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The CENTER for AGROECOLOGY & SUSTAINABLE FOOD SYSTEMS

in this issue:

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Center Examines Phosphorus Levels in Local Watersheds

The use of phosphorus fertilizers on farmland can affect the health of adjacent waterways, such as Elkhorn Slough (foreground, Monterey County).

Most growers along California's Central Coast use phosphorus fertilizer (along with nitrogen and potassium sources) to maintain crop production levels. However, increasing evidence suggest that crops cannot take up all of the phosphorus fertilizer being applied,[1] and as a result, excess phosphorus is accumulating in the soil. High levels of soil phosphorus in turn lead to higher phosphorus levels in water draining from agricultural fields.[2] This increase in phosphorus can trigger conditions that compromise drinking water quality and degrade wildlife habitat (see sidebar, next page).

As part of their work monitoring water flow and quality in the Central Coast region, researchers Pepper Yelton, Kristy Morris, and Marc Los Huertos of the Center for Agroecology and Sustainable Food Systems (the Center) measured phosphorus levels from 60 sampling sites throughout the Pajaro River and Elkhorn Slough watersheds over the past 4 years. Sites were selected to bracket agricultural activity and other land uses in order to compare concentrations upstream and downstream of potential nutrient sources. This project was initiated in October 2000 by Center director Carol Shennan, with funding provided by the U.S. Department of Agriculture and the Regional Water Quality Control Board. Cooperators on the project include the Santa Cruz County Farm Bureau, local Resource Conservation Districts, and other agencies.

In this article we present data from several key monitoring sites that demonstrate spatial and temporal patterns found to be characteristic of the entire watersheds. We examine the implications of these data for agricultural regulations, and offer suggestions to reduce phosphorus losses from farmlands.

PAJARO AND ELKHORN WATERSHEDS

The Pajaro River watershed drains approximately 1,300 square miles of land, with 7.5% (60,815 acres) of the watershed in agriculture. Agricultural activity is concentrated primarily in three productive areas: on the flood plain of the Pajaro River near the towns of Watsonville (Santa Cruz County) and Aromas (Monterey County); in South Santa Clara Valley near Gilroy and San Martin (Santa Clara County); and in the

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San Juan Valley near San Juan Bautista and Hollister (San Benito County). Production near the coast is dominated by cool-weather vegetables, berries, flowers, and apples. In the warmer inland areas—east of the Santa Cruz and Gabilan ranges—growers rotate crops of cool- and warm-weather vegetables, along with grapes, flowers, and stone fruits.

Approximately 70 square miles in size, the Elkhorn Slough watershed drains northern Monterey County and a small portion of San Benito County. Approximately 24% of the watershed is in agriculture (10,318 acres), with strawberries and cool-weather vegetables making up the majority of cultivated acreage.

AGRICULTURAL LAND USE AND SRP

Comparisons of sites upstream and downstream of agriculture revealed higher downstream soluble reactive phosphorous (SRP) concentrations in many waterways, providing evidence that agricultural land is a source of phosphorus in surface waters. In Watsonville Slough, and in the Elkhorn Slough watershed in Corn Cob Canyon and Carneros Creeks, SRP concentrations were elevated at all locations, but were particularly high downstream of agriculture (Table 1, above). In Watsonville Slough, concentrations exceeded the 0.12mg/L target at Ohlone Road (upstream) in 80% of samples, compared to 96.1% at Shell Road (downstream). In Carneros Creek the median SRP concentration was 0.10 mg/L at Dunbarton Road, upstream

Table 1. Median concentrations and percent of samples that were over the Regional Board target of 0.12mg/L SRP for biweekly samples collected between Oct 2002 and September 2004. Sites are listed from most upstream to most downstream for each waterway.

Location	Median concentration (mg/L)	% samples over 0.12 mg/L target
Llagas Creek		
Below Chesbro Reservoir	0.045	9.8
Monterey Rd.	0.034	10.5
Bloomfield Ave	0.054	15.7
Uvas Creek		
Below Uvas Reservoir	0.028	8
Highway 152	0.027	9.84
Bloomfield Ave.	0.033	15.7
Miller's Canal		
Frazer Lake Rd	0.047	26.7
San Benito Creek		
Y Road	0.023	3.4
San Juan Ditch		
Anzar Road	0.29	96.8
Pajaro River		
Chittenden	0.137	53.6
Murphy's Crossing	0.097	22
Main Street	0.11	35.8
Corralitos Creek		
Las Colinas Rd.	0.113	40.4
Green Valley Rd.	0.081	25.7
Salsipuedes Creek		
Riverside Drive	0.149	62.3
Watsonville Slough		
Ohlone Rd.	0.309	80.4
Shell Rd.	0.252	96.1
Corn Cob Canyon Creek		
Lewis Rd.	0.113	48.7
Hudson Landing Rd.	2.163	100
Carneros Creek		
Dunbarton Rd.	0.093	40.9
San Miguel Canyon Rd.	0.526	100

Phosphorus Impacts

Reactive forms of phosphorus, called orthophosphate (OP) or soluble reactive phosphorus (SRP), are readily taken up by algae, and in excess levels may lead to algal "blooms." Small losses of phosphorus from farmland are enough to stimulate algae growth in lakes and streams. The excess growth of algae or aquatic plants—a process termed eutrophication—can threaten drinking water supplies by creating toxic conditions and fouling water intakes. The algal bloom and the microorganisms that feed on dead algae can reduce the availability of dissolved oxygen, thus limiting or killing populations of fish, amphibians, and other organisms.

As part of state and federal efforts to protect and restore water quality, regulatory agencies have been charged with establishing target concentrations for various nutrients and other pollutants. The Central Coast Regional Water Quality Control Board has set a preliminary target of 0.12mg/L for Soluble Reactive Phosphorus (SRP) concentrations, based on the lowest concentrations they have observed in the Pajaro River watershed with excessive plant or algae growth. This pollution is thought to come primarily from diffuse, or "non-point" sources, which include urban and rural land uses.

Under state legislation known as the Agricultural Discharge Waiver that took effect in January 2005, farmers are required to develop farm water quality plans to protect surface waters along the Central Coast. One goal of the water quality monitoring research being conducted by the Center for Agroecology and Sustainable Food Systems is to inform growers of current water quality conditions in waterways adjacent to their land and in the region so that they can take steps to reduce their impacts on waterways while continuing to farm profitably.

of agriculture, and 0.53 mg/L at San Miguel Canyon Road, downstream of agriculture. In Corn Cob Canyon Creek the median SRP concentration was 0.11 mg/L at Lewis Road, an upstream site, and 2.2 mg/L downstream at Hudson Landing. At the downstream locations in both creeks, SRP concentrations exceeded the 0.12 mg/L target level in 100% of biweekly samples.

In the Pajaro River, elevated SRP concentrations occur in the upstream reaches of the river at Chittenden Gap, due in large part to input from San Juan Creek and associated drainage ditches that drain irrigated fields in the San Juan Valley. Unlike tributaries draining the south Santa Clara Valley, San Juan Ditch had elevated SRP levels throughout the year (median of 0.29 mg/L) and was a significant source of nutrients to the Pajaro River during summer months. Other, less accessible agricultural ditches in the south Santa Clara and San Juan Valley regions may also be present and may contribute nutrients to the Pajaro River that are currently unaccounted for.

In addition to agriculture, natural processes and urban runoff may also contribute phosphorus to waterways. Small amounts of phosphorus are deposited from the atmosphere in rainfall and in dry airborne particulates. Urban sources include residential fertilizer use, automotive products, and septic tanks and leach fields. In the past, detergents were a significant source of urban pollution, but most detergents are now phosphate-free. Although no increase in phosphorus levels was detected at urban sampling locations on Llagas and Uvas Creeks (data not shown), it is possible that urban runoff contributes to elevated SRP levels in Watsonville Slough and the lower Pajaro River.

SEASONAL PATTERNS OF SRP

In many waterways we detected seasonal changes in SRP concentrations. In several waterways SRP concentrations increased late in the summer, between September and the first winter storms. This pattern occurred in San Juan Creek, in the Pajaro River at Chittenden Gap, and in Corn Cob Canyon Creek (Figure 1c). All of these sections of waterways have high SRP concentrations and receive discharge from agricultural areas. The late summer increase in SRP levels may be due to the combined effects of agricultural discharges and decreasing stream flows, which limit the capacity of waterways to dilute nutrient inputs.

In contrast, Watsonville Slough had its highest SRP concentrations from fall through spring, with concentrations declining to an annual low point in mid summer (Figure 1a). High SRP concentrations in the winter may be associated with an increase in the amount of water flowing from beneath agricultural fields (subsurface lateral flow) along Beach Road, where the water table is particularly high. It is also worth noting that Watsonville Slough at Ohlone Road, our most upstream site in the slough, had a period of very high SRP concentrations in the late summer through fall of 2003; these may be associated with a construction project that occurred adjacent to the sampling site.

