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A Guide to the Pomona College Organic Farm: An Introduction to the Farm's History and Basic Gardening Skills and Techniques

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Introductory Note – A Practical Approach to the Senior Thesis

It was almost four years ago when I first visited the Pomona College Organic Farm during a campus visit in my senior year of high school. From that moment on, I began learning about how the Farm works – from the basics of gardening to the complex steps required to organize students for events and activities. As I learned more and saw so many students come and go, I saw a need for written documentation that would allow future generations of students to benefit from the skills that my peers and I have learned in our time at the Farm. The value of the Farm is grounded in having a vibrant physical space, and right now the knowledge to maintain and improve this space is only passed down from person to person. While this is how I and many others have learned everything we know about the Farm, I hope to eventually combine the disparate bits of knowledge that I have accumulated over the years into a single guidebook. This thesis project, which is the first major section of that guidebook, covers the Farm's history and basic technical skills like soil preparation, planting, plant maintenance, weeding, pest control, and tool use.

In terms of an Environmental Analysis (EA) senior thesis, this guidebook project is quite unusual in that it is inherently practical in nature rather than based in theory. At first, I was concerned about the value of a practical approach to the senior EA thesis and if that had the same merit as the more typical theoretical approach. In general, academics at Pomona College encourages and favors the theoretical approach for its value in developing a student's analytical perspective on important issues. While I do value this skill, I have also found that creating a guidebook that is both detailed and accessible is an intellectual challenge. For the history section, I combined the widely varying oral and written accounts

of over a decade of history into one cohesive story, working through dozens of discrepancies. I have also had to translate years of gardening knowledge gained through personal experience and research into text that someone with no prior gardening experience can easily understand. Just as a theoretical thesis helps students with analytical writing, writing this guidebook has helped me to develop a practical writing style, which has its own merits.

But the true value of this project, its practical value as a training manual for students, faculty, staff, and others, will certainly be realized over the coming years. Copies of the completed document will be left in accessible locations at the Farm and online so that anyone can reference it when they have questions. Further sections of this guidebook will go beyond technical gardening skills to discuss the people aspect of the Farm – how the student Farm Club operates, the ideal role of a Farm Manager, and the steps required to ensure that chickens at the Farm are sanctioned by the Biology department. However, it is important to note that this is a living document and as such it will never be "finished," just constantly updated as the Farm changes and grows and as new information comes to light. Although the Farm has come a long way over the years, it still has a lot of unrealized potential, and I hope that this document both facilitates and records the great changes that are soon to come.

Acknowledgments

First and foremost, I would like to thank Professors Richard Hazlett and Char Miller for advising me through this entire process. I am especially grateful to them for their care and understanding as I worked through some medical issues in the first half of the

semester. I would also like to thank Juan Araya and all of the students, faculty, staff, and community members that I have learned from over the past few years at the Farm. They have taught me almost everything that I know about farming and gardening. Thanks also to Professor Richard Worthington and Geordie Schuurman for assistance in reconstructing an accurate history of the Farm. Lastly, thank you to my fellow Farm Leaders, friends, and family for your love and support for me and my work on this project.

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INTRODUCTION

History of the Farm

The Pomona College Organic Farm (the Farm) is located at the southern end of what is commonly known as "The Wash," a low area which was a natural drainage for water from floods. The Coast Live Oaks that populate The Wash today likely have grown there for hundreds of years, their limbs providing shade and acorns food for the Serrano people who used to populate this region. Spanish settlers in early 1800s forced the Serrano people off their lands, and all had left by the mid-1880s, around the time that Pomona College was founded. Since the early days of the college, The Wash was a favorite spot for "picnics and

Figure 1: Blanchard Park (The Wash) in 1946. *Special Collections, Honnold/Mudd Library of the Claremont Colleges.*

other activities,"[1] and so in 1905 trustee Nathan Blanchard provided the funds to purchase and set aside the 40 acres as a live oak preserve. Only 10 acres of that land remains untouched today, and the rest has developed for other uses such as playing fields, buildings, and other infrastructure.

Farm Beginnings

One part of The Wash, an open area used as a gravel pit and trash dump, caught the eye of a few Pomona College students in the late 1990s. In the fall of 1998, they began using The Wash as a site for spreading composted food scraps from the dining halls as part of the student initiated Compost Club. The Farm was eventually born in the spring of 1999 when these students shaped the accumulated soil and compost into a few beds. Although very little survived this first summer at the Farm, students came back in the fall of 1999 inspired to continue work, and they planted more vegetables and founded the original Associated Students of Pomona College (ASPC) "Gorilla Farming Club" (for a copy of the club's original constitution and bylaws, see page 104 in the Appendices). Students, faculty, staff, and community members spent countless hours every day during this first year removing trash and rocks, building up the soil with compost and nitrogen-fixing clover, and maintaining vegetable plots. Starting in the spring of 2000, a wide variety of fruit trees were planted across the Farm and enough produce was grown to donate to local food banks.

During these early years, the Farm was still run almost entirely by students and community members as largely uncontrolled grassroots effort. Soon, however, the college took the first steps to officially recognize the existence of the Farm and provide guidelines

[1] http://www.pomona.edu/about/pomoniana/the-wash.aspx., last accessed November 21st, 2012.

for its use. In the early 2000s, the Dean of Students Office created a student-faculty committee to set basic rules for temporary use of the Farm. The rules they developed, such as no planting under oak trees, no fires, and no illegal activity have been adapted and are still in use today (see the Community Member Farm Pass Documents section on page 101 of the Appendices for a copy of the current rules). However, some students disregarded these rules and built fire pits, planted in restricted areas, and used the Farm as a site for illegal activity, which fostered a distrusting relationship between the early Farm students and the administration at the time. At the same time, there were a few students who worked hard to keep the Farm looking neat and attractive and were influential in healing the negative feelings that characterized the early relationship between the Farm and the administration.

Figure 2: Dedicated to keeping the Farm looking presentable, Severine von Tscharner Fleming '04 is seen here weeding a plot at the Farm in 2003.

Academic Involvement and the Earth Dome

There were several successful early efforts to connect the Farm with academics at the college. In the fall of 2001, a student organized 19 others for an independent study class with Professor Rick Worthington about green architecture, which was later titled "The Politics of Community Design." Since 2001, this class has been taught 7 or 8 times, along with other classes such as "The Politics of Food and Agriculture," The Politics of Water," The Politics of Environmental Activism," and "Environmental Studies," which often included projects at the Farm. Not only did these classes use the Farm as a real-world laboratory for class topics, they also designed and implemented a wide variety of sustainability related projects inspired by research and field trips.

One such visit to The California Institute of Earth Art and Architecture (Cal-Earth) in Hesperia, California in late 2001 exposed students to architect Nader Khalili's "superadobe" structures. These structures are permanent, earth-based buildings constructed by filling long fabric tubes with dirt, stacking these coils into walls, arches, and domes, and then covering the surface with plaster. Farm students were inspired by one of Mr. Kahlili's earthen dome designs and made an initial proposal to construct what they called an "Earth Dome" at the Farm. Many reasons have been given for the value of constructing such a feature. Primarily, the Earth Dome was intended as a way to further the Farm's ability to be model of an earth-based sustainable homestead and provide students and others hands-on experience with natural construction techniques, in addition to providing a space those at the Farm could use for meetings, storage, and other activities. But another goal was that Earth Dome would serve as permanent feature at the Farm that would discourage the land from being put to alternate use.

This first dome project started during the spring and summer of 2002 with funding from Ronald Lee Fleming '63, father of active Farm student Severine von Tscharner Fleming '04. The students intended the dome to be small enough that it would not need a building permit, per square footage and human occupancy limitations set by the City of Claremont. While some maintain the structure complied with these regulations, others have noted that the first dome was pushing the limitations provided by the city. As a result, the dome was fenced off before classes in the fall of 2002 and then destroyed by the college due to the concerns that it was against code.

The second Earth Dome, which survives to this day, was started in April 2003 with a proposal to the City of Claremont Architectural Commission, which was approved in early 2004. Peter Stanley, President of Pomona College at the time, generously allocated $10,000 for the Earth Dome and a donation from Mr. Fleming covered the rest of the cost for this larger scale, city-permitted project. Work on concrete and rebar foundation began in the summer of 2004 by students Joseph Prows and Geordie Schuurman and Professor Worthington. After period of limited student involvement at the Farm in the fall of 2004, the remainder of the Earth Dome was constructed during the spring of 2005 by students in Professor Worthington's class, a class from Pitzer College, and dozens of volunteers from the colleges and the wider community. Work on filling and stacking long bags with dirt began on February 16th, and this step was finished in just under three months on the day before graduation. Over the summer of 2005, wire mesh and rebar was installed around the stacked bags and a first layer of gunite was applied (see Figure 3). Later that fall, a final gunite was added to finish the Earth Dome in accordance with building codes. Later improvements such as surface plastering, drainage trenches, a hand-carved door, hand-

Figure 3: The second Earth Dome at the Pomona College Organic Farm in July 2005. Note the tubes of soil, the rebar and wire mesh, and the first layer of gunite on the bottom half of the structure. *http://en.wikipedia.org/wiki/File:Front_of_dome.jpg.*

painted interior art, and a concrete floor were developed and implemented over the course of many years and not finally completed until 2011.

"Save the Farm" Movement

Although Pomona College was supportive of the second Earth Dome project, there were still numerous tensions between Farm supporters and the college's administrators in the mid-2000s. Some lingering concerns about the safety of activities conducted at the Farm were raised by the Dean of Students at the time, Anne Quinley, who was not generally supportive of the Farm. Additionally, as the students responsible for the initial push to

create the Farm began to graduate, volunteer student participation waned in what was still a largely student-run, guerilla operation. Wishing to expand and formalize the Farm's boundaries, a group of professors met with President David Oxtoby and other college administrators and grounds supervisors at the Farm in December 2005. To their surprise, the administrators indicated that the master plan of the college had actually designated parts of the Farm for other uses, but they agreed to postpone any final decisions until students returned in the spring.

This group of professors also proposed allocating a new space for Professor Hazlett's first Farms and Gardens class which was being offered during the upcoming spring semester. This new space, originally known as the "Experimental Field" or the "Academic Field," was a mostly empty plot of land on the far side of a hammer throw field to the east of the original Farm site (see the Maps sections on page 82 of the Appendices), amongst a few oak and sycamore trees and a fruit grove surreptitiously planted by students in 2004. Additionally, current Vice President and Dean of the College Gary Kates, agreed to provide temporary funding, at Professor Hazlett's request, for a part-time Farm technician to manage the Experimental Field and assist in the instruction of the Farms and Gardens class. Juan Araya was hired for this position in January and rehired on the official payroll at the start of the new budget cycle in July of 2006.

A meeting with students, faculty, and administrators in January 2006 ended with the understanding that the original Farm boundaries would be maintained and space would be allocated for Professor Hazlett's course. To confirm, professor Worthington sent a follow up e-mail to President Oxtoby in mid-February but was surprised hear that a differing

proposal was soon to be submitted to the Board of Trustees. This alternate proposal would have demolished everything except for what was within a 20 foot radius of the new Earth Dome. It was even rumored that the physical relocation of the Earth Dome and fruit trees was at one point an option on the table as well. When students learned of this plan, they were understandably upset, and the "Save the Farm" movement was born. Students quickly organized a meeting with President Oxtoby to request that the Board of Trustees postpone a vote on the alternate proposal until their next meeting in May 2006, and the President agreed.

After this accomplishment, Farm students mobilized to design a flyer, contact alumni, paint Walker Wall, make posters, get petition signatures, and do anything they could to teach others about the value of the Farm and get support to save it from development. The efforts of the first Farms and Gardens class, consisting of 43 students who received cultivation instruction at the original Farm site, tilled the first plots in Experimental Field (see Figure 4), and installed a new shed, also played an important role in showing the administration the importance of the Farm. A core group of Farm students, as well as many in Professor Worthington's "Politics of Community Design" class, also began work on a proposal that President Oxtoby had requested as a way to begin official dialogue between students and faculty about the future of the Farm. Hundreds of students, community members, staff, and faculty came out in support of the Farm, with dozens writing the administration with letters of support and almost 900 signing a petition. Finally, in response to student pressure and a faculty letter of support, President Oxtoby formally agreed to support the preservation of the Farm in early April.

Figure 4: Students shaping beds after tilling the soil in the new experimental field for the first time in the spring of 2006.

The students' proposal, which hoped to formalize the Farm's original boundaries and management protocol, was submitted to President Oxtoby on April 11th, 2006 and mistakenly rejected as an attempt to enlarge the original Farm site. Soon after, however, a faculty and staff committee was formed to incorporate suggestions from the student proposal into a unified proposal submitted to the Board of Trustees on May 13th. This proposal was accepted and the boundaries set remain in place today. Although the Environmental Analysis (EA) program was never formally appointed to oversee the Farm, because of the Farm's inherent connection with the, EA faculty's support for the Save the Farm movement, and the new Farms and Gardens class, EA began to provide financial and

operational support for the Farm at this time as well. This top-down support was intended to be solely for class operations in the Experimental Field, but oversight often spread to the original Farm site as well. Even today, the role of student versus EA oversight of the Farm continues to evolve.

Overall, the Save the Farm movement was a key turning point in the history of the Farm, a significant and "very diplomatic"[2] effort by students, faculty, and others to save a valuable and unique educational resource at Pomona College. While this effort to formalize boundaries and rules for the Farm was necessary to save it from development, this recognition ironically changed the very nature of the Farm, as it was no longer a purely student-run, grassroots operation. However, as was eloquently put by an anonymous author who contributed to a 2006 Farm Anthology, "What matters most is that the Farm continues to serve as an example of sustainable agriculture, spark new ideas and ways of thinking, foster creative energy, inspire people to seek alternative solution, and be a reminder of hope."

The Farm Today

Today, this vision lives on but in a different form. The first garden site, now known as the "West Farm," is a .60 acre site occupied by the original trees and plots, the Earth Dome and Farm library, a tool shed, the Outdoor Classroom (originally built in 2006), a chicken coop (originally completed in 2008 and then expanded in 2011), and a composting toilet. Students, faculty, staff, and their families can check out a plot on the West Side for free to grow their own produce with seeds, water, and tools provided by the college. The

[2] Richard Worthington, personal communication, 2012.

Figure 6: The first Outdoor Classroom framework during construction in 2006.

Figure 5: The original chicken coop after its completion in 2008.

Experimental Field, which was continually expanded and improved since the first Farms and Gardens class in 2006, is now a .46 acre section of the Farm known as the "East Farm." This area continues to host what is now the very popular "Food, Land, and Environment" class as well being the site for the dining hall food scrap composting system, a greenhouse, beehives, a fruit tree grove, and production-oriented row crops. Due to repeated tool theft, totaling in the tens of thousands of dollars, cargo containers are now used store tools, equipment, and other supplies on the East Farm.

As of late 2012, the Farm is managed by Farm Manager Juan Araya, several students employed under work-study, and nine volunteer student Farm Leaders of the current ASPC Organic Farm Club (Farm Club), collectively known as Farm Staff. Although there is ambiguity about who oversees which aspects of the Farm, generally, the Farm Manager and employees oversee day-to-day operations, including composting, irrigation, planting, and other repairs and maintenance, primarily on the East Farm. Accordingly, Farm Leaders and the general student body are mostly responsible for overseeing student-led initiatives on the West Farm and planning events, speakers, workshops, activities, field trips, Farm Stands, and other forms of outreach about the Farm. Countless other students, faculty, staff, and community members from all backgrounds visit and help out at the Farm with daily chores, special workshops, artistic pieces, celebratory events, and musical performances. Many more come to the Farm just to walk around, hang out, relax, or do homework.

