URBAN FARMS
BEST PRACTICES MANUAL

A general reference guide for urban farmers in the Greater Phoenix area at The Society of St. Vincent de Paul

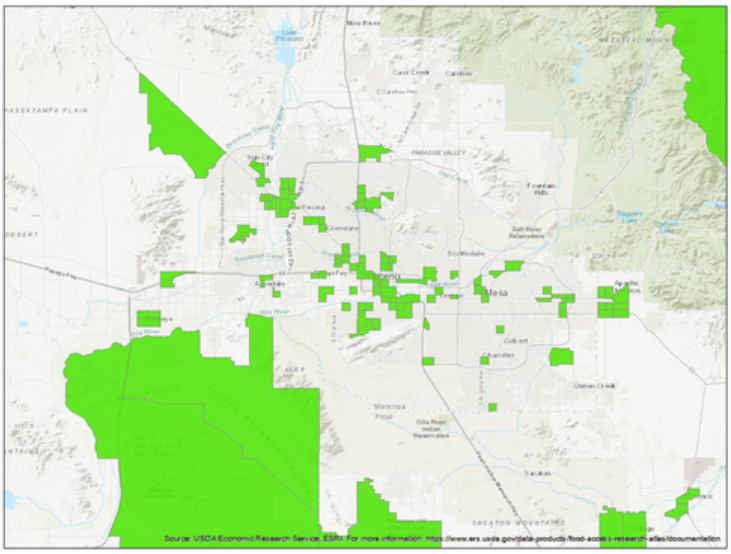
Table of Contents

Written By:
Leigh Orlando-Ward
For SVdP, 2021/22

SVdP Urban Farms Program Overview

SVdP Urban Farms Mission Statement

"Our mission is to grow healthy, nutritious food to feed those in need while increasing diversity, educating, and empowering community members to discover and participate in a local food system by learning through practical work experience. Our Farms provide an educational and active volunteer experience at all three locations, in accordance with the SVDP fellowship mission." - Dave Smith



This map exhibits areas of food insecurity in the Phoenix Metropolitan Area as defined in 2019 by the U.S. Department of Agriculture

What is this manual for?

This best practices manual is intended to be a go-to resource and starting point for all knowledge required to operate a SVdP Urban Farm in the greater Phoenix area. This manual provides basic info for immediate problem solving as well as in-depth discussion of various core concepts for further learning. In some cases, the information provided here is considered standard across all SVdP Urban Farms. In many cases, this manual attempts to display the breadth of options a farmer can take in many urban farming scenarios leaving the choice of which path to take up to the farmers on duty. The information provided here is specific to Maricopa County and the surrounding area. This material is based on farming conditions in zones 9b and 10a which are the current zone designations defined by the USDA for the Phoenix Metropolitan Area as of 2021. It is the intention of the SVdP Urban Farms program to operate under pretenses of organic farming and environmentally friendly methods to the greatest extent possible. The information included in this manual reflects those values.

Everyone working on SVdP urban farms should have access to this manual; it should be the starting point for all SVdP Urban Farms volunteers and staff. Another intended goal of this manual is to develop and maintain consistent practices throughout all facilities across SVdP's Urban Farms program. Working in a united effort, with room for flexible approaches in unique situations, allows for optimized utilization of resources and efforts leading to a greater impact on food insecurity in this region.

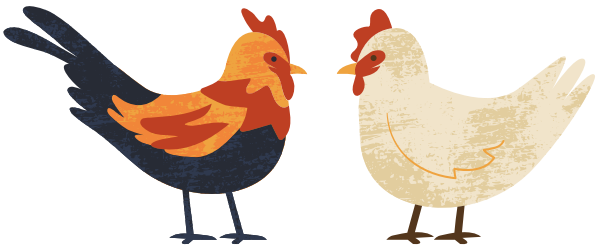
SVdP Urban Farms Program Overview

The Importance of Organic and Ecological Farming Practices

The definition of organic farming, generally, is farming done without the use of synthetic chemicals. This means that an organic farmer can still use an array of modern farming techniques to grow their crops. These techniques simply have to include only natural chemical compounds. Synthetic chemicals can last for weeks or months in a soil. Naturally derived compounds will usually degrade in less than a day or two. Artificial compounds which remain in or on crops after harvest can be toxic to humans. More broadly, a number of non-natural chemicals have been found to detrimentally impact an array of natural organisms. To support the natural life in ecosystems local to SVdP Urban Farms, the program operates under theories of ecological farming practices in conjunction with organic methods. This means that through techniques such as organic fertilizer and pesticide application, companion planting, crop diversity and crop rotation, and a number of other ecologically focused farming practices, SVdP Urban Farms build healthy environmental habitats for the benefit of their crops, for the surrounding environment, and for local communities.

Acknowledgments

The creation of this manual would not have been possible if not for the incredible knowledge and efforts displayed by a number of SVdP Urban Farm Staff and Volunteers. Chanika Forte, as the SVdP Urban Farms Program Manager, is a unifying force who conceived and supported this project aiming to help continuously optimize and expand SVdP Urban Farms operations while furthering education for the communities they aid. Nika was the impetus behind its inception and without her passion and tireless efforts, this manual, and much of the Urban Farms program in general, would not exist today. Mary Ann Rickets, the Mesa Dining Hall Farm Manager and one of SVdP's most dedicated volunteers, was a wellspring of information and motivation throughout the process of creating this manual. Mary Ann's amazing attitude and hard work inspires her team and anyone who works with her. Taylor Scarpelli spearheads an incredible effort on the Rob and Melani Walton Urban Farm. Taylor kindly and carefully directs volunteer operations to produce a beautiful and highly productive farm on the biggest and busiest property in the program. Dave Smith's daily impact working with Taylor to run the Rob and Melani Walton Urban Farm may be enormous, but his amazing green thumb and visionary strengths are even more significantly felt through his leadership as the SVdP Urban Farms Program Director. A huge portion of this program and its current successes can entirely be attributed to Dave, without which this manual could not have been made.



Volunteer Programs

The SVdP Urban Farms program serves many missions, one of the most prominent being the development and support of members of the community from all walks of life. While gaining personal and professional experience, those who choose to give their time working on and for these farms are able to give back through their efforts. Volunteers have the opportunity to work for the SVdP Urban Farms Program in a variety of capacities.

AmeriCorps -

AmeriCorps is a federally funded program aimed at reducing poverty and its consequences by supporting and sponsoring passionate individuals hoping to develop a career in the non-profit and public sectors. The SVdP Urban Farms Program has a history of working with AmeriCorps and its subsidiary program, AmeriCorps VISTA. The development of this manual is a result of AmeriCorps VISTA's sponsorship of its author, Leigh Orlando-Ward. Nika Forte began her career with the Urban Farms Program sponsored by AmeriCorps, other AmeriCorps members have also worked for and assisted the program in a number of capacities and instances. If someone is hoping to develop a career in farming, sustainable food systems, or more general community development work with other SVdP Departments, they can reach out to SVdP lead staff for more information regarding opportunities with the organization sponsored by AmeriCorps.

LIA Program -

Other chances for project based volunteer work with SVdP in general and more specifically with the Urban Farms Program are offered through the Leadership in Action Fellowship program. St. Vincent de Paul's Leadership in Action Fellowship gives students and young professionals the opportunity to put their passions into practice, while enhancing their skills and self-knowledge and making an impact in the community.

SVdP Fellows are current university students or recent graduates who strive to be a part of the solution by sharing their gifts, expertise, and passion with SVdP and those we serve. At the core of the Fellowship is the desire to co-create an experience that helps to develop the next generation of strong social leaders and builds the capacity of SVdP to serve the community.

- What work will be involved in the Leadership in Action Fellowship?

SVdP Fellows engage in a continuous learning framework to build their leadership skills, personal leadership style, knowledge of themselves, and become more confident in their abilities. This is achieved through one-on-one mentorship, biweekly cohort gatherings, monthly educational sessions, an intentional feedback process, and guided reflection. This framework also helps fellows support one another, learn from each other, and provide a space to share their ideas.

Fellows have the opportunity to choose from several different types of projects. This could be serving within a specific project or department at SVdP to help advance its mission and work, or bring new ideas to help improve current processes. Or, Fellows can choose to engage in an entrepreneurial project, which would be co-created with a mentor.

SVdP Urban Farms Program Overview

- Required/Desired skills of an SVdP Fellow:

Mission oriented: Passion for working to fulfill the needs of the most vulnerable in our community. Strong interest in issues of poverty and homelessness.

Interpersonal Skills: Ability to empathize and strong communication skills

Leadership: Ability to take initiative and provide direction to others

Team-Oriented: Able to collaborate well with others.

General Computer Skills: Microsoft Word, Excel, and Powerpoint

Flexibility: Able to go where the need is and change course upon discovery of new information

Self-awareness and Humility: Interest in personal growth and honest feedback. Desire to continuously improve oneself

- How can I apply to be an SVdP Fellow?

If your university uses Handshake, please visit Handshake and search "The Society of St. Vincent de Paul". Please follow the instructions to apply via Handshake.

If your university does not use Handshake, please view opportunities and send a resume and cover letter, explaining your interest, experience, future career goals, and which specific fellowship you are interested in, to svdpfellows@svdpaz.org.

Future Projects

The urban farm is an ever-evolving program which looks to engage all communities on Sustainable Growing Practices as well as Whole Health and Wellness. In the future the program hopes to add in more sustainable programs like a Farmers Market, additional community plots for growing, educational greenhouses, Natural Growing Certifications for each one of our farm spaces, Yoga/Meditation spaces and experimental unconventional farm plots.

Social Impact

If you are interested in further reading on social impact and community engagement in urban farming, here are some helpful guides:

- Mercer, M. (2019, June 1). A Guide to Social Impact Through Urban Farming. Rob and Melani Walton Urban Farm at St. Vincent de Paul, Rob and Melani Walton Sustainability Social Services at Arizona State University. https://www.stvincentdepaul.net/sites/default/files/UrbanFarmGuide_digital.pdf

- This guide was created by a team from ASU working in conjunction with SVdP Urban Farms staff and volunteers. It provides and in-depth discussion of developing an urban farm program and its integration with a local community.

Educational Opportunities and Future Projects at SVdP Urban Farms

In addition to feeding those in need and providing experiential opportunities to the community, SVdP Urban Farms have a goal of education for all involved with the program. Below are some examples of courses which the program has offered in the past and may offer again in the future.

-Free painting class for shelter guests
-African dance class for Dream Center children
-Dream center garden club
-Chakra balancing meditation for shelter guests
-Junior Master Gardeners Program
-Permaculture Practices
-Healthy eating for children
-Basic beekeeping
-Yoga for shelter guests
-Meditation and Art Therapy
-Seed starting class for Dream Center Children
-Ozanam meditation and wellness class
-Chair yoga for elderly shelter guests
-Chicken care for children
-Seed saving class
-Fall art festival

Equipment, Health, and Safety

General Tool and Equipment Use

There are a wide variety of tools one might encounter on a farm. Some have broad applications and are useful for diverse tasks. Other tools are more specified and are only useful in certain situations or when used in particular ways. Regardless of the tool, learning to use any equipment properly and safely is paramount for a farmer's health and effectiveness.

Manual labor in general involves many movements and procedures which can be difficult and harmful if done incorrectly. Urban farming environments present their own unique safety challenges. General knowledge of safe manual labor practices provides farmers with a foundation for many years of healthy and happy work around any farm. This section of the SVdP Urban Farms Best Practices Manual provides a basis for optimizing a farmer's health and safety while working on a farm, both short and long term. This section also includes information regarding safe food handling practices in urban farming. For more in depth discussion of all equipment and safety subjects, see the references listed at the end of this manual.

Using power tools can add a significant amount of danger and required skill to any task. A farmer should always be sure they are comfortable with any power tool they use and well trained in its operation and potential hazards. Using power tools on SVdP Urban Farms requires training and supervision from a lead staff member or lead volunteer. Do not attempt to use a power tool on any SVdP Urban Farm without first consulting a lead staff member or lead volunteer.

Basic Safety in Manual Labor

All farming tasks contain the possibility for injury. Here are some general tips for working safely on a farm and in any manual labor environment:

- All manual labor practices generally require a flat back, tight core, and effective use of one's legs.
- A task should always be assessed before work begins to ensure a safe work space and comfortable accessibility.
- Any bending motions required should always be done by a person's knees and with the strength of their legs, not their back. A farmer should avoid bending their back, keeping it straight and in line with their head and neck.
- All standing tasks on a farm are best done with spread, stable, and planted feet.
- Moving any amount of material which feels excessive or too difficult should always be avoided. Ask for help or reduce the size of a material load when it feels too heavy. Employ the use of lifting aids, such as a wheelbarrow or dolly, whenever possible.
- Any loads which a farmer carries should be held close to the body at waist height. Lifting objects high over one's head, supporting significant weight far from the body's center of gravity, and twisting motions should be avoided when possible.
- When a task requires a person to stand, sit, bend, or kneel for a long period of time, it's important for a person to relax their body and regularly adjust their position.
- If a repetitive task causes any pain or discomfort, a farmer should change their approach to that task or not do it at all.

Equipment, Health, and Safety

Personal Protective Equipment, PPE

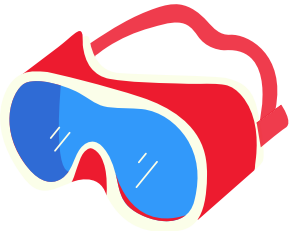
Gloves should be worn when conducting most farm tasks. Reusable gloves come in a variety of materials and thicknesses and generally protect a farmer's hands from abrasion, cuts, and excessive dirt or mess. Thick leather gloves are useful when handling sharp objects. Thinner rubber or cloth gloves can improve grip on a tool or material. Single use gloves are best for protecting skin from harmful substances and maintaining clean work environments. Single use gloves should always be utilized when harvesting.

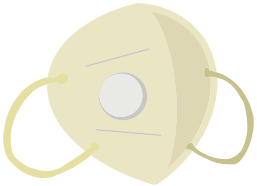
Appropriate Footwear helps to ensure a farmer has stable footing in any farm work situation. Open toed shoes should not be worn while working on any SVdP Urban Farm. When using cutting tools, especially powered cutting tools, leather boots are recommended. Shoes or boots with ankle support can also help prevent injury. In some situations, such as working in the immediate vicinity of heavy machinery, boots with a steel or composite safety toe are recommended.

Eye protection is required when particulate or larger material is liable to injure a farmer's eyes. The use of many hand tools, mainly those which involve heavy impacts such as a pick or hammer, and the use of all power tools require the use of eye protection. Any activity which has the potential to propel material into the air should involve the use of eye protection. Eye protection can also be useful when working within dense vegetation to prevent pokes and scratches.
Ear protection is required when loud noises accompany a task. Working with machinery and power tools usually requires the use of ear protection. Some hand tools, such as a post tamper, should also be used in conjunction with ear protection. Anytime an activity involves excessive noise or sound which could potentially damage a farmer's hearing, ear protection should be used.

Masks or Respirators are required when any harmful chemicals or dusts are airborne. Application of pesticides and fertilizers as well some cleaning tasks are aided by the use of a mask or respirator. A mask or respirator should always be worn when working with materials which propel a significant amount of particulate into the air, such as concrete or dry soil.

Long sleeves are helpful for reducing cuts, abrasions, and excessive dirt or mess. Long sleeves are required when applying any harmful chemicals.





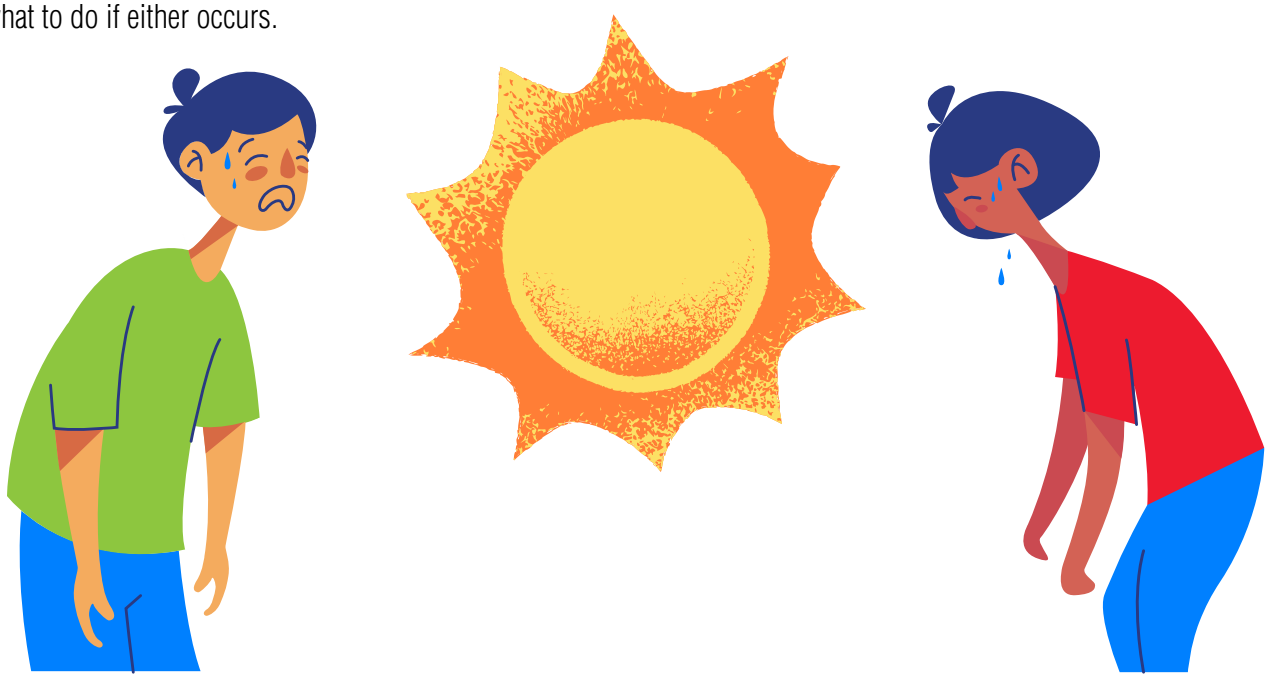

Working Safely in the Sun and Heat

Located in the Greater Phoenix Metro Area, SVdP urban farmers work in the hottest climates nationwide during certain times of the year. It is essential for anyone working outside in conditions above 80 degrees Fahrenheit to be aware of how to handle working in the heat as well as the signs of heat stress and what to do if it occurs.

Here are some general tips for working in the sun and heat:

- Cover exposed skin with long sleeves and use sunscreen when necessary
- Wear a wide brim hat and sunglasses
- Drink small amounts of water often; try to take a sip every fifteen minutes or so
- Wear light colored and breathable clothing
- Take frequent short breaks from work, seek shade when possible
- Caffeine and alcohol can increase effects of heat
- Respirators, work suits, and other wearable equipment can increase effects of heat
- If a hot environment is new to a farmer or a person has taken extended time away from work, they will likely need to acclimate to the heat by taking their time and extra breaks

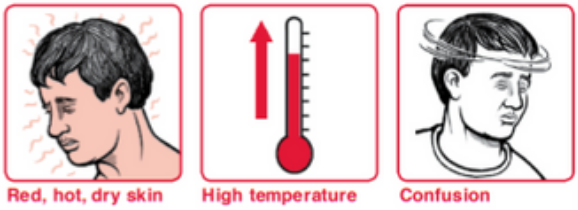
Heat stress, or heat illness, has varying degrees. Heat exhaustion is a serious condition, but it is just the first stage of heat illness. A person can often recover from heat exhaustion through basic remedies (though it can also require hospitalization in some instances). Heat stroke is the most severe version of any heat illness. If a person exhibits any signs of heat stroke, they should be taken immediately to a medical professional or 911 should be called. See the diagrams on the following pages for more information on identifying heat exhaustion, heat stroke, and what to do if either occurs.

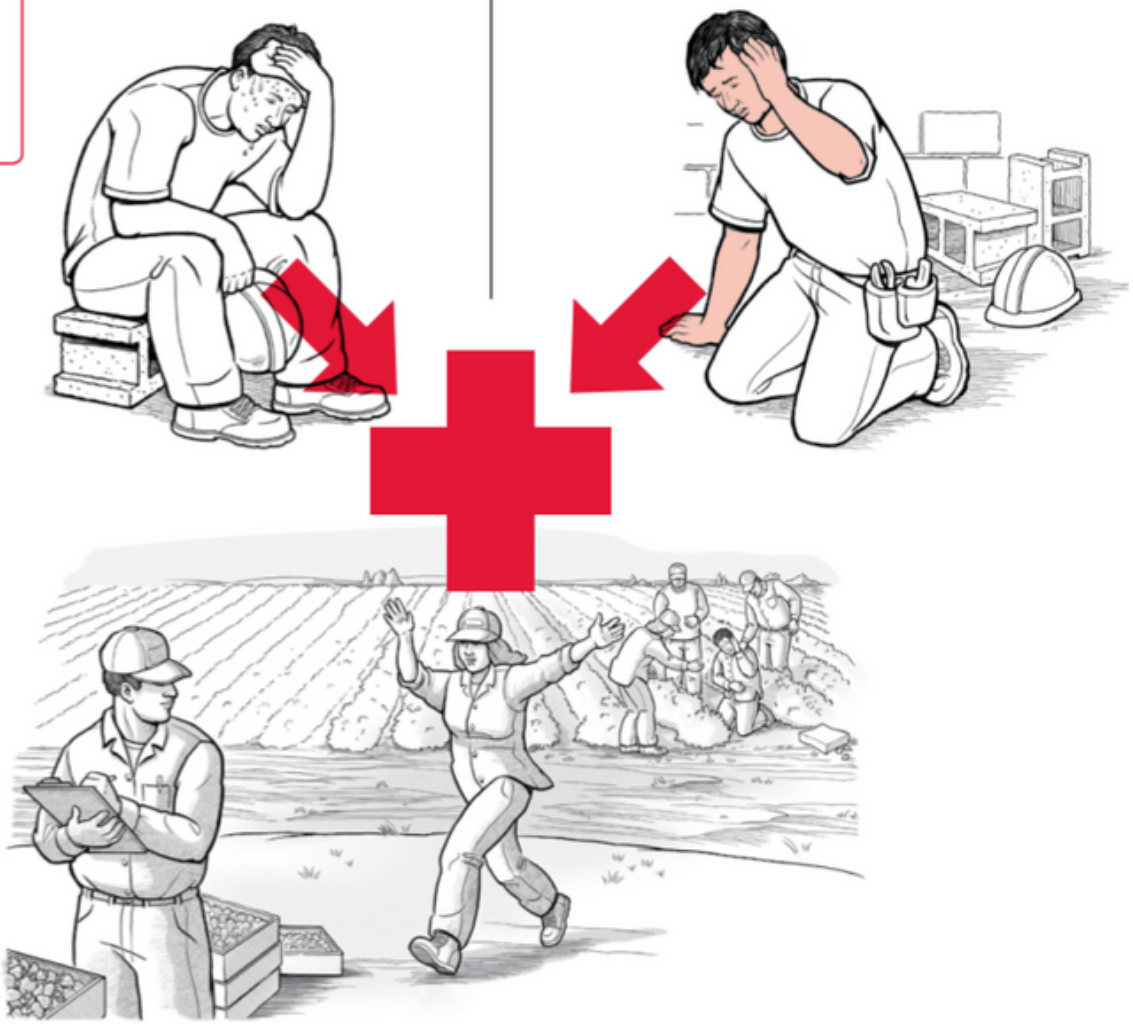


Two types of heat illness:

Heat Exhaustion

Heat Stroke





Heat kills – get help right away!

Stay safe and healthy!

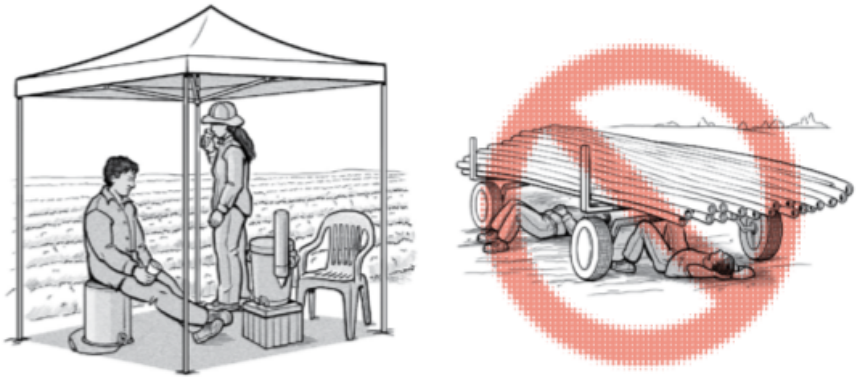
Drink water even if you aren't thirsty –
every 15 minutes

Watch out for each other

Wear a hat and light-colored clothing

Know where you are working in case you need to call 911

Rest in the shade



Heat illness can be prevented!

☑ Water

☑ Shade and Rest

☑ Training

☑ Emergency Plan

U.S. Department of Labor

OSHA® Occupational Safety and Health Administration
U.S. Department of Labor

CAL OSHA
Developed by CAL/OSHA

If you have questions, call OSHA.
It's confidential. We can help!
1-800-321-OSHA (6742)
TTY 1-877-889-5627
www.osha.gov

OSHA 3422-10R 2011 (AG/CONST)

Food safety

Good hygiene practices on a farm are essential for limiting the possibility of foodborne illness from fresh produce. A number of conditions in farming have potential to introduce microbial contaminations to produce consumers. Toxic and otherwise harmful chemicals can also be present on produce from a farm. Several steps must be taken in a food preparation environment to ensure safe consumption of freshly harvested produce. These include thorough physical or chemical sanitation steps as well as proper cooking procedures in the kitchen. For more information regarding safe food handling and preparation in the kitchen, see the references listed at the end of this manual. Most relevant to SVdP Urban Farms are the practices required for delivering the cleanest and safest produce possible to the kitchens for further processing.

Here are some suggestions for safely handling produce when harvesting:

- Single-use disposable gloves must be used when harvesting and should be changed regularly between tasks. Hands should always be washed immediately before wearing single-use gloves.
- Hands must be washed regularly while working on a farm, especially when....

1. Arriving to work
2. Beginning to harvest
3. After using the restroom, eating, or taking a break
4. After handling garbage, chemicals, or other materials which are dirty, toxic, or have the potential to remain on a farmer's skin
5. After sneezing or coughing
6. After applying sunscreen or other skin products

Hand Washing and Hygiene

This information applies to all farm personnel including farm managers, workers, volunteers, farm visitors and contractors. Everyone on the farm should understand and practice proper hand washing, regardless of their job. Please use hand sanitizers when running water or soap are not available.

Procedure to be completed before the beginning of work, after each break, after eating or smoking, after using the toilet, at the end of the day, and at any other time hands become dirty:

- Wet hands with water.
- Apply soap and lather.
- Be sure to wash the front and backs of hands as well as in between the fingers. Rub hands together for at least 20 seconds.
- Rinse hands thoroughly.
- Dry with a paper towel (and turn off faucet with the used paper towel).

All illness experienced during work should be reported to a lead staff member or lead volunteer. A farmer should never work directly with produce if they are vomiting, have a fever, or have diarrhea.

Eating, drinking, smoking, or chewing gum is not permissible while actively harvesting or generally working with produce. If these activities are engaged in during times other than those spent harvesting and working with produce, hands must be washed afterward.

Any surface which regularly comes into contact with food should be smooth and easily cleanable. Equipment which comes in contact with harvested produce should be sanitized daily. A disposable liner should be used in harvest containers when possible.

Daily Operation and Quick Start Guide

This section serves as a daily operation and quick start guide for working on SVdP Urban Farms. Quick start tips are highlighted below and can be utilized as an easy way to begin working on the farm. SVdP Urban Farmers should look for highlighted text in this section to find quick and easy suggestions when they aren't sure of what to do next. This section of the manual in general is the starting point for new urban farmers.

