CASFS
The CENTER for AGROECOLOGY & SUSTAINABLE FOOD SYSTEMS

the Cultivar

The CENTER for AGROECOLOGY & SUSTAINABLE FOOD SYSTEMS

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Center Celebrates 35th Anniversary of Chadwick Garden's Founding

Apprentice course member John Vars at work in the Alan Chadwick Garden.

This fall, staff and graduates of the Center for Agroecology & Sustainable Food System's Apprenticeship program gathered to celebrate 35 years of training organic farmers and gardeners. Several days after the reunion the federal National Organic Rule took effect—a combination of events that highlights how far ahead of the curve Alan Chadwick was when he began teaching organic gardening skills at UC Santa Cruz more than three decades ago. Chadwick's beliefs and training philosophy anticipated a number of today's trends—not only the "mainstreaming" of organic food, but the popularity of experiential ("hands-on") learning, farmers markets, heirloom varieties, and garden-fresh cooking.

TRAINING BLENDS HANDS-ON LEARNING, CLASSROOM STUDY

English master gardener Alan Chadwick first wielded his Bulldog spade and fork on a rocky hillside at the then-new University of California, Santa Cruz in the spring of 1967. From the paper-thin topsoil of that inhospitable slope, Chadwick and his student "apprentices" coaxed a bountiful garden.

Rejecting pesticides and synthetic fertilizers, Chadwick introduced the students to an organic gardening technique he called "biodynamic/French intensive," based on double-dug beds (dug two spade blades deep) amended with compost and other organic materials. According to current Chadwick Garden manager Orin Martin, the biodynamic/French intensive method "synthesized traditional horticultural practices and observations from the Greek, Chinese and Roman cultures on through 19th century French market gardeners—folk techniques with modern scientific validity."

To instruct his student gardeners, Chadwick used a method based on the time-honored practice of "apprenticing." Former Chadwick student Robert Howard wrote, "Though [Chadwick] had never taught before, he threw himself into cultivating young minds and their gardening skills. His manner of teaching was the simple, classical one of combining

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AS THE COURSE PROGRESSES, **STUDENTS ARE GIVEN MORE RESPONSIBILITY** FOR PLANTING, CULTIVATING, HARVESTING, AND MARKETING CROPS

practicality and vision. He would first demonstrate how to do something, and then put the student to work doing the same thing."

Today the tradition of hands-on learning continues through the UCSC Farm & Garden Apprenticeship, run by the Center for Agroecology & Sustainable Food Systems. Formalized in 1975, this six-month, full-time training program brings participants of all ages from around the world to learn the basic skills of organic gardening and farming, while also studying the complex social and environmental issues surrounding sustainable agriculture and food systems. Although it now incorporates lecture-style classes and readings, the apprenticeship continues to emphasize hands-on learning alongside instructors in the campus's gardens, fields, greenhouses, and orchards.

Lori McMinn, a student in the 2002 Apprenticeship class, was attracted to the course's blend of practical and academic teaching techniques. "The reason I chose the program over the others I considered was the combination of a scholastic component and hands-on work—that's unique. Also, the program offers training on both a garden- and field-scale."

Working at the original Student Garden Project (now the Alan Chadwick Garden), and the 25-acre campus farm, apprentices begin with a "basic block" of classes in soil fertility management, propagation, planting methods, irrigation, crop culture, composting, pest and disease control, and weed control. Classes and demonstrations in sustainable food systems, marketing, small farm planning, farm equipment, cooking and food preserving, and beekeeping round out the curriculum.

As the course progresses, students are given more responsibility for planting, cultivating, harvesting, and marketing crops—what instructor Orin Martin calls the "I do, we do, you do" sequence for teaching and learning new skills. "By the third month of the program you were pretty much in the 'you do' phase—it was rewarding to feel that way. I wouldn't have been comfortable being thrown into that phase at the very beginning, so I think it's a perfect progression," says McMinn.

PUTTING THEIR TRAINING TO WORK

To date more than a thousand people have completed the Apprenticeship training. Many graduates go on to start their own organic farms or market gardens, often taking on apprentices as part of their operations. Others work for school, community, and urban gardens and training programs, passing on the skills they've learned. A number have started organic landscaping businesses. Many of the international participants have founded apprenticeship-style training programs in their home countries, while other graduates travel abroad to work in the Peace Corps and other rural development projects. And some graduates have helped build the burgeoning organic food and farming movement as policy makers, extension agents, and staff of organic certification groups. Here are some examples of ways that apprentices have put their training to work —

On the south side of Birmingham, Alabama, Page Allison and Edwin Marty (apprenticeship class of 2000), have transformed a one-acre patch of vacant land adjacent to office buildings and the Southtown public housing community into Jones Valley Urban Farm, where children and adults grow organic produce and flowers while learning about food and farming. "We want to use food production and urban greening as a means to inspire pride in the city and a greater appreciation of our natural resources," says Allison. She and Marty market Jones Valley's vegetables and flowers at the local farmers market and to area restaurants and specialty stores. Residents of the local YMCA are involved in work and job training at the farm. Looking ahead, Marty and Allison hope to add three additional lots to the Jones Valley site and develop an environmental education center.

As certification manager for the California Certified Organic Farmers (CCOF), Brian McElroy has overseen the rapid growth of one of the leading organic certification organizations in the U.S. CCOF now works with 1,100 producers, and 145,000 acres are in the certification program, up from 50,000 acres when McElroy joined in 1994. McElroy, a 1994 apprentice, is also active in the international organic community, having served four years on the standards committee of the International Federation of Organic Agricultural Movements (IFOAM). This committee has developed the worldwide definition of organic for everything from field production techniques to the processing of packaged goods that are distributed around the world.

Godfrey Kasozi refers to himself as "a small boy from Africa," but he's accomplished big things since finishing the apprenticeship program in 1999. Kasozi returned to his native Uganda to share what he'd learned with small-scale farmers and others who are training farmers throughout the country in sustainable growing practices. As program director for the Center for Environmental Technology and Rural Development, Kasozi and his staff operate

FOR YEARS, COLLEGE FARMS AND OTHER EDUCATION PROGRAMS
HAVE TURNED TO THE APPRENTICESHIP FOR ADVICE
ON STARTING SIMILAR TRAINING PROGRAMS

a six-acre garden and orchard site that produces organic food for local hotels and families. The Center also hosts visits from government officers and non-governmental organizations, supplies seedlings to the community, and lobbies the government to support organic farming. Recently, Kasozi was invited to teach organic production techniques to 35 farmers in Tanzania. Says Kasozi, "We are still expanding as the need for organic products increases in Uganda because of the big struggle that myself and others are undertaking to educate the people both in rural and urban areas about the importance of eating healthy food."

Cathrine Sneed, who graduated in 1987, began the nationally recognized Garden Project for San Francisco County Jail inmates, and she launched the post-release program in 1992 to serve former offenders. The Garden Project today provides on-the-job training in gardening and tree care and boasts a recidivism rate of 24 percent, compared to the average return-to-prison rate of 66 percent. Sneed believes nature is where offenders can discover lives worth living and that working with the land breaks the cycle of crime.

As head gardener at Copia, the new American Center for Wine, Food, and the Arts that opened in Napa in 2001, recent apprenticeship graduate Richard Slye oversees a 3.5-acre garden in the heart of California's wine country. Based on formal French estate gardens, the grounds include 18 theme gardens featuring herbs, lavenders, and olives, as well as a kitchen garden, seed-saving garden, red wine garden, shade exhibition gardens, and fruit orchards. "Using the various sites, we put on a diversity of programs that give visitors a garden experience," says Slye, "including hands-on gardening classes and our popular 'lunch with the gardeners' series." Produce raised by Slye and his staff supplies Copia's restaurants, cooking classes, an employee farmers market, and Napa's food bank and a local women's shelter.

Erica Peng, a 1999 graduate, currently manages two programs in the Berkeley Unified School District that promote nutrition education and physical activity by linking gardens with the classroom and cafeteria. Through these programs, K–8 students receive weekly hands-on garden and organic cooking classes that emphasize sustainable agriculture and fresh, seasonal, organic fruits and vegetables, whole grains, and beans. Fourth-grade students go on field trips to the Berkeley Farmers' Market and all sixth graders visit farms in the region. The program also supports the Nutrition Services Department's effort to purchase fresh produce directly from farms and to incorporate healthier menus into the meal program.

Gil Carandang (2002) came to the Apprenticeship from the Philippines on a Fulbright scholarship, and is wasting no time putting his organic training to work in his home country. Carandang is setting up an ecological farm near the Tagaytay Highlands, featuring mini farm lots, a children's garden based on the Life Lab Science Program model, and a training center for organic and natural farming technologies. In a *Manila Bulletin* article, Carandang noted his excitement about implementing the organic technologies he learned during the apprenticeship and passing on those skills to others.

CURRENT PROJECTS AND FUTURE PLANS

For years, college farms and other education programs have turned to the Apprenticeship for advice on starting similar training courses. In response, the staff and invited authors have developed a training manual, *Teaching Organic Farming and Gardening: Resources for Instructors.*

The 600-page manual offers class lecture outlines, demonstrations, and hands-on exercises designed to help instructors teach basic skills such as tillage, propagation, planting, soil fertility management, compost making, and weed and pest control. Units on basic soil chemistry, soil physical properties, and soil biology and ecology provide the science background for the hands-on sections. A third section outlines the history of U.S. agriculture, introduces environmental and social issues as they relate to agriculture, and discusses sustainable agriculture and food systems. (See page 11 for additional details and ordering information.)