An average afternoon for an employee or volunteer at the Farm might consist of watering student plots, mixing fruit scraps with mulch in the compost pile, weeding a row of crops, preparing a bed, or planting a plot with seedlings from the greenhouse. Other

projects and activities are worked on only as needed, such as repairing the chicken coop, replanting the strawberry beds, and organizing the tool shed. Special activities are also frequent, with many scheduled workshops, parties, Farm Stands, field trips, and speakers each semester. Workshop topics range from soil preparation at the beginning of the semester to more advanced gardening techniques later on, and sometimes include guest lecturers who lead activities about permaculture, insect ecology, or flint knapping. Past field trips have visited various local farms (including some owned by alumni), the Cal-Earth Institute, and other local college farms.

While students, faculty, and staff of any of the seven schools in the Claremont University Consortium are free to enjoy the Farm at any time during daylight hours, the role and involvement of community members has always been an issue of debate, especially in recent years. In the early days of the Farm, community members were vitally important to the construction and maintenance of the basic infrastructure, often the sole caretakers of the trees and plants while students were away in the summer. However, problems with theft, vandalism, and homeless persons caused the administration and the Farm Manager to adopt a less friendly stance towards community involvement, which some believe simply fostered further vandalism. At the very least, this negative attitude caused a drastic decline in community member involvement at the Farm and many community members feel unwelcome at the Farm even today.

More recently, further vandalism, negative interactions between students and certain community members, and unclear guidelines for the extent to which community members can participate in Farm activities prompted a discussion to review protocols of

community member involvement. In late 2011, an outdated Farm Pass system was upgraded to include an application form, Farm rules, and community member guidelines and these documents were approved by deans in the Office of Campus Life in early 2012. A detailed description of the Community Member Farm Pass system, including copies of the documents, can be found on page 101 in the Appendices. Farm students have been slowly working to make amends and foster a mutually beneficial where community members and Farm students can learn from each other at the Farm.

Indeed, involvement with the Claremont community has increased in recent years due to these changes. A few community members have received Farm Passes and are regularly involved in Farm activities. In addition, dozens of tours have been given to visiting speakers such as Van Jones, Bill McKibben, and Mark Winne, high school college counselors from around the country, parents, alums, and others. The Farm often hosts field trips held for other nearby colleges and universities, neighboring elementary schools, and other local organizations, educating college students about the challenges and successes at the Farm and letting younger children learn about plants, composting, gardening, and healthy eating by touching, smelling, and tasting their way around the Farm. In addition to sharing gardening knowledge with others, this gives Farm students practical experience with environmental education.

Although much has changed in the 13 years since the Farm was created, the spirit of the space remains largely the same. Today, the Farm is the physical foundation of the Environmental Analysis department but also a resource for a wide range of other academic disciplines. However, students from across the Claremont Colleges come to the Farm not

only to learn about sustainable agriculture, but also to enjoy being in the outdoors away and from the rigor of campus life. Coming to the Farm and weeding a plot for an hour will dirty hands and clear minds just as much as it did for the first Farm students in the late 1990s. More than anything, the Farm is a space to grow people through mutual learning and a shared responsibility for a small but significant patch of land.

Regional Climate

The Farm is located in Claremont, California, about 30 miles east of Los Angeles and 3 miles south of the foothills of the San Gabriel Mountains. While often mistaken for having a desert-like climate, Claremont's weather is actually more similar to a Mediterranean climate, with 17.1 inches of rain per year and temperatures commonly ranging between 40 and 100 degrees Fahrenheit, with an average of 63 degrees. At 1,200 feet above sea level, it rarely freezes at the Farm, which allows for year-round production of a wide range of edible crops including tropical fruits such as bananas, guavas, and avocados. However, not all crops will grow well during the winter in Claremont, and, similarly, some plants will not grow well in the warm season (see the Crop Maintenance section on page 57). Additionally, the fairly low annual rainfall and near constant dry air in this region imposes certain limitations on crop growth at the Farm.

The rainy season in Southern California occurs during the winter months, with average rainfall totals of over 2 inches occurring from December to March. February in Claremont sees the most rain, with an average of 4.76 inches. It almost never rains during the summer months, from June through August, with an average rainfall of just .12 inches

for all three months combined. This means that the Farm must rely heavily on irrigation during the summer and during times that do not receive regular rainfall (see the General Growing Conditions discussion on page 54). Rain in Claremont is often quite erratic. In the fall, it is not uncommon to go weeks without a drop of rain, but sometimes in the winter or early spring it can rain straight through an entire week.

Temperature trends are similar to rain and often equally unpredictable. The winter cool season sees average high temperatures in the upper 60s and low 70s, with lows in the mid-40s. Summer is predictably hot and dry, but temperatures can range from the low 80s to over 100 degrees over the course of even just one week. Even on very hot days, the dry air usually cools down to a comfortable temperature at night. Typically, August is the warmest month of the year, with an average high temperature of 92 degrees and December is the coldest, with an average low of 42 degrees and an average high of 68 degrees. Beginning in October, cold fronts can cause drastic temperature swings, with days of 100 degree heat immediately followed by night time lows in the 40s.

One method of characterizing climate in terms of growing conditions for crops is by using hardiness zone maps published by the Agricultural Research Service (ARS) of the United States Department of Agriculture (USDA). These maps are color-coded to show the average annual minimum winter temperature, which the USDA claims is a "standard by which gardeners and growers can determine which plants are most likely to thrive at a location."[3] According to the 2012 Hardiness Zone map published the ARS, based on data from 1976–2005, the Farm is located in both Zone 9b and Zone 10a, which would imply

[3] http://planthardiness.ars.usda.gov/PHZMWeb/About.aspx, last accessed December 7th, 2012.

minimum winter temperatures of 25-35 degrees Fahrenheit (see Figure 7). While this map can be used as a general guide, it cannot predict cold snaps or heat waves which can hurt plants. Information regarding which plants can be grown in these zones is in the Crop Maintenance section on page 57).

Figure 7. USDA/ARS map showing plant hardiness zones in Southern California. *Adapted from http://planthardiness.ars.usda.gov/PHZMWeb/Images/72DPI/ca_s.jpg*

References and Further Reading

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9. http://www.weather.com/weather/wxclimatology/monthly/91711, last accessed December 7th, 2012.
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11. http://www.ci.claremont.ca.us/ps.cityprofile.cfm?ID=1703, last accessed December 7th, 2012.

SOIL

The soil which anchors the roots of every plant at the Pomona College Organic Farm contains six components: sediments and rocks deposited by floods from the mountains, water, air, organic matter from local trees and plants, microorganisms and other soil fauna, and anthropogenic additions such as compost, soil mixes, contaminants, and trash. Soil's primary purpose is as a medium for plant growth, and healthy soil serves to stabilize plant roots and provide water, air, and nutrients to a plant through its roots. For a soil-based agriculture system such as the one employed at the Farm, it is essential to understand the entire soil system in order to maximize the benefits the soil can provide to the cultivated plants. The original sediments are the foundation, dissolved minerals from sediments and organic materials provide nutrients to plants, and the soil biology cycles these nutrients around and confers other benefits to the plants. However, some soil organisms can also pose a threat to plants (and humans), and other forms of anthropogenic additions to the soil such as heavy metals and trash can cause problems as well. In this section, each aspect of the soil at the Farm will be discussed in depth so that you can make informed decisions about the care to provide to your plot.

Basic Characteristics of Soil

The key components of soil are rock and mineral particles (in varying sizes), organic materials (at various stages of decay), water, and air. Ideally, farming soil is "45% minerals, 5% organic matter, and 50% space" which is filled with a variable combination of water

and air.[4] The inorganic particles can be as large as boulders or as small as microscopic clay grains that have been weathered from larger rocks over thousands of years. The organic component of soil consists of fresh materials like leaves, grass, and sticks, partially decomposed organic matter, and more stable humus which has already undergone significant decomposition, often added as *compost* (see page 37). Water and air are found in varying amounts depending on the recent weather conditions, soil porosity, soil drainage, and other factors. More water in a soil means less air, but a balance of both is necessary because plants need water and plant roots require oxygen from the air. Soils can be classified in many ways, including by chemical and physical composition, texture, and structure.

Composition and Texture

Small mineral particles make up the largest part of most soils and consist primarily of quartz, feldspar, and mica (the three components of a typical granite). These particles are often characterized by their average diameter, known as *grain size*. Over time, the larger rocks and pebbles break down into smaller particles characterized by three primary grain sizes: sand (.05 – 2 mm in diameter), silt (.002 - .05 mm in diameter), and clay (<.002 mm in diameter). The texture classification of a soil looks at relative proportions of these three parts (see Figure 8). In terms of inorganic components (minerals), a healthy soil falls in the loam category, which is about 40% sand, 40% silt, and 20% clay. While larger components like rocks, small stones, and pebbles are common in many soils, they are largely inert (thus playing no role in soil fertility) and have little effect on farm and garden

[4] Stephen R. Gliessman, *Agroecology: Ecological Processes in Sustainable Agriculture*, CRC Press LLC, Boca Raton, FL, 2000, pg. 99.

soils other than being a nuisance. Sand, however, serves as a framework and structure for a soil, keeping it loose, permeable, and porous enough to allow proper water and air content. Silt holds water in a soil, much of which is available for plants to use. While too much clay can decrease soil permeability and make it difficult for roots to grow and water to percolate and drain, clay is necessary for soil nutrition and to bind soil particles together.

Indeed, clay is the most important inorganic component for soil fertility because they contain a readily available source of nutrients. Hydrogen ions from slightly acidic

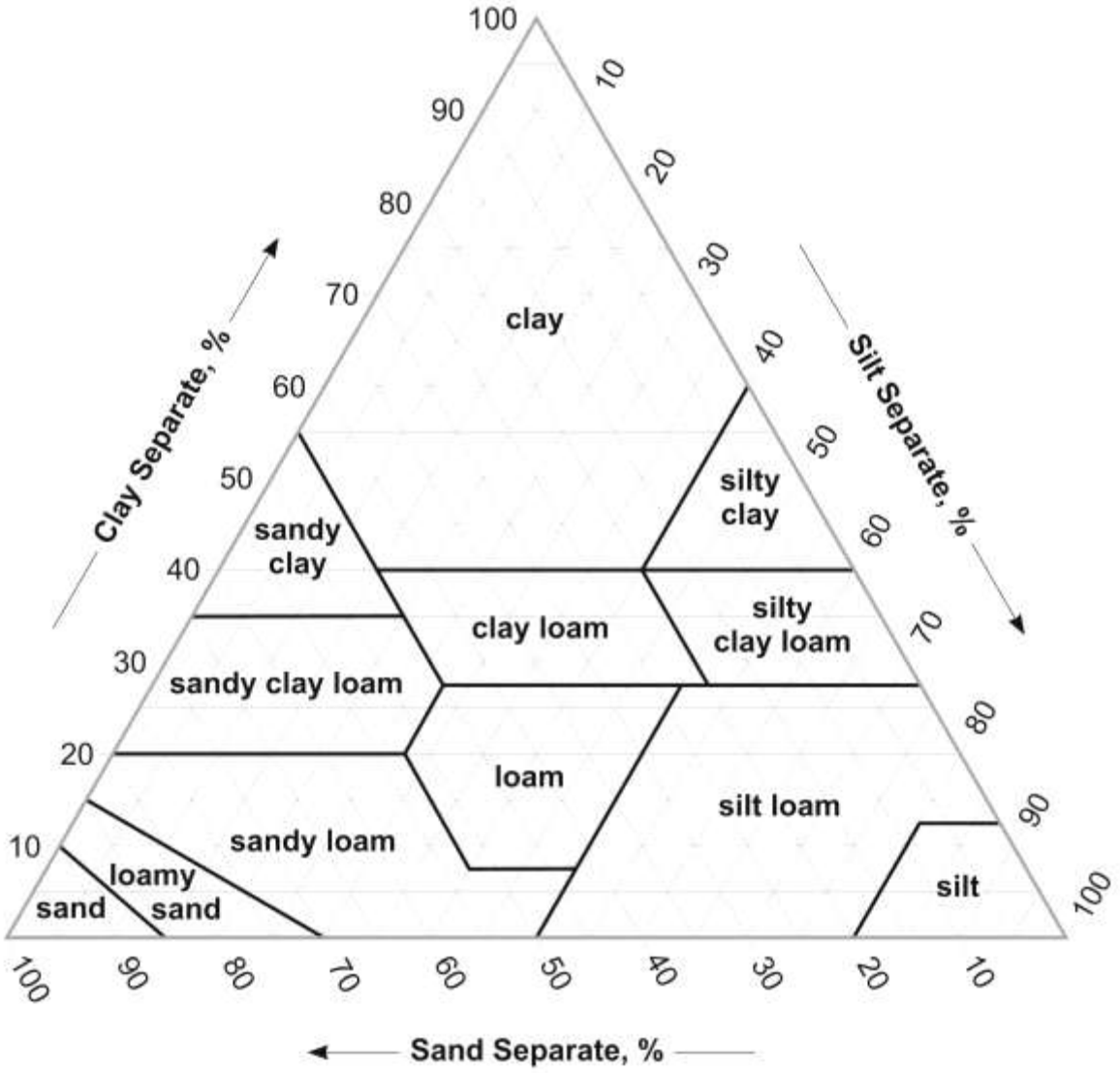

Figure 8: Soil texture classification chart. Note the "loam" region which represents an ideal soil texture. *http://soils.usda.gov/education/resources/lessons/texture/textural_tri_hi.jpg*

percolating water are absorbed at the surface of clay grains and nutrients like calcium, phosphorus, sulfur, potassium, magnesium, potassium, and sodium are released into the soil solution and made available to plants (*bioavailable*). The large surface area to volume ratio of clay grains (5 cm^2 of clay has a surface area of 113,000 cm^2, whereas the same volume of sand has a surface area of only 11 cm^2) means that essentially all inorganically derived bioavailable nutrients come from chemical reactions with these particles.

Organic matter is also very important to healthy soil and should constitute about 5% of the soils total volume, with concentrations of up to 20% seen in the top layers of soil. Soil organic matter (SOM) originates as a living plant, which is typically about 80% water with the remaining 20% composed of hydrogen, oxygen, carbon, nitrogen, and trace elements. Plant matter added to the soil is first broken down into basic compounds and by macro- and micro-organisms in the soil, creating a more stable organic matter called *humus*. Mineralization processes then further break down these compounds by releasing their mineral components into the soil solution. Like clay grains, SOM has a large surface area to volume ratio which allows for nutrients to be easily released and incorporated into the soil solution which is available for uptake by plant roots. SOM is also beneficial because it holds water in the soil, like silt, and keeps the soil light and aerated, like sand. The more SOM in a soil, the darker it is, and healthy soils should be dark brown to black in color.

The acid-base balance of a soil is also an important factor that affects the release of nutrients from clay and SOM into the soil solution and the nutrients' subsequent uptake by plants. Soil acidity is measured using the pH scale which ranges from 0 to 14, where a low pH corresponds with acidic conditions, pH of 7 is neutral, and a high pH is basic. It is

important to have soil that is just slightly acidic (ideally between 6.6 and 7.0) so that there are hydrogen ions available to release nutrients into the plant-accessible soil solution. Very acidic soil can cause a toxic amount of macronutrients like aluminum, iron, and manganese to go into the soil solution, while soil that is too basic can reduce the bioavailability of important micronutrients like copper, nickel, and zinc. Although each crop has a slightly different ideal soil pH level, few crops do well outside of a pH range of 5 to 8.

