SUSTAINABLE GARDENING AND SERVICE LEARNING AT THE UNIVERSITY OF REDLANDS

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INTRODUCTION

Founded in 2009, the Sustainable University of Redlands Farm (or SURF) is an ever-evolving campus farm that functions primarily as an outdoor classroom. The farm is located on the University of Redlands campus in Redlands, CA. The site currently employs a single full-time farm manager, with all other requisite labor being provided by student employees or volunteers. In its short history, the farm has educated hundreds of students in sustainable living practices, provided countless hours of community service outreach, and has hosted several high-profile environmentalists.

KEYWORDS

Organic Gardening, Higher Education, Sustainability, Student Organizations, Community Service

FIGURE 1. A view from the gate. The Zuni Waffle Garden is on the immediate right, Produce Field I is to the left, with the community plots across from it. *Photo Credit: Alleah Schweitzer*

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HISTORY

The program was originally established by a professor of education, the office of Community Service Learning, and a group of students at the Johnston Center, as an alternative education program that is part of the greater University of Redlands campus. It was originally installed on the far southwestern side of campus, and students involved in the project constructed a small garden patterned after a traditional Native American design. This Zuni Waffle garden was a collection of raised earthen berms, pounded flat at the tops to allow for walking space, with 1 cubic foot planting spaces in between. The university's version of this design measured 50' by 50', with 25 1'x1' beds, and a large 4'4' bed area in the middle. The berms were raked up and constructed from the dense clay soil that was already abundant in the area, while the planting space was aerated extensively, and amended with steer manure. The original design called for a clay bed garden that was irrigated once weekly by means of diverting a small stream. The tightly-packed and poorly drained soil would retain water for extended periods of time, allowing food crops to be grown even in the arid American Southwest. The gardening program continued in this way for a short while, until it was adopted by the university's office of Community Service Learning. The office took over general maintenance of the garden, and hired several work study students to help with this task, as well as a part-time graduate assistant to manage the small team.

In 2010 the university began construction on a brand new studio art building, with the project slated to occupy the site of the Zuni Waffle Garden. After several meetings with the university administration, the fledgling gardening program was gifted a 2.1 acre parcel of land directly behind the upperclassmen apartments on the opposite end of campus – the land that it currently occupies. There, the garden was rebuilt, and official irrigation was installed. Because there were no streams nearby that could be reasonably diverted, the SURF garden elected to run dripline throughout the berms. To keep pressure constant, the garden was serviced by three separate ½" lines, with a single adjustable-flow bubbler style micro head in each bed space. In July of 2011, a full-time garden manager position was created to oversee this program. Expansion occurred in the form of the California Natives garden, an area constructed to showcase drought-tolerant native plants – an area that has only increased in relevance since that point.

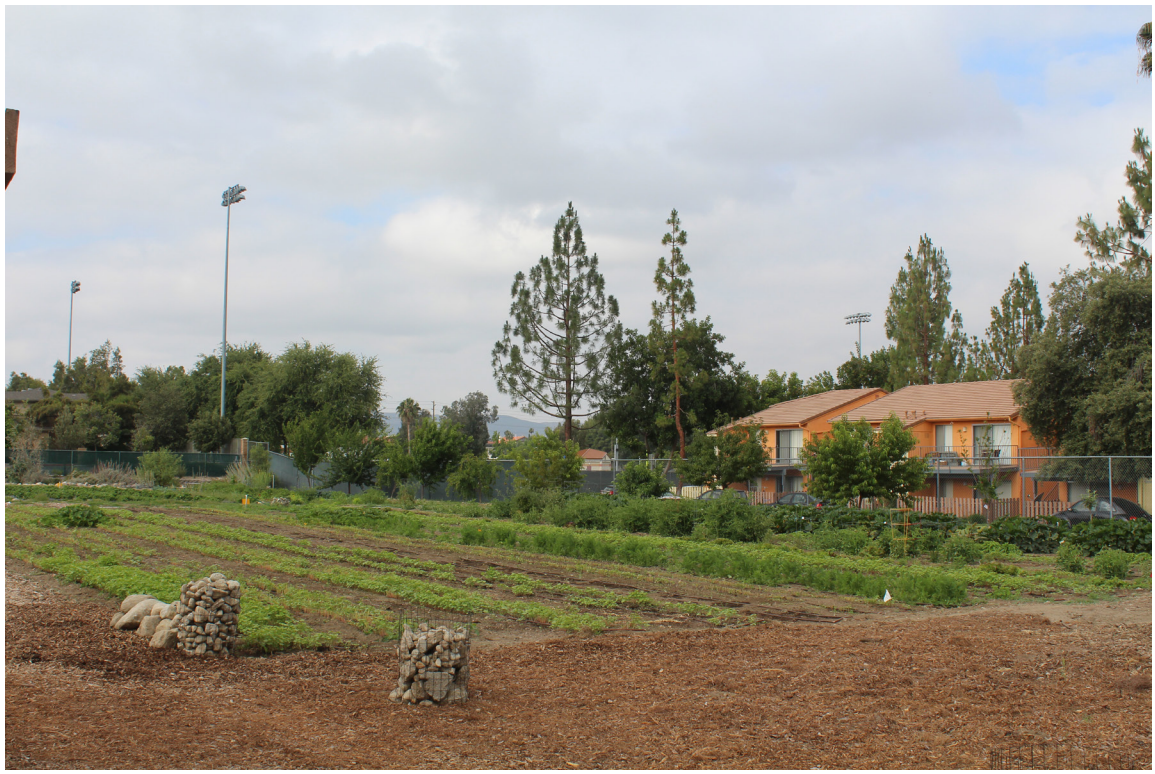
FIGURE 2. The Zuni Waffle Garden, the first element of the SURF garden. The picture was taken shortly after the garden was moved to its present location. *Photo Credit: Erin Sanborn*

The California Natives Garden was constructed by a dedicated senior student with the help of Dr. Tim Krantz, the university's resident native plant expert. The slopes and beds of the garden were painstakingly reproduced in accordance with actual measurements occurring in California landscapes. A large variety of native plants were selected, with a combination of succulents, cacti, bushes, flowers, and a desert willow tree. The area was filled with gravel to minimize weed growth as well as to tie it together aesthetically, and irrigated with .5 GPH micro heads. Due to the garden's drought-resistant properties, it is typically only irrigated once every alternating week, assuming zero rainfall. In the event of rain, irrigations are simply moved forward one week.