As the Apprenticeship course continues to evolve, staff members are working to increase training opportunities for UCSC undergraduates through Environmental Studies classes and other programs. They are also considering a 10-week summer course and "short courses" to serve a broader audience of people interested in the skills taught through the Apprenticeship. Work on additional training manuals is also underway, with a manual on teaching the skills needed to start and run a Community Supported Agriculture project in progress.

–Martha Brown

For more information on the six-month Apprenticeship training course, see www.ucsc.edu/casfs, email apprenticeship@cats.ucsc.edu, or call 831.459-2321.

from the
director

This fall we marked the 35th anniversary of Alan Chadwick's breaking ground for an organic garden on the UCSC campus. Chadwick arrived in 1967, soon after the university opened on the Cowell Ranch's rolling meadows and redwood groves. Amid the turmoil of construction work on the brand new campus and the era's political rancor, the garden offered students a "sense of place," where they could make a hands-on connection to gardening.

As we look back on three and a half decades of growth, both on the campus and at the Center, we find that although much has changed, students still seek hands-on learning experiences at the Chadwick Garden and the UCSC Farm through undergraduate classes, internships, and through the six-month Apprenticeship training program. This issue of *The Cultivar* features a brief review of the Apprenticeship (*see cover story*) and reports on how some of the program's more than 1,000 graduates have put their training to work.

After 35 years we thought it was time to put some of the Apprenticeship's training material down on paper in a form that others could use. *Teaching Organic Farming and Gardening: Resources for Instructors* (*page 11*) was developed by Center staff and invited authors as a tool for teaching the basic skills and concepts offered during the six-month Apprenticeship course. The training manual includes lecture outlines, demonstrations, hands-on exercises, lists of print and web-based resources, and much more, covering skills and practices, soil science topics, and social issues in sustainable agriculture. We hope it will serve as a valuable resource for others interested in teaching these skills.

Other articles in this issue reflect the Center's interest in the practical side of sustainable agriculture. Farm manager Jim Leap reviews some of the techniques and timing for growing organic row crops, including the importance of choosing the right equipment (*page 5*). Chadwick Garden manager Orin Martin offers tips for growing two garden staples, onions and leeks, in the home garden using organic techniques (*page 13*).

The Central Coast Research Project continues into its third year of work on water quality and food systems study on California's central coast. This fall we debuted our first two Research Briefs (*page 10*) based on work from the project. The first reports on the experiences of Community Supported Agriculture (CSA) members who belong to CSA farms on the central coast; the second summarizes the first two years of water quality data collected as part of an effort to improve water quality protection efforts by local farmers.

I also had a fruitful trip to the United Kingdom and the Netherlands this fall (*page 10*), where I visited a number of other programs working on sustainable agriculture. It was exciting to learn about their efforts as well as to share news of the Center's work.

- Dr. Carol Shennan

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Steps to Successful Organic Row Crop Production

After farming and teaching others to farm for more than twenty years, Jim Leap looks as comfortable behind the wheel of a tractor as most of us do driving a car. Leap grew and marketed row crops near Fresno in California's Central Valley for 15 years before moving to his current job as farm manager and instructor at the Center for Agroecology & Sustainable Food System's 25-acre organic farm at UC Santa Cruz in 1990.

During his career Leap has experimented with many types of row crop cultivation and planting equipment, discovering what combinations work best on small- to medium-scale farms producing a diversity of crops. His expertise puts him in demand for talks at farming conferences, field days, and as an advisor to others looking to start their own farms or convert from conventional to organic practices.

At the UCSC Farm, Leap and Community Supported Agriculture (CSA) project manager Nancy Vail work with students in the Apprenticeship training program (*see cover story*) to produce crops for a 100-member CSA project and a twice-weekly campus roadside stand. They grow more than 25 different crops—most stagger planted throughout the season—using organic techniques.

Leap identifies several keys to successful, diverse row crop production: identifying the bed configuration that will work best for a variety of crops, choosing the right equipment, and perfecting the sequence and timing of preparing beds, and planting, cultivating, and irrigating crops. Here he offers a review of the steps involved in producing organic row crops.

CHOOSING A BED CONFIGURATION

Perhaps the most important decision a beginning grower will make is to choose a bed configuration that will meet the particular needs of the cropping system. Efficiency in your production system is critical, and it is best to have a set configuration. You don't want to be adjusting equipment and tractors each time you need to perform a field operation. The goal is to be able to grow a broad range of crops with a narrow range of equipment.

Jim Leap

CSA manager Nancy Vail drives the Massey Ferguson 35, while apprentices Elizabeth Mukunga and John Bailey plant onions on the UCSC Farm's 2-row bed system.

Since smaller-scale growers will typically be limited to one or two tractors, it's most efficient to decide on one configuration and make it work for all crops in the system. Many large vegetable farms set up 40-inch beds (center-to-center) and then use tractors that are set at 80 inches (center-of-tire-to-center-of-tire) that straddle two beds. On farms larger than 50 acres it's common for cultivation and planting implements to be set up to plant or cultivate four beds at a time.

Most smaller farms are set up to plant and cultivate two beds at a time in what is referred to as a two-row system. The Center's Farm at UC Santa Cruz is set up on 36-inch beds and our cultivators and planters work two beds at a time (see photo). This system works well for us and gives us the ability to plant either two lines per bed, single lines per bed, or every other bed, to meet the needs of the par-

> *continues on next page*

ticular crop. The only exception to this 36-inch configuration on our farm is our strawberry beds, which are set at 54 inches wide. The drawback to having two different spacings on one small farm is that it requires us to change the cultivating tractor tire spacing and have an additional bed shaper. Although it takes us only 30 minutes to change tire spacings, this is not a tremendously efficient use of time.

It is also common for smaller-scale growers to plant a single 60-inch bed with the tractor set at 60 inches. This is an ideal spacing for smaller horsepower (HP) tractors, although clearance becomes an issue since the tractor must be able to clear the crop.

In making your bed layout decision it's important to consider what configurations are most common in your area, since growers often share equipment. Use of standard configurations also makes it easier to locate and purchase both new and used equipment.

CHOOSING TRACTORS AND OTHER EQUIPMENT

Once you've decided on an optimal bed configuration, you're ready to purchase a tractor. Probably the second most important decision a grower will make will be what tractor or tractors to buy. A grower just starting out may be tempted to buy a tractor that can do all the farm's operations. This can be a real challenge—one size can't fit all when it comes to tractors.

There are two distinct types of field operations in most row crop production systems, each requiring specific tractor configurations. Primary tillage, heavy residue incorporation, and bed formation typically require high horse power tractors with good traction capability. This means heavily weighted wheel tractors with wide tires and four wheel drive.

After the beds are formed the requirements change dramatically. For planting and cultivating (weed control) you need a tractor that has narrow tires and high clearance. Often very small farms (1 to 5 acres) rely on one tractor for primary tillage and bed formation, and then use hand tools for planting and cultivation. Farms larger than 5 acres typically use two tractors—one for tillage and heavy work, and one for planting and cultivation.

Here is a checklist of tractors and other essential equipment for 10- to 20-acre vegetable row crop operation–

Tractors

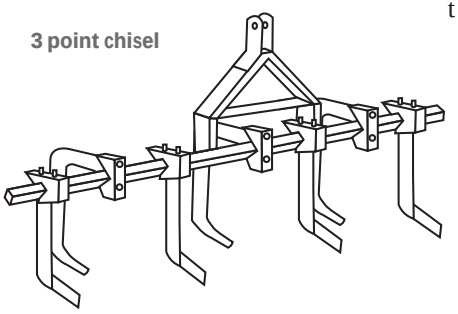
1) *Primary tillage tractor* – 50 to 80 HP diesel tractor, 4WD, wide tires, wheel weights and front weights, draw bar, category 2 3-point hitch with draft control, auxiliary hydraulics, PTO, creeper gear.

2) *Cultivating tractor* – 25 to 35 HP tractor, 2 WD, adjustable wheels, high clearance, category 1 or 2 3-point hitch, creeper gear, tall skinny tires.

Primary tillage implements

1) *Off-set wheel disc* for incorporating crop residue. Depending on soil type and disc diameter and configuration, figure roughly 7 HP per working foot of disc. In other words, if your primary tillage tractor is 49 HP then a 7 foot offset disc would be a good match. High traction requirement.

2) *Chisels* and/or *subsoiler* for breaking compaction. Depending on soil type, chisels or subsoilers may or may not be necessary. Always subsoil or chisel when soil is dry enough to fracture. Chisels typically run up to 12 inches deep and subsoilers run 12 inches to 36 inches deep. Always run subsoilers below the compacted layer. High traction requirement. Chiseling is typically done annually and subsoiling is done as needed.



3) *Rototiller* for preparing seed beds. Rototillers are great for breaking clods, incorporating residue, and seedbed preparation, however they can be overused, and, depending on soil type and moisture levels, can break down soil aggregates and cause compaction. Depending on soil type a rototiller may not be necessary.

4) *Mechanical spader* for incorporating cover crop residue. Although slow and expensive, spaders can replace both the disc and chisel. Most mechanical spaders run best at optimal engine RPM of about 0.8 MPH ground speed. This will require a creep gear. There is no traction requirement for a spader so this is the one primary tillage implement that can be run behind a tractor configured for cultivating. Depending on soil type and condition, and depth of operation, mechanical spaders require about 10 HP per working foot. Spaders typically run 12–16 inches deep and do an excellent job of heavy residue incorporation. They cause no compaction.