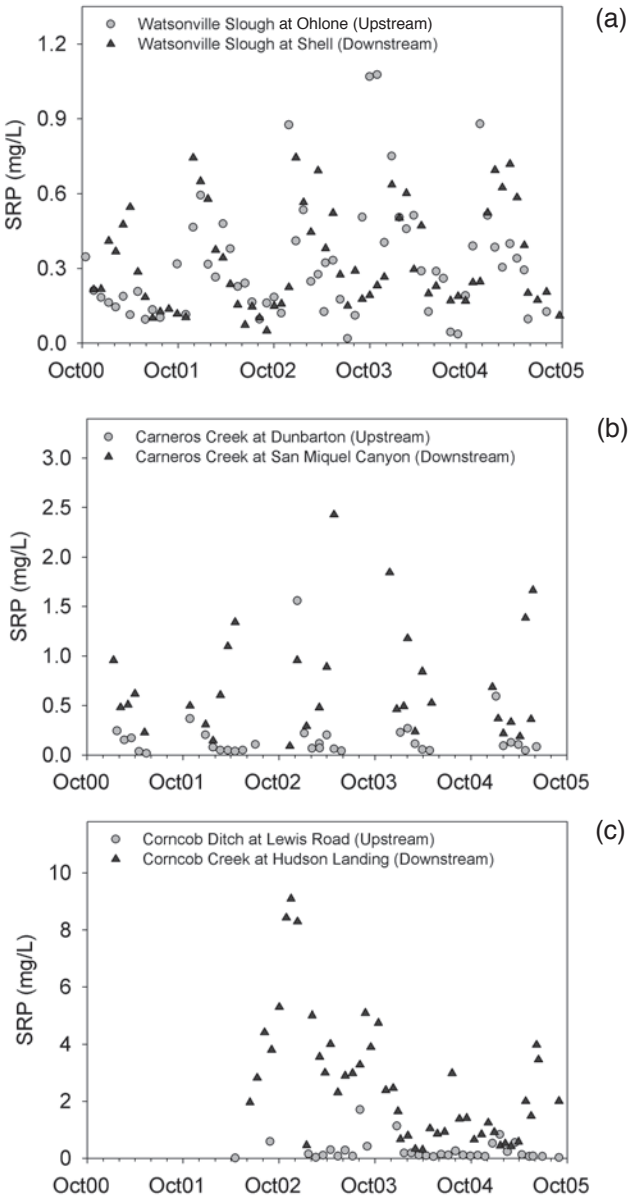

Figure 1. Median monthly SRP concentrations in a) Watsonville Slough, b) Carneros Creek, and c) Corn Cob Canyon Creek. Carneros Creek had no flow from May–December and Corn Cob Canyon Creek at Lewis Road had no flow from October to first rains.

In Carneros Creek, which is dry from approximately May until December each year, a different seasonal pattern emerged (Figure 1b). SRP concentrations were moderately elevated at sites both upstream and downstream of agriculture following the first winter rains, which suggests that soil phosphorus accumulates over the summer months and is flushed into the creek with the first rains. At upstream sites, sources likely include natural decomposition in grasslands, cattle grazing, and rural residential land use; downstream sites also include agricultural land use. At San Miguel Canyon Road, downstream of agricultural activity, SRP concentrations also increased in the late winter and spring during the 2002 and 2003 seasons, reaching very high levels

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from the director

This fall's issue of *The Cultivar* reflects the diversity of the Center's activities. From water quality monitoring, to consumer surveys, to children's education programs, to organic gardening practices, Center members are working on many fronts to develop a more sustainable food and agricultural system.

The water quality monitoring efforts we initiated in 2000 have grown rapidly over the past five years, as growers and policy makers confront the issue of how best to minimize the impact of farming practices on the Central Coast's streams, rivers, and wetlands. In our cover article we report the results from our phosphorus monitoring research. A new grant from the State Water Resources Control Board (*page 11*) will enable us to expand our monitoring and education projects over the next several years, along with efforts to better understand the many factors that affect water quality in the region.

Work by our social issues staff on consumer interest in food system issues has revealed some compelling information on the audiences that are most interested in topics such as better salaries and conditions for farm workers, humane animal production practices, and support for local growers. Data on consumer demographics and behavior analyzed by Phil Howard (*page 7*) can help growers and educators find support for improving farming and food system practices. Our recent survey of UCSC students, staff, and faculty on similar issues (*page 11*) will help those working with the campus food system better understand the concerns of consumers who use the campus's cafeterias and restaurants.

A new grant to the Center from the California Department of Education (*page 5*) will expand the already-popular programs of the Garden Classroom, located on the UCSC Farm. This educational garden, run collaboratively by the Life Lab Science Program and the Center, serves more than 3,000 students, teachers, and other visitors annually with programs in garden-based science and nutrition. In recognition of these efforts, the Department of Education grant designates the Garden Classroom as one of three state Regional Training Centers in Nutrition Garden Based Learning, bringing expanded programs to teachers and students in the 5-county Central Coast region.

Also new this fall is a publication by Orin Martin, master gardener and longtime manager of the Center's Alan Chadwick Garden. Orin's *Rose Primer: An Organic Approach to Rose Selection and Care*, offers gardeners tips on how to choose and cultivate roses using organic techniques (*page 6*). In this issue he also shares ideas for growing lettuce in the home garden (*page 13*), along with recommendations for some delicious additions to your salad bowl.

I hope you enjoy reading about the multifaceted nature of the work we're doing here at the Center.

– Dr. Carol Shennan, Director

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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.

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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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California Department of Education Designates Garden Classroom as Regional Training Center

After a morning of pressing apples for juice, studying worm compost, shucking corn to grind for tortillas, and learning about plant parts, a third grade student on a field trip to the Garden Classroom was overheard saying, "This is the best day of my life, so far." Starting in 2006, a grant from the California Department of Education to the Center for Agroecology and Sustainable Food Systems (the Center) will give even more students and teachers the chance to enjoy a great day—and a great learning experience—at the Garden Classroom, run collaboratively by the Life Lab Science Program and the Center.

Surrounded by the UCSC Farm's organic fields and orchards, the Garden Classroom offers students hands-on lessons in garden-based science and nutrition. The outdoor classroom includes raised beds planted in vegetables, herbs, flowers, and perennials; a kid-friendly flock of chickens; a native plant meadow; worm and compost bins; an observation beehive; an outdoor kitchen; and many other features designed to immerse visitors in the world of plants and the connections amongst the gardens, the fields, and the table.

In 2006, the Garden Classroom will join the San Diego Resource Conservation District and the UC Davis Children's Garden Program as a California Department of Education (CDE) Regional Training Center in Nutrition Garden Based Learning. CDE funds for this effort will support a new program coordinated by the Center, targeting public school educators and students in grades K-8 in the Central Coast counties of Santa Cruz, Monterey, Santa Clara, San Benito, and San Mateo.

The regional training centers are part of a statewide effort to expand garden-based nutrition education to schools throughout California. Garden Classroom staff will provide programs and support for a variety of projects on the Central Coast, including –

- Six half-day garden-based learning workshops for Central Coast teachers, with an emphasis on nutrition education
- A Garden Based Nutrition Workshop Track as part of the Ninth Annual Spring Conference of Life Lab Science Program's Monterey Bay Science Project
- Consultation site visits to schools beginning edible garden projects
- A garden-based learning session as part of the UCSC Masters of Education/Teacher Credential program
- Facilitation of a regional garden coordinator/nutrition educator network

John Fisher

Pajaro Valley teachers at a training workshop learn an easy way to sow seeds with kids at a "Plant It, Grow It, Eat It" workshop at the Garden Classroom.

- Participation in the UC Garden Based Learning Work Group
- Participation in the newly formed California School Garden Network

The Garden Classroom's new status as the Central Coast Regional Training Center is the latest step in a 35-year history of garden-based education at UC Santa Cruz. Both the Center and the Life Lab Science Program have long worked to train educators, students of all ages, and the general public in plant- and garden-based science and nutrition education. In 2000, the Life Lab Science Program and the Center collaborated to create the 2-acre Garden Classroom to serve as a model educational garden and as a site for public outreach and training related to garden-based learning. The kitchen component of the Garden Classroom was completed in 2002, enhancing nutrition-based learning and training on the Central Coast.

UCSC students working as interns at the Garden Classroom have played a major role in its development, creating many of the learning stations and leading tours for visiting classes. Center staff and members of the Apprenticeship training program are also active in helping create programs and resources

Since its founding, the Garden Classroom has become a popular destination for field trips, workshops, and tours, serving over 3,000 students and hundreds of educators annually. Each weekday during the school year, pre-school through middle school students from throughout the Central

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New Book by Chadwick Garden Manager Demystifies Organic Rose Care

Master gardener Orin Martin cuts a lush bouquet of fresh, organically grown garden roses for his eldest daughter each year on her birthday. What's unusual is that she was born November 9. Better yet, when Martin sits down to Thanksgiving dinner, a rose-based bouquet often adorns his table.

Impossible, you say? Not so, replies Martin, manager of the celebrated Alan Chadwick Garden at UC Santa Cruz. "Roses require a little bit of attention every day, and for that, they'll reward you with a spectacular bloom in April, a mini-spring in August and September, and blossoms into November and December, depending on the weather," said Martin.

After years of perfecting the art of organic rose care, Martin shares his expertise with the rest of us in the new book, *A Rose Primer: An Organic Approach to Rose Selection and Care*, published by the Friends of the UCSC Farm & Garden and the Center for Agroecology & Sustainable Food Systems.

The book spells out the steps to success in a year-round guide to the care and feeding of organically grown roses, and includes Martin's tips regarding selection, sources, and planting, as well. Each section ends with a handy "In a Nutshell" summary for busy gardeners. Though focused on rose-growing on California's Central Coast, the book is filled with principles that carry over to rose cultivation in other areas.

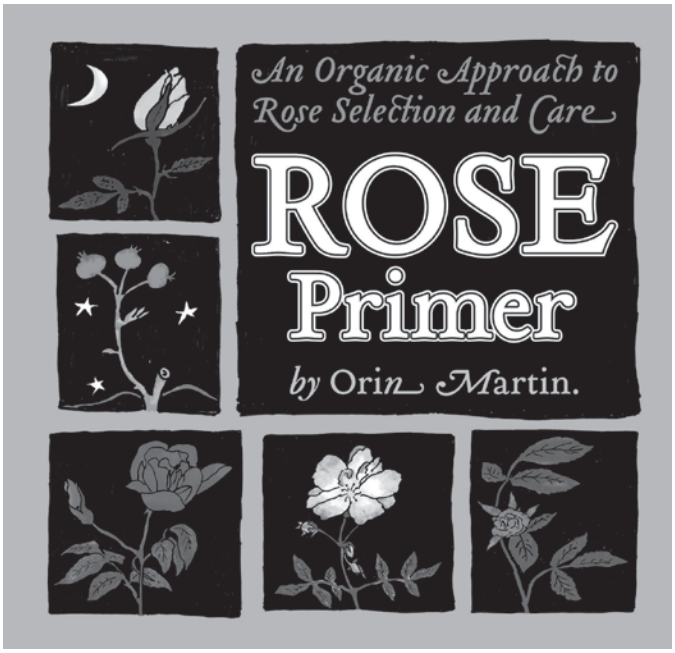
"People think of roses as requiring lots of chemicals, but really what they need is care. If you have five minutes a day, you can do it," said Martin. "Roses are resilient. Even if you run into problems with disease or pests, with good care, you can turn them around in a matter of weeks during the growing season."