Learning how to effectively approach daily allocation of time and labor is one of the most important skills a farmer can develop. It can seem like there are endless tasks on a farm. Figuring out how to prioritize and optimize work efforts is often daunting. No farm work methodology is perfect, but there are some fundamental factors and daily steps which can give a farmer the best opportunity possible for highly successful crop production. This section of the SVdP Urban Farms Best Practices Manual provides a basic structure for efficient daily operation of a farm, urban or otherwise. More specific planning and preparation techniques for various farming subjects can be found in their corresponding sections of this manual. For more information on how to conduct research on a farm, see the references listed at the end of this manual.

Ultimately, the delegation and prioritization of daily tasks is up to the farm manager or lead volunteer on staff at any given time. Any time a volunteer works on a SVdP Urban Farm, the first step they must take is signing in at the front desk. Their final task for the day is to sign out at the same location.

The Gardening Scientific Method

The following steps and their organization generally represent a good daily workflow. It is important that observation comes first, regardless of the order of the subsequent steps. Observation can also be thought of as the initial step to each of the other steps. Any task completed on a farm should start with situational assessment. This model of approaching daily operations can be utilized on a short term or long term scale.

Step 1, Observation – Every day a farmer should take the time to thoroughly walk through their farm observing all of its facets along the way. A farmer should be intimately in tune with the space they are working in. If any changes occur they should be immediately apparent to a farmer who is well aware of the conditions on their farm. This can be aided by taking careful notes during observations. The most common approach is to walk through all areas of a farm with a pen and pad, or mobile phone or tablet, and take notes of any and all observable conditions. This is an opportunity for a farmer to take on a highly scientific approach. Any observed change, or lack thereof, no matter how minute, should be recorded. Once a walk-through has been conducted across an entire farm, a farmer can prioritize tasks and delineate work for the day. Prioritizing work should always be based on what's most immediately necessary. The following categories can help a farmer organize the work which follows a morning farm walk-through.

Quick Start Guide, Observation: How does the farm look today? Walking around, are there any simple tasks that are immediately obvious? Is everything clean and organized? These are some general questions farmers can ask themselves when walking around their farm first thing in the morning. More specific investigative questions are found in each of the following steps.

Daily Operation and Quick Start Guide

Daily Operation Note At the HSC Farm, it's essential to regularly check if the chickens require food, water, or if their enclosure needs cleaning. Other animals, such as cats, are often present and being cared for on each of the farms. Check with lead farm staff or volunteers to see what animals are onsite and if they need any care.

Step 2, Plant Care and Planting- After observations across a farm are made, plant-oriented tasks for the day can focus on care of existing plants, installation of new plants, or preparation for future care or installation. If no planting should occur on a given day, that might be a great opportunity to spend extra time caring for the plants already present on a farm. Based on plant health observations, a variety of plant maintenance tasks can, and likely should, occur on a daily basis. Accessibility of resources should also be assessed. A farmer should check soil moisture on a daily basis and adjust watering practices as necessary. For more information regarding watering, see the section of this manual titled Irrigation and Watering starting on page 71. Farming in any setting, especially one as diverse and multi-faceted as SVdP Urban Farms, involves a combination of planning and flexibility.

There are usually a few main planting seasons per year, but in reality, planting can occur continuously as a farm evolves throughout its various growing seasons. It is often most effective to approach optimization of crop productivity on a daily basis instead of on occasion. A farmer, especially in a setting serving those in need such as SVdP Urban Farms, should try their best to grow as much food as possible. Filling all usable growing spaces at any given time of year can result in a more continuous food supply in the long run. That being said, overplanting and overextending a farm's resources can be detrimental to its overall productivity. A farm can only grow the amount of food its resources will support. This can be thought of as an exercise in quantity versus quality. If more plants are installed than can be cared for, general productivity can slow or halt completely. If time and labor are in short supply, it is important to only plant the amount that can be cared for. If there's no space, not enough hands, or not enough time for new planting and all existing crops have been properly cared for, a farmer can also prepare for future planting. Tasks such as seedling propagation, row plotting, or seed bank organizing are all great ways to spend time working toward another day's planting projects. For more information regarding plants and planting, see the section of this manual titled The Plants on SVdP Urban Farms starting on page 27.

Quick Start Plant Questions – Here are some basic questions farmers can ask themselves about plants and planting to get the work day started:

- Do any beds, rows, pots, or individual plants need watering?
- Is there anywhere I can plant more crops?
- What kind of crops can be planted this time of year? For more information regarding planting and crops, see the section of this manual titled The Plants on SVdP Urban Farms starting on page 27.

One of the most important questions regarding plants is, are they healthy? Plants and their health are one of, if not the, most important aspects of operating a productive farm. Each morning an urban farmer should inspect all of their crops for any changes in growth patterns, signs of distress, or poor health. Here are some basic signs a plant might be experiencing health issues:

- Changing foliage coloration on a plant, usually from green to yellow or brown. Spotting or burned edges on leaves are also poor health indicators.
- Wilting or drooping foliage
- Dried, stiff, or "crispy" foliage
- Holes, cuts, or other damage in foliage
- Unusually slow or stunted growth
- Unusual leaf shapes or other growth patterns
- Little to no development of flowers, fruits, or other reproductive parts
- Bugs collected on areas of a plant in dense numbers

For more information regarding plant health and what these indicators might tell a farmer about a plant's health, see the sections of this manual titled The Plants on our Urban Farms and Ecological Farming Practices and Integrated Pest Management starting on pages 27 and 76.

Step 3, Harvesting – A farmer, especially on SVdP Urban Farms, should check daily if any crops are ready for harvest. On farms practicing ecological farming methodologies, there are less defined harvest seasons and times. Harvest periods can last multiple months and spread over several growing seasons in some cases. On SVdP Urban Farms, food is sent to kitchens and food banks on a daily basis when available. Maintaining a regular supply for SVdP Dining Halls is one of the main goals of the Urban Farm Program. Harvesting periods for crops on SVdP Urban Farms can be constant and do often overlap, most of the time intentionally. These are just some of the reasons a farmer should always be on the lookout for crops to harvest. If there are none, a farmer can take on a number of other tasks to prepare for the next harvest. Preparing a site by ensuring there is adequate room for people and equipment during harvesting can make a significant impact come harvest time. General cleanups and maintaining a clean work space are useful for all farming tasks but can be especially so in consideration of harvesting.

Quick Start Harvesting Questions – Here are some questions a farmer can ask themselves about harvesting:

- Are there crops that need harvesting? If a crop looks ready to harvest, it very likely is! A farmer should harvest any crop which appears ripe. For more information regarding how to determine harvest readiness, see the Harvesting Techniques and Individualized Care subsection starting on page 49.
- Have crops already been harvested and need to be transported to the kitchen or prepped for serving?
- Are any crops past their prime? If so, they should be removed and composted.

Daily Operation and Quick Start Guide

Step 4, Composting – This step of daily operation is focused on the processing of waste and maintenance of a clean and effective workspace on a farm. If planting or harvesting were conducted on any given day, it is very likely some waste material was left behind. In general, farm tasks produce a lot of waste, some of it is plant or other organic waste, a lot of it is trash! In either case, processing waste on a farm not only preserves a clean space to work in, it also can provide valuable resources. Other than invasive weed materials, all plant waste material should be composted. For more information on composting and how it's done, see the section of this manual titled Soil Science, Fertilizer, and Compost starting on page 55. Paper and cardboard products can be utilized as mulch or, if they contain entirely natural materials, can sometimes be added to compost if broken down into small pieces. All plastic or other synthetic material wastes should be placed in the appropriate trash or recycling receptacle. Before a farmer leaves work for the day, all waste material should be collected and handled appropriately.

Quick Start Compost Questions – Here are some questions a farmer can ask themselves about composting:

- Are there plants that are finished growing and need to be removed?
- Is there any general plant waste which needs to be collected for composting?
- Has the compost been turned? For more information regarding the steps to making compost, see the section of this manual titled Soil Science, Fertilizer, and Compost starting on page 56.

Step 5, Soil Care and Fertilization – Once the plants on a farm are cared for and any waste is cleaned up, a farmer can turn their attention to the soil on their farm. Weeds should be removed as often as possible in farm growing spaces. Amendments, such as fertilizer or compost, can be added to soil to improve plant growth when needed. Mulch can be applied on top of soil for a number of reasons. Several tasks can be conducted on a daily basis to optimize a farm's soil and growing spaces in general. For more information on fertilization and soil care, see the section of this manual titled Soil Science, Fertilizer, and Compost starting on page 56.

Quick Start Fertilization and Soil Care Questions – Here are some questions a farmer can ask themselves about fertilization and soil care:

- Are there weeds which need to be pulled?
- Is there mulch or compost which needs to be spread?
- When were fertilizers or soil amendments last applied? Check with a lead SVdP volunteer or staff member to see if soil needs to be fertilized or amended in any way.

Step 5, Cleanup – All tools and equipment utilized in farm work should be cleaned and returned to their designated locations. All pathways and working areas should be free of items or debris.

Repeat!

Utilize the forms shown on the following pages to track all farm tasks done on a daily basis.

Harvest Log

Date	Item (Crop)	Weight in Lbs	Signature

Volunteer/Guest Appreciation/Compensation

Date	Volunteer	Signature	Item	Staff Initials

Planting Log

Plant Type	Number Planted	Location	Signature

Hand Watering Log

Date	Tree or Area	How Much/How Long?

Composting Log

Date	Bin #	Added, Turned, or Watered?	Temperature

Chemical Log (Pesticides and Fertilizers)

Date	Chemical Used	Area(s) of Work	Goal/Reason

Animal Care Log

Date	Cat(s)	Chickens	Task (ex. fed)

Equipment Log

Tool	Date	Task (ex. repaired)

Food Waste Mitigation Log

Date	Lbs of Food Waste Composted

Tasks Accomplished (Daily Activities Log)

Date	Item (Crop)	Weight in Lbs	Signature

Basic Plant Science

The most important part of any farm is, of course, the plants. Knowing the basics of how plants live, how they grow, and how a farmer can help them succeed is essential to productive farming on any scale. This manual presents basic information regarding plant biology for the function of working on an SVdP Urban Farm. For more in-depth information, see the references listed at the end of this manual.

Plant Morphology (Parts of a Plant):

Root – A plant's roots (aka root system) anchor and support the above-ground (aka shoot system) portion of a plant, they absorb nutrients and water, and they act as storage for unused nutrients.

Stem – The stem or stems of a plant are the main above-ground structure of a plant. Stems transfer nutrients throughout the plant and support all of its above-ground features. A plant's branches are an extension of its stem. Stems come in a wide variety of shapes and sizes. There are a number of terms used to describe leaves which can help in plant identification. For more information regarding stem descriptions, see the references listed at the end of this manual.

Leaf – Leaves on a plant primarily serve the purpose of collecting light to fuel the plant's growth through the process of photosynthesis. Secondarily, leaves regulate a plant's moisture and temperature levels. Leaves come in a wide variety of shapes and sizes. There are a number of terms used to describe leaves which can help in plant identification. For these terms and more information regarding leaf descriptions, see the references listed at the end of this manual.

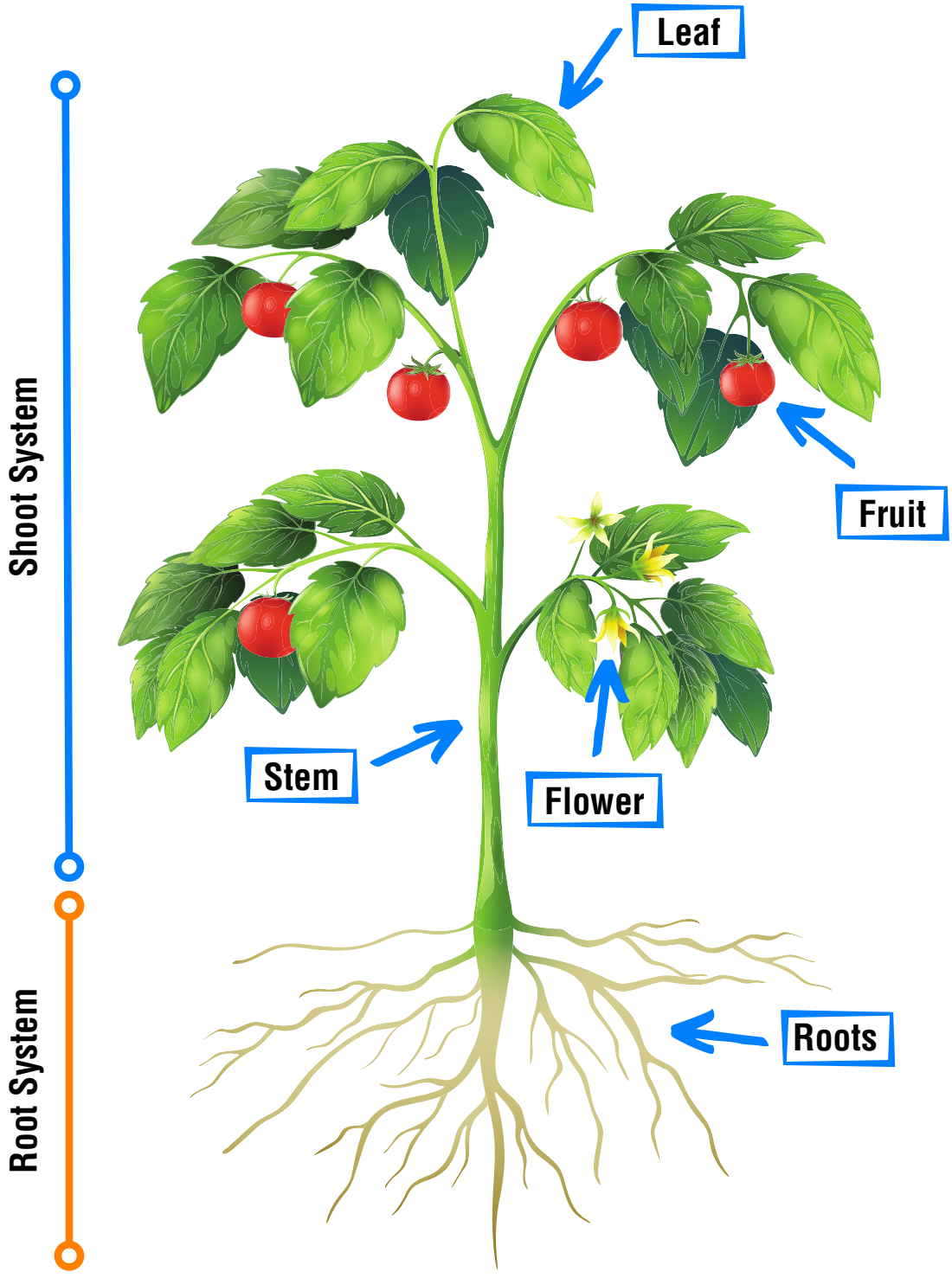
Flower – Flowers produce viable seeds through pollination. Flowers are only grown by flowering plants, otherwise known as angiosperms. Pollen is dispersed from the flower of one plant to another by pollinating insects, animals, wind, and other natural processes. This process fertilizes a plant's seeds. Plants which don't grow flowers, otherwise known as gymnosperms, grow pollen cones instead. Further in-depth discussion of angiosperms and gymnosperms can be found in the following section titled Plant Classification by Reproductive Method.

Fruit – Fruits on a plant carry and disperse seeds for reproduction, fruits are the mature ovaries of a plant. Seeds within a fruit are dispersed by insects and animals, water, and other natural processes. Fruits are only grown by flowering plants, otherwise known as angiosperms. Plants which don't grow fruit, otherwise known as gymnosperms, grow seed cones instead.

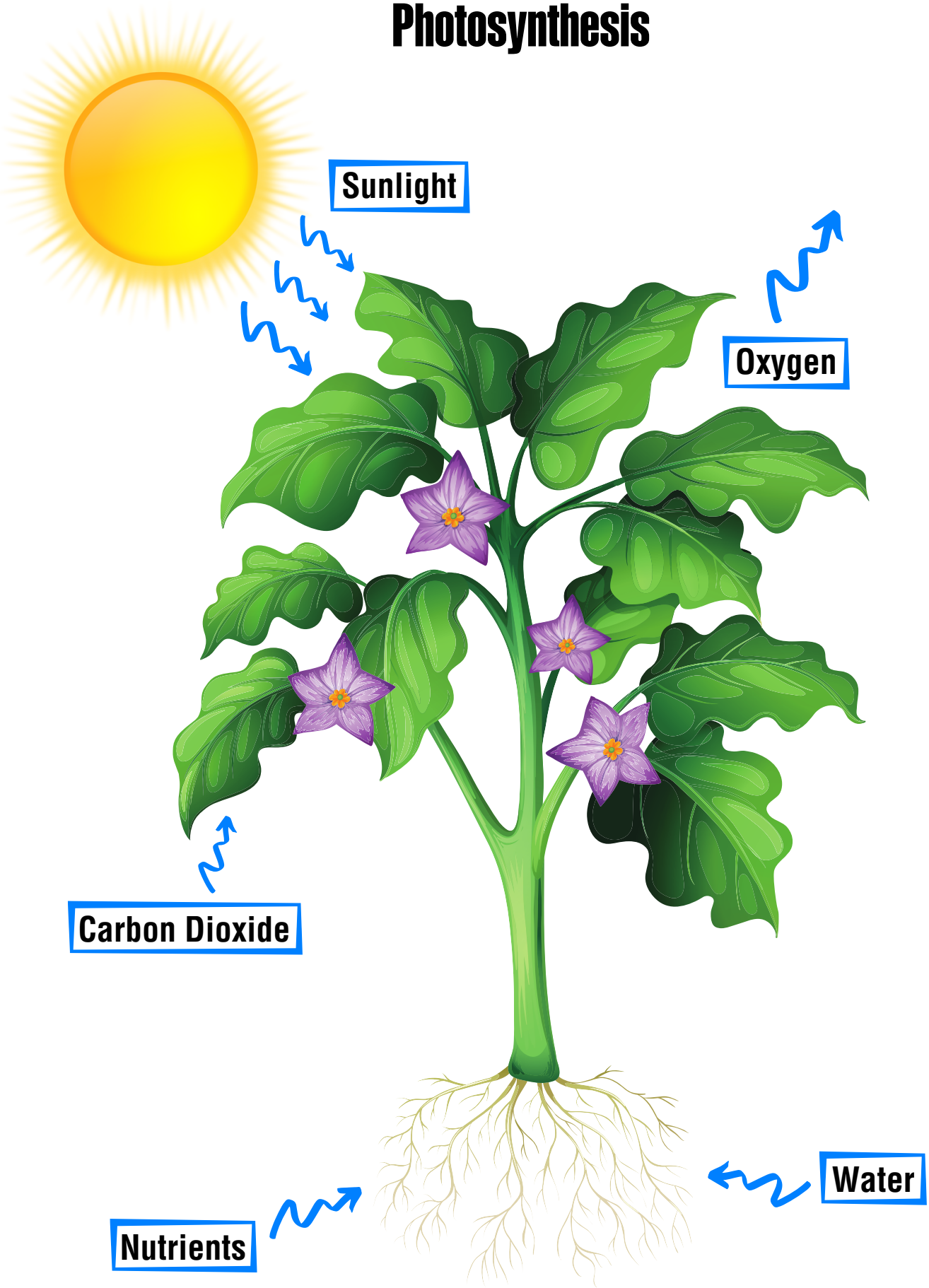
Node/Bud – Nodes are the parts of a plant where new growth develops. They can produce stems, leaves, and reproductive growth such as flowers, fruit, and cones. A bud is any new growth developing from a node, where that node is found on a plant determines what that bud is called. For example, the top most bud on a stem is called the apical bud. Buds, or nodes, are not shown in the diagram on the following page. For more bud types and information on nodes/buds, see the references listed at the end of this manual.

Seed – Seeds carry a plant's genetic information necessary for reproduction. A seed can be thought of like an egg; it contains genetic material waiting to be fertilized. In plants, pollen is the material which fertilizes a seed.

Plant Morphology (Parts of a Plant)



Photosynthesis

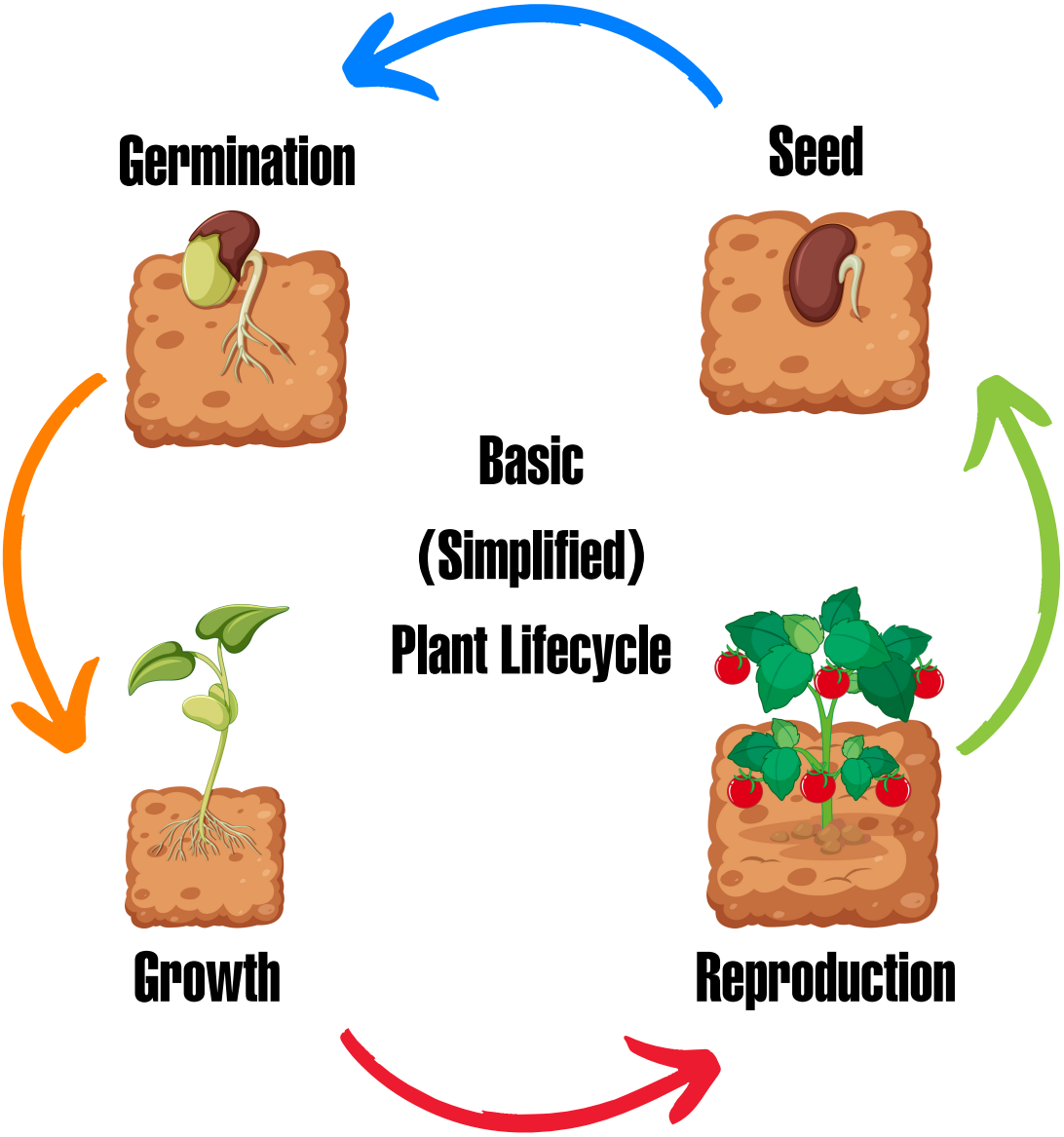


The Plants on SVdP Urban Farms

Plant Lifecycles

Nearly all plants live out the same lifecycle. Different plant species live out the distinct growing periods of this lifecycle over varying timelines (for more information regarding the time it takes a plant to go through all of its lifecycles, see the section below titled Plant Classification by Lifecycle.)

Whether it's a tree, a flower, a shrub, or any other type of plant, it starts its life as a seed. This seed germinates in a growing medium, such as soil, when it senses the presence of moisture and other environmental factors (for more information regarding seed germination, see the section below titled Seedling Propagation Techniques). A germinated seed then begins developing vegetative growth like stems, leaves, and roots. Based on the time of year and other environmental conditions like temperature and sunlight, a plant then grows reproductive organs such as flowers, fruits, and seeds. Finally a plant's genetic material is dispersed and it either dies or goes into dormancy.



Plant Classification and Identification

Plant classification systems are a great way to learn more about plant biology in general. This section of this manual is intended to give a broad overview of plant biology while explaining some ways to categorize plants. Throughout history, there have been more than sixty systems (depending on how they're counted, there could be many more) to define different types of plants, some methods more scientific and complex than others. Humans have tried to understand and define the planet's diverse plant life for thousands of years. Each of the plant classification systems created over time has tried to emphasize important similarities various plants share. Distinguishing essential plant features such as growth habits, reproductive methods, and life cycles have been used to group various plants together. As science developed, the complexity and number of these distinguishing essential features have grown immensely. Plant science becomes increasingly useful the larger an agricultural operation is. A deep scientific knowledge of modern plant science and classification is not necessary for the purpose of learning to farm in a setting such as the SVdP Urban Farms (though more knowledge is always helpful!) For in-depth discussions of all things plant science, see the references listed at the end of this manual.

A person should introduce themselves to a few different common ways of classifying plants. Gardening and farming are the culmination of knowledge from a plethora of disciplines throughout human history. Some research shows that people have been engaged in agricultural activity for twenty thousand years or more. Whatever plant classification method a farmer chooses, in practice, the most important reason for categorizing plants is that the knowledge of why a plant belongs to a certain category should inform a farmer or gardener of how to care for that plant. Teaching one's self a working knowledge of basic plant biology and at least one plant classification system will give a person the most basic tools for being a successful gardener or farmer.

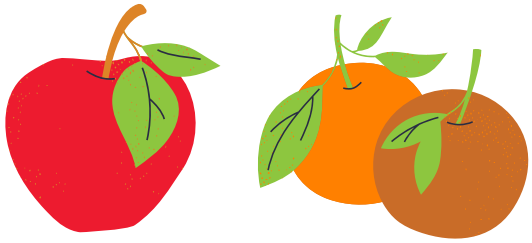
Plant Classification by Lifecycle

One of the easier ways to classify and distinguish different plant types is by the length and timing of their lifecycles. All varieties of plants live out their lifecycles in one of three ways: Annual, Biennial, and Perennial.

An annual plant goes through all lifecycles, starting from seed, and dies at the end of a single year.

A biennial plant goes through these stages over the course of two years. The first year is generally focused on vegetative growth, like leaves and stems, and the second year on reproductive growth, such as flowers and fruits).

A perennial plant will go through all lifecycle stages in a single year and will continue to do so for many years to come (aside from seed germination which only occurs the first year of a perennial plant's life.) The eventual lifespan of a perennial plant is dependent on the species and growing conditions. The crops on SVdP Urban Farms can come from any of these three categories, yet because of the nature of farming, all plants which are utilized as crops are treated as annual plants and are removed at the end of their lifecycle.