5) *Moldboard plows* for incorporating crop residue and aeration. Moldboard plows are commonly used in conventional agriculture and rarely used in organic agriculture. If used very selectively, they can play an important role in weed and disease management due to their ability to deeply bury the upper soil profile. However, plows are notorious for creating compaction and for burying residue too deep for adequate aerobic decomposition.

Secondary Tillage Implements

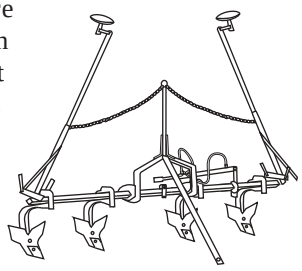
1) *Tandem disc harrow* for maintaining fallow ground. Tandem discs run fairly shallow and are well suited for ground that tends to form clods. This is a great tool to follow primary tillage such as chiseling.

2) *Spring tooth harrow* for maintaining fallow ground. Spring tooth harrows are best suited to lighter ground and are excellent tools for managing perennial weeds because they tend to bring field residues to the surface.

3) *Ring rollers* for breaking clods and firming soil. Ring rollers are typically pulled behind primary tillage tools and are most often used in heavier soils that are prone to clod formation.

Bed-Forming Tools

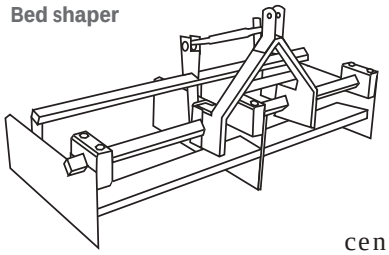
1) *Lister bars* with markers are typically used to form beds on larger farms. Lister bars consist of 2 or more furrowing shovels mounted on a tool bar. Hydraulically operated markers are commonly used to leave a mark for the next pass and are essential for creating straight rows.



Lister bars

2) Once the beds are formed, *bed shapers* are used to give the final shape to the bed. Planters or markers for transplants are typically run directly behind shapers. Bed shapers help create the uniformity necessary for precision cultivation. The general rule for bed shapers, in determining the width of the bed top, is to subtract 15 inches from the width of the bed center-to-center. For example, if the bed, center-to-center, is 40 inches then the bed top will be 25 inches wide. This is assuming a bed height of 5 inches. For each additional 1-inch increase in bed height, subtract 2 inches in bed width.

Bed shaper

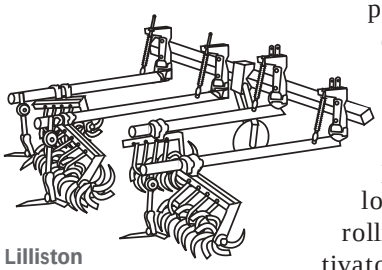


Planters

There are numerous planters available for direct seeding vegetable crops. Just like tractors, each type of planter is well suited to a specific crop and spacing. We use John Deere 71 Flexi-planters for our large-seeded crops that are direct sown to moisture, e.g., beans, corn, and squash. We use a set of four Plant Jr. planters behind a bed shaper for all of our direct-sown small-seeded crops such as carrots, spinach, beets, and salad mix.

Cultivators

A number of types of cultivators are used in row crop systems. Cultivators are used primarily for weed management in row crops both in fallow beds and in planted beds. Cultivators usually consist of a series of knives, sweeps, disc hillers, and crust breakers mounted on tool bars and adjusted specifically to get as close to the planted crop as possible in order to disturb or undercut small weeds that will compete with the planted crop. One of the most effective and popular cultivators for fallow bed cultivation is the rolling cultivator. Rolling cultivators also are well suited for cultivating crops planted in single lines on beds spaced from 36 inches to 40 inches. Rolling cultivators are extremely effective on soils prone to crusting. Most cultivators have a very low traction requirement.



Lilliston cultivator

Mowers

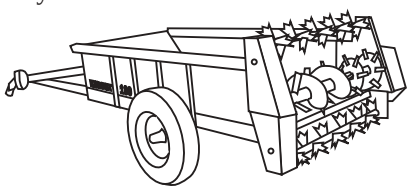
Mowers are an important tool used to knock down cover crops and standing crops prior to incorporation. Mowers run off of the tractor's PTO and have no traction requirement. Flail mowers are best suited for heavy residue chopping since they cut the residue into small pieces that can be easily incorporated and will break down quickly. Mowers are only essential in areas where cover crop biomass production is heavy.

Leveling Tools

There are many different types of leveling tools, which are critical in furrow- or flood- irrigated systems. Each time an implement is drawn across a field, soil is moved and either pulled away from the point of entry or deposited at the point of turn around. Over time this will cause high and low spots across a field, particularly row ends, which will require leveling. Land planes, wheel scrapers, 3-point terracing blades and 3-point box scrapers can all be used, although land planes and wheel scrapers are best suited to this purpose.

Compost Application Equipment

Compost application equipment such as manure spreaders and tractor-mounted loaders are considered luxury items on most small farms. If you have ever tried applying 20 tons of compost per acre by hand you will greatly appreciate this equipment, but most small farms simply can't afford to buy and maintain equipment that sits unused most of the year. In most agricultural areas there are custom applicators that can apply amendments such as compost for as little as $10 to $20 per acre depending on the size of the job and distance to the job site.



Manure spreader

PRODUCTION SEQUENCE AND TIMING

The sequence and timing of row crop production will vary depending on soil type, the cover crop, amendments applied, and crops being grown (see examples on next page and on page 19). Despite these variations, the basic sequence involves the following steps –

- Mow and incorporate cover crops and/or apply and incorporate soil amendments such as compost
- Form beds with a lister and work beds with a rolling cultivator
- In dry climates, irrigate beds to encourage a flush of weeds
- Cultivate/flame-weed beds to eliminate germinating weeds and create good seed bed tilth
- Plant crop
- Cultivate to eliminate weeds

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· Irrigate as needed with drip, flood, or sprinkler irrigation, or rainfall
· Cultivate as needed to control weeds
· Harvest
· Flail mow and disc crop residue
· Prepare new seedbed
· Plant second crop or cover crop, depending on season length of initial crop

At the Center's UCSC farm, where we typically receive 35 inches of rainfall during the winter months, cover crops form a key input in the fertility and soil quality management program. Our preferred cover crop is a mix of bell beans, vetch, and oats. We are currently planting at a rate of about 200 lbs/acre with a 50/50 mix of the bell beans and vetch and about 10 lbs/acre of oats. Although a cereal crop like oats helps control weeds and does a good job of holding leachable nitrogen, we have found that at rates higher than 10 lbs/acre it will dominate the legume mix. Other drawbacks to the cereals are that they are slow to break down in the spring when incorporated, and have a tendency to set seed early.

Although we rely heavily on the legume covers for nitrogen input, we still add compost at a rate of about 5 tons per acre per year. We have found that the best time to apply compost is when we incorporate cover crops, although this is not always practical due to the high equipment demands in the spring.

The challenge we face in the spring is incorporating the volume of biomass generated by the cover crop mix into the soil profile and then preparing a seed bed adequate for our early plantings. We typically start mowing and spading in cover crops the first week of April and usually have plantable beds by May 1st. If our timing is right in terms of soil moisture and cover crop maturity, we can get beautiful tilth with a single pass of the mechanical spader. In the spring it is always interesting to watch the deeper soil moisture being rapidly depleted by the standing covers, yet see the surface moisture remain high due to the surface shading effect of the standing cover crop. When deciding to cultivate, it is a delicate balance between too dry and too wet, and every season is different.

The mechanical spader is an excellent tool for incorporating high-biomass cover crops and we have noticed a gradual improvement in soil condition since we started spading 10 years ago. We use a 5-foot spader behind a 50 HP tractor and it takes us almost 4 hours to cover an acre of ground. There is no other tool that I know of that does as good a job of incorporating cover crops. One great advantage of the spader is that is works the ground uniformly and due to the action of the spades creates no compaction. We have a real "patchwork" farm with many 1/3- and 1/2-acre plots, and with the spader we can easily and uniformly work up a 3-meter x 3-meter plot without moving soil around. This is a tremendous advantage for our experimental plot work and also for our diverse CSA cropping system.

For the past several years we have developed a cover crop incorporation/bed forming strategy that looks something like this: When we determine soil moisture is right for tillage in the spring and we get a clear 5 day weather

> continues on page 18

Sequence of tillage, bed preparation, planting, cultivation and irrigation for direct-sown sweet corn using heavy residue cover crop for fertility (UCSC Farm; MF = Massey Ferguson)

Date	Operation	Tractor	Implement	Approximate time/acre
1-Apr	Mow cover crop	35 HP MF	6 foot flail mower	1.5 hours
2-Apr	Spade incorporate residue	50 HP Kubota	5 foot mechanical spader	4.5 hours
15-Apr	List beds	50 HP Kubota	4 bottom lister	0.5 hour
16-Apr	Work beds with rolling cultivator	35 HP MF	2 row lilliston cultivator	0.5 hour
16-Apr	Sprinkle irrigate (1" to 2")			
24-Apr	Work beds with rolling cultivator	35 HP MF	2 row lilliston cultivator	0.5 hours
1-May	Plant corn to moisture	35 HP MF	John Deere 70 planters	1 hour
15-May	First cultivation	35 HP MF	3 bar cultivator (sweeps, knives)	1 hour
1-Jun	Lay out drip lines			
2-Jun	Second cultivation	35 HP MF	2 row lilliston cultivator	1 hour
	Irrigate as needed (approximately 1"/week through harvest)			
15-Aug	Pull drip lines, flail mow corn plants			
16-Aug	Disc incorporate crop residue (2 times)	50 HP Kubota	8 foot offset wheel disc	1.5 hours
17-Aug	Level ends of field	50 HP Kubota	6 foot terracing blade	1 hour
20-Oct	Drill cover crop seed mix	35 HP MF	7 foot grain drill	1 hour

Research

Updates

Social Issues Researchers Present Work on Alternative Agrifood Initiatives

The Center's research on alternative agrifood initiatives, such as farmers markets, community supported agriculture, regional foodsheds, and farm-to-school programs, examines innovative approaches being taken to encourage more socially and ecologically sustainable food systems. Social issues analyst Patricia Allen and researcher Jan Perez recently made presentations on the results of this research at two conferences. The first, the California Food Security Summit, was attended by California activists working on food security issues at the local or statewide level. The second, the Agriculture, Food, and Human Values Society annual meeting, was attended by academics (primarily in the social sciences and humanities) and practitioners working on cultural, political, economic, and ethical issues around food and agriculture systems.