Success lies in a program of pruning, fertility, and disease control, according to Martin.

• **Pruning**—Winter pruning is performed during January's brief period of dormancy to stimulate growth. Counterintuitively, the more you prune, the more growth you'll get. Heavy pruning is followed by "finger pruning" (pinching off sprouts) in February and March to control new growth and shape the plant.

• **Fertility**—Winter pruning should be followed with a liberal two-inch layer of organic compost, topped by an inch of mulch to control weeds and hold moisture.

• **Disease control**—Following the winter pruning, a light spray of dormant petroleum oil will combat insects and lime sulfur will reduce fungus. Using both produces a synergistic effect and requires one-third less product, noted Martin. "If you do nothing else with your roses, prune them hard in the winter and use these sprays in tandem," said Martin.



Other rose necessities include good drainage, regular water, and tidy surroundings. "Remove spent blooms and any diseased foliage promptly, and keep the soil at the base of your roses free of leaves, which are disease vectors," urged Martin. After the first bloom, apply more compost and a granular organic fertilizer, followed by a deep watering, and you'll be rewarded in a matter of weeks. "Roses are cyclical, with a four- to eight-week hiatus between blooms," said Martin. "When you cut a spent flower, it prompts the plant to create a new bud. As my grandmother always said, with roses, you've got to take to get."

A Rose Primer: An Organic Approach to Rose Selection and Care is a 40-page, spiral-bound guide available for $10 from the UCSC Center for Agroecology and Sustainable Food Systems (CASFS). To order, send $10, plus $2 for shipping and handling, to Rose Book, c/o CASFS, UC Santa Cruz, 1156 High Street, Santa Cruz, CA 95064. Checks should be made payable to UC Regents. For more information, visit www.ucsc.edu/casfs or call (831) 459-3240.

– Jennifer McNulty

In 2006, Orin Martin will present a workshop on winter rose care and a workshop on selecting and caring for roses using organic techniques. See the calendar on page 20 for details.

Central Coast Consumers' Interest in Food Systems Issues: Demographic and Behavioral Associations

In the summer of 2004, social science researchers from the Center for Agroecology and Sustainable Food Systems conducted a survey to find out what Central Coast consumers wanted to know about their food.

We found that consumers were dissatisfied with the amount of information currently available. They wanted to know more about the safety and nutrition of their food, but were also interested in ethical issues, such as the treatment of animals in agriculture, environmental impacts, and the wages and working conditions of those who produce their food. They were most interested in obtaining this information through labels or in-store displays, and expressed the greatest support for labels that represented humane, local, and living wage criteria. Most respondents also indicated a willingness to pay more for a label that represented both a living wage and safe working conditions for the workers producing strawberries, particularly if this price premium was relatively small. (See Center Research Brief #5, Winter 2005, and *The Cultivar*, Vol. 22 #2, for more details on the survey methodology and results.)

To determine whether demographic and behavioral characteristics were associated with different levels of interest in these topics, we conducted further analysis using multiple regression. This statistical technique allows us to look at the association between one variable and another, while also controlling for the influence of many others. For example, we could examine the association between level of education and interest in the topic of nutrition, while simultaneously controlling for the fact that respondents' interests may also differ according to gender, household income and/or purchasing behaviors.

In this article I summarize the demographic and behavioral findings from three parts of the survey: 1) preferences for alternative "ecolabels", 2) willingness to pay for strawberries with criteria for a living wage and safe working conditions for farmworkers, and 3) interest in food system topics, such as safety, nutrition, and workers' wages. Variables included in these analyses were gender, age, ethnicity, income, education, frequent sourcing of local food, and frequent purchasing of organic food.

We also tested, and included where statistically significant ($p < .05$) in at least one model, the following variables: households with children, and level of agreement with the following statements: "I try to consider how my purchase(s) will affect the environment," "There isn't much that an individual consumer can do about environmental problems," and "Most people don't care about how their food is produced."

The American Humane Association's Free Farmed Certified label is an example of an ecolabel that certifies humane production practices.

All of these variables were dichotomous (i.e., binary choices like yes or no) with exceptions of age, which had a range of 20 to 99, and those that asked for agreement with the statements above, which were measured on a scale from 1 to 7.

PREFERENCES FOR ALTERNATIVE ECOLABELS

Sales of organic products have grown rapidly over the last 15 years, and many small-scale growers have expressed interest in addressing additional criteria that consumers might support. To help determine what label criteria might be most popular, we asked survey respondents to choose from among five potential options representing standards other than those embodied in the USDA Organic label. These were –

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

The format was a series of ten paired comparisons—for example, respondents were asked to choose between a product that was a) humanely produced, or b) locally grown, assuming they were otherwise identical. We used a technique called logistic regression to analyze the variables associated with making particular choices. This technique compares respondents selecting one potential ecolabel to those selecting the other in the pair.

Regression analysis was conducted only for three of the five labels. These were humane, local and living wage (the highest ranked choice of 30.5%, 22.0%, and 16.5% of

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respondents respectively). U.S. grown and small-scale were chosen much less frequently (the highest ranked choice of 5.9% and 5.2% of respondents respectively) and therefore provided less power to detect associations with demographic or behavioral variables.

Table 1 reports the odds ratios for models comparing the likelihood of choosing one of the top three choices over another. An odds ratio of greater than 1.0 demonstrates a preference for the standard of interest (listed first) while an odds ratio of less than 1.0 demonstrates a preference for the reference standard (listed second).

Humane vs. Locally Grown. The first comparison was between humane and local, and the data indicate that women are almost twice as likely as men to prefer humane. Those that consider the environment when making purchases were also more likely to prefer humane; every 1 unit increase on this 7 point scale was associated with a greater than 20% increase in the odds of choosing humane. Two variables were associated with preferring local: Asian-Americans were almost twice as likely as European-Americans to choose the locally grown option, and each additional year in a respondent's age was associated with increasing odds of choosing local.

Local vs. Living Wage. For the comparison between local and living wage, having children was associated with a greater than 200% increase in the odds of preferring local. Increasing age was also associated with choosing local over living wage. Respondents who consider the environment when making purchases, or who feel like consumers can do something about environmental problems, were more likely to choose living wage. Those who tended not to think that other people care about how their food is produced were also more likely to prefer living wage. A potential explanation for this result is that people who perceive little societal interest in the food system may feel a heightened sense of responsibility for workers' wages. Alternatively, their concern could be associated with a sense of moral superiority. Women were 68% as likely as men to choose local, and Hispanic-Americans were half as likely as European-Americans to choose local. Middle-income and upper-income respondents also tended to express a preference for living wage—both of these groups were more than twice as likely as low-income respondents to make this choice.

Table 1. Odds ratios for logistic regression of choice of alternative ecolabels on demographic, behavioral, and attitude variables (n=423). ** p < .01, * p < .05, + p < .10.

		Humane over Local	Local over Living Wage	Living Wage over Humane
Gender	Men (reference group[1])			
	Women	1.89**	0.68+	1.34
Age	Years	0.98*	1.02**	1.02*
Ethnicity	European-American (reference group)			
	Asian-American	0.51*	0.78	1.62
	Hispanic-American	0.55	0.51+	4.32**
	Other	0.59	1.15	2.20+
Income	Low income (reference group)			
	Middle income	0.97	0.58+	1.46
	High income	0.73	0.50+	1.92+
Education	High school or less (reference group)			
	Some college	1.29	1.17	1.01
	College	1.21	1.76	1.22
	Grad school	2.09+	1.07	1.43
Children	Household with children	0.78	2.05**	1.01
Purchasing behaviors	Frequent local	0.88	1.49	0.57+
	Frequent organic	1.39	1.38	0.59*
	Consider environment	1.22**	0.82**	1.10
Attitudes	Consumers can affect environment	0.95	0.85*	1.10
	People care about how food is produced	1.01	1.16*	0.89+
	-2 (log likelihood)	497.5	515.3	483.3
	Pseudo-R square	0.14	0.16	0.12

[1]For variables with subgroups there is one reference group, to which the related variables are then compared. For example, if men are assigned to be the reference group, the results indicate how women differed from men.

Living Wage vs. Humane. In the comparison between living wage and humane, older people were more likely to choose living wage. For example, controlling for other variables in the regression, someone who is 25 years older than an otherwise similar respondent is 60% more likely to choose living wage rather than humane. Minority ethnic groups were more likely to prefer living wage in comparison to European-Americans. Hispanic-Americans were more than 4.3 times more likely to choose living wage over humane. Other ethnic groups were more than twice as likely to select living wage, and Asian-Americans were 1.6 times more likely to choose living wage, although neither of these had associated p values of less than .05. High-income groups were 1.9 times more likely to choose living wage over humane. As with the comparison with local, those who thought most people don't care about how their food is produced were more likely to choose living wage, with the odds of choosing this criteria over humane 10% higher for each 1

point change on the 7 point scale. However, people who obtained food locally were 57% as likely to choose living wage over humane, and frequent organic purchasers were 58% as likely to choose living wage over humane.

In summary, humane was more likely to be preferred by women, European-Americans, younger people, frequent organic purchasers, and those who consider the environment when making purchases. Older people and households with children were more likely to choose local. Living wage was associated with a stronger preference by Hispanics, high-income households, and consumers who don't think that other people care about how their food is produced. In comparison to local, living wage is also preferred by younger people, consumers who consider the environment when making purchases, and those who think that consumers can affect the environment.