After the induction of these two areas, it was decided that something more needed to be done with the space – the two developed garden areas occupied approximately only 1/16th of the total land. In the spring of 2011, construction was started on the first of two produce fields. Assistance with the planning and execution of this task was provided by a pair of local organic farmers, and the fields were laid out to be 100 feet long and 50 feet wide with growing spaces measuring 100' x 2' – a scaled-down version of dimensions adopted from the notable organic farmer Eliot Coleman, in his book *The New Organic Grower*. The fields were cleared and prepped with a gas-powered rototiller, with a large amount of organic horse manure being introduced to make the dry sandy soil arable. The SURF garden has been fortunate in that while the original garden soil was sandy and tended toward alkalinity, most of the trace nutrients were intact. With few notable exceptions, steer and horse manure have proven to be effective soil amendments, binding agents, and pH stabilizers. These fields were drip irrigated with Netafirm dripline, with an overall output of nine tenths of a gallon per hour (.9 GPH). This rate ensured effective water percolation into the shallow root zones of vegetable crops, while the drip system minimized evaporative loss. All of the primary vegetable crops are set for frequent, shallow irrigation. During most months, the produce field irrigation runs for fifteen minutes four times each day, but the events are increased to twenty-five minutes over summers. Plants needing more specific watering schedules are grown in separate areas, and serviced with more easily adjustable irrigation systems.

The second produce field and 34 community plots were added a year later, in the spring of 2012, and the university community was encouraged to start getting involved with the program. Plots were leased out to professors, students, and alumni of the university, in an effort to get members of the University community more actively involved in supporting the program. These plots were laid out in two rows parallel to the produce fields and measured 10' by 20'. Every two plots, garden staff installed a 2' riser with a Y-splitter, so that each plot could have its own dedicated water source. Plot tenants are encouraged to purchase and maintain their own irrigation systems. Dripline has always been encouraged as an effective irrigation choice, but in light of the recent drought, aboveground sprinklers are no longer allowed in the community plots. These were rented out for $10 per semester, in an effort to keep interest high and affordability at a maximum. Once the basic infrastructure was in place, crop production began, with small improvements occurring as the means were made available. A wide variety of low-chill fruit trees were added in the margins between the two produce fields and the fence surrounding the farm. Fruit grown on SURF includes plums, pluots, apples, pears, and kumquats, with nectarines and pomegranates being the most successful crops. A variety of edible climbing plants were also added along the base on the chain link fence on the west side of the garden, in order to maximize the available growing space. Operations continued in this manner for two years.

FIGURE 3. Produce field two, planted with a summer cover crop of buckwheat and cowpeas. Squash plants are visible towards the right of the field, with the fruit trees lining the fence behind them. *Photo Credit: Erin Sanborn*



GREENHOUSE GROWING AND SEED STARTING

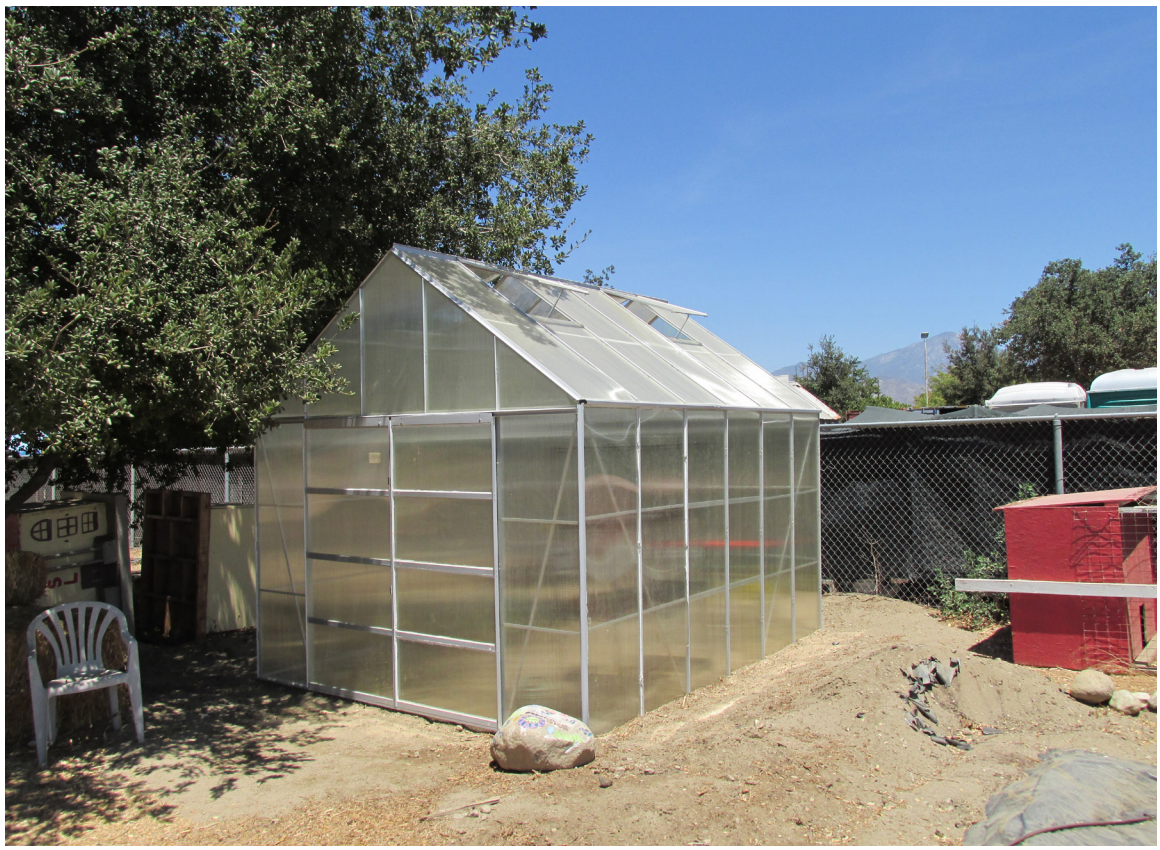
In May of 2014, students participating in the Urban Gardens May term course helped the farm manager construct a 10' by 12' vinyl greenhouse. The foundation was dug eight inches into the ground, with the sides measuring 11' by 13'. This was to ensure that as the greenhouse was constructed, dirt and gravel could be backfilled around the foundation. In this manner, the greenhouse would be safe from the powerful Santa Ana winds that tended to hit the area in the winter, but was still able to be dismantled and moved in case that proved necessary. The greenhouse was furnished with a small table to be used for potting plants and mixing soils, a low shelf for storage of pots, trays, and fertilizers, and a tall shelf to be used for seed-starting.

