A Victory Gardens for Peace Growing Guide

By Victor E. Gardener

A best practices garden guide to achieving greater food security, climate resilience and healthier more sustainable communities

Victory Gardens for Peace is a project of Ecology Action a 501C3 non-profit based in Mendocino County, California

Dedicated to Alan Chadwick who taught that through breathing life back into the soil we breathe life back into ourselves. He believed we could achieve peace through rediscovering our relationship to Nature in the garden.

"It is not the gardener that makes the garden. It is the garden that makes the gardener."
-Alan Chadwick

And to John Jeavons who has devoted his life to helping humanity realize the power within themselves to grow a healthy soil, food and community through sustainable agriculture. John has worked tirelessly with people around the world to develop the biointensive system of agriculture which has the potential to revolutionize the way we grow food.

"Feed your dreams and your fears will starve."
-John Jeavons

And to You! May all of your harvests be abundant and delicious!

Hello Gardener!

Did you know that less than 1% of our population knows how to grow a significant portion of their own diets?

There will again come a time where gardening is no longer a hobby, but a way of life. The focus of this booklet is to provide a methodology for gardening which is low-input, high-yielding and sustainable. With resource scarcity already occurring and another 2 billion people projected to be on the planet in the next 30 years it is essential that we move away from high input, energy intensive agriculture. A renaissance of the gardening culture means a transition from the paradigm of doing less with more, to achieving more with less and a transformation of our own selves as we draw closer to the art of gardening through the hand work and love we experience as we participate directly in the give and take of nature- nurturing that which nurtures us- and rediscovering a sense of wholeness in ourselves and the world around us.

We hope that you find inspiration in this booklet and share the abundance with friends and family!

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The Victory Gardens for Peace Movement

During World War I and World War II, the United States Government enacted a series of policies aimed at reducing our resource consumption while increasing production to meet the demands of war. Many of our farmers were sent overseas to fight, and our citizens and troops needed to be fed. "Victory Gardens" were promoted as a way to meet the demands of war and increase food security during arduous times.

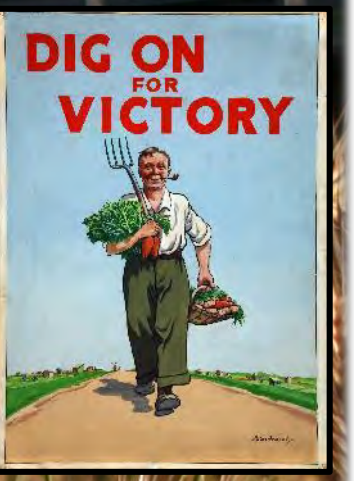
Mobilization for the war engaged all industries and communities in the war effort. Trains and buses used for transporting food were shipped abroad to move soldiers and so Victory Gardens became an important component of localization. Public parks were opened to community gardens and people began growing food everywhere- on rooftops, window boxes and backyards. School gardens sprang up to provide food for lunch programs, government agencies printed recipe booklets, food preservation pamphlets and encouraged people to eat less meat.

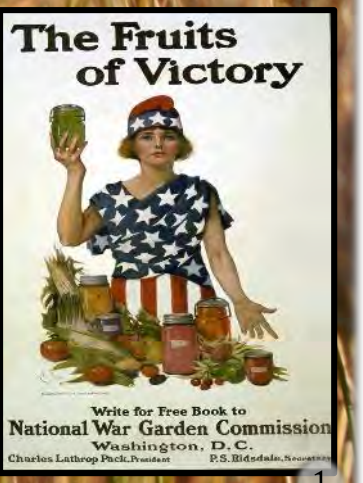
Victory Gardens not only increased our food security during this time, but also gave citizens a sense of contributing to the war effort. People were proud of their gardens and knew that they were doing their part. When Victory Gardens were at their peak, there were over 20 million Victory Gardens accounting for 44% of the food produced in the US.

We live in times of great change, and this change threatens the stability of our societies. Pandemics, natural disasters, economic collapse, climate change- these are all showing us the importance of becoming locally resilient and ready. The stronger we can become and the more we work together, the better equipped we will be. We must keep peace, equality and sustainability as our goals.

Together we stand, divided we fall.

Today the Victory Gardens movement remains relevant and important to overcoming the challenges of our time. The lessons learned from the Victory Gardens Movement demonstrate that when people are given the opportunity and are equipped with the knowledge and tools, individuals and their communities mobilize to share and create abundance even during times of great difficulty. As we move into the future together, let's start gardens, get to know our neighbors and celebrate the shared effort in creating a peaceful more resilient future for everyone! *We can do it, Si se puede!*





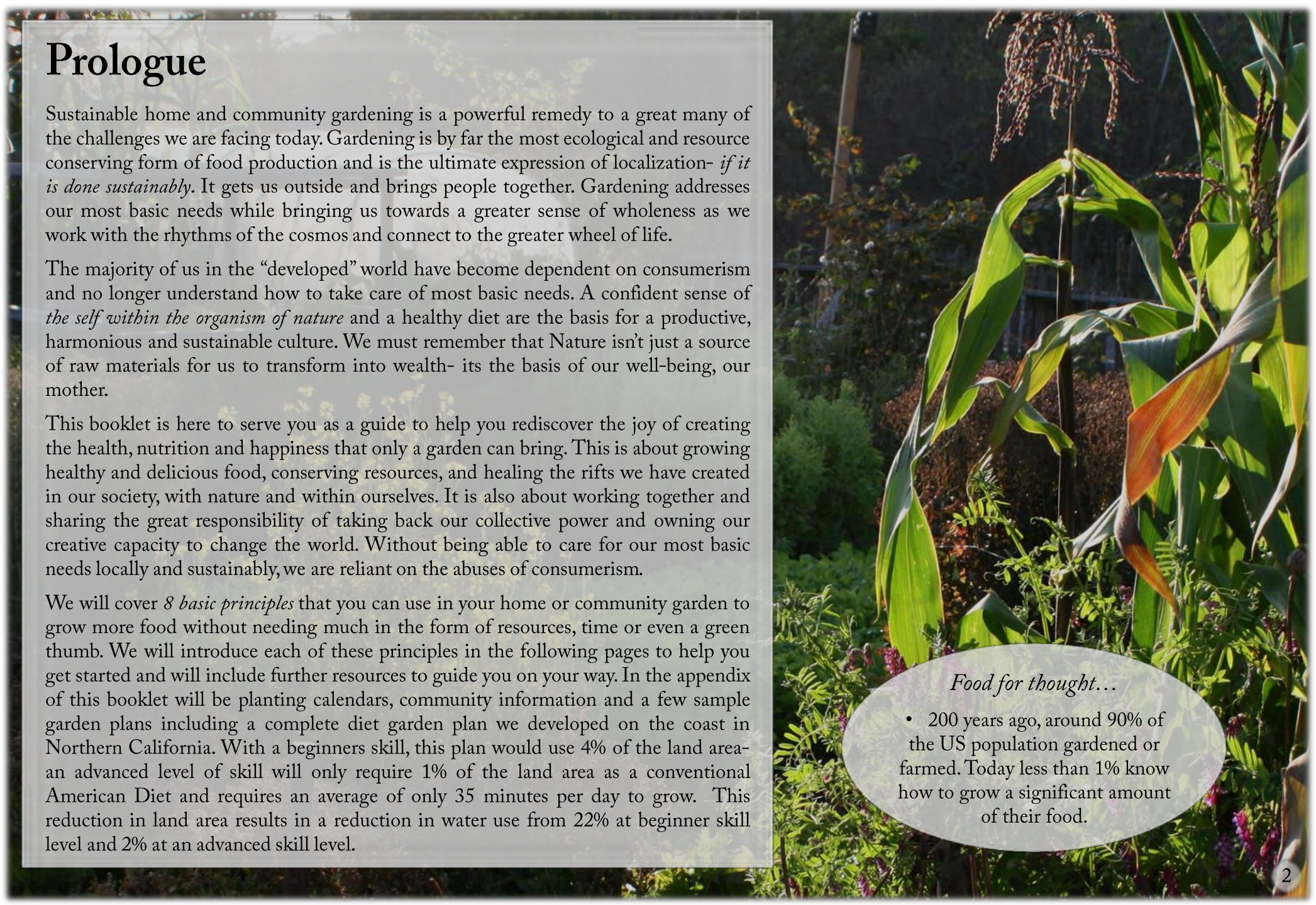
Prologue

Sustainable home and community gardening is a powerful remedy to a great many of the challenges we are facing today. Gardening is by far the most ecological and resource conserving form of food production and is the ultimate expression of localization- *if it is done sustainably*. It gets us outside and brings people together. Gardening addresses our most basic needs while bringing us towards a greater sense of wholeness as we work with the rhythms of the cosmos and connect to the greater wheel of life.

The majority of us in the "developed" world have become dependent on consumerism and no longer understand how to take care of most basic needs. A confident sense of *the self within the organism of nature* and a healthy diet are the basis for a productive, harmonious and sustainable culture. We must remember that Nature isn't just a source of raw materials for us to transform into wealth- its the basis of our well-being, our mother.

This booklet is here to serve you as a guide to help you rediscover the joy of creating the health, nutrition and happiness that only a garden can bring. This is about growing healthy and delicious food, conserving resources, and healing the rifts we have created in our society, with nature and within ourselves. It is also about working together and sharing the great responsibility of taking back our collective power and owning our creative capacity to change the world. Without being able to care for our most basic needs locally and sustainably, we are reliant on the abuses of consumerism.

We will cover *8 basic principles* that you can use in your home or community garden to grow more food without needing much in the form of resources, time or even a green thumb. We will introduce each of these principles in the following pages to help you get started and will include further resources to guide you on your way. In the appendix of this booklet will be planting calendars, community information and a few sample garden plans including a complete diet garden plan we developed on the coast in Northern California. With a beginners skill, this plan would use 4% of the land area- an advanced level of skill will only require 1% of the land area as a conventional American Diet and requires an average of only 35 minutes per day to grow. This reduction in land area results in a reduction in water use from 22% at beginner skill level and 2% at an advanced skill level.



Food for thought…

- 200 years ago, around 90% of the US population gardened or farmed. Today less than 1% know how to grow a significant amount of their food.

Prologue

As more and more people inhabit the Earth, we navigate an ever-evolving and dangerous perfect storm. This perfect storm can be transmuted into creative energy. The *force-multiplier* of climate change necessitates that we act swiftly and with great sensitivity. In this moment, we can either come together to create a better future, or be torn apart fighting over what is left.

This is, in fact, the opportunity many of us have been waiting for. There are cracks in the old paradigm and the light is entering in. At Ecology Action, we have seen how restoring hope through home and community gardening can change the world.

"You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete."

R. Buckminster Fuller

The methods outlined in this booklet have been developed over almost 50 years of research, education and demonstration by Ecology Action. The biointensive approach is the result of working with people in over 150 countries, in virtually every soil and climate where food can be grown. We've seen it work in the slums of Nairobi, in Mexico City, 12,000 feet up in the Andes, in tropical jungles and high deserts with almost no rainfall. We share this booklet with you because this work gives us hope and we know you can do it too. We can create a more peaceful, abundant future! Grow a Victory Garden for Peace!

"Another world is possible. It is a call to return to manual work in dialogue with the mountains, the harvests, the weeds, the animals, the sound of the stream and the whisper of the wind among the pines, the full moon and the waning, the constellations and brother sun. That is to say, it is the manual work of the gardener or farmer with spirituality, a call to the alchemical language of the gardener… to live in harmony with neighbor and nature."

Mario Mejia Gutierrez, National University of Columbia, Palmira

Food for thought…

- In Russia, gardens produce 53% of the food using 3% of the land. 47% of the food is produced on farms using 97% of the land. The gardening culture in Russia is 38x more efficient at producing food that farming


"When I go into the garden with a spade and dig a bed I feel such an exhilaration and health that I discover that I have been defrauding myself all this time in letting others do for me what I should have done with my own hands."
Ralph Waldo Emerson (1803-1882)

Microscaling Agriculture: The Key to Sustainability

Agriculture is defined as the art and science of cultivating crops. This art and science is built on the unique contributions of cultures throughout history including cultivation techniques, crop diversity, rituals, medicines, recipes and relationships to nature that form the backbone of our communities.

Agriculture is a relationship to the land. It is a story of moving from hunting and foraging, to cultivation, domestication of crops and animals, the invention of the plough, the discovery of fossil fuel energy, the development of chemistry, synthetic fertilizers, biocides and GMOs. And now artificial intelligence piloting driverless tractors and drones. The health and well-being of humanity is intimately tied to healthy soils and ecosystems- why would we outsource that relationship to artificial intelligence? We need to restore the notion that farmers and gardeners are stewards of the land responsible for the health of our environments and families. What does the agriculture of today say about us as a species? There is a fine line between the idioms *working smarter not harder* and *too smart for ones own good.* Growing soil, food and community is an honorable task.

Agriculture is about adapting to conditions to provide for our basic needs. The way people farmed and gardened for the last thousand years might not work today- or, it might work better! What are the current global conditions and how might the agriculture of today adapt for tomorrow?

Here are a few facts:

- Currently over 875 million people (around 1 out of 10 people) go to bed hungry each night.
- By 2050, the UN states there will be another 2-3 billion people on the planet.
- In less than 10 years, the UN states that 2/3rds of the global population will not have adequate water to grow their own food.
- In the US, 80-90% of our water use is for agriculture.
- The UN stated in 2015 we had less than 60 years of soil remaining and that by 2050 we need to increase farm production 70%.[1]
- Each year we need an additional 12 million acres of farmable soil. Each year we lose 30 million acres of soil to wind and water erosion.
- It takes between 500-2000 years to build an inch of soil in nature.
- Climate change will continue to destabilize cultures and contribute to mass migrations which put stress on global systems.

We may have reached the limits of our technological, resource extractive and globalized agriculture. The agriculture of the future will at once microscale our footprint, reduce water and resource consumption, stabilize and regenerate soils, feed our expanding population and increase the health and diversity of our ecosystems. This new model must empower people around the world to be able to feed themselves sustainably and inspire new generations to meet the challenges that we will increasingly encounter into the future. We must understand sustainability to not just be about our soil, our farm or garden- but about our community, ecosystems and biosphere as a whole. *This new model is right in your backyard and you are the solution.*

The latest results of this work have led to sustainable agriculture models which demonstrate that there is enough for everyone, including our ecosystems. The designs and garden plans provided in the appendix of this booklet and will be elaborated upon in a future Ecology Action publication.

[1]Note that the UN figures on 60 years of soil remaining are considered at current rates of soil loss- it is highly probable that there is less than 25 years of soil remaining due to the fact that as soils begin to erode, the rate of erosion increases and the demands on those soils by populations experiencing yield loss will cause further increased degradation.

3 Keys: Experimentation, Observation and Reflection

There are many ways to grow a sunflower. What drives the research of Ecology Action is a whole systems approach to understanding how to grow a sunflower using less resources and in a way that actually enhances the health of soil, people and the biosphere. Through experimentation, observation and reflection we can determine what methods accomplish these goals and how we can incorporate them most effectively across cultures, climates and soil types around the world.

The Blind Men and the Elephant
John Godfrey Saxe, 1887I

It was six men of Indostan to learning much inclined,
Who went to see the Elephant though all of them were blind
That each by observation might satisfy his mind.

The *First* approached the Elephant
And happening to fall against his broad and sturdy side
At once began to bawl: "God bless me! but the Elephant is very like a WALL!"

The *Second*, feeling of the tusk,
Cried, "Ho, what have we here, so very round and smooth and sharp to me 'tis mighty clear
This wonder of an Elephant is very like a SPEAR!"

The *Third* approached the animal,
And happening to take the squirming trunk within his hands, thus boldly up and spake:
"I see," quoth he, "the Elephant is very like a SNAKE!"

The *Fourth* reached out an eager hand,
And felt about the knee
"What most this wondrous beast is like Is mighty plain," quoth he: "'Tis clear enough the Elephant is very like a TREE!"

The *Fifth*, who chanced to touch the ear, said:
"E'en the blindest man can tell what this resembles most;
Deny the fact who can, This marvel of an Elephant
Is very like a FAN!"

The *Sixth* no sooner had begun about the beast to grope,
Than seizing on the swinging tail that fell within his scope,
"I see," quoth he, "the Elephant is very like a ROPE!"

There are many ways to interpret this allegory in the context of learning how to garden sustainably. In one way, the elephant is the garden and we are blindly prodding around nature trying to understand how it works. In another way, this allegory reminds us that by working together and sharing observation and reflections, we can work with others to engage their perspectives and better understand how to garden sustainably.

Experimenting can be an important part of the gardening experience. Experimenting helps us validate if something works for us, or doesn't. *An experiment tests a hypothesis and provides a control which helps us measure the value of an approach.* The garden can be a place full of experiments! However, try to keep things simple and keep records of your experiments or you may lose track of key learning opportunities.

Experimenting can help us grow in many direct and indirect ways. Following up experiments with regular observations, we can notice how a companion plant not only effects the insect-life around the plants, but also the structure of the soil or the presence or lack thereof certain weed species. Creating a framework for recording these observations can help accelerate the process of learning and bring us closer to the garden. This can be a notebook or garden journal. Oftentimes, we learn as much if not more from our failures. An expert is only someone who has made more mistakes!

Most of our experiments in the garden focus around the following:

1. Variety trials for soils and climates/microclimates
2. Spacing trials to see optimum centers for various crops and varieties
3. Companion planting and interplanting combinations
4. Composting approaches, in particular *cold composting*
5. Timing, crop rotations and seasonal plantings
6. Cultivation timing and techniques

A Few Simple Tools

The following tools are all you need to get started. Consider starting simple so you can focus your learning qualitatively before scaling up. Check out the self-teaching section at www.growbiointensive.org for our free resources and videos to refine your technique!

Starting a garden doesn't have to require huge amounts of time or money. Alla you need is a garden bed or two and few good tools. It is a good idea to invest in quality tools. Keep them clean and use them correctly and they will last a lifetime.

D-handled tools are more ergonomic and easier to use. A **flat spade** enables you to double-dig more effectively than a pointed shovel. A **spading fork** with a good shoulder helps you stay on the tool without slipping off as you work the soil. Stainless steel tools slide through the soil easier than forged steel but are not as strong and more expensive.

It is also very important that the handles are made of a durable quality hardwood such as ash or hickory. Plastic or fiberglass handles are lighter weight but do not have the same feel as a natural wooden handle.

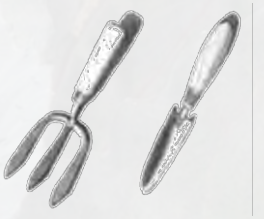
A good **bow rake** has a long wooden hand and a metal rake with slight flex. This tool can be used to level beds after they have been dug and also to cultivate soil or chop in amendments.

A **digging board** is important as you are working across the bed. To make your own use a 1/2-5/8" thick plywood board cut 2-3' long by 3-5' wide. Size this board appropriately to your bed. You want to be able to sit on it, with your tools and a flat by your side, and also be able to maneuver comfortably as you dig and rake the bed.

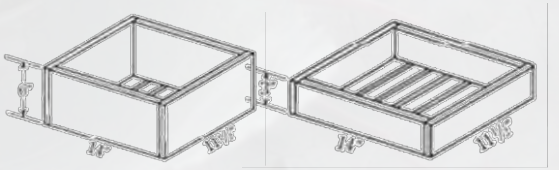
If you do not have a wheelbarrow, a few 5-gallon buckets will suffice. You can run a small section of an old garden hose around the handle for comfort.

A good **hand-fork** is useful for removing plants from flats prior to transplanting. Be sure to choose a hand-fork which has a nice bend in the neck. The importance of this will become apparent as you work with flats- especially if you have a straight hand-fork!

Transplanting trowels come in various shapes and sizes. One that is about 2-4" wide and 6-8" long is fine.



It is important to have the correct size **flats** in the garden. There must be at least 3" of root zone. The information provided in most horticultural books (including How to Grow) follows standard dimensions. We like to build ours of recycled redwood or cedar- they are rot resistant and hold up will over the years. The flats below are 6" and 3" deep half-flats.



7 Tips for Grounding and Growing in the Garden

A few tips to get you out of the house, into the garden and growing strong:

1. *Don't be afraid to start, and don't be afraid to make mistakes.* An expert is only someone who has made more mistakes and it's these mistakes we learn from. You will have failures- it is life! Don't lose yourself in the frustration of things not working out the way you planned- in fact, our plans are only so good as to get us organized and started. You have to leave room for improvisation, for magic and serendipity. And of course, for weather!

2. *Start small, keep it simple.* Going big from the get-go actually slows you down. It slows down your ability to relate to the small things, to those finer and more subtle things which are your greatest teachers. Starting small means you need less to start, and if you screw up, it is easy to get going again. I recommend starting with 1 bed, or maybe 3- but wait until you feel ready to take on that 4th or 5th. By your 3rd year, you may be ready for 10 growing beds. The growing beds we refer to in this booklet are 100 sqft beds.

3. *Have fun and experiment.* Give different plants, planting combinations and crop rotations a try. Try new varieties, different timing and procedures. Whenever you experiment, experiment small but not too small. Our experience shows that you don't want to go under 25 sqft blocks for your trials and you want to run them for several years before coming to any conclusions. There are so many things which influence growth in the garden and replicating experiments helps narrow the variables to better determine the results. And keep data because it is easy to forget what happens!

4. *Observe.* The more you observe, the more you experience. Plants are sensitive and they appreciate the attention. I enjoy hand-watering. It slows me down and affords me time to observe- it's when I notice the aphids, or the weeds. It is also when I tend to notice how beautiful that flower is, or how wonderful that breeze feels. Observation is also a time for reflection and meditation- it is the act of taking in sense perception, digesting its sensations and creating the mental images, the imaginations which marry our consciousness to our work. It brings us closer to the garden and ultimately, closer to ourselves. It allows us to enjoy the work of the garden.

5. *There are always at least 5 reasons.* Don't jump to conclusions in the garden. It's easy to assume something is happening, and natural to look for the reasons. But challenge yourself to look for at least 5 causes to any situation. Often the aphid is there because of the conditions of the soil, the atmosphere, the life-stage of the plant, the amount of water we have been applying to the soil or not…flexing your mind to see more, hear more and feel more will help you and your garden grow together.

