RECOMMENDED CROP LIST

THE PURPOSE OF THIS GUIDE

The decline of the family farm and the advent of hydroponics has changed the shape of farming. Hydroponic techniques often require different crop conditions, and when conditions are different, management is different.

This guide is written to help you optimize growing conditions and practices to grow crops better than ever before.

Use this guide to build a crop list; compare the ideal pH and EC ranges, imagine the labor involved in planting and harvesting, and always be aware of the different space requirements of each plant.

Editor's Note: This eBook was originally co-authored through ZipGrow and uses examples and data from a ZipGrow operation. However, the principles presented in this eBook are helpful to most small farmers and can often be applied to other techniques such as DWC, NFT, and Dutch buckets.

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DIFFERENCES BETWEEN CROPS

ENVIRONMENTAL NEEDS

Growers benefit from new technology and resources by being able to grow almost anything anywhere. All they need to do is choose crops that can grow together in the environment they choose

There are some tricks for growing dissimilar crops in the same environment.

For example, differences in irrigation needs can be solved by plumbing your system with valves on each section to control irrigation, timing, and pressure for independent sections. A grower with rosemary in one section can turn the valve onto that sector for a few hours a day, but still water fennel or lettuce on a constant drip by controlling the valves on those crops' respective sections.

NPK Ratios		
Greens	8-15-36	Lettuce, chard
Herbs	2-3-8	Rosemary, basil
Flowering & Fruiting	2-9-19	Strawberries, tomatoes

REPRODUCTIVE CYCLES

The reproductive stage of a plant's life cycle is cued by age and environmental values like heat and light. You can steer your crops to or away from these life cycles by pruning, and by adjusting light ratios, nutrient ratios, and temperature.

For most greens and herbs, reproductive growth means bolting. During this stage, vegetative growth slows down and the leaves become bitter and tough.

For other crops such as strawberries, cucumbers, squash, melons, etc., reproductive growth is the desired outcome.

Pollination can be an issue for indoor fruiting crops. Growers have several options:

- Find varieties that are self pollinating
- Introduce pollinators (bees)
- Hand pollinate using a paintbrush, toothbrush, etc.

HARVESTING AND PRUNING

Differing crop varieties and techniques require different harvesting methods. Some crops (like lettuce) are only harvested once before being torn out and replanted. Other crops, such as kale, mustard, chives, chard, and some herbs can be harvested multiple times.

Check out this video for information on harvesting equipment and this video on how to harvest different crops.

Harvest and prune carefully to maximize the next production cycle of the plant.

On woody plants like basil, a main stem grows upward and dominates production. There is a pair of lateral buds on the stem which do not grow into branches unless the main (apical) stem is cut. If you cut the apical stem, you can trigger growth from the lateral buds, replacing the one branch with two branches, increasing production with bushier growth. This is one way to increase the production of a basil plant. Other growers prune to favor a center stem, which is harvested more frequently and has a more consistent length.

For mint and chives, on the other hand, growers can trim the growth down completely to one inch from the face of the tower.

**A note on EC/PPM. PPM readings may differ from instrument to instrument. These PPM levels are standard to a Hanna Instruments meter. When in doubt, refer to EC over PPM as the unit.

IDEAL TECHNIQUES

ZIPGROW TOWERS

ZipGrow Towers are a media-based vertical technique used for either hydroponics or aquaponics. A hybrid of NFT and media systems, ZipGrow offers high biological surface area in a modular form.

ZipGrow Towers best grow high-dollar small statured crops such as herbs and greens, although users have experimented successfully with larger crops such as tomato and squash. Larger vining or sprawling crops require more labor and don't take advantage of ZipGrow's labor-focused design. To learn more about spacing, production, and ZipGrow products, visit the ZipGrow website.

DEEP WATER CULTURE

Deep water culture (DWC) or raft systems are a water-based system using floating rafts to house plants. A slow-moving and recirculating hydroponic solution delivers nutrients to plant roots, which dangle into the water below. DWC systems can be used in either aquaponic or hydroponics. (For more info on aquaponic DWC, see the Upstart University class.)

Since plants in DWC rely on the rafts to keep them afloat as they grow, size is a major limiting factor for DWC crops. Large statured plants - especially those like cucumber or tomato which can grow to several meters tall, are not recommended for DWC systems. Medium statured plants such as okra will require extra support from trellising or twine. Greens are often the crop of choice for DWC growers, and in fact many hydroponic lettuces bought in grocery stores are grown in DWC systems.

DWC is a favorite in tropical climates, especially where space and labor are cheap. To learn more

about production techniques in which is right for you, take the Choosing a Production Method Course.

BATO BUCKETS

Bato buckets or Dutch buckets use modular media beds typically filled with perlite or hydroton. Bato buckets are most often used in greenhouses for vining crops. Pay attention to available spacing, spacing recommendations, and crop size as you choose Bato crops.

Best used for hydroponics, Bato buckets may be run as either a precisely irrigated drain-to-waste system or a (more difficult to manage) recirculating system. A sub technique of Bato buckets is the bag system, where plastic bags filled with coir or other loose media hold crops. Another sub technique is homemade bucket system, which can be cheaper but are ineffective on a commercial scale.

Many Bato systems are used in conjunction with lean-and-lower systems, a trellising system for tomatoes which slowly lowers top branches as the vine grows from below.
To learn more about building a Bato bucket system, check out our blog. Thinking about going commercial? Don't miss the tips in the Upstart University Bato buckets course.

GLOSSARY

Apical growth: growth which grows upward from the apical bud of the plant; usually results in the "main" branch of the plant.

Bolting: a shift from vegetative to reproductive growth, usually resulting in a tall inedible flower stalk and a bitter taste.

Cole crops: (Brassicas) varieties of the species *Brassica oleracea*, including mustard, cabbage, kale, broccoli, and kohlrabi, among others.

IPM: (Integrated Pest Management) a pest management strategy which utilizes multiple types of control and precise timing to control pest populations for the best economic outcome in the long term.

Lateral buds: the set of undeveloped buds situated on the side of the stem of a plant which grow if the apical branch is badly damaged or removed.

Turn: the time it takes for a plant to grow from transplant to harvest-able crops.

As you can see from the elongated stem and the leaves which are starting to turn inward, this lettuce plant is beginning to bolt and will soon become bitter.

GREENS

Greens are considered low-dollar crops, fetching $3.50-5.00 per pound. Though they bring in less per pound than most herbs, greens can be a benefit to farmers because they satisfy a consistent need in most communities.

Greens can also be a liability-reducer for farmers, who can rest assured knowing that it will only take four to six weeks (a typical turn for greens) to return to full production.

SWISS CHARD

pH range: 6.6-7.0
EC/PPM: 1.8 to 2.3 / 900 -1150
Light: 4-8 hours
Temp: 55-75° F; frost tolerant

Planting: Easy to grow from seed
Harvesting: Only harvest 30-35% of the plant, leaving the rest of the plant to support another harvest
Yield: .5 lbs./ Tower/ 6-week turn

Pests & Diseases: Minimal; very rarely, aphids & powdery mildew

Ideal Technique: ZipGrow Towers; DWC

ABOUT CHARD

Chard is a French green popular in greenhouses and kitchens around the world. The tender leaves add freshness and a mild buttery flavor to dishes like soup, the bacon-friendly southern dish "greens and beans", and even in salads or on BCG (beet, chard, and goat cheese) sandwiches.

Chard leaves grow on elegant stems which range in color from red, to yellow, to white, and can get larger than a dinner plate. Chard is a good crop for beginners.