Garden staff quickly tired of using watering cans and handheld misters to care for the seedlings, and several months after the greenhouse was built, a new watering system was introduced. A ½" length of dripline was run from the nearest hose bib and under the foundation. From there, it was run up the side of the shelving unit and split off into parallel lines that were then tied to the undersides of the shelves themselves. In this manner, each shelf of plants has its own dedicated watering lines. Each of the lines has an adjustable-flow 10 GPH button mister spaced roughly every twelve inches. These misters have been adjusted to the point of delivering water quickly and efficiently without enough volume to displace the seeds. Currently, thirty seconds of watering once per day has proven more than sufficient for any seedlings being grown.

With the addition of the greenhouse, garden staff was able to further diversify their vegetable production, making the addition of plants that are notoriously difficult to direct-seed possible. For the first time, students were able to grow peppers, tomatoes, and melons in quantities sufficient for whole-row plantings. Generally, these seeds would be started in 2" cell trays, in quantities of 128 at a time. Garden staff used to mix the seed-starting medium on site, using a blend of equal parts vermiculite, perlite, sphagnum moss and finished compost. However, many of the seedlings developed problems and it was found that large quantities were damping off. This condition manifested itself when seemingly healthy seedlings would die with little to no warning. It was later ascertained that this was due at least in part to the inclusion of compost in the medium, and the decision was made to use prepackaged medium from then on. Damping off occurs when pathogens attack young seedlings, causing dramatic loss of vigor and frequently, death. It is especially prevalent in damp conditions, and the addition of compost meant that the seedlings were often growing in wet soil that was host to a multitude of bacteria and pathogens. Presently, staff members use Pro Mix with mycorrhizae in order to promote strong primary root development. To further combat the spread of pathogens in the greenhouse, pots and trays are only used one time before they are set aside to be sanitized with bleach.

Current garden policy is to seed fairly heavily when starting seeds, and thin the plants perpetually as they grow. This ensures high germination percentages, and also lets garden staff hand pick the healthiest and most vigorous specimens. After several weeks of growth, a small amount of kelp meal is sprinkled into the soil around each plant. Kelp meal is an all-purpose fertilizer with a high potassium content. Not only is this an effective general-purpose amendment, the potassium helps with the seedlings' overall vigor, leading to healthier plants with a more rapid growth pattern. This is especially important for plants being grown in a greenhouse, as they are not able to photosynthesize as effectively as plants growing outdoors. It is at this point that cucurbits would be moved outside of the greenhouse to harden off. Hardening off is the process of leaving a plant in its cell tray, but moving it outside to acclimate it to the natural weather fluctuations. This ends up developing a hardier plant that is less susceptible to transplant shock. This is especially important when growing plants such as those in the cucurbit family that have only a short period of time in the greenhouse before being set out. Since cucurbits should not be left in the greenhouse for extended periods of time, they are typically moved outside to harden off after two or three weeks in the greenhouse. After a few days outside, they are ready to be transplanted. Most other plants in the greenhouse take much longer. Peppers, for example, are started around three months before staff is planning on transplanting them. Plants like these that are in the greenhouse for extended periods of time need to be periodically moved into larger containers. A plant in a cell tray is referred to as a "plug". Once a plant has become too large for a cell tray, it is moved into a small pot with a two inch diameter, predictably called a "two-inch". Most plants do not require any further pots, and are typically planted once they start outgrowing the two inch pot. In the event that a plant is not ready to be put in the ground, for example if tomato plants are being grown while there is still a danger of frost outside, it can be moved into a four-inch pot. However, these are only rarely used on SURF.

FIGURE 4. The greenhouse on SURF, inside and out. Note the automatic irrigation installed along the bottoms of the shelving unit. *Photo Credit: Erin Sanborn*



STUDENT INVOLVEMENT

The primary goal of this program is and always will be education. Garden staff has been devoted to planning and showcasing as many different growing techniques as possible. To date, students involved in the program have participated in activities centered around Native American growing techniques, drought-tolerant plants, arboriculture, vertical pallet gardening, greenhouse growing, hydroponics, seed-starting, viticulture, compost and vermiculture, and a huge variety of row crop production techniques.