A summary of the agrifood initiatives research was published this winter in the international scholarly publication the *Journal of Rural Studies* (Shifting plates in the agrifood landscape: The tectonics of alternative agrifood initiatives in California, *Journal of Rural Studies* 19 (1): 61–75). The article reviews the current discussion of common themes and strategies in agrifood initiatives within the academic literature; the history of these initiatives in California; and the results of interviews with 37 current leaders of California agrifood initiative organizations. Patricia Allen was lead author for the paper; Center faculty affiliates Margaret FitzSimmons and Michael Goodman and Environmental Studies graduate student Keith Warner coauthored the paper.

Water Quality Monitoring Work Expands on Central Coast

As part of the Central Coast Research Project, Center researchers Marc Los Huertos, Lowell Gentry, and Center director Carol Shennan have been monitoring water quality in the Pajaro River and Elkhorn Slough watersheds (see *The Cultivar,* Vol. 19 #2). The group is now in its third season of measuring nitrate and phosphorus levels from sampling sites through the watersheds. This work aims to inform growers about the impacts of their operations on water quality in the region, and to help them develop management strategies to reduce the movement of nutrients into sensitive waterways.

This winter the Center was awarded a contract from the local Regional Water Quality Control Board to measure nutrient loading from Santa Clara and San Benito Counties to the Pajaro River. The funds have been used to substantially increase the Center's current sampling area and better determine the sources of nutrients in the Pajaro River and ultimately the Monterey Bay. These data will also form part of the basis for the TMDL (Total Maximum Daily Load) process in the Pajaro River, a process designed to determine the origin and levels of point source and nonpoint source pollutants that impair water sources, and to reduce them over time. Center researchers have collected data for the TMDL process over the past several years, and these new sampling efforts will significantly increase the available data to determine source areas and loading rates.

Lowell Gentry

Center researchers monitor water quality in central coast streams, rivers, sloughs, and agricultural drainages to determine effects of various land use activities.

Researchers Report On Center's Work

Center researchers Marc Los Huertos and Lowell Gentry presented results from the water quality monitoring work (see above) at the annual Agronomy and Soil Science Society meetings in Indianapolis this fall. After attending the meetings, Center director Carol Shennan traveled on to the United Kingdom and the Netherlands. At the University of Southampton's Geography Department, she reported

> continues on next page

on her research on crop rotation strategies to improve both farming conditions and wildlife habitat in the Tulelake Basin. She discussed the Center's research, education, and outreach work to members of Wye College, home to the Centre for European Agri-Environmental Studies. And at the University of Wageningen in the Netherlands, Shennan presented information on the Center's water quality monitoring work to the Biological Farming Systems Research and Education Group, which emphasizes research on organic farming systems.

Trap Crop Study in Strawberries Continues

Center researchers Janet Bryer and Diego Nieto continue work on finding ways to control lygus bugs (*Lygus hesperus*) in strawberries using trap crops and tractor-mounted vacuums. Working with Center entomologist and extension specialist Sean Swezey, the researchers have developed a blend of trap crop species that is highly attractive to lygus.

The researchers have learned from past projects that without serious control the lygus "spill" from the trap crop back into the adjacent strawberries, causing significant damage to fruit in the first two rows. With funding from the USDA's Sustainable Agriculture Research and Education program (Western-SARE) the team is testing the effectiveness of using grower-owned tractor-mounted vacuums in the trap crop. The overall objective of this effort is to try and significantly and economically control lygus in the trap crops and adjacent strawberry fields by using vacuums only on the trap crops. If successful, this could reduce costs of running vacuum equipment over the berry fields, as well as reduce the spread of molds and mildews from frequent equipment movement.

Disease Prediction Model Tested

Center extension specialist Sean Swezey and Jenny Broome of the UC Sustainable Agriculture Research and Education Program received a grant from the US Environmental Protection Agency to establish a weather station network to support research into weather-driven pest models. This project uses real-time weather data collected on farms as part of an integrated management program for Botrytis Fruit Rot or Gray Mold (*Botrytis cinerea*).

Botrytis is the most common—and most serious—aboveground strawberry disease in California. The main conventional control method is calendar-based sprays of fungicides, where 7–10 applications of Captan and Iprodione per season are not unusual. Both of these chemicals have been identified as probable human carcinogens.

The use of weather-driven spray forecasting can reduce the overall use of pesticides by targeting the application to when the disease is most active in invading tissue or causing damage, or when the disease is at its most vulnerable life stage. On-site weather stations monitor temperature, relative humidity, and leaf wetness. Using a Botrytis infection model based on the interaction of hours of surface wetness and the average temperature during the wetness event can potentially reduce the reliance of California's strawberry producers on the fungicides mentioned above.

Habitat Diversity Monitored

Center researchers Janet Bryer and Diego Nieto are working with the Community Alliance with Family Farmers (CAFF) on a project to improve water quality and habitat diversity on farms in the Pajaro Valley. Funded by the State Water Resource Control Board, this project addresses threats to water quality in the Pajaro watershed from nonpoint source pollution, much of which is the result of agricultural runoff.

To encourage habitat diversity and minimize runoff from farms, growers are planting hedgerows of native perennials on their sites. Bryer and Nieto monitor perennial hedgerows for major crop pests as well as beneficial insects at four selected farms. They will provide information to the growers on potential impacts of these insects on adjacent crops and give suggestions for hedgerow management.

Center Research Brief Series Debuts

This winter the Center initiated a Research Brief series, designed to provide timely reports of Center research activities in a more in-depth format than is often possible in this newsletter. The reports are designed for growers and researchers, extension personnel, policymakers, and others interested in the Center's various research projects.

The initial titles in the series report on work from the Central Coast Research Project. Brief #1, *Community Supported Agriculture on the Central Coast: The CSA Member Experience*, details the experiences of CSA members in the central coast's 5-county region: who and why they joined a CSA, their connection to farmers, reasons for staying with or leaving the CSA project, and the impact of the CSA on their eating habits and on their awareness of agricultural and environmental issues.

Brief #2, *Land Use and Water Quality on California's Central Coast: Nutrient Levels in Coastal Waterways*, reports on two years of water quality monitoring data, focusing on nitrate and phosphorus levels in the Pajaro River and Elkhorn Slough watersheds. The project was developed in collaboration with a variety of groups working on water quality protection efforts in the central coast region, with the goal of providing data to growers, researchers, and policymakers on the impacts of various land use activities on sensitive waterways that affect the Monterey Bay.

Center Research Briefs are available free by contacting CASFS, 1156 High St., Santa Cruz, CA 95064, email to mtbrown@ucsc.edu. They are also be available on the Center's web site, www.ucsc.edu.

New Guide Offers Resources for Teaching Organic Farming & Gardening Skills

Staff members of the Center for Agroecology & Sustainable Food System's Farm & Garden Apprenticeship (*see cover story*) are often asked to share their expertise and lesson plans with other groups that want to develop similar training programs. Drawing on the Apprenticeship's 35-year history, the staff and seven invited authors have written and produced a curriculum guide, *Teaching Organic Farming and Gardening: Resources for Instructors*, that presents material for teaching the basic skills and concepts covered in the six-month apprenticeship training course.

The training curriculum is designed for–

- Urban agriculture, community gardens, school gardens, master gardeners, and farm training programs
- Farms with internship or apprentice components
- Universities and colleges with programs in sustainable agriculture
- Agriculture extension stations
- Organizations such as the Peace Corps, US AID, and other groups that provide international training in food growing and ecological growing methods

The 600-page manual includes basic lecture outlines for instructors and detailed outlines for students. Demonstrations and exercises build on the lecture content and give students hands-on practice in a variety of skills. Each unit also contains a resources section offering annotated print and web-based references. Although much of the material is designed for field or garden demonstrations and skill building, the curriculum can also be tailored to a classroom setting.