Structure

The overall structure of a typical undisturbed soil which has undergone the chemical and biological processes discussed above for hundreds of years is described by its *soil profile* (see Figure 9). This profile, a cross-section of soil from the top layer to a meter or so underground, is composed of four distinct *soil horizons*, or layers. The top few centimeters of soil is known as the *O-horizon*, a thin layer of recently deposited organic material that is very biologically active and serves an important role in soil development and fertility. Next is the *A-horizon*, or topsoil, a 10 to 25 cm thick layer rich with stable organic material and minerals leached from above which contains most of the plant roots. Many of these nutrients leach further downward, accumulating in the *B-horizon* and accessible to the deepest plant roots. Nutrients that build up in this soil level can often precipitate into mineral structures which can form a hard substance

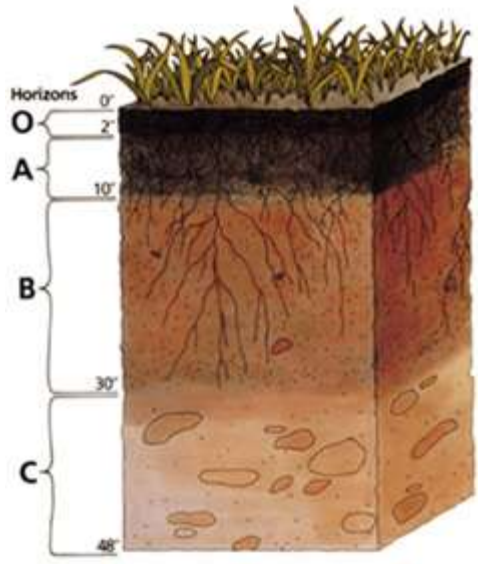

Figure 9: Diagram of a typical soil profile showing the four horizons. *http://soils.usda.gov/education/resources/lessons/profile/profile.jpg*

called *soil pan* which is impermeable to plant roots. The next layer is the *C-horizon* which is a compact layer of the original sediments weathered from local parent rock (*residual soil)* or deposited by floods (*transported soil)*.

Soil structure is also defined by the *soil aggregation* or *crumb structure*. Crumb structure develops when individual soil particles are attracted to each other or become attached with either clay or SOM as a binding agent. Good crumb structure, also known as good *tilth*, exists when a clod of surface soil crushed in the hand breaks up into smaller rounded clumps or crumbs. This is ideal for farming operations because these clods resist erosion and promote a more porous soil, allowing for easy growth of plant roots and proper water and air content in the soil. Other patterns of soil aggregation can be described as blocky, platy, or columnar and are more common in deeper soils. Maintaining soil health by adding organic materials and properly aerating the soil can the formation of these hard, blocky soil clods.

Source of Sediments at the Farm

The original sediments and rocks that make up the majority of the ground beneath the Farm were deposited by floods from San Antonio Canyon in the San Gabriel Mountains over tens of thousands of years. This mountain range, which towers over the Farm to the north, was formed due to a bend in the San Andreas Fault. The land masses on either side of this fault normally slide past each other (which often causes earthquakes), but this bend causes the land masses to slide into each other, creating a compression zone. This forces the land up, creating the rocky mountain ranges that surround the Inland Empire today. Of course, what goes up must come down, and these mountain ranges are quickly weathered

Figure 10: Photograph of The Wash in 1906 looking north towards the San Gabriel Mountains. Note the large cobbles and other debris left by previous floods. *Special Collections, Honnold/Mudd Library of the Claremont Colleges.*

and eroded by water, wind, temperature extremes, plant roots, and earthquakes. Over time, floods have washed sediments and rocks out of the mountains, filling in the valleys below with hundreds of feet of detritus in what is known as an *alluvial fan* (see Figure 10). Today, the ubiquitous "Claremont potatoes," as the large stones are known, can be found in any soil that has yet to be worked, and you can see them lining the beds and pathways across the West Farm.

The sediments originally deposited by floods have been further modified prior to human interaction by chemical weathering and biological cycling of nutrients. Trees and plants absorb macronutrients dissolved out of the finer sediments and incorporate them

into their carbon-based structure. As the plants die, nutrient-rich organic material builds up at the surface, providing habitat and food for decomposers and other soil organisms. Many of these plants also provide food to larger animals which die and also become a part of the nutrient cycle that modified the soil at the Farm for thousands of years. Floods from the mountains continuously brought new rocks, sand, and nutrients into the valley below while washing away surface material that had built up since the last flood. Fire was also a naturally occurring part of this ecosystem, and while fires volatilize sulfur and nitrogen, other nutrients like potassium, phosphorus, calcium, and magnesium are concentrated in ash and easily available in a soil solution.

Human Modification of the Soil

At the end of the 1800s, the Spanish ranchland dwindled in favor of citrus groves, which occupied much of what is now Claremont. At the same time, the Santa Fe Railroad was built and recently founded Pomona College relocated to the Claremont area, creating a small town site. The City of Claremont was incorporated in 1907, and the population increased over the coming decades, especially after World War II when freeways were constructed and citrus groves were bulldozed to accommodate demand for residential neighborhoods. This changing land use, from coastal scrub to citrus to residential, led to a huge increase in human activity around The Wash and introduced a number of harmful pollutants into the soil. Because the rising population, a major flood in 1938 forced the construction of an earthen dam across the mouth of San Antonio Canyon at the north end of Claremont, which was completed in 1956. This dam cut off the seasonal floods which

prevented rocks, sand, silt, and nutrients from getting deposited and reduced the erosion of soils in the valley, including in The Wash at Pomona College.

Little is known about how college activities may have affected the soil at the Farm over the decades. The site where the West Farm is located now was and open space used as a gravel pit and trash dump. There was little plant life there in the late 1990s, and the soil was very nutrient-poor and possibly contaminated from an unknown history of trash dumping. Before planting anything, the early students and community members involved in creating the Farm planted Dutch White Clover which fixes nitrogen (an essential nutrient, more in the Composition and Texture section on page 28) into the soil via bacteria that live on the roots of the plant. These early students also started composting with fruit scraps, old plants pulled from beds, weeds, mulch, leaves, and straw, which added organic material, nitrogen, and other important nutrients to the soil. Soil and mulch from outside sources was also brought in to supplement what was created on site, and this also played a role in the early formation of healthy soil at the Farm.

Once students began planting at the Farm, various changes to the soil structure, texture, and composition have occurred. The nitrogen deficient soil was first planted with a nitrogen-fixing species of clover, which added nutrients and biomass to the soil. *Tilling* (see page 39) also modified the soil by mixing various existing soil layers with *soil amendments* (compost, fertilizer, etc.) which started to change the soil characteristics. Rocks were also being constantly removed to make the soil more hospitable to plant root growth. Moreover, fruit trees, vegetables, and herbs each began to remove and accumulate different amount of nutrients, some of which are composted after they die and added back to the soil later.

Soil Preparation

In order to be an effective medium for growing crops using an organic system, soil should have a balance of clay, silt, sand, and organic materials; a light, airy texture allowing oxygen to enter the soil; and a wide range of nutrients, especially nitrogen, phosphorus, potassium, sulfur, and calcium. However, the exact balance of these elements all depends on the location of your plot and what you wish to grow. In a low area with limited drainage, for example, a soil with more sand or gravel might be desirable to drain excess water more quickly. Conversely, a plot located at a higher point might benefit from more clays or organic materials to retain the water. Each type of plant also benefits from slightly different nutrient levels, pH, and soil texture (see the Crop Maintenance section on page 57 for more details about the specific requirements of common crops).

At the Farm, most areas used for growing have been worked before, so the soil is much healthier than the native soils found in the C-horizon or in The Wash. Even so, there are often several steps one must take to ensure the soil is ready for planting each season. For any method of soil preparation, the first step is to remove weeds and any non-soil objects on the surface of the plot. For plots which have not been recently worked, tools such digging shovels and digging forks (see the Tools section on page 78 and see Figure 11) should be used to loosen the soil, break up any large clods, and remove rocks, sticks, and other non-soil objects which may be found underneath the soil. Next, and most importantly, nutrients should be added, often in the form of compost or green manure, but also as organic fertilizers or soil additives. At this point, many soils will have to be tilled or mixed to remove the smallest weeds, aerate the soil, and incorporate the added nutrients. Later in

Figure 11: Farm student loosening soil in her plot with a digging fork. *Adam Long*

this section, another method of preparing beds for planting called the double-dug method (page 40) will be discussed as well.

Composting and Green Manure

Often, the most important step is to make sure that your soil has enough nutrients to support the growth of healthy crops. At the Farm, this is done primarily through the use of *compost* which is produced on the East Farm. Composting is the controlled decomposition of a mix of fruit and vegetable scraps (nitrogen-rich materials) and mulch, leaves, and thin paper (carbon-rich materials). At the Farm, this compost is created using scraps from the three on-campus dining halls and mulch from around campus that is dumped in The Wash by Facilities and Grounds. First, compost drivers transport the food scraps from the dining

halls in bins which are dumped against the active compost pile. Next, Farm employees spread a 10 to 15 cm thick layer of mulch on top of the new food scraps. About once a week, Farm employees use a small diesel tractor to reshape the newest pile, taking the new fruit scraps and mulch from the front of each pile and pushing it to the top and back of the mound. These piles will heat up to about 160 degrees Fahrenheit on the inside from microbial activity as bacteria, mold, and other microorganisms work to break down the mulch and fruit scraps into a rich, dark, moist, and healthy compost.

After around 6 to 8 weeks, the original pile will finish decomposing, losing much of its volume in the form of outgassed carbon dioxide and water vapor. This finished pile will be moved to a separate location so that a new pile can be started. Usually there are a total of three piles, each in various stages of the decomposition process. The finished pile can still be quite hot, and it is important to make sure the compost has cooled before spreading it onto beds as excessive heat could kill plants and beneficial soil life.

Once the pile has cooled, anyone can use the compost for their personal plot or during work on group plots. First, the compost must be sifted by rolling a wheelbarrow underneath the green metal frame provided by the finished pile, shoveling compost into the wood and wire mesh sifting tray on top of the frame, and then shaking the tray by pulling it back and forth. This sifts the compost, removing the largest rocks, sticks, and other debris that accumulated during the composting process. The sifted material should feel light and somewhat soft, albeit containing some small rocks and pieces of wood. This material can then be directly added to a plot and either tilled into the soil or spread across as top layer of an otherwise fully prepared soil plot.

In addition, *green manure* can be added to a plot as another form of nutrient addition. Green manure consists of any crops, weeds, or other plants that are pulled out and laid on top of the soil or tilled into the soil. This green manure will then begin to break down, providing nutrients (especially nitrogen) and adding a small amount of humus to the soil. After adding green manure to a plot, it is best to wait at least three weeks before planting to allow the plants to begin decomposing. Sometimes cover crops are grown for the purpose of being added to the soil later as green manure. Cover crops are planted between seasons or in the off-season of a crop rotation to hold the soil together, prevent weed growth, and many varieties also fix nitrogen into the soil via bacteria in the roots, if the seed is inoculated with the proper bacteria before planting

Tilling

Tilling is used to remove weeds, aerate the soil, and incorporate any added compost or other fertilizers. Tilling involves either manually mixing the soil or use of a rototiller, plow, or large tractor-pulled tilling equipment. Hand mixing techniques include using a digging shovel, digging fork, or pick-axe (see Tools on page 78) to dig out soil and then stir, overturn, and break up any clods. Tilling is used in many organic agriculture systems to kill weeds, loosen the soil to allow root growth, and incorporate any soil additives. However, tilling also disturbs the soil structure and soil ecosystems, allows for nutrients (especially nitrogen) to outgas which depletes the soil, and it can unearth dormant weed seeds which will begin to sprout once exposed to sunlight and water at the surface. It is best to use tilling only when necessary, for example on a plot that has not been worked in a few years, an area with very compact, or in a light colored, nutrient-poor soil.

Double-digging Method

Another method of soil preparation especially appropriate for soils that have not been worked in many years is the double-digging method. This method was a key feature of biointensive gardening techniques that were developed in 19th century French market gardens to make the best use of a very small growing area. To double-dig at the Farm, first select an approximately rectangular site and mark it at the corners with stakes. This site can be either your personal plot or a group area with approval from Farm Staff. Then, use a digging shovel to remove the first 8 to 12 inches of soil from one section of the plot and set it to the side. Any rocks, large sticks, trash, or other non-soil objects should be removed during this process as well. Then, use a digging shovel or digging fork to loosen the next layer of soil to an additional depth of 8 to 12 inches for a total worked soil depth of 2 feet (see Figure 12). Note that this second layer of soil might have been undisturbed for decades and can be cemented together and full of large rocks. If this is the case, you will likely have to use a pick-axe to break up the soil and remove the rocks before moving on the next row of your plot. Compost should be added and worked into the bottom layer of soil at this

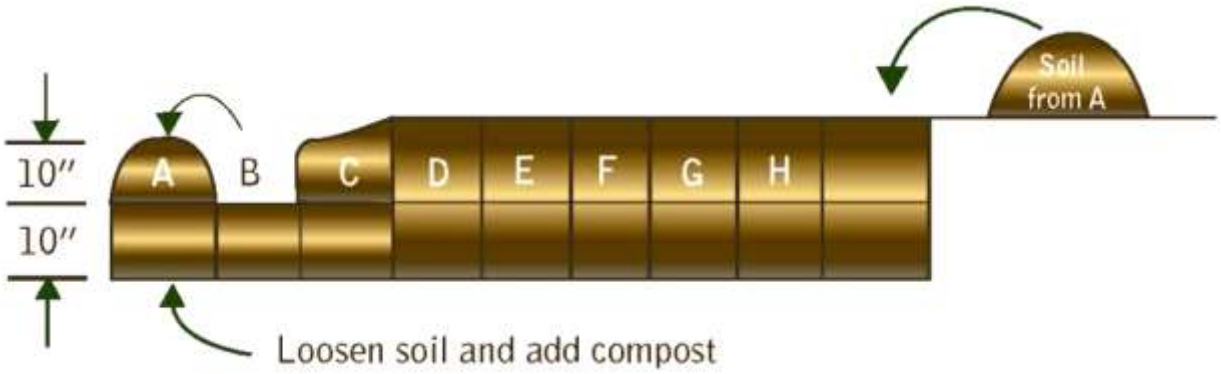

Figure 12: Diagram of double-digging a long bed. First, you remove the soil from section A and put it to the side. Then, you loosen the next layer soil underneath section A. Then you remove the upper soil from section B and place it on top of the loosened subsoil in section A and so on until you have double-dug the entire space. *http://www.plant-materials.nrcs.usda.gov/pubs/mipmcot9407.pdf*

point. Then, remove the top layer of soil from the next section of the plot and mix it with compost to replace the soil you removed from the first section.

After the bed has been completely double-dug, you will be left with a deep plot of loose, nutrient-rich soil that allows for deep root growth and water percolation. Even if you had to remove numerous large rocks in this process, the bed will likely be mounded above the original soil level at least by a few inches, but the soil will subside as the soil compacts with rainfall or irrigation over time. At this point, the soil is ready for planting and is especially well suited to growing roots crops like beets and carrots which benefit from the loose soil. Because double-digging is so labor intensive, it is recommended to only use this method on very compact or underworked soils. Once a bed is has been double dug, it will not need to be double-dug again for many years. Double-digging is important to allow for the dense planting associated with a biointensive organic agricultural system.

Soil Characteristics at the Farm

At the Farm today, the soil is much healthier than when students first took a shovel to the ground in the late 1990s. 13 years of amending the soil and growing plants and trees has drastically increased the amount of organic material and the general health of the area's original transported soils. At the same time, there is still room for improvement as the soils constantly degrade over time and need careful tending to maintain fertility. There are also some concerns with the chemical properties of Farm soils that should be noted for the edification of anyone referencing this guide. Accordingly, this section will briefly cover current soil characteristics such as structure, composition, pH, and heavy metal concentration as well soil testing options that are available to Farm users.