6. *Practice "hard-focus" and "soft-focus".* When we zoom in on something to look more closely at the details we are practicing hard focus. Soft-focus is a process of relaxing ones' self, to get a sense of the periphery and surrounding environment or the bigger picture. With the soft focus you are able to see more of the interconnections in the greater garden organism. It is also good for the spirit- it relaxes us and allows our mind to be more limber and alert. The hard-focus is equally important for addressing the moment. Use them both and see if you can increase the dimensionality of your experience.

7. *Be patient.* The garden will only grow as fast as it wants and forcing things can complicate things and doesn't always end well. Have patience for our own growth as well. For me, the greatest increase in fertility, yields and understanding has come with time- the more of the rhythms and cycles that I am blessed to experience in the garden, the more I see and learn. Patience truly is a virtue.

8 Principles: A Simple Approach to Sustainability

With 8 simple principles you can start your garden, increase your yields, conserve water and grow soil! We will move through each of the 8 Principles of Biointensive Food Production with a brief description of each principle, why it is important and what to expect as a result.

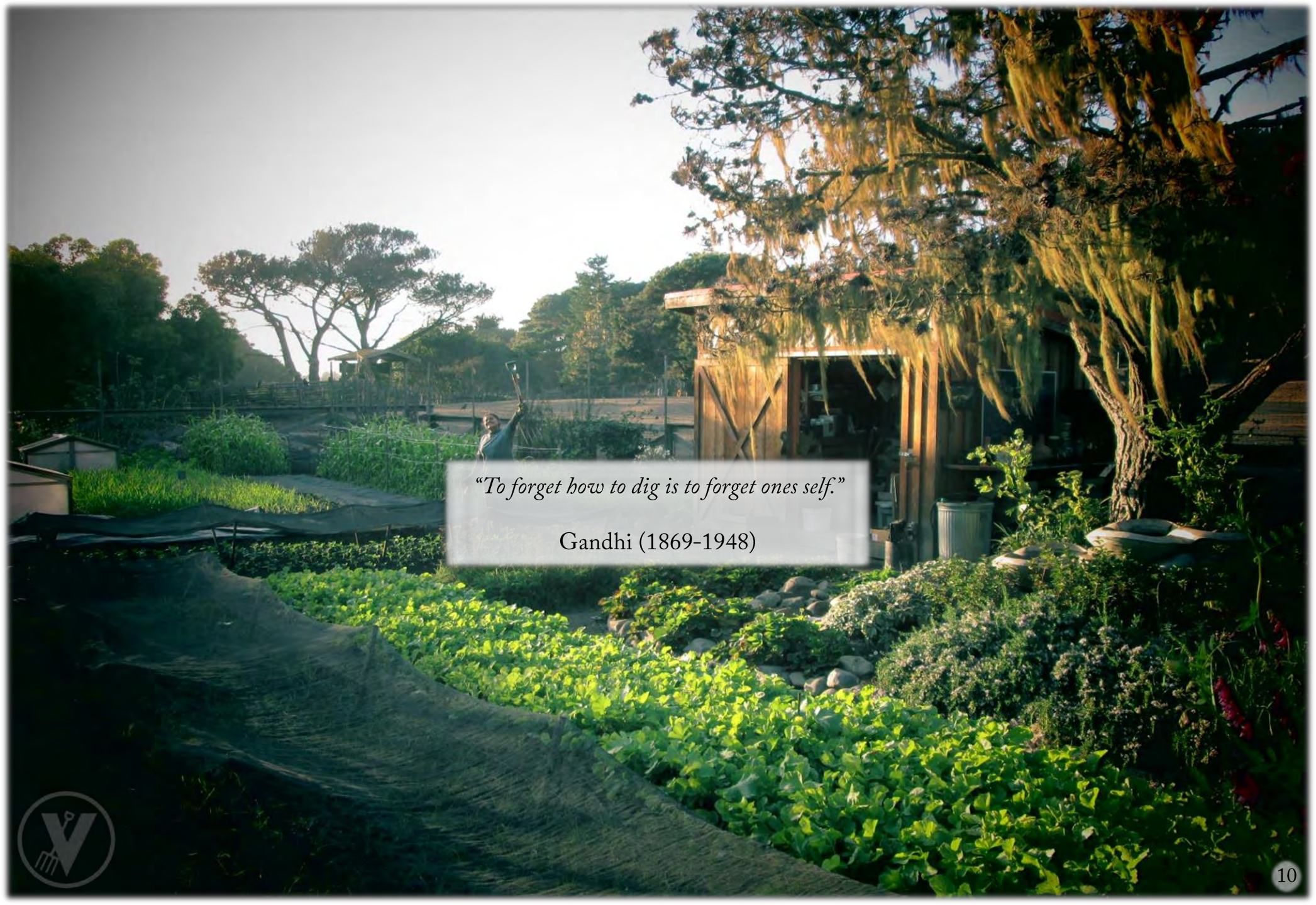
8 Basic Principles of Biointensive

1. ***Deep Soil Preparation:*** Establish good soil structure and increase nutrient cycling
2. ***Close Plant Spacing***: Encourage good growth, high yields and a microclimate
3. ***Companion Planting:*** Understand and work with the relationships in nature
4. ***Composting:*** Maximize microbial diversity and the quantity and quality of compost
5. ***Carbon Farming:*** Sequester carbon, compost and grow your soil
6. ***Calorie Farming:*** Grow more food while microscaling your footprint
7. ***Seed Saving***: Growing and adapting your own seeds
8. ***Whole Systems Perspective:*** Understanding the garden as an organism and integrating the 8 principles

Advantages of Biointensive vs. Conventional Forms of Food Production*

- Uses 67-88% less water
- Uses 50-100% less purchased fertilizer
- 94-99% less energy with a fraction of resources used
- Produces 2-6x the food of conventional
- Builds soil 60x faster than naturally occurs
- Microscales the human footprint of agriculture

*Jeavons, J. Biointensive sustainable mini-farming. Journal of Sustainable Agriculture, Vol. 19(2) 2001.


"To forget how to dig is to forget ones self."
Gandhi (1869-1948)

Principle 1: Deep Soil Preparation

Goal: Establish good soil structure and increase nutrient cycling

Tools: Digging Board; D-Handled Fork; D-Handled Spade; Buckets or a Wheel Barrow

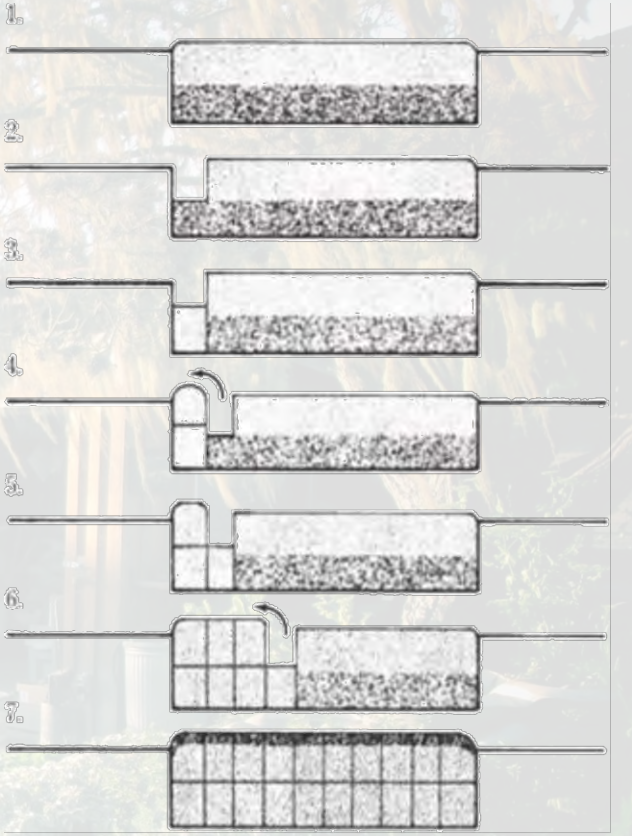
Why should I dig?

Soil cultivation has been used for thousands of years to promote good soil structure and increase biological nutrient cycling. Double-dug soil breathes deeper, accepts water and air, promotes biological activity and increases the capacity for roots to get what they need. Double-Digging once per year after winter compaction and prior to the main season crop will help you achieve a healthier, more productive garden. For subsequent crops that year, single dig with a fork and cultivate. Eventually, you may only need to surface cultivate if a stable soil structure has been achieved- run experiments to see if double-digging is still necessary.

The digging process:

1. Mark beds and paths clearly. Loosen the soil with a fork and remove vegetation.
2. Place your digging board 12" away from the front edge of the bed and remove the first 12" deep trench into your wheel barrow or 5-gallon buckets with your spade.
3. With a spading fork, loosen the lower 12". You have now loosened the soil 24" deep.
4. Moving backwards through bed 12" at a time, push the soil from the new trench into the trench in front of you. Keep the top on the top and the bottom on the bottom.
5. In the new trench, loosen the lower 12" with a spading fork.
6. Repeat the process: work your way back across the bed moving the top 12" forward with your spade, and loosening the lower 12" until you reach the end of your bed.
7. After the lower 12" in the last trench is loosened, dump the soil from the first trench into the final trench. Keep 1 bucket stored for use in compost building and flat mix.
8. Rake the bed smooth, cultivating larger clumps into small ones ½-1" in size.
9. After the bed has been raked even, broadcast compost and necessary amendments evenly across the soil surface and cultivate *in-situ* to the top 4-6". Be careful not to push or pull amendments across the bed- cultivate them directly into the soil below.

The Double-Digging Process



Results:

- Soil structure is optimized with good aggregate, porosity and capillary. Balanced nutrient availability and soil respiration start you off in the right direction.
- As the soil re-awakens, the rate and depth of nutrient cycling increases 4-6x.

Principle 1: Deep Soil Preparation

Key Resources

Albrecht, William. Albrecht on Soil Balancing. The Albrecht Papers Volume 7. Austin, TX: Acres U.S.A., 2001

Belfour, Lady Eve. The Living Soil. London: The Soil Associate Ltd., 2nd ed. 2006.

Brady, Nyle C. and Wyle, Ray R. The Nature and Properties of Soil. NY: Prentice Hall, 14th ed. 2007

Fenzau, C.J. An Acres U.S.A. Primer. Raytown, MI: Acres U.S.A., 1979

Howard, Albert. The Soil and Health. NY: Devein-Adair, 1956.

Lowenfels, Jeff and Lewis, Wayne. Teaming With Microbes. Portland, OR: Timber Press, 2014.

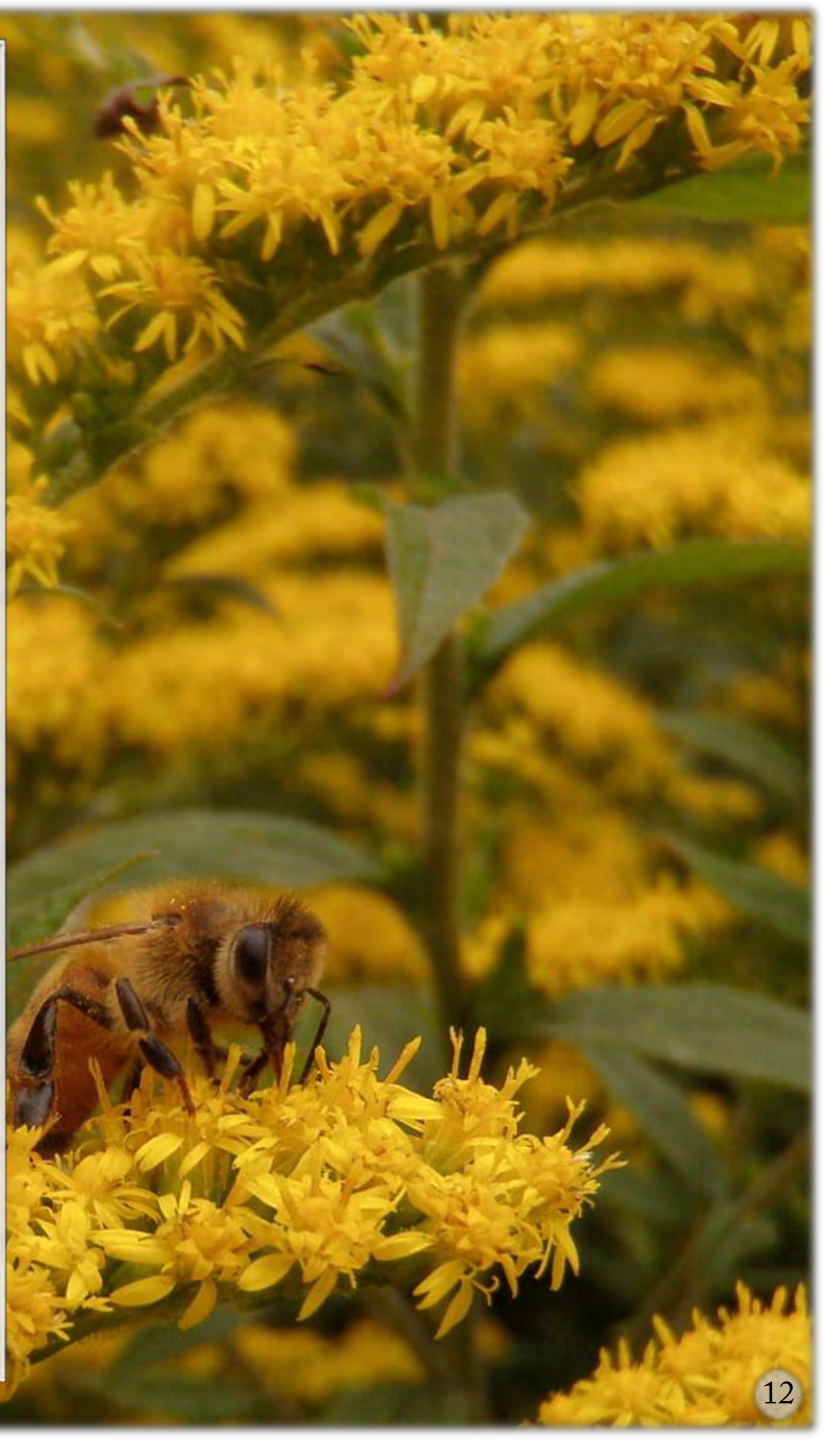
Lowenfels, Jeff and Lewis, Wayne. Teaming With Nutrients. Portland, OR: Timber Press, 2014.

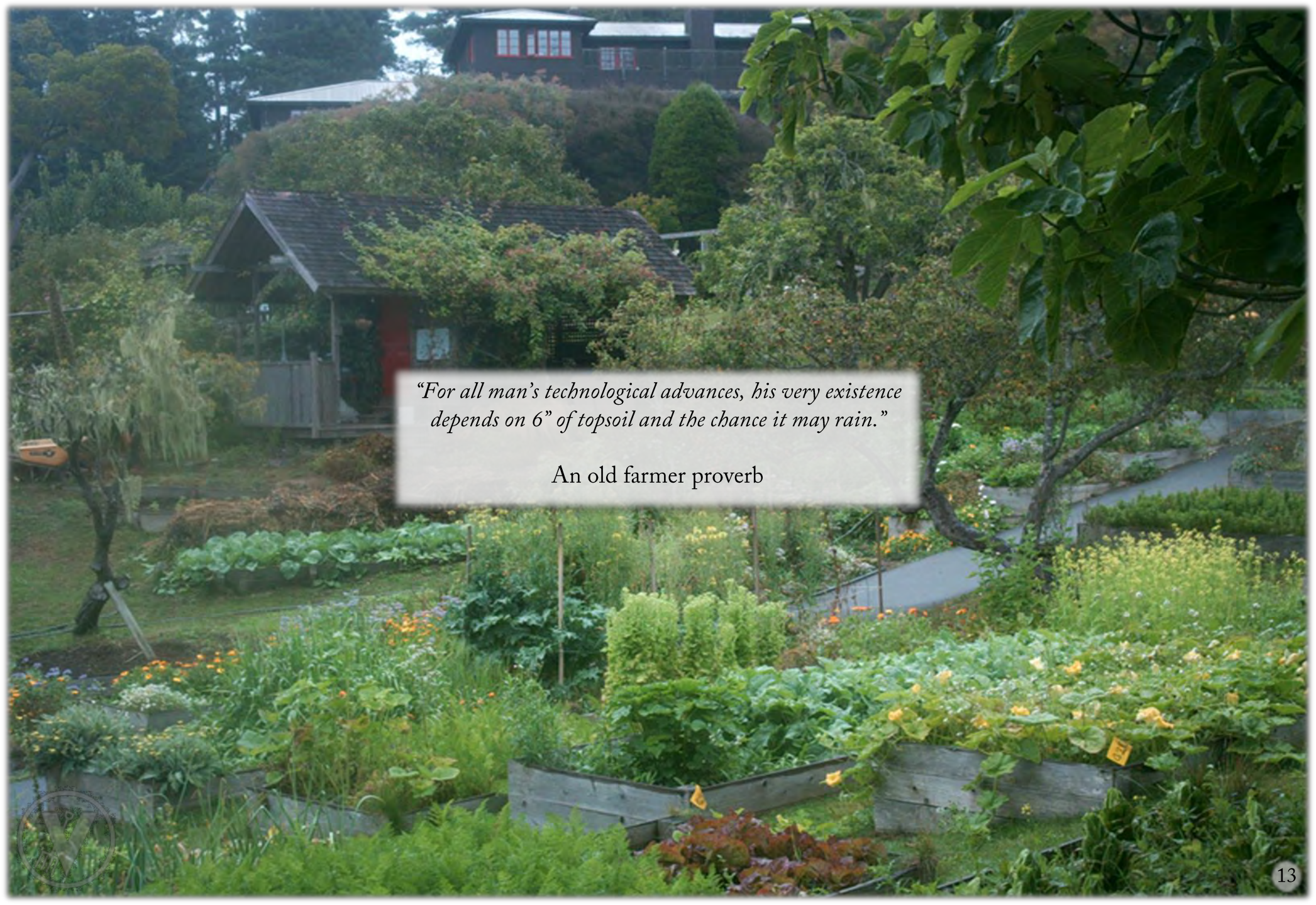
Navta, Phil. Building Soils Naturally- Innovative Methods for Organic Gardeners. Austin, TX: Acres U.S.A.

Sachs, Paul. Edaphos Dynamics of a Natural Soil System. Newbury, VT: Edaphic Press, 1999.

Syltie, Paul. How Soils Work. Fairfax, VA: Xulon Press, 2002.

Wildman, William. Soil: Physical Environment and How it Affects Plant Growth. Leaflet 2280. University of California, June 1975.





"For all man's technological advances, his very existence depends on 6" of topsoil and the chance it may rain."

An old farmer proverb

Principle 2: Close Plant Spacing

Goal: Encourage good growth, high yield and a microclimate

Tools: Hand Fork; Transplanting Trowel; Spacing Sticks; Digging Board; How to Grow More Vegetables *Mastercharts.*

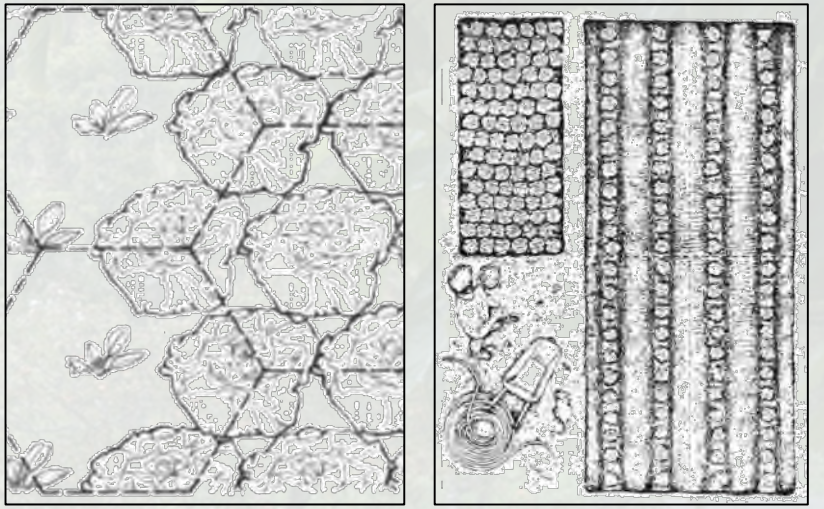
Why transplant vs. broadcast?

Raising your vegetables in flats is fun and if done properly enhances plant health. It uses a fraction of the seed compared to broadcasting and encourages rapid establishment of a microclimate conserving soil and water while limiting interference from weeds and pests. Transplanting allows you to select the healthiest plants and give them optimal spacing and timing to promote the most productive and efficient results.

The transplanting process using close plant spacing:

1. After the growing bed has been prepared lay your digging board across the bed and determine the spacing you wish to use.
2. Gently remove 2-5 plants from the flat using a hand fork, getting beneath the plants and lifting them to prevent root damage while lightly grabbing the plant by its leaves and not its stem or roots.
3. Space the first transplant ½ its spacing distance from the edges of the growing bed. Slide in the transplanting trowel and open a hole. Set your plant in place and sweep the soil in behind the plant making sure the roots remain vertical as they are tucked in. Each transplant thereafter will be transplanted *on-center* across the growing bed.
4. After completing the first row slide the board back and using the spacing stick offset the next row so that each 3 plants form an equilateral triangle. As you continue to transplant further, you will notice that 6 of these triangles forms a hexagon- this is sometimes referred to as *hexagonal planting.* With proper spacing, mature leaves will touch, filling in the microclimate and conserving resources while maximizing yield.

Close Plant Spacing



Results:

- Increased time and space efficiency- as a crop matures in the bed the next is being raised in a flat. Leeks can spend 12 weeks in a flat, enough time to grow an entire crop of carrots.
- Deep soil preparation increases to root zone and nutrient cycling enabling us to plant more plants on closer centers, increasing overall production.
- An established microclimate reduces evaporation by as much as 63% while increasing photosynthesis per unit of time and space.
- Raising vegetables in flats conserves a significant amount of water.
- Close-Plant spacing in a properly prepared bed can result in 50-75% reduction in overall area needed in production.
- Significantly less time watering, weeding and cultivating once microclimate established.

Process: Flatting

Overfill flats ¼" above top with flat mix. Place seeds hexagonally.