The Plants on SVdP Urban Farms

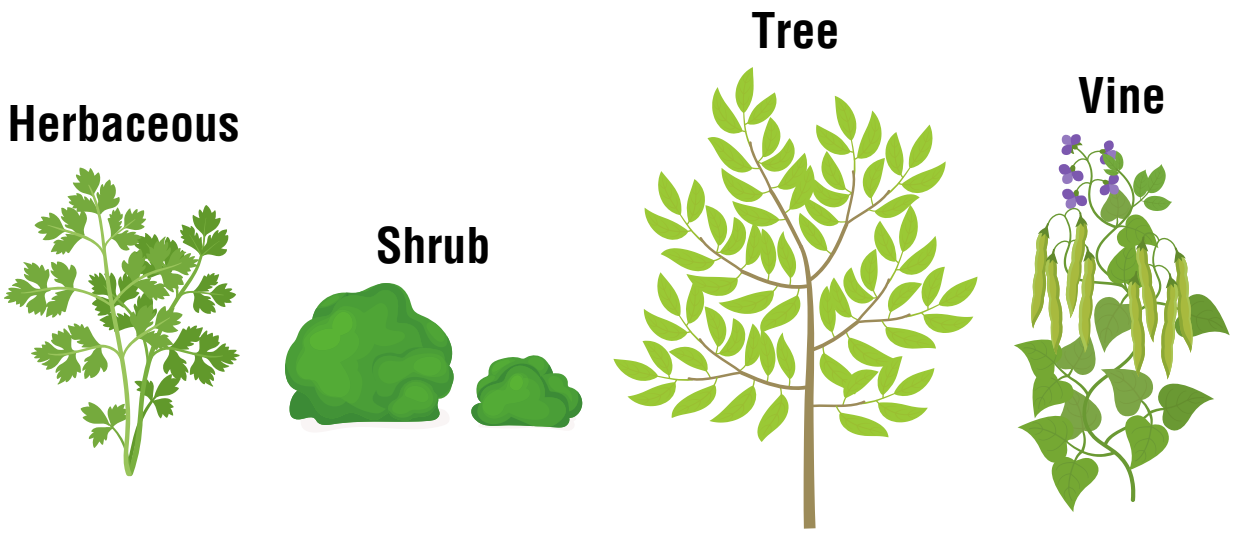
Plant Classification by Growth Habit

A fairly basic and visual way to classify plants is by their growth habit. This system can be somewhat ambiguous because there are exceptions in each of the categories listed below which don't follow the rules outlined. For example, a sunflower is considered an herbaceous plant yet many varieties can grow much taller than most shrubs and even some small tree species. This system can be a good starting point for a lot of people when identifying a plant or determining its care.

Four identifying terms used in this classification system are woody, non-woody, evergreen, and deciduous. Woody plants have hard stems which are usually a shade of brown. Non-woody plants have softer stems which are usually a shade of green. Evergreen plants maintain their leaves over winter and deciduous plants lose them.

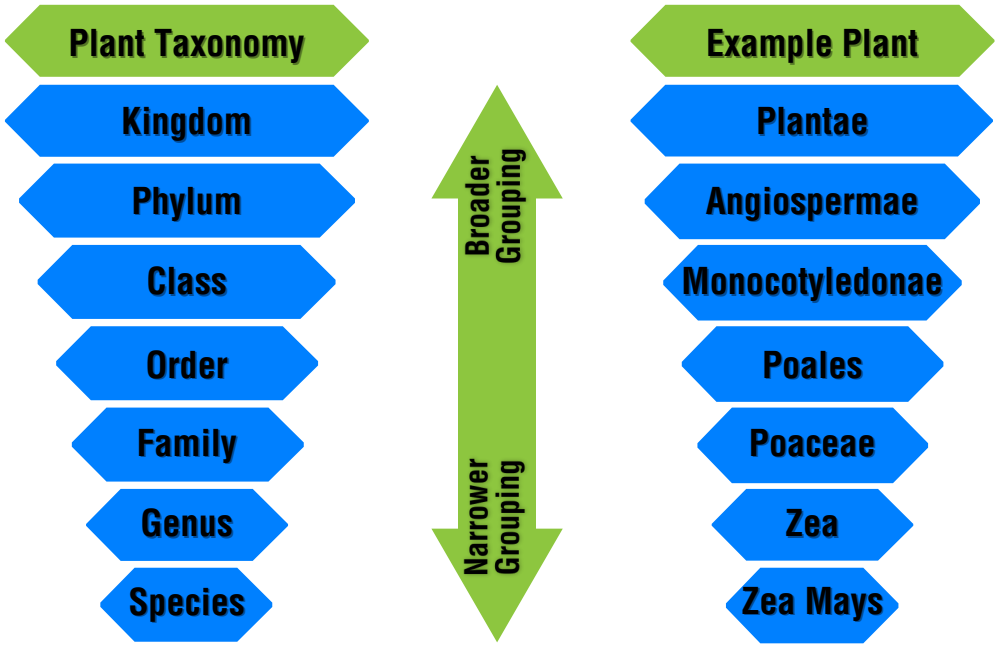
There are four main categories to consider when classifying plants by growth habit, they are:

- Herbaceous Plants (or Herbs) are most often non-woody, short plants that can only be annual or biennial. They are generally deciduous flowering plants. The majority of plants grown for crops on SVdP farms are considered herbaceous plants.
- Shrubs are generally woody, medium sized plants which are taller than herbaceous plants but shorter than trees. They usually have many stems and branches and are mostly deciduous but can be evergreen as well. Shrubs often produce flowers and fruits and are mostly perennial.
- Trees are tall woody plants which usually have a single main stem or trunk. They can produce fruit and flowers or seed cones and pollen cones. Trees can be deciduous or evergreen and usually have the longest lifespan of any plant growth type.
- Vine Plants are usually non-woody small to medium sized plants. They have long thin stems and are separated into two subcategories, creepers and climbers. The stems of creeping plants use the ground as their support, "creeping" along as they grow horizontally. The stems of climbing plants reach out for a vertical structure to support upward growth. Vines usually produce flowers and fruits and can be deciduous or evergreen.



Scientific Plant Classification (Plant Taxonomy)

Scientific Plant Classification is broad and complex. DNA analysis only became recently available in the history of Botany and has revealed that many plants once thought to be related are in fact not related in any significant ways. It is useful to be aware of the concept of classifying plants based on genetics as it is an essential part of science-based farming. It is, however, not necessary to know the complexities of this subject to be a highly successful farmer in general. The main taxonomic categories discussed in plant science are shown in the chart below.



(The column on the right of this chart shows an example plant species, Zea Mays, and its grouping for each taxonomic category)

The most important takeaway everyone can gain from the scientific plant classification method is the relevance of Latin/scientific names for plants. In the example shown on the right side of the chart above, the scientific name Zea Mays consists first of a plant's genus followed by its species. Plant species are the narrowest classification of plants, a plant's species is synonymous with its scientific name. Scientific names for plants are often more useful then common names (Zea Mays is know most commonly as Corn) because they inform a person of a plant's genus and species. Plant species which are in the same genus will generally display similar growth habits and require similar growth environments. Plants exhibit fewer similar characteristics as the plant taxonomic categories rise from species to kingdom. A farmer's knowledge of one plant species in a genus can, generally, inform the farmer about the requirements of other plant species in that same genus.

The most common broad classification of plants utilized today pertains loosely to the various plant phyla defined in the modern plant taxonomy discussed and shown above (as phylum). The four main plant phyla referred to in science are mosses and worts, ferns, gymnosperms, and angiosperms. These are discussed further in the following section of plant classification by reproductive method. These four main phyla do not represent the entirety of known plant phyla. For more information regarding plant phyla and taxonomy in general, see the references list at the end of this manual.

The Plants on SVdP Urban Farms

Plant Classification by Reproductive Method

Another helpful way of classifying plants is to group them by similar reproductive processes. These groups are connected to the four main plant phyla discussed in the scientific plant classification method.

The main categories used when classifying plants by reproductive method are flowering and non-flowering. These categories are self-explanatory, they are distinguished by plants which produce flowers and those that do not. The non-flowering category is separated by plants which reproduce through spores and by plants which reproduce through seeds and pollen. Ferns and mosses are examples of plants which use spores to reproduce. Spore-bearing plants are not relevant to the discussion of plants found in urban farming, more information can be found in the references listed at the end of this manual.

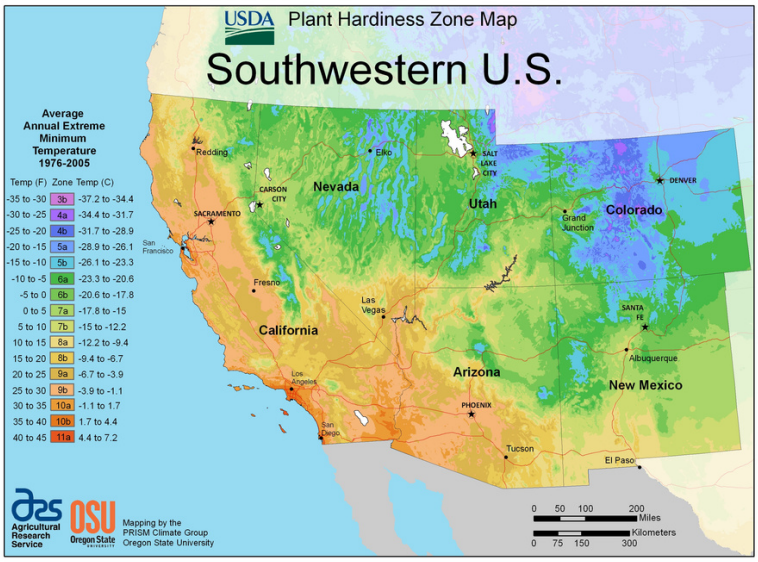
Non-flowering plants which reproduce through seeds and pollen are called gymnosperms. Gymnosperms grow pollen cones and seed cones to reproduce. The term gymnosperm is from the Greek language and translates to “naked seed.” These plants do not enclose their ovules (the structures which produce seeds) within ovaries (the structures which protect ovules.) Instead, the seeds of gymnosperms are formed on the outside of leaf-like plant parts called scales. A pine cone is one of the more recognizable examples of a “naked” seed. Each point on a pine cone is a collection of scales. Each scale has a seed growing on its surface. The gymnosperm group predominantly consists of conifers such as pine or cypress. Gymnosperms can make up an important part of a holistic farm ecosystem, but they are not commonly found on SVdP Urban Farms.

The vast majority of plants found on SVdP Urban Farms are flowering plants, otherwise known as angiosperms. The term angiosperm is also from the Greek language and translates to “hidden seed.” Angiosperms encapsulate their ovules within ovaries in the form of a fruit or other reproductive organ. A common example of “hidden” seeds would be those found inside of an apple. Angiosperms are the most prolific form of life found on earth after insects.

The two subcategories of angiosperms are called monocots and dicots. All angiosperm seeds contain cotyledons which are the basis for the first leaves that a plant will grow from seed form. The features of a plant are dictated by whether the plant starts with one cotyledon (a monocot) or with two cotyledons (a dicot). These classifications begin to get more complicated than is necessary for successful farming on an SVdP Urban Farm, but it can be useful to understand some differences between monocots and dicots, the two main groups of angiosperms. For more in-depth information regarding monocots and dicots, see the reference list at the end of this manual.

For all intents and purposes when classifying plants by reproductive methods, a farmer can think of the two main categories in a few different ways. They can think of plants on an urban farm as flowering and non-flowering, angiosperms and gymnosperms, or perhaps most appropriately, fruit bearing and non-fruit bearing.

Environmental Conditions for Planting



(Source: USDA. (2012). Southwestern U.S. https://planthardiness.ars.usda.gov/pages/view-maps)

Whether starting from seed or transplanting a start, planting conditions are essential for a crop's ultimate success. The USDA Plant Hardiness Zones Map designates gardening zone classifications for the entire United States. Plant hardiness zones dictate what varieties of plants can be planted in a specific region based on that region's annual average minimum temperature range. The hardiness zone scale goes from 1-10 with subcategories delineated by A and B. SVdP Urban Farms are located in zones 9b, and 10a, 2 of the 3 hottest possible zone designations in the contiguous United States.

All plants have their own preferred growing habitats. Some grow most successfully with lots of sunlight and hot weather. Others would rather be in the shade and cooler temperatures. Generally, plants will not survive in consistent temperatures below freezing. Always check your seed packet, or another trusted resource such as the planting calendar shown below, for information regarding a plant's preferred environmental growing conditions.

In regards to temperature and weather, farms in the general Phoenix Metro area experience very different seasonal changes than farms on many other parts of the planet. Farmers here are very lucky to have one of the best growing environments in the world. Because temperatures generally stay above freezing even in winter, farmers in the Phoenix Metropolitan area can enjoy growing crops nearly all year long.

The EPA has defined a number of different ecological regions around the United States called Ecoregions. Broadly, the Southern half of Arizona, where SVdP Urban Farms reside, is in one of the only ecoregions in the US called a Hot Desert. As a farmer in this area, it's important to remember that Southern Arizona is one of the hottest places in the country. This means that, although farmers here can grow crops nearly all year round, there are special considerations to take into account regarding heat and sunlight. Intentional farm design can allow a farmer to optimize growing conditions for any plant variety.

Farm Design for Plant Success

Light and Temperature around a Farm

Getting to know the environmental conditions of any space on a local scale is just as important as knowing the conditions of a general region. Mapping out how much light each area of a farm or garden gets will significantly help to optimize a grower's chance for success. If a plant's seed packet says it requires full sun exposure for six or more hours a day, then that plant most likely will not grow with much success if planted in the shadiest part of a gardener's yard. The sun travels along an East to West path each day changing light exposure on the ground as it moves. This means that one part of a growing space which may be shrouded in shade every morning might be getting blasted by the afternoon sun. It is important to keep in mind that light exposure periods will also change throughout the year based on the position of the sun in the sky. At varying times of day throughout the year, observe where light is strongest and weakest in a growing space. Regularly walking around a growing space, observing conditions, and taking notes on those observations are fundamental aspects of successful farming. More information regarding observation and note taking can be found in the section of this manual titled Daily Operation and Quick Start Guide starting on page 13.

Heat is somewhat analogous to light exposure. It is often true that an area which receives a lot of light exposure will be one of the hotter parts of a growing space. An area which receives low light exposure will often be cooler than other parts of a farm or garden. High temperatures are good for certain plants, low temperatures are better for others. In general, temperature is predominantly a product of season and local weather conditions.

The planting calendar shown at the end of this section is the perfect resource for information on when to plant a crop. It can't be stressed enough that information regarding the specific planting conditions for a plant species is absolutely essential for the success of that plant. Always check a seed packet, a seed producer's website, or another trusted resource for planting information regarding a species' preferred environmental conditions.

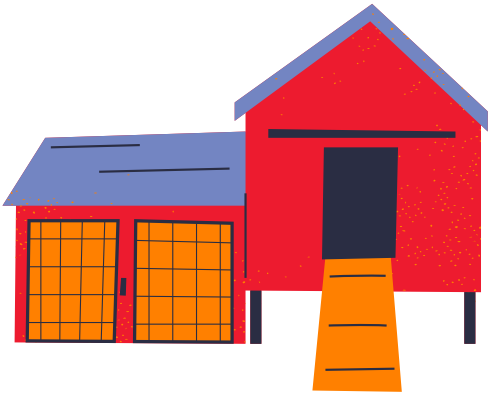
If sun and heat cause growing issues, there are a few tools and techniques a farmer can use to provide cooler and shadier conditions:

Shade cloths are a simple and effective way to keep an area of plants protected during the hottest times of the year. Shade material used in farming and gardening does allow some sunlight through. It is only intended to cool temperatures by reducing the amount of sunlight reaching an area. Shade cloths can be installed permanently and span over large areas with heavy duty support systems, as is done in a number of places on SVdP Urban Farms. They can also be manually draped (lightly) over plants for temporary periods as short as a few hours. Or, shade cloth can be installed with lightweight and basic support systems (such as simple PVC hoops buried at each end) on a seasonal basis. For more information regarding shade in the garden and using shade cloth, see the references listed at the end of this manual.

(Shade cloth at Mesa Farm shown above)

(Tree Shade shown above)

Tree shades are an effective, simple, and mobile tool for protecting younger trees from the hot afternoon sun. Throughout the varying seasons of a year, sunlight reaches the ground from different directions. The direction of the sun's rays needs to be accounted for and tree shades should be positioned accordingly. If a farmer has young trees which are showing signs of damage by the sun, the farmer should observe what time of day is hottest in that area of the farm and from what direction the sun's rays are hitting the ground at that time. The farmer should then position their tree shade so that it is blocking sunlight during the sun's strongest periods of the day.



The Plants on SVdP Urban Farms

Growing Area Design

A space for growing crops can be designed in a variety of ways. However a growing space is assembled, the general goal is to provide crops with healthy soil and adequate light in an environment which is easy to operate in. Giving crops enough space to grow and leaving space to work comfortably adjacent crops are two essential aspects to consider as well.

Raised beds are one option which can be designed in a variety of ways. The base utility of any raised bed is to provide a space with walls to contain nutrient rich soil. They can be a good choice when local soils would require significant amendment to be viable for growing. A farmer or gardener can purchase (or produce through composting) their preferred growing medium to fill a raised bed, giving them confidence that their plants are provided the nutrients and soil conditions they require.

Usually raised beds are designed in a box shape, but they can be built in whatever size, shape, and fashion best fits a farmer or gardener's needs. It is advisable to think of accessibility when building a raised bed. If a bed is too big, a farmer may need to step into the bed to work in it which can disturb plants. Some raised beds are built on legs raising them to around three feet tall, usually considered the most comfortable design for working in. These are ideal for farmers and gardeners who want to reduce physical input and strain on their body. Examples of these beds can found in the ADA compliant portion of the Rob and Melani Walton Urban Farm. Other raised beds are built on the ground with walls ranging from about six inches high to a few feet tall. Basic and inexpensive raised beds have been utilized at the SVdP Mesa Dining Room Urban Farm with great success. These are built using a square block at each corner of a raised bed. These blocks have slots cut on each side for a two inch wide board. Two inch by eight inch boards are then slid, standing eight inches vertically, into each slot to form a rectangular or square bed.

(Raised bed at HSC Farm)

Row Planting is the more conventional form of growing bed design. Row planting is fairly self-explanatory; plants are grown in rows which are generally one to two feet wide. For row plantings irrigated by a drip system, a 30 inch wide row with multiple driplines is often the most efficient design. Planting row length is based on the space available. Rows are usually separated by a one to two foot wide pathway or trench which provides a farmer space to access crops.

Plant rows are often raised in a mounded form to aid in flood irrigation. This can be done by adding material from an outside source or trenching out dirt between rows to be used for mounding. Trenching between rows can also provide canals for flood irrigation. Row mounding is not necessary when irrigating a row planting with a drip system.

(Trenched rows at HSC Farm)

Trellising is a way of providing support for climbing plants. Trellises can come in a variety of forms but they are generally comprised of a mesh material stood upright in one way or another. This can include mesh fencing secured to upright posts, metal grids attached to walls, wooden trellises staked into the ground, and more. Another form of trellising is done by growing a plant up a vertically drawn string attached to a support system above the planting area. Some plants require trellising to grow; others can be grown with or without a trellis to various detriments and benefits. Using trellises to control pest populations is discussed in the section of this manual titled Ecological Farming Practices and Integrated Pest Management.

(String trellis at RMW Farm)

(Short conventional style trellis at HSC Farm)

Planting Techniques

SVdP Urban Farms recommends either the University of Arizona Cooperative Extension Maricopa County Planting Calendar or The Urban Farm Low Desert Planting and Harvesting Calendar (found on pages 41 - 44 of this manual) as reference for information regarding planting seasons, harvest times, if a seed should be transplanted or directly sown, and other helpful information. Any planting information not found from these resources should be found on the seed packet, from the seed producer, or from another trusted source. For more information on this subject, see the references list at the end of this manual.

Seedling propagation techniques

Direct Sowing/Seeding is the most basic way to grow any plant and is simply the process of placing a seed in the ground and watering it. This sounds simple but there are a lot of problems which can occur during seed germination. Always check the seed packet for instructions on seeding conditions such as ambient temperature, plant spacing, and planting depth. If a trusted resource suggests starting a particular variety indoors and then transplanting as a start, these seeds likely should not be direct sown. Some seeds require preparation such as soaking in water or nicking/scarring the exterior seed hull before propagation; ensure these steps are not ignored if recommended on a seed packet or from a trusted source. Most seeds prefer a fairly loose growing medium. Lightly till the area to be planted to loosen up the soil for root growth. Another option is to dig a hole a few inches wide and deep for each seed, fill these holes with a loose growing medium such as compost or peat moss, and plant seeds directly into that new loose growing medium.

The Plants on SVdP Urban Farms

Sometimes an individual seed simply isn't viable. This can be caused by improperly storing seeds or storing them for too long. Generally seeds should be stored in a cool dry place and can still be viable two to three years after purchase. Usually a seed packet will provide an expiration date, but sometimes seeds can be viable for much longer than is expected. One way to check viability of seeds in a packet is to attempt to germinate a few of those seeds in a folded wet paper towel put inside a plastic bag. These seeds should begin to germinate within approximately two to three weeks. Seeds stored in a cool dry place, such as a jar in the cupboard, can last for years.

Moisture, temperature, and nutrients are as essential to seed germination as they are to all other stages of plant growth. Seeds require moisture to germinate but they don't necessarily like to be in heavily saturated soil. Proper drainage and a specific watering schedule based on the plant variety are important for a new seed's success. Temperature is very important for seed germination, usually seeds prefer temperatures over 60 degrees Fahrenheit but this is dependent on the variety being germinated. Generally higher soil temperatures will result in increased germination rates and times. Specific nutrients are less important to a seed than they are to a growing plant, but pH level is extremely important for seed germination. If a soil's pH is too high or too low a seed likely will not germinate. A simple soil pH test is recommended prior to any planting.

Using a seeder can make the process of seeding large beds much more efficient. A variety of products are available which apply seeds at consistent rates and spacing throughout a planting area. These are best used when time or labor is in short supply.

Seeds can be collected from plants to be used in future seasons. Seeds are found in mature flowers at the end of a plant's growing season. They can be manually removed from a flower by hand, or a farmer can hang a flower upside down above a receptacle to collect seeds over time.

Transplanting starts is very similar to direct seeding. The only difference being that starts which are to be transplanted are first seeded in an enclosed growing space. Seeding plants in an enclosed growing space, like a greenhouse, helps to ensure their early success. A plant grown in a weather and temperature controlled environment safe from pests produces the most growth that it possibly can in its early life. This early success will lead to a stronger and healthier plant later in its life.

A start for transplanting is grown just like a plant which is directly sown. The only difference, a start is being grown in an enclosed space such as a greenhouse. Follow the directions on a seed packet, from a seed producer, or from another trusted resource when planting a seed indoors to be transplanted into a growing space later on. Starts can also be purchased from a nursery, this can be useful if time and labor resources are short. Starts which are purchased have usually received a lot of careful care by trained professionals meaning they're usually strong and exceptionally healthy. Starting out with healthy and vigorous plants gives a crop even more opportunity for great success.

Planting calendars used by SVdP Urban Farmers are shown on the following pages.

THE UNIVERSITY OF ARIZONA COOPERATIVE EXTENSION

Maricopa County Garden Planting Calendar for Fruits and Vegetables

Fruit • Vegetable	Time to Harvest	Jan.		Feb.		March		April		May		June		July		August		Sept.		Oct.		Nov.		Dec.	
		1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15
Artichokes, Globe	4-6 months		T	T	T	T	T															S	S	S	
Artichokes, Jerusalem	6-8 months		T	T	T	T	T	T	T	T	T														
Asparagus	2-3 years	T	T	T																		T	T	T	T
Basil	T = 30 S = 60-75 days				S	T/S	T/S	T/S	T/S	T/S	T/S														
Beans, Lima	60-100 days						S	S																	
Beans, Pinto	60-90 days														S										
Beans, Snap	60-90 days						S	S	S						S	S	S	S							
Beans, Yardlong	60-90days						S	S	S	S	S	S	S	S											
Beets	60-80 days	S	S	S	S	S													S	S	S	S	S	S	S
Blackeyed Peas	90-120 days							S	S	S	S	S	S	S	S	S	S								
Bok Choy	45 days	S	S	S	S												S	S	S	S	S	S	S	S	S
Broccoli	T=90-100 S=120-130 days	T/S	T														S	S	T/S	T/S	T/S	T/S	T/S	T/S	T/S
Brussel Sprouts	T=100-120 S=130-150 days																S	T/S	T/S	T/S	T/S	T/S	T/S		
Cabbage	T=80-90 S=120-130 days	T/S	T														S	S	T/S	T/S	T/S	T/S	T/S	T/S	T/S
Cabbage, Chinese	T=45 S=70-80 days	T/S	T														S	S	T/S	T/S	T/S	T/S	T/S	T/S	T/S
Carrots	60-100 days	S	S	S	S	S	S	S	S							S	S	S	S	S	S	S	S	S	S
Cauliflower	T=90-100 S=120-130 days	T/S	T														S	T/S	T/S	T/S	T/S	T/S	T/S	T/S	T/S
Celery	120-150 days																S	S	T/S	T/S	T/S	T/S	T/S	T/S	T/S
Chard	60-90 days	T/S	T/S														S	S	T/S	T/S	T/S	T/S	T/S	T/S	T/S
Collard Greens	80 days	S	S	S	S												S	S	S	S	S	S	S	S	S
Corn, Sweet	70-90 days				S	S	S	S							S	S	S								
Cucumbers	60-90 days				S	S	S	S	S								S	S	S						
Cucumbers, Armenian	55 days				S	S	S	S	S	S	S	S	S	S											
Eggplant	70-120 days					T	T																		
Endive	80-120 days	S	S															S	S	S	S	S	S	S	S

S = Seeds T = Transplants X = Sets of Cloves

THE UNIVERSITY OF ARIZONA COOPERATIVE EXTENSION

Maricopa County Garden Planting Calendar for Fruits and Vegetables

Fruit • Vegetable	Time to Harvest	Jan.		Feb.		March		April		May		June		July		August		Sept.		Oct.		Nov.		Dec.	
		1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15	1	15
Garlic	5-7 months																			X	X				
Kale	60-90 days																S	S	S	S	S	S	S	S	SS
Kohlrabi	T=45-60 S=50-60 days	T	T	T													S	S	S	S	T/S	T/S	T/S	T	T
Lettuce, Head	50-100 days	T/S	T/S	T													S	S	T/S	T/S	T/S	T/S	T/S	T/S	T/S
Lettuce, Leaf	30-90 days	T/S	T/S	T/S	T												S	S	T/S	T/S	T/S	T/S	T/S	T/S	T/S
Leek	180-200 days	S	S														S	S	S	S					
Melons, Cantaloupe Honeydews, etc.	80-120 days				S	S	S	S	S	S	S	S	S	S	S										
Melons, Watermelon	90-120 days				S	S	S																		
Mustard	35-45 days	S	S	S	S												S	S	S	S	S	S	S	S	S
Okra	70-100 days						S	S	S	S	S														
Onions, Bulb	Sets=4-5 months S=7-8 months	X	X	X																S	S	S	S	X	X
Onions, Green	T90-100 days	S	S	S	S	S	S	S	S							S	S	S	S	S	S	S	S	S	S
Onions, Shallots	T80 - 110 days													X	X										
Parsnips	100-120 days																	S	S	S	S	S	S		
Peanuts	5 months						S	S	S																
Peas	Sept.=60-120 Nov.=120-150 days	S	S	S	S														S	S	S	S	S	S	S
Peppers	90-120 days				T	T	T							T	T										
Potatoes	90-120 days	S	S	S	S	S																			
Potatoes, Sweet	120-160 days					T	T	T	T	T	T	T	T												
Pumpkin	90-120 days					S	S							S	S	S									
Radishes	30-60 days	S	S	S	S	S	S	S	S									S	S	S	S	S	S	S	S
Rutabagas	100-120 days	S	S															S	S	S	S	S	S	S	S
Spinach	30-90 days	S	S	S	S													S	S	S	S	S	S	S	S
Squash, Summer	60-90 days				S	S	S	S									S	S							
Squash, Winter	90-120 days					S	S							S	S	S									
Sunflower	90-110 days			S	S	S	S	S	S	S	S	S	S	S	S										
Tomatoes	50-120 days				T	T	T								T	T									
Turnips	75-120 days	S	S	S	S												S	S	S	S	S	S	S	S	S

S = Seeds T = Transplants X = Sets of Cloves

Low Desert Planting & Harvest Calendar

Brought to you by the Urban Farm, Greg Peterson and Matt Suhr

For information on classes and events offered on gardening and sustainability visit our website at UrbanFarm.org and add yourself to our email newsletter. This document is copyrighted and cannot be manually or digitally reproduced & distributed without written permission.