Soil Structure and Composition

The original soils at the Farm result from a combination of the local climate and geology: frequent floods (climate) which wash out weathered bedrock from the San Gabriel Mountains (geology). The last major flood event in 1938 deposited a 1 to 3 foot thick this soil across the Claremont area. Unworked soils at the Farm and open areas in The Wash show very little soil horizon development because of this recent and frequent flooding history and the low biological activity prior to the first cultivation of the Farm. The native soil is, therefore, best classified as an *entisol* because it exhibits essentially no soil horizon development; there is not much more than a tiny layer of leaves sitting on top of hundreds of feet of sediments and rocks. The composition of the soil is equally immature, consisting primarily of sand and rocks, and low in clay, silt, and organic material. In addition, much of this soil has been cemented together by mineral oxides which causes a very hard, blocky crumb structure. For these reasons, native soils near Claremont are not well suited for agricultural operations and must be significantly amended before farming.

The worked areas on both sides of the Farm, on the other hand, are much more developed in soil composition because of the tireless work of students, faculty, staff, and community members at the Farm. You will notice the soil in many beds on the West Farm is much darker the soils in The Wash, indicative of the high SOM concentration, and it is also much softer if you were to mistakenly step in a bed. In some areas, the same patch of soil has been tilled and amended for 13 years in a row, resulting in the nutrient rich soil seen today. In these areas, the depth to the C-horizon is usually 1 to 2 feet, depending on how deeply the bed was dug originally. If you pick up a handful of soil from one of these beds, it should easily break up into small, granular crumbs, exhibiting good tilth.

Soil Acidity and pH

The original soils near the Farm are generally acidic due to fungal growth in oak leaves that make up the O-horizon, which slowly lowers pH over time. However, many years of working the soils at the Farm seems to have brought the pH values up to more neutral levels. Indeed, soil tests conducted for this guidebook confirmed that a wide range of pH values exist for various soil types in and around the Farm. The least disturbed soil samples, taken from underneath live oak trees just to the east of the West Farm, have an average pH of 5.7 – very acidic indeed, much more than is healthy for most crops. Soils in the pathways at the Farm, which have not been directly worked, but have been mulched and watered, are generally more neutral, with pH averaging around 6.7. Soil samples from average, recently worked beds which have fairly rich soil averaged a pH of around 7.3, slightly basic but still in a healthy range. This makes sense, given that the average pH value for finished compost from the Farm's composting system is a rather basic 7.8. Overall, pH should not be of much concern at the Farm where basic soil amendments are helping to offset the naturally acidic soil.

If soil testing reveals that a certain plot or growing area at the Farm has an extreme pH value, various steps can be taken to offset this. Traditionally, acidic soils are treated with a light application of agricultural limestone ($CaCO_3$), a natural mineral additive which neutralizes soil acidity by the reaction of carbonate ions (CO_3^{2-}) with hydrogen ions (H^+). Even well-powdered limestone takes weeks to months to completely react in the soil, so it is best to add it well in advance of planting. Basic soils can be treated numerous ways as well. Soils will naturally acidify over time due to microbial activity and organic acids produced by plant roots. Compost or mulch made from acidic materials (orange peels, pine

needles, and other residue from coniferous trees) can also be added and will slowly reduce the soil pH. Certain chemicals like sulfur, ferrous sulfate, and ammonium fertilizers can also be used to lower soil pH, although this is recommended only as a last resort.

Trace Metals

Although many trace metals are necessary micronutrients for plants, some can be toxic to plants or harmful to humans who ingest contaminated soil. Overall, the Farm is lucky to have heavy metal concentrations well within safe limits in most areas. Students with a Summer Undergraduate Research Project (SURP) grant in the summer of 2010 and students in Professor Chuck Taylor's Advanced Analytical Chemistry class in the fall of 2010 used an x-ray florescence spectrometer (XRF) housed in the Pomona College Geology Department to analyze Farm soils for trace elements in parts per million (ppm). Lead, a common heavy metal contaminant used in paint and gasoline prior to the 1980s, averaged only 37.3 ppm (n = 25) with a standard deviation of 10.1 ppm, well under the 400 ppm safety level established by the EPA. One isolated spot near the northeast corner of the East Farm had a lead count of 573.0 ppm, however, which may indicate point source pollution, perhaps from previous dumping of electronic waste or building materials. Because significant lead contamination is not seen across the Farm, the source is unlikely to be from vehicle exhaust.

Soil Testing

For those who wish to learn more about the chemistry of soils at the Farm or in a personal plot, there are many options for soil analysis. Soils tests that can be done at the

Farm with little prior experience include LaMotte brand soil macronutrient and plant tissue micronutrient test kits (Farm Staff can make these available upon request) and pH tests. The cheapest pH meters available online have two metal rods that are inserted into the soil, but these only measure electrical conductivity which is not always an accurate analog of soil pH. Electronic pH meters (again, available on request) are more expensive, but they measure true pH often down to 0.1 unit accuracy. To use these meters, mix 10 grams of soil with 10 milliliters of distilled water in a clean glass jar, stir vigorously, and then allow the mixture to settle for a few minutes. Then, dip a calibrated pH meter into the slurry and stir gently until pH reading stabilizes.

Other more advanced tests can sometimes be made available to students of the Claremont Colleges through various academic departments. The Pomona College Geology Department's XRF can be used to test for trace elements such as lead by analyzing pellets of compressed soil powder. The Geology Department also houses an Elementar Vario Micro Cube CHNS-O-X Analyzer, which can be used to determine the exact amount of carbon, hydrogen, nitrogen, sulfur, oxygen, and chlorine in a soil sample. Use of both of these testing methods requires extensive training, permission, and cooperation from Geology Department faculty and staff. The Pomona College Physics Department also hosts a Scanning Electron Microscope (SEM) which can be used to detect elemental composition in soils, rocks, wood, paint chips, or many other objects of interest in a soil. Again, special training and permission is always required to use this equipment. Contact information for these departments can be found on page 81 in the Appendices.

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PLANTS

This section will discuss the full lifecycle of crops grown at the Pomona College Organic Farm, from planting seeds to saving seeds and everything in between. This includes methods of planting seeds, propagating plants with cuttings, starting and planting seedlings, and detailed plant information for a variety of crops such as planting depth, row spacing, proper maintenance, when to harvest, and how to save the seeds. Basic plot arrangement and general plant growing conditions will be covered as well.

Starting Crops

Most often, starting crops at the Farm requires *germinating*, or sprouting, a seed collected during the crop's previous season or purchased from a seed company. From a sustainability and self-sufficiency standpoint, saving seeds (discussed in detail later) is the most preferable option, but this is not always possible and sometimes requires more time or effort than it is worth. If seeds have not been saved, it is advisable to purchase organic seeds at a local garden store such as Armstrong Garden Center at (located at 735 E. Foothill Blvd., Claremont) or online from Peaceful Valley Seed Co. (www.groworganic.com), Seed Savers Exchange (www.seedsavers.org), or other organic seed sellers. Seeds can be started in one of two ways at the Farm: by directly planting them into a bed or row, or by starting them in a seed tray in the greenhouse and then planting the resulting seedlings, also known as *transplants* or *starts*, a few weeks later. Starts can also be purchased from a local garden store, but this is often much more expensive per plant than buying and can be avoided by planning ahead and starting your own seedlings in the greenhouse.

Direct Seed

Although some crops benefit from the more controlled conditions in a greenhouse, many vegetable seeds can also be successfully started by planting seeds directly into the soil. Root crops like carrots, beets, parsnips, radishes, must be directly seeded. For the direct seed method, first you must rake or and smooth the very top layer of soil, called the *seed bed*, in a fully prepared planting area, making sure that it is level and free of any rocks, sticks, or other objects that could get in the way of a sprouting seed. For large plants like broccoli, kale, zucchini, peppers, eggplants, or corn, use the hole method: poke a single small depression or hole in the soil with a finger, place 2-3 seeds in the hole, and then gently cover with nearby soil. Space the planting holes in a hexagonal arrangement, allowing enough space for each plant at maturity (according to plant spacing distances found in the Crop Maintenance section on page 57). For smaller crops like carrots, radishes, lettuce, spinach, it is usually easier to use the row method by creating shallow linear depression with a finger or a stick, placing or sprinkling the seeds closely together along this line, and then gently covering them with soil. You can also plant smaller crops by selecting an area of the plot, sprinkling the seeds evenly across that area, and then covering the seeds with a thin layer of light soil or compost (the area method).

As a general rule, plant seeds at a depth that is twice the size of the seed. Pumpkin seeds, for example, may be up to a half and inch long and thus should be planted at least 1 inch deep, while carrot seeds rarely exceed ⅛ of an inch in length and thus should be planted within ¼ inch of the soil surface. Additionally, because germination rates are never 100%, it is also advisable to plant more seeds than you wish to grow into fully developed crops. Soaking seeds in water for 24 hours before planting can also help increase

germination rate and reduce germination time and, especially for seeds with thick or tough outer shells like squashes and beans.

Once planted, water the bed regularly but lightly, making sure to not wash away the soil and the seeds you just planted. You can press a finger into the water flow coming out of a plain hose, creating a light spray, or attach a conventional hose spray nozzle and use the "mist" or "shower" setting. Depending on the crop, the growing conditions, and any seed preparation steps taken, the seeds will germinate after two days to three weeks. When the young plants are about an inch tall, you will need to go through and thin out any that are growing too closely together. For the large plants, carefully remove seedlings until you are left with one plant per hole. For those plants in rows or areas, remove seedlings such that the plants are evenly spaced from each other according to the specific plant spacing distance guidelines found in the Crop Maintenance section. Some plants can tolerate closer spacing, but most will be too crowded and will not develop to their full potential. At this point, your seedlings should be good to go and will only need occasional tending per the suggestions given in the later sections of this guide.

Starting Transplants

Any non-root crops can be started by planting seeds in a seedling tray in the greenhouse on the East Farm. The greenhouse keeps the seedlings warm and moist and diffuses incoming sunlight, which can help sensitive young plants grow during their first few weeks. Warm weather crops can also be started in the greenhouse as early as mid-February, four to six weeks before the warm season begins, which means you will have healthy summer seedlings to plant as soon as it begins to warm in the spring. Because

Figure 13: Farm student Nell Baldwin '09 carrying seed trays during fall planting in 2009. *Adam Long*

greenhouse space is limited and prone to becoming disorganized, it is best coordinate with Farm Staff and other Farm users when planting in the greenhouse so that you can plant a full tray of each crop and everyone can use a portion of the seedlings.

To plant in the greenhouse, start by getting an empty black seed tray from the shelf to the west of the greenhouse on the East Farm. For most plants, the large, black trays with many small 1.5 inch square cells are big enough to accommodate the young plant, but small enough that you can make efficient use of greenhouse space. Most of the trays at the Farm are around 6 cells wide and 12 cells long (see Figure 13). For plants like squashes and beans which have larger seeds (and thus larger seedlings), it may be necessary to use seedling trays with larger cells. Next, fill each cell in the tray with a light and airy store-bought potting soil, commercial seed-starting mix, or a self-made mix. The mix recommended by April Johnson of the Rodale Institute in Pennsylvania is a blend of 4 parts screened compost, 2 parts coconut coir, 1 part perlite or sand, and 1 part vermiculite. It is important that a seed-starting medium strikes a balance between water retention (vermiculite and compost) and good drainage (perlite or sand) so that seeds and young plant roots can have oxygen and space to grow, but also ample access to water.

Then, like with direct seeding, create a small depression in each cell that is approximately twice as deep as the seed is long, place 2 to 3 seeds in the hole, gently nudge the surrounding soil over the seeds, and lightly tamp the soil in place. The crops most commonly started in the greenhouse include broccoli, cauliflower, cabbage, kale, Swiss chard, and onions for the winter and tomato, eggplant, pepper, squash, cucumber, and basil for the summer. Keep in mind that it is also usually best to thin greenhouse seedlings down to one plant per cell, and that can be challenging if there are 20 little plants sprouting in one small cell. Once the seedlings are 3 to 4 inches tall, which takes anywhere from 4 to 8 weeks, it is time to transplant them. Seedlings that are allowed to grow any taller will start to outgrow the small cells and their growth could be permanently stunted.

To use seedlings from the greenhouse or starts purchased from a local garden store, first you must carefully remove the plant by placing the base of the stem between your thumb and forefinger and gently tugging upwards. If the plant does come out easily, do not pull harder because you could rip the roots. Instead, use a stick to poke up through the drainage hole in the bottom of the cell to push the start up. If the seedling still seems to be stuck, gently squeeze the sides of the cell, which will help loosen the soil, and then repeat the steps outlined above. Once you have removed a seedling, carefully place it in an empty seed tray and continue removing seedlings until you have only what you need for your plot or for the group bed that you are planting.

Asexual Propagation

While most crops at the Farm are started by seed, some can also be started using asexual or vegetative reproduction. For example, garlic bulbs contain up to 20 cloves, and

each clove that is planted will form a new plant. Similarly, dried baby onion bulbs, or *sets*, will also grow into full onion plants and produce large bulbs. As you may have noticed, potatoes left in a bright area for some time will grow small sprouts, and these sprouted potatoes can be chopped into a few pieces and then planted directly. Asparagus reproduces from *crowns*, which are subsoil stems that can produce asparagus stalks for years. Artichokes and strawberries reproduce via naturally occurring plant offshoots (*suckers* and *runners*, respectively) which can be separated from the mother plant and replanted.

Lastly, a few crops like tomato and mint family species (peppermint, spearmint, lemon balm, basil, etc.) can be reproduced via cutting. For these plants, simply cut off a branch from an existing plant, pull the leaves off the lower 2-3 inches of the stem, and set the stems in a jar of water (with optional root hormone) in a warm, well-lit location. After a week or two, the stems should have begun to grow roots and can be planted.

Planting a Plot

Before you begin planting seeds, transplants, or cutting into your plot or a group plot, however, you should sketch out a simple garden plan, keeping in mind a few key points. First of all, make sure that you arrange the plants in your plot so that they do not crowd each other out when they are mature and so that tall, leafy plants do not shade out shorter plants. For example, in the winter you could plant peas (which can grow very tall if given something to grow on) at the northern end of your plot, broccoli (which is big and leafy) in the middle, then carrots and spinach at the southern end of your plot. This will allow the low southern sun to hit the leaves of all of the plants in your plot. Also keep in mind that some plants grow well together and some plants do not (see the Companion

Planting section on page 86 in the Appendices). Lastly, time the planting of seeds and transplants such that one plant cannot take advantage over another. For example, if you are growing tomatoes and basil together in the summer, remember that basil grows quickly and easily, producing large leaves. Because your primary crop is tomatoes, plant the tomato starts first and let them get establish over the first week or two before planting the basil. As always, feel free to consult with member of Farm Staff who can offer personalized feedback and suggestions for how to arrange your plot.

After preparing the soil and creating a plan, direct seed your plot first following the guidelines discussed in the Direct Seed section on page 48 and considerations outlined above. After allowing these seeds to grow for a few weeks (thinning and replanting bare spots as needed) you can now plant transplants and cuttings. In both cases, start by digging a hole in your plot that is slightly wider and deeper than the roots of the seedling or cutting

Figure 14: Farm student planting lettuce seedlings in a plot on the West Farm. *Adam Long*

you wish to plant. For transplants, carefully remove the seedling from the transportation tray and (optionally) loosen the roots by lightly squeezing and poking the root ball. Then, set the transplant or cutting upright in the planting hole and fill the hole up with soil or compost so that all of the roots are fully covered. For most plants, especially tomatoes, it is better to plant the start deep enough that the final soil level extends up the stem of the plants to just underneath the lowest leaves.

To finish, lightly tamp the soil around the seedling in place with your hands and add a thin layer of compost around the base of the plant to provide further nutrients. Continue with the rest of the starts until everything is planted. Return any unused starts to the proper seed tray in the greenhouse. After you are finished planting, make sure the soil is as level as possible, and water the new plants consistently for the first week. You can also add a layer of mulch or straw on top of the soil to provide further nutrients and prevent water from evaporating, but keep in mind that carbon-rich materials like mulch, straw, and leaves can absorb nitrogen from the soil during decomposition. You may always wish to leave some sections of your plot empty so that you can plant a few weeks later which will allow for successional harvests.