Cover seeds with a layer of soil the thickness of the seed.

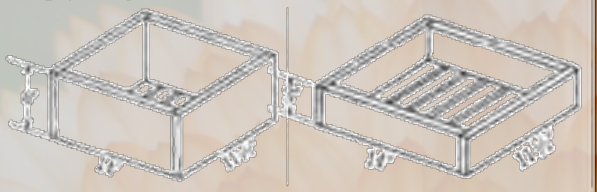
An in-ground ***nurse bed*** can function substitute wood flats.

Principle 2: Close Plant Spacing

Flatting, Pricking Out and Seed propagation

Starting seedlings in flats is easy and can lead to great results- water conservation, more efficient use of time and space, healthier plants, and less competition from weeds and pests. Here are a few notes to help you get started:

- Build flats of recycled rot-resistant wood such as cedar or redwood. Leave a small 1/8" gap between bottom slats so the flats breathe. Try to stay away from using plastic flats.



- You can make your own flat soil mix: 1 part sifted compost; 1 part old flat soil; and 1 part sifted bed soil taken from the double-digging process (see Deep Soil Prep. section). Bagged soil mixes are costly and have negative environmental impacts. Grow your own!
- The *Master Charts* in How to Grow More Vegetables (HTGMV) by John Jeavons contain details on spacing, timing, and other key information.

CROP	SEED				PLANTING	FLATS							BEDS	
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
21 Corn, Sweet	110–156	0.75	1.0–0.72 / 2–1½ c	5	F 1	107	0.45	3–5 days	—	—	—	—	12	84

- A greenhouse or mini-greenhouse is helpful to get seeds started. Keep seeds watered and maintain good air flow in the greenhouse. For small gardens, a windowsill indoors will work just fine to get your seeds started.
- After seeds have sprouted in the first flat you may want to transplant them into a second flat with larger spacing. This is referred to as "pricking out". This enables you to increase the time in flat giving you healthier plants while buying you more time for other crops to mature. The *Master Charts* in HTGMV will indicate whether this is advantageous for a given crop. Harden plants off out doors a few days prior to transplanting to enable them to normalize to the garden climate.

Process: Pricking Out

Always seek a comfortable working position where you do not stress your body and feel relaxed.

Use a ***widger*** or butter knife to get under the plant, lifting it by the leaves and not the stem.

Consolidate your movements. As you open the hole with one hand, place the plant with the other, sweeping the soil in and keeping the roots vertical as the whole fills in.

Principle 2: Close Plant Spacing

Process: Flatting, Pricking Out, Deep Soil Preparation and Transplanting

Magnolia flatting scarlet runner beans

Philomena and Vivian pricking out kale seedlings

Flats in the greenhouse, some are ready to harden off

Rachel teaches how to double dig the first trench

Joey continues double digging, Nazaire composts

Max cultivates compost into a finished bed

Paul and Rachel transplant winter rye together

Transplanted lettuce on hexagonal spacing

Mature lettuce on larger centers for seed saving

Principle 2: Close Plant Spacing

Process: Watering to maintain optimal soil moisture, structure and plant health

Maintaining optimal moisture in the bed is critical to resource conservation and plant health. It is also important to understand the difference between evaporation and transpiration. Evaporation is the movement of water from the soil surface to the atmosphere. Transpiration is the movement of water from the soil, through the plant to the atmosphere. Here are a few things to keep in mind:

- Make sure the bed is optimal moisture prior to digging or cultivating. A single dig prior to double digging can be used to dry a bed out or with a heavy water, allow water to enter deeply.
- If the lower trenches are dry, water the lower trench while double digging.
- After transplanting, water. The use of shade-net can conserve water and help your plants get established until the microclimate fills in. *Remember that you are watering the soil and not the plant.*
- Always arc the water into the bed, never shoot it down onto the plants or soil.
- In a drier situation you might water 10-15 gallons per day. In moist situation, you may only water 5 gallons per day or not at all. Stick your fingers in the middle and edges of the bed and see how moist it feels. You want the bed sufficiently moist all the way down. Water the edges twice as much as the middle to account for evaporation on the edges. Observe and understand how to adapt your watering techniques to conditions. Consider the following:
    - Apply water over several passes, lightly pulsing the water into the bed as a light rain would. Try applying it all in one pass- mimicking a heavier more saturating rain. How do they differ?
    - How does watering in the morning, vs watering in the evening effect the bed moisture?
    - Does a freshly transplanted bed without a microclimate need more water than an established bed? Does a freshly transplanted bed accept water easier than an established bed?
    - Does a freshly transplanted bed dry out faster than a mature bed? How does a mature bed effect soil moisture all the way down through the bed profile? Will a mature bed dry out faster than a freshly transplanted bed? Does the bottom of the bed profile dry out faster than the top?
    - How do you shift your watering regime in the spring vs. in the fall?
    - Are there conditions that you might water twice per day? Would you water the same amount each time?
- Lay a few cups, or jars randomly in the bed. Water and see how much water actually reaches the soil.

Principle 2: Close Plant Spacing

Comparison: Hand-watering to the use of drip-irrigation

A Whole-Systems Comparison of Drip-Irrigation to Hand-Watering For Water Conservation

Most people advocate drip irrigation because they believe it saves water- but does it? What are the costs of using drip irrigation and how does it fit into a whole systems perspective of our agricultural challenge?

Method	Description	Water Use[1]		Input		Analysis	
		Direct Conservation	Indirect Usage	Financial Cost	Resource Import	Pros	Cons
Drip-Irrigation	8-10 mil plastic with holes on 12-18" centers either placed on or below the soil surface. Delivers water drop by drop, leading to water conservation through greater absorption less run-off. Suited mostly to row-culture, more complicated for close-plant spacing and tighter gardens.	Conserves water, delivery directly to the root zone. This can result in significant water savings on site.	The 2,000 lbs of polyethylene plastic in a lifetime of drip-use would require 44,000 gallons of water.[2] Consider also aquifer contamination from fracking and plastic waste pollution in surface waters reducing water availability.	$700 every 2.5 years, $22,400 over an 80 year lifetime.	128lbs of plastic every 2 years, over 2,000 lbs in a lifetime. There is 65x the embodied energy in the drip irrigation required to water 40 beds vs a 100' garden hose.	Allows the garden to be watered without being present. Conserves water compared to sprinkler or flood irrigation.	Requires more embodied energy, creates more plastic waste, requires frequent maintenance. The cost-benefit is greater to farmers than gardeners due to overall area managed. If everyone used drip irrigation it would generate 14.25 billion tons of plastic which could wrap the circumference of the Earth 9,000,000 times.[3]
Hand Watering	The most inert and weather-resistant garden hose is made of EPDM. A 100' garden hose will last 20-30 years and is easily repairable and durable.	Can accomplish the same water savings as drip-irrigation and better per lb of biomass and calorie produced.	No information available, however, over a human lifetime likely significantly less due to longevity of EPDM vs Polyethylene drip tape.	$100 every 25 years for a total of $400 over an 80 year lifetime.	15 lbs of EPDM every 25 years for a total of 60 lbs of waste in a lifetime. 65x less embodied energy compared to drip.	With practice uses water more efficiently than drip irrigation. Waters the soil and not the plant, puts you into direct relationship with the plants and soil you work with.	Requires daily application. For each 10 beds it may take 15 minutes each day to water 100-150 gallons depending upon your climate and soil type.

[1] *Direct Conservation* refers to water conserved directly on site. *Indirect Usage* refers to the embodied water to produce the materials.

[2] It takes 22 gallons of water to make 1 lb of plastic.

[3] As of 2017, humans made 8.3 billion tons of plastic. If everyone grew their food biointensively, microscaling their agricultural footprint and using less drip irrigation we would need almost double the amount of plastic. Grown conventionally would take at least 4 times the area, requiring almost 6x the plastic we have created to date- resulting in 6x the plastic pollution. A lifetime use of drip irrigation is factored by the following equation:

An average biointensive beginning diet design of a 40-bed unit would take around 5,250' of drip irrigation costing $700 and generating 128 lbs of plastic. This drip irrigation would be placed in several rows through the growing beds aligning the 12" center holes hexagonally across the bed. Due to weathering and ultraviolet degradation this would be replaced every 2.5 years- many farms

A hand-watering gardener who knows their soil, plants and climate will more skillfully and efficiently apply water. Drip irrigation, timers, probes and computers all have their own complications. I hand water because I love giving the attention to my garden. It is actually one of my favorite tasks! The set it and forget it mentality of drip irrigation does not make one a better gardener, it actually distances one from the garden. Every opportunity we have to connect and relate to the garden makes us a better gardener. Simplify life, create less plastic pollution, drop the drip and water with a garden hose!

Principle 2: Close Plant Spacing

Comparison: Importing straw mulch vs creating a living mulch with close plant spacing

A Whole-Systems Comparison of Importing Dead Mulch to Living Mulch Created Through Close-Plant Spacing

Mulch is often used to conserve water and protect the soil. Is this the best use of these materials

Method	Description	Water Use[1]		Input		Pros	Cons
		Direct Conservation	Indirect Resource	Financial Cost	Resource Import		
Dead Mulch	2 bales of straw (hay may contain weed seeds!) will cover 100 sqft to a depth of 3".	Can reduce evaporation by 80%.	1 Bale of straw requires 8,690 gallons of water to grow[1]. Each bed requires 17,380 gallons of water to grow 3" of straw mulch. A 40 bed complete diet design with 3 crops per bed each year would require 2,085,600 gallons of water for 240 bales.	$10-$15 per bale. 40 beds mulched 3x each bed per year would cost $1,200-$1,500 dollars/year	1 acre produces 50 bales of straw. Importing straw means importing the soil nutrients from the acre it was grown. Those bales are better composted on-site and not exported.	Conserves water and soil structure.	Habitat for slugs and some disease organisms- light surface airflow can be beneficial to your plants. If the straw contains herbicide or pesticide residues these can enter your garden soil. Over a gardeners lifetime, with a 40-bed design and importing mulch for each crop, over 165,000,000 extra gallons of water would be required at a cost of $96,000-$120,000 dollars.
Living mulch	The most inert and weather-resistant garden hose is made of EPDM. A 100' garden hose will last 20-30 years and is easily repairable and durable.	Can reduce evaporation by 63%.	None. With the water saved each year (2,085,600 gallons) and with the 10-bed diet design in the appendix of this guide, complete diets for 60 people could be grown biointensively without importing mulch.	None. By using close plant spacing instead of mulch you save $96,000-$120,000	None. On the 4.8 acres it took to grow the straw for mulch, an ecosystem could be restored or the farmers fertility better managed.	Conserves water and soil structure without costly inputs financially or environmentally. The living mulch materials grown from close plant spacing are then composted on site and turned into soil humus to further increase water conservation and moisture holding capacity of the soil.	For the first 3-4 weeks before the microclimate fills in, double the water might be necessary to maintain optimal soil moisture. Once the microclimate is established, significant water efficiencies are achieved.

[1]Wheat requires 434,500 gallons of water per acre to produce 50 bales. This works out to 8,690 gallons of water to produce each bale.

The *Living Mulch Effect* created by close plant spacing creates a microclimate conserving soil moisture, soil structure and trapping carbon dioxide respired from the soil microbes utilizing it for plant growth through photosynthesis. This living mulch can reduce evaporation by up to 63% in the growing bed, fixes carbon and is later composted on-site to regenerate soils and further increase water holding capacity. *Dead Mulch* is imported from off-site and robs another's soil to feed your own.

Principle 2: Close Plant Spacing

Key Resources

Bubel, Nancy. The New Seed Starters Handbook. Emmaus, PA: Rodale Publishing, 1988.

Jeavons, John. How to Grow More Vegetables. Berkeley, CA: Ten Speed Press, 2017

Knott, James Edward. Handbook for Vegetable Growers. NY: John Wiles and Sons, Inc, 1957.

Reilly, Ann. Parks Success With Seeds. Greenwood, NC: Geo W. Park Seed Co, 1978.

Sutton and Sons. The Culture of Vegetables and Flowers From Seeds and Roots. London, Kent: 1898.

Food for thought…

It took 200,000 years for human population to reach 1 billion people. It has only taken 200 years to reach 8 billion. The UN states that we have to increase food production 70% by 2050 to meet a global population of 10 billion people


If you have a garden and a library you have everything you need."
Cicero (106 BC-43 BC)

Principle 3: Companion Planting

Goal: Understand and work with the relationships in nature

Tools: Hand Fork; Transplanting Trowel; Spacing Sticks; Digging Board

Why Companion Plant?

The relationships in nature hold ecosystems together. Understanding these relationships can help you manage pests, fertility and resources while increasing the productivity and efficiency of the garden. The garden is also a place for us to grow and as we understand our greater place in these relationships we experience more deeply the peace, sustenance and creative joy that gardening brings.

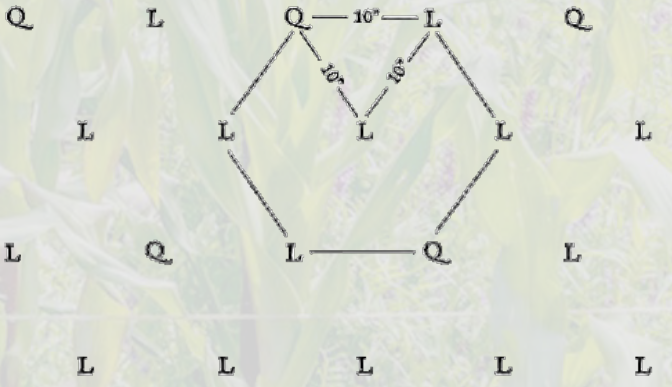
There are many examples of companion planting combinations. My advice to you: *try them out, run experiments with controls and record your observations.* Planting nasturtiums in the garden can help control aphids and whitefly; interplanting potatoes with flax will help deter potato bugs; interplanting legumes into your grains will help supply the soil with nitrogen. *Record your yields and observations.* You may find that sometimes planting things separate but close is more beneficial than interplanting everything together.

A few guidelines to help you with choosing your companion plants:

1. Run experiments with controls- how else will you know what is working!?
2. Strong smelling herbs like oregano and flowers like marigolds can confuse pests and attract beneficial organisms. Green beans and strawberries produce better together than apart. Alliums seem to have a negative effect on beans and peas. There are many combinations out there to promote the growth of one thing, or discourage another!
3. Try to rotate crops so that crops in the same family are not planted in the same bed 2 years in a row. This disrupts pests cycles and encourages a balanced, healthy soil.
4. What works in your climate and soil, might not work in another and *vice versa*. Timing might be altered, for example with the three sisters corn, beans and squash. You may find that planting one before the other helps immensely.

Process: Interplanting Design

Above, quinoa is interplanted with lettuce on 10" centers. The lettuce will be harvested a few weeks in just before the canopy of the quinoa closes. This is called relay cropping. **Below,** a diagram shows the spacing. When interplanting, add the spacing of each crop together and divide by 2. This will give the average spacing which is a good starting point for experimenting with interplanting.



Principle 3: Companion Planting

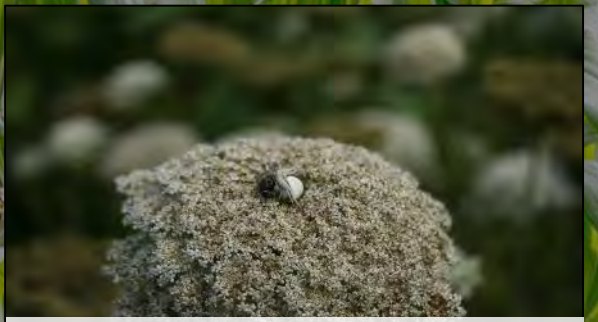
Examples in the Garden

Relay cropping lettuce, peas and quinoa

Legume interplanting woolly pod vetch and quinoa

Kale and radish work well above and below ground

Flowering umbelliferae attract a variety of beneficials



Crab spiders wait atop flowering plants to catch pests

Strong scented flowers and herbs keep pests away

Salad mix (*light feeder*) with cauliflower and carrots

Head lettuce interplanted with mizuna

A *diverse garden* is full of companions

Principle 3: Companion Planting

Special Notes: Experimentation, Observation and Reflection

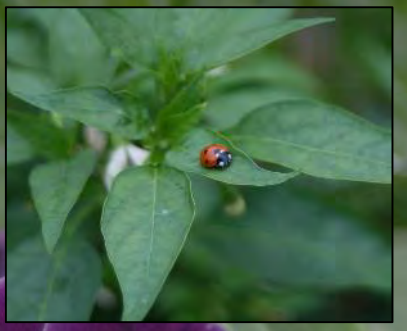
A few years ago we learned that woolly pod vetch can fix up to 3x the nitrogen of other annual legumes. In addition, it interplants well with grains. In this experiment, we grew two beds of quinoa, side by side and found that more overall biomass was produced by the vetch/quinoa interplant than the quinoa alone. However, the control quinoa (without vetch) produced slightly more calories. We learned that next we should experiment with different rates of broadcasting woolly pod vetch in with our quinoa to see how this affects yield. This in part led to our 2-Bed Test which is described in the appendix of this booklet.

Replicate experiments for at least 3 years in a row. This will help narrow variables. Challenge yourself to look for at least 5 reasons why something is happening and allow each learning experience to lead into the next.

Principle 3: Companion Planting

Special notes: Non-Pesticide Management (NPM)





A pest can be defined as any organism detrimental to our crops including fungus, weeds, bacteria, insects, virus or animals. There are many approaches to handling pests in the garden, in a biointensive system we utilize an approach we call *Non-Pesticide Management* (NPM). NPM is a pest-control philosophy that focuses on soil health, plant health and ecosystem diversity to self-regulate pests. NPM relies on cultivating a healthy farm ecosystem as a foundation and shifts perspective- viewing the pest as a symptom of imbalance and not the cause of the problem.

<u>4 Tenets of Non-Pesticide Management:</u>

1. Soil health is foundational to plant health: Soil is a living tissue and organic matter levels must be maintained and the mineral composition balanced. Deep soil preparation, composting and carbon farming are critical to maintaining a well-structured healthy soil.
2. Crop rotations maintain balance: Rotating crops, making sure no two plant families are grown in the same bed 2 years in a row helps maintain a balanced soil. Keeping the soil covered with a microclimate at all times throughout the year and including nitrogen fixing legumes in the rotation help keep soils and plants healthy. Crop rotations deter pests and encourage diversity.
3. Diversity creates resilience: The organisms we call pests often play key roles in stabilizing ecologies. Companion planting, good crop rotations and a diversity of plant selections growing in healthy soil creates the basis of a natural garden immune system of pests, predators- without the pest, you wont have the predator!
4. Microscale management for success: The more we focus on a smaller area the better we are able to manage pest populations and encourage good habitat and healthy soil.

In nature, there are 3 causes for disease. The first is genetics which can be addressed by growing healthy plants and saving good seed. Second is diet- a healthy soil is the foundation for a healthy garden. The third, lifestyle relates to our management- are we creating harmony within the rhythms of nature, or are we creating chaos, imbalance and stress? If you notice disease ask the following:

- Is the plant receiving to much or too little sunlight, water or warmth?
- Was the soil properly prepared, balanced in nutrient and given sufficient compost?
- Were the plant roots damaged during transplant and are they planted too close or too far from one another?
- Are good crop rotations being employed in the garden and is there a diversity of crop type and age present. Is there habitat and food source for beneficial organisms?

Principle 3: Companion Planting

Some Key Resources:

Carr, Anna. Good Neighbors: Companion Planting Guide for Gardeners. PA: Rodale Press, 1985

Cunningham, Sally Jean. Great Garden Companions. PA: Rodale Press, 1998.

Francis, Charles A. Multiple Cropping Systems. NY: Macmillan, 1986.

Littlewood, Michael. Companion Planting. (Poster)

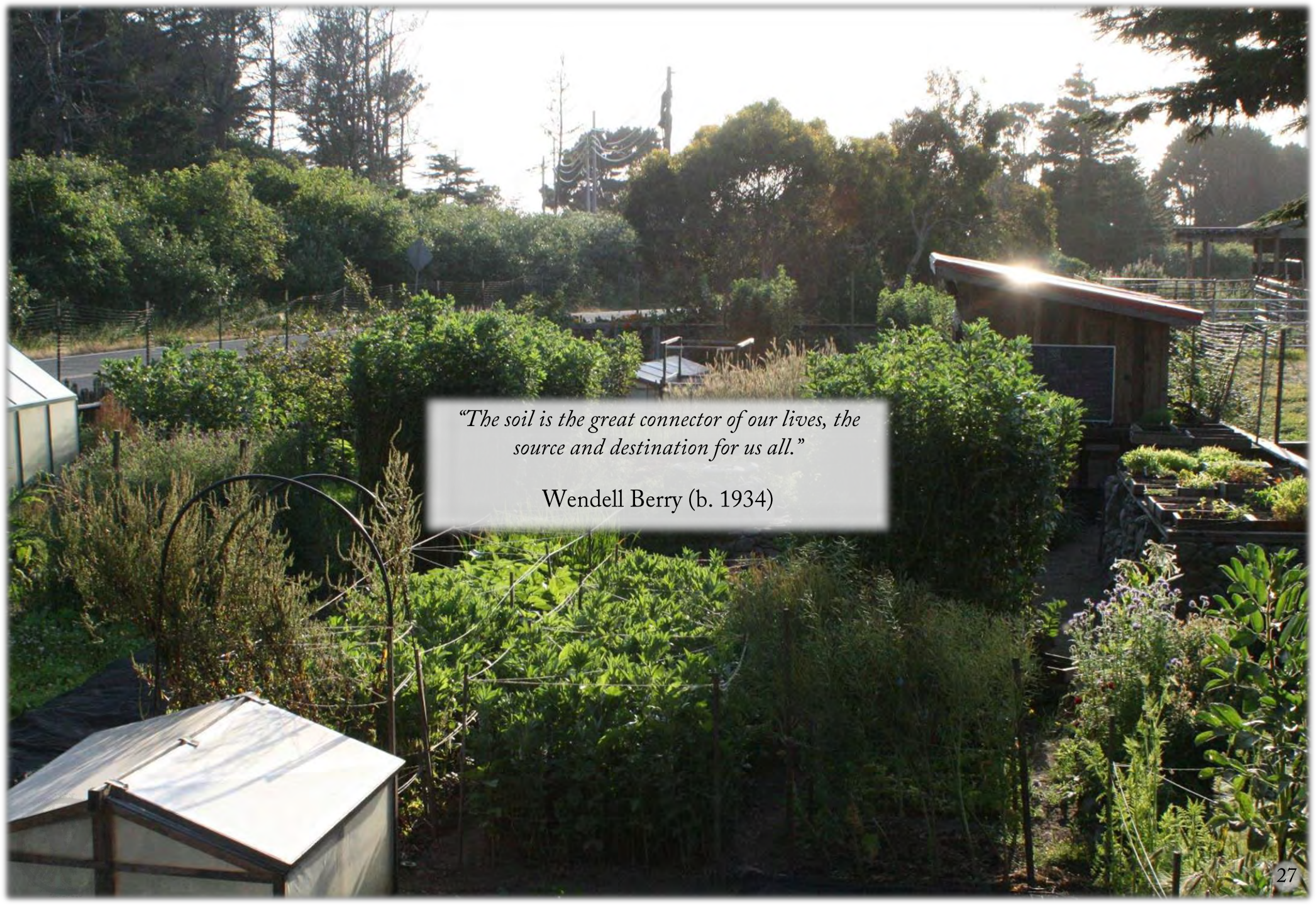
Philbrick, Helen. Companion Plants and How to Use Them. Old Greenwich, CT: The Devein-Adair Company, 1966.