Updated October 2020 by Raymond Jess & Greg Peterson to reflect changing climate conditions.

KEY

- = Harvest time
- s = Plant from seed
- t = Plant from transplants
- b = Plant from bulb/rhizome/root cutting

Crop	Hardiness Temp	JAN 1	JAN 15	FEB 1	FEB 15	MAR 1	MAR 15	APR 1	APR 15	MAY 1	MAY 15	JUN 1	JUN 15	JUL 1	JUL 15	AUG 1	AUG 15	SEP 1	SEP 15	OCT 1	OCT 15	NOV 1	NOV 15	DEC 1	DEC 15	Comments
Artichoke– Globe	20	t	t	t	t	t	t													s/t	s/	t	t	t	t	Light frost helps first year harvest.
– Jerusalem	< 0	b	b	b	b	b	b	b	b	b	b															Comes back every year. Plant from bulb/rhizome
Asparagus	< 0			b	b	b	b	b												b	b	b	b			Don't harvest until 3rd year.
Bean–Blackeye	32					s	s	s	s	s	s	s	s	s	s	s	s									Performs well in full summer heat.
--Fava	20																		s	s	s	s	s			Dislikes heat.
--Garbanzo	25	s	s	s	s														s	s	s	s	s	s	s	Stays low to ground.
--Green snap	32				s	s	s	s	s						s	s	s	s	s							Seed will rot if planted in cold soil.
--Lentil	25	s	s	s	s														s	s	s	s	s	s	s	Harvest entire plant and thresh when dry.
--Lima	32				s	s	s	s	s						s	s	s	s	s							Does best with trellis.
--Pinto	32				s	s	s	s	s						s	s	s	s	s							Harvest entire plant and thresh when dry.
--Soy	32				s	s	s	s	s						s	s	s	s	s							Use special varieties for edamame.
--Yardlong	32					s	s	s	s	s	s	s	s	s	s											Black-seeded types do best.
Beet	25		s	s													s	s	s	s	s	s				Be sure to thin if you want big beets.
Bok Choy	22	t	t														s	s	s	s/t	s/t	s/t	t	t	t	Bolts quickly in Spring.
Broccoli--head	25	t	t														s	s	s	s/t	s/t	s/t	t	t	t	Light frost improves flavor.
--Raab	25	t	t														s	s	s	s/t	s/t	s/t	t	t	t	Pick frequently to maintain production.
--Romanesco	27	t	t														s	s	s	s/t	s/t	s/t	t	t	t	Allow 15" spacing between plants.
Brussels Sprout	22																s	s	s	s/t	s/t	s/t	t			Only early hybrids do well."Oliver" is best.
Cabbage–Chinese	24	t	t														s	s	s	s/t	s/t	s/t	t	t	t	Heads form quickly. Be sure to thin.
–standard	26	t	t														s	s	s	s/t	s/t	s/t	t	t	t	Red varieties take a little longer to head.
Carrot	23		s	s	s	s	s									s	s	s	s	s	s	s				Slow to sprout–mix in a few radish seeds.
Cauliflower	27	t	t														s	s	s	s/t	s/t	s/t	t	t	t	Fold leaves over exposed heads.
Celery	28															s	s	s	s	s/t	s/t	s/t	s/t	s/t		Often stringy and bitter in desert conditions.
Collards	25	t	t														s	s	s	s/t	s/t	s/t	s/t	t	t	Light frost improves flavor.
Corn--flour	32				s	s	s	s	s				s	s	s	s	s									Allow to totally dry on stalk.
–ornamental	32				s	s	s	s	s				s	s	s	s	s									Plant in blocks for good pollination.
–popcorn	32				s	s	s	s	s				s	s	s	s	s									Harder kernals than flour corn.
–sweet	32				s	s	s	s	s				s	s	s	s	s									Supersweet var. need very warm soil to sprout.
Cucumber--Armenian	32					s	s	s	s	s	s	s	s													Withstands heat better than standard types.
–standard	32					s	s	s	s						s	s	s									Harvest frequently for best quality.
Eggplant	32				s/t	s/t	t	t	t	t																Best production in Fall.
Endive	25	s	s																	s	s	s	s	s	s	Pull leaves over center to blanch.
Garlic	10																	b	b	b	b					Harvest when tops die back.
Jicama	32					s	s	s	s	s	s	s	s													Does well with trellis.
Kale	22	t	t														s	s	s	s/t	s/t	s/t	t	t	t	Pick outer leaves for continual harvest.
Leek	15	b	b	b														s/b	s/b	s/b	s/b					Pile dirt over stalks to blanch.
Lettuce--head	28	t	t	t																s	s	s/t	s/t	t	t	Allow 8-12" per plant for big heads.
–leaf	28	t	t	t																s	s	s/t	s/t	t	t	Won't sprout in hot soil.
Melons	32				s	s	s/t	s/t	s/t	s/t	s/t	s/t	s/t	s/t	s/t											Rich soil, lots of H2O, lots of room.
Mizuna	25	t	t																s	s	s	s/t	s/t	t	t	Good as baby greens or full-size.

Crop	Hardiness Temp	JAN 1	JAN 15	FEB 1	FEB 15	MAR 1	MAR 15	APR 1	APR 15	MAY 1	MAY 15	JUN 1	JUN 15	JUL 1	JUL 15	AUG 1	AUG 15	SEP 1	SEP 15	OCT 1	OCT 15	NOV 1	NOV 15	DEC 1	DEC 15	Comments
Mustard Greens	27	t	t																s	s	s	s/t	s/t	t	t	Light frost improves flavor.
Okra	32					s	s	s	s	s	s	s	s	s	s											Pick frequently to maintain production.
Onion--bulb	15	b	b	b														s/b	s/b	s/b	b	b	b	b	b	Harvest when tops die back. Use short-day type.
--multiplier	15	b	b	b	b	b	b									b	b	b	b	b	b	b	b	b	b	Don't produce seed. Divide to propagate. Eat tops &
--scallion	15	b	b	b	b	b	b									b	b	b	b	b	b	b	b	b	b	Use long-day type.
Parsnip	25																	s	s	s	s	s	s	s	s	Dig root before flower stalks form.
Peas	26																	s	s	s	s	s	s			Does best with trellis. Blooms are frost-tender.
Pepper	32			s	s	s/t	s/t	t	t	t	t							s/t	s/t							Start indoors in winter. Best harvest in fall from plants planted in spring.
Potato	32		b	b	b	b																				Harvest when in full bloom. Red potatoes do best.
Pumpkin	32					s	s	s	s	s	s	s	s	s	s											Plant June 15 for Halloween.
Radish	25	s	s	s	s	s	s	s											s	s	s	s	s	s	s	Do best when day-length is short.
Rutabaga	26																	s	s	s	s	s	s	s	s	Harvest before flower stalks form.
Spinach	22	s	s	s	s	s														s	s	s	s	s	s	Bolts quickly in Spring.
Squash--summer	32					s	s	s	s	s	s	s	s	s	s											Pick frequently to maintain production.
--winter	32					s	s	s	s	s	s	s	s	s	s											The longer they are left on the vine, the sweeter.
Sunflower	32				s	s	s	s	s	s	s	s	s	s	s											Quite drought-tolerant
Sweet Potato	32					b	b	b	b	b	b															Cure tubers in warm place before storage.
Swiss chard	26	s	s															s	s	s	s	s	s	s	s	Pick outer leaves for continual harvest.
Tomatillo	32	s	s	s	t	t	t	t	t								t	t	t							Easy. Start seeds indoors for planting after last frost.
Tomato	32	s	s	s	t	t	t	t	t								t	t	t							Do best w/ shade cloth. Start seeds indoors for planting after last frost.
Turnip	25	s	s	s	s											s	s	s	s	s	s	s	s	s	s	Best flavor in cool weather.
Watermelon	32					s	s	s	s	s	s	s	s	s	s											Rich soil, lots of H2O, lots of room.
Herbs																										
Arugula-Annual	15	s	s	s	s														s	s	s	s	s	s	s	May be planted thickly.
Basil-Annual/Perennia	32	s	s	t	t	t	t	t	t	t	t	t	t	t	t	t	t					s	s	s	s	Plants don't like cold & will slow down in winter. Frost
Cilantro-Annual	28	s/t	s/t																	s/t	s/t	s/t	s/t	s/t	s/t	Flowers attract beneficial insects.
Dill-Annual	27	s/t	s/t																	s/t	s/t	s/t	s/t	s/t	s/t	Very easy from seed. Does not transplant well.
Fennel--bulb vaiety	27	s	s	s	s	s												s	s	s	s	s	s	s	s	Leave some bulbs in the ground for perrenial harvest.
--herb/leaves	25	s	s	s	s														s	s	s	s	s	s	s	Flowers attract beneficial insects.
Lavender-Annual	0			t	t	t													s	s	s					Needs sandy soil.
Mint-Perennial	< 0	t	t	t	t	t	t											t	t	t	t	t	t	t	t	Can be invasive. Doesn't come true from seed.
Oregano-Perennial	<0	t	t	t	t	t	t	t	t	t	t							t	t	t	t	t	t	t	t	Keep flowers trimmed for best leaf production.
Parsley-Annual	20	s	s	s	*													s	s	s	s	s	s	s	s	Very slow to germinate. Otherwise easy. Self seeds annually
Rosemary-Perennial		t	t	t	t	t	t	t	t	t	t							t	t	t	t	t	t	t	t	Harvest year around.
Sage-Perennial	< 0	t	t	t	t	t	t	t	t	t	t							t	t	t	t	t	t	t	t	Many varieties with different requirements.
Thyme-Perennial	< 0	t	t	t	t	t															t	t	t	t	t	Prefers sandy soil.

Hardiness Note Hardiness temp, is the point at which damage occurs in exposed plants. Extent of damage depends on length of exposure, as well as micro-environmental factors. Covering plants with frost cloth can give anywhere from 2 to 10 degrees of extra protection. Coverings are most effective when suspended close to, but not in contact with, the plant.

Microclimates The exact season of growing depends greatly on your particular microclimate. A microclimate is any area of your yard that is warmer or cooler than the rest of the yard: such as planting next to a block wall that retains heat into the night. Many frost sensitive plants can be grown through the winter in milder low desert locations, though with slower growth rates. Likewise, with appropriate shading many heat-sensitive crops can be grown into the summer months in outlying areas with cooler nights, though quality and vigor can be reduced.

Rotate crops and plant diverse growing spaces whenever possible

Changing what crops are planted in which beds helps to ensure nutrients are depleted at an even rate. Maintaining a variety of crops at a single time throughout a growing space provides a diverse habitat for beneficial organisms and reduces the impact of a variety of pest infestations. Crop rotation is an essential aspect of ecological farming practices, more information regarding this topic can be found in the section of this manual titled Ecological Farming Practices and Integrated Pest Management.

Plant companion plants along with crops whenever possible

Companion plants are planted alongside crops for their benefits. Companion plants can provide structure, shade, moisture retention, nutrient availability, protection against pests, and other conditional benefits. Companion plants can be treated as a secondary crop, but species selected for companion planting do not always produce harvestable material. If companion plants are chosen as a secondary crop, this could be considered a type of intercropping, a technique involving multiple rounds of planting and harvesting per season from the same growing bed. One commonly used planting design involves planting rows of companion plants along the edges of a raised bed as a protective barrier for the main crop planted closer to the center of the bed. Companion plants are also highly useful in ecological pest control methods, more information regarding this topic and intercropping can be found in the section of this manual titled Ecological Farming Practices and Integrated Pest Management.

(Example of companion planting at Mesa Farm)

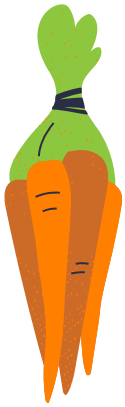
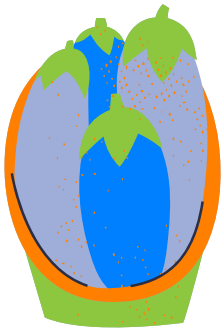
A list of companion plants which may be useful on SVdP Urban Farms can be found on the following pages. This list was sourced from, Kuepper, G., Dodson, M. (2001, July). Companion Planting: Basic Concepts & Resources. Appropriate Technology Transfer for Rural Areas.
https://www.asu.edu/fm/documents/arboretum/CommunityGardenATTRACompanionPlanting.pdf

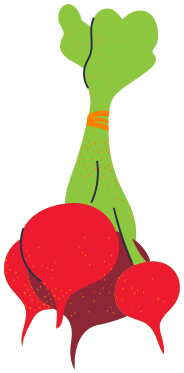
The Plants on SVdP Urban Farms

Crop:	Companions:	Incompatible:
Asparagus	Tomato, Parsley, Basil	
Beans	Most Vegetables and Herbs	Onion, Garlic, Gladiolus
Beans, Bush	Irish Potato, Cucumber, Corn, Strawberry, Celery	Onion
Beans, Pole	Corn, Radish	Onion, Beets, Kohlrabi, Sunflower
Beets	Cabbage and Onion Families, Lettuce	Pole Beans
Cabbage Family	Aromatic Herbs, Celery, Beets, Onion Family, Chamomile, Spinach, Chard	Dill, Strawberries, Pole Beans, Tomato
Carrots	English Pea, Lettuce, Rosemary, Onion Family, Sage, Tomato	Dill
Celery	Onion and Cabbage Families, Tomato, Bush Beans, Nasturtium	
Corn	Irish Potato, Beans, English Pea, Sunflowers, Radish	Tomato
Cucumber	Beans, Corn, English Pea, Pumpkin, Cucumber, Squash	Irish Potato, Aromatic Hebrs
Eggplant	Beans, Marigold	
Lettuce	Carrot, Radish, Strawberry, Cucumber	
Onion Family	Beets, Carrot, Lettuce, Cabbage Family	Beans, English Peas
Parsley	Tomato, Asparagus	
Pea, English	Carrots, Radish, Turnip, Cucumber, Corn, Beans	Onion Family, Gladiolus, Irish Potato

The Plants on SVdP Urban Farms

Crop:	Companions:	Incompatible:
Potato, Irish	Beans, Corn, Cabbage Family, Marigolds, Horseradish	Pumpkin, Squash, Tomato, Cucumber, Sunflower
Pumpkins	Corn, Marigold	Irish Potato
Radish	English Pea, Nasturtium, Lettuce, Cucumber	Hyssop
Spinach	Strawberry, Faba Bean	
Squash	Nasturtium, Corn, Marigold	Irish Potato
Tomato	Onion Family, Nasturtium, Marigold, Asparagus, Carrot, Parsley, Cucumber	Irish Potato, Fennel, Cabbage Family
Turnip	English Pea	Irish Potato



Plant cover crops in empty growing spaces

A farmer can significantly benefit from planting cover crops in empty beds to maintain soil health and moisture retention. Cover crops can be seeded, transplanted, or allowed to self-seed. They can be planted in empty space alongside a farmer's main crops, or they can be planted in completely empty beds between seasons for main crops. Cover crops can be harvested and treated as a main crop, or they can be allowed to go to flower, providing significant benefits for local pollinators. Cover crops are also highly useful in ecological pest control methods, more information regarding this topic can be found in the section of this manual titled Ecological Farming Practices and Integrated Pest Management.

A list of cover crops which may be useful on SVdP Urban Farms can be found on the following page.

The Plants on SVdP Urban Farms

Table 1. Selected Cover Crops and Their Characteristics

Name	Type	Growth characteristics	Other notable characteristics	Seeding rate (in pounds per acre for a single-species planting)
Alfalfa	Perennial	Cold-tolerant, nitrogen-fixing legume.	Low shade tolerance, deep-rooted, drought-tolerant.	15–18
Annual grasses (wheat, barley, oats, annual ryegrass, cereal rye, triticale)	Winter annual	Cold-tolerant, rapid growth rate, inexpensive seed.	High lime tolerance, low drought and generally low salinity tolerance (barley is salt-tolerant), moderate moisture use.	Wheat, barley, oats, triticale: 60–120 Annual ryegrass: 15–30
Austrian winter pea	Winter annual	Moderately cold- and drought-tolerant, nitrogen-fixing legume.	Can provide high biomass, moisture-efficient, can suppress weeds due to rapid growth in spring, low shade and traffic tolerance.	60–80
Brassicas (mustards, turnips, forage radish)	Winter annual	Tap-rooted, some are moderately cold-tolerant, can be seeded in fall.	Mustard can act as a bio-fumigant, radish and turnip can break soil compaction, low to high salinity tolerance depending on species, moderate to high drought tolerance.	Mustard: 5–12 Turnip: 4–7 Radish: 8–12
Buckwheat	Summer annual	Cold-sensitive, rapid establishment and growth.	Moderate drought and shade tolerance, can suppress weeds, can do well in relatively poor soils, good for soil aggregation, can reseed if flowers mature.	50–60, drilled
Cowpea	Summer annual	Cold-sensitive, nitrogen-fixing legume.	Drought-tolerant, can do well in relatively poor soils and can fix up to 150 lb N per acre.	50–100
Foxtail millet	Summer annual	Short growing season, cold-sensitive.	Drought-tolerant, grows fast with adequate moisture.	15–20
Hairy vetch	Winter annual	Cold-tolerant, nitrogen-fixing legume.	Moderate tolerance to shade, drought, and soil lime; low salinity tolerance.	15–20
Lablab	Summer annual	Vining and spreading legume. 'Rio Verde' lablab (developed by Texas A&M) also has high nutritive value as forage.	Provides very good soil cover that can suppress weeds, good nitrogen fixation.	50–60
Pearl millet	Summer annual	Cold-sensitive, deep-rooted, fast-growing grass.	Drought-tolerant, provides good soil cover that can suppress weeds, requires less nutrients and water than sorghum–sudangrass.	15–20
Red clover	Perennial	Short-lived, cold-tolerant, nitrogen-fixing legume.	Moderate tolerance to soil lime, low drought and salinity tolerance, intolerant to shade.	20–28
Sesbania	Summer annual	Erect legume with good nitrogen fixation, can establish well in weedy fields.	Grows very fast and attains up to 5 ft in height in about 2 months, great biomass and good nitrogen fixing potential.	30–40
Sorghum–sudangrass	Summer annual	Cold-sensitive, fast-growing annual grass with good root system.	Drought-tolerant, can suppress weeds, large amounts of biomass possible, water- and nutrient-use efficient.	15–40
Yellow sweetclover	Annual, biennial, or short-lived perennial	Cold-tolerant, nitrogen-fixing legume with strong tap roots.	High tolerance to drought, salinity, and soil lime; intolerant to shade.	8–15

Source: Idowu, J., Kulbhushan, Grover. (2014, December). Principles of Cover Cropping for Arid and Semi-arid Farming Systems. College of Agricultural, Consumer and Environmental Sciences. New Mexico State University. Cooperative Extension Service. https://extension.arizona.edu/sites/extension.arizona.edu/files/attachment/PrinciplesofCoverCroppingforAridandSemi-arid.pdf

Harvesting Procedure, Techniques, and Individualized Care

There is a wealth of information available regarding all plant varieties grown on SVdP Urban Farms. Entire books could be, and have been, written on how to care for singular species. This manual only discusses basic harvest tips and indicators for each of SVdP Urban Farms' commonly planted varieties as well as some essential specialized care techniques. General harvesting seasons, some harvesting tips, and other useful information can be found in the Urban Farm Low Desert Planting and Harvest Calendar. Most seed packets will provide an approximate days-to-harvest time for the plant variety, this is a basic starting point for determining when to harvest any crop. For more specific information regarding how to care for certain varieties of plants commonly found on SVdP Urban Farms, see the references listed at the end of this manual.

Once crops are harvested into a sanitized or lined container, they should be weighed and recorded on the Harvest Log (which can be found in the section of this manual titled Daily Operation on page 17), the harvest container should be labeled with the harvest date and the contents, then brought to the kitchen for further processing. Lead farm staff should be notified of any produce left in the cooler. If produce is being washed in the kitchen by volunteers, the procedure is as follows:

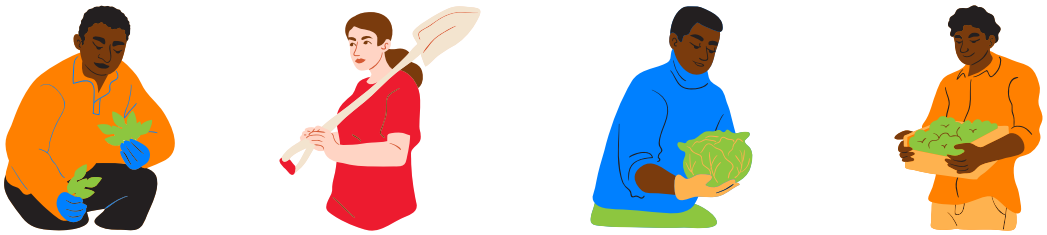
Materials Required for Washing Produce

- Three sanitized sinks (or partitioned sections of a sink)
- Running water
- Vegetable wash solution
- Ice (if no access to cold water)
- Salad spinner or other drying method
- Container for clean produce
- Compost bin
- Gloves, hair net or hat, and apron
- Clean hands (for more information on proper hand washing, see the section of this manual titled Equipment, Health, and Safety)

Procedure for Washing Produce

- Once hands are cleaned and gloves, a hair net, and an apron are donned, sanitize the sinks being used.
- Fill one sink with plain cold water; this is the first rinse sink.
- Fill the next sink with a mixture of water and vegetable wash (based on the product's specifications); this is the wash sink.
- Fill the last sink with plain cold water; this is the second rinse sink to remove vegetable wash and any remaining debris.
- Remove any unwanted portions of the harvested produce, such as leaves or stems, and any visible debris by hand. Place waste into the compost bin.
- Continued on next page...

- Submerge the produce into the first rinse sink for an initial rinse, make sure to use your hands to agitate the produce in a circular motion ensuring all of produce is exposed to water.
- Transfer the produce from the first rinse sink into the wash sink. Allow the produce to sit for a minimum of 30 seconds while agitating the water and gently moving the produce around the sink.
- Transfer the produce from the wash sink into the second rinse sink. Allow the produce to sit for a few minutes, agitating the water and produce occasionally.
- Remove the produce from the second rinse sink. If the produce being washed is a leafy green, it should be dried in a salad spinner or other appropriate method- this will lengthen its shelf life. Other produce can be placed directly into sanitized containers for storage or use. The container should be labeled with the date and contents before storage. A lead farm staff member should be notified of any stored produce.
- The water in all sinks should be changed approximately every half hour of cleaning or until water is cloudy or filled with debris. The last sink should always be clear because it is the last rinse before storage.
- Warm water should never be used to clean produce. If the water coming out of the faucet is not cold, add ice until the water reaches an appropriate temperature. This ensures the produce does not wilt and stays fresh.



Harvesting Techniques by Crop Variety

- Arugula can be harvested whenever their leaves are large enough to eat. Leaves can be cut throughout the growing season.
- Asparagus is ready to harvest when spears are approximately six to nine inches long and about the thickness of a farmer's index finger. Spears are cut at their base and can be harvested continuously for multiple weeks.
- Artichoke buds are ready for harvest when they are approximately three inches in diameter and their surface is tight and firm. Artichoke buds should be harvested before they open and are cut from the stem.
- Basil leaves can be harvested whenever they are large enough to eat. They should be cut continuously throughout a growing season.
- Bean pods are ready to harvest when they are about 3 inches long and smooth. The outline of the seed inside should not be visible and the pod should snap crisply when bent in half. Bean pods can be plucked, twisted, or cut off the vine.
- Beets are ready to harvest when they begin to protrude from the soil and are dark in color. They can be dug up or pulled from the ground by their leaves.
- Bok Choy leaves can be harvested at most stages of growth, generally between six inches and two feet in length depending on the variety. Leaves are cut at their base and can be continuously harvested for multiple weeks.
- Continued on next page...

- Broccoli is generally ready to harvest when the head reaches between four and seven inches in diameter. Individual florets on the outside of the plant should be about the size of a match head. Any yellowing on a head of broccoli means it is past its prime harvesting date. Cut a broccoli head off of the stem about five inches below its base.
- Brussel sprouts are ready to harvest when the sprouts are firm and one inch in diameter. Pluck or cut Brussel sprouts off of the stem.
- Cabbage heads are ready to harvest when they are firm all the way through. Size is not relevant for determining when to harvest cabbage. Cut cabbage heads as close as possible to the bottom of the stem.
- Carrots are ready to harvest when their tops begin to protrude and measure between three quarters and one and one half inches in diameter, depending on variety. A carrot which is at its optimal harvesting stage will generally be five inches or longer.
- Cauliflower heads are ready for harvest when they are about six to eight inches in diameter. They should be all white as well as firm but smooth and compact. To harvest a cauliflower head, cut it at its base. If a cauliflower head starts to turn yellow and it begins to separate, it is past its prime harvesting stage.
- Celery stalks are ready to use when they are six inches from their base to the bottom of the leaf. Stalks can be cut at their base individually or as a whole plant.
- Cilantro leaves can be harvested any time after the plant is about seven inches tall. Cut leaves at their base. Coriander seeds can be harvested from Cilantro flowers. Cut the flowers and hang them upside down above a receptacle to collect the seeds.
- Collard leaves can be harvested any time during cool temperatures and are best when harvested after a frost. Leaves can be plucked, twisted, or cut from the stem.
- Corn is ready to harvest when the silks (tassels) at the top of the ear (also known as a cob) are dried and yellow or brown. The kernels should feel plump and the ear should be well filled with kernels. Twist or cut the ear of corn from the stalk. Pests can occasionally enter an ear of corn with no visible outer damage, waiting to only be found when the husk is shucked from the ear. For this reason, SVdP Urban Farmers take all harvested corn into the kitchen personally for initial processing. Corn ears are then opened, checked for pests, and cleaned or thrown away as necessary. After this step, corn can then be stored for further processing by kitchen staff.
- Cucurbits (cucumbers, squash, melons, gourds, etc.) show a few signs they are ready for harvest. Look for a yellow spot on the bottom of the fruit where it touches the ground. Observe the branching node on the vine above the fruit, there are small “tassels” which should be growing from the top of the node. If these tassels have withered and are dried, the crop is likely ready to harvest. Twist the fruit, breaking the vine an inch or so above its connection to the fruit.
- Dill leaves can be harvested any time after the plant is about eight inches tall. Cut leaves at their base.
- Eggplants are ready to harvest when they are firm and their skin is glossy and thin. Cutting into an eggplant is sometimes necessary to determine harvest readiness, its flesh should be cream colored and there should be small light-colored seeds. Eggplants can be twisted, plucked, or cut from the plant at their connection to the stem, just above the top or “cap” of the eggplant.
- Continued on next page...