WILLINGNESS TO PAY FOR DOMESTIC "FAIR TRADE" STRAWBERRIES

Another section of the survey asked respondents to consider their willingness to pay for strawberries that embodied a living wage and safe working conditions for the workers involved in producing them. These criteria are included in a "Fair Trade" label, certified by TransFair USA, although only for certain imported food products.

To estimate the level of support for a domestic version of fair trade labels, we asked respondents if they would pay an additional amount for these criteria, assuming a typical pint of strawberries cost $1.50. This amount was 5 cents, 25 cents, 50 cents, or $1.50 more, depending upon the version of the survey (there were four versions of the survey, differing only on this one question).

The results indicate that when controlling for all of the variables in the model, only gender and considering the environment when making purchases were strongly associated with willingness to pay for domestic fair trade strawberries. Women were more than twice as likely as men to pay more for these criteria, and the model indicates that they were willing to pay 60 cents more. For every 1 unit increase on the 7 point scale that measured consideration of the environment when making purchases, willingness to pay more for socially just strawberries increased an average of 30%. Each point higher on this scale was associated with a willingness to pay an additional 24 cents above the base price, according to the model.

These results suggest that efforts to establish a domestic version of fair trade would best be targeted to consumers who consider the environment when making purchases and to women. Targeting organic consumers with a fair trade ecolabel may be an indirect, yet effective way to reach consumers who consider the environment when making purchases.

Jon Kersey

Women, Hispanic-Americans, and those who consider the environment when shopping may be most receptive to a domestic equivalent of the existing Fair Trade label. The Fair Trade label currently applies only to certain imported products, such as bananas, chocolate, and coffee.

INTEREST IN FOOD SYSTEM TOPICS

A third section of the survey asked respondents to rate their interest in 8 food system topics on a scale from 1 to 10, with 10 representing a great amount of interest and 1 representing none at all. The topics were –

- Food safety
- Nutrition
- Treatment of animals
- Environmental impacts
- Working conditions
- Wages
- Influence of large corporations
- How far food travels

We then analyzed interest levels based on the following characteristics –

Gender. After controlling for other variables in the analysis, women were more interested than men in all of the food system topics except the highest-rated topic of safety, and the lowest-rated topic of how far food travels. The largest difference between women and men was women's greater interest in the humane treatment of animals, at nearly 1.5 points higher on a 10 point scale. This was followed by wages and working conditions: women scored these topics more than one point higher than men, on average.

Age. Age was not associated with more or less interest in any of the food systems topics.

Ethnicity. In comparison to white, non-Hispanic respondents, Asian-Americans and Hispanic-Americans were more interested in environmental impacts of their food. Hispanic-Americans were also more interested in nutrition, the wages and working conditions of those who produce their food, and in how far their food travels. Hispanic-American interest in wages was the largest difference observed in the survey results; they rated this topic an average of 2 points higher on a 10 point scale than white non-Hispanic respondents.

Income. In comparison to low-income respondents, those with the highest incomes were less interested in the influence of large corporations or how far their food travels.

Education. Higher levels of formal education were associated with increased interest in the topic of nutrition. Respondents with some college or an associate's degree were

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more interested in the influence of large corporations than those with other levels of education.

Frequent Local Consumer. Frequent sourcing of local food was, not surprisingly, associated with an interest in how far food travels when compared to those who do not frequently source local food. It was also associated with a greater interest in environmental impacts of food and the wages of those who produce their food when compared with those who do not frequently source local food.

Frequent Organic Consumer. Frequent purchasing of organic food was associated with increased interest in the influence of large corporations, the treatment of animals, and the distance food travels, when compared to those who do not frequently purchase organic.

Consider Environment When Purchasing. A higher score on a scale measuring consideration of the environment when making purchases was associated with greater interest in all of the topics, and was the best or second-best predictor of interest for each of these.

The results suggest that outreach and education on food systems could be targeted to specific segments of the population, based on their interests. For example, safety and nutrition have almost universal appeal, but those with higher levels of education express even greater interest in nutrition. Hispanic-Americans are more interested in wages and working conditions than other ethnic groups. Finally, ethical issues such as the treatment of animals, environmental impacts, and the wages and working conditions of workers all receive more interest from women and those who consider the environment when making purchases.

IMPLICATIONS FOR MARKETERS, EDUCATORS, AND CONSUMERS

Marketers and Educators. One of the most striking differences, evident in all three sections of the survey, was women's greater interest in ethical issues surrounding food production. Advocates of humane and living wage ecolabels would be well served to focus their marketing and education efforts toward women, as well as toward those who reported that they consider the environment when making purchases, as they are more likely to choose these labels.

Hispanic-American respondents indicated a much stronger preference for living wage criteria than for local or humane criteria when compared to European-Americans. Hispanic-Americans were also willing to pay an average of 24 cents more for domestic fair trade strawberries (although the difference was statistically weaker than that demonstrated for ecolabel preferences). This growing demographic group may be an important market to consider when evaluating the potential of alternative ecolabels.

Other demographic variables are likely to be less useful for marketing and education purposes. Income and education tended to be very weakly associated with ecolabel preferences and willingness to pay for domestic fair trade strawberries. Having children under 18 in the household was associated only with preferring local over living wage. For the variable of age, older respondents tended to prefer local ecolabels, and younger respondents were more likely to choose humane and living wage.

Jon Kersey

Consumers who already purchase food from local sources such as farmers' markets and roadside stands are likely to be receptive to marketing and education efforts such as the "Buy Fresh, Buy Local" campaign of the Community Alliance with Family Farmers.

Behavioral variables, by contrast, may be more helpful for predicting ecolabel preferences. For example, frequent organic consumers are likely to be receptive audiences for marketing and education efforts focused on a humane label. On the other hand, consumers who are already frequently obtain food from household gardens, roadside stands, a community supported agriculture subscription and/or farmers' markets, are likely to be interested in efforts to market a local label. A topic that has received increasing attention recently—particularly with the recent spike in gas prices—is the distance that food travels. This subject is likely to appeal primarily to local and organic consumers, with much less interest from others, particularly those with high incomes.

Consumers. Consumers have played a crucial role in the growth of the "Organic" ecolabel. Those who want even more choices in the marketplace can contribute to the development of additional ecolabels by seeking out prototypes that this research suggests could be successful on the Central Coast of California. Such efforts include the United Farm Workers' "Black Eagle" label (farmworkers with union contracts), Community Alliance with Family Farmers' "Buy Fresh, Buy Local" label (currently available on the Central Coast and six other regions of California), and a number of third-party certified humane labels, including "Certified Humane," "Humane Husbandry," and "Free Farmed." This research could also be used by consumer organizations to recruit others with similar concerns, and to build a larger movement to propel the food system toward their ideals.

– Phil Howard

Center Research Brief #7, *Central Coast Consumer's Interest in Food System Issues: Demographic and Behavioral Associations*, includes additional data from the study reported here. The brief is available from the Center's web site (www.ucsc.edu/casfs), or by contacting mtbrown@ucsc.edu, 831.459-3240.

Updates

Center Surveys Campus Members on Food System Issues

This November, 10% of UCSC's students, staff, and faculty received an online survey with a series of questions that many might not have considered before—such as how interested they are in the wages and working conditions of the people who grow, make, and sell the food they eat.

The survey is part of an effort by Center social issues researchers to assess whether those using the campus cafeterias and restaurants are interested in having the food reflect a set of social justice criteria, such as a living wage—and whether they're willing to pay higher prices for food that meets those criteria.

Jan Perez of the Center's social issues research group worked with fellow researchers Phil Howard and Patricia Allen to design the online survey, which explores the interests, concerns, and support for sustainable food systems on the part of UCSC students, staff, and faculty. UCSC's Campus Food Systems Working Group, Community Agroecology Network, Students for Organic Solutions, and UCSC Dining services also contributed to the survey's design.

Examples of survey questions include levels of concern over various national food systems issues, such as protecting the environment, improving food safety, and developing local food systems; how often the survey taker purchases local, organic, or Fair Trade items; and whether the survey taker would be willing to pay more for a meal plan to ensure that food has been produced in a socially just manner. Says Perez, "We wanted to get a sense of whether there was interest in having social justice criteria play a part in purchasing decisions."

Prior to putting the survey online, Perez pre-tested it with a variety of UCSC students as well as student-age respondents not affiliated with UCSC. "For the most part they found it interesting and said they learned things from it," says Perez. "For several of them these issues were new considerations."

Survey responses will help campus researchers, student groups, and UCSC Dining staff create education programs, inform policies, and understand the campus's concerns around specific food issues. Perez also sees applications for the Center's work on perceptions of social justice in the food system. "We're looking at consumer interest in socially just criteria in a way that hasn't been done," she says. "Most of this work has been done on Fair Trade [a standard that applies to imported food], while we're looking at it domestically. This is another method for assessing consumer interest in these topics in a quantitative way."

Jennifer McNulty

A survey of campus members will assess their interest in supporting criteria such as fair wages and safe working conditions for those growing and processing food served in UCSC's dining halls, coffee shops, and restaurants.

The Institutional Research unit, part of UCSC's Office of Planning and Budget, administered the survey. Survey results will be discussed in an upcoming issue of *The Cultivar*.

Grant Funds Expansion of Water Quality Monitoring, Grower Education

A $500,000 grant from the State Water Resources Control Board (SWRCB) to Center researcher Marc Los Huertos and Center director Carol Shennan will expand water quality monitoring and farmer education work in the Pajaro River watershed (see related story, page 1). The grant funds a three-year program to enhance monitoring efforts by increasing the number of water quality sampling sites, particularly those sites that specifically address irrigated agricultural sources of nutrient and sediment loading. Center researchers will sample nitrogen and phosphorus levels at up to 74 sites, focusing on area of irrigated agriculture in the watershed around the towns of Morgan Hill, San Martin, Gilroy, Hollister, Aromas, Corralitos, and Watsonville.