General Growing Conditions

As you plant your garden and watch you seedlings grow, bear in mind the basic elements required for all plants to grow: a growing medium (soil), air, water, nutrients, and sunlight. Remove any one of these elements entirely and the plant will not grow. A growing medium transfers water, nutrients, and some oxygen to the plant roots and then sunlight (via photosynthesis) fuels the reaction of those inputs and carbon dioxide from the air to

form the building block molecules of the plant. At the Farm, there several important considerations to make sure you plants have the right growing conditions to thrive. Proper care and maintenance of the soil in a plot, including plant nutrition, was discussed in Soil Preparation section on page 36. Additionally, while there is little we can do to control the air our plants receive at the Farm, it is important to note that the air outside of Los Angeles often contains high levels of ozone, carbon monoxide, and other harmful gases which hinder plant growth. Carbon dioxide, the most essential component of air for plant growth, is not in short supply, however.

Water is also an important issue to consider in Southern California because of the relatively dry climate. At the Farm, there are three primary ways to irrigate crops: rainfall, hand watering, and drip irrigation. As discussed in the Regional Climate section on page 23, rainfall is light and occurs only during the cool season. In the summer and other points during the year, it is necessary to used piped water to hand irrigate crops with a hose or install a drip irrigation system. For personal plots on the West Farm, the best method is hand watering, and while student employees at the Farm will water individual plots during dry spells, it is important for those with plots at the Farm to come by every few days during hot or dry periods to water their plot. Drip irrigation is used for the fruit trees and the group row crops on the East Farm. This method uses pipes and tubing with small holes to emit a slow but steady amount of water directly onto the soil surface. These are often set up on timers and are a much more efficient way to use water in a drier climate.

While most of the water used in the Inland Empire is from Northern California and the Colorado River, which is a contentious political and environmental justice issue,

Pomona College has a well which supplies much of the water used on campus. This water is first sent to the water company, treated with small concentrations of chlorine, fluorine, and other chemicals, and then sent back to the college for use on campus and at the Farm. Some argue that this treated water is detrimental to plant growth, but again, at this point it not something that we control at the Farm and likely has only a minor effect on plant growth.

Lastly, sunlight is major concern, especially on the West Farm. Many on the fruit trees on this side of the Farm are now over a decade old, and their canopies have expanded greatly in the past few years. While proper tree maintenance by Farm Staff can open up the canopy somewhat, the Farm has truly become an example of agroforestry – where ground crops are grown among trees. However, this means that many plots on the West Farm are shaded. Most vegetable crops require full sun to grow properly, and so it can be very hard to grow anything in a shady plot on the West Farm other than herbs and leaf crops like lettuce, spinach, and Swiss chard. When choosing a personal plot, make sure there is enough of an opening in the trees (particularly in the southern sky) so that your plants receive many hours of direct sunlight. Also keep in mind that some areas of one plot may receive better sunlight than others, and arrange your plant accordingly.

At the end of a plant's life cycle, it will bolt (put out a flower stalk) which will produce seeds. It is wise to allow a few plants of each crop to bloom and set seed so that you can collect this seed for next year. For most plants, cut the flower stalk once the blossoms have fallen off and the seeds are hard and brown. Put the stalks in a paper bag on a table and *thresh* them by holding the stalks and hitting them against the inside of the bag resting on the table. You can also use your hands rub and crush the seed heads so that

every seed falls off the stalk. Then you can put these seeds into a labeled paper envelope or pouch and store them in a dry location (usually the tool shed) until the next season.

Crop Maintenance

In this section, care and maintenance of the most common edible crops grown at the Farm will be discussed one-by-one. For each plant, detailed information about planting methods, preferred growing conditions, care and maintenance, and harvesting will be noted. The crops are divided into two categories: cool weather crops (planted from approximately September to March) and warm weather crops (planted from around April to August). Because of Southern California's climate, many crops will grow at any time of year, although most tend to do better in the season under which they are listed. Historically, some of these crops have performed better than others at the Farm, and this is noted when possible. Perennial crops (plants which grow for at least two years and often longer) such as herbs and fruit trees are not discussed in this section, but a list of these can be found in page 87 in the Appendices.

Cool Weather Annual Crops

Arugula (Eruca sativa)

See *Lettuce* on page 62, especially the discussion on leaf lettuce.

Beet (Beta vulgaris subsp. vulgaris)

Like most root crops, beets must be directly seeded in rich, deep, loamy soil in full sun. Plant seeds in a row ½ inch deep and space the seeds 1-2 inches, thinning after a few

weeks until there is one plant every 4-6 inches. Beets can be grown year round but tend to do best in the cool season. Harvest when the roots are between 1 and 3 inches in diameter. The greens are also edible and eaten raw or cooked. At the Farm, beets sometimes have a hard time developing to maturity and are commonly eaten by gophers. Seeds will develop along the top of the flower stalk after the plant has bolted.

Bok Choi (Brassica rapa)

Can be directly seeded in shallow rows (less than ¼ inch deep and spaced 2-3 inches apart) or planted as starts in offset rows. Can tolerate some shade but prefers sun. Space starts or thin seedlings to 1 foot apart, using the thinned plants in salad or stir-fry. When the leaves are larger about as big as your hand, begin to harvest by cutting or snapping a few outside leaves off of each plant which will allow the plant to continue growing and produce a consistent harvest for many weeks. Alternatively, you can also harvest the entire head by cutting off the root just underneath the base of the plant. Grows well at the Farm in cooler weather, but can bolt quickly if too warm. Seeds form in green pods which will dry out and turn yellowish brown when ready.

Broccoli (Brassica oleracea – Italica Group)

Broccoli is best started in the greenhouse (plant seeds at ½ inch depth) in late summer and seedlings should be planted in deeply worked but firm soils with neutral to high pH. Plant in offset rows so that each plant is about 18 inches away from another plant. Remove any bottom leaves that turn yellow and take care to pick off any caterpillars if you see holes in the leaves. A broccoli crown is ready to be harvested when it is larger than a

fist, but before the buds begin to spread apart, grow tall, and bloom (see Figure 15). Once the main head is harvested, the plant will continue to produce edible sideshoots and small leaves for many months if the side shoots are harvested before they bloom and produce seed pods. Best started in the early fall, but will grow and produce through the winter and well into summer if properly maintained. Grows very well on the West Farm even in moderately sunny areas and side shoots are very prolific. Like bok choi, the tall flowering stalks will produce skinny, green seed pods that will dry out when the seeds are ready.

Figure 15: A broccoli plant and crown at the Farm with the Earth Dome in the background. *Adam Long*

Cabbage (Brassica oleracea – Capitata Group)

Cabbage should be started in the greenhouse in late summer and the seedlings planted in the fall like the other *brassica* crops. Plant in offset rows so that the plants are 2 feet apart. They are not picky about soil characteristics but should be planted in well composted bed in full sun. The small, new leaves can be eaten when the plant is young or you can allow the plant to form a dense cabbage head. Harvest when the head is at least 4 inches in diameter and firm if squeezed. Grows fairly well at the Farm but sometimes has

trouble forming heads. Technically a biennial, cabbage will produce broccoli-like seed pods in the second season of growth if allowed to remain in place.

Carrot (Daucus carota)

Must be directly seeded in light, deeply worked soil rich in organic matter. Can be planted in rows or areas with seeds every ½ to 1 inch, planted at less than ¼ inch deep or as shallow as possible without risking the seeds washing away. Seeds can take up to 2 weeks to germinate, so be patient. It is best to thin carrots to 2-3 inches apart and continuously harvest so that the remaining carrot roots have room to grow. Densely planted carrots can be effective but may encouraging early bolting which produces small, woody roots. You can use your pointer finger to gently dig around the top of the root to check its progress, harvesting when the root is at least ½ in diameter. If the carrot is wide at the top but only a couple of inches long, the soil had probably not been worked to enough depth or was too heavy. Carrots grow very well at the Farm, especially in cool weather which sweetens the roots, but can be successfully planted year round. Said to grow well with onions. A biennial plant, so non-hybrid varieties allowed to bolt will produce a wide blossom of tiny white flowers and small seeds in the second season.

Cauliflower (Brassica oleracea – Botryis Group)

Start in the greenhouse and plant in early fall like the other *brassica* crops. Requires well composted, neutral to high pH, rich soils that are not allowed to dry out. Plant seedlings in offset rows so that each plant is 1 foot apart. After the head has started to form in the center of the plant, bend the inner leaves over it protect it from the sun. Harvest

when the head is larger than your fist or before the florets start spreading out and growing up. At the Farm, cauliflower can grow well under ideal conditions, but it often forms small heads, unconsolidated heads. Can tolerate partial shade.

Cilantro (Coriandum sativum)

Best directly seeded ½ deep in rich, well-drained soil in a sunny area. Plant using the area method and harvest when the plants are 8-12 inches tall by cutting the leaves from the base as needed. Densely spaced plants can be harvested by cutting a large bunch of leaves at once, and multiple harvests are possible if you allow the plants to grow back. Cilantro can also be grown in more organized rows or hexagonal arrangements with plants spaced 6 inches apart. In addition to using the leaves, the seeds can also be harvested once they are dried and brown and used whole or ground in cooking or saved for the next planting. Grows prolifically at the Farm but tends to bolt quickly due to the warmer weather, so successive plantings every few weeks are recommended.

Garlic (Allium sativum)

Best started by planting individual cloves 6 inches apart in offset rows anytime during the fall. Poke a hole with your finger, place the round end of the clove (where the roots will come out) down and the pointy end (where the leaves will emerge) facing up, and then cover with soil so that the tip is just beneath the surface. Garlic is not picky about soil type but requires mostly full sun. Will grow without much need for maintenance and they experience little problems with pests. Indeed, garlic is often used to plant around the border of a plot or garden because its smell can help to ward off insects and other pests. A

few months after planting, hardneck garlic varieties will put out a flower stalk called a garlic *scape*. These scapes should be removed so that the plant can focus its energy on the bulb, but they are edible and often popular at farmers markets. Harvest garlic during the summer or when the bulb has multiplied and contains 6-20 cloves and hang-dry by weaving or tying the stalks together. Save some cloves to plant again in the fall. Grows very well in sunny beds at the Farm and forms large bulbs with many cloves.

Kale (Brassica oleracea – Acephala Group)

Kale can be started in the greenhouse in the late summer and then planted in the fall much like the other *brassica* crops. Plant in offset rows or a hexagonal arrangement allowing the plants to be spaced 12-18 inches apart. Kale can also be directly seeded using the individual hole method with a ½ inch planting depth and spacing as above). Kale thrives in rich soils but is tolerant of poorer soils as well. Kale flourishes at the Farm and can easily survive the rare cold snap, sometimes growing through multiple seasons. Harvest leaves by snapping or cutting the bottom few leaves from each plant before while they are still vibrant green. Remove and compost any leaves that have turned, yellow or gray. Kale will continue to produce leaves for months unless it gets too hot.

Lettuce (Lactuca sativa)

Lettuce is best directly seeded in the fall, once it has cooled down, but can also be started in the greenhouse and then planted later to save space in the rows and grow multiple crops. Plant seeds close together, at about ¼ inch depth, using the row or area method. Thin plants to every 6-8 inches for head lettuces, and every 3-4 inches for leaf

lettuce. Head lettuce (like romaine and iceberg) should be allowed to develop full heads which are then harvested whole. Leaf lettuce is harvesting by picking a few outside leaves from each plant and then allowing the plant to grow and continue producing. You can also densely space lettuce plants and harvest by cutting all the leaves off at once when the plants are very young. Lettuce enjoys richly composted soil but can grow in most places, even under shade. While lettuce is a cool weather crop, it can be grown in the summer especially if it is well shaded and watered. This will keep the plant cool and prevent it from bolting early and producing bitter leaves. Many varieties of lettuce, especially heat tolerant varieties, grow well at the Farm but it tends to bolt quickly in warm weather.

Mustard Greens (Brassica juncea)

See *Bok Choi (Brassica rapa)* on page 58.

Onion (Alluim sepa)

Onions can be planted by direct seed, in the greenhouse, or by planting *sets*, which are dried immature bulbs from the previous season. Make sure to use "short-day" onions which will be triggered to start forming bulbs during the short summer days that we experience in Claremont (relative to northern latitudes). Plant seeds in the fall at a depth of less than ¼ inch. For direct seed, use the row method and thin seedlings to one every 4-6 inches. It can take 4-5 months for seeds to grow and mature into full onion bulbs, but the young onions can also be harvested and eaten. For a quicker maturing time, onions are most commonly planted as sets in January in much the same way as you plant garlic cloves (see page 61). Onions, however, are very picky about soil and require a growing area that is

heavily composted, loamy, well-drained, deeply-dug, and has a neutral to high pH soil. When the tops of the onions begin to droop and fall over, bend all of the leaves gently onto the ground and harvest a few days to a week later. Onions can be eaten fresh or hang-dried for long term storage.

Pea (Pisum sativum)

Best directly seeded at ½ to 1 inch depth in the fall through the spring, but can also be started in a greenhouse and transplanted. Must be planted against a trellis or fence so that the vines can have something to grow up onto. Plant one seed per hole in a single row, spacing the seeds about 3 inches apart. After the pea plants are a few inches tall, carefully guide them onto the trellis if they have not done so on their own. From there, the plants should grow up the trellis on their own, grabbing onto it with their tendrils. Peas are not picky about soil type and, if inoculated with the right bacteria, peas will fix nitrogen into the soil. Peas generally grows very well in all areas of the Farm, sometimes growing over 6 feet tall and producing dozens of large, tender pods. Harvest pods when they are young and tender for varieties with edible pods, and allow shelling varieties to grow until the peas inside are fully formed. If wait too long to harvest, the peas will be hard and bitter. At the end of the season, allow some pods to turn yellow and dry out for seed.

Radish (Raphanus sativus)

Plant radishes anywhere, in any soil type, at any time of the year. Must be direct seeded in the row or area method at a depth of about ½ inch. Thinning is not needed unless you want to grow very perfectly formed radishes. Radishes mature extremely fast and can

often be harvested within a month of planting. At the Farm, radishes grow exceedingly well and are a foolproof beginner crop.

Spinach (Spinacia oleracea)

Spinach is best directly seeded in the fall but can also be started in the greenhouse and planted later. Plant seeds at about ½ inch depth, using the row or area method with close spacing. Thin plants to every 4-6 inches and harvest by picking a few outside leaves from each plant like leaf lettuce. Plant in richly composted soil in full sun to partial shade to get large, healthy leaves. Although it prefers cool weather, spinach can be grown year round in the shade but will tend to bolt in the summer. Spinach grows very well at the Farm in the sun and the shade.

Swiss Chard (Beta vulgaris subsp. cicla)

See *Spinach (Spinacia oleracea)*, above, but allow for greater plant spacing (6-8 inches). Thrives at the Farm in cold weather.

Warm Weather Annual Crops

Basil (Ocimum basilicum)

Basil is best started in the greenhouse (planting depth of ¼ inch) and then planted outside beginning in late spring with 1-2 feet spacing between plants. Basil can grow up into a large bush (2-3 feet tall and wide) with a thick, woody stem if properly maintained. Harvest by clipping off branches 6-12 inches down from the newest growth and then pulling the leaves off the stem. Buds and blooms should be picked or clipped off as this will

promote further foliage growth. Buds allowed to bloom and be pollinated will turn brown when the seeds are ready to be collected. Thrives in the heat, but should be well watered. Very frost sensitive and growth will slow down at the first sign of cold weather in the fall.