The Plants on SVdP Urban Farms

- Endive/Escarole leaves can be harvested anytime after they are two to three inches in length. Begin by harvesting the oldest outer leaves first. Individual leaves or the entire plant can be harvested.
- Fennel leaves can be harvested any time after the plant is six inches or taller. Cut leaves two to three inches from their top. Fennel bulbs can be harvested whenever they are large enough to eat. They are dug up and removed individually or cut off of the plant.
- Garlic bulbs are ready to harvest when about half of their leaves are brown or yellow and dried and half are still green to some extent. Dig up or pull the garlic bulb by its leaves.
- Jicama is ready to harvest when its roots are approximately five inches in diameter, usually at least five months from their planting date. To harvest jicama, simply dig them up.
- Kale is generally ready to harvest when it is between six and twelve inches long, depending on the variety. Begin by harvesting the oldest outer leaves first. Kale leaves are cut at their base and a plant can be harvested multiple times per year.
- Lavender flowers can be harvested once they begin to open. Cut them at their base and hang them to dry.
- Leeks are ready to harvest when their lower white portion is three inches or longer and the top of the leek is dark green or blue-green. Leeks can be pulled from loose soil but it is often easiest to dig them up.
- Lettuce heads are ready to harvest when they are between three and eight inches in diameter and still somewhat firm. Loose-leaf lettuce leaves are ready to harvest when they are two to three inches in length. Whole heads or individual leaves should be cut at their base.
- Mint leaves can be harvested anytime throughout a growing season. Twist, pluck, or cut leaves at their base. An entire plant can be cut down near the middle or later portion of the season for a second harvesting period.
- Mizuna leaves can be harvested at almost any stage of growth but are usually cut at their base when they are three to four inches long. Leaves can be harvested individually or the entire plant can be harvested at once.
- Mustard Greens are best to harvest when they are three to four inches long. They can be plucked or cut individually or harvested as an entire plant.
- Okra seed pods are ready to harvest when they are still soft and approximately two to three inches long. Harvesting should be done several times throughout a season. Cut or twist okra pods from their stems.
- Onions are ready to harvest when their tops have dried and fallen over. They can be dug up or pulled from looser soil.
- Oregano leaves can be harvested any time after the plant is about five inches tall. Cut, twist, or pluck leaves at their base.
- Parsley leaves can be harvested typically after the plant is seventy to ninety days old. Cut or twist parsley leaves at the base of their stem.
- Parsnip can be harvested when their roots are about one and a half to two inches in diameter and eight to twelve inches long, generally one hundred to one hundred and twenty days after planting. Loosen soil with a digging fork or other similar tool and pull parsnips up by their tops to harvest.
- Continued on next page...



- Pea pods are ready to harvest when they appear full and bright green. Opening pods and tasting them throughout a growing season can help a farmer know when to harvest peas. Peas will increase in sweetness throughout the harvest season and then become bitter quickly once they've passed their optimal harvest date. Twist, pluck, or cut a pea pod from the vine.
- Pepper harvesting indicators vary significantly based on the variety, but most peppers can be harvested and eaten at almost any stage of development. Colors, sweetness, and spice will all change depending on when a pepper is harvested. A farmer can experiment with peppers at different growth stages to see what they prefer. Peppers should be cut from the stem and gloves should be worn if the variety being worked with is a hot pepper.
- Potatoes should generally be harvested when their foliage dies back. For smaller and firmer potatoes, harvest potatoes when they begin to bloom. Potatoes can be dug up or pulled from loose soil.
- Radishes can be harvested when their tops start to show through soil and measure approximately one inch. They can be dug up or pulled from the soil.
- Rutabaga is ready to harvest when its top is three to five inches in diameter. Rutabaga are simply pulled from the ground, loosen the soil around a plant if this is difficult.
- Spinach leaves are ready to harvest when they are tender and big enough to eat. Spinach leaves can be cut at their base or plucked from a plant.
- Sunflowers are not necessarily a crop but their seeds can be harvested to be roasted and eaten or to be planted next season. Sunflower seeds are ready to harvest when the back of a sunflower head has changed from green to yellow. Seeds can be collected by hand from a mature flower head, they can be collected as they drop naturally in a bag tied loosely around a maturing flower head, or a flower head can be cut before it matures and hung upside down above a receptacle to drop its seeds for collection over time.
- Sweet Potatoes are generally ready to harvest between ninety and one hundred and twenty days after planting. They can usually be harvested approximately when they appear big enough to be eaten. Sweet potatoes can be dug up or pulled from loosened soil.
- Swiss chard can be harvested any time the leaves are large enough to eat. Cut individual leaves at their base, starting with the outermost leaves and working inwards.
- Tomatillos are ready to harvest when their husks begin to split and turn yellow or brown. The fruit inside should be bright green and a bit bigger than a cherry tomato. They can be plucked, twisted, or cut from the stem.
- Tomatoes can be harvested when they have turned uniformly red and their skin is firm and shiny. They can be plucked, twisted, or cut from the stem.
- Turnip roots should be harvested when their tops are approximately one to one and a half inches in diameter, as they grow larger their flavor will become overpowering. Turnips can be dug up or pulled from loose soil. Turnip greens can be harvested throughout the turnip growing season and are cut when they are small and tender. Avoid cutting more mature leaves and maintain a portion of the plants foliage to allow the root beneath to grow.




The Plants on SVdP Urban Farms

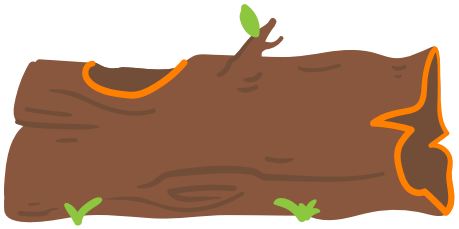
Tree Planting and Care

SVdP Urban Farms have a number of fruit trees throughout their properties. Proper maintenance of these trees is essential for their survival and long term success. If new trees are being planted, there are some basic rules to follow which will help a tree take root and grow.

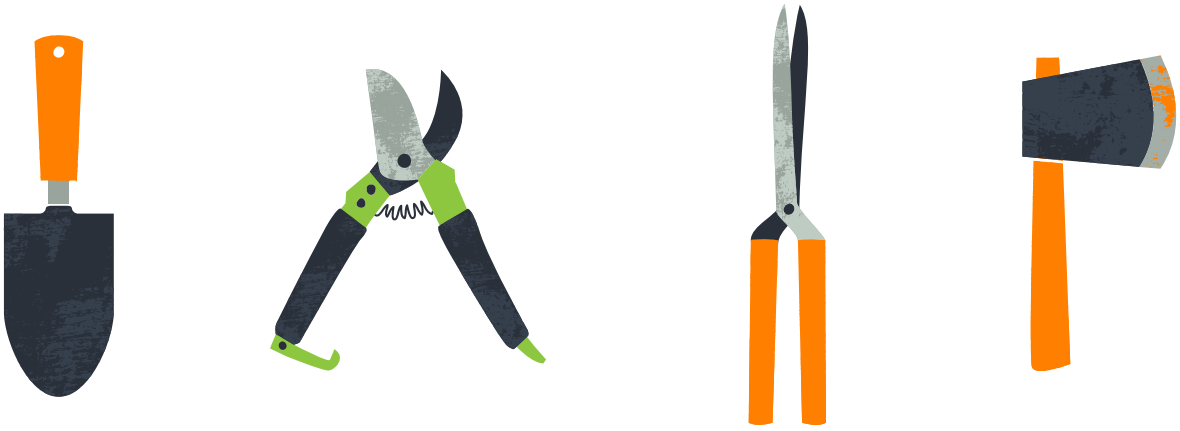
Plant any tree in a hole which is roughly twice as wide and equally as deep as the pot the tree came in. Tree roots take up a significant amount of underground space. It is important to ensure the soil around a newly planted tree's roots is loose enough for those roots to spread and take hold. Compost or mulch should be added to the soil being used to refill around a tree's root ball after it has been placed in a planting hole.

Trees purchased from a nursery can often be pot-bound. This means a tree's roots have grown to the soil's limit in a pot and are pressed up against the inner walls of the pot, often wrapping around each other and the entire root ball. This is not only unhealthy for the tree while it is in the pot, it can cause long-term health issues after a tree has been planted. If a tree is found to be pot-bound, before planting it, try to loosen up the roots and soil as much as possible. One technique is to run a digging knife or other sharp tool in vertical lines every few inches around a pot-bound root ball. Another method is to insert the tines of a digging fork or cultivator into the bound root ball, moving them in circular motions. This will not only loosen up the roots and soil around the edges, cutting or breaking these outer roots will also stimulate new growth. If the soil a tree is planted in is loose enough, this new growth will spread deeply and in all directions, anchoring the tree in place over time. If no care is given to a pot-bound root ball, a tree's roots will continue growing in a compact manner tangling together. This root ball will stay much smaller than the eventual above-ground portion of the tree, providing very little anchoring support. The roots of a pot-bound root ball will also be less effective at transporting nutrients from the soil into the rest of the tree due to strangulation of many of the roots and less direct exposure to soil.

Young trees from nurseries often need to be staked in place to avoid being blown over by wind before their roots anchor them in place. To keep a newly planted tree in place, it is generally recommended to use three tree stakes separated evenly around a tree's base in a triangular shape. A piece of rope or tree/plant wire is attached to a tree stake and stretched tightly to the tree. The other end of that rope or wire is then attached to the tree, pulling it in the direction of the tree stake. A rope or wire should be taught but it's attachment to the tree should be wide enough to allow the trunk to grow to avoid strangling the tree over time. If this is not possible, the rope or wire's tie around the tree should be loosened a couple of times per year. Once a new tree is secured tightly to three or more tree stakes spaced evenly around the tree, it will be much more likely to effectively take root and live a long successful life. Tree stakes are ideally made of a thick material and should stick out of the ground at least three to five feet. One quarter to one third of their total height should be buried into the ground for optimal holding strength.



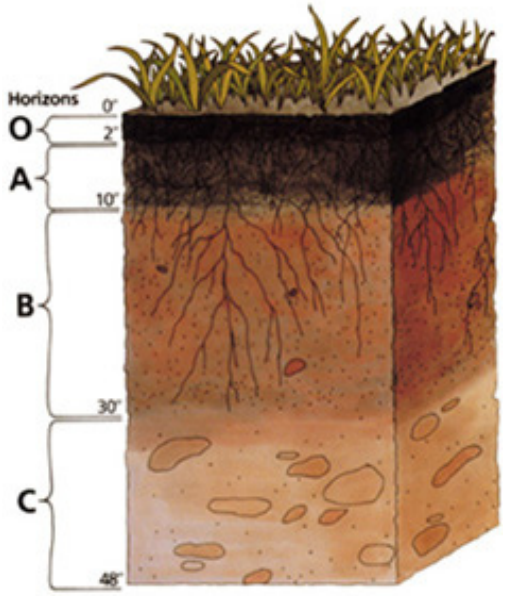
Properly pruning and maintaining fruit trees is essential for fruit production. There are different ways to prune a fruit tree to improve productivity. Generally the goal when pruning any fruit tree is to support the success of the tree's best branches all around the canopy. This means selecting strong branches in a canopy and clearing space for their growth by pruning away competing branches within a radius around the selected branch. Clearing away branches which cross over and cover the selected branch provide increased access to light and space to fill. Over the course of years, proper fruit tree pruning will produce a tree with a highly productive branch reaching in every direction. Maintaining approximately six inches to one foot of open space around each branch will aid in fruit production and increase ease of other maintenance and harvesting tasks.



Soil Science, Fertilizer, and Compost

Basic Soil Science

Soil is a natural growing medium predominantly composed of rock and mineral particulate which has been broken down and eroded by natural or artificial processes. Usually, this mineral particulate is combined with a small amount organic matter which has been decomposed by various organisms as well as natural or artificial processes. Soil is, most generally, rock and mineral particulate mixed with a bit of organic matter. Soil normally forms in layers (also known as soil horizons) over time, these layers make up a soil profile. In farming, the top three horizons (labeled O, A, and b) are generally most important.



Soil Horizons depiction, source: USDA. (n.d.). A Soil Profile. Natural Resources Conservation Service. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054308

The top most layer, horizon O, is not technically considered soil and generally contains only organic matter in various states of decomposition. As matter decomposes in the O horizon, it is transferred into the layer below called topsoil. Topsoil is the first horizon which is actually considered soil and is what constitutes soil horizon A. Topsoil is relatively loose with a significant amount of organic matter. The soil in horizon B is called subsoil. Soil in horizon b will often be similar to an area's topsoil but more compacted and containing less nutrients. There are a number of other horizons beneath the top three layers but these are less relevant to farming and gardening. For the most part, plant roots in a farming setting do not reach past soil horizon B. For more information regarding soil horizons and all things soil science, see the references listed at the end of this manual. On a more specific level, soil can be defined by its texture.

Soil texture is an important aspect of growing any plant, especially food crops. For example, some plants require a lot of water and prefer a soil texture which will retain moisture for a long period of time. Other plants will struggle and potentially die if the soil they inhabit stays damp for a long period. Another example of the importance of understanding soil texture is nutrient retention. Some soils allow so much water to move through them that nutrients are washed away quickly. Other soils will retain nutrients to such an extent that, with fertilization, a plant can actually be damaged by the excess nutrients. It's important for a farmer or gardener to learn how to roughly interpret a soil's texture by feeling and visually analyzing a soil's composition. Soil texture is designated by the ratio of three different material sizes: sand, silt, and clay. This can be a bit confusing because many people have their own specific ideas of what sand, silt, and clay mean. In soil science, these terms simply refer to three different particle sizes which are less than two millimeters (mm). Anything 2mm or larger is considered a rock fragment.

Soil Science, Fertilizer, and Compost

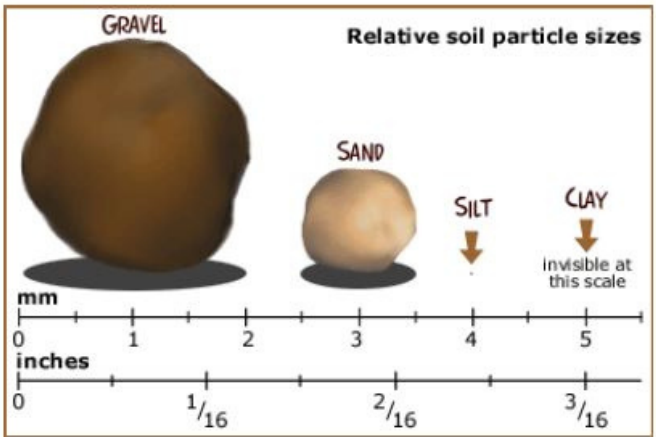


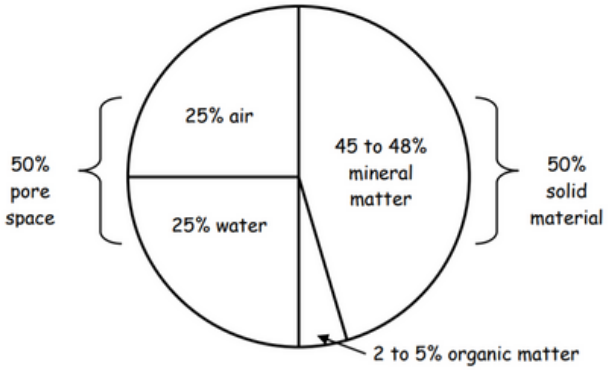
Image Source: Foster, S., Schultz, B., McCuin, G., Neibling, H., and Shewmaker, G. (2013). Soil Properties, Part 1 of 3: Physical Characteristic. University of Nevada Cooperative Extension. https://extension.unr.edu/publication.aspx?PubID=2161

- Sand particles are between .05mm and 2mm in size. Sand particles generally feel rough and coarse to the touch and can be seen with the naked eye.
- Silt particles are between .002mm and .05mm in size. Silt particles generally feel light and powdery to the touch when dry and often cannot be seen without a magnifying glass.
- Clay particles are smaller than .002mm in size. Clay particles feel extremely light, fine, and floury to the touch when dry. When clay particles are wet, they stick together and become a malleable material. They cannot be seen without a tool for significant magnification, such as an electron microscope.
- Loam is a term used when referring to soils which have a combination of sand, silt, and clay. A true loam has a roughly equal amount of each soil particle type. Loam can be rated to varying degrees. For example, a soil with mostly sand but some silt and clay might be called a sandy loam.
- Gravel could be considered a type of soil particle but is predominantly shown for comparison.

Soil Attributes

Humus – Fully decomposed organic material (such as plant matter, dead insects, and microorganisms) in a soil is called humus. Organic matter in various states of decomposition is fundamental to soil health. Larger pieces of organic matter which haven't fully decomposed help loosen soil and provide aeration and drainage. Humus is made up of smaller particles and provides nutrients to the soil. Though organic material is an essential aspect of healthy soil, it is not taken into consideration when defining a soil's texture.

Soil Porosity – The porosity of a soil can be thought of as the percentage of soil which is made up by empty space. A sponge is an effective analogy; the holes in a sponge and the empty space in those holes dictate the sponge's porosity. Some soil is highly compacted with very little space between soil particles, this soil has low porosity. Some soil is very loose with a lot of space between soil particles, this soil has high porosity. A soil with high porosity will allow air and water to move quickly through it. A soil with low porosity will resist air and water moving through it. Roughly 50% porosity is generally ideal, meaning about half of a soil's volume should usually be made up of particulate and the other half should usually be made up of empty space.

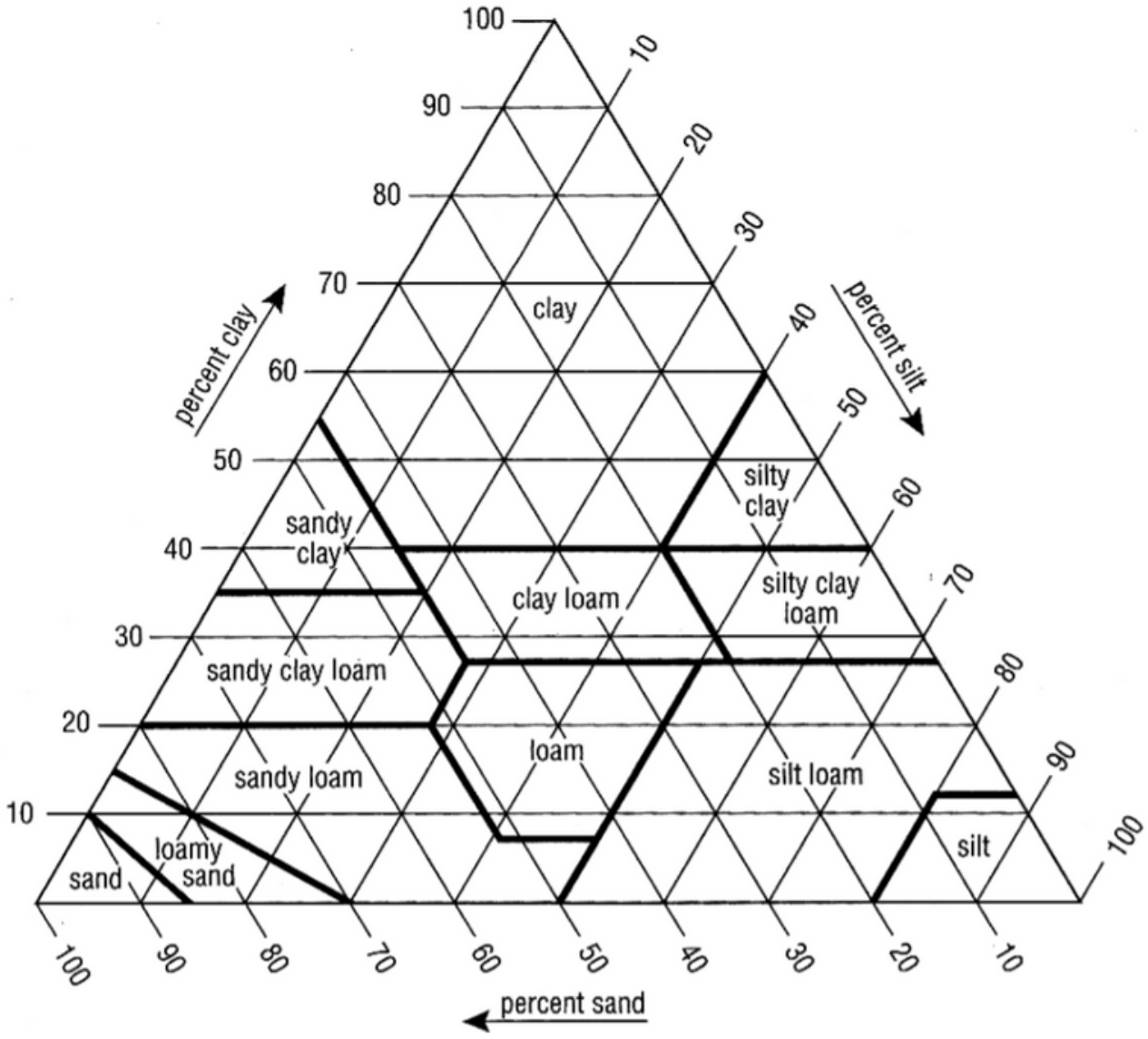


Source: Daniels, W., Haering, K. (n.d.). Chapter 3. Concepts of Basic Soil Science. Department of Crop and Soil Environmental Sciences, Virginia Tech. http://www.soilphysics.okstate.edu/teaching/soil-4683-5683/references/concepts%20of%20basic%20soil%20science.pdf

Soil Drainage and Aeration – A soil's tolerance for the movement of air and water is directly connected to its texture and porosity. Coarse soils with large particulate will have a high capability for aeration and water drainage. Coarse soils have low moisture and nutrient retention rates. This means they allow air, water, and nutrients to move quickly through them. Fine textured soils with small particulate have a low capability for aeration and water drainage. Fine soils have high moisture and nutrient retention rates.

Soil Texture Triangle

This triangular graph is used to determine a soil type based on the ratio of sand to silt to clay in a soil. Each point on the triangle represents one soil particle type. If a soil has more particles of one type than another, it is located closer on the graph to the dominant soil type.



Source: Daniels, W., Haering, K. (n.d.). Chapter 3. Concepts of Basic Soil Science. Department of Crop and Soil Environmental Sciences, Virginia Tech. http://www.soilphysics.okstate.edu/teaching/soil-4683-5683/references/concepts%20of%20basic%20soil%20science.pdf

Mulch and its Benefits

In a broad sense, mulch is simply any material used to cover soil. Mulch can be thought of as synonymous with the O horizon in a soil profile. Mulch is generally used to cover soil for moisture retention, weed suppression, erosion reduction, and soil temperature reduction.Natural mulch can be made up of organic matter like leaves or bark as well as nutrient inert materials such as gravel and stones. Artificial mulch can be made of many materials such as recycled rubber chips, plastic sheeting, or landscape fabric. Artificial mulch can sometimes leech harmful chemicals into soil. SVdP Urban Farms only recommends using artificial mulch in specific instances when it is the only viable material.

Natural mulch made of organic matter will decompose over time which provides nutrients for the soil but also means that it will have to be replaced periodically. Some people use compost as mulch, this slowly amends the soil with nutrients while also providing the benefits of covered soil for a short period. Wood chips will decompose at a much slower rate than other natural materials providing long term cover and eventual mild soil amendment. Gravel or stone will obviously not decompose, meaning it is somewhat permanent (smaller gravel or stone will be displaced over time through farm work and natural processes) but will not provide any soil amendment benefits.

Artificial mulch made of synthetic materials will only provide the basic benefits of covering soil and can also cause issues if used incorrectly. Synthetic mulch chips made of rubber or plastic simulate permanent woodchips but can leech toxic chemicals into soil over time. Plastic sheeting is an effective mulch when used carefully. For example some farmers cover the soil in their row plantings with plastic and then cut holes for crops to grow through. This ensures weeds cannot grow in the vicinity of a crop. Plastic sheeting will not allow moisture to move through it so rows of uncovered soil are required adjacent to plastic covered rows for effective irrigation. Plastic sheeting can also heat soil to temperatures which are uninhabitable for plants if exposed to too much sun.

(Woodchip mulch bed at Human Services Campus Farm)

Till or No-Till?

A controversial subject in organic farming is the choice between tilling soil and leaving soil untilled. One advantage of tilling soil is easier amendment with compost or fertilizers. Another is easier planting and weeding. One disadvantage of tilling soil is that, in large-scale conventional agriculture, heavy machinery used for tilling can compact the layers of soil beneath the top soil. This can cause issues for deeper root growth; it also negatively impacts beneficial organic life in the compacted soil. Another disadvantage of tilling soil, on any scale, is the disturbance of beneficial microbes in the top soil.

Tiny, often microscopic, organisms in soil are essential for breaking down organic matter and releasing nutrients through their excrement. Soil is also naturally tilled on a small scale by the movement of these organisms, by larger animals on the surface, and by other environmental factors such as wind and water flow. Some organic farmers and gardeners argue these natural methods are enough to provide proper aeration and resist compaction in top soil. People of this opinion also believe tilling disturbs organisms in soil to such an extent that their benefits are significantly diminished for a period of time after tilling is performed. Debate is still ongoing on this topic. In general, farmers on SVdP farms occasionally till and amend soil in their growing beds. Doing so by hand, instead of with heavy machinery, will reduce the negative impacts of tilling soil. Some SVdP urban farmers prefer only tilling the top few inches of topsoil, a process sometimes called tilthing. Regardless of whether an organic farmer or gardener is or is not tilling their soil, the organisms and nutrients present in that soil are essential to a crop's ultimate success.

Plant Nutrients

In nature, nutrients are products of decomposing organic matter. This section focuses on what nutrients plants need, how to tell if plants are getting the nutrients they need, and how to give them those nutrients. For in-depth information regarding why a plant needs these nutrients, more details regarding nutrient effects on specific plant varieties, and a guide informing some common signs of nutrient deficiencies based on the nutrient type, see the references listed at the end of this manual.

Macronutrients are the main nutrients a plant requires to grow and are essential to plant health. Macro nutrients must be present in a growing medium for a plant to succeed and can be added to soil, in measured amounts, for improved growth. The three macronutrients are nitrogen (N), phosphorous (P), and potassium (K).
Intermediate nutrients are important for plant health and should be replenished if found to be lacking in a soil analysis. The three intermediate nutrients are calcium (Ca), magnesium (Mg), and sulfur (S).

Micronutrients help a plant grow but are only required in small amounts. They can be found in certain fertilizers but are generally present, to some extent, in most soils. The seven micronutrients are boron (B), zinc (Zn), manganese (Mn), iron (Fe), copper (Cu), molybdenum (Mo), and chlorine (Cl).

Soil Science, Fertilizer, and Compost

Soil pH levels are a measure of how acidic or alkaline a soil is. A pH of 7 is considered neutral. A pH below 7 is considered acidic, a pH above 7 is considered alkaline. Soil pH is important for releasing nutrients from soil material for access by plant roots. A fairly neutral soil pH between 6 and 8 is usually ideal for growing crops. Many inexpensive and easily accessible products for measuring soil pH are available today from garden and agricultural retailers.

