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The CENTER for AGROECOLOGY & SUSTAINABLE FOOD SYSTEMS

the Cultivar

The CENTER for AGROECOLOGY & SUSTAINABLE FOOD SYSTEMS

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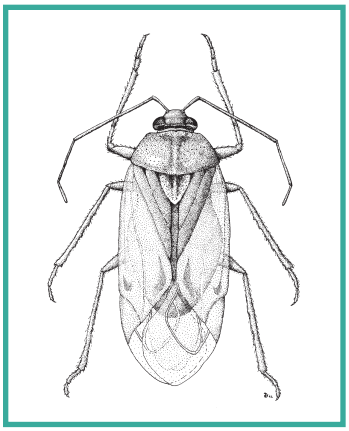
in this issue:

Trap Crops Show Potential to Reduce Pest Damage, Save Time and Energy in Organic Strawberry Production



Tara Dalton

***Lygus hesperus* is a major pest of strawberries on California's central coast.**

Organic strawberry production has become big business in California, generating more than $17 million in sales annually on over 1,200 acres—nearly 5% of California's total strawberry acreage. But as producers have found, growing this specialty crop without conventional pesticides requires a new toolbox of pest and disease control techniques.

For the past five years, researchers from the Center for Agroecology and Sustainable Food Systems (the Center) have been refining the use of trap crops in organic strawberry systems as a way to limit damage from the western tarnished plant bug (WTPB, *Lygus hesperus*, also called the lygus bug) and boost populations of the pest's natural enemies.

A serious pest native to California's central coast, WTPB feeds on developing strawberries, causing gnarled, "cat-faced" berries with enlarged, straw-colored seeds. These damaged fruit can't be sold on the fresh market. Although some organically acceptable sprays exist to treat WTPB, they're expensive and relatively ineffective.

TRAP CROPS OFFER "PREFERRED" HOST

A broad range of winter weeds in central coastal California, including wild radish, mustards, chickweed, lupine and other legumes, and knotweed, offer a winter food source for WTPB. As the rainy season tapers off in the spring and wild vegetation dries out, the WTPB adults move to flowering crops, including strawberries, and begin feeding.

Trap crops planted along the edges of crop fields or within the field have the potential to limit WTPB damage by offering the pests a food source they prefer over the crop itself. "That's the definition of a trap crop—that it's a preferred host or food source for the insect you're targeting when compared with the main crop," says Sean L. Swezey, the Center's associate director, and director of the UC Sustainable Agriculture Research and Education Program. Trap crops can also serve as habitat for beneficial insects, which can supplement pest control efforts.

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Once attracted to the trap crop, pests must be managed so that they don't eventually disperse into the fields and damage the crop you're trying to protect. Conventional growers can use a pesticide spray on the trap crops, but that's not an option for organic growers. However, tractor-mounted vacuum units known as "bug vacs" are one of the tools available for organic systems.

"I worked on research of the original proprietary bug vacs for the strawberry industry back in the late 1980s," recalls Swezey. "But back then we were using more of a shotgun approach, vacuuming all of the crop fields, which in a way was equivalent to using a pesticide because it affected all the insects in the fields—both pests and beneficials. This seemed to me to be as non-selective as an insecticide application."

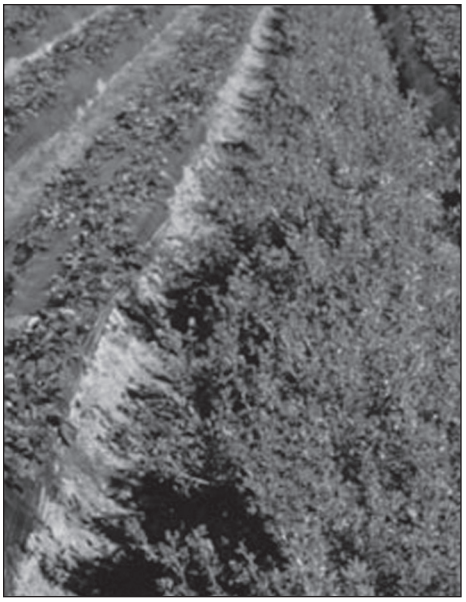
Swezey and Larry Eddings, president of Pacific Gold Farms, speculated that by concentrating the pests in one place, an effective trap crop could be managed with bug vacs, thus eliminating the need for growers to run vacuum units across their entire strawberry plantings. If effective, the approach would not only decrease WTPB damage to the strawberry crop, but would save time and energy by cutting down on the area that needed to be vacuumed, and would conserve populations of beneficial insects in the crops.

In 2002 and 2003 the Center research team of Swezey and research assistants Janet Bryer and Diego Nieto worked with Eddings and his staff at a Pacific Gold Farms site in Prunedale (Monterey County) to test their theory. Grants from the Organic Farming Research Foundation (OFRF) and the US Department of Agriculture's Western Sustainable Agriculture Research and Education program (WSARE) supported the work.

The 2003 study consisted of four treatments (each replicated four times over a 15-acre site) –

- Strawberries with culinary radish/alfalfa trap crops and trap crop vacuuming
- Strawberries with culinary radish/alfalfa trap crops and no vacuuming
- Strawberries with no trap crop and whole-field vacuuming
- Strawberries with no trap crop and no whole-field vacuuming (control)

The trap crop study took place on organically grown strawberry acreage at a Pacific Gold Farms site.



A row of alfalfa planted between strawberry rows creates a trap crop for WTPB (*Lygus hesperus*).

Each treatment plot included 16 rows of strawberries (numbered 1 through 16, with row 1 adjacent to the trap crop), with each row approximately 150 feet in length. Beds were planted with Seascape strawberries on 48-inch centers and irrigated with a strip of sub-surface drip tape. Results reported here are from the 2003 study unless otherwise noted.

MONITORING WTPB AND STRAWBERRY DAMAGE

Using a hand-held suction device, Bryer and Nieto collected insect samples in the trap crop plantings weekly beginning in January 2003. The samples were then frozen and insects (both pests and beneficials) were identified and counted under a dissecting microscope. They also monitored insects in row 1 of the strawberry plantings using the same technique. The radish trap crop flowered from February through the end of May, when it was removed. The alfalfa trap crop began flowering in mid April and continued to flower through September.

On April 11, collaborators from Pacific Gold Farm began vacuuming the beds and trap crops with a tractor-mounted unit that includes three rectangular vacuum collectors that generate a suction of approximately 28 miles/hour (40 km/hour). Operators drove the tractor at 1.2 miles per hour (2 km/hour) when vacuuming the rows, passing over the strawberry canopy at canopy height once a week, and over the alfalfa trap crop row two days a week each week through the season (ending on September 11, 2003).

In mid April, in addition to monitoring the trap crops, Bryer and Nieto began monitoring insects in strawberry rows 1, 2, 4, 8, and 16. They also examined berries from four randomly selected clusters of four strawberry plants (permanent "pick plots"); each week, developing berries that showed signs of distinct WTPB damage were counted and removed, while undamaged berries were counted once they matured.

RESULTS

Pattern of WTPB in Trap Crop Vegetation

Adult WTPB were first found in the radish trap crop vegetation on January 7, and in the alfalfa trap crop in mid April, when it began to flower. Based on a heat unit accumulation model[1] initiated when the first adult was found on January 7, the researchers predicted that a second-generation adult would not mature until July 19 at the earliest; therefore, the WTPB adults found any time before this date had migrated to the crop (rather than maturing in the crop itself). This result suggests that there is a six-month period during which migrant WTPB adults are attracted to trap crop vegetation at the edge of strawberry fields.

Figure 1 shows total (adult and nymph) accumulation of WTPB in the unvacuumed trap crop treatments and the adjacent row of strawberries. Significantly more WTPB were found in the alfalfa than in either the radish trap crop or row 1 of strawberries. For seven weeks in April and May, when both the radish and alfalfa trap crops attracted adult WTPB or nymphs hatched in the vegetation, and when the grower was conducting commercial field vacuuming treatments, alfalfa attracted or retained over 7 times more WTPB than the radish trap crop. Although it flowers and matures somewhat later in the spring, alfalfa was a significantly more effective trap crop for WTPB.

This result has management implications for central coast growers. "We'd experimented with a variety of trap crops through the years, including radish, mustard, alyssum, and other flowering annuals and perennials," says Swezey. "But we've found that the radish and some of the other crops can become difficult to deal with once they begin to die back in the summer. Given the results of this study, which show that alfalfa is far more effective at attracting WTPB, we are focusing on alfalfa."

Because heavy spring rains often continue through April, tractor-mounted vacuum management of a trap crop can only begin in early May, when muddy conditions have diminished. This is an optimum time to begin alfalfa trap crop vacuuming.

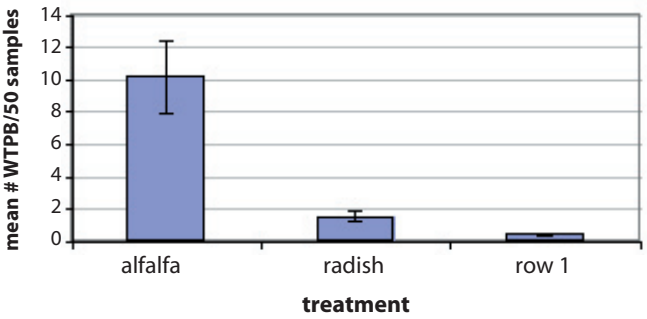


Figure 1. Total accumulated WTPB in alfalfa, radish, and strawberry row treatments, April–May 2003. All treatment means are significantly different (p<0.05; least significant difference). Bars indicate +/- SEM.

An employee at Pacific Gold Farms uses a tractor-mounted bug vac to vacuum an alfalfa trap crop.