Corn (Zea mays)

Corn comes in two primary categories: corn that is harvested when the husk is green and eaten fresh, and corn that is allowed to dry out on the plant and is then ground into cornmeal or flour. Both types of corn grow on large stalks 5-12 feet tall. In the late spring, direct seed in rows of 1 inch deep holes spaced 6 inches apart, with 3-4 seeds per hole. Space rows at least 1 foot apart. Corn requires a slightly acidic soil and a lot of nitrogen and will quickly deplete soil nutrition if it is not well composted and fertilized throughout the growing period. Good to plant with beans and squash (see the Companion Planting section on page 86 in the Appendices). We have often had trouble growing corn at the Farm in soil that is not rich and well composted, and we have also had problems with squirrels, mice, and rats which will climb the corn stalks and eat the young kernels. If the corn cobs grow successfully, harvest when the tassels sticking out of the cob have started to turn brown by grabbing the cob and snapping it downwards. Corn can be dried in the husk to save for seed.

Cucumber (Cucumis sativa)

Start in the greenhouse in early spring and transplant into light, well composted, neutral to basic soil once it begins to warm up. Can be planted 6 inches apart in rows to grow along a trellis, or you can plant seedlings on mounds that are spaced 2 feet apart with

three plants per mound and have the vines grow along the ground. If the cucumbers are not setting, you can manually pollinate the female flowers (ones with a tiny proto-cucumber between the flower and the stem) by picking a male flower and rubbing it front-to-front with the female flowers. Harvest when the fruit is 6-10 inches long or when the flower on the end has fallen off. Can grow moderately well at the Farm, but usually not a prolific cropper. To save cucumber seeds, let some fruits grow until they turn yellow, open the fruit and scoop out the seeds, and soak them in water for 2-4 days or until the gel-like substance surrounding the seeds has fallen off. Then, rinse them thoroughly to remove any remaining gel, dry them indoors until the seed snaps when bent, and store them for later use.

Eggplant (Solanum melongena)

Start seeds in the greenhouse (with a planting depth of ½ inch) in the spring and plant when it starts to get warm outside, spacing each plant 1-2 feet apart in a bed or row with full sun. After the plants begin to bear fruit, you should stake them by pushing a sturdy, 5 foot tall wooden pole into the ground a few inches away from the eggplant's main stem. Then carefully tie the main stem to the pole using twist ties, string, or garden tape such that the weight of the fruits will be supported by the stake and will not break the plant. Harvest by cutting the *pedicel* (the stem which connects the fruit to the main plant stem) with clippers when the fruit is fully formed and has lost any green color. This is one of the best summer crops to grow on the East Farm. Many varieties produce dozens of large fruits from late summer until winter.

Green Bean (Phaseolus vulgaris)

There are two main categories of green beans: bush beans and pole beans. Bush beans form low, sprawling plants whereas pole beans will grow into long vines and require a trellis at least 6 feet tall to grow on. As with peas, you may have to guide the young plants onto the trellis by gently twisting them around the trellis material. Both kinds can be started in the greenhouse or direct seeded, although direct seed is more common. Plant one seed per hole, ½ inch deep and 3-6 inches apart (bush beans may require more thinning than pole beans). Harvest bean pods when they are 3-10 inches long and somewhat firm. Waiting too long will cause the seeds inside the pod too become too hard to eat. To save the seed, wait until the pod is yellow and dry and then crush it to get the beans out from inside. Varieties include short and wide beans, long and skinny beans, purple beans, yellow beans, and multicolored beans.

Pepper (Capsicum annuum)

Includes sweet bell pepper and spicy pepper varieties. Start in the greenhouse in early spring much like eggplant. Plant seedlings 1-2 feet apart outside in composted soil only after the cool season is over as pepper plant roots do not like to be chilled. Like eggplants, some plants may need to be staked to support the weight of the fruit (especially with the larger bell peppers). All kinds of peppers grow very well at the Farm, especially spicy peppers like cayenne and jalapeño. Plants will continue to bear fruit well into the winter, particularly if it a warmer winter. Seeds can be saved from a fully developed, red fruit by simply open the fruit, removing the seeds, drying them for a few days, and then storing them in an envelope or paper pouch.

Potato (Solanum tuberosum)

Potato plants are grown from a seed potato (which can be any non-GMO potato from the store or farmers market). You can cut the potato into 3-4 pieces and plant those directly, or leave the whole potatoes in a warm, sunny, and dry location for a few weeks until small shoots begin to appear. Then, slice those potatoes into 3-4 pieces making sure to leave intact sprouts on each segment. Plant in early spring in deeply worked, well-composted, fairly acidic (pH 5-6.5) soil beds. First, make a *furrow* by out a 4-6 inch deep trench with ridges of loose soil on either and placing the potato cut side down in the bottom of the trench. Cover with soil until the shoots are just buried and water lightly – too much water and the potato pieces will rot. As the leaves begin to grow upwards, slowly *earth-up* the plant by gently pushing soil from the ridges up against the plant, allowing the newest leaves to poke up through the soil. Do this every few weeks until the potatoes are growing on a ridge rather than in the trench. Potato tubers can grow out of any point in the stem, so earthing up can lead to greater productivity. You dig up a test plant after 2-3 months to see if the potatoes have grown large enough, or you can wait until the leaves begin to wither and die and harvest then by carefully digging up the plants and searching through the soil for potato tubers. Potatoes grow moderately well at the Farm, but often get eaten by gophers before harvest.

Tomato (Lycopersicon esculentum)

Start tomatoes from seed in the greenhouse inside in early spring (planting depth of ½ inch). Once it has warmed up outside, usually by late April or May, begin to plant tomato seedlings outside in well-drained, composted soil in full sun, remembering to plant deep

enough that the first leaves are right at the soil surface. Space seedlings 1-2 feet apart and stake with a study pole, tying the main stem to the stake as the plant grow to support the weight of the fruit. As the plant grows, pick out any suckers which grow out of the joint between the main stem and a leaf or side stem as these will pull energy away from the productive parts of the plant. Harvest tomatoes when they are partially or completely red (or yellow, orange, purple, or other colors depending on the variety). Even unripe tomatoes can often ripen off the vine if left on a sunny windowsill. Many varieties produce well at the Farm, especially cherry tomatoes, and larger varieties also do well in heavily composted, deeply worked soil. Seeds can be saved in the same way as cucumbers (see page 66).

Winter Squash (Cucurbita pepo, moschata, maxima, mixta, et al.)

Includes acorn squash, butternut squash, pumpkin, and other squashes that are planted in the summer and harvested in the fall in winter as mature, hard fruits. Plant seeds 1 inch deep in large celled trays in the greenhouse in early spring, or direct seed using the hole method in late April or early May, once it begins to warm up. Winter squashes love well-composted, heavy soils and will grow very well straight out of a small compost pile. These plants form long, sprawling vines, so give them plenty of open space and space seedlings many feet apart. Harvest when the fruits have stopped growing and the skin has hardened. Many varieties can be stored for a few weeks. To save seeds, scrape out the seeds from inside the squash, rinse them thoroughly, dry them out, and store them.

Yellow Squash (Cucurbita pepo)

Yellow summer squash is started the same way as winter squash, above. Space seeds or seedlings 1-2 feet apart in well composted soil. Like cucumbers, the female blossoms of summer squash can be hand pollinated by touching the pollen from the male flowers to the inside of the female flower. The blossoms can also be eaten and are considered a delicacy in many regions. As the plants grow, clip off any older, dying leaves and use them for green manure or compost. Yellow squash is harvested while young and immature and the skin should be soft to the touch. If you let it grow too long, the skin will become tough, the seeds will harden, and the flesh will lose its flavor. You should let a few stay on the plant until this stage in order to save seeds for next season.

Zucchini (Cucurbita pepo)

See *Yellow Squash (Cucurbita pepo)* 71above. Zucchini often forms larger plants and leaves that grow on a shorter vine than yellow squash.

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PESTS

Weeds and Weeding

As with many small-scale organic farms, weeds are a constant struggle at the Farm. Put simply, a weed is any plant growing where you, as a garden caretaker, do not want it to grow. If you are a growing a bed of carrots, and a broccoli plant comes up, you may consider it to be a weed because it will grow to be very large and shade out your carrot crop. What is most commonly referred to as a "weed," however, may be defined as an invasive, fast-growing plant which will often produce large quantities of seeds. While many weeds do have edible or medicinal benefits, if allowed to grow unchecked they can shade out and reduce the availability of water and nutrients to the intended crop. Most organic gardeners and farmers, therefore, choose to employ various non-chemical weed prevention and reduction strategies which will be outlined here. A list of weeds with photos, adapted from a document produced by Professor Richard Hazlett, can be found on page 89 in the Appendices.

Tilling is the most common method organic farmers use to deal with weeds (see the Tilling section on page 39 for a description of how to till soil). Tilling before each planting kills any small weeds that are growing and allows them to decay in the soil, adding some nutrients and organic matter. However, frequent, excessive tilling can damage soil ecosystems, soil structure, cause the loss of nutrients to the air, and stir up dormant weed seeds which will begin to sprout within days to weeks after tilling. Therefore, it is

recommended to use this method sparingly, especially if the plot has been heavily worked for many years already.

After a plot has been planted, tilling is no longer an option and hand weeding is usually the best bet. The first method of hand weeding is quite straightforward: grab a weed from its base near the soil and pull it out, either leaving it on the soil surface as green manure or removing and composting it. Make sure to remove the roots or the weed may grow back. You can also use a hand hoe (see Tools section on page 78) a few weeks after planting to remove small weeds from tight spaces by scraping the tool against the surface of the soil. This will cut off or pull out most of the weeds while they are still tender and young, effectively killing them.

Another method of keeping weeds down after planting involves spreading a layer of mulch or straw down on the soil surface around the plants. This will hold in moisture and prevent all but the strongest weeds from sprouting, but carbon-rich materials like mulch, straw, and leaves absorb nitrogen from the soil during decomposition which could hinder the growth of your plants. You can also lay a black plastic sheet across a row, cut out holes, and plant seedlings in the holes. The black plastic will effectively keep down weeds, but it can also smother the soil, preventing airflow necessary for plant roots and soil fauna. This method is currently being used for the strawberry beds on the East Farm.

Long term weed seed prevention techniques mostly involve eliminating the weed seed bank and removing subsoil plant parts that can reproduce vegetatively. Every time a weed is allowed to go to seed, it disperses seeds across the nearby soil which can remain viable for many years. Thus, the most important long-term action plan to tackle weeds is to

always remove or cut weeds down before they flower and produce seeds. Plants like Bermuda grass, the most pernicious of all weeds at the Farm, can grow from a single segment, or *rhizome*, and thus utmost care must be taken to avoid chopping Bermuda grass into small pieces and fully remove the plant when weeding.

Lastly, it is important to note that not all "weeds" are detrimental to crop production. Some plants that one might consider a weed may actually fix nitrogen into the soil or use a deep root system to "mine" nutrients from deep underground and bring them to the surface where crops can access them. Although more research still needs to be done, plants such as clover, vetch, or rye grass can be *intercropped* with the primary crop as long as the plants do not compete with each other for nutrients or sunlight. Planting a low-growing clover underneath a bed of broccoli, for example, could fertilize the soil, help to retain moisture by shading the soil, and increase organic matter in the soil.

Insect Pests

While insect and bug pests are not a serious problem at the Farm, there are a few non-chemical techniques to keep in mind if you have a problem with these kinds of pests in your plot. Although you will likely have to accept a certain amount of losses, there planting techniques to avoid losing your most desired crop. One method is to plant sacrificial crops around the edges your plot or around crops you want to protect. For example, if you plant basil around your tomatoes, pests will eat the basil first which can save your tomato crop. Because basil grows quickly and easily, you are likely to have plenty left over for yourself as well. Companion planting (see page 86 in the Appendices) can also be used to repel insect pests. For example, onions are said to repel carrot flies, so it may help to grow a row of

onions with your carrot crop. Strong smelling plants like garlic or marigold can also be planted around the edge of a plot to repel certain pests.

Other biologically based techniques involve using beneficial animals and insects to control the insects that consume your plants. For example, some birds will eat slugs or other garden pests and ladybugs will consume aphids growing on your crops. You can also spray your crops with homemade insect repellant mixtures, like water mixed with cayenne pepper or chili oil, which gives the plant an undesirable taste to potential predators. Lastly, manual techniques are often required and usually very effective. For mature plants that are covered in aphids or other small pests, a forceful spray of water can wash away the pests without damaging the crop. For larger pests like caterpillars, including varieties which can consume entire broccoli leaves in a matter of hours, it is best to pick them off by hand and squash them.

Animal Pests

Gophers are the most serious animal pest at the Farm. These small rodents living underground and burrow tunnels across the West Farm and the East Farm, often excavating large amounts of soil directly onto plant beds. If you are lucky (or unlucky, depending on how you look at it), you can sometimes watch as gophers pull entire plants down into their burrows by the plant's roots. Gophers have even been known to burrow up right next to cauliflower plant and emerge from the ground to partially consume the cauliflower head before immediately going back underground.

Figure 16: A gopher briefly glancing out of its hole at the Farm. *Adam Long*

Unfortunately, gophers are very difficult to control. The most foolproof method involves installing an underground screen, but this is incredibly labor intensive: you must remove all of the soil from a plot of land, place chicken wire or another kind of metal screen on the bottom and sides of the plot, and then refill the soil. Alternatively, you can try capturing the gophers by baiting a trap and setting it right outside of a gopher's hole, although this often kills the animal (which may or may not be desirable) and does not have the best success rate. Additionally, one can never capture every single gopher. Another equally ineffective and inhumane technique involves placing chewing gum by gopher holes in the hopes that they will eat it, choke, and die. Lastly, you can try to drown the gophers out by flooding your plot, but this is a waste of precious water and only a temporary solution – the gophers will return soon after the plot dries out.

Squirrels are another common animal pest at the Farm. They will often gnaw holes in or entirely consume vegetables like corn, squash, and pumpkins. Covering these crops with a wire frame or heavy duty netting can prevent squirrels from reaching your crops, but this only works on a small scale. Another method is to work with the squirrels by providing them with a source of food like corn or other grains that they prefer over your crop. Additionally, because squirrels are territorial, if you give them a source of food they will stay in the area and prevent other squirrels from moving in.

Birds can also cause problems in a garden by digging up recently planted seeds, eating the leaves of new plants, and pecking at soft fruits and vegetables. Again, the only sure way to control this is by protecting your plants with a wire frame or bird netting. Mice will also eat freshly planted seeds and small plants, although this has not historically been an issue at the Farm. Overall, as with insect pests, you should plan for a certain amount of losses to these animal pests and not be discouraged if they take a few plants every now and then.

References and Further Reading

1. Stephen R. Gliessman, *Agroecology: Ecological Processes in Sustainable Agriculture*, CRC Press LLC, Boca Raton, FL, 2000, pgs. 217-219.
2. Richard Molinar, Dennis Pittenger (ed.), *California Master Gardener Handbook*, University of California Division of Agriculture and Natural Resources, 2002, pgs. 236-239.
3. Richard Hazlett, personal communication, 2012.
4. Geordie Schuurman, personal communication, 2012.
5. John Seymour, *The Self-Sufficient Life and How to Live It: The Complete Back-to-Basics Guide*, Penguin Books Ltd, London, England, 2004, pgs. 43, 50-55.

TOOLS

This section will cover the primary tools used at the Farm, with photographs, pictures and brief usage notes. If you ever have questions, please reach out to Farm Staff and they can demonstrate the proper use of any tool and help you determine which tool will work the best for the task you are trying to accomplish.

Digging Shovel

A digging shovel has a pointed tip to pierce the earth and pry at rocks or roots, but is also wide enough to carry a fair amount of soil. Use this tool when removing soil from the ground, such as in double-digging, or when digging large holes for transplanting bushes, established herbs, and vines. Very useful multi-purpose garden tool.

