GArdening

A Concise Guide to Efficiently Grow Organic Food

By

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A- Gardening
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Introduction

Fundamentally, growing food is as simple as putting seeds in soil, watering, and protecting them. Yet, there is a seemingly endless amount of details to this process that result in *information overload*. This guide's primary objective is to fight information overload by concisely and thoroughly summarizing the best current organic growing techniques. As a result, this is not a comprehensive guide to gardening but rather a guide to efficiently garden (for additional information, look in the Glossary or follow the links I included). Efficiency is measured in maximizing output while minimizing cost and time. The simplest way to be an efficient grower is to **not** try to achieve perfection, but simply be good enough. I refer to this as the A- philosophy.

Why A-? Marginal gains decrease the closer to perfection one tries to accomplish. For instance, the amount of time needed to study to improve your grade from a B+ to an A- is less than the additional time it takes to move from an A- to an A. Yes, we all want the biggest onions, but will be happy with ones that are big enough for dinner as long as it is fresh and 'free'. You could spend hours deciding between the ways to plant and fertilize onions to get the A+ ones you want. But life is busy, so it's best not to waste time, use the simplest methods and call it a day. This guide is a paint-by-numbers approach to growing food efficiently.

One of the most direct and impactful things you can do for your health and the environment is gardening. By localizing the food production process, ornamental urban and suburban grass is replaced with gardens. This reduces waste, transportation cost, monoculture, pesticide use, impact on insects and builds community. It also removes the economic transaction from the process, fundamentally changing the production process. Without the goal of maximizing revenue, *what* and *how* we grow suddenly shifts. You do not need to grow what drives the highest profit or what other people demand. Also, selling the produce is often more work than growing it. This makes growing food essentially free. People argue this, but it's mostly a disagreement on what free means. Pulling a tomato of the vine is getting a free tomato: you didn't pay another person for that specific tomato. Without the financial transaction that tomato is not just a commodity anymore, it is sunshine, success, and a meal. It is the pride of eating the most delicious food and sharing it with friends and family. While you might have had to pay for seeds, transplants, compost, water, time, etc., you did not have to rely on a grocery store and a paycheck to harvest that tomato. This makes growing that tomato a small taste of *free*dom.

I wrote this guide to share with people the freedom that is gained through growing your own food and demonstrate how simple it really is. As a professor with a Ph.D. in operations and supply chain management as well as a Master Gardener with decades of experience growing, I wanted to highlight the most efficient gardening practices to make gardening less of a chore and more rewarding. I have come to realize a simple trick for success: Don't try to achieve perfection, but simply good, which I call the A- philosophy.

Location

The best garden site maximizes sunlight exposure and convenience.

Food can be grown in a surprising array of places in climates all over the world. From mushrooms under trees, to fish in your basement. However, this guide is specifically targeted for growing main crop vegetables and fruit outdoors efficiently. The first step in growing these crops is finding a site to grow them. If you are a homeowner, wonderful, but that is not necessary. You can also grow food in community gardens or in grow bags on a balcony. The first principle remains the same in all situations.

Sun

Yield is a function of the number of sunlight hours it receives. This is a simple fact for *almost* all the fruit and vegetables you will grow. Ideally, you need at least 8 hours of direct sunlight during the growing season, the more the merrier, but it rarely is so easy. There are trees and buildings that might be in your way. That is life, but remember, an A- is still an A. So, start by monitoring the sun and finding locations that get the most sun. It is also important to note the light specifically in the season you are growing to get the most accurate measure of light.

Convenience

After sun, convenience is the next most important thing. Most of gardening consists of short visits to your plants to harvest, pick off bugs, or simply to assess the status of the garden. Getting to your garden easily facilitates the frequent visits that help detect problems early. Even a few feet can make a difference. The garden directly adjacent to my home is visited far more often than plants I have at the edge of my property and I live on only half an acre. Not only does the location need to be convenient, but also the tools you need to use. Keep all gardening tools in the garden area. Lastly and most importantly, ensure you have access to water. You can easily double the amount of work a garden takes if you have to struggle with hoses and water buckets. Water barrels are a fantastic and cheap way to get water in the garden if you do not have a spigot. If you can, a well is even better because then you can use sprinklers, but is much costlier.

- *Short distance to home*
- *Tools easily accessible*
- *Water source in garden*

Climate

While there are many types of climates, often referred to as hardiness zones, there are two main ones that define most of what and how you grow: *Temperate* and *Tropical*. Temperate climates are defined by their cold winters when very few crops can be grown outdoors without the help of heat. Tropical climates are defined by hot summers that make it difficult to grow in the summer. Tropical climates are usually associated with lots of rain, but desert climates are also included since the same crops are more focused on surviving the heat rather than the cold. Your climate is only important because it determines which crops you can and cannot grow.

Illustrative Example

To understand site selection, below is an example of the strategic placement of my personal garden (3), orchard (2) and vineyard (1). This space shows multiple compromises I had to make. My garden (3) is in the south facing side of the house, but it is not perfectly aligned with the sun. Additionally, the large maple tree on the south east side of the garden blocks some sun and steals nutrients from the edge of the garden. This tradeoff was accepted because the garden is adjacent to my garage, making it close with easy access to tools. Also, it required the fewest materials to fence off from large pests since the house itself accounts for > ¼ of the perimeter. The other problem with this location is water. The only water spigots are in the front and back yard. I installed a rain barrel to have a direct water source in the garden, but when it runs dry, I have a hose running to the garden from the back yard. I will replace the rain barrel with a pump and a shallow well to solve the water issue for good.