Pfeiffer, Ehrenfried. Weeds and What They Tell. Biodynamic Farming and Gardening Association, 1970.

Riotte, Louise. Carrots Love Tomatoes: Secrets of Companion Planting for Successful Gardening. Storey Publishing, 1998.

Food for thought…

A healthy garden immune system has both predator and prey. Spraying organic pesticides to kill pests may also kill beneficial organisms. Keep in mind that some organisms may be beneficial at one stage in life and a pest in another stage. Patience, understanding and a degree of tolerance are essential.


"The soil is the great connector of our lives, the source and destination for us all."
Wendell Berry (b. 1934)

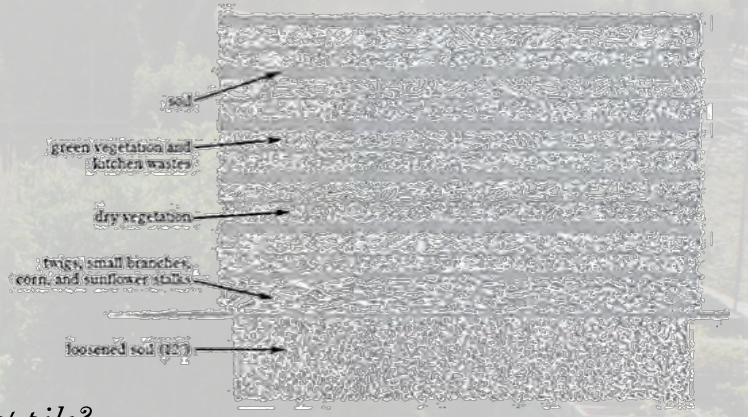
Principle 4: Composting

Goal: Maximize microbial diversity and the quantity and quality of cured compost

Why should I compost?

Composting returns nutrients and carbon back to the soil. Once in the soil, we refer to it as *soil organic matter (SOM)*. Organic matter is a sponge for life, nutrients and water. It helps buffer the soil from toxicities, extremes in pH and soil texture. It improves soil structure and increases yields. Organic matter is food for the soil, promoting healthy and balanced nutrition for our plants to grow to their fullest health.

A properly built pile is easier to maintain and results in a greater quality and quantity of compost. Build your compost piles over the growing bed, and rotate the locations of future piles throughout the garden to take advantage of nutrient leaching from the pile. Piles should be at least 3'x3'x3' for optimal breakdown. Monitor the piles regularly sticking your hand in there every once in a while to see if it is cooling, warming, breaking down, or if it needs turning. The correct moment to turn is immediately after the temperature starts to cool after the initial build. If you chose to turn, turn the outside to the middle and the middle to the outside. Make sure the pile is evenly moist- turn it if it becomes waterlogged and keep it watered regularly if it dries. Minimizing turning means more compost out and a more diversity in the finished compost which is better for the garden and your plants.



The Carbon Cycle in the Garden

Life as we know it depends upon carbon. Carbon cycles through our biosphere in many forms. It is released into the atmosphere through burning of fossil fuels, forest fires, oxidation of soil organic matter and through the respiration of animals and mammals. It is transformed into organic compounds as it is captured from the atmosphere into plant tissues through respiration and photosynthesis. We can then take these plant materials and transform them into soil organic matter through the microbial digestion of composting. These microbes break down organic matter further, releasing nutrients and exhaling carbon back into the atmosphere. Eventually, plants will bring the carbon back down to Earth and the cycle continues.

How do I build my compost pile?

1. Harvest materials, cutting plants at ground level, leaving roots in the ground to decompose. Gather mature (flowering or gone to seed) materials which are rigid and immature materials (young, before flowering) still in their vegetative phase.
2. Lay down a 4" later of rough materials, such as stalks, tree prunings or sticks.
3. Apply a 2-3" layer of mature materials- things that snap when you break them. These materials we call "structural" as they provide structure to the pile.
4. Apply a 2-3" layer of immature materials- juicy leaves, things that bend without snapping. These materials we call "metabolic" as they break down rapidly.
5. Apply a thin layer (1/4") of soil over the metabolic layer and water. Repeat steps 3-5 until you are finished.
6. When pile is finished, it will smell woodsy and look like soil. This may take from 3-8 months. Sift and store in a cool dry place until ready to use!

Principle 4: Composting

Goal: Maximize microbial diversity and the quantity and quality of cured compost

Jes adding the mature layer

Jes watering between layers

Adding the immature layer

Morgan adding the soil layer

Joey next to his finished pile

2 months later, halfway there!

Finished compost ready to sift

Sifter and sifted compost

Principle 4: Composting

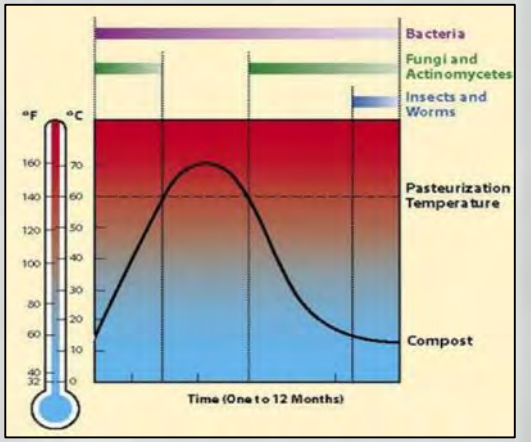
Special Notes: Cold Composting

There have been many strong advocates for the hot composting process. Especially when composting manures, hot composting is thought to kill more weeds, diseases and pests. A "hot pile" reaches 178˚F and is kept hot through frequent turning. Turning introduces oxygen and encourages *early succession microbial populations* which generate the high temperatures through their rapid metabolism. Although hot composting is a quick process, compared to cold composting it results in less compost of a lower quality.

Cold compost piles, in fact, go through a brief "hot phase" and are then allowed to mature over time gradually cooling and evolving through a *natural and uninterrupted succession of organisms*. Cooler piles invite a greater diversity of life in the composting process and result in a more complex profile of microbial byproducts which strengthen both plants and soil. If a cold pile is built correctly it will not require turning.

The more compost you create the more carbon you can sequester. Simply put, the longer the pile stays hot, the more carbon is lost back into the atmosphere through microbial respiration. Cold composting is important for addressing climate change. By growing our own food and cold composting our carbon we can significantly reduce our carbon and ecological footprints.

Compost Process, Temperature and Microbial Succession



Understanding C:N ratios and "green vs. brown" can be misleading. Upon analyzing materials you may find that green doesn't always correlate to more nitrogen and brown to more carbon. It helps to understand materials in terms of the complexity of their carbon structures and how nutrients (including nitrogen) are held within these structures. Mature plants on their way to flowering have more complex carbon structures which can hold on to nutrients more effectively than immature materials in their vegetative phase during the decomposition process. After decomposition these structures enter into a recombination phase know as humification. The incorporation of a greater percentage of mature materials into a cold composting process can result in the formation of more complex humic compounds during this humification stage. These complex humus structures may persist longer in the soil and provide a greater range of benefits and ecosystem services to the soil and plants. Remember, a diversity of materials is critically important.

Understanding C:N, Carbon Structure and Decomposition of Organic Materials					
Immature, Metabolic-Type Carbons			Mature Structural-Type Carbons		
Sugars, Starches	Crude Proteins	Hemicellulose	Cellulose	Fats, Waxes	Lignins
Breakdown					
Rapid					Slow
←					→
10:1					400-600:1

Building and maintaining a cold compost pile

1. Build your piles with more structural carbons (things that snap)
2. Add a little more soil and water to the pile when you build it
3. Don't turn unless absolutely necessary
4. Include more coarse rather than fine materials
5. Include less nitrogenous materials (legumes, manures, etc…)

Principle 4: Composting

Some Key Resources:

Cox, Carol. "GROW BIOINTENSIVE® Composting and Growing Compost Materials." Willits, CA: Ecology Action, 2008.

King, F.C. The Compost Gardener. Titus Wilson and Sons, 1943.

Howard, Albert. The Waste Products of Agriculture and Their Utilization as Humus. Oxford City Press, 2011.

Jenkins, Joseph. The Humanure Handbook: A Guide to Composting Human Manure. Jenkins Publishing, 1996.

Louie, Rebecca. Compost City: Practical Composting Know-How for Small-Space Living. Roost Books, 2015.

Rodale, J.R. and Staff. The Complete Book of Composting. Emmaus, PA: Rodale, 1971

University of California. "The Rapid Composting Method." Leaflet 21251, Division of Agriculture Sciences, September 1981.

Food for thought…

Flushing human waste demineralizes our soils. Composting human waste safely, legally and properly can help us sustainably manage our soils.

"There is one rule in the Garden above all others. You must give to Nature more than you take. Obey that one law and the Earth will provide for you in glorious abundance."

Alan Chadwick (1909-1980)

Principle 5: Carbon Farming

Goal: Sequester carbon, compost and grow soil

What is Carbon Farming?

Carbon farming refers to the growing of plants which fix carbon from the atmosphere into their bodies and into our compost piles and garden beds. In other words, we are utilizing photosynthesis to farm carbon from the air and then sequestering it into soil organic matter through cold composting. *Purchasing compost is mining someone elses soil to feed your own. Grow your own!*

Every year each of us contributes several tons of carbon to the atmosphere as a result of the way we grow our food. By growing more of our food with sustainable gardening we can begin to gracefully walk away from this agricultural system. Instead of putting carbon into the atmosphere, we can actually generate a surplus of carbon and create fertile soils in our own backyard for a healthier more abundant future for everyone.

A garden soil in a temperate climate should test somewhere in the range of 4-6% and in the tropics ~3% SOM. To maintain sufficient SOM levels one needs to produce 15-30 lbs of "air-dry biomass" (ADB) per 100 sqft bed each year. This is achievable by including any of the carbon crops from the table to the right into your yearly bed rotation. A good garden plan and crop rotation will help meet the goals for nutrition and soil sustainability. ADB is a critical measure because it gives us the true weight with the water removed. An easy way to accomplish this is to dry a representative 2 lb sample of the crop for 2 weeks in a warm, dry place and the applying the dry weight percentage to the total biomass harvest to give you a total ADB weight for the bed-crop.

Carbon Crops for Sequestering Carbon

Crop	ADB Yield/ 100 sqft* (lbs)	Planting Season
Amaranth	24	Spring
Barley	30	Spring/Fall
Cereal Rye	30	Spring/Fall
Flour Corn	48	Spring
Fava Beans	36	Spring/Fall
Millet	30	Spring
Oats	30	Spring/Fall
Quinoa	39	Spring
Rice	54	Spring
Sorghum	50	Spring
Sunflowers	40	Spring
Triticale	30	Spring/Fall
Wheat	30	Spring/Fall

* Intermediate yield with a little experience and good soil.
ADB refers to "Air-Dry Biomass"

To the right are listed some of the key crops that meet the 15-30 lbs ADB standard. Notice that these crops are staples for many people around the world. These crops are also very important to our diets. Carbon crops such as these feed not only our stomachs, but the soil. Note that certain crops will perform better in your climate and soil than others, and some can grow over winter when other crops cannot. There are also varieties which grow shorter and fix less carbon and others which are taller and usually take longer to mature. Experiment, ask local gardeners/farmers and see what is right for you.

Ecology Action's Booklet #31 *Designing a GROWBIOINTENSIVE Mini-Farm* is a key resource for helping gardeners design for complete human nutrition and soil sustainability. Below is an example of a simple crop rotation in a 100 sqft bed with ADB totals:

- Fava Beans overwintered, harvested May 15……10 lbs ADB, no food
- Flour Corn planted May 15, harvested October 30……..48 lbs ADB, plus food
- Garlic planted October 30, harvested following year……..Counted in next years totals

Total ADB = 58 lbs
(Goal = 30 lbs)

Principle 5: Carbon Farming

Carbon Farming Approaches Compared

There is a lot if information and opinions regarding agricultural approaches to sequestering carbon. Most of them will only take us so far. The biointensive technique approaches agriculture from a holistic standpoint. This means we are not just looking at saving water, building soil, conserving resources, feeding people or restoring ecosystems- *we are creating an approach that accomplishes all of these goals at once gracefully and efficiently.*

Simply put, growing your own food with the techniques outlined in this manual can leave the carbon and energy embodied in consumerism in the ground and transform your life and your community in many positive ways. Below are listed some of the common carbon farming approaches compared to the simple biointensive techniques you can do in your own home or community garden:

Method	Description	Pros	Cons	Compared to Biointensive Approach
No-till	No soil disturbance to allow the soil to create its own structure, leaving roots in the soil, sometimes crimping or mulching aboveground biomass and seeding directly into the mulch.	Increased infiltration and water holding capacity, reduced erosion, increase in SOM, increased nutrient cycling	Often require herbicides to control weeds since cultivation is prohibited. Studies demonstrate no major increase in yields. If mulch is brought in offsite it is unsustainable.	A peer-reviewed meta-analysis of over 670 studies on no-till showed an average reduction in yield of 5.1%[1]. With the whole systems approach outlined in this booklet on the average we produce 2-6x (200-600%) conventional yields[2]. The UN states we need to increase farm production by 70%.
Green Manuring	Establish a quick leguminous cover crop, let it achieve short height, uproot it and turn it into the soil to act as a mulch and rapid boost of available nutrient.	Turning in the crop increases microbial activity resulting in rapid nutrient release benefitting the next crop; the mulch conserves water	Rapid increase in microbial action requires 1-2 months of rest before planting. Rapid increase in microbial populations can consume long-term SOM.	In biointensive, carbon crops are grown to maximize carbon sequestration and diversity of longer term SOM. The biointensive approach results in 4-7x the cured carbon in a more stable form of compost than is created in green manure[3].
Rotational Grazing	As opposed to continuous grazing, this form of animal agriculture mimics the grazing patterns of nomadic herds by intensifying grazing in a small area for a brief time before moving the animals to let the land recover.	This biomimicry results in increased grass growth and higher production of animal feed stocks. In some cases it has been demonstrated to increase SOM	Although it increases the farmers SOM, the animals release Methane, Nitrous Oxide and other greenhouse gasses far more destructive than CO2 globally.	In the area it takes to raise a cow, 10-40 people may be fed biointensively. Studies have shown that if all land was rotationally grazed, 16.3 gigatons of CO2 could be sequestered by 2050. The same study states that 10 gigatons of methane would be produced, a greenhouse gas 30-80 times more destructive than CO2[4].

[1]When does no-till yield more? A global meta-analysis. Pittelkow C.M., Linquist B.A., Lundy M.E., van Groenigen K.J., Lee J., van Gestel N., van Kessel C. (2015) Field Crops Research, 183, pp. 156-168.
[2]Jeavons, J. Biointensive sustainable mini-farming. Journal of Sustainable Agriculture, Vol. 19(2) 2001.
[3]GROW BIOINTENSIVE® Composting and Growing Compost Materials, EA Staff. Booklet 32
[4]Hawken, Solimene. Carbon Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming. Old Saybrook, CT: Penguin, 2017.

Principle 5: Carbon Farming

Examples in the Garden

Flour Corn- food and carbon

Carbon crops in May

Matt in a jungle of carbon crops

Different Quinoa varieties

Susana next to Quinoa

Sunflower carbon crops

Kim happy with flowering leeks

Favas fix nitrogen and carbon

Principle 5: Carbon Farming

Some Key Resources:

Bailey, L.H. Cyclopedia of American Agriculture- Vol. II- Crops. NY: Macmillan and Company, 1907.

Cox, Carol. "GROW BIOINTENSIVE® Composting and Growing Compost Materials." Willits, CA: Ecology Action, 2008.

Francis, Charles A. Multiple Cropping Systems. NY: Macmillan, 1986.

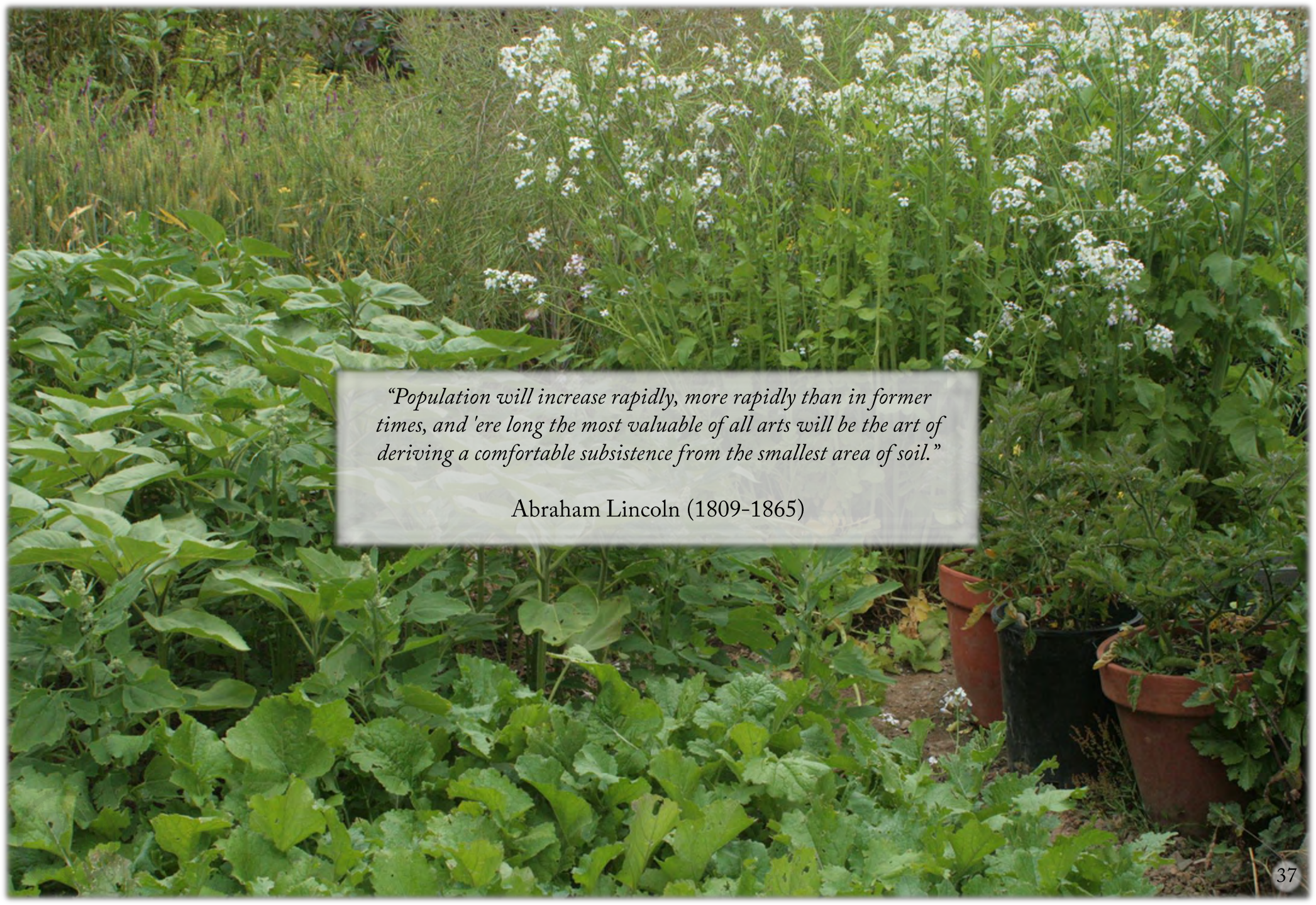
Lengnick, Laura. Resilient Agriculture- Cultivating Food Systems for a Changing Climate. Gabriola Island, BC: New Society Publishers, 2015

Morrison, Frank. Feeds and Feeding. 22nd Ed. Ithaca, NY: Morrison, 1957.

Sustainable Agriculture Research and Education (SARE). Managing Cover Crops Profitably. Washington, DC: USDA SARE, 2007.

Food for thought…

In the 1600s scientist Jean Baptiste Van Helmont took 200 lbs of soil and planted a 5 lb willow shoot, watering only when necessary. After 5 years a 164 lb willow had grown and the soil only weighed 2 oz less!


"Population will increase rapidly, more rapidly than in former times, and 'ere long the most valuable of all arts will be the art of deriving a comfortable subsistence from the smallest area of soil."

Abraham Lincoln (1809-1865)

Principle 6: Calorie Farming

Goal: Grow more food while microscaling your footprint

Why the focus on growing calories?

Every night 875 million people go to bed hungry due to a lack of calories. People around the world who rely on their gardens for their food dedicate a significant portion of the growing area to calorie production. If one grows enough calories and has a diverse diet they are on the path to a complete diet.