In addition to nutrient levels, the researchers will also examine how suspended sediments in freshwater affect water quality. Sensors that continuously measure turbidity (water clarity) will help relate impacts such as storm runoff and

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irrigation to changes in turbidity. Turbid waters may be due to suspended solids or high concentrations of algae, either of which can be a symptom of poor water quality. Soil erosion or in-stream channel erosion can be sources of water column sediments. This project will better characterize the extent to which irrigated agriculture is a source of these sediments.

High concentrations of algae may be a symptom of eutrophication, a process that impairs freshwater habitat quality by decreasing the level of dissolved oxygen in the water.. According to Los Huertos, making the link between nutrient levels and eutrophication is very difficult in streams in the western U.S., where other factors can also influence water quality. "There are a number of things that affect the levels of algae and dissolved oxygen at a site besides nutrient levels, such as whether the bottom is rock or mud, how much light penetrates the canopy, and what algae-consuming organisms such as clams and mussels are present," says Los Huertos. "We want to determine the limiting factors that control water quality characteristics, such as dissolved oxygen, and evaluate some of these factors in order to get a better sense of their role in the overall health of the system." Work on riparian corridors will take place at Uvas and Llagas creeks, Millers' Canal, San Juan Creek, the San Benito River, and the Pajaro River.

Finally, the grant will help researchers work directly with growers on their land to provide free water quality sample training and nutrient analysis. "This was designed to help growers and watershed working groups refine and improve their water quality protection plans," says Los Huertos. Results from this monitoring project would be used specifically to improve nutrient management, irrigation water management, and sediment control measures.

Center Director, Faculty Affiliate Explore Research Opportunities in Mongolia

Once inhabited by nomadic cultures, areas of Mongolia's vast steppe grasslands are rapidly being converted by settled communities that rely on agriculture and intensive grazing, activities that threaten the region's long-term sustainability. Plowing and overgrazing have led to desertification of this fragile habitat, triggering vast sand storms that have buried distant productive agricultural land in sediment. And as plowing and other development release stored carbon from the steppe's soils, the region could become a significant source of carbon dioxide, the main culprit in global warming.

This summer, Center director Carol Shennan and Center faculty affiliate Weixin Cheng were invited by China's Institute of Grasslands Study, part of the National Institute of Botany, to tour Mongolia, meet with the region's researchers, and develop ideas for collaborative projects that integrate social and economic aspects of grassland management with existing ecological research efforts.

"Chinese officials realize that they need to work with the people who live on the land to address sustainability of the grasslands," says Shennan. "Land management in cooperation with communities is an area in which we have particular experience."

Shennan noted that there has been a tremendous investment in research equipment and facilities in the steppe region, and that members of the Institute of Grasslands Study have developed a significant amount of ecological information. "The challenge now is to use the science to help the local communities, and to work cooperatively with the people who depend on the steppe environment for their livelihoods."

Shennan and Cheng envision a number of opportunities for UCSC faculty, staff, and students to become involved in collaborative research and education programs in Mongolia to address sustainable use of the environment. They will be exploring these opportunities with Chinese officials in the coming year.

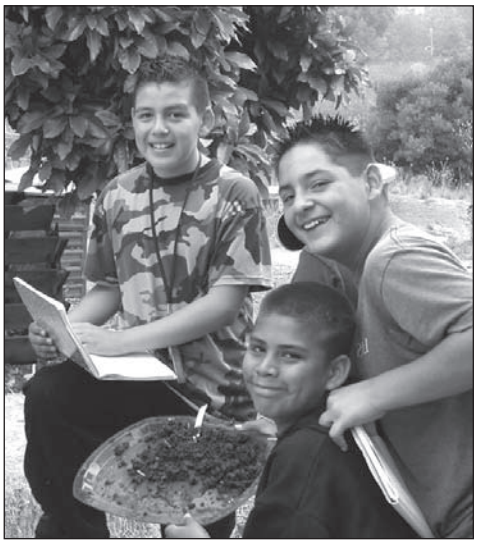
Garden Classroom

continued from page 5

Coast take part in field trips that connect them to a variety of themes, from soils and plant parts to pumpkins and pollinators. In the summer months, day camps treat campers to the joys of working and playing in the garden. The Garden Classroom also serves as a living laboratory for 40 junior high migrant education students from the Salinas area who take part in a summer science institute. Teachers attend training workshops at the Garden Classroom to learn garden-based science and nutrition lessons they can take back to their own classrooms and school gardens. And many visitors come to see the way that a garden can serve as an outdoor science learning center and basis for nutrition education.

To learn more about the Central Coast Regional Training Center and the Garden Classroom, visit www.lifelab.org/classroom or contact John Fisher at johnfish@ucsc.edu, 831.459-4035.

– John Fisher



Students on a field trip to the Garden Classroom learn how worms can "recycle" food scraps.

for the

Gardener

Lettuce Offers a Palette of Tastes, Textures, and Colors

Lettuce (*Lactuca sativa*) is a member of the *Asteraceae* (formerly *Compositae*) family. *Asteraceae*, known in the common parlance as the daisy or sunflower family, is the largest dicotyledonous family, with greater than 25,000 species and worldwide distribution. Basically, one in every ten blooming plants on the planet is a daisy!

Lettuce is thought to have originated along the eastern rim of the Mediterranean Sea, possibly as far south as Egypt, into Iraq. There are records of cultivated lettuce dating back 4,000–6,500 years. A Romaine-like lettuce is depicted on Egyptian pyramid murals 6,500 years ago. So perhaps Caesar salad is a misnomer—Pharaoh salad or Tutankhamen salad might be a more appropriate epithet.

Lettuce is an annual, cool season crop. Along with spinach and peas, it is one of the first crops planted in spring. It requires 60–80 days with temperatures below 80°F to develop. Optimal growing conditions include moderate-cool weather, high sunlight levels (especially to enhance color on red types), frequent shallow waterings, and adequate nitrogen (for leaf growth) and potassium (for leaf structure and quick maturation). Successive sowings every 10 days to 2 weeks will yield a steady supply for the salad bowl. At maturation, no lettuce will hold longer than 10 days to 3 weeks. At that juncture bitterness and/or bolting will ensue.

An especially space-efficient crop, lettuce lends itself to creative interplants and side plantings. A particularly efficient use of space is a side planting of lettuce on the edge of a climbing pea fence in spring or fall. A summer sideplant on a bean fence or interplanted in a low-density (12"–15" between plants) sunflower bed affords cooler temperatures and a little shade to offset long days and warm temperatures.

Despite its beauty and succulence, lettuce ranks low nutritionally. Leaf lettuce and romaine rank higher than butter and iceberg types. As is so often the case with vegetables, the darker, more mature outer leaves are more nutritious than the inner, blanched leaves. "Aye, there's the rub," nutrition vs. taste. Similar issues surround Chinese (Napa) cabbage, European cabbages, leeks and asparagus. While the darker red leaf types contain more vitamins and antioxidants, they can be less sweet and more astringent.

Lettuce can be a satisfying crop to grow in the home garden because of its early season and quick maturation. Its sweet, crisp succulence can create a symphony for the taste buds. However lettuce is a challenging crop to grow for market (especially the mass market). It is extremely sensitive to water and temperature fluctuations, and needs to be constantly sown and transplanted. Harvest involves bending over and back stress. It is extremely perishable once harvested and needs washing to remove grit. A graph of lettuce prices looks like a roller coaster ride, with production costs exceeding wholesale prices when there is a glut on the market. When prices are sky-high, there is usually no lettuce to be had.

CULTURAL CONSIDERATIONS

Soil. All forms of lettuce grow well in a wide range of soils: sands, silts, and clays. While each soil textural class has its pros and cons, the paramount consideration is drainage and aeration. Sandy soils offer the benefit of draining, drying, and thus warming more quickly after a rain, or at the outset of the growing season. On the downside, sandy soils tend to be lower in organic matter, not as inherently fertile as silts and clays, and inefficient at holding water and nutrients.

Clay soils are excellent repositories and reservoirs of organic matter, nutrients, and water. Conversely, unless drainage is improved, clays tend to warm slowly and stay waterlogged. Silts are intermediate between the other two textural classes. Thus early season growing favors sands, while mid-late season favors clays.

pH Levels. Lettuce tolerates a wide pH band (5.8–7.2). As is so often the case, nutrients are optimally available at pH 6.2–6.8.

Nutrients/Fertility Needs. In general, lettuce is considered a light- to moderate-feeding crop that is fertilized heavily. The reason for this is related to the nature, type and extent of lettuce roots. Lettuce features a somewhat pronounced taproot (15"–18" deep on direct-seeded crops and 6"–10" on transplanted crops). Most of the effective feeding roots are shallow (4"–8") and fibrous.

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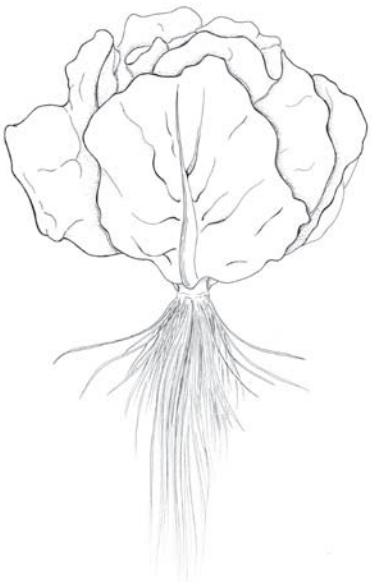


Janet Chao

Lettuce requires high nutrient levels due to its relatively shallow, inefficient root system.

Lettuce Nutrient Needs

Nitrogen	100–120 lbs/acre	moderate
Phosphorus	10–12 lbs/acre	low - moderate
Potassium	15–20 lbs/acre	moderte - high
Calcium	20–30 lbs/acre	moderate

Unfortunately the feeding roots are inefficient at withdrawing nutrients from the soil.

Nutrient needs of lettuce include –

• High Nitrogen: Pre-plant, and in the last three weeks of the crop (lettuce makes 70–80% of its total growth in the last 3 weeks of its growth cycle). N = leaf growth

• Moderate–low Phosphorus: Mostly for early root development

• High Potassium: Potassium regulates photosynthesis, hastens maturation, and creates structural strength in the leaf. You could say potassium mellows the aggressiveness of nitrogen. High calcium is required by heading types to prevent leaf-tip burn.