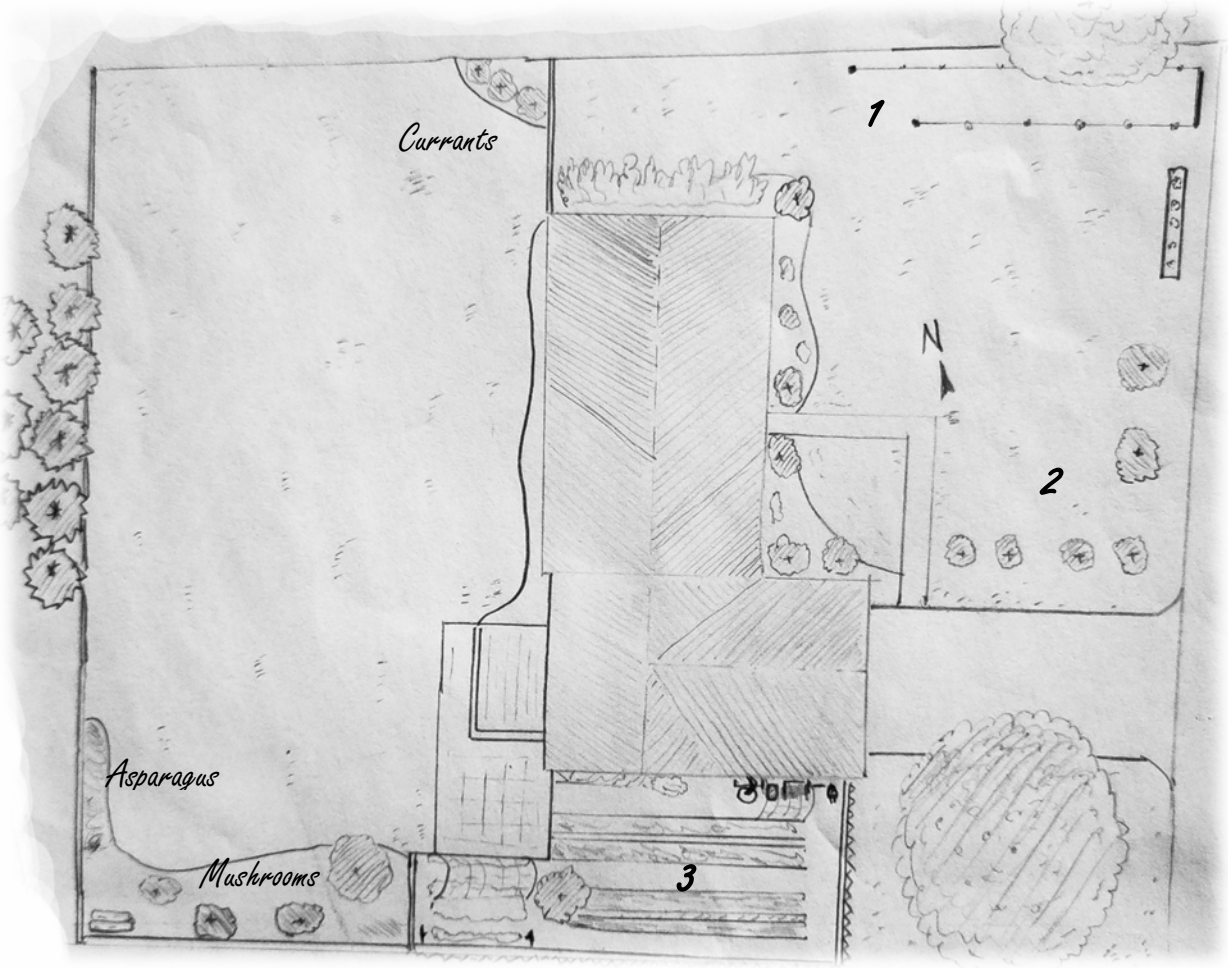

Figure 1. Example Layout

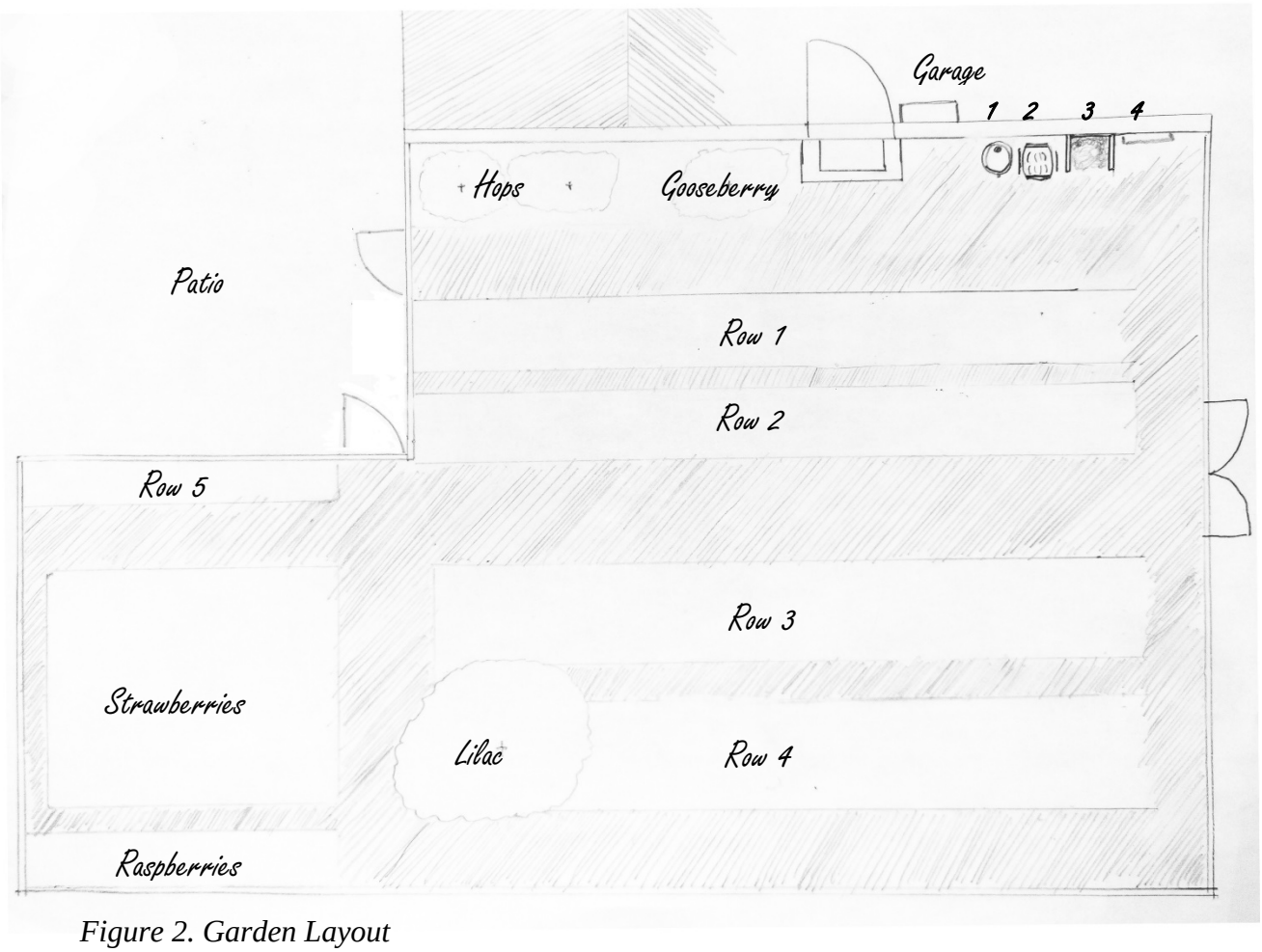

Figure 2. Garden Layout

My garden, shown in Figure 2, highlights a few design principles. Firstly, convenience is planned in the garden with my water barrel (1), tools (4), and compost (2 & 3) easily assessable. My compost consists of two parts: a tumbling composter so food scraps do not attract animals and a bulk pile. Ideally, there would be a third pile, but I do not have the space so often use an old trash can or bucket to store compost that is ready for use. Additional tools are located in the garage, but the main ones (shovels, hoe, rake, fork) hang outside. I also have a small greenhouse that I put adjacent to the water barrel in early spring.

The four main rows, 1-4, are in-ground 30” wide rows. This facilitates easy crop rotation since it is often done in a 4-year cycle. It also permits the usage of common market gardening tools since it is the standard size the professionals use. Row covers, broad forks, etc. are designed for this width. The 5th row used to be blueberries until they moved into the front yard orchard. Now, it is an extra growing space with a trellis. Strawberries and raspberries have a permanent home close together to make netting them easier. Along the house, north of the 1st row are the hops and gooseberry. The hops trellis up the house, simplifying the trellising they require and passively cooling the home in summer.

The lilac shades some of the garden, but it also attracts pollinators and provides a habitat for birds that eat insects. Flowers are also planted along the fence.

Preparation

Preparing the ground for healthy crops is going to be the most labor-intensive part of gardening. I have converted dry rocky land to raised beds, overgrown weeds to in-ground beds and ornamental grass to a productive nano-farm. Each were unique, but all required an equal amount of sweat. How to prepare the beds is straightforward:

1) Kill all vegetation
2) Amend soil
3) Grow

Killing all vegetation can be done by digging, spraying, or burning, but my favorite lazy method is occulation. **Occulation** is simple: Cut vegetation to ground (mower, string trimmer, etc.), then cover with 6 mil plastic for 6 weeks. Occulation works by creating a moist environment so seeds germinate, then blocks all light so the plants die. Organic materials like cardboard or thick straw are also fairly effective at killings most vegetation.

Next, amend your soil. While this will vary depending on your soil, you will almost certainly have to **add organic matter**, ideally rich organic compost. Soil consists of four things, clay, silt, sand, and organic matter. To test your soil composition, add soil, water and soap to a jar. Shake and let settle. Other things you may need to adjust are sand levels and pH. Adding BioChar is another way to improve your soil. I recommend getting a soil test to assist in fine tuning soil amending, but just adding compost will work just fine most of the time. I test my soil ever couple of years. The last test was $10 from the Penn State Universities extension office.