Part 1 Organic Farming & Gardening Skills and Practices

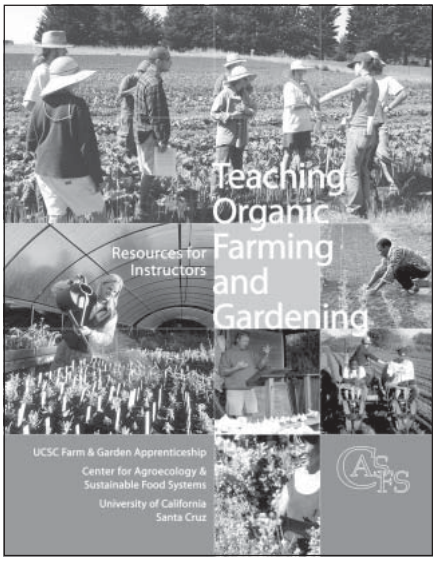
Unit 1.1 Managing Soil Fertility
Unit 1.2 Garden and Field Tillage and Cultivation
Unit 1.3 Propagating Crops from Seed/Greenhouse Management
Unit 1.4 Transplanting and Direct Seeding
Unit 1.5 Irrigation: Principles and Practices
Unit 1.6 Selecting and Using Cover Crops
Unit 1.7 Making and Using Compost
Unit 1.8 Managing Arthropod Pests
Unit 1.9 Managing Plant Pathogens
Unit 1.10 Managing Weeds
Unit 1.11 Reading and Interpreting Soil Test Reports

Part 2 Applied Soil Science

Unit 2.1 Soil Physical Properties
Unit 2.2 Soil Chemistry and Fertility
Unit 2.3 Soil Biology and Ecology

Part 3 Social and Environmental Issues in Agriculture

Unit 3.1 The Development of U.S. Agriculture
Unit 3.2 Social Issues in Modern Agriculture
Unit 3.3 Environmental Issues in Modern Agriculture
Unit 3.4 Introduction to Sustainable Agriculture



Center staff and seven invited authors developed the lectures, demonstrations, and hands-on exercises in the 600-page training manual.

Part 1 emphasizes the "how-to" aspects of organic gardening and farming. Part 2 provides a more detailed context and science background for many of the topics covered in Part 1. Part 3 outlines the history of conventional and organic agriculture, and introduces social and environmental issues as they relate to agriculture and food systems, in order to broaden students' understanding of the issues associated with farming and food distribution.

Teaching Organic Gardening and Farming: Resources for Instructors is designed to be placed in a 2-inch, 3-ring binder so that sections can be easily removed and copied for class use. It is available from the Center for Agroecology & Sustainable Food Systems for $45.00. Price includes tax, shipping, and handling; binder not included.

To order, send a check made payable to **UC Regents** to: CASFS, 1156 High St., Santa Cruz, CA 95064, attn: Teaching Manual. Please be sure to include your mailing address, or copy this page and fill out the information below to send with your check. If you have questions about the resource guide, or questions about ordering, please send email to TrainingManual@ucsc.edu. The resource guide will be available in PDF format on the Center's web site in spring 2003 (www.ucsc.edu/casfs).

Funding for development of this publication was provided by the Richard and Rhoda Goldman Fund, the Organic Farming Foundation, the Mary A. Crocker Trust, the Arkay Foundation, and the Foxwhelp Fund.

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from the
Field

Center Grants Support UCSC Students

Each year the Center for Agroecology & Sustainable Food Systems awards funds to UC Santa Cruz undergraduate and graduate students through a competitive grant process. Eric Hummel, an Environmental Studies major at UC Santa Cruz, received an undergraduate research award in 2002 (see page 17 for a list of this year's awards). Here he reports on his work exploring farmer production of organic seeds in California and Oregon.

CREATING FARMER SEED PRODUCTION SYSTEMS

In June and July of 2002, I traveled to 10 small farms in Oregon and Northern California where organic and biodynamic seed is produced. I also met with one professional plant breeder in Oregon who works on the development of useful varieties for more natural systems of food production, as well as developing perennial varieties of crop species, mainly grains.

What I found were vibrant and promising systems of livelihoods, integrating permaculture design, biodynamic agricultural practices, animal husbandry, and seed production, among other things. These farmers were practicing highly diverse methods of food production, with seed production a logical and philosophical outcome of returning to a more traditional and sustainable method of farming.

Growing much of their own seed is a significant act to these farmers. They also do a great service for other small growers by supplying organically produced seed. However, these seeds are sold first to a seed company somewhere, and then back to growers who need them. The focus of my journey was to explore the possibility of growers working together to produce locally adapted, small-farmer-grown seeds through cooperatives or networks.

The biggest barrier I came across hindering the development of such cooperatives is the scarcity of, and distance between, farmers educated and willing to produce seed. The seed growers I visited were rather isolated from one another, ranging from Santa Cruz to Sacramento, California and up to Cottage Grove and Williams, Oregon. Such distances definitely hinder interactions among growers. The town of Williams did seem to have a promising future, however. There are a number of seed growers in Williams, and a few expressed an interest in creating a Williams seed cooperative. Such a cooperative would pool the seeds produced in the area for distribution, reimbursing each grower depending on how much he/she contributed. Concerns exist, however, over keeping seed quality high, e.g., maintaining acceptable germination rates. The importance of conscientious selection and the rogueing out of off-types needs to be emphasized as well. Education and cooperation in the technical aspects of seed production from in-the-know farmers, professional breeders, and institutions are therefore critical.

Breeders and institutions play a crucial role in farmer seed systems, not only in education, but also in collaboration on breeding projects. I found a few private breeders in Central Oregon working closely with seed growers in Williams, cleaning up varieties, and developing varieties for organic systems as well. Disappointing to find, however, was the absence of any collaboration between public, institutional plant breeders and small farmers (or any farmers for that matter) on the West Coast (Carolee Bull, pers. comm., August 2002). Public plant breeding has concentrated solely on varieties for vast monocultural systems for some time, and now focuses mainly on the genetic manipulation of crops. Therefore, appropriate variety development appears to be up to farmers and breeders collaborating at the grassroots level.

As using organic seed becomes a requirement of organic certification, organic seed production may well become dominated by corporations using input substitution rather than more sustainable practices. A most essential act could be done if more small growers would participate in the art of seed growing, as integrating the lost art of farmer seed production helps small farmer cooperation and networking flourish, while making the farm and food system more sustainable. Institutional support is critical in catalyzing collaboration between farmers and breeders to produce organic seeds and varieties appropriate for organic production systems.

I hope to continue this work through academia in the future, gaining institutional support in the farmer education of the lost art of seed production and farmer-breeder participatory breeding.

– Eric Hummel

Growing Onions and Leeks in the Home Garden

Over time the genus *Allium,* which includes onions, leeks, and garlic, has been variously listed under the Liliaceae and the Amaryllidaceae families. Both families have been comprised of a wide spectrum of distantly related heterogenous plants.

In 1985 botanists Rolf Dahlgren, H.T. Clifford, and Peter Yeo published *The Families of Monocotyledons.* Their startling new view of the monocots created 40 new families! While this arrangement may be consistent with DNA sequencing, it wreaks taxonomic havoc for entry-level botanists and gardeners. Nonetheless, genus Allium is now placed in its own family, Alliaceae (technically, bulbous plants with basal leaves, flowers borne in a leafless umbel with subtending bracts and a superior ovary). The Alliums are a rarity, in that they are one of the few vegetables that are monocots.

There are approximately 400 species of wild onions, leeks, and their relatives found world-wide. The principal garden species are –

Allium cepa – bulbing onions

Allium cepa aggregatum – shallots, multiplier onions, potato onions

Allium cepa proliferum – topset onions, Egyptian onions, tree onions

Allium sativum sativum – softneck, artichoke garlic

Allium sativum ophioscorodon – stiffneck, ophio, topsetting garlic

Allium ampleloprasum (porrum) – leeks, elephant garlic

Allium fistulosum – bunching onions, scallions

Allium schoenoprasum – chives

Allium tuberosum – Chinese chives

ONIONS — *ALLIUM CEPA*

The cultivated species of onions are thought to be native to Central and Southwest Asia—Iran, Afghanistan, and Pakistan. Evidence of cultivated onions dates back to 2,800–3,200 BC in Egypt, with onions in evidence both in the decoration and hieroglyphics of the pyramids. The bulbs were also used as part of the embalming and mummification process.

Onions are biennial herbaceous plants commonly grown as annuals. They are seeded in the fall or early spring, harvested in the summer, and used fresh or stored for winter. They feature a restricted, shallow root system, with unbranched, pure white succulent roots measuring 6 x 6 inches. Much like the perennial grasses of the steppes and plains, Alliums are constantly sloughing off old roots (almost on a daily basis) and developing new feeding roots. As a result they add significant amounts of organic matter to the soil and contribute to much-improved surface soil structure.

The indispensable onion, which is basic to all soups, stews, stocks, sauces, etc., develops a distinct basal bulb. These aptly named tunicate or laminate bulbs consist of layers of swollen leaf bases that have adapted to be succulent in the center (as a food storage organ) and dry and membranous on the outside (as a protective cloak or tunic).

Onions' dry, papery outer layers protect the bulbs' succulent inner layers from drying and damage

Megan O'Dea

THE INFLUENCE OF DAY LENGTH

Bulb initiation in onions is affected by two environmental stimuli: day length and temperature. Onions are stimulated to bulb up under the lengthening days of spring into summer. Generally, day lengths of 12–16 hours induce bulbing.

Additionally, onion varieties are classified according to the photoperiod (approximately) necessary to induce bulbing. Short day varieties bulb up at day lengths greater than 12–13 hours; intermediate day varieties, greater than 13 1/2–14 1/2 hours; long day varieties greater than 14 1/2–15 hours; very long day varieties greater than 16 hours.

Basically, to cut to the chase, northern gardeners above the 40th parallel (i.e., north of San Francisco in the west or Washington, DC in the east) experience long summer days and thus grow long day and very long day varieties of onions. Conversely, southern gardeners below the 28th parallel grow short day varieties. Gardeners between 28˚ and 40˚ grow intermediate day varieties.