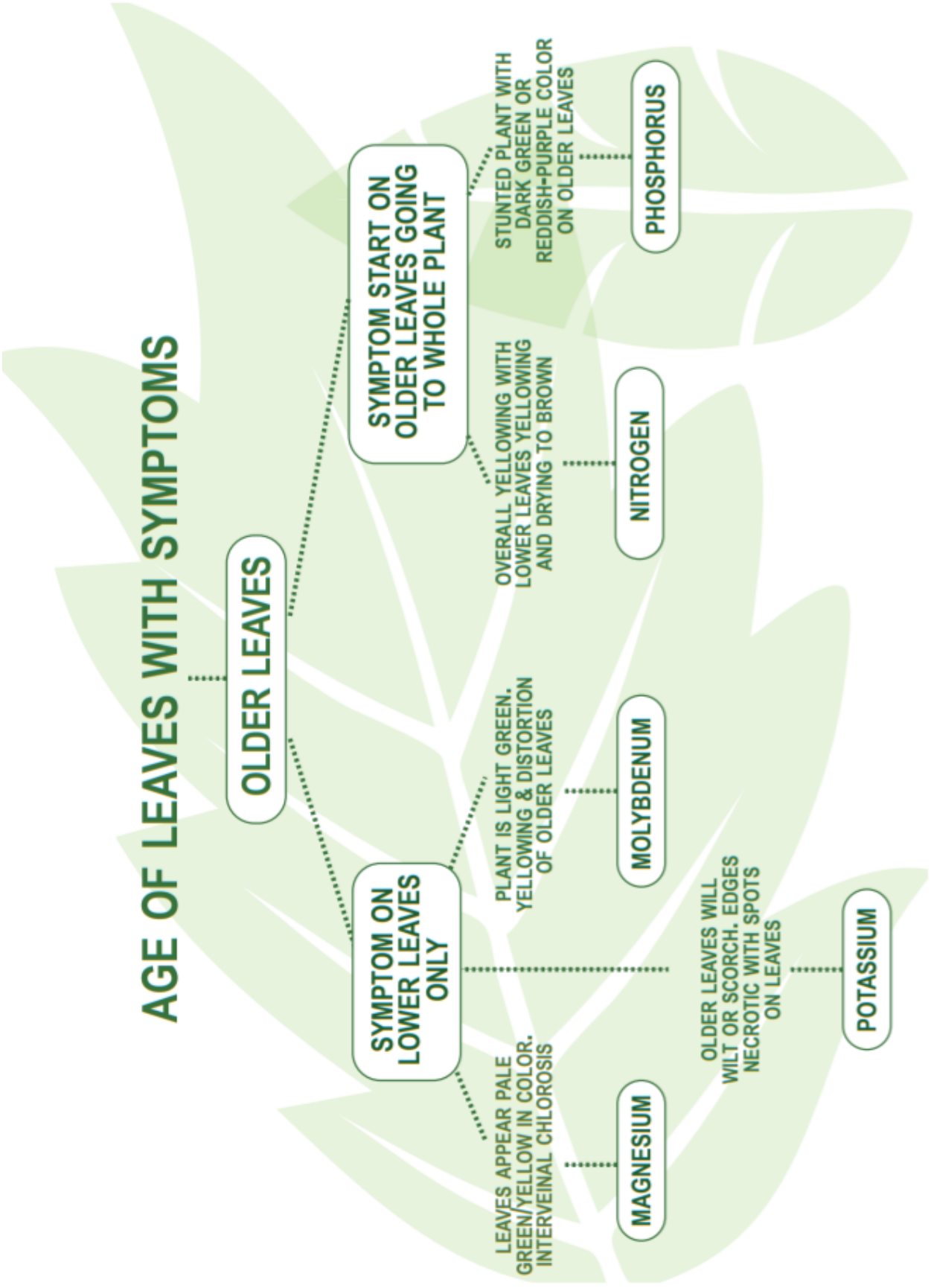
Below and on the following pages a chart and diagrams are shown describing nutrient deficiencies and how to identify them:

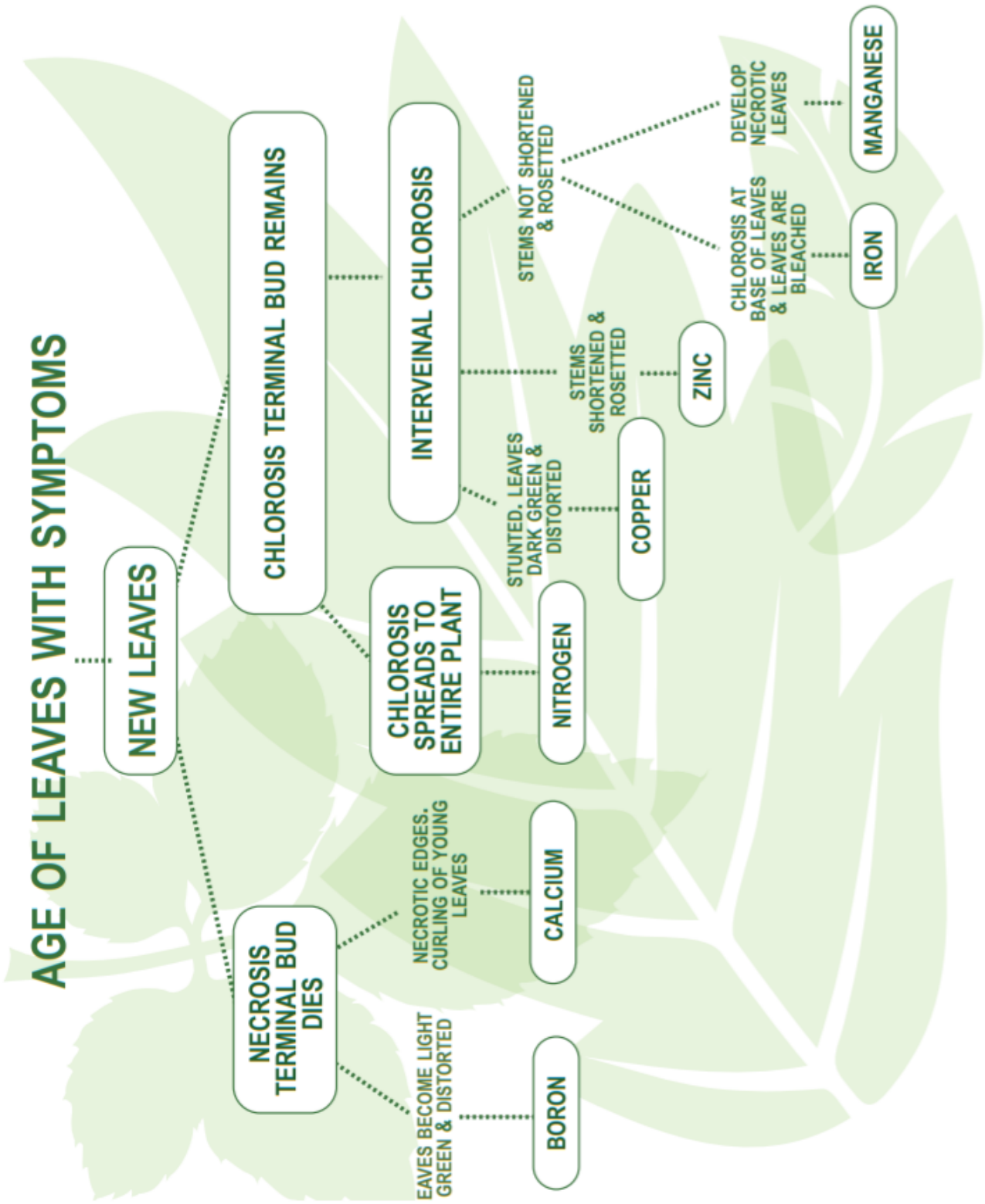
Nutrient	Deficiency Symptoms	Comments	Fertilizer Sources
MACRONUTRIENTS **Replace macronutrients in soils regularly (at least once per growing season)**			
calcium (Ca)	New leaves (top of plant) are distorted or irregularly shaped. Causes blossom-end rot.	Desert soils and water generally have plenty of calcium, so deficiency problems are rare. Excessive calcium can limit the availability of other nutrients.	Anything with the word "calcium"; also gypsum.
nitrogen (N)	General yellowing of older leaves (bottom of plant). The rest of the plant is often light green.	Most plants absorb nitrogen in the form of ammonium or nitrate. These forms readily dissolve in water and leach away.	Anything with the words "ammonium," "nitrate," or "urea." Also manures.
magnesium (Mg)	Older leaves turn yellow at edge leaving a green arrowhead shape in the center of the leaf.	Plants absorb magnesium as an ion (charged particle), which can be readily leached from soil. May be readily leached from soil if calcium is not present.	Anything with the word "magnesium"; also Epsom salts (magnesium sulfate).
phosphorus (P)	Leaf tips look burnt, followed by older leaves turning a dark green or reddish-purple.	Plants absorb phosphorus in the form of phosphate. This form dissolves only slightly in water, but pH strongly affects uptake.	Anything with the words "phosphate" or "bone." Also greensand.
potassium (K)	Older leaves may wilt, look scorched. Interveinal chlorosis begins at the base, scorching inward from leaf margins.	Plants absorb potassium as an ion, which can be readily leached from soil. Desert soils and water generally have plenty of potassium, so deficiency problems are rare.	Anything with the words "potassium" or "potash."
sulfur (S)	Younger leaves turn yellow first, sometimes followed by older leaves.	Plants absorb sulfur in the form of sulfate. This readily leaches from the soil. Sulfur may acidify the soil (lower the pH).	Anything with the word "sulfate."

MICRONUTRIENTS Replace when deficiency symptoms are evident.			
boron (B)	Terminal buds die, witches' brooms form.	Plants absorb boron in the form of borate. Problems are seen in intensely cropped areas.	Anything with the words "borax" or "borate."
copper (Cu)	Leaves are dark green, plant is stunted.	Plants absorb copper as an ion. Arizona soils have plenty of copper, so problems are rare.	Anything with the words "copper," "cupric," or "cuprous."
iron (Fe)	Yellowing occurs between the veins of young leaves.**	Plants absorb iron as an ion through their foliage as well as their roots. Uptake is strongly affected by pH. Chelated iron is readily available for use by the plant, other forms of iron may be tied up in the soil.	Anything with the word "iron chelate."
manganese (Mn)	Yellowing occurs between the veins of young leaves. Pattern is not as distinct as with iron. Palm fronds are stunted and deformed, called "frizzle top." Reduction in size of plant parts (leaves, shoots, fruit) generally. Dead spots or patches.	Plants absorb manganese as an ion through their foliage as well as their roots.	Anything with the words "manganese" or "manganous." Often required with zinc application.
molybdenum (Mo)	General yellowing of older leaves (bottom of plant). The rest of the plant is often light green.	Plants absorb molybdenum in the form of molybdate. Problems are rare in Arizona soils but are occasionally seen on legumes where it mimics nitrogen deficiency.	Anything with the words "molybdate" or "molybdic."
zinc (Zn)	Terminal leaves may be rosetted, and yellowing occurs between the veins of the new leaves.	Plants absorb zinc as an ion through their foliage as well as their roots. High pH may limit availability.	Anything with the word "zinc."

Source: Hosier, S., Bradley, L. (1999, May). Guide to Symptoms of Plant Nutrient Deficiencies. The University of Arizona Cooperative Extension. https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1106.pdf





AGE OF LEAVES WITH SYMPTOMS
OLDER LEAVES
SYMPTOM START ON OLDER LEAVES GOING TO WHOLE PLANT
STUNTED PLANT WITH DARK GREEN OR REDDISH-PURPLE COLOR ON OLDER LEAVES
PHOSPHORUS
OVERALL YELLOWING WITH LOWER LEAVES YELLOWING AND DRYING TO BROWN
NITROGEN
SYMPTOM ON LOWER LEAVES ONLY
PLANT IS LIGHT GREEN. YELLOWING & DISTORTION OF OLDER LEAVES
MOLYBDENUM
LEAVES APPEAR PALE GREEN/YELLOW IN COLOR. INTERVEINAL CHLOROSIS
MAGNESIUM
OLDER LEAVES WILL WILT OR SCORCH. EDGES NECROTIC WITH SPOTS ON LEAVES
POTASSIUM



Source: Loper, S. (2014, February). Diagnosing Nutrient Deficiencies Quick-Reference Guide. College of Agriculture and Life Sciences. The University of Arizona Cooperative Extension. https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1609.pdf

Fertilizing and Amending Soil

Soil Analysis

Knowledge of nutrient deficiency visual indicators can be exceedingly useful in a crop growing environment, but relying on human faculties to analyze deficiencies in varied environments and on larger scales does not produce consistent results. SVdP Urban Farms conduct seasonal soil analyses to optimize fertilization efforts. Tailoring fertilizer nutrient ratios based on the current state of soil on a farm allows a farmer to provide their crops the exact nutrients they need and an overall ideal growing habitat.

It is important to select soil from different areas of the farm which are distinct from one another for testing. Based on varying soil amendment projects done at different stages of farming, the type of plants being grown in various areas around a farm, and other environmental factors such as access to light and ability for water drainage, soil in different growing areas on a farm will often contain dissimilar nutrient profiles. If a growing space only has one large generalized growing space, a technique called composite sampling is ideal. In composite soil sampling, a farmer should take a number of soil samples in a grid pattern across a large growing area. All of these samples should then be combined to produce a composite soil sample which yields average nutrient values across an entire growing space.

Ideally, SVdP Urban Farm Managers and Lead Volunteers collect and send a soil sample for analysis each season. Based on these analyses, lead farmers choose fertilizers and amendments to balance nutrient profiles in SVdP Urban Farm soils.

Fertilizer Types and How to Use Them

Dry fertilizers (fertilizers which come in a non-liquid form) are applied utilizing a few different methods:

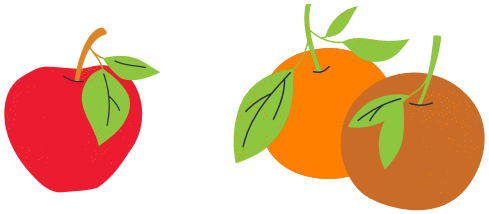
- Broadcast application is the process of evenly spreading a fertilizer over the soil's surface in a growing space. There are a variety of products available from home and garden retailers which make even application across a growing area easy and quick. The most common product for broadcast application is a walk-behind broadcast spreader, often used on larger residential lawns. Broadcast application of dry fertilizer is improved with heavy watering throughout a growing area after fertilizer application.
- Mixed application of fertilizer involves mixing a fertilizer with a soil medium prior to planting. Banded application requires burying fertilizer beneath topsoil for plant roots to access directly. Side dressing fertilizer means to place it on the soil's surface adjacent to and surrounding the base of a plant. When side dressing, fertilizer can be lightly mixed into the top inch or so of soil. Watering after any application of dry fertilizer improves its effectiveness.

Organic fertilizers

The choice of using organic or synthetic fertilizers can sometimes be difficult. In general, SVdP Urban Farms choose to utilize organic methods. There are a variety of reasons to choose organic fertilizers. However, these materials do have some caveats to consider. It's important to know the details of how to work with organic fertilizers.

Organic fertilizers are composed of naturally occurring materials. Different materials will contain different nutrient profiles which are normally listed on the product packaging (it's a good rule of thumb to always follow any application instructions and information listed on fertilizer packaging). If a homemade organic fertilizer, such as coffee grounds or egg shells, is being utilized, research should first be done regarding what nutrients that specific material contains. The main consideration to make when utilizing organic fertilizers is how they contain and release nutrients.

One benefit of a synthetic fertilizer is that a farmer knows the exact amount of nutrients they are adding to a soil. They also know that nutrients will be nearly immediately available for use by the plant. Organic fertilizers need to be broken down by soil-borne micro-organisms and other natural processes before their nutrients are available for use by plants. Being a natural product, organic fertilizers can contain slightly inconsistent nutrient amounts. This may cause minor variability in results between different applications of the same product.



Liquid fertilizers are generally applied in a few variations of the same basic method. Liquid fertilizers are mixed with water at a rate designated on the product packaging (some liquid fertilizers are pre-mixed and ready for application). This mixture is then delivered to plants in a few different ways:

- Direct watering of liquid fertilizer is the process of simply watering a growing space with a liquid fertilizer mixture. This can be done with a premixed solution in a hand-held container or a farmer can purchase a variety of products which connect to a hose and disperse liquid fertilizers at regular rates while watering.
- Soil spraying with liquid fertilizer requires a pressurized sprayer of some kind. A liquid fertilizer mixture is held in a pressurized container and sprayed onto the soil throughout a growing space. A variety of spray applicators are available from home and garden retailers ranging from a few ounces in volume held by a hand sprayer to five gallons held by a backpack sprayer.
- Foliar spraying is the same process as soil spraying except, instead of spraying the soil in a growing space, a farmer is spraying the leaves of the plants themselves. It's important to thoroughly apply a fertilizer when foliar spraying and ensure it covers both the top and bottom of all of a plant's leaves. Micronutrient fertilizers are best applied through foliar spraying. An area can be watered after soil spraying, but a foliar spray should be allowed time to be absorbed by a plant's leaves subsequent to its application to avoid washing it away during watering.

The main lesson to remember when using organic fertilizers is that organic fertilizers will not, usually, provide immediate benefits to a growing plant. They will need time to break down and will provide long term health benefits throughout a plant's life. A simple way of explanation this is to say that organic fertilizers feed the soil and synthetic fertilizers directly feed the plant. This is truer of dry fertilizers than wet fertilizers; liquid fertilizers often break down and reach plant roots quicker. In general, organic fertilizers are best applied before or between growing seasons. Planning ahead and taking extra time to prepare for a growing season are essential aspects of using organic fertilizers and organic methods in general. These characteristics of organic materials can be considered drawbacks, but they also can be considered beneficial.

As organic fertilizers are made of natural materials, they assist the general natural processes occurring in a soil. Organic fertilizers help create a holistically healthy ecosystem. Synthetic fertilizers can help develop healthy plants but they will not feed into the lifecycles of a farm's ecosystem in the way organic fertilizers will. Because synthetic fertilizers don't need to be broken down, all of their nutrients are available immediately. This can cause issues such as over-fertilization and chemical burning of a plant. Their immediate availability can also cause synthetic fertilizer run off during which nutrients are removed from a soil through the flow of water. Furthermore, synthetic fertilizers often contain a variety of chemicals which do not provide any nutrients to a plant and can remain in soil for long periods of time building up and causing long term plant health issues throughout a growing area.

Consideration for the health and prosperity of the ecosystem surrounding SVdP Urban Farms is the main reason the program supports organic farming methods and materials. For more information regarding organic and ecological farming practices, see the section of this manual titled Ecological Farming Practices and Integrated Pest Management.

Compost Creation and Utilization

In many farmers' eyes, compost is the most effective organic fertilizer and soil amender. Compost is simply organic matter decomposed by soil organisms such as fungi and bacteria. Compost can be made of almost any organic material. Not only is compost a highly effective soil amendment and fertilizer, the process of composting also helps a farmer utilize and clear away waste and debris. According to the United States Environmental Protection Agency, 63.1 million tons of food is wasted in the US every year, making up 21.6 percent of the country's total municipal solid waste dumped in landfills (United States Environmental Protection Agency, 2021). Composting is an important aspect of a more environmentally friendly future. Farmers and gardeners are fortunate that something so effective in their growing space can also have an important positive effect on the surrounding community. Modern composting science is very detailed and well-studied. For more in-depth discussions of all things compost, see the references listed at the end of this manual.

Successful composting requires the presence of four essential components: water, oxygen, organic material, and microorganisms. Water and oxygen are fairly simple to maintain in a compost pile. A pile should be watered, generally on a weekly basis, so that roughly 50% of its weight is water. A pile should also be turned over with a pitchfork or other hand tool regularly to loosen it, leaving space for airflow. Large sticks and other bulkier material which may not be broken down can be included during compost development and removed after the process is complete to keep the material loose.

In small-scale composting, such as is done on SVdP Urban Farms, there are generally two categories of organic material added to a compost pile. Brown material is made up of dry materials like dry leaves and twigs. Brown material is high in carbon, a necessary element for compost creation. Brown material may not always be brown in color, for instance, shredded paper is considered brown material. Green material is also not always green and is made up of wet or moist materials such as food scraps, coffee grounds, or freshly cut grass. Green material provides nitrogen, the other main element required in compost creation. A carbon to nitrogen ratio of approximately 30 parts carbon to 1 part nitrogen is best for healthy compost. Too much carbon will cause slowed or halted decomposition. Too much nitrogen can create foul odors and will speed up decomposition which can potentially raise compost temperatures to a level beneficial organisms cannot survive in. A farmer usually hopes for their compost to smell a bit sweet and the odor should not be overwhelmingly strong.

Some farmers use certain organic materials with known nutrient ratios to create more specifically applicable compost. SVdP Urban Farms do not go to this depth in composting processes. For more information regarding more specific compost design and creation, see the references listed at the end of this manual.

There are some organic materials which should not be added to a non-commercial composting operation. Animal products take too long to decompose without dedicated machinery and other equipment so they may attract unwanted wildlife and can harbor harmful pathogens. Oils generally will also take too long to decompose and should not be added to a compost pile. Ensure weeds are completely killed and have no potential for regrowth before adding to a compost pile. Some farmers simply throw all weeds in the trash to ensure their permanent removal.

Microorganisms can be acquired through native soil. A farmer can simply add a couple of shovels of native soil directly to a compost pile. Microorganisms play the essential role of decomposing organic matter in a composting system. On a miniature scale, a developing compost pile is its own ecosystem with a wide variety of organisms all playing their own part.

Soil Science, Fertilizer, and Compost

Note about Fungi in compost and soil Visible fungi in homemade and store bought compost and soil are common. People often notice a white fungus in compost and worry the product is no longer usable. However, the vast majority of fungi found in homemade or store bought growing mediums are entirely harmless and can often be beneficial. Most of these fungi are saprophytic fungi which decompose organic matter and aid the process of releasing essential nutrients into the growing medium. What looks like white mold in compost and soil can also be mycelium. Mycelium is the vegetative part of a fungus and is present throughout the majority of organically rich growing mediums across the earth. If there is enough present to be visible, this can be a sign your compost is highly fertile. Mushrooms, which are a fungus' fruiting body (reproductive organs), are also generally not a cause for concern. If signs of fungus are regularly observed on or around unhealthy plants, this could be an indication that this is a pathogenic fungus which is harmful to a plants health. Reference the section on pathogens in the Ecological Farming Practices and Integrated Pest Management chapter of this manual on page 90 for more information on pathogenic fungi.

The entire process of turning organic matter into compost includes three stages. The activity of organic material decomposition by soil organisms creates heat. Each of the 3 phases in compost production is defined by a different temperature range. A thermometer is a highly useful tool when creating compost. Temperatures throughout the composting process should generally range between 40 and 60 degrees Celsius (112 and 152 degrees Fahrenheit).

SVdP Urban Farms separate their composting systems into three bins, one for each stage of the process.

- Bin #1 receives raw organic material. This material should be chopped up using a shovel, mulcher, or other hand or power tool prior to being added to Bin #1. Material can be left in Bin #1 for a duration of a few days to a few weeks. Usually, SVdP Urban Farms leave compost in Bin #1 for 1 to 2 weeks. Material is ready to be moved out of Bin #1 when: temperatures rise past about 40 degrees Celsius (112 degrees Fahrenheit) and the most offensive initial odors begin to fade.

- Bin #2 receives material from Bin #1. Compost material can be kept in this bin for a duration of 3 weeks to multiple months. Usually, SVdP Urban Farms leave compost in bin #2 for 1 to 2 months. This material is ready to be transferred when: temperatures begin to recede below 40 degrees Celsius, food scraps are no longer visible, and most heavy foul odors have been replaced by lighter slightly sweet scents.

- Bin #3 receives material from Bin #2. Compost material can be kept in this bin for a duration of 1 to 6 months. Usually, SVdP Urban Farms leave compost in bin #3 for 2 to 3 months. The composting process is complete and ideal compost has been created when: all foul odors are gone and the compost smells like fresh soil, temperature in the pile is consistently below 32 degrees Celsius (90 degrees Fahrenheit), the material is loose and fairly light and fluffy, and most individual particles in the material (other than a few woodchips or sticks here and there) are 1/8th of an inch to 2 inches in size.

Compost Tea is a substance made through the process of “steeping” compost in water. A small porous bag of compost is suspended in a bucket of water and left to “brew” for approximately 3 days. An aerating pump can improve this process. Once compost tea has been made it can be applied as a foliar or soil fertilizer. It is best as a foliar fertilizer as it contains the micronutrients a plant is likely already receiving through existing soil nutrient profiles. It’s recommended to avoid using compost tea close to times of harvest.

Watering & Irrigation

General Irrigation Concepts

Irrigation is the process of intentionally transporting water to a plant's roots for absorption. Though it may be a simple concept, there are a variety of different ways to get water to plants and a number of considerations to make when doing so. Just like any resource, water should be used as minimally as possible. The first step in designing an irrigation system is to gauge what moisture conditions are like in a growing space. A farmer should carefully observe all areas of their farm continuously throughout the year, noting how easily moisture is retained in each area. Once the water requirements of the various spaces on a farm are well known, the most optimal style and design of irrigation can be chosen.

Irrigation Methods Used on SVdP Urban Farms

For the purposes of this manual, this section broadly discusses general irrigation methodologies. The intricacies of irrigation installation, setup, and design are less relevant to this conversation. Any work done directly to a property's water supply, or any utility, should only be conducted by a trained professional. Do not attempt to connect directly to, or alter in any way, a water supply on any SVdP Urban Farms. All irrigation work done by SVdP Urban Farm volunteers should only occur in locations on an irrigation system past the initial point of connection (such as a hose bib or irrigation control box). For more in-depth information regarding irrigation specifics such as different materials and products available, see the references listed at the end of this manual.

Drip irrigation is the most common form of irrigation found on SVdP Urban Farms. Drip irrigation is widely used in small to medium scale sustainably oriented agriculture today. Drip irrigation represents an effort in water conservation and focused allocation of irrigation resources. Drip irrigation helps prevent runoff and, instead of oversaturating an entire area to ensure plants receive water, drip systems only deliver the amount of water a plant needs. Not only does this save water, it ensures that empty spaces in a growing area don't fill with weeds.

On a basic level, a drip system consists of tubing with holes incrementally located along its length for water to escape. The line can be rigid or flexible. Drip tape is a highly malleable material which can be fit to any shape and rolled up for convenient storage. Drip tubing is still flexible, but more rigid than tape, and comes in a variety of sizes. Micro-tubing is very thin tubing and is generally used to connect short offshoots of irrigation from a main drip line. Soaker hose is drip tubing which is slightly porous throughout. This means that water will slowly leak from the entire tube, often useful for heavily soaking a larger area. Completely rigid PVC tubing can also be used in drip systems; however, this removes one benefit of drip tubing: it is generally mobile, easily adjustable, and can be installed temporarily. Rigid PVC makes a much more permanent irrigation system.

Emitters control how much water is delivered to a plant in a drip system and are one of the more important aspects of drip irrigation to consider. Conventional emitter perforations are simply holes in a line for water to flow through. Emitters can be installed in emitter perforations. Emitters will be labeled with a flow rate measured in gallons per hour (gph). Emitter perforations without an installed emitter usually deliver water to plants at an approximate flow rate (the amount of water moved per hour) of .5 gallons per hour.

Perforations are often cut on a line from the factory, this is called perforated drip tubing. Non-perforated drip tubing is also available for purchase. This allows customized emitter perforations to be cut using a drip tubing hole-punch. Emitter perforations can be left as they are, or, an emitter can be installed into them.

Emitters with water flow rates ranging from .5gph to 5gph or more can be installed into emitter perforations for precise water application. Emitters will be labeled with a flow rate measured in gallons per hour (gph). It is important to ensure that the correct combination of emitter flow rate and timing of the entire system is tuned to a plant's watering needs. For example, imagine a farmer has a drip line with 1gph emitters. This farmer wants their plants to receive a total of 2 gallons of water per day. With 1gph emitters, the drip system needs to be on for 2 hours per day to deliver 2 gallons of water to each of the farmer's plants. Spray emitters are a newer drip irrigation product. These project a spray of water in a variety of patterns and diameters. Basic drip emitters are best used buried under the top layer of soil or placed on the soil's surface directly adjacent a plant's base. Sprayers are best used above ground spraying water over an area.

A drip irrigation line is closed at one end. This means water can only escape through the emitter holes located throughout the line. The open end of the line is connected to a water source. Water flowing through drip irrigation creates pressure in the line. This pressure developed in a drip system due to its closed end is essential; without proper pressure in a line (generally around 20 PSI) water will not be pushed out of its emitters at the desired flow rates. If irrigation flow from emitters is strong at the start of a drip line near the water source and weak or non-existent at the end of that line, pressure in the system is not high enough to effectively operate.

Water pressure is ultimately dictated by the source of water, i.e., the water utility system being tapped into. If water pressure is too low, reduce the length of a drip system until an adequate flow rate is reached. Creating multiple systems connected to varying water sources is a common solution in larger growing spaces.