The curriculum associated with SURF has evolved over time, along with the program. What started as an independent study program for students has transitioned into a semester-long course with regular meeting times planned out and led by the program coordinator. Since the majority of Redlands students are new to the idea of

sustainable farming, the curriculum for this course was designed with the intention of starting from the ground up, and fulfills the university's community service activities requirement. Students taking this course start the semester learning essentials such as heat and tool safety, soil prep, and transplanting. During the course of the class, new and more advanced techniques are introduced. Additional topics covered include tree pruning, and sustainable living seminars. Through visits to local farms and businesses, students are able to learn skills such as seed starting, row cropping, and animal husbandry from experienced local professionals. The students meet three times per week, and a sample week would include a short lecture (let's say the topic this week is arboriculture) and demonstration of fruit tree care and pruning on Monday, practical application at the farm on Wednesday, and a tree-centered service outreach project on Friday. To date, students involved in this class have helped grow food for local families, provide landscaping and garden care to several local nonprofits, helped afterschool programs and elementary schools construct educational gardening spaces, and help develop a healthy living space for senior citizens. For their final project, each student is expected to design a garden space of their own. There is a written component, typically three to five pages, as well as a practical component, where they need to represent their garden visually. Students are expected to demonstrate basic knowledge from throughout the course, and must take climate, weeds, scale, and other variables into account when designing their growing space.

The primary driving force of this program is its dedicated student employees. These undergraduate students are in charge of making compost, maintaining unique garden spaces, and managing volunteers. There are currently seven part-time student workers employed by the SURF program. These students are divided into two teams of two and one team of three tasked with maintaining the produce fields. These students work largely independently – there is a meeting every Monday to discuss the direction in which the week's labor is headed, but aside from that, students are often given a large amount of freedom in how they complete their assigned tasks. Each worker is responsible for ten hours of work each week, and many students that get hired end up staying with the program until they graduate. Not only is each work-study student expected to fulfill their daily tasks, they also assist the program coordinator with special projects, represent the program at festivals and presentations, and assist in directing and teaching farm volunteers.

ON-CAMPUS DINING

The on-campus dining at the University of Redlands is provided by Bon Appetit, already a company recognized for its sustainable food practices, such as a robust farm to fork program. Since the farm's inception, Bon Appetit's staff has been committed to supporting the program with fair and constant prices, and to keeping the food grown there within the university community. When the SURF program was still finding its footing, its produce was delivered to the kitchens roughly once a month, and totaled around fifty dollars each. These drop-offs consisted primarily of lettuce, kale, and other staple crops. Currently, produce is sold weekly, and raise roughly $100 per sale. Due to the increased student involvement, the program was able to diversify its crops considerably, and is now selling a wide variety of vegetables. Current produce includes melons, stone fruits, onions, tomatoes, and basil. In the 2014-2015 school year, students involved in the program were able to raise several thousand dollars, which was enough to finance all of the tools, seeds, and materials for a successful growing season solely based on produce sales. While the farm was never designed to be a

FIGURE 5. Students from the Outdoor Programs Club helping garden staff to pick strawberries and clear produce field II. *Photo Credit: Erin Sanborn*

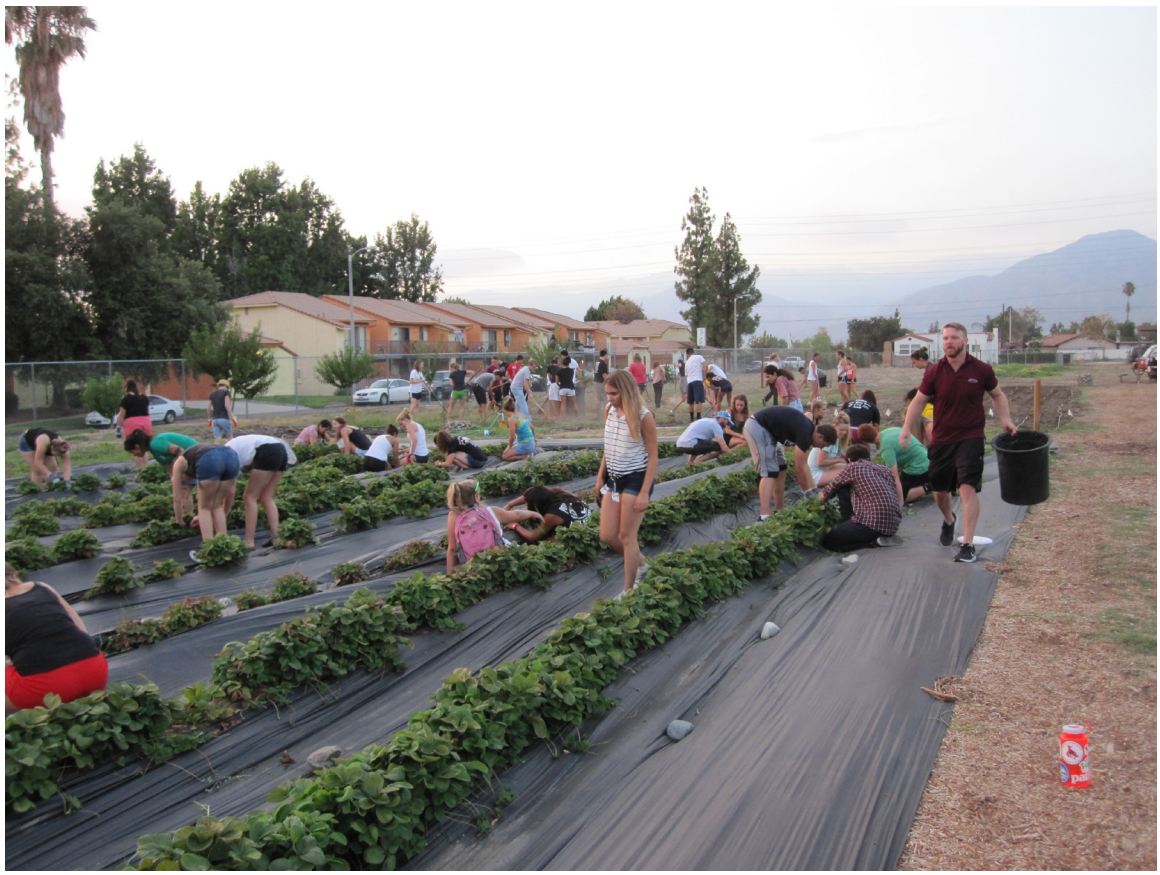


FIGURE 6. Farm produce being sold in the campus dining hall. *Photo Credit: Erin Sanborn*

moneymaking venture, this was the first time that produce sales were able to economically support the educational program. It is completely feasible that the farm will be able to stand on its own in years to come.