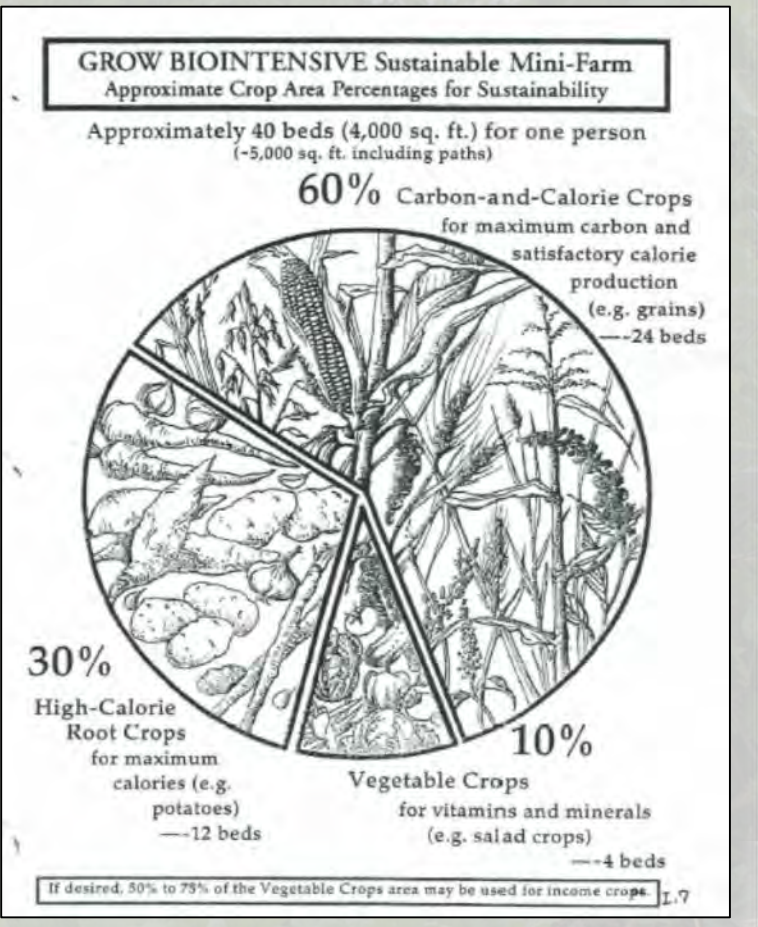
Growing *calorie crops* can take a significant amount of area, however, for thousands of years people have been breeding and selecting these amazing crops for their high production and storage potential. Calorie farming is a process of selecting and growing key crops based on their caloric production efficiencies. This equates to greater food security and more food production with less effort and resources. These are the essential crops to human nutrition.

Calorie crops can be categorized as being either *area efficient* or *weight efficient*. *Area efficient* crops like potatoes and garlic produce a significant amount of calories per unit of time and space in the growing bed. *Weight efficient* crops, such as wheat, oats or quinoa are calorically dense meaning one eats less food to acquire daily calories. Many of these weight efficient calorie crops also produce a significant amount of carbon, qualifying as true carbon crops. Both *area efficient* and *weight efficient* crops are very important to include in the garden.

The "60:30:10" Design Approach makes the process of incorporating *calorie and carbon crops* into a garden plan a simple one. This approach arrived after decades of studying complete and sustainable diet design and serves as a great starting point to growing your own food:

- 60% of the garden area is dedicated to *weight efficient calorie crops which also produce a significant amount of carbon*. These crops feed our stomachs and our soil.
- 30% of the garden area is dedicated to *area efficient crops* which produce a large amount of calories per unit of time and space effectively microscaling the agricultural footprint.
- 10% of our area is in diverse vegetable and herb production for nutrition and flavor.

60:30:10 Design Approach Over a Diet Design of 40 Beds



Principle 6: Calorie Farming

A Deeper Understanding of Calorie Crops

In most gardens the limiting nutritional factor is calories. It is important to understand the difference between *area efficient* and *weight efficient* calorie crops. Most people can only consume 4lbs of food yet require 2,400 calories daily. At your next meal, look at your plate and see where the various food crops fit into your diet and garden designs. How much area would they require and how much would you need to eat to get all of your calories in a day or a year? These types of questions help us understand the time and resources which go into producing our own food. The table below illustrates the importance of calorie crops:

Drawing the Relationship Between Calories, Carbon and Growing Our Food

Crop	Calories/ lb	Intermediate Yield/ 100 sqft	Calories/ 100 sqft	Total 100 sqft Beds Yearly Calories*	Total lbs of Food to Eat for Daily Calories*	Total ADB/ 100 sqft	60/ 30/ 10
Lettuce	59	150	8,850	99	41	0	10
Tomato	95	194	18,430	48	26	8	10
Potato	350	200	70,000	13	7	0	30
Leeks	277	480	132,960	7	9	0	30
Wheat	1,492	10	14,920	59	2	30	60
Quinoa	1,600	13	20,800	42	2	39	60

*Assuming 2,400 calories daily and 876,000 calories yearly. Data found in How to Grow More Vegetables (Jeavons)

60% Calorie-Carbon Crops		30% Calorie Crops	10% Crops
- Wheat - Rye - Triticale - Amaranth - Fava Beans - Flour Corn - Sunflowers	- Rice - Quinoa - Barley - Millet - Sorghum - Oats - Filberts	- Potatoes - Leeks - Parsnips - Salsify - Sunchokes - Garlic - Sweet Potatoes	- All other vegetable herb and flower crops

The above table shows the area and weight efficiencies of a sample of 60%, 30% and 10% crops. In most growing climates several crops can be grown per year, reducing total area required to achieve complete nutrition and sustainability. In 100 sqft, one might grow 60 sqft in quinoa, 30 sqft in potatoes and 10 sqft in tomatoes (or maybe 5 sqft in lettuce, 5 sqft in tomatoes). This is a start on growing a more balanced diet in the garden. Growing 60% of the garden in the *carbon-calorie crops* such as flour corn and quinoa provides light-weight, calorie-dense food as well as the compost materials to meet the goals of closed-loop soil sustainability. Growing 30% of the garden in *calorie crops* produces significant calories microscaling our dietary footprint. In doing so, these 30% crops result in a significant decrease in water consumption, fertilizers and time spent cultivating, transplanting and weeding. This means we can put more land into ecological restoration and habitat. Microscaling also means we have more time to relax. Only 10% of the garden needs to be in vegetable crops for flavor and nutrition when considering growing a balanced diet and compost materials. Today, most gardens are only growing these 10% crops. Without growing carbon crops, there will be a need to purchase compost. And don't forget to interplant flowers and herbs!

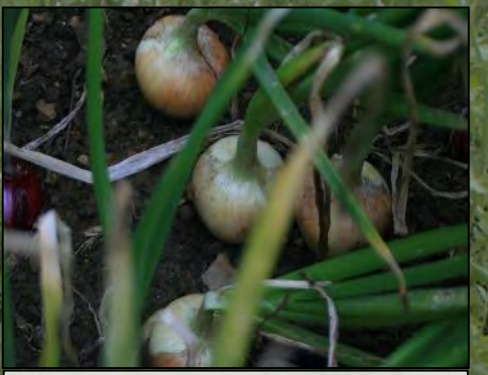
Principle 6: Calorie Farming

Examples in the Garden

Kale is a nutritious and productive *10% vegetable crop*

Garlic is an *area-efficient 30% calorie crop*

Quinoa is a *weight-efficient 60% carbon-calorie crop*



Onions are a highly productive *10% vegetable crop*

Ariel harvests oats, a *weight-efficient 60% carbon-calorie crop*

Camila among *weight-efficient 60% carbon-calorie crops*

Potatoes are an *area-efficient 30% calorie crop*

Barley, a quick *weight efficient 60% carbon-calorie crop*

Principle 6: Calorie Farming

Some Key Resources:

Agricultural Research Service, USDA. Composition of Foods. Agriculture Handbook No. 8 Washington D.C: US Government Printing Office, 1963.

Anderson, Lorraine. Cooking With Sunshine. Dacapo Press, 2006.

Brown, Edward. The Tassajara Bread Book. Boulder, CO: Shambhala Books, 1970

Greene, Bert. The Grains Cookbook. New York: Workman Publishing, 1988.

Heritage, Ford. Composition and Facts About Foods. Mokelumne Hill, CA: Health Research, 1971.

Katzen, Mollie. The Moosewood Cookbook. Berkeley, CA: Ten Speed Press.

Lappe, Francis Moore. Diet for a Small Planet. NY: Ballentine Books, 1991.

Logsdon, Gene. Small Scale Grain Raising. Emmaus, PA: Rodale Press, 1977.

Morash, Marian. The Victory Garden Cookbook. New York: Alfred A Knopf. 1982

Robertson, Laurel. Laurel's Kitchen. Berkeley, CA: Ten Speed Press, 1986.

Rubatzky, Vincent and Mas Yamaguchi. World Vegetables. New York: Chapman and Hall, 1997.

The Solar Box Cooker Manual: How to Make, Use, and Teach Others About Them. Sacramento, CA: Solar Cookers International, 1990.

Vilmorin-Andrieux, M.M. The Vegetable Garden. Ten Speed Press.

Food for thought…

Growing grains is a wonderful and fun project. They are beautiful and ancient. They are fun to thresh and winnow, and nothing like a fresh loaf of baked bread! The 60% and 30% crops can also be stored for a long time! Canning, drying and fermenting use a fraction of the energy that a refrigerator requires.


"Work is love made visible. And if you cannot work with love but only with distaste, it is better that you should leave your work and sit at the gate of the temple and take alms of those who work with joy."

Khalil Gibran (1883-1931)

Principle 7: Seed Saving

Goal: Growing and Adapting Your Own Seeds

Why save seed?

If we didn't have seed savers, we wouldn't have food. Nurturing our plants to seed and protecting that seed for future generations has enabled human beings to thrive and develop culture. The relationship between seed and seed saver have provided a rich and diverse genetic resource critically important in the challenging times ahead.

Seeds are alive- in fact, they are as old as the beginning of time. Every moment in a plants life is recorded in its genetics and within each seed lies the memory of each generation grown. Thousands of hands have touched and cared for the seed that you may hold in this moment. The process of cultivating soil, starting seeds, nurturing their growth, selecting them for unique characteristics and saving those which express that quality you love is a precious and sacred dance.

Since the early 1900s we have lost over 90% of our commercially available varieties. The corporate desire for profit and control of our food system has led to major erosion in the quality and diversity of one of humanities greatest accomplishments and most precious resources- seed. Thankfully, home and community gardeners are not driven by profit, but out of love for quality, flavor and the unique characteristics plants express. For new seed savers- once overcoming the internal hurdle of telling yourself you don't know how to save seed- you may find that this is one of the most important and fun aspects of sustainable food production. Try it, it's easier than you think.

Key Definitions

- **Hybrid seeds** are the result of two parent varieties which have crossed. For example: red tomato + yellow tomato = orange tomato. Subsequent generations will by genetically unstable and express a wide array of unreliable characteristics. The hybrid seed industry capitalizes on this, discouraging seed saving and creating dependence.
- **Open-pollinated seeds** (OP) are consistent and dependable. Open-pollinated seeds will maintain those genetics so long as they do not cross. OP seeds are the source of our heirloom genetic diversity.
- A **genetically-modified organism (GMO)** is the product of lab work. It is a process of manually injecting genetic material into crops for a specific trait, such as resistance to herbicides or pests. These seeds are intellectual property of corporations and are illegal to save.

Good Reasons to Save Seed

1. Adapt varieties to the local soil and climate
2. Create new varieties which are unique and thrive
3. Save money and increase food security/local resilience
4. Network and share with friends and other gardeners
5. Reduce your dependence on the seed industry
6. Seed savers are the caretakers of crop genetics and keep seed vital
7. Conserving rare varieties on the edge of extinction is important
8. Saving seed means more flowers, beauty, pollinators and beneficial insects
9. Plants going to seed fix more structural carbon as they grow

Remember, seed is alive! Care for it, store it properly and nurture its growth so future generations of plant and people experience its health and beauty.

Principle 7: Seed Saving

Key considerations when saving seeds

Planning for Seed Saving:

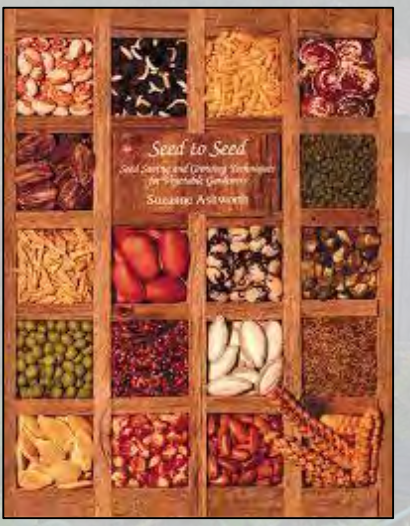
- Get to know your latin names. A *Plant Family* refers to plants of similar overall growth structure and habit. Plants of the same *Plant Genus* have similar flower and seed structures. Plants that share the same *Plant Species* can actually breed together and may cross pollinate creating a hybrid.
    - *e.g.* Rutabaga *(BRASSICACEAE Brassica napus)* will not cross with Scotch Kale (*BRASSICACEAE Brassica oleracea)* but it will cross with Siberian Kale (*BRASSICACEAE Brassica napus).*
- Are your plants annuals, biennials or perennials? Annuals flower in the same year they are planted. Biennials flower in the second year, after the winter solstice ascends towards summer.
- How do they pollinate? *Perfect flowers* have both male and female parts on the same flower such as tomatoes, beans and peas. These flowers often self-pollinate. Plants which have their male and female flower separate- either on the same plant or on two different plants- have *imperfect flowers.* Corn, squash and filberts have *imperfect flowers*. These flowers pollinate by wind or insect.

  In general, plants which self-pollinate require at least 5 plants to maintain genetic diversity and separate varieties can be saved within a few feet of one another without major risk of crossing. Insect pollinated plants should have at least 5-30 plants for diversity and should have at least 1,000' between varieties. Wind pollinated plants like corn should have at least 50 plants for diversity and at least 2,000-4,000' separation between varieties that may cross.
- Area Requirements: It only takes around 2-10% of your growing area to save all of your seeds for next year's garden. Give them a little extra spacing, around 25% more than usual for healthy seed.

Selection, Harvest and Storage:

- Save the best and eat the rest! Do not save seeds from damaged or weak plants. Encourage strong, resilient genetics and make sure not to harvest early! Immature seeds will not be viable.
- Dry seeds thoroughly, separate the chaff from the seed (rub) and winnow (blow) away the debris.
- Storage: Dry down to 5-10% moisture content and store in an air-tight container. Adding silica gel at a rate of 5-10% of seed-weight will prolong storage. Keep stored in a cool, dry and dark place.

Essential Seed Saving Resources



Suzanne Ashworth's Seed to Seed, Seed Savers Exchange

Peter Donelan's Growing to Seed, Ecology Action

Principle 7: Seed Saving

Examples in the Garden

Pollinators love seed savers

Elena checks celery seed maturity

Ariel excited for quinoa to finish

Kim using screens to clean seed

The grain-threshing dance

Seed cleaning parties get it done

Brooke winnows quinoa

Save your jars for seed storage

Principle 7: Seed Saving

Some Key Resources:

Ashworth, Suzanne. Seed to Seed. Decorah, IA: Seed Saver's publications, 1991

Conner, Cindy. Seed Libraries and Other Means of Keeping Seeds in the Hands of People. New Society Publishers, 2014.

Deppe, Carol. Breed Your Own Vegetable Varieties: The Gardener's and Farmer's Guide to Plant Breeding and Seed Saving. White River Junction, OR: Chelsea Green Publishing, 2000.

Donelan, Peter. Growing to Seed. Willits, CA: Ecology Action, July 1999.

From Seed to Seed Educational Films on Seed Production. Civique Forum, 2015

Nabhan, Gary Paul. Enduring Seeds: Native American Agriculture and Wild Plant Conservation. San Francisco, CA: North Point Press, 1989.

Rogers, Marc. Saving Seeds: The Gardener's Guide to Growing and Storing Vegetable and Flower Seeds. Pownal, VT: Storey, 1990.

Food for thought…

There are around 250,000 known plant species of which around 25,000 are edible. Of those, 250 are used for food. 60% of humanity's protein and calorie consumption comes from the grasses corn, wheat and rice. The UN FAO estimates that each year we lose 1-2% of our crop genetic diversity and since 1900 we have lost 75%.


"They tried to bury us, but they forgot we were seeds."
Dinos Christianopoulos (b. 1931)

Principle 8: Whole Systems Perspective

Goal: Understanding the garden as an organism and integrating the 8 Principles

What is a whole systems perspective and why is it important today?

There are two important components to a whole systems perspective in the garden. The first is an understanding that the garden is a part of a larger ecosystem and that gardeners are important in that relationship. Second, the principles shared with you in this growing guide are keys in maintaining the *stability and sustainability* of the garden as a whole system.

Nature pulses and thrives in an interweaving, interdependent web of relationships. The biosphere is comprised of biomes, biomes of ecosystems, ecosystems of organisms, organisms of organs, organs of organelles and so on. All of these living systems are interdependent upon and nested within one another. These systems and their relationships are the connective tissue which define the garden organism as a whole. Nature works in both directions- towards harmonic integration and also towards disturbance and disintegration. Relationships grow and evolve out of this disturbance. Disturbance is the chaos which precedes change and the manner by which systems evolve and maintain resilience in Nature. This is cultivation of the garden and oneself- *it is the garden that makes the gardener.*

As the old axiom states- as above, so below. The garden is an organism within itself and a part of a greater organism that is Nature. When the gardener is working in harmony with the living plants, insects and organisms there is a movement towards health. When the gardener is working in disharmony with the garden there is imbalance and disease. The lessons learned in the garden are lessons for life- they teach us patience, humility, reverence and obedience. Working through this process of endless discovery reveals nature's secrets. As Goethe once said:

"He to whom Nature begins to reveal her open secret, will feel an irresistible yearning for her most worthy interpreter, art."

It is time for a renaissance of the beautiful and practical art that is Gardening. Our gardens are expressions of our relationships to nature, our communities and ultimately to ourselves. In the garden we nurture that which nurtures us- we participate most directly in the give and take of nature and we experience the creative joy that brings the beauty of the world into existence. We realize our part in Nature and experience a different, more subtle yet fulfilling form of nourishment. In the garden we heal and reconcile our disconnect from Nature. *After all, this disconnect may actually be the root of our problems.* In the garden we discover that we are creative participants in a living universe. This can break the isolation, confusion and insecurity that ail so many of us. There is great joy in this reciprocity that we can experience in the garden. We can find peace and hope. We can celebrate our power to be the change we believe in. What more true, appropriate and fun task as we navigate this perfect storm of the future?

Principle 8: Whole Systems Perspective

The whole system of the biointensive garden

The whole systems perspective is the most important principle because it states that all previous principles play a critical role in maintaining the health of the garden and are essential to achieving sustainability. Sustainability has become a watered-down word but at its heart, it is about the *ability to sustain*- how long we are able to sustain is up to us. Most agricultural practices will only be able to carry us a few more decades before resources run out and worldwide famine begins. The principles shared with you in this whole systems approach to home and community gardening, when used together have the potential to microscale our impact, regenerate our soils, provide healthy and nutritious food and restore our ecosystems. Can you see how these principles can be applied in your own garden?

Principle 8: Whole Systems Perspective

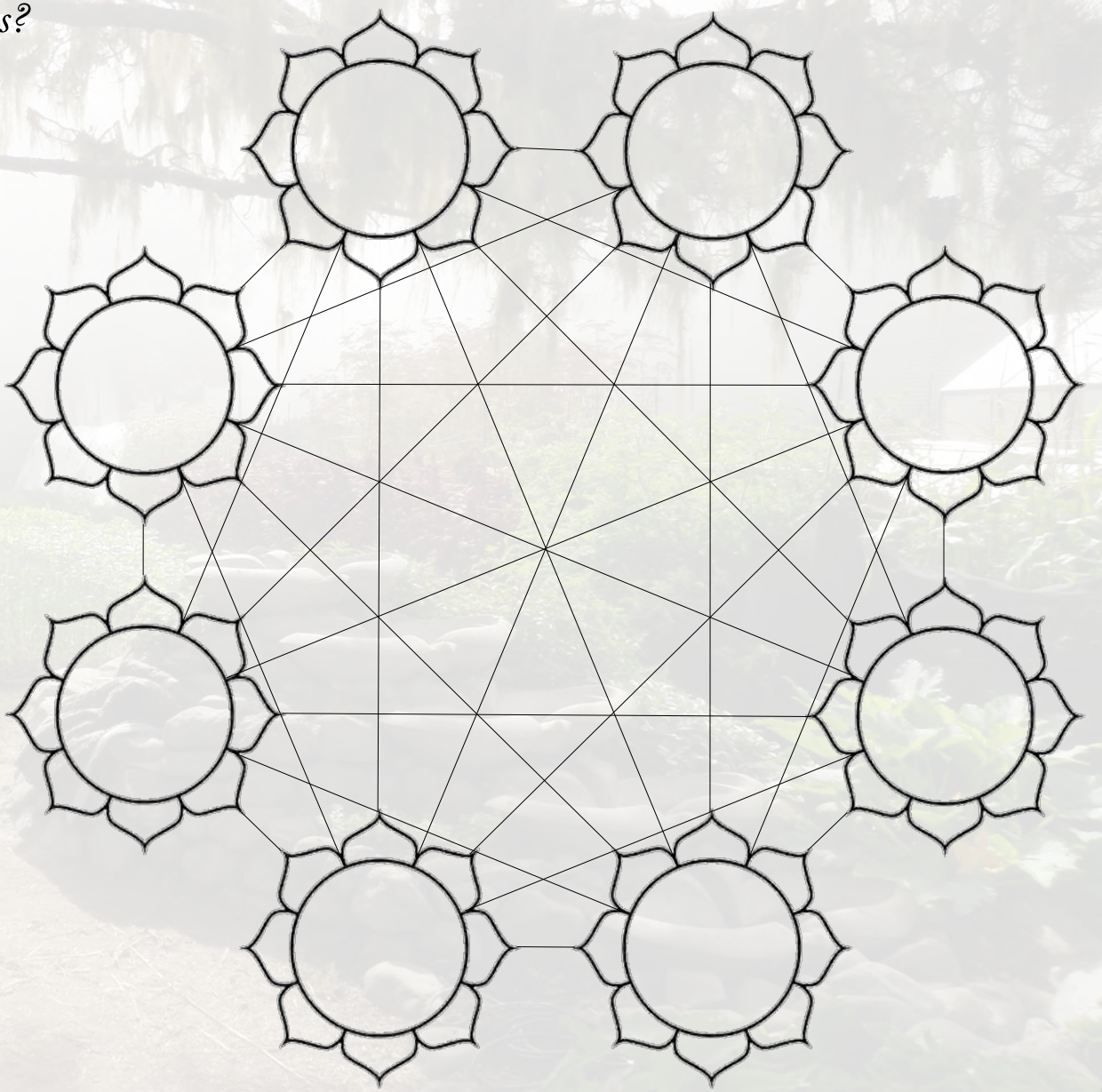
Exercise: Can you connect the principles?