The cool weather crop is not only tasty and easy to cook, but easy to grow in almost any hydroponic or aquaponic system. A multitude of varieties can be found from seed companies; our favorite is Swiss "Rainbow" Chard.

Chard is a fairly tough crop; pests include the occasional aphids and (very) occasional powdery mildew outbreak. Although high or low temperatures will affect the taste, the crop is overall very tolerant of stressful conditions.

Chard is bi-annual, so it will not bolt for the first year.

HARVESTING & STORAGE TIPS

Chard can be harvested 4-5 weeks after being transplanted, and yields well. (In ZipGrow Towers, healthy systems produce 4 lbs per 5-foot Tower per 4-week turn, and 5.5 lbs per 5-week turn.)

Growers should only harvest chard partially, leaving 65-70% of the foliage for the plant to photosynthesize to the next turn. To harvest, clip the largest leaves from the plant, as close to the base of the plant as possible. Harvesting in the morning or evening can help keep chard fresh. When harvested this way, chard plants can yield for several turns in a row.

Chard can keep over a week without beginning to wilt if treated correctly. Chard lasts longest when stored without washing and sealed in containers or bags at cool temperatures, which dramatically reduce respiration and decay incidence.

TIMELINE

Chard is easiest to grow from seed, and germinates within 1-2 weeks. Plant chard seedlings at 8-10 inches apart in most techniques including ZipGrow Towers. The plants grow quite large and can shade each other out if too close.

Seed
(0 weeks)

Germination
(5-7 days)

Transplant
(3-4 weeks)

Harvest
(4-5 weeks)

MUSTARD GREENS

pH range: 6.0-7.5
EC/PPM: 1.2 to 2.4 / 60-1200
Light: 12-18 hours
Temp: 55-75° F; frost tolerant

Harvesting: For partial harvest, only take 30% of the plant at one time
Yield: .3.1 lbs./ Tower/ 5-week turn

Pests & Diseases: Few; cabbage loopers, flea beetles, cabbage worms, and clubroot possible if grown in soil.
Ideal Technique: ZipGrow Towers; DWC

ABOUT MUSTARD GREENS

Brassica juncea, or mustard greens, is another member of the brassicas family (a relative of kale and cabbage). Although its precise origins are unknown, there's support to assume that mustard is native to Eastern Europe and Asia, as is reflected by its common names – India mustard and China mustard. Here in the West we just call it "mustard greens."

The ruffled leaves of mustard taste similar to radishes and can add a spicy bite to a salad, sandwich, or can be eaten by themselves (often steamed). Mustard is often cultivated for its seed, which is used in brown mustard (the condiment) and has been used for centuries in folk remedies for aches, arthritis, and even to promote cow milk production in some areas of the world.

A grower favorite is the Southern Giant Curled variety; however many varieties have been bred with different flavors and colors ranging from green to dark purple.

Although mustard greens aren't the first thing that come to mind when creating a weekly menu, they are a great addition to spruce up a dish that is lacking flavor. Selling mustard greens in large quantities will prove difficult. (Try suggesting a few recipes to interested customers to help them use their mustard greens!)

Mustard is another crop which is easy to grow, and a favorite with Upstart Farmers. Mustard will grow almost anywhere using any technique, and although it will survive down to 35° F, it's not as frost tolerant as some of its cousins.

When grown outside and/or in the soil, mustard greens can have issues with cabbage loopers, flea beetles, cabbage worms, and clubroot. Grown vertically and/or in healthy hydroponics systems, this is not likely.

Mustard greens can be managed similar to kale – grown from seeds, which take 4-7 days to germinate, the seedlings will be ready to transplant at 2-3 weeks later (at 3-4 weeks from the seed planting). After 4-6 weeks growing, growers can harvest the greens partially (recommended), taking only 30% of the plant and leaving the rest to continue to grow. We've experienced yields of 3.1 lbs per 5-foot ZipGrow Tower this way, although light and nutrients impact that number.

Pricing for mustard greens varies widely by market, quality, and value points, but most Upstart Farmers are getting pricing at $5.00-6.00 per pound.

TIMELINE

KALE

pH range: 6.0-7.5
EC/PPM: 1.8 to 3.0
Light: 12-18 hours
Temp: 45-85°F

Planting: Plant kale from seed
Harvesting: For partial harvest, only take 30% of the plant at one time
Yield: .4 lbs./ Tower/ 6-week turn

Pests & Diseases: Rare; aphids and powdery mildew most likely indoors

Ideal Technique: ZipGrow Towers; DWC

ABOUT KALE

Kale has been hailed as a super food and has found its way into home and restaurant menus alike. Crop varieties from the scaly-looking Dinosaur Kale (also called Tuscan Kale) and Curly Kale grace our soups, smoothies, salads, and more. Some varieties display shades of red and purple, like Russian Red Kale.

For farmers, growing kale with hydroponics can be a simple and profitable option. Kale's popularity can bring in good profit for farmers. The crop grows relatively quickly with a six-week turn from transplant to harvest, or can be harvested partially to regrow (no more than about 30% for quick regrowth). Growers using ZipGrow Towers can expect to see 4 pounds of produce per tower for a full harvest when conditions are favorable.

Kale's wide electrical conductivity (EC) range makes it compatible with many different herbs and greens, though best growth is seen closer to 3.0. (A basic greens formula will work well for kale.)

Kale is a cool weather crop, and many growers even apply cooler temperatures (down to 40° F) purposefully to draw out a smoother, improved flavor in the green.

Fortunately, kale is another crop which – when grown indoors – is targeted by only a few pests such as aphids and some powdery mildew.

TIMELINE

ARUGULA

pH range: 6.0-7.5
EC/PPM: .8-1.2 / 400-600
Light: 12-18 hours ideally, but tolerant of 8-10 hours
Temp: 50-65°F

Planting: From seed
Harvesting: Full harvest
Yield: .2-3 lbs./ Tower/ 5-week turn

Pests & Diseases: Rare; aphids and flea beetles. Disease problems rarely occur.

Ideal Technique: ZipGrow Towers; DWC

ABOUT ARUGULA

Arugula is a brassica, like mustard or kale. It carries a spicy punch in a tender leaf, making it a great addition to salads, pizzas, and sandwiches. Some varieties are spicier than others, with the Rocket variety being considered the spiciest of the three most popular (Astro, Rocket, and Sylvetta).

Though arugula grows like lettuce (some varieties are ready for harvest in just 3 weeks), it's often considered an herb. Farmers can typically get slightly higher prices on arugula than lettuce, with some sellers achieving the extreme, about 50-60¢ per ounce. A more realistic price range would be $3-5 per pound.

CABBAGE

pH range: 6.0-7.5
EC/PPM: 2.5-3.0 / 1250-2100
Light: 6-12 hours
Temp: 40-70°F

Planting: From seed
Harvesting: When head is firm; one time
Yield: 4 heads, 2-8 lbs./ Tower/ 5-week turn

Pests & Diseases: Pests include slugs, aphids, and flea beetles; Diseases include blackleg, black rot, and fusarium
Ideal Technique: ZipGrow Towers

ABOUT CABBAGE

Cabbage is one of the cole crops. (Cabbage is *Brassica oleracea var. capitata*)

Hydroponic cabbage is a fairly hands-off crop to grow. General pest control measures (use an IPM plan) usually keep pests at bay, and cabbage needs no extra pruning or training. The heads grow large (8 lbs is not uncommon), so farmers can get a fairly large crop from a small space. From one 5-foot ZipGrow Tower, for example, a farmer could get 4-6 heads totaling 30-50 lbs if grown correctly.