With lettuce, the old adage that nutrients should be applied at and slightly above the effective feeding root zone translates to a surface application and shallow incorporation. A good crop to follow lettuce would be something a little deeper rooted with moderate nitrogen and high potassium needs (e.g., carrots, peppers) to catch the nutrients as they leach downward. The finer and more particulate the compost used, the quicker and greater the nutrient availability. On fertile soils nutrient application is optional with lettuce.

Germination Temperatures. While texts state that lettuce will germinate at temperatures as low as 32°–35°F, it will take 35–40 days. In 35–40 days from transplant a leaf lettuce will be mature. So, cool soil germination is a bit of a Pyrrhic victory.

Lettuce responds to minimum temperatures of 50°–55°F and maximum temperatures of 75°F for best percentage (85%–95%) and quickest emergence of seedlings (5–7 days). Because of its Mediterranean origin, lettuce has an inhibition to germinate at sustained temperatures >75°F (thermodormancy). In its native habitat, lettuce seed would mature at the end of the cool, rainy season, be scattered on the ground in a dormant state throughout the hot, dry summer, and then sprout coincident with the onset of cool, wet weather in the fall. It is not evolutionarily advantageous for the seed to germinate at a time of year when it cannot grow optimally (hot and dry). Smart seed! So the gardener's dilemma of summer germination can be averted by outsmarting the seed and pre-chilling moistened seed in the refrigerator for 2–3 days.

Growing Temperatures. Lettuce grows optimally and produces the sweetest, most succulent crops with daytime air temperatures of 60–65°F and night time temperatures of 45°–55°F. Temperatures below 75°F are necessary to maintain the vegetative state; above that temperature, most lettuces will begin to bolt and form seed heads. While hardened seedlings can withstand temperatures in the low 20°s F, growth virtually stops below 40°–45°F.

With vegetable crops (and plant growth in general) optimal growth (and thus yields) results from diurnal temperature swings; alternating warmer day and cooler night temperatures. This differential (usually 10°–20°F) allows the plant to utilize the sun's energy (via photosynthesis) to make growth substances during the day, and convert them into new growth (via cell division and elongation) and storage ("bulking up") at night.

Environmental Factors. Lettuce is sensitive to both long days and warm temperatures. Either factor can trigger the plant to move from the vegetative state to the reproductive state, that is to bolt and run to seed.

The primary stimulus for flowering is days with over 14-hour day lengths (May 5 in Santa Cruz, 38° latitude). A secondary factor in flowering is temperatures over 75°–80°F. Lettuce grown under warm temperatures will respond more quickly to long days. Conversely, lettuce grown under cool temperatures (<75°F) will be slower to respond to long days. In a nutshell, lettuce is generally a spring and fall crop in northern temperate interiors. Cool coastal climates (such as Central Coastal California) allow year-round production.

Seed Viability. I've always found it puzzling that most texts list lettuce seed viability at up to 6 years. In truth it is good for 1 to 2 years (80%–95% germination rate), then germination drops precipitously to 50% in year 3 and lower thereafter. Buying a small amount of seed annually is the best strategy.

Germination Conditions. Again, most books (gardening and text) talk about certain species of seed needing either sunlight or darkness to germinate (light for lettuce, columbines, and snapdragons; darkness for phlox, onions, and leeks). This prescription is then offered: leave seed exposed on the soil surface, or cover with grass clippings, burlap, or a board. This is a prescription for failure. Common sense translates to a very light soil covering of 1/8"–1/4" for lettuce and the like, and 1/2" covering for alliums and such.

Seed Pelleting. Seed pelleting is a relatively new and always improving technique of coating small and difficult-to-sow seed (lettuce, carrots, snapdragons, etc.) to enlarge the seed, reduce its angularity, and facilitate ease of sowing. The coating, always a tightly-guarded company secret, consists largely of clay, talc, and agar or other binding agents. The formulation is such that moisture can permeate to the seed and break open the coating, allowing oxygen (which stimulates germination) access to the seed.

Before now, pelleted seed was only available on a large commercial scale (pounds of seed or a 500,000 seed minimum per variety). Johnny's Selected Seeds now offers pelleted lettuce (as well as carrot) seed that is certified organic. Options range from 250 seeds a packet to a pail (500,000 seeds).

Seed specs: 1 gram = approx. 800 seeds
28 grams = 1 ounce
1 ounce = 20,000–30,000 seeds
most retail packets = 200–400 seeds
(different varieties have different seed sizes)

Renee's Garden Seeds' (www.reneesgarden.com) offerings are tailor made for home gardeners, with multiple varieties of lettuce, squash, tomatoes, peppers, etc. per retail packet. The seeds are color coded (with vegetable dye) and packets contain elegant, succinct, and accurate varietal descriptions.

CLASSES OF LETTUCE

The history of lettuces and salad mix greens dates to antiquity in the Mediterranean regions of Europe. Although these fast-growing, succulent greens are now often associated with upscale, fast-paced lifestyles ("yuppie chow"), they derive from rural peasant culture, and in fact featured a blend of cultivated plant varieties and wild wayside weeds. Regionally, small towns bred indigenous varieties passed down from generation to generation, with the seed and growing techniques as closely guarded as modern-day state secrets. In those times and climes recipes for salads changed seasonally if not weekly, and were subject to almost daily improvisations.

We of the confined, controlled, contemporary climes can create the solid underpinnings of daily salads by giving some forethought to the timings and types of lettuces planted in our kitchen gardens.

There are six basic classes or types of lettuce:

- Loose leaf
- Butterhead/Bibb
- Romaine
- Iceberg
- Batavian or Summer Crisphead
- Cutting types

What follows is a thumbnail sketch of each class and a descriptive list of notable varieties—the best of both the newest and time-honored varieties.

Aside from the obvious factors of looks, taste, and texture, the primary considerations when selecting any given class of lettuce are –

Plant size. Often referred to as frame size, the choices range from small, one plant = one serving for one person (e.g., Tom thumb Butterhead), to softball-sized plants, to enormous Paris Island Romaines with their 18"-tall heads. The size of the plant influences spacing between plants.

Seasonality. While some varieties are touted as year-round types, this rarely proves to be the case. For example, the old French heirloom Merveille des Quatre Saisons (Marvel of Four Seasons) is exclusively a spring and fall affair, choosing to bolt at the mention of warm weather and long days. Winter Density, despite its name, is an excellent three-season lettuce (spring, summer, fall). Among the most heat-resistant varieties are the green leaf type Salad Bowl, the summer butterhead types Ermosa and Nancy, and all varieties of Batavian types.

Loose Leaf Lettuce (9"–12" apart for full-size varieties)

Leaf lettuce is easy and fast to mature, but not as tasty as other classes. Along with Romaine it has the highest nutritional profile, and is among the most heat and cold tolerant of all lettuces. Leaf lettuces are also the most versatile, as they can be harvested at any stage, from baby to full size. Days to maturity—baby size 20–30, full size 45–55. (Note: All days to maturity are from transplants. Plug trays produce transplants in 30–40 days.)

Most loose leaf lettuces feature frilly, wrinkled, or puckered leaves. Arrowhead, oakleaf, or deer tongue types have lobed leaves and often enormous frames (one head feeds a small family). At full maturation they are usually too big, floppy, and fragile to hold up to packing and shipping, thus they are rarely seen on the retail scene.

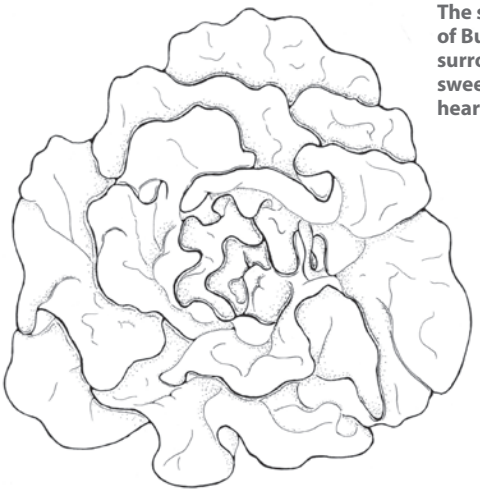
There are two trends in the world of leaf lettuces –

Red, redder, and reddest. Until recently there were no true red leaf lettuces, but rather red-tipped leaves with a green base, or red speckled over a green background. There are now true red and almost black-red at that (base to tip) varieties aplenty. Examples include Outredgeous Romaine, Galactic, and Blackjack leaf types. While there is no appreciable difference in the taste of red or green leaves, red contains more nutrition and draws the eye, thus increasing appeal and sales. So it is a good friend.

Compact, extra-frilly types. The Lollo Rossa types feature small, really slow-growing, extra frilly, bland-tasting leaves. They are virtually the miniature French poodles of the lettuce world. However, salad mix growers prefer them because they add loft to a mix and improve shelf life. C'est la difference.

Butterhead Lettuce (a.k.a Boston or Bibb)
(spacing 12"–15")

This class features soft, loose heads of silky, buttery taste and texture. It is top of the charts taste-wise. Because the beauty of these Butterhead (Bibb) types is in the mature, blanched hearts, do not harvest before maturity.



The soft outer leaves of Butterhead lettuce surround a creamy, sweet, blanched heart.

Janet Chao

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The Bibb or Boston types of Butterheads are small framed (4"–8" across), prone to bolting, and all but vanishing from seed catalogues.

Distinctive varieties include –

Buttercrunch (48 days) – Small (6"-8" head), oblong-shaped, firm-headed butter type. Dark green outer leaves with yellow blanched hearts and a smooth, creamy taste. Buttercrunch is more heat resistant than other Bibb types.

Chadwick's Rodan (58 days) – An heirloom that UCSC Garden founder Alan Chadwick brought from France. Crunchy, tender, sweet and silky, similar to Red Deer Tongue in appearance. Available from Abundant Life Seed Company (www.abundantlifeseeds.com).