Pattern of WTPB Numbers and Strawberry Damage by Treatment and Row

In June, weekly, tractor-mounted vacuuming of the alfalfa trap crop reduced total WTPB by 70% compared to the unvacuumed trap crop (see figure 2). The vacuumed trap crop treatment had the same accumulated WTPB as either the whole-field vacuuming treatment or the untreated control. In contrast, the unvacuumed trap crop consistently accumulated higher numbers of WTPB in strawberry rows 1, 2, 4, and 8. There were no differences among treatments at row 16, indicating that the trap crop's effect on WTPB numbers ended somewhere between rows 8 and 16.

Why the total WTPB numbers in the untreated control were consistently low in June is not clear. It's possible that whole-field vacuuming in the commercial fields surrounding this experiment lowered the general level of WTPB in the small test plots. Movement or "sinking" of WTPB to nearby trap crops could also explain the low numbers in the control plots.

As shown in figure 3 (*page 17*), the vacuumed trap crop treatment had a significantly lower percentage (11.1%) of damaged strawberries than either the whole field vacuuming (41% reduction) or the untreated control (48% reduction).

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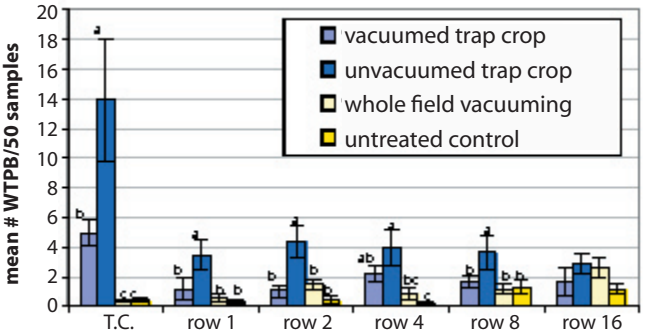

Figure 2. Accumulated WTPB by treatment and row, June 4–July 4, 2003. Treatment means not followed by a same letter are significantly different within the row; least signficant difference (p<0.05). Bars indicate +/- SEM.

from the director

As I look over the array of topics in this issue of *The Cultivar*, I'm reminded of the many efforts that the Center has undertaken to help growers improve their farming and marketing operations.

One of those efforts is our ongoing research on production practices that minimize pest damage without the use of synthetic pesticides. To that end, the Center's associate director Sean Swezey (who also directs UC's Sustainable Agriculture Research and Education Program) and Center researchers Janet Bryer and Diego Nieto have been working for the past several years with commercial organic strawberry growers to refine the use of trap crops in their production systems. See the cover story for a progress report on this research.

In another project aimed at serving local growers, we've teamed with UC Cooperative Extension researchers to study the potential for growing blueberries organically on California's central coast. A blueberry trial planted on the Center's farm last fall will generate information on the best-performing highbush varieties of this potentially lucrative niche crop (*page 7*). This spring we held a field day to introduce the project to the local farming and gardening communities, and we look forward to future field day opportunities as this variety trial progresses.

Also addressed in this issue is the often vexing challenge of gopher control. Operations assistant Thomas Wittman has become something of a local expert in this field; here he shares his tips for taking on gophers at the small-farm level (*page 13*).

Environmentalists as well as growers are concerned about the potential impacts of genetically modified crop plants on wild crop relatives. Center faculty affiliate Deborah Letourneau of the UCSC Environmental Studies Department, graduate student Joy Hagen, and UCSC biology professor Ingrid Parker, are examining this topic for *Brassica* family crops along California's central coast (*page 10*).

Farther afield, our community supported agriculture (CSA) manager Nancy Vail attended the first international conference on the CSA movement, where she had a chance to share experiences with others from around the world who are developing this unique approach to organic farming and community building. She reports that the Center's university-based training program in CSA farming operations was of particular interest to those attending this inaugural event (*page 5*).

I hope you enjoy this issue of the newsletter.

– Dr. Carol Shennan

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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, 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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Center's CSA Manager Takes Part in First International CSA Conference

This past February, I attended the first International Symposium on Local Contracts between Farmers and Consumers, held in Aubagne, southern France. The symposium was organized by an international organization called Urgenci, which seeks to be a worldwide network for information about consumer/producer and urban/rural relationships (see more at www.urgenci.net). The meeting's goal was to provide a forum for sharing information and experiences among all the participating countries with the ultimate aim of creating an interactive international network for community supported agriculture (CSA) partnerships. Conference sponsors included local municipalities in Provence and the Council of Europe.

The conference attracted approximately 500 participants (many of them local French citizens) from 15 countries. Four of us from the United States—Annie Main, organic farmer from Good Humus Produce in California's Capay Valley; Jered Lawson from the Community Alliance with Family Farmers; Karen Heisler, a community member of Live Power Community Farm's CSA; and myself, Nancy Vail, CSA Manager for the Center for Agroecology and Sustainable Food System's UCSC Farm—made presentations on the history and current status of the CSA movement in the U.S. as well as on land tenure issues and educational programs. Others shared stories about their experiences with farmer-consumer partnerships in France, Japan, Morocco, Demark, Brazil, Belgium, Switzerland, Quebec, Lebanon, and Great Britain, among other countries.

PARTICIPANTS SHARE CSA EXPERIENCES

The first day of meetings primarily consisted of plenary presentations by member delegates. The variety of stories they shared gave a sense of the range of CSA projects taking place around the world—

Japan

Shinji Hachimoto, a long-time organic farmer, reported on the history of the CSA movement in Japan, known as Teikei. Teikei translates to "food with the farmer's face on it." The concept was developed by a group of women concerned with food safety, the use of pesticides, the increase in processed and imported foods, and the corresponding decrease in the farm population. In 1965 these women initiated a direct, cooperative relationship in which consumers supported local farmers each year. There has been a strong consumer cooperative movement in Japan since the late 1800s, so the CSA/Teikei concept was readily adapted.

Jered Lawson

Two members of AMAP pick up their share of produce from Denise and Daniel Vuillon's farm, Le Gardin De Olividades, in Aubagne, Provence.

Today there are 500 to 1,000 consumer groups that are connected with organic producers in Teikei relationships across the country. Membership group size ranges from less than 10 families to more than 5,000. There are also about 650 co-ops in Japan with 16 million members; many of these co-ops participate in Teikei relationships.

Germany

Wolfgang Stränz reported on the origins of CSA at a farm called Buschberghof. In 1988 the people at Buschberghof were able to create a CSA (known in German as *Wirtschaftsgemeinschaft*, or economic community) drawing their inspiration from Rudolf Steiner's philosophies and from Trauger Groh (co-author of *Farms of Tomorrow*), who eventually left Buschberghof and began a CSA in New Hampshire.

What inspired me about this CSA project is how the community members come together annually at a mandatory meeting where the farmers present their budget for the year. The members then individually pledge whatever they can afford until the budget is met. This type of transparency informs the community members of the farm's actual financial needs and allows members to pay according to their incomes.

Canada

Members of an organization called Équiterre reported on the state of CSA in Canada, where there are an estimated 200 CSA farms. Équiterre (from the French words for equity and earth) is a not-for-profit group dedicated to promoting

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ecological, socially just choices through action, education and research from a standpoint that embraces social justice, economic solidarity and the defense of the environment.

Of their various programs, Équiterre's CSA project works to connect consumers of all incomes with local farms. Currently the Quebec CSA network has more than 80 participating farms, with several thousand consumer sharers. With this project, Équiterre aims to support the development of Quebec's organic farms and make their produce more accessible. Other programs include Energy Efficiency, Sustainable Transportation, and Fair Trade. For more information, see www.equiterre.qc.ca/english/home/indexfinal2.html.

Switzerland

Switzerland is home to the first CSA projects in Europe. Since 1978, there have been strong consumer food co-ops in Switzerland that gave rise to the country's CSA movement. Extremely high land prices make it difficult or impossible for farmers to purchase land. Land ownership was resolved by using a rental agreement; rather than purchasing the land, the cooperative pays the farmer's lease.

One farmer reported on a 400-member cooperative with 4 producers that each farmed 3 hectares. Co-op members enabled farmers to build production capital for the farms. They set a budget and divided the cost among the members (500—600 Euros per year depending on the size of the produce share). Members who do not have the money can work for their basket (14 days per year).

Jan Vander Tuin wrote "Zurich Supported Agriculture" about his experiences with Swiss CSAs in the early 1980s. He eventually returned to the U.S. and worked with Robin Van En to co-found Indian Line Farm, one of the first CSA farms in the country. See www.urbanology.com/csa/zurcsa.html to read about his thoughts on the contrast between Swiss and U.S. attitudes toward CSA.

CSA CONCEPT DEVELOPING IN FRANCE

Although Community Supported Agriculture has been growing in popularity in the U.S. since the mid 1980s, it's a relatively new concept in France. There it's known as AMAP, le Association pour le Maintien d'Agriculture Paysanne (Association for the Maintenance of Peasant Agriculture). AMAP's origins can be traced to 1992, when local councils of French farmers, consumers, and politicians formed to stop land speculation and to help new, young farmers by providing information about irrigation and soil quality. But it wasn't until 2001 that the first AMAP began at Le Gardin De Olividades in Aubagne, Provence. Farmers Denise and Daniel Vuillon first heard about the concept from their daughter, who had met CSA farmers on the east coast of the U.S. They often remarked that they wished they'd known about the AMAP concept sooner.

Daniel and Denise displayed photographs of the first meeting with their AMAP members and subsequent pictures in which the number of community members doubled, then tripled. One of the most heartening stories we heard was about the way their community members rallied to save the farm from being taken over by the local municipality, which wanted to install a tramway through the land.