To the right are 8 flowers, each one connected to all others. In each flower write in one of the 8 principles of whole systems sustainability and challenge yourself to develop the connections between each of the principles. This exercise will help you see the relationships and develop a matrix understanding of how each principle is interdependent on all others.

How can carbon farming relate to deep soil preparation or companion planting with calorie farming?

This exercise will also help you place your tasks in the garden as you understand these deeper relationships. For example, when you are harvesting seeds you see the relationship between seed saving, carbon farming and composting. This might lead you to harvest seed and build compost on the same day to maximize efficiency and efficacy in the garden. Leaving the roots in the ground after harvesting, you might then prepare the soil deeply which enables you to utilize closer plant spacing, increasing your edible and biomass harvest yields leading to more compost production. The more compost you produce creates higher yields and healthier seeds and so on.

Challenge yourself to discover these connections and accelerate your learning in the garden.



"The glory of gardening: hands in the dirt, head in the sun and heart with nature. To nurture a garden is to feed not just the body, but the soul."

Alfred Austin

Epilogue

The great task of the present is to organize and stabilize our communities in preparation for the approaching challenges ahead. In times of great change there is opportunity to reset the paradigm and recreate the world in a new light. The social and environmental stresses ahead will, bring us near the breaking point. We must work together or risk being torn apart by those who wish to exploit our differences. It is time to re-localize our economies, regenerate our ecologies, celebrate our diversity and create opportunities for all members of society to play a role in creating a peaceful and sustainable future. This shared investment must grow into a community-wide commitment to maintaining equality, security and resilience. We must protect our natural resources and hold true the vision of peace and sustainability. Healthy communities rely upon healthy ecologies, healthy food and healthy soil.

The approach shared with you in this booklet has been developed and proven over decades of committed and inspired work by people from around the world sharing the belief that the solution is within each of us and that we can create a better future together. The results have been documented- from AIDS communities in Kenya, refugee camps in Columbia, in war torn districts in Sierra Leon, impoverished communities in the Andean region of Ecuador and Peru and in communities like yours and mine. Where biointensive gardens are established, the situation is more likely to stabilize and hope takes root. As the basic needs of people are met through sustainable home and community gardening violence, disease and malnutrition decrease while peace, health and happiness increase.

We hope that you find inspiration to start your own Victory Garden for Peace and that you understand that in this simple act you are joining a global movement of people who are not waiting for an answer, or permission- but are working in their communities to celebrate the work of today and the creation of a better tomorrow. Your Victory Garden is more than just a garden- it is a powerful statement-in-action of your values and your dreams. Thank you for your garden and may your harvests be bountiful and delicious!

"You enter the garden because you love creation. You just want to grow fruits, vegetables and flowers as an expression of your soul. You love the smell of soil, the mystery of life, culture, and all the exquisite things that God gives us to live upon, look at, listen to, and enjoy. Great enchantment and productivity grow with each year of the garden. True vision, the necessary permit for this growth, expresses the enormous possibility of what can be achieved. Imagination is required right from the start. The era in which we live is a little frightening when you look at it very plainly and don't endeavor to escape the truth of what we are doing to the world. The vision of which I am talking is one of the greatest things we can possibly conceive of. It is a recovery from all the destruction going on. It is possible."

Alan Chadwick (1909-1980)

Additional Resources: Focused Biointensive Research and Publications

Below are a some of Ecology Action's helpful resources focused on sustainable small scale home and community garden food production.

Website:

- www.growbiointensive.org - online portal for information, publications and programs

Books:

- *How to Grow More Vegetables…*, John Jeavons, 2017. 10-Speed Press
- *The Sustainable Vegetable Garden*, Carol Cox, John Jeavons, 1999. 10-Speed Press
- *Test Your Soil With Plants,* John Beeby, 2013. Ecology Action

Booklets, downloadable at http://www.growbiointensive.org/ePubs/index.html :

- *Growing to Seed*, Peter Donelan. EA Booklet 13
- *The Complete 21-Bed Biointensive Mini-Farm,* John Jeavons. EA Booklet 14
- *One Basic Mexican Diet,* J Mogador Griffin. EA Booklet 15
- *Ecology Action's Comprehensive Definition of Sustainability*, John Jeavons and Steve Rioch. EA Booklet 24
- *One Basic Kenyan Diet: Diet, Income and Compost Crop Designs in Three Beds,* Patrick Wasike. EA Booklet 25
- *Grow All Your Own Food: One Bed Model for Compost, Diet and Income Crops,* Carol Cox and Staff. EA Booklet 26
- *Designing a GROW BIOINTENSIVE® Sustainable Mini-Farm,* EA Staff. EA Booklet 31
- *GROW BIOINTENSIVE® Composting and Growing Compost Materials,* EA Staff. Booklet 32
- *Grow Your Own Grains,* Carol Cox. EA Booklet 33
- *Food for the Future, Now! A Survival Garden Plan,* Miller, Cox and Mankey. EA Booklet 34
- *Growing More Food With Less Water*, EA Staff. EA Booklet 35
- *An Experimental 33-Bed GROW BIOINTENSIVE® Mini-Farm Growing Complete Fertility, Nutrition and Income,* John Jeavons. EA Booklet 36
- *Energy Use in Biointensive Food Production,* Steve Moore. EA Booklet 37

Peer Reviewed Work:

- John C. Jeavons BA (2001) Biointensive Sustainable Mini-Farming: I. The Challenge, Journal of Sustainable Agriculture, 19:2, 49-63
- M. K. Bomford (2009) Do Tomatoes Love Basil but Hate Brussels Sprouts? Competition and Land-Use Efficiency of Popularly Recommended and Discouraged Crop Mixtures in Biointensive Agriculture Systems, Journal of Sustainable Agriculture, 33:4, 396-417
- Moore, Stephen R. "Energy Efficiency in Small-Scale Biointensive Organic Onion Production in Pennsylvania, USA." *Renewable Agriculture and Food Systems*, vol. 25, no. 3, 2010, pp. 181–188
- Simon, X.; Montero, M.; Bermudez, Ó. Advancing Food Security through Agroecological Technologies: The Implementation of the Biointensive Method in the Dry Corridor of Nicaragua. *Sustainability* 2020, *12*, 844.
- Omondi, Emmanuel & Norton, Jay & Ashilenje, Dennis. (2014). Performance of a local open pollinated maize variety and a common hybrid variety under intensive small-scale farming practices. African Journal of Agricultural Research. 9. 950-955. 10.5897/AJAR2013.7359.

Learn With Us!

Ecology Action hosts several programs to train individuals in the biointensive technique of sustainable food production!

We host:

- 2, 4, 6 and 8-Month Internships
- Teacher Training Workshops and Certification Programs
- 1 and 3-Year Apprenticeships
- Online webinars and programs

In addition, our free self-teaching manuals and videos are found at:

http://www.growbiointensive.org/Self_Teaching.html

Appendix A : Design Examples for a Maritime Climate

Ecology Action's mission has been in training people in simple and effective methodologies for designing complete and sustainable diets using less resources than conventional forms of organic agriculture. The following designs combined with the 8 principles can serve as a starting point for you to evolve your own sustainable garden plans. Note that these designs are specific to our maritime climate in Mendocino, California. Try substituting warmer weather crops for more arid climate types:

- **100 sqft Basic 60:30:10 Garden Plan.** This plan is a great starting point for applying 60:30:10 and the whole system of the biointensive approach. It is best to start small and refine your technique before expanding your home or community garden plot.
- **200 sqft Garden Plan for Calories, Biomass and Nitrogen Fixation.** This design is can help you determine which crops and crop rotations are the most efficient for your soil and climate and includes the interplanting of Woolly Pod Vetch for nitrogen fixation.
- **500 sqft Garden Plan for Maximum Calories and Compost.** If immediate food is needed, this fast maturing, high calorie plan will help secure food within a few months of planting. Following the 60:30:10 design rule, sufficient compost is also produced for sustainable soil fertility.
- **1,000 sqft Complete Diet, Compost and Seed Saving Garden Plan.** With a beginners skill, this plan would use 4% of the land area of a conventional diet- an advanced level of skill will only require 1% of the land area. Based on our time trials, it requires an average of only 35 minutes per day to grow. This reduction in land area results in a reduction in water use from 22% at beginner skill level and 2% at an advanced skill level.

For more information on complete diet gardening and sustainable garden design, contact us at Ecology Action at www.growbiointensive.org

100 sqft Basic 60:30:10 Garden Plan for a Maritime Climate

Year 1

Bed Number	Sqft	Month												Sqft	Bed Number
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1	25	100 sqft Fava Beans			30 sqft Quinoa							100 sqft Barley		25	1
	50				30 sqft Sunflowers									50	
	75				15 sqft Potatoes/ 15 sqft Leeks									75	
	100				10 sqft Mixed Vegetables (Kale, Lettuce, Beets, Carrots and Tomatoes)									100	
Bed Number	Sqft	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sqft	Bed Number
		Month													

Year 2

Bed Number	Sqft	Month												Sqft	Bed Number
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1	25	100 sqft Barley					10 sqft Mixed Veggies (Broccoli, Peas, Lettuce, Spinach, Tomatoes)						100 sqft Fava Beans	25	1
	50						15 sqft Potatoes/ 15 sqft Leeks							50	
	75						30 sqft Oats							75	
	100						30 sqft Flour Corn							100	
Bed Number	Sqft	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sqft	Bed Number
		Month													

The above plan shows a 100 sqft bed over 2 years. Note in year 1, barley is transplanted on or around November 1st and carries over into the following year, harvested on or around May 21st. On the following page you will see a schedule for flatting, transplanting and harvesting to help organize seeds and garden resources. This same format will be followed for the garden designs presented in this appendix.

100 sqft Basic 60:30:10 Garden Plan for a Maritime Climate

FLATTING AND TRANSPLANTING SCHEDULE

Abbreviations: BC= Broadcasting; OW= Overwintering; TP= Transplant; IP= Interplant; IPV= Interplant Vetch rate of 5"-6" centers; DS= Direct Sow
FOPV= Direct sow the following: 10 oz Fava, Banner 10" centers; 1 oz Oats, Rhiannon 5" centers; 0.5 lb Peas, Magnus 5" centers; 2.5 oz Vetch, Woolly Pod 5" centers

Bed #	Crop, Variety	Area sq ft	Seed Needed	1st Flat[1]					2nd Flat[1]						Growing Bed			
				Date In	TP Center	# of Flats	Weeks in Flat	Date Out	Date In	TP Center	# of Flats	Flat Size	Weeks in Flat	Date Out	TP Date	TP Center	First Harvest	Last Harvest
1	Favas, Banner	100	17.00 oz	(overwintered, planted the previous fall)												8"	-	4/15
	Quinoa, Redhead	30	0.01 oz	3/18	BC	0.5	1	3/25	3/25	1.5"	1	3"	3	4/15	4/15	12"	-	11/1
	Sunflowers, Mammoth	30	0.25 oz	4/1	1"	1	2	4/15	-	-	-	-	-	-	4/15	12"	-	11/1
	Potatoes, Yukon Gold	15	3.75 lbs	-	-	-	-	-	-	-	-	-	-	-	4/15	DS 9"	-	11/1
	Leeks, Giant Musselburgh	15	0.02 oz	1/15	BC	0.5	6	3/1	3/1	1.5"	1	6"	6	4/15	4/15	6"	9/15	11/1
	Kale, Dino	5	0.01 oz	2/25	BC	0.5	3	3/15	3/15	2"	1	6"	4	4/15	4/15	12"	7/1	11/1
	Lettuce, Merlot	5	0.01 oz	3/11	BC	0.5	2	3/25	3/25	1.5"	0.5	3"	3	4/15	4/15	10"	7/15	11/1
	Beets, Cylindra	5	0.07 oz	3/15	1"	0.5	4	4/15	-	-	-	-	-	-	4/15	4"	7/15	11/1
	Carrots, Oxheart	5	0.01 oz	3/15	BC	0.5	4	4/15	-	-	-	-	-	-	4/15	3"	8/1	11/1
	Tomatoes, Black Krim	5	0.01 oz	2/7	1"	0.5	5	3/15	3/15	2"	0.5	6"	4	4/15	4/15	21"	9/1	11/1
	Barley, Purple Prairie	100	2.40 oz	10/15	BC	2	2	11/1	-	-	-	-	-	-	11/1	5"	-	OW 5/25

[1]A 3" deep flat is 14" wide x 23" long x 3" deep; a 6" deep flat is 11.5" wide x 14" long x 6" deep.

200 sqft Garden Plan for Calories, Biomass and Nitrogen Fixation

Bed Number	Sqft	Month												Sqft	Continue to
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1	25 50 75 100	100 sqft Barley, Schrene IPV					100 sqft Quinoa, Quechua IPV						100 sqft Fava Beans IPV	25 50 75 100	2
2	25 50 75 100	100 sqft Fava Beans IPV					100 sqft Potatoes, Yukon Gold					100 sqft Barley, Schrene IPV		25 50 75 100	1
Bed Number	Sqft	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sqft	Continue to
		Month													

IPV= Interplanting Vetch. Experiment interplanting Woolly Pod Vetch at a rate of 1.0-2.4 oz per 100 sqft prior to transplanting. Woolly Pod Vetch fixes more nitrogen than any other known legume interplant crop in a temperate climate. It is key to pull the vetch when it is flowering and before it overtakes the bed. Pull the plants straight up and out of the bed and the vetch will automatically break at the soil level, leaving the roots in the ground.

The above garden plan diagram is useful in 2 ways:

- *First, it shows 2 beds over the course of 1 year.* The far left column shows bed numbers 1 and 2 from January through December.
- *Second, it shows 1 bed over 2 years.* Following bed 1 through the first year, the far right column titled "Continue to" takes you to bed 2 which in this case, is year 2. The overwintering fava beans of bed 1 go into Potatoes on May 15th in the second year . Then, the barley transplanted on October 15th continues up to Bed 1 and becomes Quinoa on June 1st in the 3rd year. This diagram also shows a 2 bed crop rotation that can go on perpetually.

200 sqft Garden Plan for Calories, Biomass and Nitrogen Fixation

FLATTING AND TRANSPLANTING SCHEDULE

Abbreviations: BC= Broadcasting; OW= Overwintering; TP= Transplant; IP= Interplant; IPV= Interplant Vetch rate of 5"-6" centers; DS= Direct Sow

FOPV= Direct sow the following: 10 oz Fava, Banner 10" centers; 1 oz Oats, Rhiannon 5" centers; 0.5 lb Peas, Magnus 5" centers; 2.5 oz Vetch, Woolly Pod 5" centers

Bed #	Crop, Variety	Area sq ft	Seed Needed	1st Flat[1]					2nd Flat[1]						Growing Bed			
				Date In	TP Center	# of Flats	Weeks in Flat	Date Out	Date In	TP Center	# of Flats	Flat Size	Weeks in Flat	Date Out	TP Date	TP Center	First Harvest	Last Harvest
1	Barley, Schrene IPV	100	2.40 oz	(Overwintered from previous year)											10/15	5"	-	OW 6/1
	Quinoa, Quechua IPV	100	0.02 oz	5/3	BC	0.5	1	5/10	5/10	1.5"	1	3"	3	6/1	6/1	12"	-	11/1
	Favas, Banner IPV	100	17.00 oz	11/1	1"	4[2]	2	12/1	-	-	-	-	-	-	12/1	8"	-	OW 6/1
2	Fava, Banner IPV	100	17.00 oz	(Overwintered from previous year)											12/1	8"	-	OW 6/1
	Potatoes, Yukon Gold	100	25.00 lbs	-	-	-	-	-	-	-	-	-	-	-	6/1	DS 9"	-	10/15
	Barley, Schrene IPV	100	2.40 oz	10/1	BC	2	2	10/15	-	-	-	-	-	-	10/15	5"	-	OW 6/1

[1]A 3" deep flat is 14" wide x 23" long x 3" deep; a 6" deep flat is 11.5" wide x 14" long x 6" deep.

[2]Seeds started after November 15th will take one and a half to twice as long to germinate.

A 500 sqft Garden Plan For Rapid Calories and Compost Materials

Bed Number	Sqft	Month												Sqft	Continue To
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1	25	100 sqft Fava Beans							100 sqft Potatoes			100 sqft Barley		25	2
	50													50	
	75													75	
	100													100	
2	25	100 sqft Barley						100 sqft Quinoa				100 sqft Fava Beans		25	3
	50													50	
	75													75	
	100													100	
3	25	100 sqft Fava Beans				100 sqft Potatoes			25 sqft Kale					25	4
	50								25 sqft Chard					50	
	75								50 sqft Barley				50 sqft Fava Beans	75	
	100													100	
4	25	25 sqft Kale				50 sqft Fava Beans						100 sqft Wheat		25	5
	50	25 sqft Chard												50	
	75	50 sqft Fava Beans				25 sqft Beets								75	
	100					25 sqft Carrots								100	
5	25	100 sqft Wheat							100 sqft Quinoa				100 sqft Fava Beans	25	1
	50													50	
	75													75	
	100													100	
Ref. Key	Sqft	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sqft	Continue To
		Month													

This planting diagram for 5 growing beds works in 2 ways:

First, it shows all 5 beds throughout the year. The left column shows the bed number. In bed 3, for example, 100 sqft of Fava Beans are followed by 100 sqft of potatoes which is then followed by 25 sqft of Kale, 25 sqft of Chard and 50 sqft of Barley. The barley comes out in mid-November and goes into Fava Beans. The Kale, Chard and Fava Beans overwinter.

This diagram also shows 1 bed over a 5 year rotation. For example bed 1 is in favas, potatoes and overwintering barley in the 1st year. Note the column on the far right titled "continue to"- continue to Bed 2. In year 2 the overwintering Barley goes into Quinoa and overwintering Fava Beans. Then continue to Bed 3 where the overwintering favas become Potatoes and so on. In this way, we can use this chart to show a 5 year rotation for 1 bed.

A 500 sqft Garden Plan For Rapid Calories and Compost Materials

FLATTING AND TRANSPLANTING SCHEDULE

Abbreviations: BC= Broadcasting; OW= Overwintering; TP= Transplant; IP= Interplant; IPV= Interplant Vetch rate of 5"-6" centers; DS= Direct Sow
FOPV= Direct sow the following: 10 oz Fava, Banner 10" centers; 1 oz Oats, Rhiannon 5" centers; 0.5 lb Peas, Magnus 5" centers; 2.5 oz Vetch, Woolly Pod 5" centers

Bed #	Crop, Variety	Area sq ft	Seed Needed	1st Flat[1]					2nd Flat[1]						Growing Bed			
				Date In	TP Center	# of Flats	Weeks in Flat	Date Out	Date In	TP Center	# of Flats	Flat Size	Weeks in Flat	Date Out	TP Date	TP Center	First Harvest	Last Harvest
1	Potatoes, All-Blue	100	25.00 lb	-	-	-	-	-	-	-	-	-	-	-	7/15	DS 9"	-	11/1
	Barley, Schrene	100	2.40 oz	10/15	BC	2.5	2	11/1	-	-	-	-	-	-	11/1	5"	-	OW 6/1
2	Quinoa, Bio Bio	100	0.03 oz	5/3	BC	1	1	5/10	5/10	1.5"	2	3"	3	6/1	6/1	12"	-	11/1
	Favas, Banner	100	17.00 oz	10/10	1"	2	3	11/1	-	-	-	-	-	-	11/1	8"	-	OW 4/15
3	Potatoes, All-Blue	100	25.00 lb	-	-	-	-	-	-	-	-	-	-	-	7/15	DS 9"	-	11/1
	Kale, Red Russian	25	0.01 oz	6/1	1"	0.5	2	6/15	6/15	2"	1	6"	4	7/15	7/15	15"	11/15	OW 5/1
	Chard, Rainbow	25	0.1 oz	6/15	1"	0.5	4	7/15	-	-	-	-	-	-	7/15	8"	11/15	OW 5/1
	Barley, Schrene	50	1.20 oz	7/1	BC	1.25	2	7/15	-	-	-	-	-	-	7/15	5"	-	11/15
	Fava, Banner	50	8.50 oz	10/25	1"	1	3	11/15	-	-	-	-	-	-	11/15	8"	-	OW 5/1
4	Favas, Cascine	50	8.50 oz	4/7	1"	1	3	5/1	-	-	-	-	-	-	5/1	8"	-	10/15
	Beets, Cylindra	25	0.35 oz	4/1	1"	2	4	5/1	-	-	-	-	-	-	5/1	4"	9/1	10/15
	Carrots, Juwarot	25	0.01 oz	4/1	BC	2	4	5/1	-	-	-	-	-	-	5/1	3"	9/1	10/15
	Wheat, Hard Red Winter IPV	100	2.40 oz	10/1	BC	2	2	10/15	-	-	-	-	-	-	10/15	5"	-	OW 8/1
5	Quinoa, Appellewa IPV	100	0.03 oz	7/3	BC	1	1	7/10	7/10	1.5"	2	3"	3	8/1	8/1	12"	-	11/15
	Favas, Banner	100	17.00 oz	11/1	1"	2	3	11/15	-	-	-	-	-	-	11/15	8"	-	OW 7/15

[1]A 3" deep flat is 14" wide x 23" long x 3" deep; a 6" deep flat is 11.5" wide x 14" long x 6" deep.

1,000 sqft Complete Diet, Compost and Seed Saving Garden Plan

The diet design process developed at Ecology Action has been published in an easy-to-use manual titled **Booklet 31: Designing a GROW BIOINTENSIVE® Sustainable Mini-Farm** which is available in print or download from www.growbiointensive.org. This design process incorporates all aspects of sustainable diet design and planning.