Deer Tongue and Red Deer Tongue (46 days) – This heirloom dates back to 1840. Deltoid, triangular-shaped outer leaves, blanched heart. The habit is upright and the frame small 4" x 6".

Limestone or Kentucky Bibb (48 days) – This was one of Alan Chadwick's favorites, with seed being secreted from England to Santa Cruz. Because of climatic similarities it performed admirably here (within the constraints of its narrow seasonality, late winter–spring). It is a small (4"–6"), open head with dark green leaves and a distinctive crunchy taste. Among the more bolt prone of all lettuces. Seed is rare, but Cook's Garden (www.cooksgarden.com, Londonderry, Vermont) now offers it. Because of the small plant size, this variety can be planted intensively, 6"–8" apart.

Butterheads can be further divided amongst heirlooms and modern varieties; light or dark green color; red or red-specked color; and small-, medium- or large-framed varieties.

Distinctive varieties include –

Butterhead Heirlooms –

Merveille des Quatre Saisons (or as we say stateside, Marvel of Four Seasons) (50 days) – An excellent spring and fall variety. A large-framed (12"–16" head) plant, with bronze-red outer leaves enclosing a light green heart that is thin-leaved and succulent.

Sanguine Ameliore (45 days) – French heirloom from 1906. Small frame (6"–9"), tongue-shaped leaves with pink-tinged centers overlayed with reddish-bronze speckles.

Speckles (50 days) – An old Amish heirloom. Mottled brilliant red color overlays lime green leaf. Develops a dense yellow-green heart with extremely buttery taste.

Butterhead Modern Varieties –

Arctic King (65 days) – Probably the most reliable-performing winter butter type. Small heads in winter, large heads in spring and fall. Among the sweetest of all lettuces. Holds for up to two months at maturity in winter.

Ermosa (48 days) – Resistant to mosaic virus and mildew. Dark green, good summer heat tolerance. Uniform, reliable producer.

Esmeralda (48 days) – New and improved (really!). Extremely large frame = 1 pound heads of disease resistant, slow bolting, tender, sweet and crunchy taste treat.

Nancy (52 days) – Large frame, suitable for spring and fall, good along the coast in summer. Mildew resistant, thick crunchy leaves hold up well post harvest.

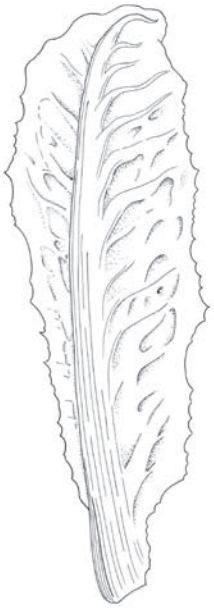
Optima (52 days) – Large-framed (12"–16"), darkest green butter type. Uniform production, heavy dense heads.

Pirat (46 days) – Firm heads of savoyed leaves, brick red over green, medium-size frame. Excellent spring, summer, fall production. Similar in appearance and taste to Marvel of Four Seasons, but more reliable.

Romaine or Cos Types (from the Eastern Mediterranean Isle of Kos)

The Romaines can be grouped into full size varieties (12"–18" tall), and compact-dwarf (mini) varieties (4"–8" tall) that are a cross between Romaine (conferring leaf shape and crunchy texture to the outside of the head) and Butterhead types (conferring a blanched, creamy texture and taste to the hearts).

The outer leaves of Romaine lettuce, with their "spoonbill" shape and pronounced, juicy midrib, surround a heart of light green, succulent inner leaves.

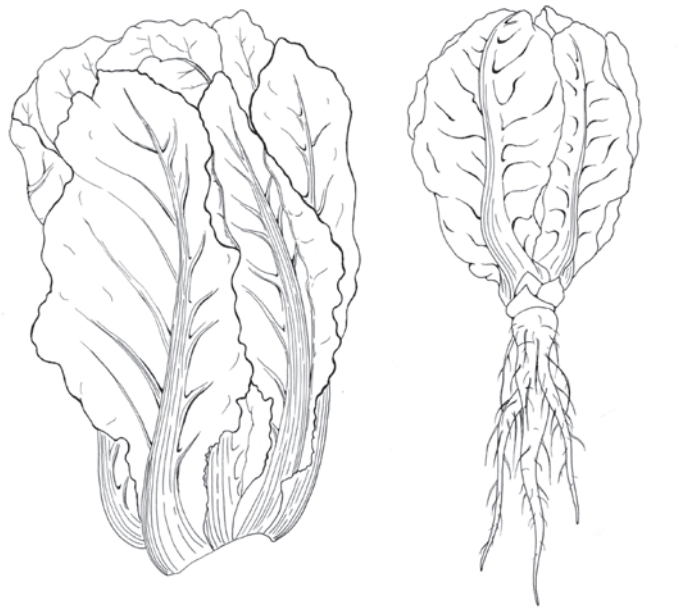


Janet Chao

Romaines feature upright, cylindrical, loose to dense heads, with spoonbill-shaped leaves. The individual outer leaves are long on crisp texture with a juicy midrib. The inner leaves (especially on mini types) are blanched, silky and sweet. Romaines can be used traditionally in Caesar salads (leaf by leaf) or stripped down to the center to comprise a hearts of Romaine mix. They are slower to maturation (70 – 90 days) than either leaf (40–55 days) or butterhead types (50–65 days). The hearts are sweet. All Romaines can be harvested young for a loose leaf mix or left to mature.

Mini Romaines

The mini Romaines are very heavy and dense for their compact size. They can be split in half longitudinally, laid



Janet Chao

Both full-size Romaine (left) and mini Romaine (right) varieties offer gardeners a rewarding crop for superb salads.

out on a long platter, and slathered with the dressing of your choice, along with pine nuts and crumbles of white Stilton cheese laced with either dried apricots or cranberries and sliced pears for a salad supreme! Because of their compactness they can be spaced 4"–6" apart in the garden. Heavy, high yields per square foot. Red leaf, red over green speckled leaf, and green leaf types.

Favorite mini Romaine varieties include –

Claremont (46 days) – A slightly bigger green Winter Density "wannabe" (see below).

Diamond Gem (42 days) – Early-maturing, upright, compact Bibb-Romaine cross. Good all-season production.

Little Gem (a.k.a. Sucrine in England) (40 days) – Old English heirloom variety with a small (4"–6"), dense head. Romaine-like in looks and texture but the hearts are as silky smooth tasting as the best of the butterheads. It defines the class. Use whole, halved, or leaf by leaf in a mix. Good fall to spring, summers only in cool areas.

Little Leprechaun – A mahogany-red Little Gem-Winter Density type. Outstanding color, pretty good taste.

Red Eruption (50 days) – Another red Little Gem type.

Winter Density (54 days) – Good three season variety, fall to spring. Summer production in cool-growing areas. A slightly bigger (8"), slightly darker green, slightly denser Little Gem type. Equally good taste as well. Space 8"–10" apart in garden beds.

Full-size Romaines

Favorite full-size Romaine varieties include –

Crispmint/Erthel – Old English variety with wavy mint green leaves, 8" x 12". Longstanding (>1 month) under moderate temperatures.

Flashy Trout Back, Freckles and Forellenschluss (75 days) – Essentially the same variety of heirloom from Austria. The Austrian name means speckled like a trout. Strikingly beautiful, mild, sweet, dark-green leaves, splashed with red that spreads and turns maroon at maturity. Loose head young, extremely dense and heavy at maturity.

Parris Island (an island off the Carolina Coast, famous for its Marine boot camp) (70 days) – Classic old style large (15"–18" tall), green, crisp-textured Romaine. A real throwback.

Rosalita (55 days) – developed by Johnny's Select Seed Co. An early red Romaine. Leaves are emerald green with a burgundy tip. Good as baby leaf mix. Loose head at maturity.

Iceberg or Crisphead Types

While these "cannonballs" respire at a much slower rate, can keep almost endlessly (up to two months) under refrigeration (33º–40°F) and provide the requisite crunch in tacos, they are virtually nutritionless, difficult to grow and thus best procured from the shelves of chain supermarkets, if at all.

French Batavians (a.k.a summer crisphead)

An unsung and underappreciated (though not so in Europe) class of lettuce. Batavians are the most versatile type of lettuce. They can be used young as cutting types or loose leaf types, at mid-maturity as a soft, loose butterhead, and at full maturity as an ersatz iceberg type, but with color and nutrition. Batavians rival loose leaf types for production in the extremes of cold and hot. They have a thick, waxy but still juicy succulent leaf structure and provide an amazing amount of biomass per plant.

Notable Batavian varieties include –

Anuenue (50 days) – Compact, non-bitter. At maturation resembles a small iceberg head. Thick, crisp outer leaves surround a tight, small heart. A popular variety in Hawaii, where it can be grown year round and withstands heat without bolting or developing tip burn.

Canasta (55 days) – A heat-tolerant Batavian that is crunchy and sweet. Red-tinged leaves and a green, soft heart.

Cardinale (48 days) – Thick, crisp, purple-black leaf. Plant color is alluring and intense. Has the habit of a wide Romaine.

Magenta (52 days) – An improved Sierra from Johnny's Seeds. Darker red leaves form a whorled, conical head with a crunchy green heart.

Cutting or Cut-and-Come-Again Types

Almost any lettuce type can be used as a cutting lettuce, but Romaine and loose leaf types work best. Cut leaves above the growing center of the plant and they will regrow vigorously—3 to 5 cuttings per plant is not uncommon. Cutting types can be densely broadcast sown or planted in clusters (3–5 plants) at tight spacing (3"–5" apart).

– Orin Martin

Center
Notes

Grant Funds Expansion of Online Educational Resources

The Center received a $5,000 grant this summer from the David B. Gold Foundation to expand and augment its online resource center for college-level instruction in ecological agriculture and sustainable food systems topics.