Encouraged by the success of their own AMAP community, Denise and Daniel have joined with a group of local organic farmers in the area and, financed by a local council, formed an organization called Alliance Provence, which develops AMAP relationships between farmers and consumers. Since 2001 they have helped create 25 AMAPs in southern France and hope to initiate another 10–15 more by next season.

Before and after presentations and workshops we toured various AMAP farms in the Provence region, and were amazed by the diversity and beauty of the mixed orchards and cover cropped fields surrounded by old stone buildings. What was so intriguing about these farms was that in most cases it was the community that rallied around the farmer to create a dedicated market for the farm's products, rather than the more common model in the U.S. where a farmer solicits support and memberships from the community. AMAP members are active participants in their farms, helping distribute membership shares, write newsletters, and organize to protect farmland.

CENTER OFFERS UNIQUE TRAINING OPPORTUNITY

Most of the conference participants noted that the university systems in their countries did not offer any practical

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Mission Statement Established

Throughout the conference, various delegations discussed CSA late into the night. From these discussions a group of us established the following mission statement for an International Network for CSA/AMAP/Teikei –

"Gathered on the occasion of the First International Symposium about Local Contracts Between Farmers and Consumers in Aubagne (France) on 26th and 27th February 2004, the delegations of the participating countries express their intention to create an international network to foster local commitments between rural and urban citizens. The network is rooted in local actions. Some of the potential objectives are –

- to facilitate the exchange of experiences and information
- to promote the concept and encourage initiatives from other countries with special attention to marginalized areas.
- to develop tools to reinforce the viability of the initiatives
- to coordinate actions at an international level
- to create a dialogue with public institutions
- to encourage the mobilization of local networks
- to reinforce the principles of local urban-rural partnerships

We encourage the involvement of all participants who share in these goals."

Researchers Examine Variety of Efforts to Reshape Agrifood System

A number of initiatives—community supported agriculture, "fair trade" marketing labels, consumer education, "buy local" marketing campaigns, the promotion of organic food and agriculture, and farm-to-school programs—are part of a broader effort by consumers, farmers, and policymakers to create an agrifood system that is more ecologically sound, economically viable, and socially just. The Center's social issues researchers are studying several of these strategies, looking at factors such as the extent to which these goals have been met, the challenges in implementation, and the opportunities for success. Current research topics include –

Local Food Campaigns

Local food systems have become increasingly popular in the last few years, and "buy local" promotions are a key strategy for developing these systems. The goal of this project, directed by the Center's social issues specialist Patricia Allen, is to learn about the motivations, understandings, visions, and assumptions behind "local" as a strategy for addressing the problems in the food system. Center researchers are studying a number of buy-local campaigns in the U.S. and will examine in greater detail the efforts of Blackhawk County, Iowa and Santa Cruz County, California. Clare Hinrichs, associate professor at Iowa State University, is collaborating on the project.

School Food Programs

While school food programs have been in operation for decades, in recent years these programs have begun to place increased emphasis on providing fresh, local produce. The purpose of this project is to understand the types of school food programs in California and the decision-making processes by which schools come to adopt or not adopt innovative programs such as farm-to-school. Coordinating the project are Allen and UCSC Community Studies assistant professor Julie Guthman, a Center faculty affiliate.

Consumer Perceptions about the Food System

The purpose of this project, coordinated by Center postdoctoral researcher Phil Howard, is to better understand the priorities and concerns of consumers on California's central coast. We asked consumers what they would like to know about the food system and examined consumer interest in food standards such as organic, humane, local, and fair trade. A survey was sent to 3,000 central coast households, about half of whom responded. We are currently tabulating and analyzing the responses.

Farm Security and Food Security

This research builds on our earlier study of alternative agrifood initiatives (AFIs) in California to examine the ways in which the twin goals of farm security and food security are being met through these initiatives. In this project we are studying three different types of AFIs: farmers' markets, CSAs, and farm-to-school programs. Allen and Guthman are currently analyzing data from surveys of CSAs and farmers' markets conducted over the winter and spring and are conducting telephone interviews with a number of the managers of these institutions.

Project Analyzes Central Coast Water Quality on Local, Watershed Scales

Center researchers are continuing their study of land use and water quality impacts, examining sites throughout the Pajaro River and Elkhorn Slough watersheds in Santa Cruz, Monterey, and San Benito Counties. The research, developed by Center director Carol Shennan and research associate Marc Los Huertos, began in 2000 and has since expanded to target water sources of the Monterey Bay located in agricultural areas. The overarching goal of this work is to correlate land uses with water quality in local watersheds, and to work with growers to improve nutrient management practices on their land. Funding for the work is provided by the US Department of Agriculture as part of the Central Coast Research Project.

In addition to sampling at both upstream and downstream locations biweekly for nitrate and phosphorous levels, the research team that also includes Claire Phillips and Alex Fields sampled several agricultural sites more intensively through the rainy season to measure concentrations of nutrients in runoff generated during storms. They are also sampling nutrient concentrations in irrigation return flow ditches that receive pumped tile drain water. In addition, automatic samplers were installed at two locations to collect water samples at higher frequencies (every 3–6 hours), and at higher intervals during the rainy season. The 2003–2004 monitoring effort will continue through the end of July.

Los Huertos observes that the past several years of monitoring work have revealed an overall pattern of increased nitrogen and phosphorous loads in the Pajaro River and

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Claire Phillips

Center research team assistant Adam Romero samples water quality at Llagas Creek, a tributary of the Pajaro River.

other waterways as they pass from upstream, relatively undeveloped land through agricultural lands. Says Los Huertos, "Demonstrating the changes in nitrate concentrations from upstream to downstream locations has increased grower interest in adopting practices to reduce nitrogen loss from farmland. In one area where agriculture clearly dominates the land use, growers have found our data compelling and are interested in developing strategies such as using drainage ditches as temporary treatment wetlands to address the problem."

To get a watershed-scale picture of how agricultural practices can affect nutrient losses, Center researchers recently partnered with Changsheng Li from the University of New Hampshire and William Salas of Applied Geosciences to develop a model of carbon and nitrogen dynamics for Elkhorn Slough. Li originally designed the computer model to estimate greenhouse gas emissions, then expanded it to include information on nitrate leaching levels.

As Los Huertos explains, "There are three potential "sinks" or places that nitrogen and carbon can end up in a system: stored in the soil, released to the air in the form of gases via respiration or mineralization by soil organisms, or leached from the soil via runoff. This model predicts the amount of carbon and nitrogen that will end up in each "sink" based on a variety of parameters."

The model, called DNDC (DeNitrification and DeComposition model) uses local weather data, soil organic matter levels, fertilizer applications, tillage frequency, and crop characteristics such as biomass to predict how much carbon and nitrogen will be lost from the soil via the flux of gases (carbon dioxide, nitric oxide and nitrous oxide) and through leaching (dissolved nitrogen). DNDC can also predict the potential for storing carbon in the soil in the form of organic matter—an important factor that affects levels of the greenhouse gas carbon dioxide.

Using information provided by Center researchers Joji Murimoto, Katie Monsen, and Los Huertos, Li and Salas will use the DNDC model to predict the amount of nitrogen lost from the soil due to gas flux and leaching for the Elkhorn Slough watershed. Los Huertos hopes to eventually extend the model to the entire Pajaro River watershed. This modeling approach can be used to better understand the relationship between agricultural practices and nitrogen movement in the environment, generating important information for policy makers, growers, and others interested in water quality issues.

Web Site Offers Information on Common Plant Pathogens, Diseases

Researchers, apprentices, and students working at the Center's 25-acre organic farm at UC Santa Cruz have a new web-based resource available, thanks to the work of Environmental Studies undergraduate Leah Funk. Leah has created a compendium of information on plant pathogens and diseases occurring at the farm, including bacterial, viral, and fungal pathogens. The site's URL is http://gis.ucsc.edu/disease/.

"A compendium of plant diseases compiles information about the triangle formed within a defined location by the pathogen, host plant, and environment," she writes in the introduction to her site. The site includes information on pathogen identification and life history, host plant range and symptoms, disease control measures that meet National Organic Program standards, and a list of selected references.

Leah became interested in developing the compendium after taking several Environmental Studies classes, including Agroecology and Plant Disease Ecology, and observing diseases in field experiments. After finding out from UCSC farm manager Jim Leap that no central data base or resource on plant diseases found at the farm existed, she decided to create a compendium that provides a quick identification tool, information source, and a basis for further research on disease management options.

The web site focuses on common fungal and bacterial diseases that occur at the Center's farm and that confront both organic and conventional commercial growers, as well as backyard gardeners. These include apple scab (*Venturia inequalis*), garlic rust, powdery mildew, *Verticillium* spp. and *Phytophthora* spp. Leah isolated many of the pathogens and diseases during field work at the farm and based other listings on reports from Leap, county extension agents, and plant pathology consultants. The site includes color microscopic and macroscopic photographs of the pathogens and of disease symptoms that are useful in identifying specific pathogens.

Environmental studies professor Greg Gilbert and Center director Carol Shennan served as faculty advisors to the project, with Leap, garden manager Christof Bernau, and members of the apprenticeship course offering additional advice and information. Research for and development of the web site was supported by funds from the Center's competitive research grants program (see *Center Notes*, page 11, for a list of this year's research grant recipients).

Center and UC Cooperative Extension Initiate Blueberry Variety Trial at UCSC Farm

Blueberries offer small-scale growers a potentially profitable "niche" crop that can be developed as a U-pick operation or incorporated into other marketing activities. Although the plants need several years to get established and require careful soil preparation and fertility management, a successful blueberry crop can generate $30,000 to $50,000 per acre (see "Growing and Marketing Blueberries," *Small Farm News*, Volume 1 2004, Small Farm Center, UC Cooperative Extension).