Image adapted from: http://www.fhwa.dot.gov/environment/recreational_trails/publications/fs_publications/05232810/fig066.gif

Digging Fork

A digging fork is another useful tool for loosening soil, tilling and moving compost around. While loose soil will fall through the tines, this tool can pick up dirt clods just as well as a shovel. It can also be used to pry rocks out, but care must be taken to not overstress the tool or the handle could break. Like a shovel, you can jump onto the metal attachment to force it deeper into the ground when digging.

Image adapted from: http://commons.wikimedia.org/wiki/File:Spitvork.jpg

Trowel

A hand trowel is one of the most classic gardening tools, but its uses are limited at the Farm. Primarily, a trowel is used to dig small holes when plant seedlings, dig out plants for transplanting, or carve out shallow rows for seeds.

Image adapted from: http://commons.wikimedia.org/wiki/File:Steel_trowel.jpg

Hand Hoe

The hand hoe is favorite tool with a variety of uses. For seeding, this tool can be used to create shallow rows or quickly till the soil bed. It is also perfect for fine-tuned weeding as it can scrape weeds out of the soil from between growing crops. The point end of the tool can also be use to chop and remove larger weeds like Bermuda grass.

Image adapted from:
http://commons.wikimedia.org/wiki/File:Schrepel_DSCN1238.JPG

Pick Mattock

The pick mattock (similar to a pickaxe) is a very useful but potentially dangerous tool. To properly use it, grip the handle with your left hand at the bottom and your right hand at the top. Raise the tool over your right shoulder and as you swing it down, slide your right hand down until it hits your left. This tool is effective at removing hard rocks and breaking through cemented soil.

Image adapted from:
http://commons.wikimedia.org/wiki/File:PSM_V09_D216_Stone_pick.jpg

Loping Shears

Loping shears are used primarily to cut larger tree branches (up to 2 inches in diameter) during pruning, especially ones that are hard to reach. Do not use to cut anything other than green wood or you risk dulling the blades. Can be used to cut large roots but avoid rocks.

Image adapted from: http://www.fhwa.dot.gov/environment/recreational_trails/publications/fs_publications/05232810/fig078.gif

Clippers

Hand clippers are primarily used to cut small plants, such as when harvesting eggplants, peppers, kale, etc. This tool is also used to prune trees, but only for small branches (less than 1 inch in diameter). Wear gloves and take care to avoid cutting your finger.

Image adapted from: http://commons.wikimedia.org/wiki/File%3AClippers_(PSF).jpg

APPENDICES

Contact Information

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Maps

This section contains aerial imagery from 1994 to 2011 as well as a map depicting the current infrastructure at the Farm. Aerial imagery was obtained through Google Earth (http://www.google.com/earth/index.html) and the USGS National Map Viewer (http://viewer.nationalmap.gov/viewer/). All Google Earth data was sourced from United States government agencies.[5] Features added to image basemaps were mapped by the author based on aerial imagery from February 2011 and site visits.

Historical Aerial Imagery

Aerial photograph from May 1994 showing The Wash and surrounding features of the Pomona College campus. Oldenborg Center is visible in the top left, the tennis courts to the south of Frank Dining Hall are in the bottom left, and 1st Street is along the bottom of each image in this series. No Farm activities had taken place at this time, as evidenced by the undeveloped open areas marked above.

[5] http://www.google.com/help/legalnotices_maps.html, last accessed December 13th, 2012.

Aerial photograph from December 2003. Note the early development of the West Farm, which at that time was primarily vegetable plots and small fruit trees.

Aerial photograph from April 2005. Note the site of the second Earth Dome, about one month into construction, visible as a slight circular form in the center of the West Farm. Also note the dots in the southeast corner of the future East Farm – these are fruit trees that were planted in 2004.

Aerial photograph from December 2006. Note the completed Earth Dome structure (easily visible) and the early development of the East Farm.

Aerial photograph from July 2008. Note the new outdoor classroom room, visible to the northeast of the Earth Dome, and the continued expansion of row crops and structures on the East Farm.

Aerial photograph from March 2011. Note the expanding tree cover on the West Farm and almost complete utilization of land on the East Farm.

Companion Planting

Companion planting involves mindfully arranging plants in a garden so that the properties of each plant benefit the plants around it. The classic is example is the Three Sisters, where corn, beans, and squash are grown together. The corn provides a stalk for the beans to grow up, the beans fix nitrogen into the soil for the corn, and the large leaves of the squash cover the ground beneath the plants and hold moisture in the soil. In this way, the combination of the three plants leads to better growth than if each plant was grown separately, and it uses less space. Some plants also produce smells and chemicals that can distract pests away from eating the primary crop.

PLANT	Companion Plants	Hindered By
Basil	Pepper, tomatoes, marigold	
Beans, bush	Cucumbers, strawberries, plant with corn	Onions
Beets	Lettuce, onions, cabbage	Pole beans
Broccoli	Beets, potatoes, onions, celery	Strawberries, tomatoes
Cabbage	Onions, potatoes, celery, mint	Strawberries, tomatoes
Carrots	Peas, lettuce, chives, radishes, leeks, onions	Dill
Cauliflower	Potatoes, onions, celery	Strawberries, tomatoes
Chard	Lettuce, onions, cabbage	Pole beans
Corn	Potatoes, peas, beans, cucumber, pumpkins	Tomatoes
Cucumber	Legumes, corn, leeks, onions, radishes, sunflowers	Potatoes, strong herbs
Eggplant	Redroot pigweed, green beans	
Leeks	Carrots, celery, onions	Bush beans, pole beans
Lettuce	Radishes, strawberries, cucumbers	Pole beans, tomatoes
Melons	Morning glory	Potatoes
Onions	Summer savory, chamomile	Peas and beans
Parsley	Tomatoes	
Peas	Carrots, turnips, radishes, cucumbers, aromatic herbs	
Potatoes	Beans, cabbage, corn, eggplant, marigolds, nasturtiums	Tomatoes
Radish	Redroot pigweed, nasturtiums, mustards	All pole plants
Spinach	Strawberries	
Squash	Icicle radishes, nasturtiums	Potatoes
Sweet Pepper	Basil, okra	
Tomatoes	Asparagus, carrots, celery, chives, garlic, onions, parsley	Potatoes, fennel, cabbage

Companion planting guide for common vegetable crops.
http://www.usda.gov/documents/Companion_Planting_and_Harvesting_Workshop_Handout.pdf

List of Perennial Species at the Farm

Below is a list of the trees, shrubs, and other large perennials growing in and around the Farm, adapted from a list compiled by Professor Richard Hazlett in 2010.

Native Trees

- California Sycamore
- Coast Live Oak
- Wild Cherry

Planted Trees

- Apple, Anna
- Apple, Golden Dorset
- Avocado, Fuerte
- Avocado, Hass
- Avocado, Pinkerton
- Banana, Burrow
- Banana, Manzana
- Carob
- Cherimoya
- Cherry, Capelin
- Chestnut, American
- Fig (multiple varieties)
- Guava, Lemon
- Guava, Mexican Red
- Guava, Pineapple
- Guava, Tropical
- Guava, White
- Jujube (Chinese Date)

- Kumquat
- Lemon
- Lime, Mexican
- Loquat
- Macadamia
- Mulberry, Pakistani
- Mulberry, Purple
- Mulberry, White
- Nectarine
- Orange, Blood
- Orange, Navel
- Orange, Valencia
- Peaches (multiple varieties)
- Pear
- Persimmon
- Plum
- Pomegranate
- Pomello
- Tangelo
- Zapote

Shrubs, Vines, and Other Perennials

- Bay Laurel
- Blackberry
- Boysenberry
- Grape, Flame
- Grape, Ruby
- Grape, Thompson
- Passion Fruit, Brazilian

- Passion Fruit, Frederick
- Raspberry
- Strawberry
- Sugar Cane

Herbs

- Amaranth
- Butterfly Bush
- Lavender
- Lemon Balm
- Lemon Verbena
- Marjoram
- Oregano, Italian
- Peppermint
- Rosemary
- Sage (multiple varieties)
- Sage, Pineapple
- Spearmint
- Stevia
- Thyme
- Thyme, Lemon

Common Weeds

Below is a list with photos and descriptions of common weeds found at the Farm, adapted from a document created by Professor Richard Hazlett. While many common weeds are featured in this guide, it is by no means comprehensive and you are likely find weeds at the Farm that are not in this list.

Stinging Nettles

http://commons.wikimedia.org/wiki/File:Illustration_Urtica_dioica0_clean.jpg

http://en.wikipedia.org/wiki/File:Brennnessel_1.JPG

http://en.wikipedia.org/wiki/File:Urtica_dioica38_ies.jpg

Nettles grow fast – up to 3-7 feet in the summer months (though we don't see them get this large at our Farm), with a winter die back almost to the ground. Their stinging stalk hairs release chemicals that both numb and pain the skin – a condition called *paresthesia*. The symptoms of paresthesia may persist for only a few minutes, or last as long as a week. Because of this property, stinging nettles are also sometimes called "burn nettles," "burn weeds," or "burn hazels." The plant serves as larval food for butterflies, which are generally beneficial insects (pollinators) in farms and gardens.

Nettles have considerable medical use. Stinging nettles were cited as an important medicinal plant in the 9th century *Anglo-Saxon Nine Herbs Charm*. Nettles were used as a folk remedy to deal with the pain of rheumatism. Users would flog themselves with the stems to inflame the pained area, so relieving the symptoms – albeit temporarily. Extracts from the roots are very effective chemicals in dealing with enlarged prostate. Extracts also are used in shampoos to make hair glossy. Some farmers, in fact, feed nettles to their cattle to improve the appearance and health of their coats.

As a food source, nettles can be very healthful. The young leaves can be eaten raw (they taste like spinach and your saliva will neutralize the sting), and are the target of the increasingly popular Stinging Nettle Eating Championship held in the United Kingdom as a creative outgrowth of a Dorsetshire farmland weed control program! Nettles contain a huge amount of protein—around 40%, and some species are a great source of Vitamin K.

Malvas – "Cheeseweed" or "Common Mallow"

http://en.wikipedia.org/wiki/File:Starr_060405-6902_Malva_parviflora.jpg

http://commons.wikimedia.org/wiki/File:Malva_neglecta_Sturm64.jpg

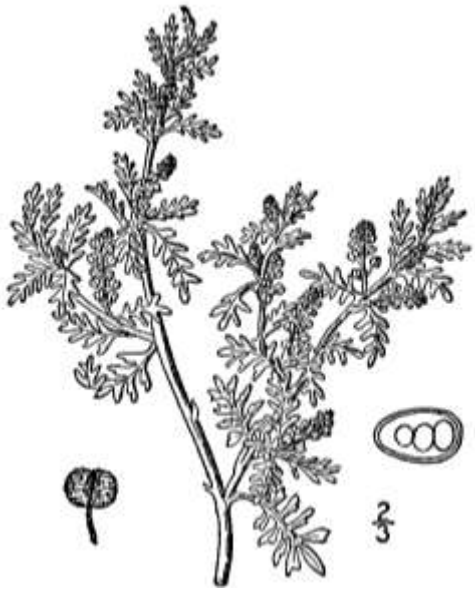
The purple-flowered cheeseweed is also a plant with strong attributes. As the quote from Horace indicates, it is also edible. In times of warfare and distress in Israel, when food supplies have been problematic, people have harvested cheeseweed to make a nourishing kibutz soup (*hubeza*), and also salads and other dishes. In China, cheeseweed is used to make an herbal infusion for colon cleansing, and also as a weight loss supplement. At the Farm, malva is one of the chickens' favorite plants to eat.

Lambs Quarters

http://en.wikipedia.org/wiki/File:Urtica_dioica38_ies.jpg

Also an edible, nutritious weed. This plant tastes a lot like spinach, collard greens, or chard, with an earthy, mineral-rich flavor. One should be careful of its identification, though, since it resembles some poisonous species. (Lambs quarter leaves often have a white, pollen-like substance coating their undersides). Lambs quarter is sometimes also called "goosefoot" in reference to the shapes of its leaves. Some varieties have a purple colored powdery substance instead of the white powder.

Swinecress



USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. An illustrated flora of the northern United States, Canada and the British Possessions. 3 vols. Charles Scribner's Sons, New York. Vol. 2: 167.

Swinecress is a weed with essentially zero redeeming value. It is a low, ground-hugging plant that may spread up to several feet from its point of emergence from the soil if left unchecked. It has very small, white flowers, and characteristically deeply wrinkled seeds that are bi-lobed at maturity. Be able to recognize this weed easily, since it can make quick inroads in your beds.

Henbit ("Babies Breath")

http://en.wikipedia.org/wiki/File:Lamium_amplexicaule_Kaldari_01.jpg

This common weed derives its English name from Dutch roots ("hoenderbeet") sometime around 2,000 years ago. It thrives in shady, cool, dry areas that have been freshly cleared for planting. Though a beautiful plant, it is widely regarded as a nuisance weed.

Wild Cucumber ("Manroot" or "Old Man in the Ground")

Adam Long

This weed, a native of the coastal chaparral zone in California, derives its folk name from the very large tuber, or thickened root, that characteristically underlies the stalk. Some tubers grow to several meters in length. The wild cucumber produces both male and female flowers on the same plant, which are white with five petals.

While we regard the wild cucumber as a nuisance, Native Americans used the spiky, green gourds and the stalk for various medical purposes. Other tribes used a mash of the fat tubers to stun fish. The wide variety of uses reflects the utility of several distinctive species of this plant.

Wild Oat

USDA-NRCS PLANTS Database / Hitchcock, A.S. (rev. A. Chase). 1950. Manual of the grasses of the United States. USDA Miscellaneous Publication No. 200. Washington, DC.

Wild oat is widespread in the grasslands of Texas and California, where ranchers value it as the most nourishing forage for cattle and horses. California's grasslands in particular are the most biodiverse in North America, not only because of the State's mild climate, but because of the impact of Spanish colonization and ranching culture, which was especially intensive here. Outside of pasture land, the wild oat vexes farmers and gardeners as a hardy weed.

Nutgrass

http://en.wikipedia.org/wiki/File:Nutgrass_Cyperus_rotundus02.jpg

A rather innocuous looking weed, but one with tremendous historical cultural importance – and possibly of great future importance too. A close relative of the nutgrass that we find at the Farm was the principal plant used for making papyrus throughout ancient Egypt and the Fertile Crescent. More recently, nutgrass has been harvested to make traditional grass mats in Polynesia and India. It is also edible. The northern Paiute peoples of the Basin and Range ate its tubers. The tribes called themselves the *tövusi-dökadö*, in fact (the "nutgrass tuber eaters").

Nutgrass is also being viewed as a major potential source of biofuel production; an option to sugar cane and corn that is associated with far less soil erosion. Nutgrass is, however, a very persistent weed with very deep roots. It is very difficult to remove and if cut at the surface it will continue to regrow.

Oxalis (Creeping Woodsorrel)

http://en.wikipedia.org/wiki/File:6h_common_yellow_oxalis.jpg

A member of this group of weeds forms the beautiful ground covers in the redwood groves of northern California. Here it is regarded as a weed, though an edible one. The leaves contain oxalic acid, which makes them refreshing to chew (in very large amounts, however, oxalic acid can be mildly toxic). The Algonquin clans in Canada ate woodsorrel as an aphrodisiac, while the Cherokee use to ease the discomfort of sore throat. The Kiowa chewed woodsorrel as we do gum to help ease thirst on long trips across the Great Plains. After dark the leaves of woodsorrel fold up for the evening.

Prostrate Knotweed

http://en.wikipedia.org/wiki/File:6h_common_yellow_oxalis.jpg

This weed is called "prostrate" because it tends to form in dense patches sprawling across the ground along pathways and in sports fields. Some branches also grow vertically. You may find it throughout the United States. This plant exudes chemicals into the soil that inhibit the growth of competitor grass species, so is widely hated by managers of field turfs. An organic herbicide made from corn gluten knocks it back.