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Allium Propagation and Cultivation Tips

Sexual Propagation

> Allium seed viability = 1–2 years
> Seeding depth = 1/4–1/2 inch
> Small seed, soft seed coat subject to rot and injury
> Soil crusting delays, retards emergence
> Germination: In 5–10 days at 68˚–86˚F (75˚F optimal)
> Can be sown intensively in flats, nursery beds, speedling trays, or six packs and transplanted at 10–12 weeks

Sowing: Timing, Temperature, and Spacing

> Sow from fall (mild winter areas) into spring
> In spring, transplant seedlings 3 weeks before last frost
> Can tolerate light frosts, although prolonged frosts induce flowering; earliest possible start is important to develop a large plant
> Cool weather to establish plants: 50˚–70˚F
> Large plant = large bulb
> Spacing is correlated to bulb size: 3–4 inches between plants = 2–3-inch bulbs; 6–8 inches between plants = 4–6-inch bulbs. Bulb size is also a function of variety (see varietal descriptions).

Irrigation, Cultivation, and Harvest

> Prefer well-drained sands and silty soils
> Soil pH 6–7 (versatile)
> Raised beds prevent root rot and increase ability to precisely control water
> Water 1–2 inches/week
> Nutrients: High nitrogen (150–200 pounds/acre or 5–10 tons compost per acre) early in cycle to establish plants; moderate phosphorus; high potassium (promotes bulb formation)
> Shallow root system necessitates surface application of nutrients (top 4 inches)
> Poor at weed competition, requiring 6-8 weedings during growth cycle
> Respond quickly to foliar feeding (fish emulsion, kelp)
> Warm weather >75˚F for bulb initiation
> Warm to hot dry weather (75˚–85˚F) for finishing off crop
> Onions cure best if they enter dormancy gradually: Reduce water at end of growing cycle and stretch interval between waterings (easier to do in raised beds where moisture is easier to control)
> Harvest when 25–50% of tops have fallen over and started to yellow or die back

Diseases: Downy mildew (*Peronospora destructor*) can be controlled by keeping foliage dry. Use subirrigation (e.g., surface or buried drip or T-tape), especially in crop's late stage. Purple blotch (*Alternaria porri*)—similar symptoms and prevention as downy mildew.

Most books and catalogues will reference day length requirements of varieties. It is important information. If, for instance, you reside in Florida or Cuba (where the longest day is approximately 13 hours) and decide to grow the very long day cultivar Maple Star (sometimes varietal names give you a clue as to geographic suitability) that requires 16 hour days to bulb up, you will be growing a perpetual scallion. Similarly, if you live in a long day area like Vermont and grow the short day variety Red Creole (hint, hint), the onion will attempt to bulb up in March or April (if it survives) and result in a thumbnail-size bulb. Pick appropriate varieties for your latitude!

Day neutral varieties are a relatively new development and a great boon to gardeners. They can be grown in almost any latitude and bulb up when the plant has sized up (12–15 leaves). See next page for varietal descriptions.

An onion plant will bulb up only after being exposed to its critical day length for several weeks. The bigger the plant when it goes to bulbing, the bigger the resultant bulb. So establishing a big, vegetative plant with 12–15 leaves is the gardener's goal.

THE EFFECTS OF TEMPERATURE

Temperature plays a secondary role in bulb initiation. Cooler temperatures (less than 70˚F average day temperature) retard bulbing even when the requisite day length is achieved. Temperatures greater than 75˚F hasten the bulbing response. Temperature also affects flowering in onions—an undesirable scenario that will lead to small, tough bulbs. Temperatures under 50˚F for 10 days or longer (if seedlings are greater than 1/4-inch stem diameter) followed by warm temperatures, in conjunction with lengthening days, will induce flowering. Thus while a bigger plant equals a bigger bulb, starting seedlings too early (especially if you experience back-and-forth spring weather) can doom your onion crop.

BULBING ONIONS

Sweet Onions

These early, large, mild, even sweet types used to be referred to as sweet Spanish or Bermuda onions. These onions can be mid size to huge, reaching 6–8 inches across. They have a high moisture content, moderate sugar, and low pungency, and feature thick, succulent rings or layers. While high water content and low sulfur contribute to flavor and sweetness, they limit storage to 3–4 months. In onions, one of the components of sulfur, pyruvic acid, contributes to pungency. Sweet onions actually have a lower sugar content than pungent storage types. They also have a lower pyruvic acid content (2–5% vs. 9–11%).

Soil sulfur content also influences sweetness in onions. Low sulfur soils yield sweeter onions. Also, as sulfur is a

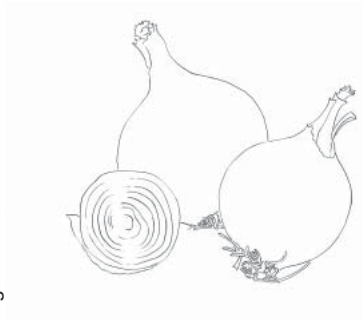
key component of organic matter, low organic matter soils produce sweeter results.

Regionally famous sweet onion varieties such as the Walla Wallas of Washington State, the Vidalia of Georgia, the Maui of Hawaii, and the Grano/Granex types of Texas are in reality the same onion bred for different latitudes and growing environments, regional chauvinism aside. Truly they are the sweetest of onions, creating a mild pandemonium when harvest time arrives in early summer, a time when cooks can say adieu to the last of the pungent winter storage onions.

Spring onion, like green garlic, is a general term applied to sweet onions harvested immature. Spring onions are small- to full-sized bulbs with the succulent green tops still attached. They are even lighter and sweeter yet. An added dividend to spring onions is that they are approximately twice as nutritious as storage onions, offering a high source of calcium, iron, and potassium.

Storage Onions

Hard storage onion varieties are higher in both sugar and sulfur. The sulfur adds not only pungency, but increases storage time to 6–10 months, and even up to 12 months. These onions are smaller, harder, and have a low moisture content. After weathering cutting and cooking (the sulfur being both water and heat soluble) the sugar is accentuated and overall they have a superior flavor. Also, as time in storage increases, sulfur decreases. The real and primary purpose of sulfur compounds is to act as natural anti-bacterial agents, preventing rot in storage. Generally the darker the skin pigmentation, the higher the sulfur, the longer the storage.



Megan O'Dea

Mini/Summer (also called Pickling or Pearl)

These and other synonyms all refer to a versatile class of onions. They are not as day-length sensitive as standard bulbing onions and can be grown over a wider area. They are much quicker to maturation (60–90 days from transplants), so they can be successively sown from late winter to mid spring. The first wave can fill the gap between the end of the storage onions and the midsummer harvest of sweet onions. These mini onions are small (1–2 inches in diameter) and make excellent bunches with the greens still intact. They tend to be sweet, not pungent

Italian Cipollini onions are usually lumped with the "minis." Cipollinis are medium-sized (1–3-inch) flat onions that come in white, yellow, and red varieties. They start out sweet and at maturity combine a sublime creamy texture with the perfect balance of sweetness and pungency. They are great keepers and display well when braided.

ONION VARIETIES OF NOTE

SD=short day
ID=intermediate day
LD=long day
DN=day neutral

Sweet Types (days to harvest are from transplants)

Candy (DN, 85 days) – Sweet, 6 inches across. Brown golden bulb wrapper, white flesh.

New York (ID, 98 days) – Early product, strain of yellow globe, reliable open-pollinated, firm flesh, mild taste. Good in sandwiches and salads.

Texas Grano (ID, 175 days) – Yellow skinned, 3–4 inch bulb. Very sweet white interior. High yields, short storage (2–3 months).

Stockton Red and *Yellow* (ID, 150–180 days) – California's Central Valley answer to Walla Walla, Vidalia, Maui, Texas Grano types. Large, flattened globe shape. Good color, savory flavor, short storage (3–4 months).

Super Star (DN, 100 days; new introduction) – Widely adapted, spring sowing. Can be fall planted in short-day areas. Uniform, white, mild onion with thick rings, short storage period (2 months).

Sweet Sandwich (LD, 110 days) – A unique sweet, long-day storage onion with 2–3 1/2 inch bulbs. Pungent when harvested, sweetens in storage (6–8 months).

Walla Walla (LD, 125 days) – Among the most popular early extra sweet onions 5–6 inches across when fall sown. Can be eaten raw. Short storage (2 months).

Pungent, Storage Types

Copra (LD, 104 days) – Rock-hard bulb, matures very early, 3–4 inches bulb, yellow skin. Pungent, stores 8–10 months.

First Edition (LD, 100 days) – High yielding, early maturing, medium size yellow skinned (2–3 inches). Pungent cream-colored flesh, great for northern climates. Stores 8–10 months.

Redwing (LD, 118 days) – Large (4–5 inches), deep red, late maturing, best northern climate red. Good storage (8 months).

Mini/Summer Varieties

Amethyst (DN, 63 days) – Similar to Purplette, with deeper red color that fades to pink when cooked.

Bianca di Maggio (ID, 80 days) – Flat, white, midsize (2-3 inches) mild-tasting Cipollini type. Good storage (5–6 months).

Blanc Hatif de Paris (SD, 90 days) – White, flattened, mild, sweet Cipollini type

Borretana (LD, 90 days) – Late, yellow-brown heirloom, unique, good storage (6-8 months).

Gold Coin (ID, 80 days) – Small to medium yellow-gold bulb (1-2 inches) flattened like Cipollini types. Both pungent and sweet. Good storage (4-6 months).

Purplette (DN, 60 days) – Early, purple skin, white flesh, used at spring onion stage or let mature. Golf ball to tennis ball size, mild, succulent taste.

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LEEKS — *ALLIUM PORRUM/AMPELOPRASUM*

The modern leek is related to the wild leek of the Mediterranean and the Canary Islands, Madeira, and the Azores. Leeks are cool-season, cold-hardy biennials grown as annuals. They are grown for the fleshy blanched sheath of the basal leaves, known as the shank in gardening parlance. While leeks have long been a staple winter vegetable of Northern Europe, they are decidedly unsung and underappreciated in the U.S.