To prepare the soil for amendment, remove any rocks or remaining weeds and build your beds. Stakeout bed location and add the organic matter, sulfur/lime, BioChar, etc. I recommend tilling the amendments into the soil the first year to get a good deep root zone, but it is not strictly necessary. The soil will natural mix over time if you prefer to avoid disrupting the sub soil layers. However, this takes a long time and is not very effective. This is the only time I recommend tilling and will only use a broad fork thereafter. Below, the disadvantages of tilling are listed, but the main reason I do not till is because it takes work with little benefit, i.e., it is not an efficient use of time.

Once your beds are prepared, it is time to grow. Over time, with proper rotation, compost application and cover crops, the soil will continue to improve.

Disadvantages of mechanical tilling

- *Soil compaction*
- *Fossil fuel usage*
- *Reduces soil biodiversity*
- *Erosion*
- *Destroys soil structure*

Raised Beds

I do not think raised beds are worth the cost and time to build and maintain in most circumstances. A mounded in-ground bed works just as well and allows for greater efficiency of scale. If you go this route I recommend cedar fence planks because they are cheap or metal beds because they are low maintenance. Filling raised beds takes a lot of soil so the Hügelkultur method is worth pursuing. I prefer grow bags or containers because they are cheap and easy to set up. Grow bags have better air pruning that containers but dry out quicker.

Planting

Once the site has been prepared, and the growing season has arrived, it is time to plant. The simplest principle to follow is: grow what you want to eat. After that, you want to think about timing the harvest so you have food throughout the summer rather than all at once. When you are ready to plant, it is critical the plants are as healthy as possible. Getting the plants started is similar to a foundation, it is incredibly important to success later on.

Planning

First, you need to decide what you will grow. Start by making a list of what you want to eat. Remove those that are not suitable to your climate. I have wasted way too much time and space attempting to grow okra and watermelon despite living in a temperate climate. Next, plan where you will grow them in your space. Either draw it by hand or use a digital tool. The space constraint determines how much of everything you will need to buy or get started. Also, I always grow around 50% extra to account for losses. Crop rotations also factor in here, with the most common being a four-year crop rotation schedule. In a home garden, rotation helps, but you do not need to be dogmatic about it since space is often limited. The next step is to determine what you will grow from seed or buy already started for you.

Winter Sowing

- *An effective alternative method for sowing seeds using old milk jugs*
- *Cut clean milk jug, fill with soil, sow seeds, tape shut, and place outside*

Sowing

Seeds can either be directly sown or young plants can be transplanted into the garden after you give them a head start indoors. The decision to direct sow versus transplant is based on the requirements for each plant (refer to the almanac or the seed packet to determine this). Direct seeding is by far the most efficient method. Often, you can just shove the seed in the ground without digging whatsoever. It is important to keep them moist until they are established. To do this, I mulch with straw or place burlap over the seed bed (the preferable option).