Is there anything positive to say about prostrate knotweed? Yes – it is a supreme *indicator weed species*. Indicator weeds provide qualitative information about the soils in which they grow. This particular plant indicates slightly acidic soil conditions.

Spotted Spurge

http://en.wikipedia.org/wiki/File:Chamaesyce.jpg

Also known as "prostrate spurge," this weed has a similar habit to prostrate knotweed and forms large, sprawling clumps that hug the soil surface. This common garden weed is found across the United States. Easily recognized by its red stem and blue-green leaves, this plant is easily removed from the soil by hand.

Crabgrass

http://en.wikipedia.org/wiki/File:Harig_vingergras_plant_(Digitaria_sanguinalis).jpg

Crabgrass is a low, spreading grass with flat leaf blades extending from elongate stems. They tend to turn upward at the tips. It is easy to recognize. Crabgrass is extremely aggressive at colonizing disturbed ground. One plant can produce 150,000 seeds in a single growing season! The seeds germinate in late spring and early summer and it prefers drier, lightly watered, and underfertilized soil with thin growth. The seeds can be toasted and ground into flour, and one species of crabgrass in sub-Saharan Africa is actually a staple crop for traditional Bantu peoples.

Shepherdspurse

http://en.wikipedia.org/wiki/File:Capsella_bursa-pastoris.JPG

Shepherdspurse may be a weed to us, but in eastern Asia it is a widely used food source. In China this plant, which is related to mustard and broccoli (in the brassica family) is gathered to mix with stir-fry rice dishes, and is used with other ingredients to make the filling in wonton soup. A Korean traditional dish, *namul*, includes parts of the roots of shepherdspurse. Other uses include in medicines and for cosmetics.

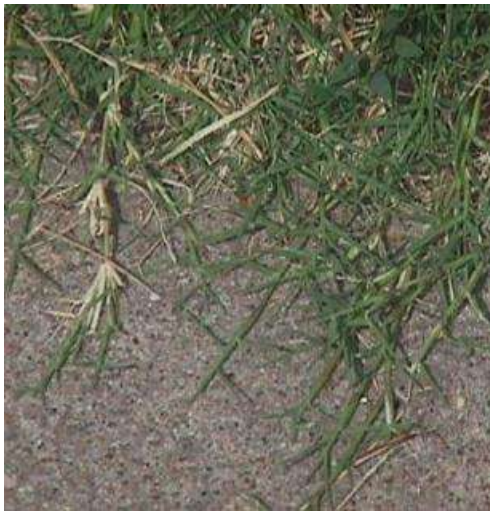
The seeds of shepherdspurse secrete a sticky, mucus like substance that some botanists think is meant to trap and kill small insects. The insect bodies provide nourishment for the growing seedling.

Dandelion

http://commons.wikimedia.org/wiki/File:Illustration_Taraxacum_officinale0.jpg

The word "dandelion" derives from the older French name for this plant, *dent de lion*, meaning lion's tooth, in reference to the shape of the plant's leaves. The original English name was *piss a bed*. Weed though it be, the dandelion has a lot of uses in folk and culinary culture. In New England dandelion is still a common ingredient in salads (though some people are subject to strong allergic reaction to it). Dandelion has also been used in remedies for urinary tract infections, and as a general diuretic. This plant is especially important as an easy source of pollen for bees; a major ingredient in the honey they produce.

Bermuda Grass



http://ag.utah.gov/divisions/plant/pesticide/utahpest/turf_weeds/bermudagrass.jpg

A dense and very aggressive grass species that many farmers and gardeners call "devil grass," for good reason. Bermuda grass invaded the southern part of the Farm in the early years, and still invades beds on a regular basis. The plant reproduces from its thick root system which can reach as much as six feet underground, giving you some clue as to how hard it is to knock down.

Bermuda grass does have some positive attributes, nonetheless. Because it grows so quickly, it is popular in some sports fields in warmer parts of the U.S. It may also have some medicinal properties.

Common Chickweed

http://commons.wikimedia.org/wiki/File:Stellaria_media_in_Bupyung_Korea_2.JPG

This plant is loved by foraging chickens, hence the name. Chickweed is a potent indicator weed genus (see Prostrate Knotweed on page 95 for definition of indicator weeds), indicative of fertile soil conditions. The plant is an edible, leafy vegetable. Many folk remedies and herbalists swear by its medicinal qualities too, but no scientific evidence exists to support these claims. As a weed, the plant is a powerful competitor owing to heavy seed production and early growth in disturbed areas. As much as 80% of some barley fields have been invaded by chickweed with significant crop losses ensuing.

Annual Sowthistle

http://commons.wikimedia.org/wiki/File:Sonchus_February_2008-1.jpg

Sowthistle can grow to four feet tall, with bright, daisy-like flowers. This weed is despised by farmers as it is a favored habitat of many crop-pest insect species such as aphids and nematodes. But some beneficial insects such as hoverflies live in these plants too. Sowthistle can also carry pathogenic plant viruses.

Rabbits and cattle love to forage on sowthistle, and indeed, we can eat its leaves too. In New Zealand in fact, sowthistle is a popular leafy vegetable, especially in the Maori community.

Yellow Sweet Clover

http://upload.wikimedia.org/wikipedia/commons/thumb/3/3e/Melilotus_indicus_(Flower).jpg/1280px-Melilotus_indicus_(Flower).jpg

Yellow sweet clover comes from Eurasia, introduced to North America as forage for cattle. It thrives in the wild, especially favoring heavy clay loams and slightly alkaline soil conditions. This plant is a legume, naturally fixing nitrogen in the soil via the bacteria that thrive around its roots. It makes an excellent green manure for fertilizing beds on organic farms. A chemical extracted from yellow sweet clover is a potent rat-killer, and indeed, moldy residues of this plant can be quite toxic.

Nettle-Leaf Goosefoot

http://en.wikipedia.org/wiki/File:Starr_040125-0029_Chenopodium_murale.jpg

This weed derives its name from the resemblance of its leaves to gooses feet (at least, that is the way it looked to the botanists who named it!). Its stems are characteristically red, or red striped (see photo below). The plant has edible leaves and seeds. Indeed, some Native American traditions hold that goosefoot was among the first plants given to humanity by the gods for its nutritional value. The leaves are storehouses of vitamins A and C, much like spinach. Also much like spinach, the leaves should be cooked to reduce the potential impact of oxalic acid content, though there is no harm in eating them raw in moderation. Nettle leaf goosefoot is quite common in the greater Los Angeles area.

Broad Leaf Plantain

http://en.wikipedia.org/wiki/File:Grote_weegbree_bloeiwijze_Plantago_major_subsp._major.jpg

The leaves of this native weed are edible, though they have a bitter taste and leave a spinach-like aftertaste. The value lies as an herbal medicine. Some treatments, as for example snakebite remedy, have no merit. But broad leaf plantain has a strong coagulant property, and has been used effectively to deal with uterine bleeding after childbirth and some serious wounds. In fact, the plant has been called the Soldiers Herb for its effectiveness in dealing with battlefield wounds. Reportedly it helps relieve the distress from mosquito bites, too.

Purslane

http://en.wikipedia.org/wiki/File:Portulaca_oleracea.JPG

Purslane is a common urban edible weed that is highly nutritious. The plant is thick and succulent with red branches that spread out along the ground. This plant is sought after by high end restaurants and can command high prices in some markets. This weed is a favorite of chickens.

Community Member Farm Pass Documents

The documents reproduced on the following three pages are e-mailed in PDF form or distributed in hard copy to any community member (including local residents and alumni) who is interested in becoming regularly involved at the Farm. This pass is required so that community members can provide identification if questioned by Campus Safety officers. Immediate family of a current student, faculty, or staff member do not need a Farm Pass, but should be able to provide the name and relation of their family member if questioned by Farm Staff or Campus Safety officers. Additionally, Farm Passes are not required for visitors using the dirt roads and trails around the Farm or for those who make very infrequent visits. It is highly recommended, however, that any visitor to the Farm emails farm@pomona.edu before their visit so that a Farm Staff member can make sure to be available to give a tour or answer any questions.

The first document below is the Community Member Farm Pass Application, the second is the Rules and Regulations, and the third is the Community Member Participation Guidelines. All of these documents were created by the student Farm Club, the Farm Manager, and professors in the EA department in late 2011 and were approved by deans of the college in early 2012. After filling out and signing the application form, the applicant must scan and e-mail the form to farm@pomona.edu or arrange to have it delivered to someone on Farm Staff. The application will be reviewed, and if approved a member of Farm Staff will sign the application and return it to the applicant via e-mail or hard copy. The applicant can then take the approved form to the Office of Campus Life to receive their Farm Pass ID card.

Pomona College Organic Farm

Community Member Farm Pass Application

Name: _____

Address: _____

Phone Number: _____

E-mail Address: _____

License or ID #: _____ Social Security #: _____

Have you ever been convicted of a misdemeanor or a felony? If so, please explain:

_____

_____

_____

Why would you like a Farm Pass?

_____

_____

_____

_____

What contribution will you bring to The Farm?

_____

_____

_____

_____

I understand that Pomona College reserves the right to perform a background check before issuing a Farm pass. I have read and agree to adhere by the attached Rules and Regulations and Community Member Guidelines. I understand that my Farm Pass may be revoked at any time and for any reason, including, but not limited to, failure to comply with said rules and guidelines.

Signature: _____ Date: _____

FOR OFFICE USE ONLY

Authorized by: _____ Date: _____

FARM STAFF

Permit Expiration Date: _____

Pomona College Organic Farm

Rules and Regulations

The Farm is managed by the Environmental Analysis Program and it is dedicated to the study of sustainable agricultural systems. The Farm is located in the southeastern corner of the Pomona College campus in a California Live Oak preserve. The current entrance to The Farm is located behind Seaver Theater (see attached map).

General Farm Rules

1. Use or cultivation outside of Farm boundaries is not permitted.
2. The Farm is the property of Pomona College and subject to all regulations and use rules that govern the rest of the Pomona College campus.
3. Identification from any of the Claremont University Consortium institutions or a Farm Pass must be presented upon request.
4. 7C students, faculty, staff and Farm Pass holders may have two guests while at The Farm.
5. Persons under 18 years of age must be under the supervision of an adult who has a valid Farm Pass or 7C ID.
6. Alcohol is not permitted on The Farm at any time.
7. Open fires and smoking is not permitted at The Farm due to fire hazard.
8. Amplified sound or drumming is permitted during daylight hours only, unless part of a registered event.
9. The Farm is open from one hour before sunrise until one hour past sunset.
10. The Farm should be kept clean and neat, and trash, recycling, and compost must be disposed of in appropriate locations.
11. Walk on the paths at all times.
12. Return tools to their proper location after use.
13. Harvest from the fruit trees only what can fit your hands and only when the fruit is ripe.
14. Harvest produce only from a plot you manage or co-manage, or from other plots only with the plot owner's explicit permission.
15. Respect the work of students at The Farm.

Events at The Farm

1. Events at The Farm must be registered with the ASPC office in Smith Campus Center.
2. Requests for events at The Farm can only come from 7C students, faculty, or staff.
3. Registered events must end by 9:00 PM.

Contact The Farm at farm@pomona.edu if you have questions or concerns. Tours are available upon request.

Pomona College Organic Farm

Community Member Participation Guidelines

Community Membership at The Farm is primarily to augment education and social life for Claremont Colleges' students, faculty, and staff at The Farm. Community Members should operate according to the administrative needs and duties of the Farm Club Leaders, the Farm Manager, and any classes hosted at The Farm. In this regard, Community Members are invited guests, not co-administrators. We seek their knowledge and experience to assist in making The Farm a richer experience for college users.

To that end, Community Members may engage in Farm activities in the following ways:

1. We invite Community Members to propose workshops in whatever area of expertise they would like to share. The Farm Club and the Environmental Analysis Program will advertise and provide resources for these workshops with the assistance of the Farm Manager.
2. Community Members may also provide class lectures or demonstrations (e.g. fruit canning in EA 85), with permission of the course instructors.
3. Community Members may team up or partner with students, faculty, or staff plot users to share a plot space on the West Side of The Farm. When a plot is assigned, applicants will be asked if they would like to include a Community Member who can assist in planting and maintenance. We encourage Community Members with Master Gardener or like background to be put their names on a list so that appropriate matches can be made.
4. The Farm will not assign exclusive use of plot space to Community Members, owing to priority and high demand for 7C needs and historical issues of plot negligence.
5. The Farm Manager and Farm Club should coordinate to keep a running list of tasks, for Community Members to sign up for volunteer assistance. West Side tasks will be listed on the permanent blackboard, and East Side tasks will be listed on a portable white board. This will include anything from weeding and watering to turning compost and even construction. Tools will be made available after 4 PM on weekdays or by arrangement with the Farm Manager or Farm Club.
6. Community Members would be welcome participants in workshops, major Farm social events and parties, Farm Stands, etc. They may even be included with planning as deemed appropriate by the Farm Manager and Farm Club.
7. Community Members are not welcome to independently organize their own social events at the Farm without full prior approval of the Farm Club and Farm Manager. However, Community Members are welcome to bring friends and family to The Farm.
8. Community Members are not welcome to harvest produce from the Farm for personal use without the permission of the Farm Club and Farm Manager.

In addition, all Community Members must fill out the attached Farm Pass Application which should be returned to a member of Farm Staff or scanned and e-mailed to farm@pomona.edu upon completion. Once this form is signed by Farm Staff and returned to the Community Member, they must bring the form to Pomona College's Office of Campus Life (333 N. College Way), where they will receive a Farm Pass ID card.

"Gorilla Farming Club" Constitution and Bylaws

The Code from Which All Life Emanates

I. Constitution of the **Gorilla Farming Club**

II. The Gorilla Farming Club's goal is to provide a forum for investigating holistic, sustainable farming. This club will emphasize hands-on experience. We aim to provide the college community and some of those less fortunate with wholesome organic food.

III. The club is open to all students, faculty and staff of the Claremont Colleges. No one shall be denied membership on the basis of race, religion, creed, national origin, sexual preference (or lack thereof), musical preference (even country), dislike of chocolate or sugar, or sex.

IV. The following officers shall be elected at the last regular meeting of the spring semester, by a majority of the members present:

A-Consuls- The consulship shall consist of two members responsible for the highest moral representation of the Club in all aspects of the function of the Club. These dignitaries must not only chair meetings and appoint committees, but shall be required to always maintain strict standards associated with the prime directive of the farmer.

B-Taskmaster- The Taskmaster will be appointed by the Royal Consuls as the most prestigious post available to humans. Her/His job will be to descrap those in need in order to maintain a semblance of "real world" bureaucracy and bookkeeping. The Taskmaster will be graciously rewarded by the Royal Court in return for its submission of the annual budget to ASPC.

C-High Priest- The High Priest is an elder position, designed to balance the rigid anti-scrap authority of the taskmaster with soothing spiritual guidance. It is the job of the High Priest to heal those members who have let the stresses of modern life impede the flow of life energy.

V Advisor- The Advisor may be chosen by the Royal Court.

VI Meetings- The Gorilla Farming Club will meet every day at four o'clock.

VII Quorum- As long as someone shows, that's business. A meeting representing the majority of interested parties will be The Royal Court.

VIII Successor Organization- In the case of a world crisis, or some other mammoth catastrophe, all assets shall be turned over to the Conscientious Food Club

IX Amendments- Amendments to this constitution may be made by a two-thirds vote of the membership present at a meeting declared special by the Royal Court.

X Ratification- This constitution shall be ratified when it is approved by a vote of two-thirds of the Royal Court.

By-Laws of the Gorilla Farming Club

1- There shall be no dues, this club works for you.

2- Executive Bored- The officers A, B, C, shall be the Chief Executives and are empowered to act for the club in times of need, so long as they inform all members.

3- Committee-Nope

4- Parlimentary Procedure- Everyone shall respect others.

5- Amendments- These by-laws can be amended any time by the Royal Court.