions—accounting for almost one-fifth of the nation's energy consumption—students have again emerged to work with UC staff to explore how the existing policy can incorporate food service components.³

Over the last two years, students from the CSSC have teamed with their student government (UCSA), student Regent, Board of Regents, Office of the President (UCOP), and Housing Directors to seek a University commitment to sustainable campus food systems. This commitment includes clear guidelines that prioritize local, organic, humane, and socially responsible purchasing, as well as waste reduction and green dining facility standards. While individual campuses continue to develop their own food service initiatives, such across-the-board UC standards would provide campuses with minimum purchasing levels and baseline indicators for a sustainable food system, as well as establish ways to measure "best practices" for both contracted and in-house food service vendors and facilities.

Recently, UC's Office of the President has made significant steps toward establishing UC-wide sustainable food system guidelines. Following a June 2006 Housing Directors Committee Meeting, the directors launched a food service task force to develop statewide guidelines to be incorporated into the existing Green Building, Alternative Energy, and Transportation Policy (concept map on next page outlines the guideline process).

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Consultation process for developing UC sustainable food systems purchasing, waste reduction, and green dining facility guidelines.

UCSC's Matthews and Galarneau (who also serves as the CSSC sustainable food initiative advisor) have taken the lead in spearheading the statewide food service task force initiative to assist the Housing Directors committee with this timely policy component. The Housing Directors task force has just released the first draft of the sustainable food service policy for statewide review and comments from UC housing, dining, and purchasing staff, and other stakeholders. Stakeholders include retail operations, hospital food services, residential dining, and contracted vendors that are being solicited for input.

The policy design currently focuses on procurement criteria (i.e., local, organic, humane, socially responsible), waste reduction measures, and water and energy conservation practices that will work in synergy with the existing statewide policy's goal of reducing greenhouse gas emissions and preserving our environment. On October 20, 2006 the UC Executive Sustainability Steering Committee sanctioned an official Food Systems Working Group under the committee to oversee completion and implementation of the statewide food policy, following its approval process within the Housing Directors Committee.

UCSC EXPANDS SUSTAINABLE FOOD SYSTEMS WORK

While efforts take place at the statewide level, food-system-based campus organizations are working in partnership with campus administrators, staff, and faculty to put in place sustainable food initiatives at each UC campus.

At UCSC, the Food Systems Working Group (FSWG) strives to increase the amount of sustainably produced food available to the campus community, and to engage

students in learning more about the food system. Last year, 18% of all produce consumed at UCSC met the sustainable food purchasing guidelines developed by the FSWG, which call for locally grown, organic produce. According to Candy Berlin, special project analyst for Dining Services, approximately 24% of UCSC's produce purchases this fall met the guidelines and 8% came from the UCSC Farm.

Building on student and staff concerns about the treatment of animals in the food system, UCSC Dining Services is also phasing in organic and sustainable dairy options and incorporating the Monterey Bay Aquarium Seafood Watch guidelines into their purchasing. The FSWG will be exploring other ways Dining Services can include humanely produced options to offer meal plan holders, including cage-free eggs. On a national level, the Center for Respect of Life and the Environment is working with organizations such as the FSWG and other groups at higher education institutions to develop alternatives to purchasing food from concentrated animal feeding operations and inhumane farming operations.

Besides working with purchasing staff to identify sustainably produced products, members of the FSWG this year helped put on several local and organic dinners that served more than 2,000 students. They also brought together the farmers of the Monterey Bay Organic Growers Consortium and ALBA Organics, who are growing food for campus dining halls and restaurants, for seasonal "reflection" dinners with campus chefs, buyers, and other stakeholders to discuss ways to improve the farm-to-college effort. In their outreach work to incoming students, FSWG coordinated an interactive food systems tent at the Fall Festival, which draws 4,000–5,000 students every year, to help students learn how to become involved in campus food system work. Students were offered local organic apple tastings from Phil Foster Ranches, fair trade juice samples from Adina World Beverages, and coffee from the Community Agroecology Network to perk up the attendees.

This fall the FSWG also released the first edition of the *Campus Food Guide*. The initial guide highlights the history of the farm-to-college movement; opportunities for civic



Candy Berlin of UCSC Dining Services helps facilitate farm-to-college activities and special events that focus on sustainable food systems.

engagement both on campus and in the community related to hunger, nutrition, sustainable agriculture, and environmental education; and seasonal food charts, recipes, food facts, and information on UCSC Dining Services' commitment to sustainability.

UCSC Dining Services has been a valuable contributor to the success of the campus's food system initiatives. This year they've committed to "going green and designing sustainable operations" as their annual focus. The overarching goal involves finding ways to meet green guidelines for all campus dining facilities, expanding their sustainable procurement, and reducing waste.

In November 2006 the campus received word that the Santa Cruz City Green Business Program had been approved; UCSC Dining Services will be the first test site for the program this academic year (2006–2007). Clint Jefferies, UCSC Food Service Manager, has been working since last spring to prepare the campus food service facilities for certification and will likely reach his department's goal of certifying all five dining halls as "green" by the end of spring quarter 2007. Efforts have included becoming the first campus dining service to become a "Buy Fresh Buy Local" member of the Community Alliance with Family Farmers; working with other campus staff and organizations to develop a composting program for dining services; and researching guidelines for purchasing energy efficient food service equipment.

CASFS SUPPORTS FARM-TO-COLLEGE EFFORTS

Members of the Center for Agroecology and Sustainable Food Systems (CASFS) play a key role in UCSC's Food Systems Working Group. From working with the Monterey Bay Organic Farmers Consortium, to growing food for the campus, to coordinating student involvement on the UCSC Farm, this role continues to expand with support from CASFS director Carol Shennan.