In collaboration with university and college instructors across the country, Center instructors have been reviewing hundreds of educational resources—textbooks, course outlines, popular books, web sites, videos, PowerPoint presentations, and more—to identify the highest-quality and most relevant materials on sustainable agriculture available. The result to date has been the creation of a web-based instructors' tool, "Exploring Sustainability in Agriculture: An Online Sustainable Agriculture Instructional Resource," housed at the Center's web site (www.ucsc.edu/casfs/instruction).

Among other resources, the site contains a catalogue description and outline for a comprehensive course on sustainable agriculture, appropriate for the community college, state college, or university level. The detailed course outline addresses topics in the history and development of agriculture; social and environmental sciences; plant, soil, crop, and animal sciences; pest management; natural resource management; the adoption of sustainable agriculture; and the growth and development of sustainable agriculture and the organic food industry.

Each major topic heading in the course outline links to an annotated list (in both PDF and Word formats) of resource materials for instructors to use in designing a class, seminar, lab, or workshop. Topics can be taught as stand-alone units, combined to create a more extensive course, or used to supplement an existing course.

Launched in the summer of 2005, the web site is still a work in progress, with the potential for additions of much more information. Center staff plan to complete the first phase of the website in 2006 by expanding, updating, and augmenting the current list of annotated materials.

The grant from the David B. Gold Foundation will fund efforts to solicit additional materials from colleges and universities nationwide, edit and update the web site's content, and work with a web developer to extend the site's linkages and capabilities. The National Sustainable Agriculture Education Conference, which the Center will convene in January 2006 (see note at right), will also generate information for the expanded web site.

Center Convenes Sustainable Agriculture Educators' Conference

The UC Santa Cruz Center for Agroecology and Sustainable Food Systems and the UC Davis College of Agriculture and Environmental Sciences and Student Farm are jointly convening a national sustainable agriculture education conference on January 24–25, 2006 at the Asilomar Conference Center in Pacific Grove, California.

The goal of the conference, "Facilitating Sustainable Agriculture: A Participatory National Conference on Post-Secondary Education," is to promote and enhance the continued development of educational programs in sustainable agriculture at U.S. colleges and universities. Faculty, administrators, staff, and students involved or interested in courses, curricula, and educational programs in sustainable agriculture are encouraged to attend.

The conference's format will feature a combination of interactive workshops and more traditional presentations. The schedule also includes poster presentations, an instructional materials exchange session, and ample time for networking.

For registration information and to learn more about the conference, go to www.ucsc.edu/casfs, or contact Albie Miles at afmiles@ucsc.edu, 831.459-4661. The educators' conference will take place in association with the Ecological Farming Conference (January 25–28) at the Asilomar Conference Grounds. For more information on the Ecological Farming Conference, please see www.eco-farm.org, or call 831.763-2111. For information on transportation and directions to Asilomar, please see www.visitasilomar.com.

ARC Meeting Planned

Making academic research more relevant to the activist community is a major goal of the Activist-Researcher Consortium (ARC). First convened in 2004 by campus researchers Patricia Allen (the Center's associate director) and Julie Guthman (Community Studies Department faculty member), the consortium will meet on January 27th at 8:30 am during the Ecological Farming Conference at the Asilomar Conference Center in Pacific Grove, California.

The consortium works to increase knowledge about and work on social justice issues within the area of sustainable agriculture, and to strengthen collective efforts in this regard. ARC also facilitates collaboration among activists, academics, and private sector representatives. Anyone registered for

the Ecological Farming Conference is welcome to attend this session to discuss social justice issues and projects, as well as the continued development of ARC. For registration information, see www.eco-farm.org, or call 831.763-2111.

Phosphorus Monitoring

continued from page 3

that frequently exceeded 1 mg/L, which suggests that agricultural activities are the source.

No seasonal concentration trends were observed in the upstream tributaries of the Pajaro River (Llagas Creek, Uvas Creek, San Benito Creek, and Miller's Canal). At these locations SRP concentrations remained low throughout the year. We calculated the SRP load carried by each tributary (2002–2003), and found loads varied seasonally, corresponding with stream flow rate. The SRP load was greatest at Chittenden during January and February when stream flow rate was also greatest. San Juan Creek was not sampled during this period, but likely accounts for a significant portion of the unaccounted load, since the creek's SRP concentrations are relatively high and flow is relatively constant year-around.

REGULATORY ENVIRONMENT AND FARM PRACTICES

Under state legislation known as the Agricultural Discharge Waiver that took effect in January 2005, farmers are required to develop farm water quality plans to protect surface waters along the Central Coast. One goal of our research is to inform growers of current water quality conditions in the region and provide information on management practices that can improve water quality while maintaining the economic viability of farming.

Because phosphorus is transported to waterways in storm and irrigation runoff, reducing soil erosion and surface runoff is an important step in reducing phosphorus losses from the farm.[3] Subsurface flow is also an important mechanism of phosphorus losses from the farm.[4] Growers can address these losses by matching phosphorus demand in plants with fertility management, keeping phosphorus concentrations in soils at agronomically responsive levels (approximately 40 ppm Olsen-P for most soils in this area), and managing irrigation to minimize or eliminate runoff.

It is important to note that many growers on the Central Coast have already initiated practices to reduce the loss of phosphorus from their farms. UC Cooperataive Extension, UC Davis, and UC Santa Cruz have several research projects in progress to document how changes in farm management can improve water quality. A number of government agencies and NGOs are also working with growers to improve water quality (see contact information, below).

Despite growers' efforts, the target level of 0.12mg/L or lower for SRP set by the Regional Water Quality Control Board may be difficult to attain in the lower Pajaro River and Elkhorn Slough watersheds, where natural sources of phosphorus may be high. Even with changes in agricultural practices, the ambient water quality improvements may not be detected for several years. Thus, long-term monitoring and training programs—particularly those that inform growers of nutrient levels associated specifically with their operations—are important. We will continue to work with growers in their efforts to minimize nutrient losses from their land and improve water quality

– Marc Los Huertos, Claire Phillips, Carol Shennan

References

[1]Hartz, T., M. Cahn, and M. Swain (2003). Efficient Use of Phosphorous Fertilizer in California Vegetable Production. Western Nutrient Management Conference, Salt Lake City, UT.

[2]Sharpley, A., B. Foy, and P. Withers (2000). Practical and innovative measures for the control of agricultural phosphorus losses to water: an overview. *Journal of Environmental Quality* 29(1): 1-9.

[3]Gillingham, A. G., and B. S. Thorrold (2000). A review of New Zealand research measuring phosphorus in runoff from pasture. *Journal of Environmental Quality* 29(1): 88-96.

[4]Simard, R. R., S. Beauchemin, and P. M. Haygarth (2000). Potential for preferential pathways of phosphorus transport. *Journal of Environmental Quality* 29(1): 97-105.

Contact Information for Central Coast Region Resource Groups Involved in Water Quality Improvement

Resource Group	Monterey County	San Benito County	San Mateo County	Santa Clara County	Santa Cruz County
Cooperative Extension	831.759-7350	831.637-5346	650.726-9059	408.282-3110	831.763-8040
Natural Resources Conservation Service (NRCS)	831.637-4360 x108	831.464-2950	831.637-4360 x108	831.637-4360 x111	831.637-4360 x111
Resource Conservation Districts	831.424-1036	831.638-6422	650.712-7765	831.464-2950	831.464-2950
Agricultural Land-Based Training Association (ALBA) (Se habla español)	831.786-8760 or 831.758-1469 (all counties)				
Agricultural Water Quality Coalition (AWQA)	www.awqa.org (all counties)				

Santa Cruz area
events

▶ **Rose Pruning Workshop**, Saturday, January 14, 10 am–1 pm, Alan Chadwick Garden, UC Santa Cruz. Orin Martin will show you pruning techniques to keep your roses healthy and productive. Wear warm clothes; heavy rain cancels. $10 for Friends' members; $15 for non-members, payable the day of the workshop.

▶ **Pome Fruit Pruning Workshop**, Saturday, January 21, 10 am –2 pm, Louise Cain Gatehouse, UCSC Farm. Garden manager Orin Martin will show you how to get the most out of your pome fruit trees (apples and pears) at this workshop. Wear warm clothes; heavy rain cancels. $15 for Friends of the Farm & Garden members; $20 for non-members, payable the day of the workshop.

▶ **Stone Fruit Pruning Workshop**, Saturday, January 28, 10 am –2 pm, Louise Cain Gatehouse, UCSC Farm. Same as above, this time with an emphasis on stone fruit trees (peaches, plums, nectarines, etc).

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

▶ **Organic Rose Selection and Care** , Saturday, April 29, 10 am–12 noon, San Lorenzo Garden Center, 235 River Street, Santa Cruz. Garden Manager Orin Martin presents a free workshop on choosing and raising roses, and controlling pests and diseases using organic techniques. This is a great time of year to choose and plant container-grown roses when you can see them in bud. Note the location: San Lorenzo Garden Center.

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

California

▶ **Facilitating Sustainable Agriculture: A National Sustainable Agriculture Education Conference**, January 24–25, 2006, Asilomar Conference Center, Pacific Grove. This conference on post-secondary education in sustainable agriculture is designed for faculty, staff, students, and administrators from two- and four-year colleges and universities. The Center for Agroecology and Sustainable Food Systems (the Center), in collaboration with the UC Davis College of Agriculture and Environmental Sciences and Student Farm, will convene this event.

For registration information, go to www.ucsc.edu/casfs, or contact Albie Miles at afmiles@ucsc.edu, 831.459-4661. See page 18 of this issue for additional details.

▶ **26th Annual Ecological Farming Conference**, January 25–28, 2006, Asilomar Conference Center, Pacific Grove. The Ecological Farming Conference is one of the largest and oldest gatherings of organic farmers, marketers, activists, and sustainable consumers in the U.S. The 2006 theme is "Savoring Connections from Seed to Table."

The conference features more than 50 workshops on innovative farming techniques and sustainable food systems. Participants enjoy organic meals, a regional farm tour, seed swap, organic wine tasting, exhibitor marketplace, and special events.

For information call the Ecological Farming Association at 831.763-2111, or see www.eco-farm.org.

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