Starting Seeds

Growing transplants indoors is great but requires equipment and is another source of failure. If you are growing at scale and for many years, this is absolutely worth the investment. You will need to buy: lights, a starter tray with a plastic lid, and some good quality seed starting soil. Heat mats are often recommended but are expensive and not strictly necessary.

What should you buy? For lights, Barrina LED or cool white fluorescent tubes fixtures are ideal. Just ensure you will to be able to adjust their height. Durable plastic cell flats are the most efficient tool for starting seeds. While you can make your own pots using toilet paper rolls, newspaper, etc., they are only worth the effort if you are planting just a handful of plants. You will also find Jiffy® pots at every nursey and box store; DO NOT buy these, they do not work well. On the other end of the spectrum, you

will see soil blockers. These are great, but expensive and time consuming.

Alternatively, you can buy starters from a local nursery or farmers market. If you will buy starters, they are always more expensive by unit than seeds, but if you have a reliable source (Not a national big box store!), they save time and provide a less obvious benefit: expertise. One of my first gardens was in Michigan and I bought everything as a start from Horrocks Farm Market. I had amazing success. I didn't realize it until I tried to grow my own starters (and failed) why I had so much success. I was buying expertise, not just baby plants. Professionals know *which* varieties grow best in your region and *how to* grow healthy seedlings. If you haven't looked in a seed catalogue before, you will be amazed at how many varieties of every vegetable there are.

When to Plant

Cold Weather Crops

There are three dates you need to know when planting crops. The first is your first *hard frost date*. You will often hear/read about your last spring frost date, however, no crops are planted on this date because your cold weather crops go in before it, and your warm weather crops go in after. The hard frost is anything under 25°F (-3.9°C). After your last hard frost date, brassicas, and other hardy vegetables can be planted. Your frost date can be found at the almanacs website and which plants are hardy can be found from the planting calendar.

For example: If I look at the almanacs guide for broccoli (a known cold weather crop), it is telling me I can plant transplants as early as April 16th. Theoretically, I can plant them when I am confident the temperature will not go below 25°F. As a data nerd, I downloaded the raw data from NOAA, and computed the confidence intervals based on the last 15 years of data. This data suggests I could plant as early as March 22, with 90% confidence, March 25th with 95% confidence, or March 30th with 99% confidence. I aim for between March 25th, and April 16th with the additional plan of using row covers. I start my seeds six weeks before that, which is right around Valentines day. I always add 1-3 weeks to what they recommend to get the plants the proper size.

Warm Weather Crops

The second date you need is your last spring light frost date with 90-99% certainty. Frost dates are based on historical data and use an average. There is still a high likelihood of frost after your last frost date and if you plant your tomatoes early, they could all die. According to the almanac's website: "The probability of a frost occurring after the spring frost date or before the fall frost date is 30%, which means there is still a chance of frost occurring before or after the given dates!" You want to plant when you are almost certain there won't be another frost. Usually this date is a week or two after the date reported as your last frost. Once the date is near, check the weather report every day. If a week after your frost date, the *next* week's weather forecast does not show a temperature less than 37°F, you can plant.

For example: Tomatoes are a known warm weather crop and the almanac says I can plant transplants outside between May 14-21, approximately 2 weeks after my listed last frost date of April 30th. From the data, those dates are conservative and I could likely plant earlier, especially if using row covers (which you always should).

Fall Planting

One of the best ways to drastically increase your yield is to properly plan your second round of plants, referred to as succession planting. Many plants do better in the fall than in the summer, such as carrots. To plan this, you need to back calculate from you first fall frost. For your cold weather varieties, you can add a couple weeks to the date you find online since they can withstand light frost. For example, my first fall frost in on October 18th. So, I can directly sow carrots seeds at the beginning of August or transplant brassicas that I started in seed trays in July in the middle of august. In the USA, all these dates can be found for free on the planting calendar link on the previous page.

However, you might not hit your date exactly because you have to harvest another crop to make room. That's okay, as long as it is close. For example, I plant carrots after I pull out the snow peas and plant a second round of snow peas after I pull out my onions. Once you have tasted carrots that you harvest in late fall, you will understand the power of this planting window.

Mushrooms

Fungi do not follow the same rules as other crops and are a perfect complement to a garden. They grow well in mostly shady areas other crops won't grow. For instance, you can buy wine cap sawdust spawn and simply sprinkle it in layers in a pile of wood chips in the spring. If you continue to add substrate, such as woodchips, you can get harvest for many years. Every mushroom is slightly different and you need to follow the instructions from wherever you buy them.

Timeline

Early Spring
- Trim perennial fruit trees/bushes
- Start cool weather crops
- Plan crop placement

Spring
- Remove weeds
- Top dress with compost and amend soil as needed
- Start warm weather crops
- Transplant cool weather crops
- Install row covers

Late Spring
- Plant warm weather crops
- Start fruit tree spraying

Summer
- Remove row covers
- Water consistently
- Monitor for pests/disease
- Harvest/preserve
- Start fruit tree spraying
- Weed

Late Summer
- Plant Fall Crops
- Add more compost
- Plant cover crop as needed

Fall
- Collect leaves for compost
- Clean up garden area
- Trim raspberries

Winter
- Vacation
- Plan next year's garden

Maintenance

Growing food is about balance, not control.

I love gardening, because nature really does most of the work after you plant. In comparison to manufacturing, where a good has to be manually constructed piece by piece, fruit and vegetables grow on their own. The goal at this phase is simply to ensure they have the ideal conditions to do so.

Protecting plants

The absolute best way to protect your plants is with physical barriers. For large animals (including children and pets), fencing is the best option. For any size animal *and* insects, row covers are the best option.

Figure 3. Row cover over brassicas

Row covers vary in thickness and the size you need will vary depending on your climate and need. As an example, I use standard grade 83" wide floating row covers (0.55 oz/yard^2) for both pest and frost protection in my temperate climate (5-6ish). For 30" beds, place 5' long bent pieces of 9-gauge galvanized wire every three feet. Use nylon to connect the hoops using a clove hitch and cover with the row cover. Hold edges down with soil, woodchips, or other things you have lying around. For larger crops, you can use 8' sections of ½" PVC spaced every 5' with a wider row cover. Young plants are the most susceptible to pests and benefit greatly from protection in a greenhouse or row cover.