Thanks to funding from the True North Foundation and the Wallace Genetic Foundation, CASFS has established a Farm-to-College staff position; along with her work as the farm's Community Supported Agriculture program coordinator, Nancy Vail supports campus education and outreach efforts that bring students and community members to the UCSC Farm, as well as coordinating deliveries of food grown by CASFS apprentices to campus food service units, and teaching a Freshman Interest Group class on organic farming. Jan Perez, a specialist with the CASFS social science research group, recently conducted an online survey that evaluates student meal plan holders' interest in social justice and environmental issues related to their food. She is also working with Patricia Allen, associate director of CASFS, on a multi-year study to review the structures and efficacy of farmer cooperative and consortium designs in relation to institutional buyers across the country, and to analyze the influence of consumer preferences on the demands of institutional markets (see cover article, this issue).

Environmental Studies student Lily Schneider's senior project is an example of the undergraduate opportunities made possible by the CASFS farm-to-college work. "Dur-



Julie Stultz

UCSC students and members of the Apprenticeship training course team up to plant strawberries at the UCSC Farm as part of an undergraduate internship program.

ing the 2006 season I completed my senior internship for Environmental Studies at the UCSC Farm, working on the farm to college program," says Schneider, who coordinated the field's campus produce sales, selling weekly to two dining halls and the Terra Fresca restaurant at the University Center. "I also led groups of College Eight first-year students in the Harvest for Health program, where they visit the farm, harvest a variety of crops, and carry them to their dining hall, literally making the farm to college connection." In addition, Schneider helped organize a new project that offered UCSC students the chance to use their meal plans to purchase shares in the campus farm's CSA program (see page 14 of this issue for details).

Based on her experience, Schneider emphasizes that CASFS is in a unique position to strengthen the farm-to-college connection at UCSC. "The UCSC Farm serves as a tangible place for students to visit and learn about agriculture, and allows them to form a connection with where their food is grown," she says. "I envision CASFS playing a key role in the farm to college movement in the future . . . Students that would like to get involved with the farm to college movement at UCSC should encourage their dining halls to buy more local, organic produce, join the CSA for the 2007 season, or consider doing an internship at the farm. There are endless ways to get involved!"

CAMPUSES ADVANCE SUSTAINABLE FOOD SYSTEMS WORK

Other UC campuses are also finding creative ways to add sustainable components to their food service programs. At UC Riverside (UCR), a collaborative program among Housing and Dining, Sustainable UCR, and the College of Humanities, Arts, and Social Sciences is building experiential residential gardens that include herbs and produce for the campus dining halls. In addition, UCR is working closely with the campus's Citrus Variety Collection staff and field crew to begin serving citrus juice blends and table fruit grown

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on site in the campus dining halls and to provide research opportunities for students.

At UC Davis, the campus's coffee house, SOHO, in partnership with student organizations, recently hosted "Local Foods" week, featuring produce from local farms, film discussions, and speaker nights. SOHO is also a "Buy Fresh Buy Local" member of the Community Alliance for Family Farmers (CAFF). Members of the UC Davis graduate student-based Students for Sustainable Agriculture (SSA) group have been working closely with Sodexo's campus dining services and staff to assess their food system and develop ways to increase local and sustainable food options, reduce waste, and find innovative solutions to food service challenges.

At UCLA, statewide graduate student representative to the Sustainability Steering Committee, Crystal Durham, coordinates the emerging Food Systems Working Group and staffs their Sustainability Committee. Accordingly to Director of Housing and Residential Dining, Mike Foraker, UCLA is approaching this at the "30,000 foot perspective," weighing food procurement, waste reduction, and energy savings. UCLA, among other campuses across the state, is working with the Community Alliance with Family Farmers (CAFF) Grower Collaborative Networks to source sustainably produced fruit and vegetables for their food service facilities.

As individual campuses build their commitment to sustainable food purchases and education-based initiatives, the UC statewide guideline process discussed above will create systemwide "best practice" models and set baselines for measurable goals. Further, it will fuel a much-needed discussion of how large universities can establish comprehensive sustainable food system programs that build on learning and education and support regional food systems, while at the same time reducing energy use and waste. The UC Green Building and Alternative Energy Policy has also been adopted by the Board of the California State University system; this creates an opportunity to offer a comprehensive food service policy as a model for the CSU system and institutions across the country.

At the UC Regents meeting in January 2007, students from the California Student Sustainability Coalition will present an update on the status of the sustainable food systems guidelines, and discuss why the Regents' continued support of this effort is essential to redefining health, wellness, and sustainability in the context of our food system.

– TIM GALARNEAU

For more information on UC statewide activities and initiatives please contact Tim Galarneau at tgalarne@ucsc.edu. For more information on UCSC's farm-to-college projects, please contact Nancy Vail at navail@ucsc.edu, or see www.ucsc.edu/casfs

¹www.ucop.edu/facil/sustain/welcome.html

²www.ucop.edu/facil/sustain/welcome.html

³www.isec.org.uk/toolkit/factsheet.html#1/facil/sustain/welcome.html

Research Updates

continued from page 8

The authors pose the question, "Are the goals of environmental protection and food safety mutually exclusive on the Central Coast, or can we have safe food and a healthy environment?" Using information from existing research, the brief examines the effectiveness of measures being used by Central Coast growers to address environmental problems. The authors then summarize the history of food safety issues on the Central Coast, and outline potential sources of crop contamination in the field. Finally, they discuss the ways that food safety guidelines conflict with environmental protection methods, proposing the idea that such methods could in fact be designed to reduce contamination sources and improve food safety.

The crux of the conflict is the possibly misplaced concern by the food industry about wildlife as a source and vector for *Escherichia coli* 0157:H7, the contaminant that caused the September 2006 outbreak of *E. coli*-related illnesses traced to spinach grown on the Central Coast. As a reaction to this and other produce-based contamination incidents, industry guidelines are calling on growers to remove non-crop vegetation located adjacent to crop fields that could attract wildlife. However, non-crop vegetation is often used as vegetative buffers, filter strips, in grassed waterways, and other "best management practices" designed to reduce the impacts of pesticides, fertilizers, and sediments originating from farms. Removing this vegetation from around cropped fields to create "clean" fields could in fact lead to water quality contamination by agricultural chemicals and sediments.