The research conducted at Ecology Action has led us to develop yield potentials for gardeners and farmers around the world based on two considerations. First, the skill and familiarity of the grower with their seed, soil and climate type. Second, the fertility level of the soil. Based on these two factors we provide *basic, intermediate and advanced yield values* to help growers plan. We encourage people to design for *intermediate level Yields* (the middle number provided in the yield column in the master charts of How to Grow More Vegetables by John Jeavons). Using *intermediate level yields* is a conservative bet if you believe you will get high yields and it's a good goal for those of us who are just beginning.

Based on my own experience, it took 2 years to get my first *intermediate level yields*. After 5 years about 30% of my yields were at or near *Intermediate* and after 10 years, 50% of my yields are at or near intermediate. Reflecting on this, I believe the greatest increase in my yields was owed to my experience level increasing and familiarity with my climate and soil.

The yield values in the master charts in How to Grow More Vegetables are based on several factors:

1. Based on Ecology Action's experience at test sites in Palo Alto and Willits, California
2. The results of others using the GROW BIOINTENSIVE® Method or similar approaches
3. A sample testing of more successful sections of beds growing certain crops which appear to be replicable and reasonable
4. A 2-year study at Ecology Action of global yields using data from Departments of Agriculture in several key countries and the United Nations Food and Agriculture Organization.

Note that the following design is for a maritime climate- crop types and planting times will differ in an arid climate.

1,000 sqft Complete Diet, Compost and Seed Saving Garden Plan

GARDEN ROTATIONS AND PLAN

Bed Number	Sqft	Month: Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sqft	Continue To
1	25	100 sqft Favas IP Vetch							100 sqft Potatoes			100 sqft Barley IP Vetch		25	2
	50													50	
	75													75	
	100													100	
2	25	100 sqft Barley IP Vetch					50 sqft Beets					75 sqft Garlic		25	3
	50													50	
	75						50 sqft Kale							75	
	100											50 sqft Wheat IP Vetch		100	
3	25	75 sqft Garlic							100 sqft Potatoes			75 sqft Barley IP Vetch		25	4
	50													50	
	75													75	
	100	50 sqft Wheat IP Vetch												100	
4	25								25 sqft Carrots				100 sqft Favas, Oats, Peas, Vetch	25	5
	50	75 sqft Barley IP Vetch					25 sqft Carrots							50	
	75						50 sqft Onions							75	
	100													100	
5	25	100 sqft Favas, Oats, Peas, Vetch				100 sqft Potatoes				50 sqft Beets				25	6
	50													50	
	75									75 sqft Leeks				75	
	100													100	
6	25	50 sqft Beets				25 sqft Quinoa IP Vetch								25	7
	50					50 sqft Quinoa IP Vetch						50 sqft Favas (Seed) IP Vetch (Seed)		50	
	75	75 sqft Leeks												75	
	100					25 sqft Compost						25 sqft Wheat (Seed)		100	
7	25					25 sqft Potatoes						100 sqft Oats IP Vetch		25	8
	50	50 sqft Favas (Seed) IP Vetch (Seed)							75 sqft Potatoes					50	
	75													75	
	100	25 sqft Wheat (Seed) IP Vetch												100	
8	25	100 sqft Oats IP Vetch							100 sqft Quinoa IP Vetch			60 sqft Favas, Oats, Peas, Vetch		25	9
	50													50	
	75											20 sqft Kale (Seed)		75	
	100											20 sqft Garlic (Seed)		100	
9	25	60 sqft Favas, Oats, Peas, Vetch					60 sqft Potatoes (Seed)				25 sqft Compost Pile			25	10
	50										12 sqft Onions/12 sqft Leeks (Seed)			50	
	75	20 sqft Kale (Seed) IP Vetch									15 sqft Vetch/15 sqft Peas (Seed)			75	
	100	20 sqft Garlic (Seed)							7 sqft Carrots (Seed)/7 sqft Beets (Seed)/7 sqft Vetch					100	
10	25	25 sqft Compost Pile					25 sqft Quinoa IP Vetch					100 sqft Favas IP Vetch		25	1
	50	12 sqft Onions (Seed)/12 sqft Leeks (Seed)												50	
	75	15 sqft Vetch (Seed)/15sqft Peas (Seed)					15 sqft Barley/15 sqft Oats (Seed)							75	
	100	7 sqft Carrots (Seed)/7 sqft Beets (Seed)/7 sqft Vetch (7 sqft Quinoa (Seed) IP Vetch June 1 after Vetch												100	
Ref. Key	Sqft	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sqft	Continue To
		Month													

1,000 sqft Complete Diet, Compost and Seed Saving Garden Plan

FLATTING AND TRANSPLANTING SCHEDULE

Abbreviations: BC= Broadcasting; OW= Overwintering; TP= Transplant; IP= Interplant; IPV= Interplant Vetch rate of 5"-6" centers; DS= Direct Sow
FOPV= Direct sow the following: 10 oz Fava, Banner 10" centers; 1 oz Oats, Rhiannon 5" centers; 0.5 lb Peas, Magnus 5" centers; 2.5 oz Vetch, Woolly Pod 5" centers

Bed #	Crop, Variety	Area sq ft	Seed Needed	1st Flat[1]					2nd Flat[1]						Growing Bed			
				Date In	TP Center	# of Flats	Weeks in Flat	Date Out	Date In	TP Center	# of Flats	Flat Size	Weeks in Flat	Date Out	TP Date	TP Center	First Harvest	Last Harvest
1	Potatoes, All-Blue	100	25.00 lb	-	-	-	-	-	-	-	-	-	-	-	7/15	DS 9"	-	11/1
	Barley, Burbank IPV	100	2.40 oz	10/15	BC	2.5	2	11/1	-	-	-	-	-	-	11/1	5"	-	OW 6/1
2	Beets, Cylindra	50	0.70 oz	5/1	1"	4	4	6/1	-	-	-	-	-	-	6/1	4"	10/1	11/1
	Kale, Red Russian	50	0.01 oz	4/1	1"	0.5	4	5/1	5/1	2"	1	6"	4	6/1	6/1	15"	8/15	11/1
	Garlic, Music	75	15.00 lb	-	-	-	-	-	-	-	-	-	-	-	11/1	DS 4"	-	OW 7/15
	Wheat, Hard Red Winter IPV	25	0.60 oz	10/10	BC	1	3	11/1	-	-	-	-	-	-	11/1	5"	-	OW 7/15
3	Potatoes, All-Blue	100	25.00 lb	-	-	-	-	-	-	-	-	-	-	-	7/15	DS 9"	-	11/1
	Wheat, Hard Red Winter IPV	25	0.60 oz	10/10	BC	1	3	11/1	-	-	-	-	-	-	11/1	5"	-	OW 7/15
	Barley, Faust IPV	75	1.80 oz	10/10	BC	2	3	11/1	-	-	-	-	-	-	11/1	5"	-	OW 6/1
4	Carrots, Juwarot	25	0.01 oz	5/1	BC	2	4	6/1	-	-	-	-	-	-	6/1	3"	9/1	11/15
	Onions, New York Early	50	0.10 oz	3/15	BC	3	10	6/1	-	-	-	-	-	-	6/1	4"	-	11/15
	Carrots, Juwarot	25	0.01 oz	6/15	BC	2	4	7/15	-	-	-	-	-	-	7/15	3"	10/1	11/15
	Fava, Oat, Pea, Vetch IP	100	FOPV	-	-	-	-	-	-	-	-	-	-	-	11/15	FOPV	-	OW 5/1
5	Potatoes, Yukon Gold	100	25.00 lb	-	-	-	-	-	-	-	-	-	-	-	5/1	DS 9"	-	9/1
	Beets, Cylindra	50	0.70 oz	8/10	1"	4	3	9/1	-	-	-	-	-	-	9/1	4"	12/1	OW 5/1
	Leeks, Blue Solaise	50	0.05 oz	6/1	BC	1	6	7/15	7/15	1.5"	3	6"	6	9/1	9/1	6"	12/15	OW 5/1
6	Quinoa, Appellewa IPV	25	0.01 oz	4/1	BC	0.5	1	4/10	4/10	1.5"	1	3"	3	5/1	5/1	12"	-	9/1
	Quinoa, Kaslala IPV	50	0.02 oz	4/1	BC	0.5	1	4/10	4/10	1.5"	2	3"	3	5/1	5/1	12"	-	11/1
	Compost Pile	25	-	-	-	-	-	-	-	-	-	-	-	-	5/1	-	-	11/1
	Leeks, Blue Solaise	25	0.03 oz	6/1	BC	0.5	6	7/15	7/15	1.5"	3	6"	6	9/1	9/1	6"	12/15	OW 5/1
	Favas, Banner	50	8.50 oz	10/10	1"	1	5	11/1	-	-	-	-	-	-	11/1	8"	-	OW 7/15
	Wheat, Hard Red Winter IPV	25	0.60 oz	10/10	BC	1	5	11/1	-	-	-	-	-	-	11/1	5"	-	OW 7/15
7	Potatoes, Yukon Gold	25	6.25 lb	-	-	-	-	-	-	-	-	-	-	-	5/1	DS 9"	-	11/1
	Potatoes, All-Blue	75	18.75 lb	-	-	-	-	-	-	-	-	-	-	-	7/15	DS 9"	-	11/1
	Oats, Rhiannon IPV	100	1.25 oz	10/10	BC	2.5	3	11/1	-	-	-	-	-	-	11/1	5"	-	OW 7/15
8	Quinoa, Kaslala IPV	100	0.03 oz	6/15	BC	1	1	6/23	6/23	1.5"	2	3"	3	7/15	7/15	12"	-	11/1
	Fava, Oat, Pea, Vetch IP	60	FOPV	-	-	-	-	-	-	-	-	-	-	-	11/1	FOPV	-	OW 6/1
	Kale, Red Russian IPV	20	0.01 oz	9/1	1"	0.5	4	10/1	10/1	2"	1	6"	4	11/1	11/1	15"	-	OW 9/15
	Garlic, Music	20	4.00 lb	-	-	-	-	-	-	-	-	-	-	-	11/1	DS 4"	-	OW 8/1
9	Potatoes, All-Blue/Yukon Gold	40/20	10.00 lb	-	-	-	-	-	-	-	-	-	-	-	6/1	DS 9"	-	9/15
	Carrots, Juwarot	7	0.01 oz	7/1	BC	1	4	8/1	-	-	-	-	-	-	8/1	6"	-	OW 10/15
	Beets, Cylindra	7	0.10 oz	7/1	1"	1	4	8/1	-	-	-	-	-	-	8/1	12"	-	OW 10/15
	Compost Pile	25	-	-	-	-	-	-	-	-	-	-	-	-	9/15	-	-	OW 6/1
	Onions, New York Early	12	0.02 oz	7/1	BC	0.5	10	9/15	-	-	-	-	-	-	9/15	6"	-	OW 10/15
	Leeks, Blue Solaise	12	0.02 oz	6/15	BC	0.5	6	8/1	8/1	1.5"	1	6"	6	9/15	9/15	6"	-	OW 10/15
	Vetch, Woolly Pod	15	0.75 oz	-	-	-	-	-	-	-	-	-	-	-	9/15	BC 5"	-	OW 6/1
	Peas, Magnus	15	2.4 oz	-	-	-	-	-	-	-	-	-	-	-	9/15	BC 5"	-	OW 6/1
10	Quinoa, Kaslala IPV	25	0.01 oz	5/1	BC	0.5	1	5/10	5/10	1.5"	1	3"	3	6/1	6/1	12"	-	10/15
	Barley, Burbank/Faust IPV	7/7	0.36 oz	5/15	BC	0.5	2	6/1	-	-	-	-	-	-	6/1	5"	-	10/15
	Oats, Rhiannon IPV	15	0.19 oz	5/15	BC	0.5	2	6/1	-	-	-	-	-	-	6/1	5"	-	10/15
	Quinoa, Kaslala IPV	7	0.01 oz	5/1	BC	0.5	1	5/10	5/10	1.5"	1	3"	3	6/1	6/1	12"	-	10/15
	Fava, Banner IPV	100	17.00 oz	10/1	1"	2	2	10/15	-	-	-	-	-	-	10/15	8"	-	OW 7/15

[1] A 3" deep flat is 14" wide x 23" long x 3" deep; a 6" deep flat is 11.5" wide x 14" long x 6" deep.

1,000 sqft Complete Diet, Compost and Seed Saving Garden Plan

COMPLETE NUTRITIONAL DATA

Nutritional Information on the 10-Bed Design																
	Potatoes	Leeks	Garlic	Kale	Onions	Carrots	Beet Greens	Beet Root	Quinoa	Barley	Fava Beans	Oats	Wheat	Target		Totals
Food Eaten (lb/day)	2.20	0.99	0.25	0.16	0.27	0.20	0.30	0.60	0.07	0.05	0.03	0.02	0.01			
----After Rehydration									0.21	0.15	0.09	0.06	0.03	4.00-6.00		5.51
Food Required (intens. yield lb/year)	800.00	360.00	90.00	57.00	100.00	75.00	110.00	220.00	25.00	17.50	9.00	7.00	5.00	-		1876.50
Sqft Grown Throughout Year	400	75	75	50	50	50	100		200	175	100	100	50	-		1425
Calories	767.80	274.00	169.00	38.30	46.00	39.00	30.00	117.00	112.00	79.00	46.40	53.00	14.90	1800.00-2400.00		1784.40
Protein (g)	17.00	6.50	6.20	2.30	1.70	0.80	3.00	3.10	5.10	2.20	3.40	1.90	0.60	46.00-56.00		53.80
Carbohydrates (g)	209.70	62.50	37.50	7.20	6.50	9.10	6.00	27.20	20.40	6.40	2.70	9.00	3.10	300.00-405.00		407.10
Fat (g)	1.00	1.40	0.60	0.70	0.10	0.10	0.20	0.10	2.00	0.10	0.10	1.00	0.10	22.00-30.00		7.50
Isoleucine (mg)	1008.80	233.70	246.30	143.10	17.20	0.10	62.30	130.80	160.20	18.80	41.70	77.60	24.60	1044.00-1260.00		2165.20
Leucine (mg)	1498.20	431.50	349.60	167.80	30.60	0.10	135.50	185.20	267.00	35.00	77.90	136.00	47.10	1392.00-1680.00		3359.50
Lysine (mg)	1518.20	350.60	309.90	143.10	47.80	0.10	87.20	158.00	243.40	19.10	66.20	80.40	18.30	1044.00-1260.00		3042.30
Methionine/Cystine (mg)	699.20	193.30	160.00	55.20	7.40	0.10	53.10	100.80	162.70	21.20	21.70	84.40	28.80	870.00-1050.00		1587.90
Phenylalanine/Tyrosine (mg)	2027.60	431.50	300.00	207.80	47.80	0.10	150.00	228.80	273.30	43.60	76.50	160.70	52.90	1392.00-1680.00		4000.60
Tryptophan (mg)	389.50	53.90	75.00	29.10	17.20	0.10	47.70	51.80	53.10	8.60	9.80	24.50	2.00	261.00-315.00		762.30
Threonine (mg)	908.90	283.20	178.20	106.80	25.70	0.20	88.50	128.00	133.80	17.50	36.80	65.30	19.70	696.00-840.00		1992.60
Valine (mg)	1408.30	251.70	330.30	131.50	25.70	0.10	88.50	152.50	188.80	25.20	46.00	114.40	30.80	1218.00-1470.00		2793.80
Histidine (mg)	539.40	112.40	128.30	50.10	17.20	0.10	46.30	57.20	129.30	11.60	26.30	43.60	15.00	-		1176.80
Iodine (µg)	11.90	5.00	1.00	1.80	1.10	3.70	0.00	1.30	0.00	1.10	0.00	0.10	0.10	110.00-130.00		25.30
Zinc (mg)	4.00	8.50	1.40	0.30	0.20	0.20	0.50	1.10	1.00	0.60	0.10	0.40	0.10	10.00-15.00		10.40
Calcium (mg)	149.80	131.80	29.00	98.10	28.20	30.00	159.40	43.60	44.80	7.70	14.00	7.20	1.10	300.00-800.00		734.70
Iron (mg)	11.00	9.40	1.90	1.20	0.20	0.30	3.50	2.20	1.50	1.00	0.20	0.50	0.20	10.00-18.00		33.10
Phosphorous (mg)	699.20	157.30	173.70	40.70	35.60	31.80	55.80	109.00	145.30	68.10	17.00	62.00	15.10	800.00		1610.60
Potassium (mg)	5343.60	809.00	455.10	324.70	179.00	290.60	1037.80	885.30	178.90	81.70	36.50	52.40	15.40	2500.00		9690.00
Magnesium (mg)	279.70	125.80	28.40	24.70	12.30	10.90	95.80	62.70	62.60	20.20	5.90	27.20	5.60	300.00-350.00		761.30
Copper (mg)	1.00	0.50	0.40	0.20	0.10	0.10	0.30	0.30	0.20	0.10	0.10	0.10	0.10	2.00		3.50
Thiamin B1 (mg)	1.00	0.50	0.20	0.10	0.10	0.10	0.10	0.00	0.10	0.10	0.10	0.10	0.10	1.00-1.40		2.60
Riboflavin B2 (mg)	0.30	0.10	0.10	0.10	0.10	0.10	0.30	0.10	0.10	0.00	0.10	0.00	0.00	1.20-1.60		1.40
Niacin (mg)	14.00	1.80	0.80	0.70	0.20	0.90	0.50	0.80	0.50	1.30	0.10	0.10	0.30	13.00-18.00		22.00
Vitamin A (IU)	100.00	189.70	10.20	7256.70	2.60	15168.10	8616.00	89.90	4.50	0.00	2.00	0.00	0.40	800.00-1000.00		31441.10
Vitamin B6 (mg)	3.00	0.90	1.40	0.20	0.10	0.10	0.10	0.30	0.20	0.10	0.10	0.00	0.00	2.00		6.50
Vitamin B12 (mcg)	From the Soil															
Vitamin C (mg)	95.90	53.90	35.40	87.20	9.10	5.40	40.90	13.30	0.00	0.00	0.10	0.00	0.00	45.00		341.20
Vitamin D	From the Sun															
Vitamin E (mg)	1.00	4.10	0.10	1.10	0.10	0.60	2.00	0.20	0.80	0.10	0.00	0.10	0.10	12.00-15.00		10.30
Vitamin K (mcg)	Synthesized in the Intestine															
Linoleic Acid (g)	0.70	0.70	0.30	0.10	0.10	0.20	0.00	0.30	0.20	0.20	0.20	0.00	0.20	3.30-4.50		3.20
Folate (mcg)	279.70	287.70	3.40	21.10	23.30	17.30	20.40	296.90	58.50	5.60	14.20	6.40	2.00	400.00-600.00		1034.50
Pantothenic Acid (mg)	4.00	0.50	0.70	0.10	0.20	0.30	0.40	0.40	0.30	0.00	0.10	0.20	0.00	5.00		7.20

1,000 sqft Complete Diet, Compost and Seed Saving Garden Plan

Crop Yields 2019 Compared to the 1,000 sqft Design

Crop, Variety	Crop Area sqft	Dates in Bed	Edible Production lbs				Biomass Production lbs							
			Edible Yield	Yield/ 100 sqft	US Avg/ 100 sqft	Yield Goal/ 100 sqft	Wet Yield	Wet Sample	Dry Sample	% Dry	Dry Yield	Dry Yield/ 100 sqft	US Avg/ 100 sqft	Dry Yield Goal/100 sqft
FOPV[1]	125	10/9-5/5	-	-	-	-	164.00	2.50	0.40	16.00	26.24	20.99	TBD	20.00
Barley, Sumire Mochi IP WPV	75	9/21-4/29	Crop Failure			10.00	26.60	2.00	0.60	30.00	7.98	10.64	9.70	30.00
Quinoa, Redhead IP WPV[2]	25	5/10-9/11	1.70	6.80	TBD	13.00	10.30	2.10	0.60	28.57	2.94	11.76	TBD	39.00
Beets, Cylindra	100	5/12-9/24	180.20	180.20	76.70	220.00	-	-	-	-	-	-	-	-
Carrots, Juwarot	25	5/11-9/23	45.10	180.40	77.80	150.00	-	-	-	-	-	-	-	-
Kale, White Russian	45	5/15-9/25	54.10	120.22	41.00	114.00	14.90	2.60	1.10	42.30	6.26	TBD	TBD	-
Leeks, Giant Musselburgh	50	8/26-4/26	81.20	162.40	TBD	480.00	-	-	-	-	-	-	-	-
FOPV[1]	150	9/21-4/26	-	-	-	-	209.40	2.90	0.50	17.24	36.10	24.07	TBD	20.00
Onions, New York Early	50	4/30-8/28	76.00	152.00	116.00	200.00	-	-	-	-	-	-	-	-
Potatoes, Purple	100	5/1-8/4	95.00	95.00	95.00	200.00	-	-	-	-	-	-	-	-
Wheat, Red Fife Spring IP WPV	30	5/11-9/10	1.90	6.33	7.00	10.00	9.60	2.10	0.40	19.05	1.82	6.07	8.10	30.00
Wheat, Sonora Spring IP WPV	20	5/11-9/10	1.40	7.00	7.00	10.00	8.50	2.10	0.40	19.05	1.62	8.10	8.10	30.00
Quinoa, Apellewa IP WPV	100	8/10-10/16	7.20	7.20	TBD	13.00	30.30	2.20	0.60	27.27	8.26	8.26	TBD	39.00
FOPV[1]	100	10/28-4/26	-	-	-	-	57.20	2.90	0.50	17.24	9.86	9.86	TBD	20.00
FOPV[1]	35	10/28-5/28	-	-	-	-	36.10	2.30	0.42	18.26	6.59	18.83	TBD	20.00
Garlic, Music	70	11/1-7/1	20.20	28.86	37.20	120.00	-	-	-	-	-	-	-	-
Carrot, Mix	25	6/4-9/23	29.90	119.60	77.80	150.00	-	-	-	-	-	-	-	-
Quinoa, Biobio IP WPV	75	7/6-9/24	4.20	5.60	TBD	13.00	23.50	2.10	0.50	23.80	5.59	7.45	TBD	39.00
Potatoes, Purple	100	5/7-8/19	89.00	89.00	95.00	200.00	-	-	-	-	-	-	-	-
FOPV[1]	150	10/31-6/5	-	-	-	-	155.56	4.10	0.80	19.51	30.35	20.23	TBD	20.00
Oats, Rhiannon IP WPV	50	10/31-6/5	Crop Failure			7.00	24.00	3.00	0.50	16.67	4.00	8.00	8.40	30.00
Potatoes, Purple	100	6/13-9/24	110.70	110.70	95.00	200.00	-	-	-	-	-	-	-	-
Potatoes, Yukon Gold	100	6/20-9/24	120.30	120.30	95.00	200.00	-	-	-	-	-	-	-	-

[1]FOPV refers to a compost crop mixture of cool-weather Banner Fava Beans, Hulless Oats, Magnus Peas and Woolly Pod Vetch.