Overgrown cabbage heads crack and split. Splitting is caused when the heads grow large and firm, then resources (such as water or fertilizer) are increased. Keep growing conditions consistent, and don't wait too long to harvest.

Cabbage is vulnerable to common pests such as aphids and fusarium, as well as fungal diseases like blackleg and black rot. The latter are usually due to the crown of the plant being kept moist. Watch out for leaks or high water levels that could do this.

In ZipGrow Towers, cabbage can be planted 4-6 plants to a Tower.

Consumers might find prices for grocery store cabbage near $.60/lb. Prices climb for organic cabbage or local cabbage, which goes for $1.25 to $2.00 per pound.

At a price of $1.25/lb a farmer could sell a 5-lb head of cabbage for $6.25 or an 8-lb head for $10. If he/she is growing in towers, they might make $25-40 off one Tower.

TIMELINE

For best germination rates, keep seedlings a little warmer than mature crops (65-70° F). Scarification of seeds can also increase germination rate. After being planted, seeds will germinate in 4-7 days, and will be ready to transplant 4-6 weeks later or when the first true leaves arrive.

Depending on the type of cabbage and the size of head desired, the crop will be ready for harvest 9 to 11 weeks later. Harvest when the head is firm and big enough for your markets.

BOK CHOY (PAK CHOI)

pH range: 6.0-7.5
EC/PPM: 2.5-3.0 / 1250-2100
Light: 6-12 hours
Temp: 40-70°F

Planting: From seed
Harvesting: When head is firm; one time
Yield: 4 heads, 2-8 lbs./ Tower/ 5-week turn

Pests & Diseases: Pests include slugs, aphids, and flea beetles; Diseases include blackleg, black rot, and fusarium
Ideal Technique: ZipGrow Towers

ABOUT BOK CHOY

Bok Choy comes in a range of sizes, including large varieties like Joi Choi and smaller varieties like Shanghai Green Pak Choy, which offer more compact, tender heads with delicate flavor.

Bok Choy (*Brassica chinensis L.*) belongs to a genus in the mustard family called the brassicas. Members of brassica include kale, cabbage, broccoli, cauliflower, and dozens of other important food crops. Perhaps the most similar member of brassica – in terms of appearance and taste, anyway – is Tatsoi.

Tatsoi (*Brassica narinosa*, also called Broadbeak mustard) displays the same thick leaves and light veins as Bok Choy and tastes just as good. Tatsoi can be grown in similar conditions.

Napa cabbage (*Brassica rapa Pekinensis*) is another brassica member which, while it looks different than Bok Choy and Tatsoi, has the same sweet flavor and crispness. It can be used in many of the same recipes (Napa cabbage is often used for the Korean dish, kimchi). Napa cabbage prefers the pH and EC range of Bok Choy as well, and tastes better when grown in cooler temperatures.

HARVESTING & STORAGE TIPS

Bok Choy has thick but fragile veins and ribs; take care when handling not to break leaves. Store Bok Choy in containers with good air circulation and high relative humidity, at temperatures in the 30's (° F), or just above freezing.

TIMELINE

Plant Bok Choy from seed and transplant as soon as there are true leaves on the plant; this will typically occur in about four weeks. Though highest yields occur at six weeks from transplant, Bok Choy may be grown on shorter turns down to four weeks.

LETTUCE

pH range: 5.6-6.2
EC/PPM: .8-1.2 / 400-600
Light: 10-18 hours
Temp: 45-70°F

Harvesting: Harvest lettuce as a whole head (or whole plant) and store at 32-35° F. Keep temperatures as consistent as possible.
Yield: 7.3 lbs./ Tower/ 5-week turn

Pests & Diseases: Aphids, leaf miners, and powdery mildew.
Ideal Technique: ZipGrow Towers; DWC

ABOUT LETTUCE

Lettuce is one of the most popular crops in the world. The cool-weather crop grows sweet and tender, a perfect addition to any fresh dish.

Lettuce grows well in almost any gardening system, whether hydroponic, aquaponic, or traditional soil gardens. It takes up relatively little space, has a short (5-6 weeks from transplant or 9-11 weeks from seed) growing cycle when it's healthy, and there is always high market demand.

Hundreds of lettuce varieties are grown around the world. The common varieties, like red and green Romaines, Iceberg, Oak Leafs, Green Leaf, and Mesclun mixes, can be found in almost any grocery store.

Don't forget about unique heirloom varieties. Seed companies like Baker Creek Heirloom Seeds offer great varieties like Deer Tongue, Bronze Beauty, Brune D'Hiver, Cimmaron, and Devil's Ear lettuce.

HARVESTING & STORAGE TIPS

Harvesting techniques can affect shelf life if the lettuce is handled roughly, bruised or crushed during the process. This makes the produce much more vulnerable to post-harvest decay and diseases, as well as impacting the scalability of the produce.

Quick tips for harvesting and storing:

- Harvest the whole head.
- Store at 32-35° F and keep temperatures consistent.
- Don't let the lettuce freeze.
- Process the lettuce minimally.

Lettuce can be harvested quickly as a batch by taking the whole head. (Many growers harvest the entire plant, including the roots, which can extend shelf life if the growing technique facilitates it.) For growers using ZipGrow Towers, a harvesting knife used to cut each head where it meets the face of the Tower is best. Horizontal growers should harvest close to the surface of the soil or other growing apparatus.

Lettuce, with so much transpiration and moisture, can be tricky to store for more than a few days before it starts wilting, or worse — gets slimy.

Lettuce needs cold temperatures to extend the shelf life. Just above freezing (35° F, or just above 0° C) is ideal, and lettuce can stay fresh for up to three weeks this way. Don't let the lettuce freeze! If frozen, the leaf epidermis will separate from the other tissues, and the leaf will decay rapidly.

Lettuce requires humidity to keep from drying out, but condensation or heavy moisture on the leaves is detrimental. The best thing that producers can do to avoid condensation is to keep temperatures very consistent. Process lettuce as little as possible.

TIMELINE

Seed
(0 weeks)

Germination
(7-14 days)

Transplant
(3-4 weeks)

Harvest
(5-6 weeks)

HERBS

Herbs are high value crops with a continuous yield.

Herbs can be easier to grow than greens, but take a longer time to reach maturity. This longer maturation time can cause problems. In case of an emergency, it takes longer for a grower to reach full production again; however, most herbs can be harvested multiple times.

Herbs regularly bring $1.99/oz.-$2.99/oz.

OREGANO

pH range: 6.0-8.0
EC/PPM: 1.5-2.0 / 750-1000
Light: 12 hours
Temp: 55-70°F

Planting: Propagation by cutting is best
Harvesting: Multiple harvest; prune similar to rosemary
Yield: 2.5 lbs./ Tower/ 8-week turn

Pests & Diseases: Thrips, whiteflies, spider mites etc.
Ideal Technique: ZipGrow Towers

ABOUT OREGANO

Oregano (*Origanum spp.*) is a small, bushy herb with a strong unique flavor that's especially pungent when the herb is fresh. The leaves are used fresh and dried in most types of cuisine, but especially Italian and French.

There are three main kinds of oregano used for culinary purposes: Greek (*Origanum vulgare hirtum*), Mexican (*Lippia graveolens*, which actually isn't oregano at all), and Italian (*Origanum x majoricum.*) Oregano has small, rounded leaves that are fuzzy in some species – this makes it harder for them to deal with high humidity.