Weeds

Weeds are a constant problem for outdoor growers and can seem daunting. To remove weeds with the least effort, hoe once a week for 15 minutes. Remember, it is okay to have some weeds, they even sometimes act as trap plants. Just never let weeds go to seed.

The one time you will have to hand weed is when you directly sow. You need to keep seed beds completely weed free to allow your plants to grow and out compete the weeds. When the plants are small, using a hoe could damage them. Take the time to hand weed seed beds early and you won't have much problems later. Flame weeding is an effective method at scale for carrots if you have a torch that attaches to a propane tank. How to: Plant a few beet seeds at the end of the carrot row during planting. When the beets first emerge, uncover and torch the entire area. The carrots will soon sprout.

If weeds are out of hand, *occulation* is best method. Refer to page 5 for the description of the process.

Watering

Watering is the most obvious gardening task and can be the laborious if it doesn't rain. To simplify this, use a rain gauge and when needed, **water using a sprinkler on a timer**. Yes, drip irrigation is more efficient from a water usage perspective, but the time it takes to set up, the added cost, and inconsistent output make them simply not worth it. I learned this from experience and talk to my therapist regularly about it. If you need to go the water efficiency route, stick to drip hosing/tape, not the black plastic tubing and emitters. Drip hosing is the perfect compromise between set up time and water usage. However, at scale, sprinklers are the most time efficient. You want one that has a stand and the wobbler sprinkler gives the most even water distribution. A rain barrel is a fantastic option if you do not have a spigot available. However, you will have to hand water if you don't install a pump with it.

How do you know if you need to water? Stick your finger into the ground to the second knuckle, if your finger tip is dry: water. To know how long to water for, set a rain gauge in the garden with the sprinkler on and time how long it takes to get to 1". 1" per week is a general guideline for how much water your garden needs, but it depends on soil type and climate. Adjust timing based on 1" rate and your garden needs.

Fertilizing

To grow the biggest plants, you will need to fertilize. There are a lot of options and getting the timing right while matching each specific plants' requirement can be truly daunting. The A- method is **just to add more compost**. Compost may not perfectly match nutritional requirements for plants at every stage of growth, but it is simple and easy. Other options include, blood, bone, fish, alfalfa, and seaweed meal. An option I see much more commonly used recently are compost teas, also known as JADAM. However, studies have shown mixed results with these fertilizers and some risks of spreading disease. I have tried to use these methods and they are too time consuming to be recommended to the A- grower.

Figure 4. Drip irrigation in my MI garden

Disadvantages of Sprinklers

- *Watering Weeds*
- *Increasing disease*
- *Inefficient water usage*

Reality

- *Weeds happen anyway*
- *Mulch and Prune reduces risk*
- *Time watering for the early morning*

Pest & Disease

The most efficient organic method for all pests is handpicking and for all diseases, removing it.

Constantly defending your crops from bugs and disease is truly daunting. I used to spend hours researching every single bug and disease, only to find that organic control methods are not always effective or harm beneficial life as well. Plus, all the fungicides and other sprays get expensive. What should you do? The first principle is to grow strong healthy plants. Plants have natural defenses against pests, the problem really only happens when pest populations explode and become out of balance. It is important to fight the innate desire to control every element in your garden, but rather act as the counter balance that keeps everything in harmony. To keep the balance: 1) *smash pests when you see them* and 2) *remove disease when you find it*.

Handpicking

Before the green revolution gave us seemingly magical chemical sprays that killed all the bugs that ate our vegetables, handpicking was the only reliable method to control pests. Yes, handpicking is just **catching and smashing bugs by hand**. At large scale, it is impossible, but for the home grower, this is a powerful organic method. It only takes a few minutes each day, is perfectly specific (i.e., there is not killing of beneficial insects), and is free. Most organic methods of pest control, such as sticky traps, neem oil, diatomaceous earth, all kill pests AND beneficial insects. Plus, these methods are not perfectly effective. On the other hand, you know for certain the pest is dead when you take sweet revenge and cut it in half with pruning shears. Having a daily stroll with your coffee is a great way to relax and detect early any signs of pests. No, you will not annihilate every single pest from your garden, but you will maintain a healthy balance in nature that your plants can survive. Pest populations grow exponentially if not kept in check. Early detection and removal of pests severely limits this growth pattern.

Disease

There are three types of disease you can get: viral, bacterial, or fungal. You can spend hours reading online (ideally from university extension offices) only to find there is nothing you can really do. For all of them, it is best to simply cut your losses, and **remove any diseased plants when they are first detected**. I usually grab a piece of plastic from the recycling bin to catch the material I cut to limit the spread of the disease as I cut it out. I keep a 10% bleach solution with my tools to dip my shears in after doing this. As always, it is best to plant varieties that are resistant to the most common diseases in your area if possible.

Summary

Keep it simple and accept that you will lose some of your crop to pests and disease. It is also important to diversify what you grow to limit losses. Not only grow a variety of types of crops, but also different varieties of each crop.

Harvest

Harvesting your crops is incredibly rewarding. Once you have grown your own food, you truly understand that there is not a direct comparison to buying produce. You may be surprised to find that the most time consuming task in your garden will be *storing excess produce*. Therefore, I ensure I do not grow too much of crops that require a lot of effort to store. The best crops to grow excess of are ones that store without much work at all: onions, garlic, winter squash, potatoes, apples, etc. The only produce that justifies the time to process are high value crops. Tomatoes and strawberries are the only two I preserve because the flavor difference is huge compared to store bought. I will give away excess beans, summer squash or any other crop that I could freeze or can, but would not be excited to pull out of the freezer or pantry in the middle of winter. Choose you battles wisely. After spending hours and hours making pickles with extra cucumbers only to eventually throw them away when I didn't eat them (I could never get them crispy) has taught me it is better to just buy some things.