According to research reviewed in the brief, wildlife has in fact been found to carry very low or no levels of *E. coli* 0157:H7. Cattle have been identified as the most important reservoir of *E. coli* 0157:H7, which can spread from cattle manure via soil or water contamination, or from direct contact with an infected animal. The authors propose that water quality improvement measures such as vegetated buffers, grassed waterways, and constructed wetlands could also be designed to improve food safety by filtering out *E. coli* and other pathogenic bacteria. Research discussed in the brief has shown the potential for such systems to reduce levels of pathogenic bacteria in the field.

See page 8 for information on receiving titles in the Research Brief series.

Vegetation barriers (left) protect wetlands from agricultural chemicals and sediments from adjacent fields.



Courtesy of NRCS

40th Anniversary Year Kicks Off at Eco-Farm Conference

The year 2007 marks the 40th anniversary of Alan Chadwick's arrival at UC Santa Cruz in 1967, when he began the Student Garden Project (now the Alan Chadwick Garden). The ideas and energy that blossomed in that 3-acre organic garden would eventually give rise to the UCSC Farm, the Apprenticeship in Ecological Horticulture, and the Agroecology Program, now the Center for Agroecology and Sustainable Food Systems.

Those attending the Ecological Farming Conference, which takes place at the Asilomar Conference Center in Pacific Grove, California from January 24–27, can help kick off the 40th anniversary year, marking four decades of organic farmer and gardener training at UCSC. On Thursday evening, January 25 from 5:30–6:30 pm, the Apprenticeship will host a mixer to bring together alumni, staff, Friends of the Farm & Garden, and other supporters for a social hour and update on 40th anniversary plans. On Friday morning from 8:30–10 am, apprenticeship staff will present one of the “Successful Organic Farmer” panels at the morning plenary



English master gardener Alan Chadwick started the Student Garden Project at UCSC in 1967.

session, featuring graduates of the training program. Over a dozen apprenticeship graduates and CASFS staff will be speaking at workshops and plenary talks throughout the conference, including a pre-conference workshop on community supported agriculture organized by Nancy Vail, the UCSC Farm's CSA manager.

To register for the Eco-Farm conference, see www.eco-farm.org or call 831.763-2111. Check the Center's web site, www.ucsc.edu/casfs, for more information on events marking the 40th anniversary year, including the upcoming “Back 40” celebration planned for July 27–29, 2007 at UCSC. If you'd like to be added to the mailing list for further information about the “Back 40” event, contact Erin Justus at farmangarden@gmail.com, 831.459-3248.

Grants Support Apprenticeship, New Greenhouses, Farm-to-College Efforts

The Apprenticeship has received two grants totaling \$120,000 from Newman's Own Organics through the Newman's Own Foundation, the largest grant award ever made to the Center's organic training program. One Newman's grant of \$60,000 will help fund the new greenhouse facilities at the UCSC Farm and an earlier grant of \$60,000 is already funding Apprenticeship staff salaries this year. Newman's Own Organics sells certified organic products and produce and donates its after-tax profits to charities.

Gaia Fund awarded a \$30,000 grant for the greenhouse project, Gaia's largest grant to the Center to date. The Stanley Smith Horticultural Trust also awarded \$10,000 for greenhouse construction. The new greenhouses will serve as organic production and teaching sites, and will also demonstrate appropriate technology use on the farm such as solar electricity and recycling of irrigation water.

A \$30,000 grant from an anonymous foundation will also help support Apprenticeship staff and second-year apprentice salaries in 2006–2007, along with outreach to let other educators know about our instructional materials.

A True North Foundation grant of \$30,000 will support two connected projects of the Apprenticeship, the Farm-to-College Sustainable Food Project and the Community Supported (CSA) Education and Training Project. The Farm-to-College project links the UCSC Farm with other local organic farms to bring organic produce to the campus dining halls, and bring UCSC students to the Farm & Garden to harvest campus crops and learn about sustainable agriculture (see article, page 9).

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Farm Offers CSA Shares for Students

Building on the farm-to-college efforts being developed by Nancy Vail, who coordinates the Community Supported Agriculture (CSA) project and the CASFS Farm-to-College programs, the Center offered CSA shares especially tailored to UCSC students this fall.

“A number of students have told us, ‘I’ve gone to school here for four years and I never knew there was a farm on campus!’” says the Farm’s field production manager Julie Stultz. Student CSA shares, which provide students with a weekly box of fresh, organic produce grown on the UCSC Farm, are one way to introduce UCSC students to the Farm and get them involved in this unique marketing and community building effort.

“In the past, the timing of our CSA was bad for students because it begins in June, right when they leave for summer break. So we tailored a special membership to suit the student calendar,” says Stultz. The student CSA began September 26th, the first full week of classes, and continued until the end of the regular CSA season (November 17th). Students were able to pay for their shares with “credit” from their student meal plans. This year the program started with 15 student CSA members. Next year the program hopes to expand to 50 students. For more information on student CSA shares, contact Nancy Vail, navail@ucsc.edu, or call 831.459-4661. For more on UCSC’s farm-to-college program, see the article on page 9.



Students pick up their weekly CSA share at the UCSC Farm (photo by Lily Schneider).

Center Members and Alumni Help Form Education Association

Participants in the January 2006 conference of sustainable agriculture educators and students held at the Asilomar Conference Center (see *The Cultivar*, Volume 24, #1) have formed the Sustainable Agriculture Education Association (SAEA). Albie Miles, the CASFS curriculum development coordinator, along with apprenticeship and UCSC graduate Damian Parr, apprenticeship graduate Kathi Colen Peck, and UCSC graduate student Katie Monsen, are part of the steering committee that is organizing the association of faculty, staff, students, administrators, and practitioners dedicated to post-secondary sustainable agriculture education.

The goal of the 2006 conference was to encourage the continued development of educational programs in sustainable agriculture and agroecology through facilitating a dialogue on learning and teaching at the post-secondary level (see <http://zzyx.ucsc.edu/casfs/education/conference/index.html> for conference information and workshop summaries). During the conference, many participants expressed interest in creating an organization dedicated to promoting sustainable agriculture education. Following on the interest expressed at the conference, a survey of conference participants, committee members, and colleagues found overwhelming support for an organization such as SAEA, and a second conference.