To learn more about the best-performing varietal options for organic growers on California's central coast, the Center initiated a variety trial of mostly low-chill, highbush blueberries at the UCSC Farm in the fall of 2003. This project is being conducted in collaboration with Aziz Baameur, Small Farm Program Advisor for Santa Clara County's UC Cooperative Extension (UCCE) office, and Mark Bolda, UCCE's central coast Strawberry and Caneberry Advisor.

Blueberries need well-drained, acidic soil (a pH of 5 or lower is ideal) in order to thrive. In November 2003, UCSC Farm manager Jim Leap applied sulfur to the trial site at a rate of approximately 2,000 pounds per acre as well as 3–4 inches of acidic (4.6 pH) mulch, then created raised beds for the plants.

With the help of second-year apprentices Aaron Blyth, Carissa Chiniaeff, Allegra Foley, Estrella Phegan, Ratoya Pilgrim, and Matthew Sutton, the research team planted out 17 varieties of blueberries in January 2004. The trial includes 4 replicates of each variety planted on 3-foot plant in-row spacing with 5 feet between rows. Peat was applied in the planting hole to further lower the pH. Varieties being tested are: Biloxi, Bluecrop, Duke, Emerald, Jewel, Jubilee, Misty, Oneal, Ozarkblue, Millennia, Santa Fe, Sapphire, Sharpblue, Southern Belle, Southmoon, Star, and Windsor.

Martha Brown

Center staff plant highbush blueberries at the UCSC Farm to test varieties grown organically under central coast conditions.

Martha Brown

Aziz Baameur discusses soil requirements for growing blueberries at a field day on the UCSC Farm.

After planting, the beds were mulched with several more inches of acidic bark, and drip tape was laid on top of the mulch. Plants are irrigated weekly with the drip tape, and during each irrigation vinegar is injected into the irrigation water to maintain a low pH. Phytamin, a liquid nitrogen fertilizer, is being applied through the drip lines monthly during the summer to maintain adequate nitrogen levels and get the plants off to a strong start.

Over the next several years, the research group will evaluate a variety of factors, including overall plant vigor, disease and pest resistance, and eventually, harvest dates, fruit taste and quality, and fruit production. Although the first harvest is still 12 to 18 months away, Leap is excited about the trial. "Blueberries offer a great marketing opportunity for small-scale organic growers," he says, adding that, "this project has also created great opportunities for interactions between the Center and our local UCCE advisors."

A blueberry field day organized by the Center, UCCE, and the Community Alliance with Family Farmers was held in early June, bringing farmers and gardeners to the UCSC Farm for a look at the new plantings. Speakers included Baameur, Leap, and Bolda, as well as UCCE researchers Richard Smith, who discussed organic weed management, and Laura Tourte, who talked about blueberry economics and marketing.

– Martha Brown

UCSC Scientists Investigate Impact of Genetically Modified Plants on Wild Relatives of Major California Crops

As an environmental scientist, Center faculty affiliate Deborah Letourneau believes policy decisions should be based on the best information available at the time. That's why she's trying to fill an information gap with her latest research on genetically modified plants.

As insect-resistance is bred into major crops, Letourneau wonders how those crops' wild relatives might be affected if they pick up the new traits. "There's been a lot of research on crop-to-crop movement," said Letourneau, referring to the contamination of organic corn grown adjacent to genetically modified (GM) corn. "But we don't know that much about the biology of wild crop relatives. If genes transferred, would it make them more weedy, more hardy, more invasive?"

To address these questions, Letourneau, a professor of environmental studies at UCSC, along with doctoral candidate Joy Hagen and Ingrid Parker, an associate professor of biology, have begun a three-year study to see what the consequences would be if GM genes transferred from *Brassica* plants through cross-pollination to their wild relatives.

Plants in the *Brassica,* or cole, family include many vegetable crops, such as broccoli, Brussels sprouts, cabbage, cauliflower, and kohlrabi, as well as common weeds like wild radish and wild mustard.

"Weed problems translate into economic problems for farmers," said Letourneau, noting that 75 percent of cole crop production in the United States is concentrated on the Central Coast of California. Stubborn weeds require more herbicide applications, with accompanying higher labor costs and environmental impacts, she said, adding that highly invasive weeds can threaten native species on nonagricultural lands, too.

Letourneau is a leading authority on the genetic modification of plants. A member of the National Academy of Sciences' 12-member panel investigating the environmental consequences of GM plants, she also coedited the 2002 book, *Genetically Engineered Organisms: Assessing Environmental and Human Health Effects*. Parker's background is in applying mathematical models to ecological risk assessment for GM crops.

A growing number of crops are being genetically modified to increase insect resistance. More than 25 percent of corn grown in the United States has been genetically engineered to contain the toxin of the *Bacillus thuringiensis* (Bt) soil bacterium, which disrupts the digestive system of a caterpillar. Transgenic cotton and potatoes also produce Bt toxin.

Little is known about the role Bt-susceptible herbivores, including caterpillars, play in regulating the health and spread of wild crop relatives. In their research project, Letourneau and Hagen are protecting wild relatives from caterpillar damage to see what could happen if modified genes moved from *Brassica* crops to their wild relatives.

The simulation is necessary because the research is being conducted in open fields—not inside greenhouses—where risks of contamination by GM plants would be high, said Letourneau. To mimic an effect of gene transfer, the UCSC researchers are spraying Bt on wild radish and wild mustard growing adjacent to commercial cole crops, and they will use models to evaluate the subsequent fitness, weediness, and invasiveness of the weedy relatives, said Letourneau.

"We can't use real transgenic crops, but we wanted to conduct this work where wild relatives live side-by-side with commercial crops," said Letourneau. Research sites include the Center's on-campus Farm and agricultural parcels adjacent to natural ecosystems from Wilder State Park to Elkhorn Slough Reserve.

Genetic links between crops and weeds are remarkably common, and cole crops are no exception, noted Parker. "In the past, the evolution of many weeds has been driven by genes coming from crops," she said. "Now those genes will be specially engineered by humans."

Research on consequences for wild relatives is overdue, said Letourneau, noting that field-testing of GM cole crops for California has been under way since 1999. "This kind of research is important now, during the process of risk assessment, to know whether new modified crops should be deregulated or not," she said. "There are a lot of Bt crops in the pipeline. Anything we can find out now can be used by regulators to make more informed decisions."

Letourneau takes nothing for granted as the research gets under way. The project will use a large number of sample plants on varied research sites, and the experiments will be replicated over three years.

Hazards of GM corn, including allergenicity and contamination of adjacent fields, were identified during extensive testing that was required because it is a food.

Because similar tests are not required on nonfood plants, it's harder to know what the hazards might be, and what the probability is that they'll occur, said Letourneau. "It might be that transgene movement to wild relatives would be no problem at all," she said. "If we don't detect any problems or hazards, we'll feel we've tried to provide the data needed for risk assessment." The three-year project is funded by a $335,000 grant from the U.S. Department of Agriculture.

–Jennifer McNulty

Center Awards Student Research Grants

Each year the Center awards research grants to support new and ongoing UCSC graduate and undergraduate projects related to the Center's mission. This funding helps make possible the fieldwork and lab work upon which students base their doctoral dissertations and senior thesis papers.

2004 Graduate Student Awards

Sarah Bothwell – Perennial Habitat for Conservation Biological Control in Annual Cropping Systems: The Role of Landscape Complexity

Roseann Cohen – Homegardening on the Urban Periphery: Translating Rurality for Cultural and Territorial Survival

Brian Gareau – Part II, Global Politics, Social Relations, and the Methyl Bromide Phaseout: Consequences for California Strawberry Production

Tara Pisani Gareau – Farmscaping with Hedgerows in the Central Coast of California: Examining the Potential for Biological Control

Suzanne Langridge – Can Natural Systems Augment Agriculture? Ecological Implications of Landscape-Level Riparian Restoration

Hillary Malcerek – Sustaining the Harvest of San Francisco Bay Area Urban Community Gardens

Dorothy Overpeck – An Interdisciplinary Analysis of Agricultural Sustainability: A Case Study from Southern Malawi

Sajeema Pasakdee – Evaluating Soil N Dynamics After Applications of Organic N Fertilizers

Alex Racelis – Palapas in Paradise: An Ethnobotanical Approach to the Commodification of Pole Wood in Central Quintana Roo, Mexico

Robert Sirrine – Preserving the Viability and Cultural Integrity of a Northern Michigan Farming Community: An Interdisciplinary Framework for Sustainable Tart Cherry (*Prunus cerasus* L.) Management

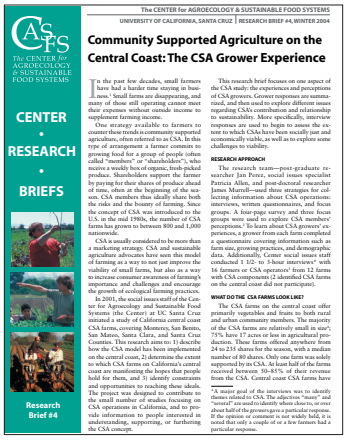
2004 Undergraduate Student Awards

Leah Funk – A Compendium of Plant Diseases at the Center for Agroecology and Sustainable Food Systems

Alija Mujic – Reduction of Caffeine in Coffee Grounds through Mushroom Cultivation

Melanie Timpano – Center for Agroecology and Sustainable Food Systems' CSA Herb and Flower Garden: Improving Access to Information

Newest Research Brief Reports on CSA Growers' Experiences


The CENTER for AGROECOLOGY & SUSTAINABLE FOOD SYSTEMS
UNIVERSITY OF CALIFORNIA, SANTA CRUZ | RESEARCH BRIEF #4, WINTER 2004
Community Supported Agriculture on the Central Coast: The CSA Grower Experience
CENTER • RESEARCH • BRIEFS
Research Brief #4

The latest title in the Center's Research Brief series examines the experiences and perceptions of growers running CSA operations on California's central coast. Research Brief #4, *Community Supported Agriculture on the Central Coast: The CSA Grower Experience*, is based on interviews and surveys with growers from Monterey, San Benito, San Mateo, Santa Clara, and Santa Cruz Counties. It was written by Jan Perez, the Center's associate specialist in social issues.