There is great difficulty in describing the taste and texture of leeks; they are singularly unique. Both gardening and cookbooks abound with comparisons between leeks and other vegetables: poor man's asparagus; sweet onion-like; bulbless onions, etc. As Shakespeare said, "Comparisons are odious," and to call them mild onions is a disservice. Leeks are prized for their succulent, rich, yet delicate mildly sweet taste. When used in soups and stews they add a creamy texture and thickness.

Leeks can be harvested almost year-round in most climates. Along with kale, they are the most cold-tolerant of vegetables. If established in late summer they can overwinter through the frozen ground and snow pack of northern New England. In fact, the colder the temperature, the sweeter the taste. On the other end of the spectrum, they will endure, but are not particularly fond of temperatures consistently above 85˚F.

Leeks are cold tolerant, resist insects and diseases, and will grown in a wide variety of soil conditions

Megan O'Dea

There are two basic types of leeks: summer types (long shanked—bulbless) and winter types (short shanked—slight bulbing). Summer varieties feature taller plants with light- to mi-green foliage, almost to the point of appearing nitrogen deficient. The shanks are long (8–12 inches) and self-blanching. They are "quicker" to maturation (90–100 days; all dates are from transplants) than winter types and have a lighter, slightly milder taste. Summer types are more heat tolerant and less cold hardy than winter varieties. They are generally grown spring to fall, although in mild winter areas they are overwintered.

Winter varieties possess dark, almost blue-green foliage with shorter, squat plants. They are slower to mature (120 –180 days) and the shanks are fatter, growing 3–4 inches across, often with some basal bulbing. Even with hilling there is less blanched, succulent edible portion of the stem. They offer a richer, meatier taste and texture. Winter types feature minimal heat tolerance and excellent cold tolerance with temperatures consistently in the teens being acceptable.

Stalwart, long, slow and steady are operative words when thinking of leeks–

Stalwart—Cold tolerant, persisting through the snows of winter undeterred. Leeks are virtually bulletproof when it comes to pest and disease problems.

Long—Tall; some winter varieties achieve the same dimensions as a baseball bat. In fact, leeks, unlike most vegetables, achieve full flavor and ideal texture as they size up. A full-size, mature leek eclipses a young baby leek in both categories.

Slow and steady—While most books and catalogues indicate 4–8 weeks from seeding to transplant and 50–100 days from transplanting to maturity, 10–12 weeks from seed to transplant and 90–120, or even 180 days from transplanting to harvest is the norm.

Culture (also see sidebar, page 14)

Leeks lend themselves to transplanting versus direct sowing. A transplantable seedling (10–12 weeks old, 1/4-inch stem diameter) can be raised in intensively broadcast sown flats or nursery beds. Because they are monocots with a vigorous fibrous root system and a narrow, waxy leaf surface, leek transplants can be barerooted with minimal transplant shock. The blanched, succulent shanks can be increased slightly by planting seedlings up to the first leaf, or more significantly by planting in a 6–8 inch V-shaped trench and subsequently hilling up soil around the base of the plant as it grows (2–3 times).

Spacing is extremely variable on leeks (as with most Alliums). Baby or bunching varieties (see varieties list) can be transplanted 1–2 inches apart or clusters of 3–5 seedlings 4 inches apart in rows 6–8 inches apart. Midsized leeks (1–2 inch stem diameter) can be achieved by spacing transplants 4–8 inches apart in the row and 6–8 inches between rows. Fullsize, overwintering varieties (2–3 inch stem diameter) should be given ample room—8–10 inches between plants and 8–12 inches between rows.

While leeks will grow on light-textured soils, sands, and silts, more than any other Allium they thrive on heavier-textured clays.

LEEK VARIETIES OF NOTE

Summer Types (all summer types can be grown as baby leeks)

Columbus f-1 hybrid (85–90 days) – Medium-sized shanks (2 inch x 10 inch) mature quickly. Some winter hardiness.

Kilma (90 days) – Fast-growing summer leek with 10–12-inch shanks. Only tolerates slight frosts.

King Richard and *Titan* (90-100 days from transplant) – Virtually indistinguishable from one another. One of the earliest-maturing varieties. Long (10–12 inch) self-blanching shanks. Light green foliage. Light, sweet texture and taste. More heat tolerant than any other variety. Some cold tolerance (35˚–32˚F), but not truly winter hardy. Will deteriorate quickly with extensive winter rains.

Lincoln – Often used for baby leeks or bunching, leaves similar to King Richard.

Rival f-1 hybrid – Can grow to 36 inches with 12-inch blanched shank. 2-inch stem diameter.

Upton f-1 hybrid (70–80 days) – A new variety from Johnny's Seeds. Achieves large size (3–4-inch) stem diameter quickly (for a leek). Extremely vigorous, uniform, tall, broad-leafed plants. Almost every one identical in size and quality. Darker blue-green foliage is unusual for a summer variety. Expensive seed: 250 seeds for $5.60; 1000 seeds for$16.00 vs. King Richard, 2500 seeds for $4.90. Great taste, creamy texture, easy peeling and cleaning.

Winter Varieties

American Flag (130 days) — Pure white blanched stems with mild sweet flavor and good winter hardiness.

Blue De Solaise (105 days) – Old French variety with blue-green to almost blue foliage tinged with red. Extremely cold hardy with fat, succulent shanks.

Broad London (120 days) – Very squat, short (4–6 inch) shanked, sweet, creamy-textured old variety. Some heat tolerance and moderate cold tolerance.

Giant Musselburg – Old German variety, 150 days to maturation, pure white, sweet, tender, short shank, dark green foliage.

Lancelot f-1 hybrid (120 days) — Very short plant and shank (4–6 inch) with gray-green foliage. Excellent flavor.

Laura f-1 hybrid (180 days) — Short, sweet, thick, tender shanks with dark green foliage. Among the most cold-tolerant varieties.

With rare exceptions, U.S. seed catalogues usually offer only one to three varieites of leeks. Two exceptions are Irish Eyes and Garden City Seeds, which offer ten varieties. Northern European seed companies usually feature greater varietal diversity, types and varieties.

SHALLOTS — *ALLIUM CEPA AGGREGATUM*

Shallots are a variation on the theme of onions. Until recently they have been cloaked in a gourmet, snobbish mystique with minimal supply and maximum price (it's a Euro-thing). Thankfully, that veil is lifting. Shallots are small, onion-like bulbs (round, oblong, or tear-drop shaped) with a unique flavor—more intense than onions yet less pungent and less sweet. Used in soups and sauces or even as a relish they lend an additional layer of flavor that is more complex than onions, garlic, or even leeks.

– Orin Martin

Center
Notes

Center Awards Graduate and Undergraduate Research Grants

The Center's annual graduate and undergraduate grants encourage research on topics relevant to the Center's mission and provide funds for students to conduct their field work and complete their thesis projects. This winter, the Center presented the following awards–

Graduate Students

Ariane de Bremond: Land Rights, Land Use and Environmental Governance in the Post-war Resettlement of Agrarian Landscapes in El Salvador

Tara Pisani Gareau: Survey of the Ecological and Cultural Value of Hedgerows in the Elkhorn Slough Watershed of California

Jill Harrison: Drifting into Action—Grassroots Critique of Pesticide Drift and its Contribution to Sustainable Agriculture in California

Katie Monsen: Seasonal Nitrate Movement in Soil and Soilwater Profiles Under Organic Management Practices

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

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

Keith Douglass Warner: Nature, Networks, Knowledge and Risk in California Winegrape Partnerships

Undergraduate Students

Serena Coltrane-Briscoe: Availability of Organic Food on Campus

Timothy Galarneau: UCSC Campus Ecology and Sustainability Awareness Survey

Apprenticeship Receives Grants, Gifts

For the second year in a row, Stonyfield Farm, Inc. has given a $10,000 gift to the Center's Apprenticeship Program. Former apprentice Meg Cadoux Hirshberg (1984) and her husband Gary Hirshberg, president and CEO of Stonyfield, deserve many thanks for this important support of the six-month training program in organic farming and gardening.

The Stanley Smith Horticultural Trust has awarded a grant of $10,000 to the Center for an organic ornamental demonstration and education project. The Center's Apprenticeship staff will use these funds in 2003 to create a perennial border demonstration at the entrance to the UCSC Farm's hand-worked one-acre garden, as well as a demon-

> *continues on next page*

stration terraced garden at the entrance to the Alan Chadwick Garden. These and other ornamental plantings will be incorporated into education for apprentices and the public on organic landscaping and ornamental care.

Paul Newman, through his philanthropic business Newman's Own, has made a gift of $10,000 to the Farm & Garden Apprenticeship for the second year in a row. Nell Newman, a long-time supporter of the Apprenticeship, granted $25,0000 earlier in 2002 through her company and foundation, Newman's Own Organics.

In 2003 the apprentices will again learn about and enjoy the connection between growing quality produce and cooking delicious and nutritious meals thanks to a grant of $5,000 from the Chez Panisse Foundation. This project will feature seasonal cooking classes from the garden for apprentices and the public, presented by 1993 apprentice Amy Linstrom and her catering partner Heidi Schlecht of Feel Good Foods.

Eric Biderman, a 1997 apprentice, gave a $4,000 gift to the Apprenticeship for general support of the training program. Eric, who is farming organically on 20 acres in Ribara, New Mexico, said that his grandmother passed some money on to the grandchildren and encouraged them to use it to support a good cause.

A $10,000 grant from Nan Tucker McEvoy and a $3,000 gift from the Dash Family will provide scholarship funding for apprentices from disadvantaged backgrounds in the 2003 program. The Margoes Foundation will again provide full scholarship funding for two participants from Africa.