You can buy oregano in bulk for $60-65/lb, which ends up being about $4/oz. Dried oregano is $2.50–4/oz, and dried organic oregano comes in higher at $5-5.50/oz. Fresh oregano pricing varies by market and grower, but Upstart Farmers can consistently receive at least $2-3/oz. for herbs.

Because oregano is a popular herb, demand isn't difficult to secure. Be sure to check in with your local markets. Your crop choices should heavily depend on real-life feedback that is specific to your

situation.

Oregano can bring in a lot of profit, but be aware that the growing timeline is much longer. Oregano is a slow grower – the first harvest is 8 weeks after transplant. Once established, the tips can be harvested every 3 or 4 weeks.

Oregano needs dry periods in irrigation and thoughtful pruning.

Oregano suffers from typical greenhouse pests like thrips, whiteflies, and sometimes aphids. Be especially aware of over watering: Like rosemary, oregano prefers low watering and is susceptible to root rot and other diseases if over-watered.

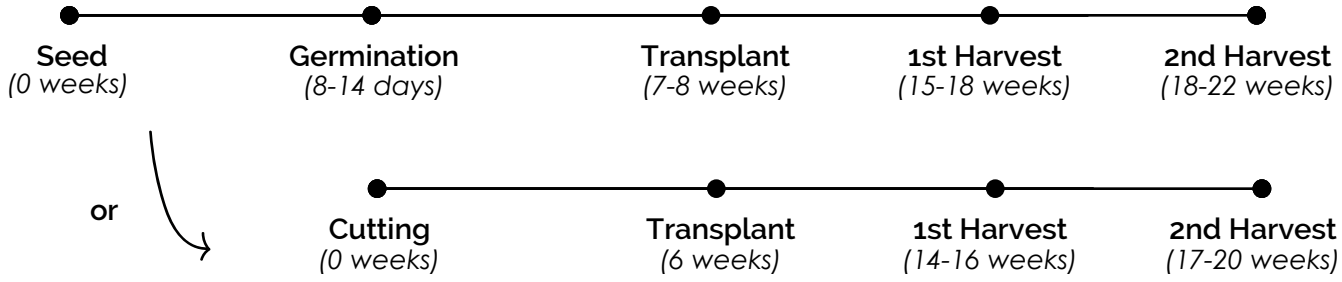
HARVESTING & STORAGE TIPS

Once harvested, fresh oregano sprigs have a shelf-life of 1-3 weeks. Be careful of over-chilling or excessive moisture on the foliage.

TIMELINE

Oregano can be started from seed, but growers can both shorten timelines and achieve more consistent tastes if they propagate oregano from cuttings instead. Use a rooting hormone and a substrate with good water-holding capacity; rockwool or peat work great. When 5-10 roots are sprouting from the sprig, it's ready for transplant. This could take up to 6 weeks.

Once transplanted, oregano typically takes about 8 weeks to mature and be ready to harvest. After that, it can be harvested in 3-4 week turns. Harvest the tips of the branches during the cool part of the day and take only about a third of the plant, leaving the rest for it to photosynthesize and regrow.



MINT

pH range: 6.5-7.0
EC/PPM: 2.2-2.6 / 1100-1300
Light: Full sun / 14-18 hours
Temp: 55-70°F

Planting: From cutting or rootstock
Harvesting: Complete, multiple
Yield: 3-4 lbs./ Tower/ 3-week turn

Pests & Diseases: Occasional verticillum wilt and powdery mildew
Ideal Technique: ZipGrow Towers

ABOUT MINT

There are dozens of types of mint, but the main varieties are spearmint (*Mentha spicata*), peppermint (*Mentha x piperita*), and pennyroyal mint (*Mentha pulegium*); some of the other mints like lemon mint (*Monarda citriodora*) are actually not mint at all. When mint is used in the kitchen, it's usually spearmint.

Mint's bright leaves grow lush, making full gardens or ZipGrow Towers that look beautiful wherever they are. This makes them superb candidates for live sales and displays. Because it grows so fresh and tender, it also makes a great cut product for day-of-harvest deliveries. Both of these sales models are viable, easy solutions and have proven to be well received by clients.

Mint is tolerant of low EC and some temperature variation, although it doesn't do well when heat

spikes above 80° F. It struggles less with pests than many of the herbs, although verticillium wilt and powdery mildew can become problems. Keep your greenhouse dry and stay on top of pest control.

Mint can be grown from seed, but using cutting or rootstock is much quicker, especially on a commercial scale. From mint cuttings, or "clones", mint roots out and grows to maturity within a few weeks.

For stem cuttings, you can select healthy green sprigs and simply set them in water.
We've also used cotton or loose soil to set cuttings. Haydn Christensen, owner of Bayberry Fresh, takes it one step further, and just drops his mint cuttings in the gutter that runs below the towers.

For rootstock, you can pull out the media when a mature tower becomes overgrown, remove some root material to populate a new tower, and simply tuck the root material in the new media. Then replant both towers – one with old and one with new root material – and voila! You have two towers of mint.

Since mint grows quickly, we run mint on a 3-week turn, harvesting it completely between each new turn. It's a lightweight herb but still produces about 3-4 lbs per ZipGrow Tower. Depending on local markets, growers can expect anywhere from $2-4 per ounce. Specialty markets sometimes sell mint for even higher prices! Check with local consumers, stores, and markets to see if there's demand for mint in your area.

HARVESTING & STORAGE TIPS

Mint is ready to be harvested when it is 8+ inches tall. To harvest mint, shear across the face of the growing plane with a knife, leaving 1-2 inches of plant to regrow and harvested again in only 2-3 weeks. (Mint can be harvested the same as chives – see how that's done here.)

Some growers do prefer to harvest sprigs with shears so that they can pick and choose the young tender shoots as a premium product.

TIMELINE

Cutting
(0 weeks)

Transplant
(2-3 weeks)

Harvest
(5-6 weeks)

CHIVES

pH range: 6.1-6.8
EC/PPM: 1.8-2.2 / 900-1100
Light: Full sun / 12 hours minimum
Temp: 65-80°F

Planting: From seed or from root (by breaking apart mature plants)
Harvesting: Harvest every 2-3 weeks by cutting the plant to 1-2 inches from the crown
Yield: 3-5 lbs./ Tower/ 4-week turn

Pests & Diseases: Rare; most common in hydroponic systems are viruses and fungus gnats
Ideal Technique: ZipGrow Towers

ABOUT CHIVES

Common chives are the variety most used. A few other varieties, like garlic chives and Chinese chives are also available.

Chives are a tough crop that will survive a wide range of temperatures and can even go without water for a while without it impacting quatlity. Chives are also fairly pest-resistant, rarely infected with diseases, and rarely are targeted by insect pests.

Chives propagate rapidly from roots, and can be planted by division. Growers using ZipGrow Towers can simply tear apart the roots of a plant from another ZipGrow Tower and use it to plant multiple others.

Rarely will growers need to use seeds to grow chive seedlings, unless mature chive plants are nowhere to be found.