The research brief explores such topics as why growers started their CSA operations, the impact of the CSA on the farm's economic viability, the challenges of running a CSA, and how central coast CSAs are addressing the issue of equal access to food. Research Brief #4 is available free from the Center, or can be downloaded as a PDF from the Center's web site (www.ucsc.edu/casfs). To request a copy, call 831.459-3240 or send email to jonitann@ucsc.edu.

First Activist–Researcher Consortium Meeting Held

Initiated in the spring of 2003, the activist-researcher consortium (ARC) brings together activists and researchers to collaborate on research and action aimed at improving social conditions in California's agrifood system. The UCSC Center for Global, International and Regional Studies (CGIRS) and the Center for Agroecology and Sustainable Food Systems provided funding for the project.

Following several months of planning, Patricia Allen, the Center's social issues specialist, and UCSC community studies professor Julie Guthman coordinated ARC's inaugural meeting on January 21st at the Asilomar Conference Center in Pacific Grove, California (as a pre-conference to the Ecological Farming Conference put on by the Ecological Farming Association). Forty invited participants, about half

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of whom were activists and half were researchers, attended this initial meeting. They accomplished the following –

- Agreement on a working definition of social justice in food systems to undergird all future work (see below).
- Identification of possible research topics and other institutional collaborations and an informal matching of people to areas of shared interest.
- Establishment of four working groups to pursue specific collaborations and report back to the entire group.

Two of the four working groups were organized around specific research areas where the most participants expressed interest and potential support from their home institutions. They are –

- Assessing the opportunities and constraints to the incorporation of social justice principles and practices in food and farm-related businesses.
- Analyzing food access as an economic and racial justice issue, including assessment of food access in farm worker communities.

The other two groups will focus on strengthening the institutional basis for collaboration among activists and academics. They will –

- Develop vehicles (e.g., workshops, retreats, discussion groups) where activists and researchers can further engage in discussions about how to effect positive social change and learn from the past and from each others' experiences.
- Create a list-serve, web-based workspace, and database for researchers and activists to communicate about the projects they are working on and encourage informal collaborations.

Details on the progress of the ARC project will appear in the next issue of *The Cultivar*.

Working Definition of Social Justice in Food Systems

A socially just food system is one in which all people have their basic needs met, have access to information, and participate in decision making. Meeting these conditions requires a food system that is free of oppression, exclusion, and exploitation.

• Oppression means inequitable treatment based on ascribed characteristics. An example is discrimination based on gender or ethnicity.

• Exclusion is the prevention of equal access to social goods. An example is hunger.

• Exploitation is the condition of inequitable distributions of economic resources and power in which some are able to use the efforts of others with asymmetric rewards to the participants. An example is the conditions and wages of farm workers.

2005 Apprenticeship Training Program Announced

The Center's six-month Apprenticeship in Ecological Horticulture course provides training in the concepts and practices of organic gardening and small-scale farming. This full-time program is held annually from mid April through mid October at the 25-acre Farm and 2-acre Alan Chadwick Garden on the UC Santa Cruz campus.

The Apprenticeship course carries 20 units of UC Extension credit for the approximately 300 hours of formal instruction and 700 hours of in-field training and hands-on experience in the greenhouses, gardens, orchards, and fields.

Each year 35 to 40 apprentices come from all regions of the U.S. and abroad for the six-month course. Most apprentices choose to live on the UCSC Farm in their own tents, sharing cooking and other community responsibilities in a common kitchen/dining facility. Tuition is $3,250. Due to our interest in increasing the diversity of participants in the program, there are several scholarships available for people of color and limited income applicants.

The next Apprenticeship course will run from April 11 to October 14, 2005. Application deadlines for the 2005 program are September 1, 2004 for international applicants and October 15, 2004 for U.S. and Canadian citizens.

For more information, contact –

Apprenticeship Information
CASFS, UCSC
1156 High Street
Santa Cruz, CA 95064
(831) 459-3240
apprenticeship@ucsc.edu

Detailed information and application materials are available on the Web –

www.ucsc.edu/casfs/training/index.html

Kellogg Funds Sustainable Ag Curriculum

The Kellogg Foundation's California Food, Fiber, and Futures Project (CF3) has awarded a second grant to the Center for a statewide course development project that will aid sustainable agriculture educators at colleges and universities in California and beyond.

The $12,500 grant will be used to develop a web-based resource list and course outline for a farm-based introductory sustainable agriculture course. The funds will also make it possible for the Center to coordinate several meetings of the College Farms Sustainable Agriculture Educators Workgroup to assist with the course development project and other initiatives.

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Gopher Control on Organic Farms

Thomas Wittman is the operations assistant at the Center's UCSC Farm and Alan Chadwick Garden, and has helped hundreds of homeowners and local growers control gopher infestations in their gardens and farms through his business "Gophers Ltd." Here he offers advice on incorporating gopher control into organic farming practices.

Farmers face a variety of challenges in getting a crop from planting to market. Carefully planned strategies to build soil fertility, control weeds, and suppress pests and diseases through techniques such as cover cropping, mechanical cultivation, and crop rotations can help avert problems. But often growers neglect gopher control in their planning—instead, they do little until threatened with large crop losses.

Left unchecked, one gopher can decimate many row feet of crops, and in the case of high value crops or perennials, can cause hundreds of dollars per day in damage. A systematic approach to controlling gophers can head off or minimize damage, saving time, money, and the frustration that comes with watching crops droop or disappear into gopher tunnels. Based on my experience, I'll discuss organically acceptable ways to integrate gopher control into an overall farm plan and suggest a variety of techniques for keeping gopher damage to a minimum.

NATURAL HISTORY

Botta's pocket gopher (*Thomomys bottae*), the smallest gopher in the U.S. at approximately 6 inches long, is the dominant species in central California. The pocket gopher is named for the external cheek pouches it uses to carry food and nesting materials down into tunnel storage areas. They feed on a wide variety of vegetation, but generally prefer herbaceous plants, shrubs, bulbs, and trees.

Gophers can bear two to four litters per year of up to ten pups each (although usually only one per year in non-irrigated settings and colder climates), so populations can climb quickly under ideal conditions. Once weaned, the young disperse immediately, traveling on the surface to search for new, unoccupied territory.

Except during the breeding season, pocket gophers are solitary and territorial. Population densities average approximately 30–40 per acre, although up to 200 per acre have been observed where food is plentiful and other conditions are favorable.

As they dig their burrows, gophers push soil to the surface, creating mounds of loose soil adjacent to the plugged burrow entrance. A gopher usually creates one to three new mounds per day, excavating and constantly enlarging and moving its main feeding burrow. Gopher numbers are often overestimated due to this activity, and to the mistaken belief that gophers live in colonies. Because they are quick to repopulate empty burrow systems it may appear that the burrows are populated communally, when in fact gophers will fight to the death to protect their territories.

CULTURAL PRACTICES

By thinking of a gopher infestation as a pest problem that has similar attributes to, for example, an insect pest problem, cultural practices can be adjusted to create conditions that discourage the presence of gophers.

As with other pests, gopher populations increase when food is abundant. Leaving overwintering corn trash or other culls that do not decompose rapidly in the field will boost the gopher population. Weeds that gophers prefer to feed on, such as malva (cheeseweed), dock, clovers and dandelions, will also help maintain a higher wintering population.

Many perennial crops provide a winter food source and a harbor for gophers. Artichokes and other crops with large crowns are especially susceptible, and some growers have begun to grow these crops as annuals in part to avoid building up gopher populations in the winter season. Young orchard trees seem to provide the most winter-time food for gophers; however, mature orchards and vineyards also harbor gophers through the winter months.

Cultural practices, along with cover cropping sequences and composition, can help systematically address the problem of gophers in both annual and perennial systems. Some cultural controls I recommend include –

- cleaning up culls and other food sources on the soil surface
- keeping weeds down in field borders and orchards, allowing you to monitor and limit gophers populations through trapping and other techniques (see below)
- using appropriate winter cover crops to discourage the presence of gophers (see below)
- cross ripping orchard centers to break up old tunnel systems

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- using fish-based fertilizers applied via rainbirds to discourage gophers from establishing burrows
- using a propane/oxygen "Rodenator" (see below) in vineyards and closely spaced orchards to eliminate burrows along plant rows and help slow re-invasion

Other cultural practices appropriate to row crop systems include using a disk plow or spader between crops where gopher populations are high. This can reduce the numbers dramatically, especially if you have a dog or two follow the plow and snap up the gophers on the surface. Directly after plowing is also the ideal time to conduct an aggressive trapping session, as new burrows are easy to spot.

COVER CROPS AND ROTATIONS

Some cover crops can both benefit your crop rotation or winter fallow and help limit gopher populations. Research has shown that gophers much prefer clover cover crops over small grains such as barley, oats and Sudan grass. And although most clovers attract gophers there is a sour clover (*Melilotus indica*) that appears to discourage them. This can be used as a winter cover combined with a small grain to move populations out of the fields to areas where they can be trapped.