Timing

Harvesting varies by crop. The main advantage to home production is you can maximize freshness. A tomato at the store has been picked, shipped and stored while the one you grow can be eaten directly after harvesting. You will likely have to harvest frequently, especially for fruit like strawberries or raspberries. The main threat here is to spread out your crops so that you don't grow too much food that ripens at the same time. Look at the average days to maturity on the seed package and the almanacs website to plan harvest timing.

Preserving

You can find a lot of detailed information on how to make jam or can tomatoes. The 'correct' way requires lots of time and specialized equipment. The A-method does not. For tomatoes, I simple boil them in my biggest pot, immersion blend them, and put them in clean (not sterile) glass containers. Then, I just freeze them. I have a chest freezer and they will not spoil in the freezer. Sometimes I season them, sometimes I don't. You can also just put whole tomatoes in a plastic bag and freeze. While easier initially, I have found that the total work is actually more for this method.

For details on harvesting and storing each crop, click or scan

I used to make strawberry jam with my excess strawberries. Then I discovered that the jam was much more useful when it didn't set and wasn't jam at all, but a thick puree/sauce. Jam doesn't go well on ice cream or in homemade sodas, but strawberry sauce does. It also doesn't require the insane quantity of sugar required for pectin to set. Similar to my tomato method, I just boil and immersion blend my excess strawberries, but I do add some sugar and low sugar pectin (or if I have them, I'll substitute the pectin for black currants or gooseberries). Then I jar and freeze. At most, I add only half of the sugar the pectin requires (even the low sugar stuff requires an unhealthy amount of sugar). Using this method also allows for alternative sugars to be substituted and you don't have to stress about it setting. I still use pectin simply to thicken it to a nice consistency.

Orchard

Orchards are very rewarding, providing years of abundant harvests. They also require a lot of space, many years to mature, and every pest seems to loves fruit as much as we do. There are only a few keys steps to growing a successful crop. Most of the information in this section is drawn from "The Holistic Orchard: Tree Fruits and Berries the Biological Way" by Michael Phillips. Phillips has been growing for a long time in Maine and his book is one of the leading in the field. Here is the summary of his methods in 3 pages.

Planting

Once you select a site, you need to kill off any vegetation and then dig a hole to loosen up the soil so the roots can grow. There is not a strict requirement, but the hole should be around 3x the root ball or approximately 3' in diameter. Plant disease resistant varieties in the spring that are suited for your zone. If the soil is poor, add approximately 10% compost by volume of soil. If you want to go for perfection, add 1 lb of each of these 3 amendments: Rock Phosphate (such as Tennessee Brown), Azomite clay and humates (shale/humic acid). Adding mycorrhizal spores is another bonus that can boost root growth. Protect the trunks with plastic or metal mesh (NOT the spiral guards). Protect from deer with larger fencing or netting. Filling the tree circle with 3-4" of pea gravel also protects against voles as long as it is kept below the graft.

After the first year, each year in the spring add 2 lbs long term nitrogen fertilizer such as soy or alfalfa meal.

Spraying

The most difficult aspect of growing an organic orchard fruit is protecting the fruit from pests and disease. Philips has a 4 part spray that has worked well for years for him. He applies it 4 times a year, timed according to bud development:

1 | ¼" green (late spring early summer)

2 | Early Pink (when the first signs of pink blossoms show)

3 | Early Petal fall (when the pedals begin to fall off, late June in Maine)

4 | 7-10 days after previous application

The spray consists of four components

- Pure Neem Oil
- Liquid Fish (NOT emulsion)
- Seaweed powder
- Effective microbes

Instructions

In a Solo 4-gallon sprayer with piston pump and brass tip, mix

- 2.5 oz pure neem oil
- 1 tsp biodegradable liquid dish detergent
- 10 oz liquid fish
- 5 TBSP Microbes
- 1 TBSP Molasses
- ½ oz liquid or 2 TBSP dry Seaweed

Spray on every part of the tree, even the base of the trunk and surrounding soil. Recommended brands for these products are Organic Gem liquid fish (3-3-.3), North Country Organics Stress-X Seaweed powder, and ProBio Microbes. Compost tea is a substitute for microbes.

These sprays are designed to inhibit pests during their natural life cycles. Monitoring these pests is the A+ way to ensure you are targeting the right pests. During early pink spray, if caterpillar damage is observed around buds, BT can also be sprayed. If coddling moths are detected around the last spray application, Kaolin clay is also effective at protecting young fruit development. Coddling moths can be trapped using pheromone traps. Sav fly populations can be monitored using white sticky traps when bloom begins. Apple maggot flies are attracted to the yellow sticky traps. Just like the vegetable garden, simply finding the bugs and smashing them can be an effective method of control in small orchards with young trees. Especially for borers, that can kill a tree but if found early can quickly stopped without any spray.

In late June, herbal tea can be sprayed on the trees to boost health. Philips method for herbal spay is fermenting Comfrey, Stinging nettle and Horsetail in 5-gallon buckets for 5-7 days. Each plant is placed in individual buckets, broken down with a kettle of boiling water, topped off with water and garlic scapes as a bonus. After 5-7 days outside, they are filtered, mixed together and sprayed on the leaves, branches and fruit.

Other tips for dealing with pests including: a sticky ball trap (representing an apple) for apply maggot flies. Bacillus thuringiensis (BT) or granulosis virus for codling moth applied at the 4th spray can be effective along with pheromones to disrupt mating. A trap tree can also balance out the population. Trap trees work when you limit access to soil around the tree. Laying old carpet around the base of the trap tree is one recommendation to stop pest from laying eggs or larvae around the soil of the tree.

Harvesting and Soil

Harvesting the fruit is pretty straightforward: In the fall when the fruit taste good, pick them. Do not yank them off the plant, but rather twist them like you were opening a door.

Tips for building the soil: mulch with ramial wood (small branches, less than 2” in diameter). Grow comfrey around drip edge of tree ring. You can also suppress weeds with sheet rock, also known as dry wall, a gypsum board that will add limit weed growth and add some calcium to your soil. Works best in clay soil and do not use any dry wall with additives, such as the mold resistant kind that is usually not white in color.