HARVESTING & STORAGE TIPS

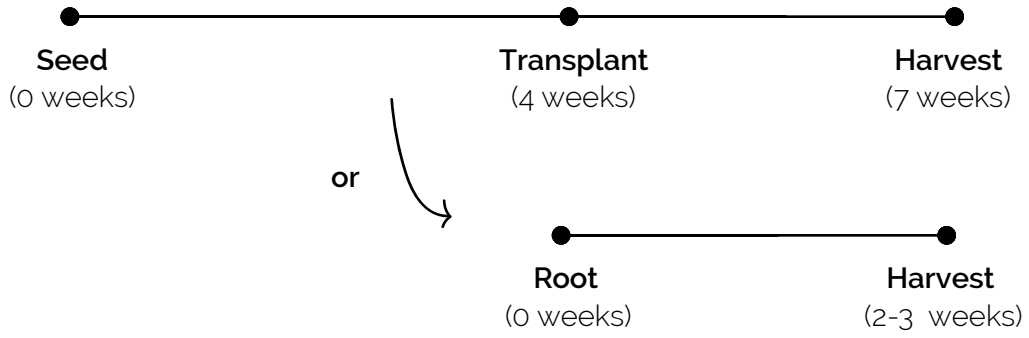
Chives should be trimmed back to about 1-2 inches above the crown every two weeks (three at the most). This will give growers a nice harvest and will keep the chives looking lush and green.

(See how to harvest chives in this video)

Chives are very easy to harvest with a pair of shears or a harvest knife. Hold the top of the plant in one hand and (carefully) cut through the greens near the base. You'll be left with a handful of the tasty herb.

TIMELINE

If chives are grown from seed, seedlings will be ready to transplant about 4 weeks later, and ready to harvest 3-4 weeks later. When planted from root, chives will be established within 2-3 weeks and will grow thicker with every harvest. Eventually, chive plants will inhabit every inch that you let them.



FENNEL

pH range: 6.4-6.8
EC/PPM: 1.0-1.4 / 500-700
Light: 12 hours
Temp: 60-70°F

Planting: Plant from seed
Harvesting: At first harvest, only take 30% of the greens. Take full plant at second harvest.
Yield: 5-8 lbs./ Tower/ 8-week turn

Pests & Diseases: Rare; aphids and damping off
Ideal Technique: ZipGrow Towers

ABOUT FENNEL

A mildly sweet herb with a taste reminiscent of anise, fennel is edible both as bulbs and greens. The greens may be harvested once before a full-plant harvest a few weeks later.

While most grocery stores carrying fennel sell it at between $1 and $1.50 per bulb, some online sellers can sell a bulb for up to $5.75.

Most Upstart Farmers will be somewhere between these two. Growers should do a survey of local markets to determine potential pricing.

Fennel prefers a lower EC and moderate pH. Though fennel often proves drought tolerant, heat tolerant, and cold tolerant, it is not frost tolerant. Fennel rarely struggles with pests if it's kept healthy,

although aphid infestations could affect the crop.

Fennel has a wider range of germination rates, from about 60% to 90%. Be sure to get good seeds (Baker Creek and Johnny Seeds are both great places to start). Seeds take 1-2 weeks to germinate and are typically ready to plant 3-5 weeks later. The bulbs can be harvested as soon as the grower wants, but .5 to 1lb bulbs are standard at most markets. From seedlings it takes most plant 6-8 weeks to reach

HARVESTING & STORAGE TIPS

Fennel may be harvested twice (once for the greens, once for the bulb and greens together) if you have a market hungry for the greens. As with chard and kale, only 30% of the greens should be harvested at first. In a healthy system, fennel can yield 5-8 lbs per ZipGrow Tower per 8-week turn.

TIMELINE

Seed
(0 weeks)

Germination
(7-14 days)

Transplant
(3-5 weeks)

Harvest
(10-15 weeks)

BASIL

pH range: 6.2-6.8
EC/PPM: 1.6-2.2 / 800-1100
Light: Full sun / 14-18 hours
Temp: 65-95°F

Planting: From seed or clone
Harvesting: Prune apical meristem to cue lateral growth
Yield: 3-4 lbs./ Tower/ 5-week turn

Pests & Diseases: Pests include nematodes, aphids, thrips, flea beetles, whiteflies, and snails/slugs. Diseases include damping off, root rot, leaf spot diseases, fusarium wilt, and downy mildew
Ideal Technique: ZipGrow Towers

ABOUT BASIL

There are dozens of basil varieties, from spicy bush basil, to lemon basil, to Thai basil. Favorites are the classic sweet basil, Genovese basil, and dwarf basil. Basil grows better in ZipGrow Towers than in any other growing technique in the world and yields 3-4-lbs./ Tower/ 5-week turn.

Basil prefers warmer temperatures (65-95 °F) with a lot of light (14-18 hrs of good light), a pH range of 5.6-6.6, and EC between 1.4-2.3.

HARVESTING & STORAGE TIPS

Basil has been bred to be a single-stemmed plant growing upward. For ZipGrowers, a bushier multi-stemmed plant is better. A pruned tower looks better, makes your towers balanced and easier to carry around, and yields more.

Upward growth is called apical growth. To change the way that basil grows, growers can trigger a secondary type of growth that moves outward and up instead of straight up. This is called lateral growth.

A young basil plant (say 5-10 inches tall), has places on the stem with buds on the side of the stem that haven't grown out yet. Those are the lateral buds; they're like back-ups that will only grow if the main stalk gets badly damaged or removed.

This means that if growers clip the stem right above those lateral buds, they will be triggered to grow out. There are two instead of one, growers increase the production of that branch.
When pruning, snip the stem right above the lateral buds. (Not at the base of the plant.)
If you prune a basil plant correctly, you'll see an increase in yield each time you harvest for the first three harvests at about weeks 5, 8, and 11.

To extend the shelf life of basil, store it above 55° F (preferably at a temperature of 60°) where it can attain a shelf life of 12 days. Instead of cooling the basil, keep it in a higher-temperature cooler, or on a counter in a cool room.

If growers package basil in bags or cartons that reduce moisture loss (plastic with little or no air exchange), be sure to keep storage temperatures steady to avoid condensation.

Handle basil gently, as bruising can increase the rate of deterioration. Many Upstart Farmers have found that selling basil packaged in clamshells is helpful for preserving the herb..

TIMELINE

CILANTRO

pH range: 6.5-7.5
EC/PPM: .8-1.8 / 400-900
Light: Full sun / 14-18 hours
Temp: 50-85°F

Planting: From seed
Harvesting: Complete
Yield: 1.5-2.5 lbs./ Tower/ 5-week turn

Pests & Diseases: Pests include fungal wilt, leafhoppers, and aphids; Diseases include powdery mildew
Ideal Technique: ZipGrow Towers

ABOUT CILANTRO

Cilantro can be a tricky crop to grow since it bolts very easily, especially in hot conditions.

If bolting is triggered, trim the bolts and adjust environmental conditions. Be aware that the flavor of the greens becomes more bitter and harsh once the plant has bolted. Growers can purchase slow bolting seeds to minimize the potential for crop failure.

TIMELINE

Seed
(0 weeks)

Germination
(7-10 days)

Transplant
(4 weeks)

Harvest
(8-10 weeks)

PARSLEY

pH range: 6.0-7.0
EC/PPM: .8-1.8 / 400-900
Light: Full sun / 14-18 hours
Temp: 60-75°F; but cold-hardy

Planting: Plant parsley from seed
Harvesting: Harvest parsley twice before re-planting
Yield: 3-4 lbs./ Tower/ 5-week turn

Pests & Diseases: Rare; most common are thrips and aphids
Ideal Technique: ZipGrow Towers

ABOUT PARSLEY

Parsley is a Mediterranean native used worldwide both as a garnish and as a popular addition to savory dishes. Several varieties of parsley exist, from the more bitter and frilly garnish parsley to the flavorful, tender large leaf varieties. Though popular mostly as a cooking ingredient, parsley has been used in a variety of ways, from a medicinal ingredient to a symbol in ceremonies like the Seder dinner.