Many thanks to these and our other supporters!

"Buy Fresh, Buy Local" Campaign Kicks Off at Center's Annual Harvest Festival

A campaign to encourage consumers to support local growers kicked off this fall at the Center's annual Harvest Festival at the UCSC Farm. Coordinated by the Community Alliance with Family Farmers (CAFF), the campaign features a logo that identifies locally grown produce in a number of the region's grocery stores. Says CAFF spokesman Jered Lawson, "Buying local makes sense for a variety of reasons. There is a positive ripple effect with every purchase. We contribute to the local economy, consume foods from farmers we come to know, and reduce our dependence on fossil fuel." The Harvest Festival included displays from a number of local growers and drew nearly 1,000 participants for a day of music, food, talks, tours, and children's activities.

Organic Row Crop Production

continued from page 8

report, we hook up the 6 foot flail mower to our cultivating tractor and hook up the spader to our primary tillage tractor. We start in mowing right ahead of the spader and run the spader 12 hours per day, which translates into 3 spaded acres per day. If we keep this up for 5 days we get over 15 acres in that 5-day period.

Following cover crop mowing and spading we like to see an inch or so of rain, since the covers break down better with moisture and the spader tends to dry the ground out. I have learned that if we are expecting a heavy rain it is better to leave the covers standing. If we get a rain between mowing and spading, the ground is slow to dry down since the covers can no longer transpire deeper moisture, and the surface residue acts like a surface mulch and traps moisture.

After mowing and spading we will then come in after about 2 weeks of initial breakdown and form beds on the entire 15 acres with our 4-shovel lister and markers. We will then come right behind the lister with the cultivating tractor and rolling cultivator and break up any clods and give some shape to the beds. Once this is done we can begin to apply overhead water with hand-moved aluminum pipes. We typically apply 1.5 inches of water to the cultivated beds. We then wait about 10 days and are then ready to run the rolling cultivator over the beds. Afer that we either shape the beds for direct sowings of small-seeded crops or direct sow or transplant our single-line crops. Once the beds are planted we usually do two cultivations for weed control.

CONCLUSION

Some of the most important things to keep in mind when setting up a cropping strategy are –

- your bed configuration
- the tractor or tractors you'll be using
- how can you minimize time spent changing cultivators and tractor wheel spacings to accommodate crop diversity

Diverse, small-scale systems can be extremely challenging to manage, but once you work out all the details of your system they can be incredibly productive and aesthetically pleasing. The trick is to have the tools ready to go when you need them. It is not uncommon for us to hook up to and operate 10 different tractor-mounted implements in a single day. With 25 different crops and as many as 12 different planting dates per season for many of those crops, we stay busy on the tractors but we love it.

– Jim Leap, Martha Brown
illustrations by Cathy Genetti Reinhard

Sequence of tillage, bed preparation, planting, cultivation and irrigation for direct sown carrots double cropped with transplanted broccoli utilizing low residue cover crop and compost (UCSC farm, MF = Massey Ferguson)

Date	Operation	Tractor	Implement	Approximate time/acre
1-Apr	Mow cover crop	35 HP MF	6 foot flail mower	1.5 hours
2-Apr	Apply compost (5 tons/acre)	35 HP MF	compost spreader	2 hours
3-Apr	Spade incorporate residue and compost	50 HP Kubota	5 foot mechanical spader	4.5 hours
15-Apr	List beds	50 HP Kubota	4 bottom lister	0.5 hours
16-Apr	Work beds with rolling cultivator	35 HP MF	2 row lilliston cultivator	0.5 hours
16-Apr	Sprinkle irrigate (1" to 2")			
24-Apr	Work beds with 6 foot rotovator	35 HP MF	6 foot Howard rotovator	1.5 hours
25-Apr	Shape beds	35 HP MF	2 row bed shaper	1 hour
26-Apr	Sprinkle irrigate (1" to 2")			
3-May	Flame weed beds	35 HP MF	2 row flamer	1 hour
4-May	Direct sow carrots (coated seed)	35 HP MF	Stanhay Robin planters	2 hours
4-May	Sprinkle irrigate (1" to 2")			
9-Apr	Lay out drip lines/irrigate as needed			
14-May	Cultivate	35 HP MF	3 bar cultivator (sweeps,knives)	2 hours
24-May	Cultivate	35 HP MF	3 bar cultivator (sweeps,knives)	2 hours
15-Jul	Harvest carrots			
16-Jul	Pull up drip lines			
16-Jul	Apply comopost (5 tons/acre)	35 HP MF	compost spreader	2 hours
17-Jul	Work beds with 6 foot rotovator	35 HP MF	6 foot Howard rotovator	1.5 hours
17-Jul	Reform beds with rolling cultivator	35 HP MF	2 row lilliston cultivator	1.5 hours
18-Jul	Shape and mark beds for translanting	35 HP MF	2 row bed shaper/marker	1 hour
19-Jul	Hand transplant broccoli			
19-Jul	Lay out drip lines/irrigate as needed			
27-Jul	Cultivate	35 HP MF	3 bar cultivator (sweeps,knives)	2 hours
6-Aug	Cultivate	35 HP MF	3 bar cultivator (sweeps,knives)	2 hours
17-Sep	Harvest broccoli			
1-Oct	Flail mow broccoli	35 HP MF	6 foot flail mower	1.5 hours
5-Oct	Disc incorporate crop residue (2 times)	50 HP Kubota	8 foot offset wheel disc	1.5 hours
6-Oct	Level ends of field	50 HP Kubota	6 foot terracing blade	1 hour
20-Oct	Drill cover crop seed mix	35 HP MF	7 foot grain drill	1 hour

Santa Cruz area

events

▸Spring Cooking Workshop, Saturday, March 22, 1 pm–4 pm at the Feel Good Foods Kitchen, 306 Potrero St., Santa Cruz. Caterers Amy Linstrom and Heidi Schlecht will show you how to turn spring produce into a wonderful meal. Learn new cooking tips and ideas from two expert chefs. $30 for Friends of the Farm & Garden members; $40 for non-members, includes food costs and tastings. Please pre-register by Tuesday, March 18 by calling 831.459-3240.

▸ Chicken and Eggs in the Garden, Saturday, April 5, 1 pm–3 pm, Life Lab Garden Classroom, UCSC Farm. Families are invited to learn creative ways to dye eggs using natural materials. $5 for Life Lab members, $10 for non-members. Reservations required, 831.459-20012.

▸ Introduction to Bee Keeping, Saturday, April 19, 2 pm–6 pm, Louise Cain Gatehouse, UCSC Farm. Join Albie Miles for a look into the life of the honeybee. If you're thinking about getting into bee keeping, this workshop will be a great introduction. $5–$10 (sliding scale) for Friends of the Farm & Garden members, $10 for non-members, payable the day of the workshop.

▸ Preparing the Spring Garden, Saturday, April 26, 10 am–1 pm, UCSC Farm. Get ready for the gardening season as you learn how to amend the soil, prepare beds, set out seedlings, and much more. $10 for Friends' members, $15 for non-members, payable the day of the workshop. Call 831.459-3240 for more information.

▸ Spring Plant Sale, Saturday and Sunday, May 2 and 3, 10 am–2 pm, Barn Theater Parking Lot, UCSC. The biggest and best collection of organically grown flower, herb, and vegetable starts, perennials, grasses, and other landscape plants available in the region. Friends of the Farm & Garden members receive early entry from 9 am–10 am on Saturday.

▸ Gopher Control and Exclusion, Saturday, May 17, 10 am–12 noon, UCSC Farm. Thomas Wittman of Molino Creek Farming Collective will reprise last year's popular workshop on the best ways to keep your garden gopher free. Learn the newest ideas and gopher control techniques from a local expert. $10 for Friends of the Farm & Garden members, $15 for non-members, payable the day of the workshop.

▸ The 2003 International Short Course on Agroecology, July 13–25, UC Santa Cruz. This course is designed to give extension agents, farm advisers, trainers, NGO managers, farmers, advanced undergraduate students, graduate students, researchers, professors, and other agricultural professionals a practical, "hands-on" experience with the application of agroecological principles to the design and management of sustainable farming systems.

The course will focus on the interactions between human and ecological communities in rural landscapes. The course is organized by Stephen Gliessman's agroecology research group at UCSC's Department of Environmental Studies, the Program in Community and Agroecology (PICA), and the Community and Agroecology Network (CAN).

The deadline for early registration is March 1, 2003. Updated course information is available at www.agroecology.org/shortcourse.htm. For additional questions, contact shortcourse@agroecology.org.

California

▸ Organic Strawberry Short Course, February 27–28, Salinas, CA. Two-day course includes talks and panel discussions on marketing, site selection; fertility management; organic management of diseases, weeds, and pests; nurseries and planting material; and sustainability indicators. Simultaneous Spanish translation provided. Registration is $125, with scholarships available for limited-resource participants. To enroll, call UC Davis Extension, 800.752-0881. For specific program information, contact Debbie Roberts, 530.757-8899 (phone), 757-8634 (fax).

▸ BioCycle West Coast Conference, March 3–5, Los Angeles, CA. This conference focuses on composting, organic recycling, and bioenergy. For information, contact BioCycle, 610.967-4135, ext. 21, biocycle@jgpress.com, www.biocycle.net.

▸ American Farmland Trust National Conference, March 10–12, Pacific Grove, CA. This year's conference theme is "Farming on the Edge: Finding the Balance." For information, contact AFT, 202.331-7300, www.farmland.org/conference_2003.

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