Produce sold to Bon Appetit often ends up in a wide variety of dishes. Typically leafy greens are chopped, mixed, and set out in the salad bar, while stone fruits and melons are sold whole in the student market. In 2014, Bon Appetit unveiled the SURF meal station in order to keep up with the increased volume of sales coming from the farm. This station is committed to providing a showcase of the fruits and vegetables grown on campus by Redlands students, as well as using ingredients purchased locally from farms and orchards in the surrounding area. The food is always vegetarian and frequently vegan, and the menu rotates daily.

COMPOST

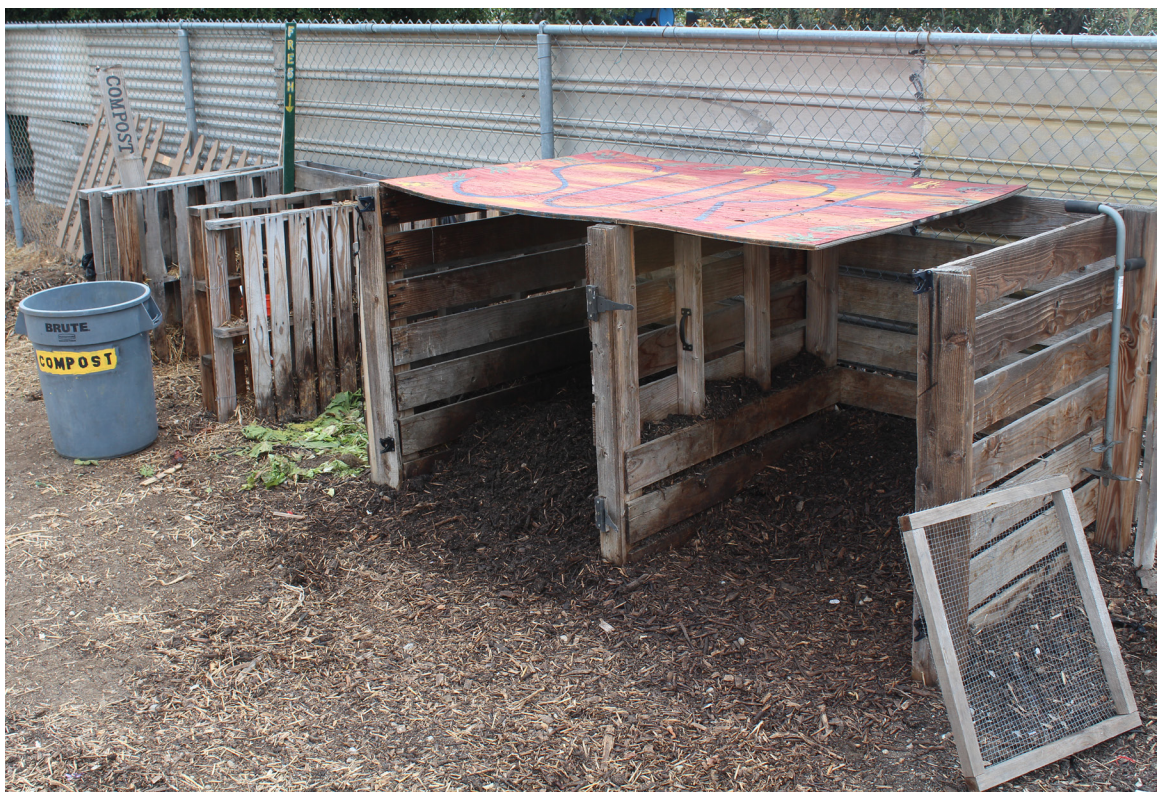
A huge part of the program's sustainability efforts centers around waste diversion. Garden staff works tirelessly to find items and resources around campus that are otherwise destined for the trash. The highlight of these efforts is the farm's compost system, which has evolved to a five-bin system constructed from reclaimed pallets. Two students work part-time as dedicated composters, and are able to pick up food waste from the university dining hall, as well as coffee grounds from the campus café. Currently, SURF is only able to compost pre-consumed food waste, but once the new vermiculture program is fully underway, staff will hopefully be able to collect and recycle post-consumed waste as well. All said, these students are able to divert between 75 and 100 gallons per week – equivalent to 834 pounds. Last year, student gardeners collected roughly 10,500 pounds of pre-consumed waste, and were able to distill that amount down into only 40 gallons of compost. This year, numbers are expected to increase, with the compost being further refined by feeding it through the worm bins before it is amended in to the produce fields.