I've also observed that gopher populations move to farm road edges and other border areas when a winter cover crop of bell beans or fava beans are planted. A focused trapping effort in these areas during winter will help limit breeding numbers. Be aware, though, that many studies have shown gophers to be extremely adaptable in their feeding habits, so no cover crop will guarantee a gopher-free field.

When considering rotations on diverse farms, include gophers in the equation. If you follow a crop that attracts gophers, such as potatoes, with another that they feed on, like onions, you will exacerbate gopher problems by providing a continual food source. However, if you follow potatoes with a sour clover or small grain, populations are less likely to rise.

BARRIERS

Farmers and gardeners have tried all manner of barriers to discourage gophers. These include wire mesh, gravel, trenches filled with glass and rocks, corrugated roofing, even trenches with buried buckets that act as pitfall traps—anything that presents an obstacle for persistent gophers. These all have some effect on slowing invasions.

The most promising approaches are those that create both an above- and below-ground barrier. One of the most successful is fencing made of steel corrugated roofing. Not only is it impenetrable, but gophers cannot climb the exposed portion. Because gophers can scale a welded wire fence, above-ground wire barriers must have the wire bent outward at the top or a wooden or metal rim installed.

I'm currently experimenting with a material called "Root Guard," a thirty-six inch wide plastic sheeting seventy mils thick used by landscapers to keep bamboo roots from spreading. At $3–$4/foot, Root Guard is too expensive to use in large-scale operations, but may be cost effective for areas of an acre or less. Large farms may benefit by blocking major gopher access routes with any available solid material, but I don't believe there is a viable material that will completely head off an infestation.

FLOODING, GASSING AND BLASTING

Although not appropriate for all operations, flood irrigation can be extremely effective not only at killing gophers under the water but also at driving the survivors to field edges where they can be trapped. Flooding burrows with a hose can sometimes be effective in a small operation, providing that it is done at a fresh burrow.

Gas cartridges with sulfur and sodium nitrate as active ingredients are still allowed by organic certifiers and can be effective if used on new burrows (mostly in the winter months or in wet soils). They cost $1–$2 per cartridge and have an approximately fifty percent success rate. After inserting a gas cartridge in a burrow, be sure to cover the opening to prevent the gas from escaping. One company sells a blower that is supposed to move the gas beyond blocks in the tunnel system. I feel this may dilute the strength of the gas, although no scientific evidence yet exists to validate this idea.

The "Rodenator Pro" (also called the "gopher blaster" or "Rodex Torch") is a device that injects a mixture of propane gas and oxygen into a gopher burrow and then ignites it with a spark, destroying the tunnel system. I recommend occasional use of the Rodenator in vineyards and orchards to remove permanent tunnels that run along perennial crop rows. It's not appropriate for annual vegetable operations as it can damage crops and is unwieldy in row crop settings. Some growers use trapping as a main strategy and the Rodenator for areas where gophers and ground squirrels have settled. A truck or tractor is needed to move the propane and oxygen tanks around the site to be treated.

PREDATORS

Attracting predators is probably the least expensive and most effective supplemental gopher control option available. I say supplemental because predators don't eliminate all the prey in a single, concentrated area; instead, they tend to select prey from a wide territory.

A Rodenator can be used to eliminate tunnel systems along rows of perennial crops or where gophers and ground squirrels have settled.

Barn owls are the most effective gopher predators—their diets can consist of up to ninety percent gophers, and a barn owl family attracted by a nest box can eat up to a thousand gophers per year. There are many designs for barn owl nest boxes (type "barn owl nest box" into any web search engine to find examples). The main criteria is that the box's opening be approximately five inches in diameter; any larger and the barn owl's main predator, the great horned owl, can get at the young birds

Gopher snakes do in fact eat gophers, but only one every six weeks to two months. Bobcats and coyotes also eat gophers, although I've found that coyotes prefer gophers caught in traps, which often disappear after they dine. Domestic cats can be a significant help in controlling gophers. Cats hunt more when well fed and cared for, as the sporting aspect seems to be the attraction.

TRAPPING METHODS AND STRATEGIES

After poison baits, which are no longer allowed under organic certification rules, trapping is the most effective way to control gophers. The best sites for setting traps are where there has been recent activity, marked by fresh mounds of moist, dark soil in the morning or by holes that have been recently plugged.

Three trap designs currently dominate the market. The most common in California is the Macabee trap, invented by Zephyr Macabee in 1900 to protect his Santa Clara Valley almond orchards. The Macabee is a "pincher" type trap that impales two wires in the body of the gopher when it bumps into a trigger. The usual set for these traps is to locate and dig down to the main, larger burrow (rather than a side run) and insert two traps facing away from each other, connected by a wire. After the set is completely buried the wire is left on the surface and flagged to help find the traps.

There are different opinions about letting light and air into the tunnel where the trap is located. Some say light and air will encourage the gopher to pack the trap area with soil and not set the trap off, and some say it is the light that draws the gopher to the trap. I've found that both methods work and that adding some vegetative bait (such as the plants being affected or a succulent weed) helps as well. I've seen some modifications where the Macabee trap is inserted into a section of two-inch ABS drain pipe about eight inches long, either left open or closed at one end (both techniques work). This addition seems to help catch the gopher even if it is pushing soil ahead of it.

Another older, standard trap design that is still popular is the box trap. This small wooden box is open on the bottom and at one end, and houses a trigger and metal "choker" loop or cable that grabs the gopher as it enters. A more modern version called the "Black Hole" is made of plastic tubing and a cable choker. These traps work by fooling the gopher into thinking it is still in the tunnel. The gopher is lured to the end of the trap where a small opening allows light and air in and the gopher gets caught trying to close the opening. Box traps are also placed in the main tunnel in pairs, although I've seen a single trap work when placed in the mound's entrance tunnel.

Although both Macabee and box-type traps are effective, I've had the most success using the Cinch trap from Oregon. This is also an older trap that for many years was used only by professionals and can be slightly hazardous and difficult to set due to its double trigger and strong spring. It was originally designed for moles but is extremely effective on gophers.

Like the box or Macabee traps, Cinch traps can be used in pairs, but can be set more quickly and can be even more effective than the other trap types when placed singly in the burrow entrance. The method I use is to open the burrow at the freshest mound (as indicated by dark, moist soil) and insert the round, extended jaws of the trap into the burrow entrance. I use a stake that is sized to open the burrow as wide as the trap's jaws and then use the same stake to mark the trapping site. The gopher is caught when it comes to the surface to close the opening in the mound.

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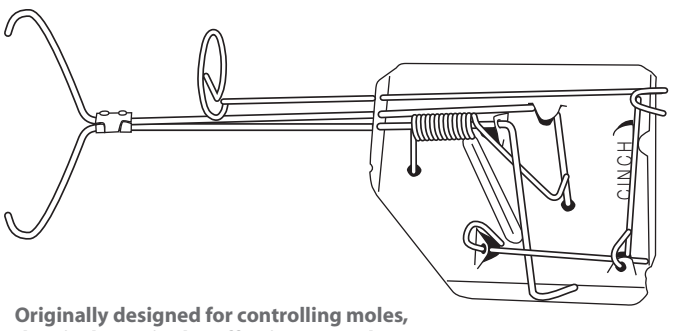


Originally designed for controlling moles, the Cinch trap is also effective on gophers.

Nancy Enge

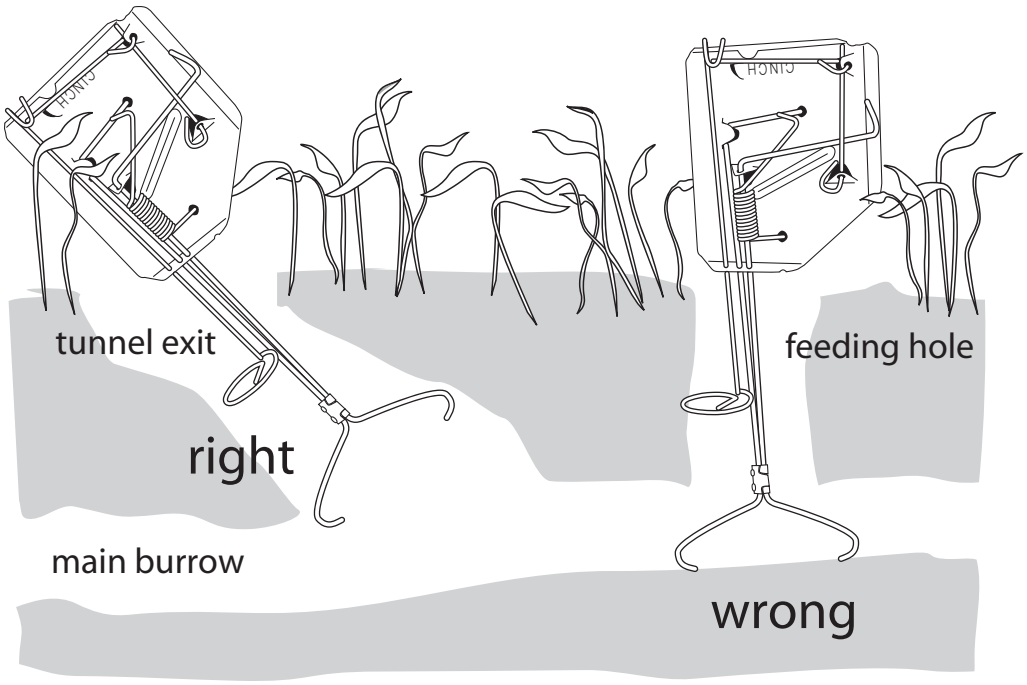
Mole or Gopher?