An initial steering committee has identified the SAEA mission as promoting and supporting the development, application, research, and dissemination of best teaching and learning practices in post-secondary sustainable agriculture education and curricula through communication, training, development, and collaborative activities for teachers and learners. Subcommittees are working on developing the organizational structure and determining potential funding sources. The 2007 conference, to be held at Cornell University July 11–14 (see page 20, this issue), is being organized by a separate steering committee of students, faculty and administrators from Cornell University, Pennsylvania State University, UC Davis, Mercyhurst College, Delaware Valley College, and the Rodale Institute. For conference details, please contact conference coordinator Kathi Colen Peck at kscp@turbonet.com.

Ann Lopez Joins as Visiting Professor

Ann Lopez will join CASFS as a visiting professor for 2007. Lopez, who received her PhD in Environmental Studies from UCSC in 2002, focuses her work on the global relationship of market forces and global trade to international migration. Her current efforts include working to preserve the traditional *campesino* corn strains in a remote village of Jalisco by establishing a market for the non-GMO contaminated corn (*maiz criollo*) in the Latino community of San Jose. Says Lopez, “As the Latino community becomes more and more aware of the perils of consuming corn that is not officially organic, they are demanding uncontaminated corn from Mexico. The exchange of money for the traditional corn is good for all concerned: the *campesino* farmers, the Latino community, and the environment.

Lopez is also working with a cooperative effort that involves people in the Willow Glen community of San Jose and the east-side San Jose Latino community to establish a community-based market that provides organic produce to San Jose residents.

As a visiting professor with CASFS, Lopez plans to establish a non-profit foundation to support farmworkers and their families in Mexico in a variety of activities, and will be a resource for others at the Center and at UCSC working on farmworker and other labor issues. Her book, *The Farmworkers’ Journey*, will be published by UC Press in May 2007.

Growing a Goose Foot Trio: Spinach, Beets, and Chard

The Chenopodiaceae or goose foot family (the reference is to the deltoid-shaped leaves) is a numerically small plant family (100 genera, 1,500 species). The family has many weedy species and only a few garden vegetable crop representatives, mostly annuals and biennials –

<i>Spinacea oleracea</i>	Spinach
<i>Beta vulgaris</i>	Beets (table, sugar, mangel [cattle fodder])
<i>Beta vulgaris cicla</i>	Chard
<i>Atriplex hortensis</i>	Orach
<i>Chenopodium album</i>	Lamb's quarter
<i>Chenopodium quinoa</i>	Quinoa

Family members occur primarily in temperate and subtropical climates. They often populate saline habitats—the salt-rich steppes of Central-Eastern Asia, marshes, bogs and river estuaries of the Eastern Mediterranean Zone, the Red and Caspian Seas. Chenopodiaceae members are classified as halophytes, plants that can tolerate high concentrations of sodium salts in the soil and an associated high pH >7.0. They also reside where there are high atmospheric salts, sea sprays, etc.

Members of the Chenopodiaceae family (Chenopods for short) have evolved several ingenious strategies to cope with salty conditions. Many species have a deeply penetrating tap root that can draw on fresh water beneath either salty or brackish surface water. They also have a waxy leaf cuticle that both retards the transpiration of precious fresh water and protects against depositions of atmospheric salts. Chenopods also have very efficient “sodium pumps” that remove sodium from their cells and deposit it either outside of cell walls or into a membrane-bound cavity within the cell (a vacuole), which functions as a “toxic dump.”

Chenopods are wind pollinated, with small, inconspicuous flowers. Since there is no need to “advertise” for pollinators, they partition their resources differently, putting more energy into developing leaves.



Melissa Beveridge

SPINACH (*SPINACEA OLERACEA*)

Spinach is a fast-growing annual crop cultivated for its nutritious, succulent leaves. It is generally grown in two ways –

- 1) Baby or loose pack style
- 2) Mature bunching style (whole plant harvested)

Baby or loose pack spinach can be seeded intensively (10–20 seeds/foot), harvested at 20–30 days after germination, and enjoyed raw by itself or included in fresh salad mixes.

Mature bunching spinach is seeded at 6–10 seeds/foot, harvested at 30–50 days after germination, and used either raw, lightly steamed, or in a stir-fry.

Environmental Conditions. Spinach is emphatically a cool season crop. Along with peas, spinach is among the first sown and earliest harvested of garden vegetable crops. It is a cool temperature germinator (60 days to emergence at 30°F, 27 days at 40°F), or so the texts claim. At a more genial 50°–70°F, emergence occurs at 6–12 days and maturation at 30–50 days. Thus it doesn't really make sense to sow at temperatures below 50°F. At the upper end of the temperature range, spinach experiences a thermodormancy and markedly suppressed germination will occur when soil temperatures are in the mid 70's. Even at 70°F, germination can be retarded as much as 50%. This thermodormancy is a natural strategy to prevent germination at a time of year when growth would be poor. Quality (succulent and sweet) spinach is best produced with 30–50 days of night-time temperatures from 40°–50°F, and daytime temperatures from 55°–65°F.

Spinach is also a day-length sensitive plant. Most modern varieties respond to day lengths greater than 14 hours (early May–early August in Santa Cruz at 38° latitude) by bolting and running to seed. Some older varieties and over-wintering types bolt at 12 1/2 hours of day length. Thus varietal resistance to bolting is an important selection criterion. With requisite day length and cool temperatures (<75°F) bolting is retarded; with requisite day length and warm temperatures (>75°F) bolting is accelerated. Large plants and crowded plants respond more quickly and run to seed. A cold exposure (<50°F for >10 days) followed by warm temperatures, especially in conjunction with lengthening days, also hastens bolting.

Spinach (as well as lettuce) perceives light via a plant pigment (photochrome) in its outer leaves. Photochrome is biologically active and stimulates enzymatic reactions. It is the basis of photoperiodicity in plants. In this case it causes

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the production of the hormone florigen, which translocates from outer leaves to the apical growing point and induces flowering. The home gardener strategy of successive harvests of outer spinach (and lettuce) leaves delays bolting by as much as 1–2 weeks under cool conditions.