Compost on SURF is broken down aerobically, meaning it is taken out of the bins and flipped twice weekly, before it is put back and covered with a tarp to minimize moisture loss from the intense sunlight. In the five-bin rotation that garden staff uses, the first bin is used primarily to store dead plant matter, or "browns" – this consists of any old plant matter pulled from the garden, but is mostly made up of hay that has been redirected from the manger display at the university's annual Christmas pageant. The second bin in the rotation is where new food waste is introduced. This element of the process is known as "greens", and consists of fresh plant and vegetable matter. Greens make up the majority of the compost, but it is essential to have browns in the proper ratio (roughly 30:1) to help stabilize the decomposition. The 30:1 ratio refers to the proper balance between carbon and nitrogen – carbon is provided primarily by dead, woody plant matter, where nitrogen is released as fresh, green vegetation decomposes. Each week, the pile of fresh compost is moved down to the next bin as it decays. In this fashion, by the time a pile of compost has been moved all the way down to the rightmost and final bin, it is almost ready to be used. This process typically takes about 5 weeks – a fairly rapid turnaround. Flipping the piles so frequently encourages rapid and vigorous growth in the populations of bacteria and microbes that break down the compost. As a side effect, heat is produced, and it is not unusual for the compost piles on the farm to remain upwards of 130 degrees for several days at a time.

Typically, after five to seven weeks of decomposition, the scraps have finished composting and are in a usable state. At this point, they are sifted through a screen to remove any large

particles such as fruit pits or hay, and are set aside for use as a soil amendment. They are incorporated into the garden differently depending on the current state of the vegetables growing in the produce fields. Empty rows get compost spread thinly on top and then mixed in, either once per season or every other season. If a row has not been amended in the recent past but is full of vegetables, the compost will be side dressed since the most valuable nutrients in it – nitrogen, most importantly – are also the most mobile.

FIGURE 7. The compost system on SURF, with a small amount of finished compost in the two closest bins. The compost is typically shaded to keep the piles from drying out. *Photo Credit: Erin Sanborn*



Worm Composting

Worm composting has been a recent addition to the program, but has proven to be very successful in only a short time period. The homemade vermiculture bin on SURF is populated with Egyptian red worms instead of earthworms, as the latter are prolific diggers, and often end up tunneling their way out of bins. Red worms, however, are generally poor diggers and are perfectly content to remain where they are so long as new food is continually introduced. The worms are currently housed in a bin measuring 3'x3'x4', with a plywood lid. The bin itself is unremarkable aside from a large wooden door set into the bottom of the front side. The program was started with only two pounds of worms, and while it is difficult to weigh the current contents of the bin, staff members estimate that the worms have reproduced at least tenfold. Under ideal conditions, worms should be able to produce one hundred times per year. Assuming one knows the best way to take care of worms, an impressive operation

can be established with only a minimal startup. To start, the worms are introduced into a bed of steer manure, unfinished compost, shredded newspaper and food scraps. On SURF, the worms are fed with scraps from the produce fields; vegetables that are unfit for sale, or fruit that has become too soft and rotten. The only limiting factor on what worms are able to eat is their numbers. Foods that spoil quickly, such as meats and bread products can only be fed to very large worm populations that are able to quickly eat and digest them. Otherwise, the rotting food will attract insects and other animals, which will inevitably end up preying on the worms. As the worms eat, digest what they have been given, and produce castings, the level of soil in the bin will naturally rise. When it is time for the worms to eat, new food is only introduced at the very surface of the pile. This is covered over with a fresh layer of damp, shredded newspaper to discourage flies or other insects from laying their eggs in the food. Once the contents of the bin reach a certain height, one can be assured that the bottom layers consist only of worm castings. It is at this point that the door in the bottom of the bin can be opened to retrieve the castings for use as soil amendments. Containers can also be laid underneath the bottom of the bin in order to collect the water that inevitably drips out. This nutrient rich liquid is called 'worm tea,' and can be used as a potent foliar fertilizer for plants.

Soil Fertility

While garden staff uses compost and worm casting that are produced on site as soil amendments, great care is also taken to maintain the fertility of the produce fields. The decision was made a year ago to stop mechanically tilling in the produce fields. Tilling with powered equipment tends to pulverize the soil rather than mixing it, causing severe compaction over time. Powdery soil is built up of smaller particles, meaning that it tends to clump when wet, as opposed to draining, and it is tougher for water and nutrients to percolate further than the first several inches of the soil strata. The ground on SURF is primarily made up of clay, meaning that the preexisting dirt particles are already quite small. Further decreasing the particle size can lead to formidable levels of compaction. One of the most important elements of fertile soil is the presence of small pockets of air. Microorganisms and worms in the soil need access to oxygen in order to live, and loose, fluffy soil ensures a plentiful population of beneficial organisms. In order to make clay soils more arable, they must be loosened rather than compressed.

Instead of tilling, students on SURF have been using a broadfork to loosen up the fields to prep for plantings. A broadfork is built like a large pitchfork with two handles. The tines are worked into the soil to a depth of about ten inches, and the tool is then pulled by the handles until it is level with the ground. This deeply aerates the soil without inverting the soil strata, as would happen with double-digging or rototilling. Students using the broadfork typically work while walking it backwards, so as not to step on the freshly loosened soil. While this is more work than rototilling, it has already proven its value in the produce fields. Repeatedly running heavy machines over the surface of the soil causes soil compression in layers below where the tines are able to cultivate. This hardpan (or tiller pan) is generally impermeable to water, nutrients, and plant roots. Using the broadfork, garden staff members were able to break up several years' worth of hardpan, causing the soil to soften dramatically over the fairly short time period of a year.