Many fields, orchards, and vineyards will host both gophers and moles. Moles don't eat vegetation; these insectivores feed on earthworms, grubs, beetles, and other soil-dwelling insects. Occasionally a mole burrow or mound will disturb a newly planted crop row, but on balance moles are beneficial, eating insect pests such as the potato bug, and aerating the soil.

Discerning a mole mound from a gopher mound takes practice. When a gopher makes a mound it pushes the dirt loosened from the tunnel out the opening like a small bulldozer, creating a fan- or horseshoe-shaped mound with some evidence of a plug or open tunnel. A gopher always plugs a mound when not actively pushing dirt out.

A mole never comes out of the burrow it digs. It makes lateral tunnels off of its main tunnel and pushes dirt straight up through the opening. The resulting mound looks like a symmetric miniature volcano with no apparent opening. Moles will also make tunnels close to the surface, creating a visible raised runway.

Once you know the difference it's fairly easy to distinguish the two types of mounds and focus on the gophers. Setting a gopher trap in a mole run will not usually catch a mole or a gopher.



Nancy Enge

A Cinch trap can be set in the burrow entrance, making it easy to place and monitor. Make sure the jaws are placed in the angled tunnel exit/burrow entrance (left) and not resting on the bottom of the main burrow (right).

When placed in the burrow entrance, the Cinch trap's trigger and spring mechanism are on the surface where they can be easily monitored to see if there is a catch, a miss, or no activity. I move these traps to the freshest mounds daily and have been able to limit the time I spend at each trapping site to a few minutes, since there is no need to dig into the main burrow to set the traps.

Thomas Wittman

A Cinch trap is inserted into the burrow entrance and tied to a stake to mark the trap's location.

No matter what trap or other method you use, a systematic and consistent gopher control program will help head off serious infestations. Remember –

- always trap right after plowing or mowing
- trap all through the winter to keep breeding populations down
- on large farms, try to focus on one area at a time and mark your traps well
- if you have orchards or vineyards, be sure to work as many gophers out of them as possible—because orchards often have a cover all year, they are great breeding grounds for gophers

Above all, don't get discouraged—although it may look like an overwhelming invasion, remember that just a few gophers can create many mounds.

– Thomas Wittman

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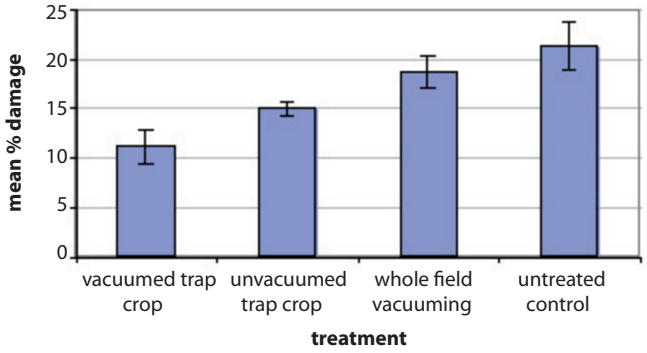

Figure 3. Accumulated WTPB damage by treatment, June 4–July 4, 2003; least significant difference (p<0.05). Bars indicate +/- SEM.

Interestingly, the unvacuumed trap crop treatment did not show a significant difference in damage when compared to the vacuumed trap crop in June, even though it accumulated more WTPB in rows 1–8. Also interesting is the fact that the highest damage was seen in the untreated control, which did not accumulate high numbers of WTPB. This could indicate that WTPB not associated with or feeding on nearby trap crops do more per capita damage to strawberries.

"It's possible that trap crops may partially satiate WTPB and thus minimize the amount they feed on developing berries, so that WTPB abundance alone does not correspond well with strawberry damage estimates," says Swezey. "This is a hypothesis we plan to pursue in future research."

In July, vacuuming the alfalfa trap crop reduced WTPB numbers by 79% compared to the unvacuumed trap crop (figure 4). Except in row 1, the vacuumed trap crop treatment also had the same accumulated number of WTPB as either the whole-field vacuuming treatment or the untreated control.

Vacuuming the trap crop reduced total damage to the strawberries in July by 49% when compared to the unvacuumed trap crop (figure 5), although no significant differences could be detected between the vacuumed trap crop and either

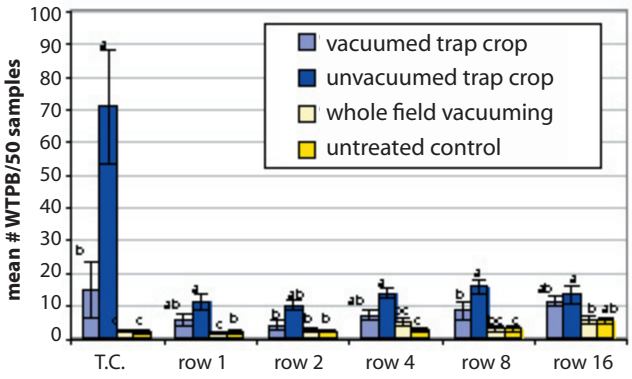

Figure 4. Accumulated WTPB by treatment and row, July 10–July 31, 2003. Treatment means not followed by a same letter are significantly different within the row; least signficant difference (p<0.05). Bars indicate +/- SEM.

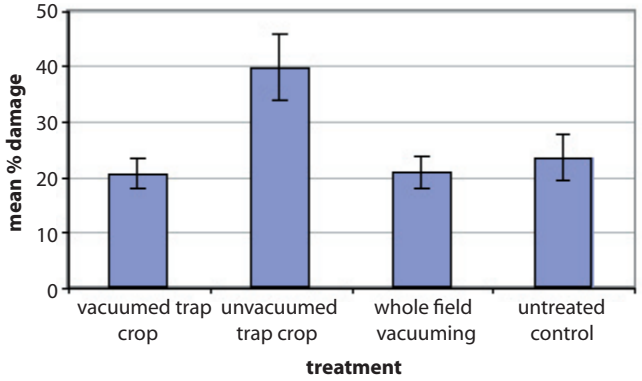

Figure 5. Accumulated WTPB damage by treatment, July 10–July 31, 2003; least significant difference (p<0.05). Bars indicate +/- SEM.

the whole field vacuuming or untreated control treatments. These results show that in July, WTPB in an unvacuumed trap crop will generate significantly higher damage to adjacent strawberry crops than other treatments.

"We do not want the trap crop to become a source of pests," says Swezey. "That's why it's critical to manage it throughout the growing season."

The research team is still evaluating data collected in August 2003 to see whether the differences in treatment continued through the late season.

Natural Enemies Conserved

The big-eyed bug (BEB), *Geocoris* spp., was the most abundant beneficial insect collected from the trap crop and strawberry fields. This native insect feeds on WTPB eggs and nymphs.

Results from the 2002 study show that in June, the vacuumed trap crop treatment had significantly more BEB in the trap crop and all strawberry rows than did the other three treatments. This result indicates that the trap crop vegetation increased the numbers of the most abundant generalist WTPB predator in the strawberry rows at the farthest distance sampled. This effect was somewhat less prevalent in July, and by August BEB populations had declined in all the treatments, possibly as a result of the BEB entering diapause.[2] Results from 2003 are still being analyzed.

SIGNIFICANCE AND FUTURE WORK

Results from this study show that a field edge alfalfa trap crop can successfully attract and concentrate WTPB numbers, and that tractor-mounted vacuum devices can remove significant numbers of WTPB from the trap crop. The trap crop vacuuming treatment offers the same or reduced WTPB damage to fruit in adjacent strawberry rows when compared with the grower's whole field vacuuming program.

"The study also showed us that, at least for WTPB, alfalfa is a terrific trap crop," says Swezey. "We wanted to develop a type of vegetation management system specific to this pest, and I think we've shown that alfalfa is effective."

Swezey also cautions that trap crops must be used carefully. "It's one of those 'Don't try this at home' situations,"

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he says. "If you're going to use trap crops, you have to be ready to manage them as diligently as the crop itself—that includes irrigation, fertilizer, and weeding—and then you have to manage the pest once it's in the trap crop."

Perhaps the most important result for the Pacific Gold growers was that vacuuming the field-edge trap crop reduced the operation time of their tractor-mounted vacuum by 75% as compared to vacuuming the entire strawberry field, while giving the same or better level of WTPB control. This approach to limiting WTPB damage translates to savings in operator time, tractor wear, and fuel costs. Center researchers are now compiling economic information on the actual cost savings represented by the trap cropping treatments.

Pacific Gold president Eddings is happy with what he's seen so far. In a *California Farmer* interview published in September 2003, Eddings noted, "Dr. Sean Swezey and his group have been a valuable asset. They use our ground to carry out a lot of research trials, and we give them free rein. We've implemented a lot of their data on a very large scale, and it's been very beneficial to us."

Swezey points out that these same results have implications for smaller-scale growers as well. Scaled-down versions of the large "bug vacs" are one management option for growers with smaller operations. "A reversed leaf blower or garden vacuum will also work on trap crops," says Swezey. "The most important thing is to be consistent both in maintaining the trap crop and managing the pests."

In April of 2003, Swezey shared the results of the trap crop study with growers at an extension meeting hosted by the Community Alliance with Family Farmers in Watsonville, California. In July 2004, he presented the study's results at the California Conference on Biological Control held at UC Berkeley.

The trap crop research will continue through the 2004 cropping season. Swezey is particularly interested in expanding the work to include studies of introduced natural enemies. "We're interested in a diversity of management strategies," he says. "We're experimenting now with an introduced wasp that parasitizes WTPB. It may be that a trap crop can be an effective place to colonize with mass-reared natural enemies. If the natural enemies are effective, we may not need to vacuum every trap crop area every year, and thus preserve natural enemy activity."