[2]IPWPV refers to interplanting Wooly Pod Vetch at a broadcasting rate of 4-6" centers

The above crop yields from 2019 did not include seed saving. About 90% of the design is identical to the adjusted 1,000 sqft design presented in this guide. In 2019, there was significant gopher damage to oats, potatoes and leeks. Several days of late and heavy rain in May also contributed to stress on recent transplants and resulting decline in yields for those crops. Each year presents its own challenges which lead to evolutions in the timing, crop selections and rotations of our designs. **Based on these yields, it would have required an additional 430 sqft to grow a complete diet in 2019- a total of 1,430 sqft.** We suggest that you plan in an extra 50% of the area for food security if you are attempting to grow a complete. Doubling the area from 1,000-2,000 sqft still represents a significant microscaling of the agricultural footprint.

1,000 sqft Complete Diet, Compost and Seed Saving Garden Plan

FOOD AVAILABILITY THROUGHOUT THE YEAR

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Potatoes	Cold Storage											
Leeks	Fresh				Dehydrated							Fresh
Garlic	Cold Storage					Dehydrated/Pickle	Cold Storage					
Kale	Dehydrated							Fresh			Dehydrated	
Onions	Cold Storage				Pickled/Dehydrated						Cold Storage	
Carrot Root	Cold Storage			Canned					Fresh		Cold Storage	
Carrot Green									Fresh			
Beet Root	Fresh				Cold Storage/Canned/Pickled					Fresh		
Beet Green	Fresh									Fresh		
Quinoa	Dry Storage											
Barley	Dry Storage											
Fava Beans	Dry Storage											
Oats	Dry Storage											
Wheat	Dry Storage											

FOOD STORAGE CONDITIONS

Crop	Optimal Humidity %	Optimal Temperature °F	Storage Life
Potatoes	85-90	38-40	5-8 Months
Leeks[1]	90-95	32-40	2-6 Months
Garlic	65-70	35-40	5-8 Months
Onions[1]	65-70	32	6-7 Months
Carrots	90-95	32-35	4-6 Months
Beets	93-95	32-35	1-3 Months
Quinoa[2]	60-70	40-50	12 Months +
Barley[2]	60-70	40-50	12 Months +
Fava Beans[2]	60-70	40-50	12 Months +
Oats[2]	60-70	40-50	12 Months +
Wheat[2]	60-70	40-50	12 Months +

[1] For dehydration: dehydrate at 125°F for 3-9 hours then store in an air-tight container or jar in a dark, cool, dry location.

[2] Harvest crops when fully mature and dry down to 10-13% moisture level. Increasing the air temperature by 20°F doubles the moisture holding capacity of the air and cuts the humidity in half. Once dried to optimum level, store in a cool, dark and dry location. Adding a small amount of silica gel at the rate of 10% total seed weight will help keep moisture content low.

Food for Thought…

Refrigeration is responsible for around 32% of the total energy use in our food system. Solar drying and fermentation can reduce the energy needed to preserve food by 30 times!

Appendix B: Planting Calendars for Coastal Mendocino County

Soil and Aboveground Temperature Conditions For Germination and Growth

Victory Gardens for Peace PO BOX 1253 Mendocino, CA 95460 www.Victorygardensforpeace.com

Soil Temperature Conditions For Vegetable Seed Germination
***Handbook for Vegetable Growers*, James Knott 1957**

Crop	Minimum °F	Optimum Range °F	Optimum °F	Maximum °F
Aparagus	50	60-85	75	95
Bean	60	60-85	80	95
Bean, Lima	60	65-85	85	85
Beet	40	50-85	85	95
Cabbage	40	45-95	85	100
Carrot	40	45-85	80	95
Cauliflower	40	45-85	80	100
Celery	40	60-70	70*	85*
Chard, Swiss	40	50-85	85	95
Corn	50	60-95	95	105
Cucumber	60	60-95	95	105
Eggplant	60	75-90	85	95
Lettuce	35	40-80	75	85
Muskmelon	60	75-95	90	100
Okra	60	70-95	95	105
Onion	35	50-95	75	95
Parsley	40	50-85	75	90
Parsnip	35	50-70	65	85
Pea	40	40-75	75	85
Pepper	60	65-95	85	95
Pumpkin	60	70-90	95	100
Radish	40	45-90	85	95
Spinach	35	45-75	70	85
Squash	60	70-95	95	100
Tomato	50	60-85	85	95
Turnip	40	60-105	85	105
Watermelon	60	70-95	95	100

*Daily fluctuation to 60°F or lower at night is essential

Temperature Range For Plant Growth
***Handbook for Vegetable Growers*, James Knott 1957**

Crop Season	Temperature Range °F	Optimal Temperature Range°F	Plant
Cool-Season Crops	30	60-65	Asparagus, Rhubarb
	40-75	60-65	Beets, Broad Bean, Broccoli, Brussels Sprouts, Cabbage, Chard, Collard, Horseradish, Kale, Kohlrabi, Parsnip, Radish, Rutabaga, Sorrel, Spinach, Turnip
	45-75	60-65	Artichoke, Carrot, Cauliflower, Celeriac, Celery, Chinese Cabbage, Endive, Florence Fennel, Lettuce, Mustard, Parsley, Pea, Potato
	45-85	55-75	Chicory, Chive, Garlic, Leek, Onion, Salsify, Shallot
Warm-Season Crops	50-80	60-70	Bean, Lima Bean
	50-95	60-75	Corn, Cowpea, New Zealand Spinach
	50-90	65-75	Pumpkin, Squash
	60-90	65-75	Cucumber, Muskmelon
Hot-Season Crops	65-85	70-75	Sweet Peppers, Tomato
	65-95	70-85	Eggplant, Hot Peppers, Okra, Sweet Potato, Watermelon

Appendix B: Planting Calendars for Coastal Mendocino County

Mendocino County
Region: Coastal

Victory Gardens for Peace c/o Matt Drewno
PO Box 1253 Mendocino, CA 95460

Instructions: The darkened areas below represent planting times for various crops. In many cases a few weeks before or after the darkened areas may be appropriate for seeding flats or vegetable beds. This data was collected from a number of sources including planting guides and the testimony of gardeners and farmers in the area. Write us an let us know your experience!

Soil and Aboveground Temperature Conditions For Germination and Growth

Victory Gardens for Peace PO BOX 1253 Mendocino, CA 95460 www.Victorygardensforpeace.com

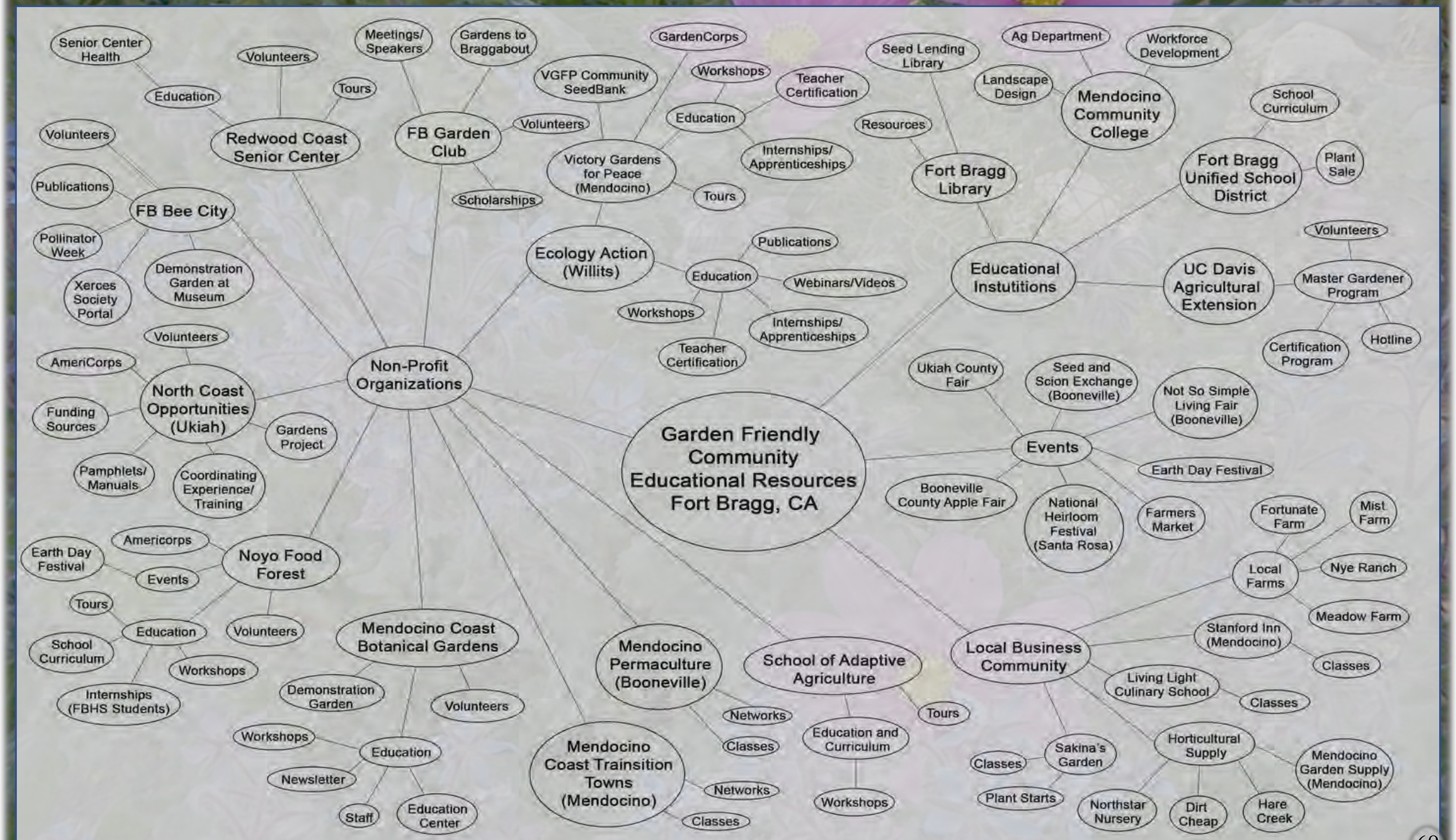
Crops for Fall And Winter Consumption (Cold Frame or Mini-Greenhouse Helps)
Four-Season Harvest, Eliot Coleman 1999

Crop	Planting Dates	Harvest Dates
Arugula	8/1-8/21	10/1-Spring
Chicory, Sugarloaf	7/1-7/15	11/1-Spring
Endive	7/10-7/20	9/15-11/30
Escarole	7/10-7/20	9/15-11/30
Italian Dandelion	8/1-8/15	10/1-Spring
Kohlrabi	8/1-8/15	11/1-Spring
Lettuce	7/21-9/7	9/15-11/30
Mache	9/15-11/15	12/1-Spring
Mizuna	8/1-8/15	9/15-11/30
Parsley	6/1-7/15	10/1-Spring
Radicchio	6/1-8/1	12/1-Spring
Radish	9/1-10/15	10/1-11/30
Scallion	7/1-8/1	10/1-Spring
Spinach	8/1-10/15	10/15-Spring
Swiss Chard	7/1-8/1	10/1-Spring
Tatsoi	8/1-8/15	9/15-11/30
In addition, we are experimenting with the following crop/dates		
Beets	7/15-8/15	11/1-Spring
Broccoli	8/15-9/15	11/15-1/15
Cabbage	8/15-8/30	12/15-Spring
Carrots	7/15-8/15	10/1-11/30
Kale	7/15-8/15	10/1-Spring
Leeks	3/20-5/20	8/20-Spring
Parsnips	7/15-8/15	11/1-Spring
Peas	10/15-11/15	1/15-Spring

*Note, experiment with different varieties as they have differing needs and givings

The key to establishing your winter garden is to get your crops to mature size by around mid-November or sooner. Around that time, daylength slips below 11 hours per day which significantly slows the growth the your garden. From that point until daylengths increase over 11 hours in mid-February, crops will grow very slow. The goal is to have your crops to mature size, the microclimate established and harvested fresh throughout the winter. Many root crops and others that store well could be harvested in autumn, preserved or stored and cover crops transplanted to protect the soil while fixing nitrogen and carbon.

Appendix C: Resources in Fort Bragg and Mendocino County



Appendix C: Resources in Fort Bragg and Mendocino County

Community Gardens	Caspar	Caspar@mcn.org	707-964-4997
	Fort Bragg	Info@victorygardensforpeace.com	-
	Ukiah	gardens@ncoinc.org	707-462-1958
Educational Organizations, Non-Profits	Anderson Valley Foodshed	www.avfoodshed.com	707-895-3897
	Ecology Action	ecologyactionom@gmail.com	707-459-0150
	Fort Bragg Bee City	cjreynolds@sbcglobal.net	707-494-2149
	Fort Bragg Garden Club	Kathleen.holmes@sbcglobal.net	707-964-0317
	Fort Bragg Unified School District	jcastillo@fbusd.us	707-961-2850
	Master Gardeners Mendocino	mastergardener@gardenbythesea.org	707-964-4352
	Master Gardeners Ukiah	anrmgmendocino@ucanr.edu	707-463-6360
	Mendocino Coast Botanic Gardens	info@gardenbythesea.org	707-964-4352
	Mendocino Coast Transition Towns	info@transitionmendocinocoast.org	-
	Mendocino Comm. College Fort Bragg	-	707-961-2200
	Mendocino Comm. College Ukiah	-	707-468-3000
	Mendocino Permaculture	-	707-895-3897
	Gardens Project	gardens@ncoinc.org	707-462-1958
	Noyo Food Forest	admin@noyofoodforest.org	707-357-7680
	Redwood Coast Senior Center	director@rcscenter.org	707-964-0443
	School of Adaptive Agriculture	office@adaptiveagriculture.org	-
	Victory Gardens for Peace	info@victorygardensforpeace.com	-
Garden Events	Earth Day Festival	admin@noyofoodforest.org	707-357-7680
	Santa Rosa Heirloom Festival	info@theheirloomexpo.com	417-924-8917
	Not So Simple Living Fair	info@notsosimple.info	707-895-3243
	Seed and Scion Exchange	www.avfoodshed.com	707-895-3897
	Mendocino Cty. Fair and Apple Show	mcofair@pacific.net	707-895-3011
Health and Nutrition	Whole Plant Foods	petra@wholefoods.info	707-397-5575
	Living Light Culinary Institute	info@rawfoodchef.com	707-964-2420
	The Stanford Inn by the Sea	concierge@stanfordinn.com	707-937-5615
Horticulture supply	Northstar Nursery	info@northstarnursery.com	707-961-1074
	Dirt Cheap Garden Supply	dirtcheaphydro@mcn.org	707-964-4211
	Hare Creek	harecreek@att.net	707-964-4648
	Mendocino Garden Shop	mendocino@gardener.com	707-937-3459
	Sparetime Supply	-	707-459-3576
Local Seed Companies, Seed Banks and Seed Libraries	Open Circle Seeds	www.opencircleseeds.com	-
	Quail Seed Company	Quailseeds@gmail.com	-
	Seed Library Fort Bragg	-	707-964-2020
	Seed Library Point Arena	-	707-882-3114
	Seed Library Round Valley	-	707-983-6736
	Seed Library Ukiah	-	707-463-4490
	Seed Library Willits	-	707-459-5908
	Sundial Seed Co.	healinhortestea@gmail.com	707-456-7131
	Victory Gardens for Peace Seed Bank	info@victorygardensforpeace.com	-
Mendocino County Farmers Markets	Boonville	aforestperson@gmail.com	707-489-5034
	Fort Bragg	forestlove@comcast.net	707-357-6035
	Laytonville	glorianhy@willitsonline.com	707-560-4938
	Mendocino	sakina@mcn.org	707-357-1241
	Redwood Valley	alfskitchen@gmail.com	707-391-7416
	Ukiah	headoflet@gmail.com	707-380-9988
	Willits	ciscotso@gmail.com	510-679-7470
Plant Nursery	Sakina's Garden & Nursery	sakina@mcn.org	707-964-9232
	Blue Sky Nursery	roundwheelz@gmail.com	707-292-3645
	Northstar Nursery	info@northstarnursery.com	707-961-1074
	Hare Creek Nursery	Harecreek@att.net	707-964-4648
	Mendocino Coast Botanical Gardens	nurserymanager@gardenbythesea.org	707-964-4352

Appendix C: Resources in Fort Bragg and Mendocino County

Local Farms	Bee in my Bonnet	glorianhy@willitsonline.com	707-560-4938
	Big Mesa Farm	caymininski@yahoo.com	707-721-6299
	Brady Family Farm	halledgb@yahoo.com	707-513-0121
	Brock Farms	vbrock@mcn.org	707-895-3407
	Broken Oak Ranch	anthonywbrowning@gmail.com	707-472-6193
	Buckeye Ridge Ranch	weeadsnmendo@msn.com	707-354-5734
	Busalacchi Farms	marebusalacchi@yahoo.com	707-483-3769
	Cinnamon Bear Farm	Sara.nielson007@gmail.com	707-245-9479
	Covelo Organics	Brandon@coveloorganic.com	707-272-0623
	Deer Meadow Farm	currydiane@hotmail.com	209-662-0658
	Elmer Orchards	papasuddi@hotmail.com	707-272-4249
	Fairall's Farm	alfskitchen@gmail.com	707-391-7416
	Fantail Flowers	Fantailflowerdesign@gmail.com	707-972-0072
	Floodgate Farm	edibleland@earthlink.net	707-272-1668
	Flora Mendocino	flora@mcn.org	707-734-0809
	Flora Quest Farm	floraquestfarm@gmail.com	708-752-3417
	Forget-Me-Not Flowers	Forgetmenotflowers2018@gmail.com	707-962-4149
	Fortunate Farms	fortunatefarmllc@gmail.com	707-962-4149
	Frelima Farmette	forestlove@comcast.net	707-357-6035
	Green Uprising Farm	Foley.mw@gmail.com	707-216-5549
	Good Things Farm	allthegoodthingsfarm@gmail.com	707-367-2735
	Inland Ranch Organics	inlandranch@gmail.com	707-391-7687
	John Ford Ranch	jcford@saber.net	707-459-5193
	Live Power Community Farm	-	707-983-8196

Local Farms	Loasa Farms	nelliedown@mac.com	707-349-2184
	McEwen Family Farm	orienmcewen@gmail.com	707-472-9009
	Meadow Farm Community	info@meadowfarm.org	707-813-9234
	Mendocino Flowers	mgomez@mcn.org	707-937-5678
	Mendocino Gourmet	davidasamas@gmail.com	707-972-1753
	Mulligan Gardens	Michiel.rueb@gmail.com	957-999-0987
	Natural Products of Boonville	trout@naturalproductsofboonville.com	707-272-3474
	Nature's Tune Farm	info@naturestunefarm.com	707-884-9411
	New Agrarian Collective	joshuadruckers@gmail.com	707-841-1947
	Noyo Food Forest	admin@noyofoodforest.org	707-357-7680
	Nye Ranch	NyeRanchFarm@gmail.com	530-514-3047
	Oliveto del Vecchio	theresar@pacific.net	707-489-5212
	Ortiz Family Farm	-	707-584-4649
	Parents and Friends Inc.	gardenleader@parentsandfriends.org	707-357-4719
	Petit Teton	farmer@petiteteton.com	707-684-4146
	Redtail Ranch	marbrysip@gmail.com	707-272-1907
	Seven Farms	ybuke@yandex.com	707-354-8568
	Shamrock Artisan Goat Cheese	ana@shamrockartisan.com	707-367-1817
	Soul Shaker Acres	benmwolff@gmail.com	707-272-1512
	Strong Roots	stroots@juno.net	707-354-1556
	Sucher Nova Farm	suchanovafarm@gmail.com	415-238-2246
	The Forest People	aforestperson@gmail.com	707-489-5034
	Wavelength	kelanilyadaniel@gmail.com	310-433-4600
	Yerba Sana Goat Dairy	yerbasanta@juno.com	707-263-8131
	Yokayo Roots Farm	yokayoroots@gmail.com	601-543-6222

Appendix D: The Victory Gardens for Peace Initiative Resources

The Victory Gardens for Peace Initiative

A project of Ecology Action in partnership with the Stanford Inn and the Mendocino Center for Living Well

Victory Gardens for Peace (VGfP) works with communities to address issues of health, food access and sustainability through home and community gardening through the biointensive method. We help individuals empower themselves through a co-creative, inclusive process of developing and implementing the following projects:

Victory Gardens for Peace is dedicated to a peaceful, sustainable future through:

- Research, education and demonstration of the biointensive method
- Focusing on localization and self-empowerment
- Developing community models which increase access to soil, water, food and seed
- Working with communities around the world to implement programs
- Certifying teachers to strengthen the global biointensive network

Research, Education and Demonstration of the Biointensive Method: The biointensive method reduces water use, fertilizer inputs, energy needs and land area required while increasing yields sustainably. We host tours, workshops, internships, apprenticeships and teacher certification programs.

The Victory Gardens for Peace Seed Bank: Our seedbank conserves and adapts local seed varieties, makes them available to our community for free, increases awareness of issues surrounding seed access and is supported through a bioregional network of local seed savers.

Garden Friendly Community Resolution (GFC): The GFC is a resolution communities can adopt which recognizes the importance of a strong home and community gardening culture. It serves to help communities become healthier and more resilient by increasing access to garden spaces and strengthening garden programs in our schools and communities.

GardenCorps: The GardenCorps Program trains small teams dedicated to service through creating community gardens and spreading awareness of the importance gardens play to the health and resilience of our communities.

For more information on our programs or initiatives, visit:
www.victorygardensforpeace.com or contact info@victorygardensforpeace.com