Pruning

Pruning and training the branches is key to maximizing harvest. The main step in pruning happens in early spring or late winter (January – April depending on zone). There is not a one size fits all strategy for this since every tree grows differently. The goal is for each branch to get minimum 30% of available sunlight and to achieve an ideal Christmas tree shape: a cone, round from the top view and triangular from the side view. To do this, start with the structure of the tree, cut the larger branches first, then move to the smaller ones. You want 3-5 limbs per

scaffold layer, ideally spaced evenly around the trunk. Each layer should have space between them, minimum 8”, to allow for sunlight penetration and airflow. Also, ensure there is only one leader at the top of the tree and that branches do not cross.

In summer, 30-40 days after bloom, thin the apple buds to only the center king fruit. Each bloom grows in groups of 3 or 5 and the king fruit is the largest one in the center. Remove all but the king bud unless it is diseased or has bugs, in which case remove the bad buds and pick another one to keep. At this time, small vertical suckers branches can also be removed. You can also ensure the limbs are at the correct angle (between 45-60 degrees from main trunk) by using spreaders. For small trees, clothespins are effective spreaders, for larger trees, use pieces of wood with notches at the end. For very large branches, tires can be hung from the branch.

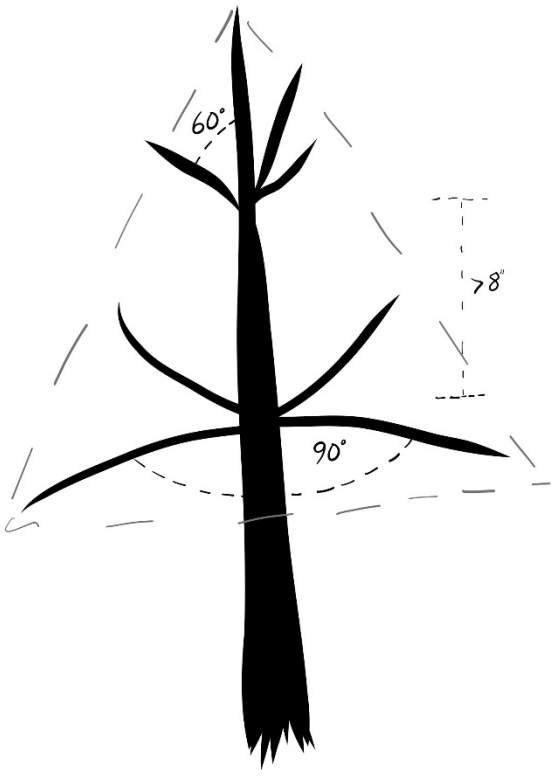

Figure 5. Fruit Tree Pruning

Perennial vegetable/fruit guide

Asparagus

Asparagus are the first food you will start to harvest in temperate climates. They take a few years to mature, but result in years of food.

Planting

Year 1: Transplanting crowns. Amend the soil (as you would with any plant) and dig a trench about 30 cm (12”) wide by 20 cm (8”) deep. In the bottom of the trench add a ridge of soil about 10 cm (4”) high. Place the crown of the plant about 30 – 40 cm (12”-18”) apart at the top of the ridge spreading the roots down the sides of the ridge. Cover the crown and roots with soil and keep the plants well-watered. Once planted just leave the plants to grow (no harvesting).

Year 2: I recommend waiting another year to harvest but if plant growth is very strong, you can harvest one stem per plant to possibly harvesting for two weeks.

Year 3: 1st year of harvesting. Some suggest that you can now harvest for the full season others suggest cutting for just 3 - 5 weeks.

Year 4+: Full harvest, i.e., harvest for an 8-week season.

Maintenance

- Cut back every year in the fall when they yellow. Cover soil with leaves
- Top dress with fertilizer/compost every early spring.

Blueberries

Blueberries are one of the slowest berries to mature, but like all perennials, produce for years.

Planting

Plant new bushes in the spring 3’ apart in acidic soil (pH 4.0 – 5.3) that is rich and well-draining.

Maintenance

- As with most plants, top dress with compost in the spring.
- After the first or second year, prune the bushes annually in the early spring to remove old or diseased wood. Keep young green stems since fruit only develops on one-year old branches.

Currants and Gooseberries

These bushes produce fruit that is tart and mostly useful for making jam as a pectin replacement.

Planting

Plant bare-root plants in early spring in rich and well-draining soil.

Maintenance

As with most plants, top dress with compost in the spring and keep weed free.

After three years, prune the bushes annually in the early spring to remove old or diseased wood. Leave 9-12 canes of various ages. Do not let the branches touch the ground; they will develop roots and spread.

Hops

A key ingredient in beer, but also great for tea.

Planting

Transplant rhizomes in early spring to well-draining rich soil, spacing 3’ apart.

Maintenance

Trellis >10’ and top dress with compost in the early spring when they emerge from the soil. I use jute rope and replace it every year. Cut completely back in fall.

Raspberries

Raspberries are just too easy to grow for anyone not to. However, they require a trellis to keep them upright. A simple trellis consists of two 6’ tall posts at each end of the row with two horizontal section approximately 2’ in length attached at the top and middle. Connect the opposite horizontal sections length wise along the row with galvanized wire. There are two main classification of raspberries, primocane and floricane, so make sure you know which type you planted.

Planting

Transplant canes in early spring to well-draining rich soil, spacing 2’ apart.

Maintenance

Prune back in late fall (preferred) or early spring. Thin to 4 to 5 canes per foot of row. Cut canes to 4-5’ tall, within 12” of the center of the row.

Top dress with compost in spring and remove weeds by hand as they grow.

Strawberries

Strawberries are the first fruit you will start to harvest in temperate climates. They take one to two years to mature and produce food for many years.

Planting

Plant transplants in the spring. There are several different varieties, I recommend planting at least two with different harvest times. Amend the soil (as you would with any plant) and plant about 30 – 40 cm (12”-18”) apart. You can harvest the second year onwards.

Maintenance

The strawberry plants will spread. Use this to your advantage to maintain constant new growth while trimming them back so they do not take over your garden.

In early spring, weed entire strawberry patch, remove old and diseased plants, top dress with compost and cover with straw.

After harvest, in mid to late summer, mow the entire patch flat and rake out debris. Thin plants and keep patch weed free by hand weeding. Before winter, cover with layer of leaves or straw.