When first starting with this tool, students were instructed to use the broadfork to prepare the soil for each consecutive planting, but as the soil loosened, it has only become necessary once per season. For light cultivation, students instead use a wheel hoe. This is a tool

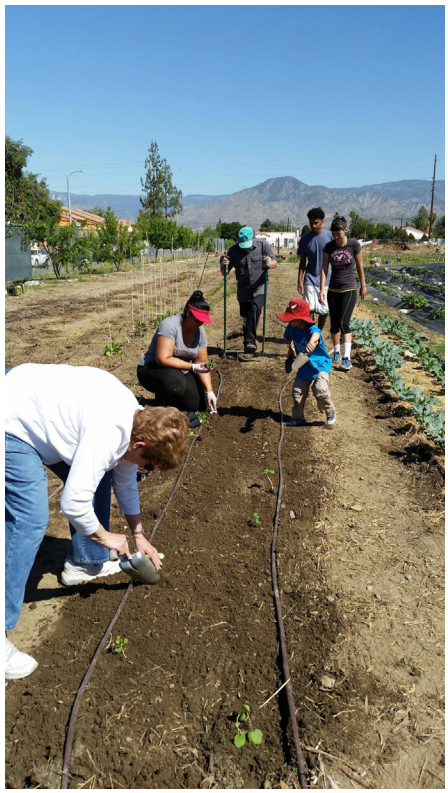


FIGURE 8. Community volunteers using the broadfork to prepare a bed for planting produce that will be donated to a local food bank. *Photo Credit: Malik Coburn*

that combines a long, sharp cultivating blade with a set of upright handles and is designed to cut plants off at the root below the soil. This is an excellent tool for upkeep, as one user is able to weed a standard 100 foot row of crops in roughly ten minutes. This tool is used frequently, as it is adept at clearing weeds and old plantings alike, while lightly cultivating the soil. It can even be used to mix in amendments. Assuming that the weeds in question are annuals that have not yet begun flowering, they can simply be left in the soil to decompose and further add to the organic matter content.

Once basic amendments have been mixed in, and general fertility has been established, occasional addition of compost and fairly frequent light cultivations has been enough to maintain fertility during the year. Over summer, however, SURF faces a problem unique to university farms – the students all leave. Furthermore, the university kitchens close for the summer, so the demand for produce dries up as well. From June until September, the program coordinator needs to be able to run the farm with little assistance. Because of this interruption, cover crops are sown in the produce fields over summer to increase ease of maintenance as well as restoring soil fertility. This year, a mixture of cowpeas and buckwheat is being used. Peas and beans have structures along their root systems that attract bacteria known as rhizobium. As these bacteria feed on atmospheric nitrogen, ammonia is produced as a byproduct, and then released into the soil. This converts atmospheric nitrogen into a much more plant-soluble form, and leaves it in the soil as a resource for future plantings. These cover crops need to be cut down periodically to ensure that they do not flower. If the plants are allowed to flower, they will obviously produce seed and reseed themselves, but that is not the only reason they are mowed under. If the plants are allowed to flower and then fruit, they will end up consuming more nitrogen than is added back into the soil by the rhizobium.

Waste Diversion

In addition to using kitchen waste to fertilize the crops, the farm has several other notable waste diversion programs. All of the pathways have been covered over in a process known as sheet mulching. Large pieces of cardboard packaging salvaged from various departments across campus are laid end-to-end over the tops of pathways, and are subsequently covered over by a four to six inch layer of mulch collected from local tree-trimming businesses. For two years, the SURF program has been allowing a local tree-trimming business to dump the contents of their chippers on the property. This ensures a constant flow of high-quality mulch for the farm, as well as saving the business' trucks the half-hour drive and $70 dumping fee to take it to a nearby landfill.

As an organically practicing garden, there are no pesticides used on the pathways or fields in SURF, meaning that weeds are a constant presence. Applying a four to six inch layer of mulch goes a long way towards preventing persistent perennial weeds growing along the pathways by adequately depriving them of light and oxygen. Additionally, due to the preponderance of ornamental Eucalyptus trees in the surrounding area, a large majority of the mulch delivered consists of the leaves and branches of Eucalyptus trees. Eucalyptus oil is a natural herbicide, and shredding the trees in such a manner ensures that the oil permeates throughout the piles. This helps even more in weed suppression, although great care does need to be taken to keep Eucalyptus oil off of established plants.

Irrigation

Irrigation is arguably the most important part of any garden infrastructure, and the SURF garden uses drip irrigation exclusively. The basic infrastructure is constructed of PVC, but the systems transition to dripline in the areas of production. It is preferred for several reasons, chief being ease of use. All of the elements of a drip system come in standard sizes – either one half or one quarter of an inch. All of the parts are completely modular, and are designed to be used and reused rather than being discarded after a single season. Another reason that drip is preferred is its versatility. Systems can be purpose-built to provide exactly what each specific plant needs. Drought-tolerant natives are given .5 gallon per hour drip heads, whereas trees are able to make use of much higher-flow 10 gallon per hour micro sprinklers. Even the greenhouse on site has driplines running along the bottoms of the shelves, which are able to deliver all of the water the seedlings need with roughly 30 seconds of watering per day.