There are a few other essential and non-essential components which can or must be included in a drip system. A backflow regulator ensures water does not flow from a drip line back into a water source when flowing water is turned off, this is a legal requirement in most areas. A pressure regulator will ensure that pressure coming from a water source is not too high and does not damage a drip line, these are necessary in most applications. A drip irrigation filter reduces particulate collection within a line, lengthening its useful lifetime and reducing maintenance, these are useful but not necessary. Some systems are automatically turned on and off by timers and timed valves which themselves can operate in diverse manners. The timers on SVdP Urban Farms are set by farm management staff. For more information regarding irrigation control and timing, see senior farm staff.

Drip systems do have the major drawback of being fragile. Repairs will occasionally be required on most drip systems. One basic maintenance task is clearing out a drip line every so often. This simply involves removing whatever device is being used to close the end (an end cap, threaded end cap, closing loop, or other) and running water through the line for 5 to 10 minutes. In cooler climates where temperatures drop below freezing, drip irrigation systems should be removed during seasons with frost potential. Frozen water expands and can crack or rupture drip irrigation equipment from within.

If damage is done to a drip system through any number of ways, repairs are often easy. Heavy duty waterproof exterior grade tapes can patch small holes; some proprietary tapes are made for this explicit purpose. Goof plugs are a product available which simply plugs an incorrectly placed hole. These can be very helpful if a farmer might want to move an emitter location or if there are unused emitter holes leaking unnecessary water. More serious damage to drip irrigation can be repaired using basic couplings or connectors. In this instance, the damaged line is cut on either side of the site of rupture. The newly cut ends are then inserted into each end of the coupler which takes the place of the damaged portion of drip tubing. A coupler should generally be twice the length of the section being removed to ensure proper connection with the cut line. If the length of damaged drip tubing is longer than the repair coupler, two couplers can be connected with an additional piece of drip tubing in between. This entire piece can then be installed in place of the damaged portion of the line.

Hand watering is fairly basic and straightforward. There are no specific rules for watering by hand. A farmer can use a hose, a watering can, or any other manually operated tool. An average garden hose has an approximate flow rate around 7gph to 15gph. Watering cans usually have measuring lines for ounces, liters, and gallons. Using these various measurements in conjunction with knowledge of a plant's moisture requirements can help optimize hand watering efforts. Using manually operated sprinklers can be considered a form of hand watering. A number of tools exist to aid a farmer in manually dispersing water throughout their growing spaces.

When watering by hand, the ground around a plant should be fully saturated at a depth accessible by plant roots. Allow water on a soil's surface to soak into the soil, then water the area again. This process can be repeated until soil is soaked to a reasonable depth. Continuously running water to an open area will often not give the soil time to deeply soak up moisture. Digging a small hole for a finger or hand to reach in and feeling soil for moisture multiple inches below the surface is a useful and basic way to tell if an area has been watered sufficiently. Soil moisture meters are also available for purchase from a variety of farm and garden retailers.

Buried or Installed Irrigation is the conventional style of irrigation found in most residential and commercial landscapes. This style of irrigation involves rigid PVC (other materials can and have been used but are much less common) buried approximately 6 to 18 inches underground. Sprayer outlets (aka sprinkler heads) are connected vertically to the buried PVC reaching above ground and placed strategically around a growing space. Installation of PVC systems should usually be left to a professional contractor or other experienced individual. Details regarding buried irrigation design and installation are not discussed in this manual. For more information on this subject, see the references listed at the end of this manual.

Watering & Irrigation

Minor repairs and upgrades can be done to a buried irrigation system with relative ease. Small broken sections of PVC can be replaced with couplers or connectors. The broken section is cut out and PVC glue (purchasable in a number of forms from most home retailers) is applied to the inside of the coupler and to the outside of each newly cut end of the existing pipe to be repaired. The coupler is then slid over the newly cut ends of the existing pipe, replacing the broken section. This process is improved by ensuring a large hole is dug around the area to be worked in. When repairing buried PVC, the pipe will need to be moved back and forth slightly to insert a coupler. This can further damage the pipe if the pipe is not allowed to flex by removing soil from the area surrounding work. This problem can also be worked around by installing a U-shaped coupler instead of a straight coupler.

Sprayer outlets can become clogged or damaged but can easily be replaced. The old sprayer outlet is simply unscrewed and removed and the new unit is threaded into place. Sprayer outlets can be repaired as well. Replacement parts are generally available from any irrigation retailer. Plumber's tape wrapped around threads in any irrigation application can reduce the chance of leaks over time.

Buried PVC irrigation is not as common as other styles in agriculture, but there are some examples of it found throughout SVdP Urban Farms. One advantage to buried PVC irrigation is that it can handle much higher internal water pressures. This feature is useful on the farm at the Mesa Dining Room. Low pressure in the drip system does not provide adequate reach in some parts of the property in this location. In this instance, above ground sprayers have been utilized to compensate. Flexibility is essential in agriculture and combining multiple methodologies can be a useful way to circumvent obstacles, such as in this instance.




Watering times and amounts

Various plant types have differing water requirements due to their growth habits. These differentiations can be learned from the seed packaging, the seed producer's website, or a trusted source. Minor changes in irrigation rates may also be required due to varying moisture retention rates in diverse soils and other growing mediums.

More broadly, irrigation rates in any growing space are determined by seasons and their resulting climates. Generally, cooler and wetter seasons require less water while hotter and drier seasons require more. In some climates, no irrigation is required at all. In the Phoenix Metro area and specifically on SVdP Urban Farms, a lot of water is required to grow the bountiful crops which feed thousands of people in need every year.

LANDSCAPE WATERING GUIDELINES						
TYPE OF PLANT	WATERING NEEDS	WATERING FREQUENCY - DAYS BETWEEN WATERINGS				WATERING DEPTH
		SPRING Mar - May	SUMMER May - Oct	FALL Oct - Dec	WINTER Dec - Mar	
Trees	Desert Adapted	14 - 30 days	7 - 21 days	14 - 30 days	30 - 60 days	24" - 36"
	High Water Use	7 - 12 days	7 - 10 days	7 - 12 days	14 - 30 days	24" - 36"
Shrubs	Desert Adapted	14 - 30 days	7 - 21 days	14 - 30 days	30 - 45 days	18" - 24"
	High Water Use	7 - 10 days	5 - 7 days	7 - 10 days	10 - 14 days	18" - 24"
Groundcovers & Vines	Desert Adapted	14 - 30 days	7 - 21 days	14 - 30 days	21 - 45 days	8" - 12"
	High Water Use	7 - 10 days	2 - 5 days	7 - 10 days	10 - 14 days	8" - 12"
Cacti & Succulents	n/a	21 - 45 days	14 - 30 days	21 - 45 days	If Needed	8" - 12"
Annuals	n/a	3 - 7 days	2 - 5 days	3 - 7 days	5 - 10 days	8" - 12"

Water to the outer edge of the plant's canopy and to the depth shown. Watering frequency will vary depending on season, plant type, weather and soil. These watering guidelines are for established plants (one year for shrubs, three years for trees). Additional water is needed for new plantings or unusually hot or dry weather. Less water is needed during cool or rainy weather. Drip run times are typically two hours or more for each watering.

Source: City of Phoenix. (2021). Landscape Watering Guidelines. https://www.phoenix.gov/waterservices/landscapewatering

When using this guide as a reference, the majority of plants found on SVdP Urban Farms will be watered as if they are annual plants

Watering is one aspect of farming which can be effectively adjusted based on human observation alone. Plants will look noticeably dry if they are not receiving enough water. First, the edges of an under-watered plant's leaves will start to turn yellow and brown, followed by its branches and stems. Leaves will begin to curl and the entire plant will droop. Plants which are not receiving enough water will be brittle or "crispy" to the touch.

If a plant is receiving too much water it will also exhibit leaves and stems which turn yellow or brown. The entire plant will go limp and begin wilting. The main difference between an over-watered plant and an under-watered plant is the texture. Instead of becoming dry and brittle, a plant receiving too much water will become soft, often even slimy or gooey to the touch. Using visual and other sensory indicators to gauge appropriate irrigation rates for plants is essential, even if a calendar or other guide is being followed.

Mulch for Moisture Retention

In desert soils and climates, it can be difficult to get an adequate amount of water to a plant's roots without losing excess water to runoff. Mulch and mulch basins are two highly effective tools for water use optimization on SVdP Urban Farms. In a desert environment receiving lots of sun, soil undergoes significant moisture loss through evaporation from the soil's surface. Mulch protects soil from evaporating sun rays and locks in moisture despite sun exposure. Mulch basins, also known as micro-basins or mulch rings, are circles of raised mulch placed around a plant approximately 1 to 2 feet from its base. Mulch rings are usually used on larger more permanent plants, such as trees, but have a wide variety of applications. A mulch basin forms a dish around the base of a plant, concentrating water saturation around its roots. Tree wells can also be formed for a similar effect. For more in-depth discussion of mulch, see the section of this manual titled Soil Science, Fertilizer, and Compost.

Ecological Farming Practices

Ecological farming practices focus on growing food in healthy and balanced ecosystems. Based in contemporary environmental science, many farmers today find that developing a holistic ecosystem in their growing spaces produces higher crop yields with less overall labor. Additionally, these methods help to maintain healthier ecosystems in a farm's regional environment. The potentially harmful tactics used today in modern conventional farming methods are a central underlying motivation for a transition toward more ecologically focused practices. The wide spread use of synthetic chemicals and their effects on human health brought the dangers of conventional farming into the spotlight and spurred on a movement toward environmentally friendly food production.

Integrated pest management is a modern concept which combines ecological farming practices with an overall farm management plan to control pest populations and maintain a highly productive farm. Integrated pest management is, perhaps, the one aspect of farming which relies most on the creation of a holistic ecosystem. Integrated pest management can broadly be described as the practice of maintaining a farm as a healthy and diverse ecosystem. Therefore, in this manual, this chapter presents an overall framework for healthy ecosystem management on a farm within the discussion of pest control strategies. Here a reader will find some basic arguments against "big-agriculture's" conventional farming methods in favor of smaller-scale ecological farming practices.

What is Integrated Pest Management?

Integrated Pest Management shortened to IPM, approaches pest solutions from all perspectives. Pests in this case are defined as any living organism in a growing environment which causes significant negative impact to the productivity of a farm. This can include insects, animals, plants, fungi, bacteria, viruses, and other organisms. Methods in IPM seek to solve pest problems before they arise through proper planning, preparation, and management utilizing long term methods of pest exclusion. On occasions when pest infestations do occur and negatively impact the production of a farm, short term reactionary solutions can be utilized. Techniques utilized across IPM include manual/physical control methods, chemical control methods, cultural control methods, and biological control methods.

Ipm is:

'…based on a broad knowledge of the agro-ecosystem and will seek to manage rather than eliminate pests' in ways that are 'profitable, safe, and durable.' In addition to reducing pest damage, shifting your farming system to ecological pest management will bring multiple benefits to your operation. For example, moving from monoculture to longer rotations improves water- and nutrient-use efficiency. Cover crops planted to attract beneficial insects also suppress weeds, improve the soil, provide moisture-conserving mulch, fix or store nitrogen for subsequent crops and contribute to overall nutrient management goals. (Altieri, 2005)

Ecological Farming Practices and Integrated Pest Management

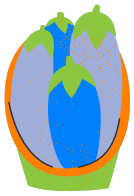
Generally, some basic IPM principles are to:

> "Select and grow a diversity of crops that are healthy, have natural defenses against pests, and/or are unattractive or unpalatable to the pests on your farm. Choose varieties with resistance or tolerance to those pests. Build your soil to produce healthy crops that can withstand pest pressure. Use crop rotation and avoid large areas of monoculture. Stress the pests. You can do this using various management strategies described in this book. Interrupt their life cycles, remove alternative food sources, confuse them. Enhance the populations of beneficial insects that attack pests. Introduce beneficial insects or attract them by providing food or shelter. Avoid harming beneficial insects by timing field operations carefully. Wherever possible, avoid the use of agrichemicals that will kill beneficials as well as pests."
> - (Altieri, 2005)

Manual control methods are those which kill, remove, or restrict the introduction and development of pests through mechanical means. These methods involve physically removing a pest or restricting its introduction to an area or to its development in one of various ways. Manual control methods can be used as both long term management solutions and short term reactionary solutions.

Chemical control methods are those which kill, remove, or restrict the introduction and development of pests with chemical pesticides. There are numerous products available, some are considered organic and less toxic (to varying degrees). Synthetic pesticides are not organic and often contain chemicals which can be toxic to people, animals, insects, and desirable plants. Organic pesticides (look for an OMRI listed certification on the product packaging for general confirmation that the product is considered organic) are naturally derived from non-synthetic components and break down quickly in the environment with no long term effects on organic matter in the surrounding area. However, organic pesticides can still be harmful to beneficial organisms.

SVdP Urban Farms strongly recommend avoiding the use of any chemicals, even if they are organic, whenever possible. If chemical control methods are to be utilized, they should be used sparingly and with caution. Furthermore, the SVdP Urban Farms Program adamantly avoids the use of chemical pesticides which are not considered organic. Some farmers and gardeners who advocate for the use of organic pesticides do occasionally utilize synthetic chemicals in isolated instances. This is a hotly contested subject and often one of personal choice. If a pest infestation is so significant that it threatens the survivability of an entire crop, a whole portion of a farm, or the entire farm itself, then synthetic non-organic pesticides are sometimes considered by advocates of organic and ecological practices. Chemical control methods are predominantly used as short term reactionary solutions but can occasionally be used on a long term basis when the negative environmental effects are minimal or controllable.

Ecological Farming Practices and Integrated Pest Management

Cultural control methods are those which reduce or restrict the introduction and development of pests through environmental control. Examples of cultural control methods include crop rotation, adjusting planting and harvesting dates to avoid or deter pests, or adjusting planting methods to avoid or deter pests. Cultural control methods are used as long term management solutions. Cultural control methods are the embodiment of ecological pest management. Ideally, a perspective of ecological pest management is what's first considered by a farmer. Chemical and manual control techniques should only supplant and support the control systems created by cultural control methods. Biological control methods should be a natural product or result of an ecologically developed farm with consistent and effective cultural control methods in place.

Biological control methods are those which take advantage of beneficial relationships with natural enemies or predators of various pests (otherwise known as beneficials) to reduce or restrict their introduction and development. These beneficial organisms can be introduced to a farm ecosystem or can be attracted to it through environmental manipulation. Biological control methods can be used as both long term management solutions and short term reactionary solutions. The basic steps to using biological control methods with the beneficial organisms already present on your farm are to:

1) Identify which beneficial organisms are present
2) understand their individual biological cycles and resource requirements
3) change your management to enhance populations of beneficials
- (Altieri, 2005)

Many control methods can be adjusted to apply as both long term management solutions and short term reactionary solutions. IPM seeks to utilize a combination of all methods to create a cohesive low maintenance ecosystem. The goal of IPM is to create resistance (the ability to withstand or avoid significant pest damage) and resilience (the ability to bounce back from pest infestations or other maladies).

Questions to Ask Before Pest Management Decisions Are Made:

What pests are present, in what numbers and stages of development?
What conditions exist that may increase or decrease pest problems?
What natural enemies of the pests, such as parasites, predators, and diseases, are present that may play an important role in control?
What amount and type of damage is being caused or may soon be caused by pests?
What is the stage of development, condition, and value of the crop?
What is the potential for economical injury? How much damage is tolerable? Has the action threshold been reached?
What pest management options are available, and how do the advantages and disadvantages of each apply?
If alternatives are not available, is a pesticide treatment justified for the situation? If so, what is the material of choice?
If a pesticide is not justified, what approaches, if any, should be taken?
- (Texas A&M)

Ecological Farming Practices and Integrated Pest Management

An urban farmer should know, to some extent, what the conditions are in all areas of their farm. A farmer should be regularly walking throughout their farm, scouting for issues and recording any observed environmental changes. Regular scouting throughout the farm and recording of farm conditions are vital steps to reducing growth and frequency of pest infestations. For more information on observation and record keeping on a farm, see the section of this manual titled Daily Operation and Quick Start Guide.

How to Manage Pests on SVdP Urban Farms

Pest Insects

Many insects can be detrimental to the productivity of a farm. Various insect species have developed specialized ways of targeting specific plant species or families. In some cases, a pest insect infestation can quickly change in the span of days or weeks from a few bugs and no noticeable plant issues to hundreds, if not thousands, of pest insects and near total crop devastation. Keeping an eye out for collections of insects in confined areas and investigating any unknown insects are essential steps for maintaining a farm's viability. Significant gatherings in particular spaces of a specific insect type is one sign that insect might be a pest, another is if insects of that type are regularly seen around plants which are weak or otherwise display declining health traits. Oftentimes the impacts of a pest insect population are the only indications they are there in the first place. When obvious damage is done to plant, search all parts of the plant and the area surrounding it for any insects. Tracking what insects are where and in what conditions can help a farmer decide if an unknown insect is a pest.

Common Pest Insects on SVdP Urban Farms

- Squash Bugs (Anasa Tristis) are small hard-bodied beetles found, usually, at the base of various plants in the cucurbit family such as squash, cucumbers, melons, and pumpkins. They will also be found on the stems and leaves of plants, especially in places where they can hide from view. Squash bugs damage a plant by eating portions of it, most often the stems. All stages of growth from eggs, to nymphs, to adults are present throughout the season as they continually reproduce. Eggs specifically will often be found on the underside of leaves but can be located anywhere on or near a plant. The adults can hibernate over winter and will continue to reproduce the following season if allowed.

Adult Squash Bug

Damage caused by Squash Bugs

Ecological Farming Practices and Integrated Pest Management

- Aphids are tiny soft-bodied insects which are sometimes difficult to see at first glance. They come in a wide variety of colors including green, white, brown, and black. There are many different varieties of aphids and some target specific plant species. Aphids damage a plant by sucking sap from its stem or branches. Aphids will generally be found collected at the base of leaves, branches, or flowers.

Very heavy infestation of Aphids on a Dill flower

- Caterpillars are the younger stage of beloved insects such as butterflies and moths. They are soft-bodied insects which come in all shapes and sizes. Some are commonly called a type of worm (like the Tomato Hornworm) but they are still caterpillars. Many caterpillars, and there are a vast number of varieties, voraciously eat a number of common crop plants. Identifying the specific type of caterpillar is not necessary for treatment because the damage they cause to plants is obvious. Harmful caterpillars eat large portions of plants, usually the leaves, very quickly. An observant farmer should see the effects of a caterpillar infestation fairly immediately and will likely find the offending caterpillar near the affected area.

Cabbage Looper Caterpillar and the damage it causes

Possible Western Tent Caterpillar with Cabbage Looper Pupa seen below

- Whiteflies are soft-bodied flying insects which are not actual flies but are more closely related to aphids. There are thousands of species of whiteflies, but in general they cause damage similar to aphids by piercing vegetation and sucking out nutrients. They are very small and can reproduce quickly with infestations creating “clouds” of whiteflies around an infested plant.

Ecological Farming Practices and Integrated Pest Management

Manual control methods for pest insects include:

Manual termination or removal of pest insects by physically squishing them is the most basic form of pest insect control. Most pest insects can also be killed by placing them into a container of soapy water and leaving it overnight. Pest insects can alternatively be flicked away or picked up and removed from an area of infestation without termination. Using a dedicated shop vacuum to suck up pest insects can improve efficiency of manual removal. Another technique is to leave cardboard or newspaper on the ground around plants overnight. This causes insects to gather underneath the material for easier collection early in the morning. Overall, these most basic manual solutions are best for small infestations and are difficult on a large scale. If labor resources are high, such as on days with an excess of volunteers, this method can be utilized to effectively control pest populations across a farm. Manual termination is the main form of pest control on the Rob and Melani Walton Urban Farm.

- Effective on: All pest insects

Pruning and removal of infested plants and plant material is another basic manual pest insect control method. Pruning most or all of a plant's foliage back to the stem or branch can often cause an infestation of pest insects to move on since they're targeting the softer new growth and leaves. In some cases, a plant must be cut all the way to the ground or completely removed to properly eradicate a localized pest infestation. Care should be taken to avoid dropping pest insects along the way as the infested material is moved offsite. This methodology is most useful when infestations are isolated to individual plants, as heavily pruning or removing plants from large swathes of a farm is often not viable.

- Effective on: All pest insects

Burning plants which are found to harbor any pest infestation can be an effective and certain way to ensure those pests do not proliferate. A weed torch (purchasable at most garden and farm retailers) is used to engulf the plant in flames, killing the plant and any pests on or around it. This can be an intense pest control method and should predominantly be used in extreme circumstances. Burning an infested plant, instead of simply removing it by hand, severely limits the chance of that pest being spread in the process of its removal.

- Effective on: All pest insects

Continued from previous page...

Diatomaceous earth (shortened to DE) can be applied to soil in the area surrounding a pest insect infestation and onto the foliage of affected plants. DE's abrasive texture damages insect exoskeletons causing them to dehydrate and die. DE is mostly used as a reactionary solution upon discovery of an infestation. It can take approximately 48 hours for the effects to become visible. DE can be used dry or wet in a mixed solution. Apply dry powder directly to soil and effected plants on a weekly basis after pests are discovered and until infestation is reduced to tolerable levels. Utilizing an applicator tool can optimize the use of dry DE. For wet application, mix one pound of DE with 1 gal water, agitate the mixture, and spray directly onto the foliage and in the general area of plants affected by pests. DE is completely non-toxic to animals and humans. However, DE does not discriminate between pests and beneficial insects. Use DE sparingly and only in circumstances of significant infestation. Apply DE when bees and other beneficials are less active to avoid injuring them.

- Effective on: All pest insects, has potential to also harm beneficial insects and any others living in effected area

Fabric or plastic barriers, such as netting or shade cloth, can be used as a cover to prevent adult pest insects landing on or accessing plants in spring and summer. A material used for this purpose can be laid lightly on top of plants or installed via a support structure built above plants.

- Effective on: All flying pest insects, has potential to also inhibit plant access by flying beneficial insects and any others living in an effected area
- Especially effective on: Squash Bugs

Molasses is a pest insect control tool which can reduce whitefly populations and deter their return. It is unclear how molasses works in restricting whitefly and other flying soft-bodied insect infestations, the effectiveness of the process is not scientifically verified. However, in experimentation conducted at the SVdP Mesa Dining Room Urban Farm, plants treated with molasses showed a significantly reduced whitefly population one week after application. This effect was noticeably more prevalent than on plants treated with a Neem Oil mixture (which is the general recommended solution made by organic farmers for whitefly infestations). An effective molasses mixture for reducing whitefly infestations consists of two ounces of molasses mixed with one gallon of water.

- Effective on: Whiteflies, small soft-bodied flying insects

Chemical control methods for pest insects include:

Neem oil applied to the entire plant, the soil in the surrounding area, and directly onto pest insects, especially effective on younger generations of insects. Neem oil and other plant-oil-based insecticides work by interrupting the hormonal cycles of insects halting their development and restricting their ability to reproduce.

- Effective on: All pest insects to varying degrees of effectiveness, has potential to also harm beneficial insects and any others living in effected area

Other plant-oil-based insecticides such as Thyme, Cinnamon, or Rosemary oils applied to the entire plant, the soil in the surrounding area, and directly onto pest insects, especially effective on younger generations of insects.

- Effective on: All pest insects to varying degrees of effectiveness, has potential to also harm beneficial insects and any others living in effected area

Ecological Farming Practices and Integrated Pest Management

Continued from previous page...

Insecticidal soap applied to the entire plant, the soil in the surrounding area, and directly onto pest insects, especially effective on younger generations of insects

- Effective on: All pest insects to varying degrees of effectiveness, has potential to also harm beneficial insects and any others living in effected area

Pepper-based solutions can be mixed at home and sprayed onto plant foliage as a deterrent to pest insects and animals. There are a number of mixes which generally include an exceptionally hot pepper such as cayenne or habanero (or dried powder of a hot pepper variety) blended with water, a natural non-detergent based soap, vegetable oil, and optionally garlic and/or onion. SVdP's Urban Farm program recommends this recipe:

-1 gallon of water
-10 hot peppers chopped finely (Cayenne, Habanero, or whatever is on hand)
-4 to 5 Tablespoons of hot pepper flakes (If not using fresh)
-1 teaspoon of olive oil

Simmer the mixture in a pan for about 15 minutes to release oils. Allow the solution to sit for about a day, strain out the large particulate, and add in a teaspoon of olive oil (dish soap can be used as well but olive oil is nice for its natural content).

- Effective on: All pest insects to varying degrees of effectiveness, has potential to also harm beneficial insects and any others living in effected area
- Especially effective on: Hornworms and other caterpillars

Pyrethrin based insecticides are heavy duty organic insecticides that can be used in extreme circumstances. This is a chemical compound found in plants from the chrysanthemum family which is highly toxic to nearly all types of insects. These products are very strong and should be used sparingly in controlled areas surrounding infestations. Pyrethrin based insecticides will not discriminate between beneficial insects and pest insects. Bifenthrin is a commonly used synthetic pyrethroid insecticide which, due to its artificial nature, is not organic but has been used on SVdP farms when pest infestations significantly threatened the viability of the farm.

- Effective on: All pest insects to varying degrees of effectiveness, has potential to also harm beneficial insects and any others living in effected area

Ecological Farming Practices and Integrated Pest Management

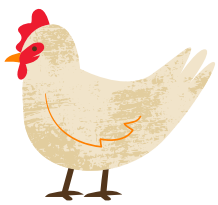
Biological control methods for pest insects include:

Beneficial insects which are natural enemies or predators of pest insects can significantly reduce pest insect numbers. Beneficial insects can be attracted to a farm through a number of different companion plants and environmental conditions which are favorable to the predatory species. Beneficial insects can also be introduced to a farm. There are a number of commercial retailers which sell a wide variety of beneficial insects for farming. Once released, introduced beneficial insects will need habitat to live and thrive in. Make sure the environmental conditions are suitable for their success before introducing any living organisms to your farm. Plant trees and other large habitat providing plants interspersed in and around growing spaces. Provide a water source for beneficials by creating small ponds around a growing space when possible. If introducing beneficial insects, release them in the evening and water thoroughly beforehand.

- Effective on: All pest insects. Most beneficial insects only target certain species. Whether they're being introduced or attracted to a farm, ensure the beneficial insect species you're working with will prey upon the specific pest insects found in an infestation. If possible, attract or introduce multiple different known beneficial predator species for your specific pest insect infestation. Praying Mantis', Damsel Bugs, Minute Pirate Bugs, and Spiders are some common beneficial insects which will attack many varieties of pest insects in an ecosystem. For a complete list of known beneficial insects, the species they target and plants they are best for protecting, and how to attract or introduce various beneficial species, see the references listed at the end of this manual.
- Beneficials for Squash Bug Control: Natural predators of Squash Bugs include Damsel Bugs, Big-eyed Bugs, Tachinid Flies, and Scelionid Wasps. Introduce these beneficial insects to your farm or attract them by planting companion plants such as Queen Anne's Lace, Dill, Carrots, Sunflowers, Clovers, and Alfalfa.
- Beneficials for Aphid control: Natural predators of Aphids include Ladybugs, Hoverflies, and Lacewing fly larvae (aka Aphid Lions). Introduce these beneficial insects to your farm or attract them by planting companion plants such as Queen Anne's Lace, Dill, Carrots, Sunflowers, Clovers, Marigolds, Lavender, Yarrow, and Dandelion.

Beneficial animals which are natural enemies or predators of pest insects can significantly reduce pest insect numbers. If chickens, ducks, or other poultry are on the property, release them to graze in vegetable patches regularly. Avoid doing this while crops are still growing, the chickens might eat crops in addition to pest insects. Cats will also consume larger insects and can be allowed to roam through vegetable rows if living on a farm. Wild birds will also consume pest insects and can be attracted to a farm through habitat development around the property. Regularly thinning beds will allow birds to more easily graze on insects. Animals which are beneficial for pest insect control will not discriminate between pest insects and beneficial insects.