Parsley's tolerance of a wide temperature range and EC range make it an easy crop for farmers to add into a crop set. Large leaf varieties like Italian flat leaf grow abundantly in hydroponics (or aquaponics), and farmers using ZipGrow Towers should plan on harvesting a lot of weight from the large plants, which grow 12-18 inches from the face of the Tower or media.

HARVESTING & STORAGE TIPS

Parsley can be harvested multiple times similarly to chives. Use shears or a harvesting knife to cut the crop down to 2-3 inches from the face of the Tower or the media, and keep it in the system to regrow. Another harvest may be taken about 3 weeks later.

We recommend starting a new cycle for parsley after the second harvest. Parsley yields can be very high in healthy hydroponic systems – one 5-ft ZipGrow Tower can yield 3-4 pounds per Tower each harvest.

TIMELINE

Parsley comes as an affordable seed and germinates within 3-4 weeks with good moisture. Seedlings are ready to transplant a few weeks later when they display their true leaves, and first harvest typically happens 5-6 weeks later.

Seed *(0 weeks)*

Germination *(3-4 weeks)*

Transplant *(6-8 weeks)*

1st Harvest *(11-14 weeks)*

2nd Harvest *(14-17 weeks)*

ROSEMARY

pH range: 5.5-6.0
EC/PPM: 1.0-1.6 / 500-800
Light: 6-8 hours
Temp: 75-85°F

Planting: Propagation from clone fastest
Harvesting: Multiple
Yield: 7.8 oz / Tower/ Week turn

Pests & Diseases: Rare, botrytis and powdery mildew when over-watered
Ideal Technique: ZipGrow Towers

ABOUT ROSEMARY

Rosmarinus officinalis belongs to the family Lamiaceae like many of our culinary herbs. Rosemary is a great fit for indoor farming because it can be very compact.

Although rosemary has a longer turn than greens, it can achieve good pricing. Non-local rosemary can be bought at a typical grocery store for $2.25-2.50 / oz, but local and organic farmers list prices up to $3.90 / oz. Growers should conduct basic local market research and compare different herbs prices.

Like its co-members of Lamiaceae, lavender and thyme, rosemary prefers dry feet. This means that growers should give roots a dry period between watering. For example, in our greenhouse, we have run oregano, thyme, and rosemary on a separate circuit. We ran our drippers through that block of towers twice a day for about 30 minutes each time.

Rosemary is typically pest-free and can even deter many pests, but growers will occasionally see powdery mildew or mite infections. Botrytis and root rot can be an issue if growers over water. Growers raising rosemary in hydroponics should be especially careful about this, as it's easy to over water.

Starting rosemary from seed can be a finicky process – the seeds need consistent moisture and germination rates tend to be around 30-50%. Growers are often better off propagating the plants from cuttings, although some argue that best flavors and aromatics come from seed-grown plants.

HARVESTING & STORAGE TIPS

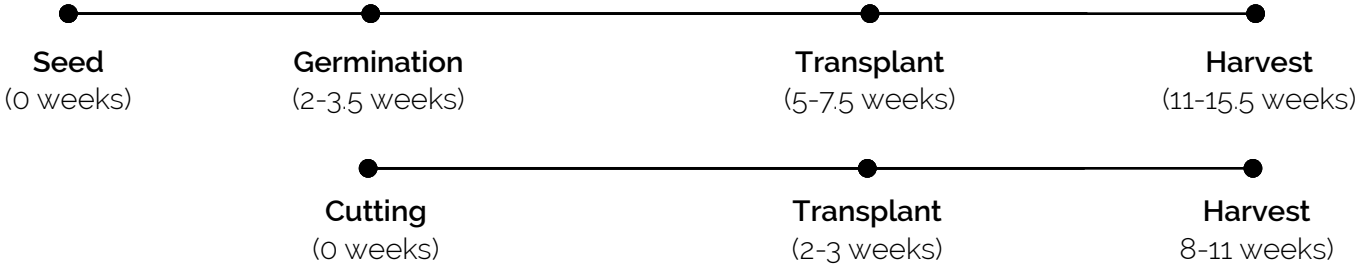
Rosemary is a perennial; the plant's natural lifetime can extend for decades. It can be harvested many times by pruning (similar to basil). Farmers should never take more than 30% of the plant at once, leaving 70% for the plant to photosynthesize and continue to grow. Like basil, rosemary grows best when pruned just above the apical shoots (the "V" in the stem).

TIMELINE

Seed-grown rosemary takes 2-3.5 weeks to germinate and an additional 3-4 weeks until they are ready to transplant.

Cuttings are ready to plant when roots are established and the sprig has grown past a few inches in height. This should happen in 2-3 weeks.

From transplant to the first harvest, rosemary takes 6-8 weeks. Growers should expect lower yields for the first few harvests while the plant is growing more mature. In time, mature plants can give over 7 ounces per ZipGrow Tower per week.



FRUITING CROPS

Fruiting crops are productive and satisfying to grow in ZipGrow Towers, but are slightly more labor intensive due to the typical size of fruiting crops and to higher nutrient requirements.
Large statured plants may require trellising, which may be done with string, wood, netting, or wire. The large plants may make your towers bulkier and more awkward to move.
Since fruiting crops have to produce both vegetative and reproductive growth, nutrient requirements are much higher. Nutrient levels in a system with fruiting crops require more active management than systems with greens or herbs.

Strawberries are the easiest fruiting crop to grow, being smaller plants. Other common fruiting crops include tomatoes, melons, peppers, squash, and cucumbers.

STRAWBERRIES

pH range: 5.5-6.8
EC/PPM: 1.2-1.5 / 600-750
Light: 6-10 hours
Temp: 65-75°F

Planting: Propagation from clone fastest
Harvesting: Multiple
Yield: 7.8 oz / Tower/ Week turn

Pests & Diseases: Rare, botrytis and powdery mildew when over-watered
Ideal Technique: Bato (Dutch) Buckets

ABOUT STRAWBERRIES

Growers can order strawberries from most big seed companies like Burpees or Johnny's Seeds. Dozens of different varieties are available with different environmental preferences and different bearing timelines. The two main types of strawberries are ever-bearing and june-bearing. We recommend ever-bearing (or "day-neutral") varieties for indoor growers.

Strawberries are best grown from rootstock rather than seed. Vegetative growth (runners) tends to be much faster than sexual reproduction (seeds), so you can cut the time from planting to production by months or years by using rootstock.

Strawberries are prone to pest and diseases like spider mites, pythium, and crown rot. Use miticides to manage mites, a fungicidal dunk before planting to prevent fungal infections, and plant the rootstock correctly to avoid crown rot.

**Remember: ALWAYS read the label before using a pesticide. It is a legal document, and straying from instructions is unlawful!

The crown of the plant is the region where the roots become the stem. Keeping the crown dry is key to avoiding crown rot. When you plant your root stock, choose the plants with thicker crowns and talk to the provider about sterilized rootstock or a recommended fungicide dunk for the rootstock. Plant the rootstocks at an angle so that the crown of the plant is angled upward. If the plant is planted at a downward angle, then water can run down the roots and over the crown, creating crown rot problems down the road.

You'll see a woody "stalk" or stump near the crown of the plant that looks different from the other shoots. That is the remains of the runner from which the plant grew. Try to keep the runner on the top side of the plant.