Sowing. Because spinach develops a deep tap root (and therefore doesn't transplant as effectively as crops with more fibrous roots, such as lettuce) it should be directly sown 1/2" deep. It can be planted in rows as close as 4"–6" apart for baby loose-pack or rows 10"–12" apart for full size plants. Seeding density –

- Baby: 10–15 seeds/foot, no thinning
- Full size: 6–10 seeds/foot, thin to 6"–8" early and throw the trimmings (*sans* roots) into a salad bowl.

Timing and strategies for sowing –

Spring crops – sow 4–6 weeks before 14 hour day lengths

Summer crops – pre-chill (refrigerate) seed 3–5 days to overcome thermo dormancy. Cold, frequent water, light shade cloth, and a thick mulch can retard soil temperatures and prolong cropping.

Fall/Winter crops – sow 4–6 weeks before first frost, mulch heavily once crop is established.

Spinach seed is only viable for 2 to 3 years, so buy small lots annually.

Watering. Spinach can tolerate some soil drying during germination—but don't push it. Once germinated, spinach is all about quick, succulent growth: provide 1"–2" of irrigation per week at 3–5 day intervals to a depth of 12" at maturity. Overhead watering is okay, but warm and wet weather promotes mildew; T-tape or other drip irrigation is a valuable tool in preventing mildew problems.

Soils/pH. Spinach can succeed in a wide range of soils. Sandy soils offer quick drainage and early warming in the spring. Clay soils offer greater water- and nutrient-holding capacity. The issue with clay is drainage, which is requisite for the 8"–15"-long primary tap root of spinach; the well-dug raised bed can be an ally in helping clay soils drain effectively.

Spinach is a very pH-sensitive plant (as are all chenopods) and does not perform well in even mildly acidic soils (<6.5 pH). Under acidic conditions it exhibits chlorotic (yellow) and stunted leaves that mature slowly. Soil pH can be adjusted by adding lime. Liming agents (calcium carbonate and dolomitic lime stone) have ancillary benefits in addition to adjusting soil pH. Lime increases the availability of nitrogen by promoting nitrifying bacteria (nitrosamines) that convert ammonium (NH₄⁺) to nitrate (NO₃⁻), a more usable form for plant uptake. Liming also promotes heterotrophic organisms that speed up the breakdown of organic matter, making phosphorous and molybdenum more available. *Caveat:* Adding too much lime, especially on sandy soils, can liberate nutrients in the short run but "burn out" a soil in the long run unless accompanied by the addition of organic matter. Thanks to the soil types on which it evolved (see above),

spinach is tolerant of alkaline soils (pH >7.0), the optimum range being pH 6.5–7.5.

Nutrients [N 60–100 lbs/acre; P 12–35 lbs/acre; K 50–100 lbs/acre]. As a fast-growing leaf crop, spinach puts a premium on quickly available nitrogen in the form of nitrate (NO₃⁻). Availability or uptake can be a problem in cold, wet, and poorly drained soils seasonally. The remedies –

- Wait until the soil warms (patience).
- Incorporate fully mature, fine particle size compost, as the smaller the particle size, the quicker and greater the NO₃⁻ availability.

Potassium (K) is a much overlooked but important nutrient for all leaf crops. In layman's terms, potassium "mellows" the rapid growth of nitrogen by creating a good "rib structure" to support the succulent growth. It gives the leaf "strength." Potassium speeds growth, enabling quick maturation while the weather is still cool and days are short. On a cellular level, potassium regulates the opening and closing of stomata as well as water retention. This regulation promotes rapid photosynthesis and quick, succulent growth, all toward a good end (product). A well-seasoned compost that contains poultry manure (high N, high P), and horse or pig manure (high K) goes a long way toward meeting the primary nutrient needs of spinach.

Seed Saving. Spinach is dioecious (literally meaning two houses), with male plants (pollen bearing) and female plants (seed bearing). Additionally, plants express themselves according to their flowering habits –

Extreme male plants – small plants, small deltoid-shaped leaves, early bolting. These are usually the weakest plants and the first 10% of bolters in a stand. They should be rogued out (pulled and discarded).

Vegetative males – larger leaves, early bolters.

Female plants – these are largest leaved and the last to bolt. Spinach is a wind pollinated species. Pollen is light and transferred by wind (up to 1 mile) from male to female plants.

Commercial seed mixes contain mostly vegetative males and female plants. A ratio of 1 male to 2 female plants is adequate for pollen transfer. Only one variety at a time can be saved, or varieties can be isolated by caging them with cheesecloth or remay (the fine grained pollen can pass through mesh screen). The seed is mature when it is hard and turns dark, dirty brown and can easily be stripped off the plant. By only saving seed from the last 10–20% of bolting plants it is possible to develop an endemic variety in your garden with higher yields and a longer cropping period.

Nutrition: 1 cup of spinach –

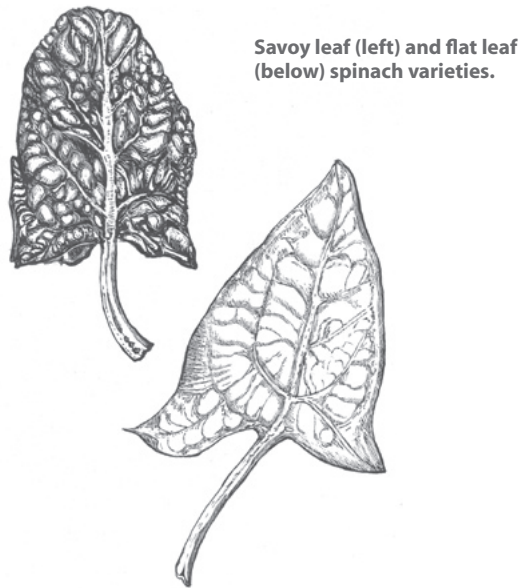
40 calories	
100% RDA	Vitamin A
62% RDA	Vitamin C
60% RDA	Thiamine
40% RDA	Iron*

It is also a moderate source of vitamins B6 and Niacin

*Note: Oxalates are the salts of oxalic acid, which is a byproduct (waste) of plant metabolism found in most chenopods. Oxalic acid crystals can be seen on the underside of spinach leaves. Its presence is most pronounced just prior to flowering. The sodium and potassium salts are soluble, but the calcium salts are insoluble. They can irritate the mouth and digestive tract. Calcium combines with the soluble oxalates to form kidney stones. So while spinach is a healthful foodstuff, there can be too much of a good thing.