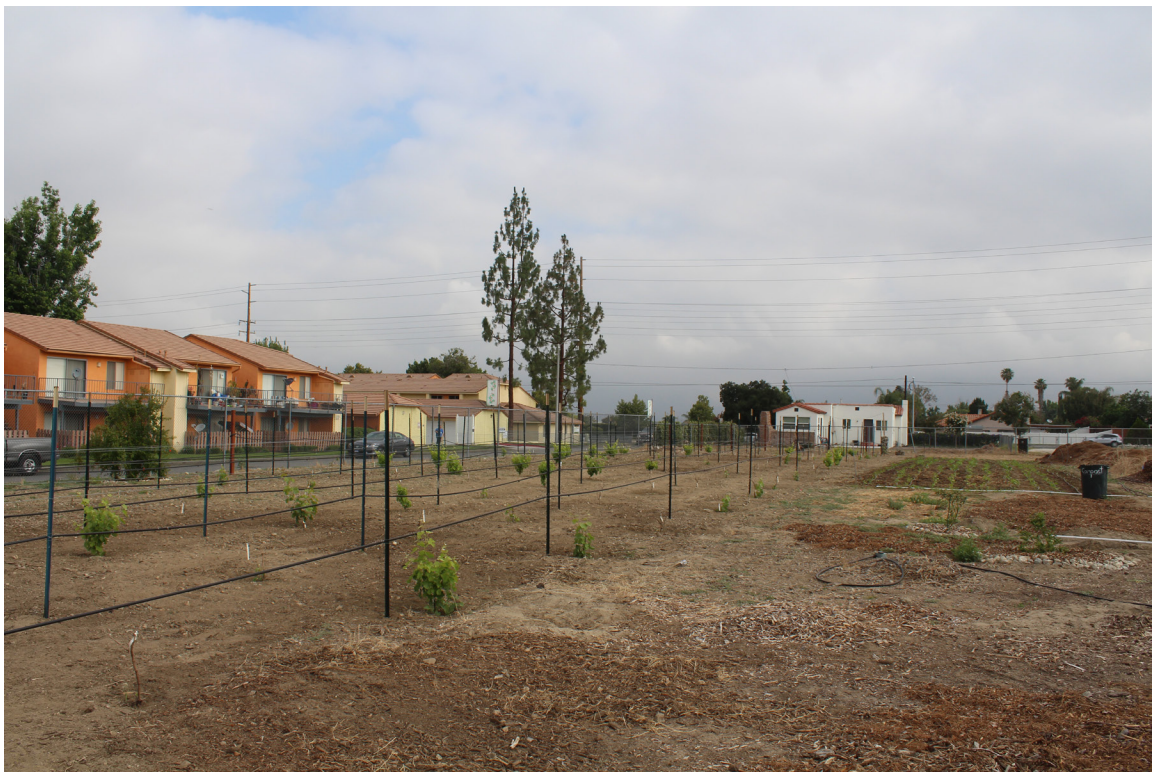
Vineyard

In May of 2014, after submission of a proposal by a group of students at the Redlands School of Business, ground was broken on an eight-row vineyard. The students had been assigned a project wherein they were expected to submit a proposal for a program for the betterment of the university community. Working together with the farm manager, the group set forth a five-year plan for the program, starting with a complete list of materials and up-front costs, and concluding with a proposed partnership with a local winery, who agreed to assist in the bottling and aging of the wine at cost. Student volunteers began working to clear the land for the proposed vineyard, as well as driving support posts and digging holes to plant the vines. This May, the first phase of the project was completed.

The vineyard occupies roughly a third of an acre, and consists of 7 150' rows, and one truncated 110' row. The end support posts are 8' 4'x4's, sunken to a depth of two feet. 7' metal stakes have been driven along the rows with a distance of 10' in between each. High-tensile

steel wire has been fed through the endposts and then lashed to each of the metal stakes in turn, to provide a set of three wires for the vines to grow along in an espaliered pattern. The irrigation has been strung parallel to the bottom wire, and was constructed onsite. Garden staff designed a belowground ¾" PVC system which feeds into 2' risers before transitioning to ½" dripline. ½ GPH drippers were installed above each of the 150 vines to provide a long, narrow watering cone – ideal for encouraging robust primary root growth. After about a year, the emitters will be moved further away from the established plants, this time to encourage secondary root development.

FIGURE 9. The vineyard on SURF. Note produce field three in the background, with a summer planting of squash and melons. *Photo Credit: Erin Sanborn*



LOOKING TO THE FUTURE

Gardening staff is currently developing a partnership with the special education division of the Arrowhead Christian Academy, and is on track to have a full program laid out by fall of 2015. One of the Environmental Studies professors has been bringing her uniquely-abled son and a close friend to the garden every week, where they work alongside staff and volunteers learning a variety of sustainable farming techniques. So far, the pair has had experience preparing soil beds, sowing and subsequently thinning seeds, as well as general farm upkeep. The pilot program has fared well, with the two boys learning the basic elements of sustainable gardening, building relationships with garden staff, and taking ownership over certain elements of the garden.

The final incarnation of the program would involve the Academy students taking the bus from school to the garden, which will help teach them valuable lessons about getting around,

in addition to putting them where they need to be. There will be a twenty foot by twenty foot area devoted to this program, where the Academy students would learn about basic crop rotation, and get experience growing a variety of different vegetables. In order to fulfill the community service requirements of their program, they would also assist garden staff in maintaining the dedicated Redlands Family Services plot on site.

There are also plans to better develop naturally-existing predator and prey relationships on SURF. A key element of sustainable farming is fostering effective natural predator and beneficial insect populations. In the coming years, a special focus is going to be put on growing flowers and other native plants in order to attract and build a strong population of beneficial insects. Several raised beds near the front of the farm have been dedicated to this purpose, as well as large portions of the Zuni Waffle garden, California Natives garden, and small areas adjacent to the two produce fields. There are also plans to introduce a relocation hive in order to attract a small population of bees to aid in crop pollination. A university student also volunteered his time to construct a pair of bat roosts designed to be hung around the farm. There is already a sizable bat population in the Redlands area, and the animals are able to consume one third to half of their weight in insects each night. Being able to house several of them on site would ensure a dedicated source of insect control.

A student recently finished building a small chicken coop on the farm, and the program is expected to take on several chickens in the coming school year. The coop is designed to comfortably house five birds, with the intention being to teach students practical animal husbandry skills, while providing a small number of eggs for them to take home. There is a 6' by 3' wire run in addition to the roost, and chickens will be periodically let out to scavenge for insects and weeds seeds in the produce fields. Chicken manure is also quite high in a variety of nutrients, and will be an effective addition to the composting program. Garden staff has been researching chicken breeds, and it is expected that the coop will be populated with Buff Orpington chickens. This is an even-tempered breed renowned for both its egg-laying capabilities and its heat tolerance.

Construction was also recently finished on a third full-size produce field, which is currently being planted with a summer crop of cucurbits. This area is designed to be used as a summer produce field as well as a staging area for new projects and ventures, such as a potato field or a pumpkin patch.

In conclusion, the SURF garden is a constantly changing program. The students and staff have been able to accomplish a large amount in only five short years, and there is no intention of losing momentum in years to come.