Glossary and Recommended Products

How do I find additional information?

This guide is meant to cut through the endless information to get you 90% of the way to a successful garden. When you eventually need to look up more information do, always include the term 'extension' in your search. The university extension programs in the US are wonderful sources of detailed, science backed information, not the click bait blogs populating the top google search results. For best results, use information from extension offices that have a similar climate as the one you are growing in, e.g., for my climate in New York I will use information from Cornell, Penn State, Minnesota, etc., but not Florida or California.

Air pruning: Exposing seedlings' root tips to air, promoting the growth of healthy roots

BioChar: Biomass heated at high temperatures in closed containers with little to no oxygen. (Lehmann and Joseph, 2015). Research has shown this is an effective soil amendment.

Broadfork: Similar to a pitchfork, but designed to aerate soil for low till gardening.

Cell trays: Containers with many separate cells for starting seeds. They vary greatly in size and quality. Determine how many and what type of plants you plan on starting. Use this information to buy the right size.

Compost: A mixture of organic matter that has been digested by organisms and is a rich source of plant nutrients. All compost is not equal. Many municipalities offer free compost, you just have to pick it up. However, it is often not well balanced and may be contaminated. A horse stable is another free source of compost, but you will have to find one willing to let you take it and you should find one that provides high quality feed to their horses. For the best quality, look for *organic vermicompost*.

Making your own: Similar to gardening, making your own compost is fundamentally simple, you mix food scraps and other biodegradable material together in a pile and wait. Also like gardening, doing it right requires understanding a few basic principles and doing it efficiently requires translating the theory to practice.

The theory: There are two things you need to balance in compost pile: Carbon/Nitrogen ratio and moisture content. If the compost is too dry (i.e., it crumbles rather than clumps when squeezed into a ball), add water. If it is too wet (i.e., looks like mud), allow it to dry or cover it from rain or other water sources, whichever is causing the problem. It is more challenging balancing the C/N ratio, which should ideally be 30 parts carbon to 1-part nitrogen. Nitrogen components, also called the 'greens,' are your food scraps. You will need 30x the mass of carbon, also known as the 'brown' component. This can create a problem since food scraps are accumulate throughout the year and add a lot of moisture to your compost. You can find a full list of green and brown components at any extension office website, but what they fail to mention is how to ACTUALLY balance them.

In practice: You will need a minimum of two compost piles, one to continually add to and another allow to age and pull compost from. I prefer a tumbling composter for adding food scraps too because it 1) keeps animals out and 2) is very easy to turn, incorporating oxygen into the pile and speeding decomposition. My second compost pile is just a pile on the ground, contained by a 3' x 3' structure made from reclaimed wood. As you add food scraps, the C/N ratio quickly gets out of balance and the pile becomes too wet. What do you do when this happens: keep a large pile of leaves from the fall at all times in your garden. I usually have a large trash bin stuffed with leaves for this purpose because the compost pile usually falls out of balance in the spring and summer when the trees still have their leaves. Adding dry leaves both adds dry material to an overly wet mixture and a free source of brown.

Compost Tea (JADAM): A liquid fertilizer made from scrap organic material such as weeds and an inoculate such as leaf mold, compost or potatoes. Some teas do not require aeration (such as the one described by Philips in the section on Orchards) while others require a pump to push air into the liquid. This has become very popular but the benefits are not scientifically established due to inconsistent inputs and processing techniques. The quality can vary dramatically and can actually introduce disease to your garden (it also stinks oh so bad).

Efficiency of Scale: Economies of scale are the cost advantages that enterprises obtain due to their scale of operation, and are typically measured by the amount of output produced per unit of time (Wikipedia).

Hoe: A tool with a flat blade attached approximately at a right angle to a long handle, used for weeding, cultivating, and gardening. (The American Heritage® Dictionary of the English Language, 5th Edition)

Hügelkultur: "A sloped and raised planting bed filled with topsoil, wood, and organic materials" (Oklahoma State Extension)

Greenhouse: Greenhouses are the cheat code to gardening. They vary in shape and design, from small hobby greenhouses to deep winter greenhouses. If you have the space and financial means to build one, do it. I use a small cheap one I bought on Amazon to extend my growing season. The main drawback of a greenhouse is the cost of installing and maintaining it. The pest pressure is usually better than outside, but the common pests are different and require manual intervention because the predators that naturally manage pests are removed from the system. You can easily roast your plants if you don't manage the ventilation and leave it closed on a sunny day. My small one also can blow over, which can be a costly mistake.

Rain Barrels: Food grade plastic containers that store non-potable rain water to be used in the garden. You can make one yourself for less than $40 if you call your local brewery and ask if they have any. They have to pay to dispose of them! You will need to drill a hole and install a spigot at the bottom of the rain barrel. If you place it near a downspout, you can buy an adapter that directs the water into the barrel, but there are several ways to set it up. Find the one that works best for your situation.

Row Covers: Woven fabric that protects plants from pests and frost. Can be laid directly on plants (floating row cover) or suspended over some type of structure (as described on pg. 9). The main disadvantage of row covers that no one talks about is the hassle of removing them for watering, weeding, or just simply checking on your plants.

Soil blocker: A metal hand-held device to create soil blocks for seeding and transplanting. Great for plant health due to maximum air pruning, but more time consuming than cell trays and relatively expensive. A plastic free way to start seeds.

Tilling: The mechanical manipulation of soil.

Trap plants: Sacrificial plants that attract pests rather than your crops.

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About the Author

The author has grown food in four states in the US over the last 2 decades. Richard has a master's degree in Chemistry from the University of Oregon and a PhD in operations and supply chain management from Michigan State University. Additionally, Richard trained and volunteered as a Master Gardener through the Monroe County extension office of the Cornell cooperative. The author has published several academic research studies in the area of sustainability, innovation and risk management. Richard is also a carpenter, building both structures and furniture. He has brewed 100s of gallons beer in the last 16 years and definitely never made moonshine or grown medical herbs. Richard is just another earthling hoping to make the world a better place if only ever so slightly. To find out more or connect with the author, visit the author's personal website: www.rkraude.com