– Martha Brown

[1]heat accumulation model: a model used to predict the time it takes for an organism to develop from one point in their life cycle to another, e.g., from egg to adult, based on the amount of heat accumulated.

[2]diapause: a genetically-determined state of low metabolic activity, triggered by environmental change. Metamorphosis stops in the diapausing stage, and does not resume until a favorable environmental cue. During diapause, environmental resistance is strengthened in order to survive periods of unfavorable weather and low host or prey abundance.

Center Notes

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Newmans and Other Funders Support Apprenticeship

Newman's Own Organics, Nell Newman's successful organic food company, granted $30,000 to the Center's Apprenticeship training program in organic farming and gardening this spring. This marks the eighth year of support from Newman's Own Organics, and its largest donation yet to the Apprenticeship training course. Additionally, Paul Newman gave $25,000 to the Apprenticeship Program this spring. While these funds will primarily provide vital support for Apprenticeship staff salaries, $5,000 is earmarked for the creation of a booklet profiling the work of Apprenticeship graduates around the world. This $5,000 will match a $5,000 gift for the alumni booklet from Stonyfield Farm Yogurt Company and alumna Meg Cadoux-Hirshberg and her husband Gary Hirshberg.

The NALITH Foundation has granted $4,000 to support classes for the Apprenticeship trainees in cooking seasonal, organic, vegetarian meals. This grant will support classes in 2004–2005, building on the past Farm and Garden cooking training done by Feel Good Foods catering company and supported by the Chez Panisse Foundation.

The Margoes Foundation has granted $11,000 as its final installment of a multi-year scholarship grant for African apprentices participating in the 2004 Apprenticeship. Emelia Addi from Ghana and Joy Msomi from South Africa are the two scholarship participants this year.

The Monterey Bay Chapter of the California Association of Nurseries and Garden Centers granted $3,000 last fall to support new acquisitions for the Apprenticeship library and new trees for the Farm and Alan Chadwick Garden's demonstration orchards.

We want to thank these generous funders for supporting the work of the Apprenticeship training program.

Center Researcher Gives Invited Talks at Delta State University

Social issues researcher Phil Howard was invited to lecture at Delta State University in Mississippi this spring as a guest of the Institute for Community-Based Research, and Pi Gamma Mu, the Social Science Honors Society. Howard spoke about the idea of "public intellectuals" at the 2004 Honors Banquet for Social Sciences, History, Languages, and Literature. He also made a presentation on the Center's work to members of the Delta State University Center for Community and Economic Development, and gave a guest lecture to the Sociology of Rural Poverty and Research Methods class.

Participate in the Global Farmers Market and Taste the Difference!

CAN (Community Agroecology Network) is a Santa Cruz-based nonprofit organization started by professor of Environmental Studies and founding Center director Steve Gliessman, and environmental educator Robbie Jaffe. The organization helps facilitate a producer-consumer network by developing consumer awareness and providing technical assistance to farmers in five CAN communities in Mexico and Central America (see "CAN encourages sustainable farming, community self reliance," *The Cultivar,* Vol. 21, No. 2, Fall/Winter 2003).

CAN supports community-based projects such as organic production, reforestation, "agroecotourism," and the development of a women's craft cooperative by linking university interns and researchers with the communities and supporting farmer exchanges between the CAN communities.

You can support the development of a sustainable agricultural community by ordering high quality coffee direct from the Coopabuena farmers' cooperative in the CAN community of Agua Buena, Costa Rica. You can have delicious coffee delivered to your front door for the same price you normally pay (or less), while returning five times the conventional price and three times the "Fair Trade" price to the cooperative.

Learn more about CAN and its work, and download an order form from the Community Agroecology Network website: **www.agroecology.org/can.**

Highest Quality Coffee

The Coopabuena Cooperative is Fair Trade certified by the Fair Trade Labeling Organization, guaranteeing democratic participation in the small-scale farmers cooperative, which supports community economic and social development. Only the highest quality coffee is sent through CAN's fair trade direct market. Many participating farmers use organic farming techniques; all actively participate in technical assistance programs on sustainable practices. Your direct purchase funds helping these farmers learn ecologically sound farming methods such as composting and alternatives to pesticide use.

The Direct Difference

The full price you pay for your coffee is returned to the Coopabuena cooperative. About half of it pays for the mailing, packaging and roasting. The remaining half is distributed to the farmers, co-op, and to community projects. Your purchase of coffee direct from the farmer really does make a difference. By ordering through CAN you are participating in an alternative market that bypasses many "middle men," giving farmers more control over their livelihoods.

Please visit **www.agroecology.org/can** to order quality coffee from the Coopabuena cooperative or to learn more about CAN and its communities.

International CSA Meeting

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agricultural training. They were surprised and fascinated by our Apprenticeship in Ecological Horticulture, where apprentices have the opportunity to learn hands on at the UC Santa Cruz Farm and Garden facilities about CSA production and marketing.

We fielded numerous questions about how university farms are funded in the U.S., if there is any government support for organic farming, if students have adequate resources to take their knowledge into the real world of farming, etc. Clearly the chance to learn practical agricultural skills in a university setting sets our program apart from other internship and apprentice opportunities.

During this first international meeting, we realized the power of "globalizing localism" as a way of combating the deleterious effects globalization has had on local economies. Through sharing our stories, skills, and experiences, and by gathering together annually, we hope to keep the inspiration and enthusiasm alive around the world.

– Nancy Vail

The group's next conference is scheduled for December 2004 in Portugal.

Santa Cruz area
events

▸UCSC Farm & Garden Fall Plant Sale, Friday, September 10, 12 noon–6 pm, and Saturday, September 11, 10 am–2 pm, Barn Theater Parking Lot, UC Santa Cruz. Extend your gardening season and give perennials a good head start for spring with organically grown fall and winter vegetables, and perennial landscape plants. Proceeds support the Apprenticeship training program. For more information see www.ucsc.edu/casfs, or call 831.459-3240.

▸UCSC Farm & Garden Harvest Festival, Saturday, October 9, 11 am–5 pm, UCSC Farm. Don't miss our biggest event of the year! Enjoy great food, music, tours, talks, kids' events, apple tasting, community booths, farmstands, and restaurant displays at the UCSC Farm. $5 general admission; free for Friends of the Farm & Garden and kids 12 and under. For more information see www.ucsc.edu/casfs, or call 831.459-3240.

▸Annual Arboretum Fall Plant Sale, Saturday, October 9, 10 am–12 noon (members), 12 noon–4 pm (general public), Eucalyptus Grove, UC Santa Cruz. Choose from a wide variety of Mediterranean climate plants, including California natives. For more information, see www2.ucsc.edu/arboretum/, or call 831.427-2998.

California

▸Natural Patterns and Permaculture Principles: Ecological Design Workshop, September 10–12, 2004 , Tunitas Creek Ranch, Half Moon Bay. Permaculture teachers Toby Hemenway, author of *Gaia's Garden, A Guide to Home Scale Permaculture*, and Tom Ward, an ethno-botanist, eco-forester, and Permaculture designer, will present a system of practical techniques that develop the skills of ecological design. The workshop will focus on increasing the diversity, resilience and harmony of your own home-landscape or farm.

For more information on the workshops and presenters, see www. bioneers.org, email agworkshops@bioneers.org, or call 831-338-1202. If you are ready to register, call the Bioneers main office toll-free at 877-246-6337, ext. 115.

▸Fall Native Plant Sale, Saturday, October 9, 2004, 10 am–4 pm, Hidden Villa Ranch, Los Altos Hills. Hundreds of species of native plants, seeds, and bulbs suitable for California gardens. Speak to experts about lawn alternatives such as native perennials, wildflowers, and grasses. Organized by the Santa Clara Valley Chapter of the California Native Plant Society. The sale will take place at Hidden Villa Ranch, CNPS Nursery, 26870 Moody Road, Los Altos Hills (2 miles west of interstate 280). For more information see www.cnps-scv.org, email gstigall@aol.com, or call 650.941-1068.

▸Bioneers 15th Annual Conference, October 15–17, 2004, San Rafael. This year's conference theme is "Visionary and Practical Solutions for Restoring the Earth and People."

For program details and registration information, see www.bioneers.org/conference/, email info@bioneers.org, or call toll free 877.246-6337.

▸25th Annual Ecological Farming Conference, January 19–22, 2005, Asilomar Conference Center, Pacific Grove. One of the largest and oldest gatherings of organic farmers, marketers, activists, and sustainable consumers. The 2005 theme is "Eco-Farm Silver Anniversary: Shining Light on the Path to Sustainable Agriculture."

The conference includes more than 50 workshops, organic meals, a regional farm tour, seed swap, organic wine tasting, exhibitors, and more.

For details and registration information, contact the Ecological Farming Association, 831.763-2111, or www.eco-farm.org.

National/ International

▸Cultivating a Sustainable Agriculture Workplace, September 12-14, 2004, Troutdale, Oregon. This conference brings together experts in occupational health and safety and sustainable agriculture to address how these topics can be integrated into sustainable agriculture practices and how research and outreach can contribute to that effort.

Conference sessions will consider a range of topics, including "Current Workplace Practices and Challenges,""Organic vs. Conventional Farming and Worker Safety and Health," and "International Standards and Certification."

Details and other conference information is available at http://depts.washington.edu/pnash/conf04/index.htm

▸American Community Gardening Association's 2004 Conference, October 1–3, 2004, Toronto, Ontario. This year's conference theme is "Gardens of Diversity: Growing Across Cultures."

For conference details and registration information, see www.communitygarden.org.

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