If you don't have the space to plant all of your rootstock, you can store it in a fridge or cooler (depending on the variety, most seed companies will tell you to store the rootstock at about 32° F) for a limited time.

Strawberries prefer lower salt levels (an EC of 1.2-1.5 is best), long day length, and a pH range of 5.5 to 6.8. Keep the temperature in the high 60's and keep the growing facility dry.

For farmers growing a variety of crops, salt content could be an issue in their strawberry -growing efforts. While strawberries flourish in most hydroponic systems, the high EC levels required by some crops can cause depressed yield for strawberries in the same system.

In a healthy system, strawberry rootstock will have new growth sprouting up in less than a week. Pinch back the buds for 4-6 weeks to keep the plant's resources directed towards vegetative growth. This gives the plant the ability for higher yields later on.

If flowers are allowed to develop, fruit forms and ripens in about 2 weeks.

Cutting
(0 weeks)

Transplant
(4-6 weeks)

Harvest
(6-8 weeks)

TOMATOES

pH range: 5.5-6.5
EC/PPM: 2.0-5.0 / 1400-3500
Light: 8 hours
Temp: 58-79°F

Planting: From seed or seedling
Harvesting: Gradual
Yield: Variety-dependent

Pests & Diseases: Many, including verticillium, fusarium, nematodes, spider mites, aphids, damping off, mosaic virus, and more.
Ideal Technique: Bato (Dutch) Buckets

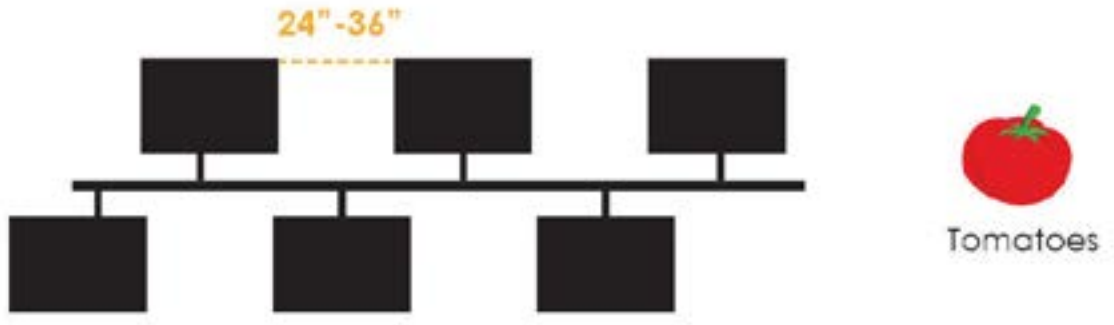
ABOUT TOMATOES

Native to the Andes, tomatoes started traveling the world in the 1600's. Though enjoyed as a food by Mesoamericans, the tomato was used mostly as an ornamental in Europe for centuries. Over the years, the crop has become a favorite food and can now be found in practically every grocery, restaraunt, and market stall. Its long history with the peoples of the world has resulted in hundreds of tomato varities, from the dependable Roma, to the garden-friendly Early Girl, and dozens of heirloom varieties like the Cherokee Purple.

Tomatoes come in a versatile array of yellows, browns, oranges, pinks, purples, reds, and greens. They range from sweet and tart to smokey flavored, and have graced too many dishes to count. Their popularity makes them a common sight in Bato bucket systems and greenhouse settings.

Tomatoes typically grow in one of two patterns, depending on the varety. Bushy varieties are especially common in heirlooms, and can be more difficult to manage. Bushy tomatoes tend to sprawl along a greenhouse floor, making trellising difficult to impossible. As a result, growers can have trouble reaching fruit, pruning plants, and navigating the greenhouse. Vining varieties are preferable to most growers, since the plants can be pruned to a single "leader" and trellised neatly above the bucket using a lean-and-lower system. This makes plants more accessible and much faster to harvest and prune.

A typical Bato and tomato setup includes two plants per bucket, with buckets 24-36" apart.



One downside of tomatoes is that they are vulnerable to a wide range of diseases and pests, from the common aphid and spider mites, to verticillium and fusarium wilt, and more specific pests like mosaic virus. When purchasing toatoes or seeds, look for the "VFN" label. This indicates resistance for verticillium, fusarium, and nematodes.

HARVESTING & STORAGE

Tomatoes need cooling to extend shelf life, but shouldn't be refrigerated in typical fridge temperatures (40-55˚F). Advise your customers to store tomatoes outside the fridge, in a cool cupboard or on the counter.

TIMELINE

Tomato lifecycles vary based on the variety, but many greenhouse growers run their tomato system for 8-11 months of the year. For instance, Bayberry Fresh, a farm in Fort Collins, Colorado, starts seeds in March and sets up the tomato system in high tunnel greenhouses in April. The tomato system runs until November, production peaking in the summer months before tapering off. (Learn more about the Bayberry system here.)

A typical tomato life cycle may take 5-10 days to germinate, 4-6 weeks after that to reach transplanting size (about 8 inches), and anywhere from 1-2 months to start setting fruit.

Cutting	**Transplant**	**Harvest**
(0 weeks)	(4-6 weeks)	(1-2 months)

CUCUMBERS

pH range: 5.5-6.5
EC/PPM: 1.7-2.5 / 1190-1750
Light: 8+ hours
Temp: 65-85°F

Planting: From seed or seedling
Harvesting: Gradual
Yield: Variety-dependent

Pests & Diseases: Aphids, bacterial wilt, powdery and downy mildew, mosaic virus, leaf spot, and others.
Ideal Technique: Bato (Dutch) Buckets

ABOUT CUCUMBERS

Cucumbers boast a wide range of shapes, sizes, flavors, and colors and have proven to be an incredibly versatile ingredient to many types of cuisine. From 3-4 inch pickling cucumbers and 7-14 inch slicing cucumbers, to more unique varieties like the 1 inch Mexican Sour Gherkin Cucumber, varieties exist for almost any purpose. (Although the Mexican Sour Gherkin is technically not a cucumber.) Cucumber and other cucurbit flowers are even used in gourmet cuisine, often filled with a savory paste or cream.

Like tomatoes, cucumbers have been bred to both bushy and vining varieties, with vining cucumbers easier to manage in a greenhouse setting. Cucumbers, however, don't reach the same height as tomatoes and typically stop growing when vines reach 6-7 feet long.

Cucumbers come in three sexual breeds:

- a half-and-half mix of male and female flowers (monoecious)
- a seventy-thirty mix of female to male flowers (gynoecious)

By planting parthenocarpic plants you can cut hand-pollination from your labor.

The one downside to virgin cucumbers is that the pollen transmitted by bees and other pollinators can corrupt parthenocarpic plants. When purchasing seeds, check the packet or container for the monoecious, gynoecious, and parthenocarpic terminology.

HARVESTING & STORAGE

Like tomatoes, cucumber plants are more productive when fruit are continually harvested. The longer a cucumber stays on the vine past ripening, the tougher the skin will get, and the fruit may grow bitter. Harvest fruit when firm, evenly green, and the right size for the variety. As always, shears or a harvesting knife will speed up harvesting and protect the plant.

Cucumbers can be wrapped in plastic for fridge storage.

TIMELINE

Cucumbers take seven days for germination in warm temperatures. Fruit will appear around 60-70 days later, and will continue to fruit for three to five months.