Spinach Varieties of Note

Spinach varieties come in two basic leaf types: flat leaf and savoy (wrinkled) leaf (see illustration). In general, western growers favor flat leaf types and eastern growers savoy types. Flat leaf types are more succulent; savoy leaves are sturdier, darker, and more nutritious. The leaf vein on savoy leaves grows more slowly than the rest of the leaf, giving it more surface area and more nutrition per unit of space.



Savoy leaf (left) and flat leaf (below) spinach varieties.

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America (43–55 days; Seed Savers Exchange) – Bloomsdale type. Longstanding, bolt-resistant, compact plant, dark, thick savoyed leaves, slow growing, slow bolting, heat tolerant.

Bloomsdale Longstanding – (50 days to maturation; Territorial Seed Co., Fedco Seeds, Seed Savers Exchange). Longtime open pollinated, thick, dark savoy leaf standard. Definitely prone to bolting despite what catalogs advertise. Best as early spring, late summer crop. About the best winter cold tolerance (if fully established). Dates back to early 1900s and Holland. Best as full size plants.

Geant d'Hiver (Giant of Winter) (Fedco Seeds) – Old rapidly vanishing French variety that, along with the aptly-named *Monstreaux* (virtually vanished) offers some of the biggest, thickest, yet melt-in-your-mouth succulent, most bolt-prone spinach on the market.

Olympia (38 days; Fedco Seeds) – A hybrid bred specifically for fall, winter crops. Bolt prone in spring. Fast growing, tender taste, high yields.

Oriental Giant: (40 days; Territorial Seed Co.) – Produces up to three times yield of other varieties. 12–15 inches tall, upright, smooth leaf, sweet taste.

Space: (37 days; Johnny's Seeds, Fedco Seeds) – Slowest-bolting smooth leaf type. New highly productive hybrid. Upright growth, smooth, slightly savoyed leaf. Vigorous and quick to mature in all seasons, especially fall–winter.

Teton: (45–50 days) – Good for late spring, summer, fall production. Slow bolting, dark green, smooth leaves. Upright growth habit. Easy to harvest.

Tyee (44 day; Fedco Seeds) – An older hybrid. The most bolt-resistant spinach with savoy leaf, upright habit, good taste.

BEETS (*BETA VULGARIS*)

Beets are herbaceous biennial plants requiring two seasons (parts of two calendar years) to produce seed. The species probably evolved from a wild species, *Beta maritima* (Sea Beet), native to coastal marshes and estuaries in southern Europe. The crop has been in cultivation in one form or another since Roman times.

Beets are an extremely versatile crop offering a variety of shapes, sizes, colors, and uses. They can be grown as a leaf crop, using baby thinnings raw in salads to full-size steamed greens. In fact, there are varieties that are bred primarily for their abundant, attractive, tasty, and nutritious tops. One cup of beet greens provides 185% R.D.A. of Vitamin A, 20% R.D.A. of riboflavin, and 20% R.D.A. of iron (see varieties section). Other beet types and uses include: round table beets of diverse colors, pickling beets (cylindrical shape), sugar beets (rough and coarse-textured, from which 30% of the world's sugar is produced), and fodder mangel or mangel wurzels (often fermented and used as an animal fodder for diverse livestock—from rabbits to pigs to cattle).

Cycle of Growth. Beets usually complete their life cycle in two years. Germination and vegetative establishment occur in the spring and summer of year one, followed by root enlargement. The “root” of the beet is actually the swollen hypocotyl (the germinating shoot in seedlings, from the prefix *hypo* meaning under). In mild climates beets stay evergreen over the winter; in colder climates they lose their foliage. In the spring of year two beets make a little foliage growth and then—as a response to a cold chill (< 50°F for greater than two weeks) followed by a warm period in conjunction with the lengthening days of spring—will flower, set seed, and die. Sometimes as a response to back and forth weather, early spring beets will receive a cold chill sufficient to cause bolting.

A variety of plants (beets, carrots, radishes, turnips, etc.) form storage roots as a dividend after first meeting their basic foliage and root requirements. Thus with beets, quick establishment and a healthy, leafy plant give way to big, sweet beets.

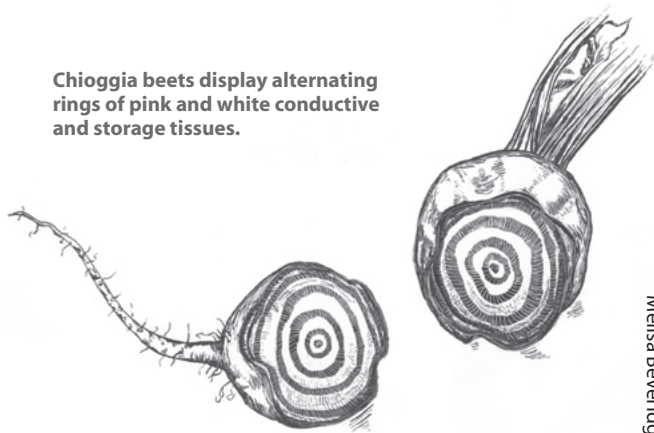
Beets form concentric rings of vascular cambia (xylem and phloem) as part of the root enlargement process. The rings or zonation in a beet consist of conductive tissues (xylem

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toward the inside and phloem toward the outside). Mixed in with these narrow, light-colored conductive tissues are bands of dark, broad storage tissues. This zoning varies in thickness and color with different cultivars. Probably the most striking example of this is the Italian heirloom variety Chioggia—with its alternating interior rings of pink and white, and its sweet flavor, the epithet candy stripe or candy cane befits it.