- Effective on: All pest insects, also harms beneficial insects and any others living in effected area



Ecological Farming Practices and Integrated Pest Management

Continued from previous page...

Beneficial pathogens which are harmful to pest insects can significantly reduce pest insect numbers. Beneficial pathogens include a variety of microorganisms such as bacteria, fungi, and viruses. Bacillus Thuringiensis (shortened to BT) is a beneficial bacteria commonly used as an insecticide. This bacteria is toxic to the larvae of certain pest insects when ingested, its effects are not visible until 24 hours or more after application. There are variations of BT which have been developed to target a growing number of species over the years. BT should be used sparingly as there is evidence showing it can harm beneficial insects and other organisms in the surrounding ecosystem. Follow dilution instructions as directed on the product label then, in the morning or evening, spray the product onto foliage which is targeted as food by young pest insects. There are other beneficial pathogens for pest insect control, for more information on beneficial pathogens, see the references listed at the end of this manual.

- Effective on: All pest insects, potential to also harm beneficial insects and any others living in effected area

Cultural control methods for pest insects include:

Cultural control methodology is fairly consistent regardless of the pest being dealt with. As a reminder, the most general way to approach cultural control methods is to treat a farm as its own ecosystem. A farmer's job in this setting is to grow, develop, and maintain a holistically diverse and healthy environment.

Mixing plant varieties (also known as intercropping) to avoid development of monocultures (large swathes of a single plant variety) is perhaps the most important cultural control method for a farmer practicing ecological farming. A farm which grows large amounts of only a few plant varieties will be much more susceptible to pest infestations. For example, if a farm only grows 3 different varieties of squash during the summer and nothing more, all of their crops are susceptible in the event of a squash bug infestation. This farm has provided a buffet as well as a continuous habitat for pest insects to grow and travel in. A farm which, instead, grows varying amounts of many plant varieties will be less prone to pest infestations. Another benefit to crop variation and diversity is that crops other than those targeted by pests will still be produced despite an infestation. There is also less food and shelter on this second example farm for the squash bug infestation to develop in.

- Effective on: All pest insects

Transplanting seedlings instead of sowing directly from seed gives young plants a head start on getting strong enough to survive some pest insect attacks.

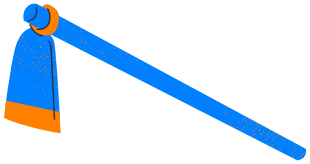
- Effective on: All pest insects

Trellising certain plants to grow vertically makes them more difficult to access and gives pest insects less covered ground to live and reproduce on.

- Effective on: All flying pest insects

Crop rotation can help reduce numbers of returning pest insects the year after an infestation by providing an undesirable habitat for pests. Replacing a crop which was attacked by an insect infestation with another crop or plant variety which is undesirable to that pest insect can limit their presence in a growing space.

- Effective on: All pest insects



Continued from previous page...

Planting "trap" plants can help keep pest insects off of your crops. These plants attract pests, such as aphids, and provide an alternative food source. Trap plants can be planted alongside a main crop, with at least 1 to 2 feet of separation, and should be planted approximately a month before the main crop. Once a pest is spotted on a trap plant, treat the pest in whatever manner seems most appropriate. Ideally this will kill off the majority of pests which would have attacked a main crop if the trap plant hadn't been there first.

- Effective on: All pest insects

Maintaining clean and organized beds is a straightforward way to limit pest insects' ability to move and develop throughout a garden. Remove decaying plant matter from vegetable beds whenever possible, this reduces the amount of space in your farm which a pest insect may see as a favorable habitat. Limit plant growth to it's the specific growing area you have designated. For example, don't allow squash vines to reach out of their designated growing space into adjacent beds or pathways. Limiting plant growth to a designated area reduces pest insects' ability to travel throughout a farm.

- Effective on: All pest insects

Pest Plants

Unwanted plants can rob crops of light, nutrients, moisture, and space. Highly competitive plants can quickly outgrow and overtake farm and garden beds. The list of plants which are considered pests is long, variable, and somewhat subjective. There are some general ways to tell if a plant is a pest on a farm. If a plant suddenly appears out of nowhere and grows or spreads rapidly, it might be a pest! If a plant species is regularly sighted growing adjacent crops with low success rates, it might be a pest! If a plant is growing on top of or over your crops, it might be a pest! Any plant which is in competition with a crop and is not providing any environmental benefits is undesirable and should be removed. Pest plants are those which cause significant harm to the production of a crop or entire farm. There are plenty of species which are beneficial to grow alongside crops, these are called companion plants. Generally a companion plant's growing habits compliment those of a neighboring crop plant and do not compete with the crop's success. For more information on companion plants, refer to the chapter of this manual titled The Plants on SVdP Urban Farms. Here are the main pest plants you might encounter on SVdP urban farms:

Spurge is a very common kind of pest plant in the American Southwest. There are a number of varieties of spurge, all of which belong to the Euphorbia family. Spurge spreads out in dense mats which can quickly take over and cover a significant area. It also contains a photo-toxic sap which can cause mild skin irritation.

Amaranth (aka Fat Hen, Goosefoot, and a variety of other common names) is a widespread plant species with the scientific name Chenopodium Album. It is not always considered a pest and has been cultivated as a crop across the globe for hundreds if not thousands of years. In open spaces like a farm or garden, this plant will spread quickly and its seeds often last many years in soil.

Ecological Farming Practices and Integrated Pest Management

Continued from previous page...

Purslane is one of the most prolific pest plants encountered on SVdP Urban Farms. However, it is not always considered a pest plant. Two different kinds of purslane are present on SVdP Urban Farms: Common Purslane (Portulaca Oleracea) grows yellow flowers and is found on many continents across the globe and has been collected as a wild edible plant by many cultures throughout history and in modern times. Desert Horsepurslane (Trianthema Portulacastrum) grows purple flowers and is a native variety used as a summer edible green by the local Tohono O'odham people. Both of these varieties can easily take over a well irrigated open space. Purslane can be easier to remove than other pest plants and has been allowed to fill open spaces as a cover crop in certain instances on SVdP Urban Farms.

Bermuda Grass (Cynodon Dactylon) is often considered one of the most difficult pest plants to eradicate. It is regularly planted as a hardy lawn grass, but in situations where it is unwanted, it can persistently return despite a farmer's best efforts. Rhizomatous growth comes from cells called Rhizomes which exist in the roots of some plants. This growth allows Bermuda Grass to spread quickly underground and regrow from root material, even if its above ground foliage has died completely.

Bermuda Grass

Spurge

Amaranth

Purslane

Manual control methods for pest plants include:

Hand removal of an entire plant including as much root material as possible. Loosen the soil around the base of the pest plant and carefully pull up the entire plant, shaking off any remaining soil. Removing as much root material as possible is vital as many plant species can propagate through rhizomatic growth (rhizomes are cells which produce growth underground). A number of tools are good for hand removal of pest plants such as the pick-mattock, hoe or adze, cultivator, or even the simple shovel. There are countless ways to remove pest plants by hand, don't be afraid to experiment and utilize whatever techniques work best for you. Take your time and vary your tasks or working habits when hand removing vast quantities of plants, it may be simple but it can be labor intensive work!

- Effective on: All pest plants

Manual removal of Bermuda Grass

Solarization is the use of a cover material (most commonly black or clear plastic) to restrict pest plants from accessing light and moisture and to increase heat around pest plants to intolerable levels. This process also kills seeds present in the soil. Solarization is most effective during the hottest times of the year. A cover material, most often plastic sheeting, is secured over an area infested with pest plants for a period of multiple months over the hottest season of the year. Cover material can be removed after pest plants have died off or it can be left down and covered with natural mulch or other materials for long term pest plant control in specific areas. Solarization is improved by cutting the plant down to the ground or applying herbicide prior to cover application.

- Effective on: All pest plants

Solarization

Burning pest plants can be an effective and certain way to ensure those pests do not proliferate. A weed torch (purchasable at most garden and farm retailers) is used to engulf the plant in flames, killing the plant and any pests on or around it. This can be an intense pest control method and should predominantly be used in extreme circumstances. Burning a pest plant, instead of simply removing it by hand, severely limits the chance of that pest being spread in the process of its removal.

- Effective on: All pest plants

Chemical control methods for pest plants include:

SVdP Urban Farms do not recommend the use of any chemical control methods for pest plants. Organic chemicals have shown to be predominantly ineffective and time consuming in attempts at pest plant control. Synthetic chemicals for pest plant control are considered too toxic and dangerous both for humans and the environment.

Biological control methods for pest plants include:

There are no specific biological control methods for pest plants used by SVdP Urban Farms. Many desirable plants will out-compete pest plants but this is considered a cultural control method.

Cultural control methods for pest plants include:

Cultural control methodology is fairly consistent regardless of the pest being dealt with. As a reminder, the most general way to approach cultural control methods is to treat a farm as its own ecosystem. A farmer's job in this setting is to grow, develop, and maintain a holistically diverse and healthy environment.

Mixing plant varieties to avoid development of monocultures (large swathes of a single plant variety) is perhaps the most important cultural control method for a farmer practicing ecological farming. A farm which grows large amounts of only a few plant varieties will be much more susceptible to pest infestations. A farm which, instead, grows varying amounts of many plant varieties will be less prone to pest infestations. Another benefit to crop variation and diversity is that crops other than those targeted by pests will still be produced despite an infestation. There is also less food and shelter on this second example farm for the squash bug infestation to develop in.

- Effective on: All pest plants

Cover crops and Companion Plants installed in empty growing spaces cover bare soil and limit the ability for pest plant seeds to drop into that soil. They also limit light and moisture access for whatever weed seeds may already be present in that soil.

- Effective on: All pest plants

Mulching involves laying thick layers of mulch over bare ground to reduce a seed's ability to access viable soil and will restrict growth for any weed seeds already present. For more information regarding mulch, see the section of this manual titled Soil Science, Fertilizer, and Compost.

- Effective on: All pest plants

Other physical barriers, separating a growing space from areas which are allowed to exist more naturally is essential for reducing weed growth in growing beds. Create a pathway with landscape fabric and a dense layer of mulch which surrounds a growing space and separates from other areas of a farm or garden. Short walls, paved pathways, and garden edging are other options for physical barriers.

- Effective on: All pest plants

Pest Pathogens

This pest category includes fungi, bacteria, viruses, parasites, nematodes, and more. Pathogen based damage to a plant can vary widely depending on the pathogen and the plant variety. There are numerous pest pathogens in the world of farming, only those that have been encountered on SVdP Urban Farms in the past are included here. Generally, looking for negative health indicators such as wilting or spotted leaves can lead to the discovery of a harmful pathogen. If a plant which appears unhealthy is otherwise found in favorable conditions (enough water, appropriate sunlight, etc.) a harmful pathogen might be to blame. If poor plant health begins with one plant and spreads to others in the area, it is likely a pathogenic issue and all plants which show any negative health indicators should be removed immediately.

The most common pest pathogen found on SVdP Urban Farms is:

Powdery Mildew is the visible growth of several fungus varieties. It appears as white or light grey spots of a powdery substance usually found on the tops and bottoms of leaves and occasionally on stems and branches. Powdery Mildew most often appears during warmer seasons, but is also associated with the presence of moisture. Powdery Mildew can kill individual leaves and eventually an entire plant if left unchecked. SVdP farms have experimented with a diluted milk spray applied to plant foliage for powdery mildew control and only had minimal success.

Manual control methods for pest pathogens include:

Hand Removal of a plant infested by a pest pathogen is the most certain way, and can also be the easiest way, to ensure the pathogen is not spread to other plants on a farm. Carefully remove the entirety of a plant, avoiding unnecessary shaking or jostling to reduce the chance of pathogen material dropping off and being left behind. Bagging plants with heavy infestations of pest pathogens before removal can reduce the chance of spreading the pest pathogen to other plants in the area.

- Effective on: All pest pathogens

Sanitizing cutting tools between working with differing plant varieties can reduce the likelihood of spreading a pest pathogen. A tool can be dipped in a sanitizing solution such as rubbing alcohol, or the solution can be sprayed onto the tool. Allow the tool to dry before using.

- Effective on: All pest pathogens

Burning plants which are found to harbor any pest infestation can be an effective and certain way to ensure those pests do not proliferate. A weed torch (purchasable at most garden and farm retailers) is used to engulf the plant in flames, killing the plant and any pests on or around it. This can be an intense pest control method and should predominantly be used in extreme circumstances. Burning an infested plant, instead of simply removing it by hand, severely limits the chance of that pest being spread in the process of its removal.

- Effective on: All pest pathogens

Ecological Farming Practices and Integrated Pest Management

Chemical control methods for pest pathogens include:

Neem oil foliar spray applied to all surfaces in a plant's foliage at a rate of two tablespoons per one gallon of water has been shown to reduce and restrict infestation by some pest pathogens.

- Effective on: Powdery Mildew

Biological control methods for pest pathogens include:

There are no biological control methods for pest pathogens used by SVdP Urban Farms.

Cultural control methods for pest pathogens include:

Mixing plant varieties (sometimes called intercropping) to avoid development of monocultures (large swathes of a single plant variety) is perhaps the most important cultural control method for a farmer practicing ecological farming. A farm which grows large amounts of only a few plant varieties will be much more susceptible to pest infestations. A farm which, instead, grows varying amounts of many plant varieties will be less prone to pest infestations. Another benefit to crop variation and diversity is that crops other than those targeted by pests will still be produced despite an infestation. There is also less food and shelter on this second example farm for the squash bug infestation to develop in.

- Effective on: All pest pathogens

Transplanting seedlings instead of sowing directly from seed, this gives young plants a head start on getting strong enough to survive some pest pathogens.

- Effective on: All pest pathogens

Crop rotation can help reduce numbers of returning pest pathogens the year after an infestation by providing an undesirable habitat for pests. Replacing a crop which was attacked by a pathogenic infestation with another crop or plant variety which is undesirable to that pest pathogen can limit their presence in a growing space.

- Effective on: All pest pathogens

Identifying and removing or reducing favorable conditions for pathogens. Remove decaying plant matter from vegetable beds whenever possible. Limit plant growth to the specific growing area you have designated. For example, don't allow squash vines to reach out of their designated growing space into adjacent beds or pathways. Limiting plant growth to a designated area reduces pest pathogens spreading throughout a farm.

- Effective on: All pest pathogens

Ecological Farming Practices and Integrated Pest Management

Friendly Animals on SVdP Urban Farms

Bees are an integral part of the ecosystem on many farms today. Pollinating insects and animals are essential for the wide spread success of many plant species. Wind only moves so much pollen and does so indirectly. Insects such as bees directly carry pollen from one flower to another ensuring proper pollination. Without pollinator species, most plants would not be able to reproduce and humanity would not be able to farm on the scale seen today.

Honey bees are one of the most common and important pollinators in a farm or garden. Many farms house bee hives on their properties to ensure the presence of a healthy population of pollinators. An example of this can be found at the Rob and Melani Walton Urban Farm. Nika Forte, SVdP's current Urban Farm Program Manager, also operates a small business called Baehive keeping bee hives, producing honey products, and teaching women throughout the Valley about beekeeping.

Chickens can provide a significant amount of food through their eggs. They can also be used for pest control and light soil tilling. Chickens and other livestock have been an integral part of naturally oriented traditional farming throughout the history of agriculture. For more information regarding chickens, bees, and the roles of animals on a farm, see the references listed at the end of this manual.

Here are some instructions for chicken care on SVdP Urban Farms from Nika herself:

- "We feed our chickens a mixture of scratch and grain mix. From time to time we do give them mealworms as a treat. Chickens are fed everyday and to ensure this we have set up automatic feeders which hold about 30lbs of scratch.
- Cleaning and refreshing water at least every 2 days.
- We dust the chickens and coop area every two - three months to help prevent mites, lice and spiders from taking over the coop and infesting the chickens.
- Changing out the nesting material is done once a month and cleaning up debris and trash from the area is done as needed.
- From time to time we have to take extra care of the chickens if we see feathers matting around the rear area. If we notice that their feathers are matted together we will apply vaseline to the area and gently rub until the feathers separate.
- There are also times when the ladies may be egg bound which is when their eggs get lodged in the cloaca (the area where egg is released), if this happens we will place the chicken in a epsom salt bath and massage the area until the eggs are released. Signs that your chicken is egg bound include: walking very slowly and low to the ground, appearing lethargic, heavy panting and little to no interest in eating.
- Another thing you may want to look out for that is rather easy to spot and fix is the clogging of their nostrils. Chickens like to peck around in the dirt and over time their noses can get clogged. When this happens the chicken has a hard time breathing and may pant or look lethargic. This is a rather easy thing to fix as you just have to clear the nasal passage and your chicken will be back to its happy self."

-Nika Forte

References

Here is a list of all references used in the creation of this manual. Opportunities for further learning about all things urban farming can be found by accessing the links contained within each of these references. Each of these categories corresponds with a section of this manual. The majority of the references on this list are categorized alphabetically within the category which they informed. When information from a single reference was used to inform multiple sections, those references are listed under the category they most closely pertain to. A short description is included beneath each reference to further assist navigation of this references list.

Daily Operation and Quick Start Guide:

Pagliari, P., Potter, B. (2017). On-Farm Research. University of Minnesota Extension. https://drive.google.com/file/d/19XNpKzmx5awnZUgSa0mOdFEHbhIrAOOh/view

- General but thorough guideline for conducting scientific research in farming settings

The Plants on SVdP Urban Farms:

Arizona Department of Agriculture. (2019). Arizona Specialty Crop Guide. https://agriculture.az.gov/sites/default/files/ADA%202019%20Crop%20Guide%20Update%20-%20spreads.pdf

- Broad discussion of specialty crops being grown in Arizona in 2019, local farmer's markets, and some recipes using local specialty products

Bailey, R. (2021, September 3). What Are Gymnosperms? ThoughtCo. https://www.thoughtco.com/what-are-gymnosperms-4164250

- Thorough discussion of gymnosperms and related topics

Balfour, I., Rendle, A. (2017, December 27). 1911 Encyclopedia Britannica/Angiosperms. Wikisource. https://en.wikisource.org/wiki/1911_Encyclop%C3%A6dia_Britannica/Angiosperms

- Thorough discussion of angiosperms and their place in botany

BYJU's. (2021). The Classification of Plants. https://byjus.com/biology/the-classification-of-plants/

- General discussion of plant classification

BYJU's. (2021). Plants – Classification Based on Growth Habit. https://byjus.com/biology/plants/

- Specific discussion of plant classification by growth habit, basic

The Editors of Encyclopedia Britannica. (n.d.). Ovule. Encyclopedia Britannica. https://www.britannica.com/science/ovule

- Basic discussion of ovules

References

Ersek, K. (2012, September 14). Monocots vs. Dicots: What You Need to Know. Holganix. https://www.holganix.com/blog/monocots-vs-dicots-what-you-need-to-know

- Basic discussion of monocots versus dicots and why they matter

Growing in the Garden. (2021). How to Create Shade in the Garden. https://growinginthegarden.com/how-to-create-shade-in-the-garden/

- Basic discussion of shade in the garden

Gast, K. (1994, November). Harvest Maturity Indicators for Fruits and Vegetables. Kansas State University. https://bookstore.ksre.ksu.edu/pubs/mf1175.pdf

- General discussion of harvest procedures, also includes entries regarding specific techniques for numerous common vegetables

Iannotti, M. (2020, December 7). What are Cotyledons, Monocots, and Dicots? The Spruce. https://www.thespruce.com/what-are-cotyledons-monocots-and-dicots-1403098

- Very basic discussion of cotyledons and their relation to monocots and dicots

I Dig Organics. (2021). Vegetable Garden Shade Ideas. https://www.idigorganics.com/garden/vegetable-garden-shade-ideas.html

- General discussion of shade cloth usage including material types and basic system designs

Johnny's Selected Seeds. (2021). Seeders. https://www.johnnyseeds.com/tools-supplies/seeders/

- Seeders and seeding tools available for purchase

Maricopa County. (n.d.). Plants Found in Maricopa County, AZ. Parks and Recreation Department. https://www.maricopacountyparks.net/assets/1/6/Plants_FINAL.pdf

- Common native and naturalized plants in Maricopa County

Meleen, M. (n.d.). 4 Main Types of Plants for Kids. Your Dictionary. https://examples.yourdictionary.com/4-main-types-of-plants-for-kids.html

- Basic discussion of plant classification designed for kids, loosely by Phyla

Morrisey, S. (n. d.). Basic Botany. University of Wisconsin Extension, Southeast Wisconsin Master Gardeners. https://milwaukee.extension.wisc.edu/files/2010/09/BasicBotany.pdf

- Thorough presentation on all aspects of basic botany

National Geographic Society. (2020, June 18). Photosynthesis. National Geographic . https://www.nationalgeographic.org/media/photosynthesis/

- Detailed overview of photosynthesis

North Dakota State University. (n.d.). Plant Classification. PLSC 210: Chapter 2. https://www.ndsu.edu/pubweb/chiwonlee/plsc210/topics/chap2-classification/classification.html

- Specific discussion of plant classification by growth habit, detailed

Schuch, U. (2015, July). Arizona Climate Zones and their Application to Growing Plants. The University of Arizona Cooperative Extension, College of Agriculture & Life Sciences. https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1673-2015.pdf

- Thorough discussion of climate zones in general, what zones are in Arizona, how to grow plants in those zones, and a list of common plants grown in these zones

Sexton, S. (2019, May 28). A No-Nonsense, Illustrated Guide to 49 Botanical Terms. The Grow Network. https://thegrownetwork.com/botanical-terms/

- Thorough list of botanical terms with descriptions and illustrations

The University of Arizona Cooperative Extension. (2020, February 16). Yavapai County Native & Naturalized Plants. https://cals.arizona.edu/yavapaiplants/

- Common native and naturalized plants in Yavapai County, can be seen as approximately representative of plant species throughout similar regions within the Sonoran Desert, such as those on which SVdP Urban Farms are located

Vanstone, E. (2020, April 28). What is Photosynthesis? Science Sparks. https://www.science-sparks.com/what-is-photosynthesis/

- Basic discussion of photosynthesis designed for kids, contains useful illustration

Whitmeyer, A. (2017). Plant ID Websites. Identify That Plant. http://identifythatplant.com/plant-id-resources/plant-id-websites/

- Plant ID online resources list

Harvesting and Specialty Care Techniques by Plant Variety:

Arugula –

Albert, S. (2021). How to Harvest and Store Arugula. Harvest to Table. https://harvesttotable.com/harvest-store-arugula/

Asparagus –

Albert, S. (2021). How to Harvest and Store Asparagus. Harvest to Table. https://harvesttotable.com/harvest-store-asparagus/

References

Artichokes –
Albert, S. (2021). How to Harvest and Store Artichokes. Harvest to Table. https://harvesttotable.com/harvest-store-artichokes/

Basil –
Albert, S. (2021). How to Grow Basil. Harvest to Table. https://harvesttotable.com/how_to_grow_basil/

Beans (also includes additional info on Lettuce, Carrots, Corn, Radishes, Potatoes, Cauliflower, Broccoli, Peas, and Onions) -
Campbell, L. (2020, July 6). How to Know When it's Time to Harvest. Modern Farmer. https://modernfarmer.com/2020/07/how-you-know-when-its-time-to-harvest/

Bok Choy –
Grant, L. (2021, June 29). Bok Choy Harvesting – Learn When and How to Harvest Bok Choy. Gardening Know How. https://www.gardeningknowhow.com/edible/vegetables/bok-choy/bok-choy-harvesting.htm

Broccoli –
Rhoades, H. (2021, June 28). How to Harvest Broccoli – When to Pick Broccoli. Gardening Know How. https://www.gardeningknowhow.com/edible/vegetables/broccoli/harvest-broccoli.htm

Brussel Sprouts –
Drost, D. Johnson, M. (n.d.) Brussel Sprouts in the Garden. Utah State University. https://extension.usu.edu/yardandgarden/research/brussel-sprouts-in-the-garden

Cabbage –
Badgett, B. (2021, July 26). Cabbage Harvest Time – Information on Harvesting Cabbage. Gardening Know How. https://www.gardeningknowhow.com/edible/vegetables/cabbage/harvesting-cabbage.htm

Carrots –
Carrol, J. (2021, June 12). Carrot Harvest Time – How and When to Pick Carrots in the Garden. Gardening Know How. https://www.gardeningknowhow.com/edible/vegetables/carrot/picking-carrots.htm

Cauliflower –
Albert, S. (2021). How to Harvest and Store Cauliflower. Harvest to Table. https://harvesttotable.com/harvest-store-cauliflower/

Celery –
Albert, S. (2021). How to Harvest and Store Celery. Harvest to Table. https://harvesttotable.com/harvest-store-celery/

Cilantro/Coriander –
Albert, S. (2021). How to Grow Coriander and Cilantro. Harvest to Table.
https://harvesttotable.com/how_to_grow_coriander_and_cila/

Collards –
Albert, S. (2021). How to Harvest and Store Collards. Harvest to Table.
https://harvesttotable.com/harvest-store-collards/

Corn (includes a general harvesting discussion and specific techniques for several other crops) –
Gast, K. (1994, November). Harvest Maturity Indicators for Fruits and Vegetables. Kansas State University. Pg.3.
https://bookstore.ksre.ksu.edu/pubs/mf1175.pdf

Dill –
Albert, S. (2021). How to Grow Dill. Harvest to Table.
https://harvesttotable.com/how_to_grow_dill/

Eggplant –
Albert, S. (2021). How to Harvest and Store Eggplants. Harvest to Table.
https://harvesttotable.com/harvest-store-eggplants/

Endive/Escarole –
Albert, S. (2021). How to Harvest and Store Endive and Escarole. Harvest to Table.
https://harvesttotable.com/harvest-store-endive-escarole/

Fennel –
Albert, S. (2021). How to Grow Common or Sweet Fennel. Harvest to Table.
https://harvesttotable.com/how_to_grow_common_or_sweet_fe/

Garlic –
Ly, L. (2021). The Trick of Knowing When to Harvest Garlic. Garden Betty. https://www.gardenbetty.com/the-trick-of-knowing-when-to-harvest-garlic/

Jicama –
Milham, A. (2018, October 4). How to Grow Jicama. Premeditated Leftovers.
https://premeditatedleftovers.com/gardening/how-to-grow-jicama/

Kale –
Boeckmann, C. (2021). Kale.https://www.almanac.com/plant/kale

References

Lavender –
Albert, S. (2021). How to Grow Lavender. Harvest to Table.
https://harvesttotable.com/how-to-grow-lavender/

Leeks –
Albert, S. (2021). How to Harvest and Store Leeks. Harvest to Table.
https://harvesttotable.com/harvest-store-leeks/

Lettuce –
Albert, S. (2021). How to Harvest and Store Lettuce. Harvest to Table.
https://harvesttotable.com/harvest-store-lettuce/

Mint –
Albert, S. (2021). How to Grow Mint. Harvest to Table.
https://harvesttotable.com/how_to_grow_mint/

Mizuna –
Albert, S. (2021). How to Grow Mizuna. Harvest to Table.
https://harvesttotable.com/how-to-grow-mizuna/

Mustard –
Albert, S. (2021). How to Grow Mustard Greens. Harvest to Table.
https://harvesttotable.com/how_to_grow_mustard/

Okra –
Albert, S. (2021). How to Harvest and Store Okra. Harvest to Table. https://harvesttotable.com/harvest-store-okra/

Onions –
Jauron, R. (2021). Harvesting and Storing Onions. Iowa State University Extension and Outreach.
https://www.extension.iastate.edu/news/2009/jul/062201.htm

Oregano –
Albert, S. (2021). How to Grow Oregano. Harvest to Table.
https://harvesttotable.com/how-to-grow-oregano/

Parsley –
Albert, S. (2021). How to Grow Parsley. Harvest to Table.
https://harvesttotable.com/how-to-grow-parsley/