EGGPLANT

pH range: 5.5-6.5
EC/PPM: 2.5-3.5 / 1750-2450
Light: 12-14 hours
Temp: 65-90°F

Planting: From seed or seedling
Harvesting: Gradual
Yield: Variety-dependent

Pests & Diseases: Verticillium wilt, aphids, two-spotted spider mites.
Ideal Technique: Bato (Dutch) Buckets

ABOUT EGGPLANT

Eggplants, or aubergines, are a thick, richly flavored fruit native to southeast Asia. Best for Bato buckets, eggplants can be shaped by the grower through careful pruning. Unlike tomato and cucumber, however, this plant does best with a bushy stature. This can be achieved by "pinching" or pruning the terminal bud (the top) of the plant as it grows. Similar to basil, the apical or sideways growth is cued with the terminal bud is cut.

Eggplants are a greedy crop, thriving at high temperatures and requiring a lot of space between each plant. Bato buckets solve the space issue, but casual growers might not be able to regulate temperatures to keep the eggplants happy while growing other crops in the same environment. Pair eggplants with other heat-loving plants.

HARVESTING & STORAGE

Eggplants are ripe when the skin becomes glossy.

TIMELINE

Eggplant will germinate about one or two weeks after planting. After germination, expect four to six weeks before being able to transplant. Once planted, the eggplants will be ready to harvest ten to twelve weeks.

PEPPERS

pH range: 5.8-6.3
EC/PPM: 2.0-3.0 / 1400-2100
Light: 14-18 hours
Temp: 65-85°F (Variety-dependant)

Planting: From seed or seedling
Harvesting: Gradual
Yield: Variety-dependent

Pests & Diseases: Aphids, thrips, two-spotted spider mites, etc.
Ideal Technique: Bato (Dutch) Buckets

ABOUT PEPPERS

Peppers are a crop so diverse that pinning down ideal conditions for the crop is nearly futile. Native to South America, peppers traveled throughout the world during the Columbian Exchange and have been bred and adopted in every country in the world. There are five main species of pepper in the genus (Capsicum) and hundreds of varieties, from the Italian Sweet Pepper and Pimenta Piquinho to the Bulgarian Carrot and Carolina Reaper.

For hobby farmers, our friends at Crop King recommend sticking with sweet peppers before experimenting with the fussy hot or heirloom pepper breeds.

Like eggplant or basil, peppers may be pruned to increase apical growth.

HARVESTING & STORAGE

Peppers can be stored in the fridge, but don't let it get too cold - temperatures under 45˚F will increase decay of the fruit.

TIMELINE

(Variety-dependent)

APPENDIX A - CROP SETS

COOL REGION CROPS

- Lettuce
- Arugula
- Kale
- Mustard Greens
- Bok Choy
- Mint
- Cilantro (Coriander)
- Tarragon
- Fennel
- Nasturtiums
- Peppermint

WARM REGION CROPS

- Bok Choy
- Oregano
- Basil
- Lemongrass
- Spearmint

LOW WATER CROPS

- Cilantro
- Sage
- Chives
- Oregano
- Tarragon
- Fennel
- Nasturtiums
- Peppermint

CROPS FOR BEGINNERS

- Lettuce
- Bok Choy
- Mustard Greens
- Chard
- Kale
- Mint
- Arugula
- Chives
- Fennel

APPENDIX B - GROWTH RATES

Herbs	Seed to germination	Germination to transplant	Transplant to harvest
*Genovese Basil	7-10 days	3-5 weeks	5 weeks
*Lime Basil	5-15 days	3-5 weeks	5 weeks
*Cilantro	7-10 days	3-5 weeks	5 weeks
*Oregano	8-14 days	5-7 weeks	8-10 weeks
Fennel	7-14 days	3-5 weeks	6-7 weeks
*Mint	12-16 days	4-5 weeks	6 weeks
*Parsley	21-28 days	3-4 weeks	5-6 weeks
*Chives	15-21 days	4 weeks	6-8 weeks
*Lemon Thyme	8-20 days	4 weeks	6-8 weeks
Lemongrass	10-90 days	4-5 weeks	5-6 weeks
*Nasturtiums	7-14 days	3-4 weeks	3-4 weeks
*Tarragon	10-14 days	5-7 weeks	8-10 weeks
*Chervil	7-10 days	4-5 weeks	3-5 weeks

Greens	Germination time	Time to transplant	Time till sale(turn)
Lettuce	7-14 days	3-4 weeks	5 weeks
*Chard	5-7 days	3-4 weeks	5-6 weeks
Bok Choy	4-7 days	3-4 weeks	4-6 weeks
*Mustard Greens	4-7 days	3-4 weeks	4-6 weeks
*Kale	4-7 days	4-5 weeks	5-6 weeks
*Arugula	5-7 days	3-4 weeks	6-7 weeks
Strawberries		n/a	9-35 weeks

APPENDIX C - PH

Crop	pH	EC/PPM
Basil	6.2-6.8	6.2-6.8 / 800-1100
Cilantro	6.5-7.5	.8 -1.8 / 400-900
Oregano	6.0-8.0	1.5-2.0 / 750-1000
Fennel	6.0-7.5	1.0-1.4 / 500-700
Mint	6.5-7.0	2.2-2.6 / 1100-1300
Parsley	6.0-7.0	.8 -1.8 / 400-900
Chives	6.1-7.8	1.8-2.2 / 900-1100
Rosemary	5.5-6.0	1.0-1.6 / 500-800
Lettuce	6.2-6.8	0.8-1.2 / 400-600
Chard	6.0-7.0	1.8-2.3 / 900-1150
Bok Choy	6.0-7.5	1.5-2.0 / 750-1250
Mustard Greens	6.0-7.5	1.2-2.4 / 600-1200
Kale	6.0-7.6	1.8-3.0 / 900-1500
Arugula	6.0-6.8	.8-1.2 / 400-600
Strawberries	5.5-6.8	1.2-1.5 / 600-750
Cabbage	6.5-7.0	2.5-3.0 / 1250-1500
Tomato	5.5-6.5	2.0-5.0 / 1400-3500
Cucumber	5.5-6.0	1.7-2.5 / 1190-1750
Eggplant	5.5-6.5	2.5-3.5 / 1750-2450
Pepper	6.5	2.0-2.4 / 1400-1680

More information GTG Hydroponics, Hydroponic.co.za

APPENDIX D - IDEAL TECHNIQUE

Crop	ZipGrow	Bato (Dutch) Buckets	DWC (raft) systems
Basil	X		
Cilantro	X		
Oregano	X		
Fennel	X		
Mint	X		
Parsley	X		
Chives	X		
Rosemary	X		
Lettuce	X		X
Chard	X		X
Bok Choy	X		X
Mustard Greens	X		X
Kale	X		X
Arugula	X		X
Strawberries	X		
Cabbage	X		
Tomato		X	
Cucumber		X	
Eggplant		X	
Pepper		X	

ABOUT US

Being a modern farmer requires equal parts adaptability, creativity, perseverance and customer service. In addition to growing fresh, flavorful food, they're also a marketer, plant scientist, plumber, salesperson, community educator, social media manager and everything in between.

The problem? A lot of today's most passionate growers don't have the skills or experience they need to start or scale a hydroponic farm with confidence. That's where Upstart University comes in.

Upstart University makes hydroponic learning accessible to anyone with an internet connection. With 30+ multimedia-rich courses, engaging student forums, and free educational articles, Upstart U can empower you to build, operate, and succeed with your own modern farm.

If you're ready to learn from industry experts about everything from business planning to nutrient management, enroll today at upstartuniversity.net.

halle@upstartuniversity.com