Beets get their color from a group of pigments called anthocyanins. The specific pigment betacyanin contributes to red coloration. Golden and yellow varieties derive from betaxanthin. Betacyanin is neither heat nor water soluble, so it is not destroyed in the cooking process and will bleed red into soups and stews. The yellow betaxanthin is destroyed by cooking and thus doesn't stain.

Chioggia beets display alternating rings of pink and white conductive and storage tissues.



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Cultivation

Seed viability. 2-4 years optimal

Seed planting depth. 1/2"–3/4"

Seeding density. Direct in rows 10"–14" apart with 10–15 seeds per foot. Thin to 3"–5" apart (depending on the size of the variety at the four-leaf stage).

Germination. 50°–85°F/65°–75°F optimal
10–14 days/7–9 days

Soils/pH. As with most root crops, an open, friable soil with good aggregation and a sandy or silty texture well fortified with organic matter grows the biggest roots with even shape. As with all Chenopods, acid conditions slow growth; a pH of 6.2–6.8 is optimal. Beets can tolerate a pH as high as 8.0.

Water. 2"–4" every 7–10 days

Nutrients. Moderate nitrogen, 50–100 lbs/acre; moderate phosphorous, 25–50 lbs/acre; high potassium, 100–300 lbs/acre

Nitrogen is needed early in the growth cycle, but should be limited later. Beets have high micronutrient needs, especially for boron. Boron deficiencies cause black spotting (internally and externally) and are also exacerbated in soils low in boron, high in calcium, with a high pH and under dry conditions. Other important beet micronutrients: iron,

manganese, copper, and molybdenum. Granulated and liquid kelp products are an organic gardener's insurance policy against micronutrient deficiencies.

Timing. Cool nights (40°–55°F), warm, sunny days (60°–75°F) coupled with an open, permeable soil and a steady supply of water (2"–4" every 7–10 days) promote rapid, uninterrupted growth, good color, and sweetness. Seed should be sown 4–6 weeks before the last frost in cold winter areas, and in March to early April in mild winter sites. Successive sowings are possible through August, with the last sowing overwintering for spring harvest.

Growing Tips and Addenda. While beet culture is much like spinach culture, beets remain vegetative under warm conditions and long days. Young beets have poor tolerance for water stress and weed competition. Established stands are good at out competing weeds owing to their broad leaf cover.

Despite their relatively shallow tap root system (6"–10" deep), beets are efficient at foraging for nutrients. Don't over-feed—especially with nitrogen—late in the growing cycle; this retards root development, suppresses sugar content, and contributes to hairy roots. Thin early as competition affects root size.

A tip on thinning—do it carefully so as not to disturb remaining plants and do it late in the day to avoid heat stress. After thinning, lightly water remaining plants to firm in roots and minimize "weeding wilt." If root tops are exposed to sunlight they become tough and corky. Close spacing of rows and/or hilling soil up around the shoulders solves the problem.

It takes 60–70 days to produce a good-sized table beet. Baby beets are truly varieties that are small at maturation with full color, flavor and nutrition, not merely immature, full-size varieties.

Beet Varieties of Note

Leaf types (can begin harvesting at 20–30 days)

Lutz Green Leaf, a.k.a. *Winter Keeper* (60 days; Fedco Seeds, Territorial Seed Co.) – An heirloom variety from Europe, introduced to the U.S. in early 1900s. The leaves are a glossy yellow, green and are excellent young in salad mixes or mature steamed. Roots are slow to develop but get quite big (4"–5") and are especially sweet when baked.

McGregor's Favorite – An old Scottish heirloom grown for its striking metallic red/purple narrow triangular leaves. Unfortunately it is all but impossible to get seed (Seed Saver's Exchange — crop failure in 2006).

Bull's Blood (60 days) – Similar to McGregor's but readily available. The roots are rough textured and odd shaped.

Novelty types

Chioggia, a.k.a. *Bassano* (55 days; Johnny's Selected Seeds) – Named after the Venetian hill town where it was developed. Old heirloom with good sweetness, light red exterior and pronounced zonation of pink and white. Zoning blurs when steamed but stays intact baked.

Golden (60–70 days; Fedco Seeds, Johnny’s Selected Seeds, Seed Savers Exchange, Territorial Seed Co.) – An old Burpee Seed Co. introduction. Green tops, yellow stems and bright golden/orange exteriors. Mild, tender, not sweet flavor, doesn’t bleed when cooked. That’s the good news. The bad news is: an erratic seed supply year-to-year, poor germination, especially in soils cooler than 65°F, prone to damping off fungus problems, slow to size up, variable size and rough odd-shaped exteriors, and expensive seed (average price/oz [1500 seeds] for beets \$3–\$5; Golden beets \$9–\$12/oz).

Cokes Golden (55 days; Fedco Seeds) – Salinas area grower Dale Coke has been growing his own golden beet seed for over 10 years. He has developed a more vigorous, quicker-maturing, rounder, more uniform variety.

Albino (50 days; Seed Savers Exchange) – A white, sweet beet owing to its sugar beet parentage. A little rough textured.

Blankoma (55 days; Johnny’s Selected Seeds) – An improved white beet. Best taste when harvested 2”–3” across.

Cylindra, a.k.a. *Formanova* and *Forono* (Fedco Seeds, Johnny’s Selected Seeds, Seed Savers, Territorial Seed Co.) – An old, carrot-shaped, oblong variety 6”–8” long, that is sweet, peels easily, has a smooth texture, and is easy to slice for canning and pickling. Keep shoulders hilled to prevent sunburn.

Red Types

Kestrel (53 days; Territorial Seed Co.) – A great baby beet! Sweet, smooth, dark red beets that are the most bolt-resistant variety. A clean leaf that is resistant to cercospora fungus.

Red Ace (55 days; Fedco Seeds, Johnny’s Selected Seeds, Territorial Seed Co.) – An improved hybrid that is quick to grow, sizes up quickly and uniformly. Uniform beets that are large, smooth, and sweet even when older.

Moneta (46 days; Johnny’s Selected Seeds) – A hybrid monogerm variety containing only one seed. Most beet seeds are fruits containing 2–6 seeds. Eliminates the need for thinning.

Early Wonder Tall Top (45 days; Johnny’s Selected Seeds, Territorial Seed Co.) – As the name implies, this early cool season beet allows early seeding. Staggered maturation, non-uniform roots. Mild, sweet taste.

SWISS CHARD, *BETA VULGARIS CICLA*

The word chard is derived from the French word *chardon* for thistle, owing to its large, succulent, savoyed leaf similarity. Chard is also referred to as perpetual spinach, or sea kale beets in England. In essence it is a beetless beet, or a spinach with panache.

In the kitchen chard is actually two different vegetables—the leaves (leaf blade) and stem or rib (petiole). In cooking they should be separated and prepared separately. The leaves steam or sauté quickly; the ribs are tougher and require longer cooking.

Chard varieties fall into two camps –

“Old School”—full size, thick, dark green, white-stemmed or rhubarb with deep crimson leaves contrasted with dark green veins and an apple-red stem. Old School varieties are actually sweeter and full of flavor as they mature.

“New School”—plants with stems of many colors: gold, pink, yellow, purple, red, and white. They have smaller, less-savoyed leaves. The catalogues tout them as “mild tasting,” arguably a euphemism for bland. Additionally, plants of this type are often weaker, to the point of lacking enough turgor to stand fully erect, and are easily damaged in post-harvest handling.

Old School Varieties of Note

Argentata – Vigorous; the most cold hardy chard. Wide silver mid-rib. Sweeter with less salty, oxalic acid taste than other chards.

Fordhook Giant – Introduced by Burpee Seed Co. in the early 1900s. Broad white stems, dark green leaves. Vigorous 3’-tall plants.

Rhubarb – An heirloom European variety (1850s). Deep crimson stalks and leaf veins. Dark, metallic-green foliage. A striking ornamental plant as well as good tasting.

Italian Silver Rib – Old Italian variety. Wide ribs of silver-white. Large, glossy, heavily savoyed leaves. Big plant, big succulent leaves.

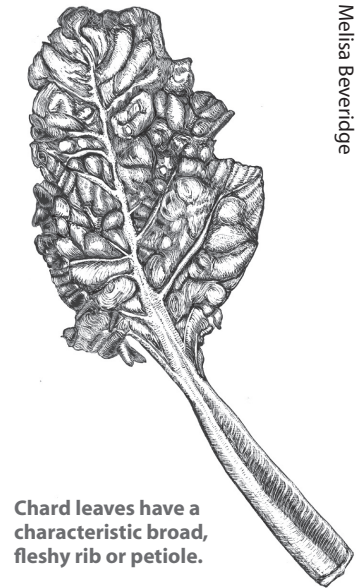
New School Varieties of Note

Bright Lights – Originally selected and bred by amateur gardener John Eaton of New Zealand. Brought up to commercial standards by Johnny’s Selected Seeds (All American Selections winner 1998). Many-colored stems—purple, pink, gold, yellow, red, and white. Smaller, flatter-leaf type with light green or bronze color. Mild taste. Impressive looking on the shelf and in salad mixes. There are a number of individual colors offered from this mix: bright yellow, pink passion, magenta sunset, pot of gold, etc. A word of note, in the “nothing new under the sun” category: Aristotle first observed colored pigmentation in chard in 400 BC!

– ORIN MARTIN

Seed Sources

Fedco Seeds, fedcoseeds.com
 Johnny’s Selected Seeds, www.johnnyseeds.com
 Seed Savers Exchange, www.seedsavers.org
 Territorial Seed Co., www.territorial-seed.com



Chard leaves have a characteristic broad, fleshy rib or petiole.

Melissa Beveridge

Santa Cruz area events

► **Fruit Tree Q & A**, Saturday, February 3, 10 am–12 noon, Lumberman's (formerly San Lorenzo Garden Center), 235 River St., Santa Cruz. Bring your fruit tree questions to this free Q&A session with Chadwick Garden manager Orin Martin. Orin will discuss varieties, pruning, fertility, and general fruit tree care techniques.

► **Bread Baking Workshop**, Saturday, March 17, 4 pm–7 pm, Feel Good Foods Kitchen, 306 Potrero St., Santa Cruz. The experts from Companion Bakers team up to teach you the basics of baking great bread. This hands-on workshop will cover ingredients, sourdough starters, shaping loaves, baking times, and other tips. \$20 for Friends' members; \$25 for non-members. Please pre-register for this event by Monday, March 12 by calling 831.459-3240 or send email to jonitann@ucsc.edu.

For information on the above events, call 831.459-3240, email jonitann@ucsc.edu, or see www.ucsc.edu/casfs.

Second National Conference on Sustainable Agriculture Education Planned

The 2nd National Conference on Facilitating Sustainable Agriculture Education will take place July 11–14, 2007 at the Alice Cook House Conference Center of Cornell University, located in Ithaca, New York. The conference will draw a diverse gathering of faculty, staff, undergraduate and graduate students, administrators, extension educators, farmers, and food system practitioners who are active or interested in sustainable agriculture education at post-secondary institutions.

Says the conference steering committee:

If you joined us for the 2006 conference at Asilomar, in Pacific Grove, California, we will continue and improve upon what we started! If you are joining us for the first time, we hope you will become a part of this innovative gathering of friends and colleagues to:

- Promote and support sustainable agriculture education
- Share curricula teaching experiences and hands-on learning approaches
- Exchange educational approaches and materials
- Learn how to start and sustain sustainable agriculture education programs
- Celebrate and further develop the Sustainable Agriculture Education Association
- Discuss opportunities and create strategies to work together

The conference will use interactive and participatory formats for workshops and discussions. There will also be ample time for networking.

The Alice Cook House Conference Center was selected for its affordability, location in the eastern United States (the first conference was held in the west), and access to local food and "green" conference services. Scholarship assistance may be available to students. The event will begin on the evening of July 11, include numerous field trips and field exercises in the region, and continue until mid-day on July 14, allowing adequate travel time at both ends. Conference details are now being developed.

For more information and to receive conference updates, please contact Kathi Colen Peck, Conference Coordinator, at kscp@turbonet.com.

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