

Crops Grown in Vertical Farming

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INTRODUCTION

When deciding which crop to grow on a vertical farm several factors need to be taken into consideration like cost and time. The costs for the setup can be influenced by the technique used and the climate. Use of an inappropriate technique can increase the production costs and, depending on the crop, the climate can affect the heating/cooling and lighting costs. Another factor affecting the crop selection is the time a crop takes to grow from a seedling to being ready for harvest.

Once the crop has been selected, the method to use needs to be selected. These methods can include a hydroponic system, an aeroponics system or a system designed specifically for a particular crop.

I. LETTUCE

Lettuce is a crop that can grow well in most gardening systems including aeroponic and hydroponic systems. Lettuce is the best grown crop with hydroponic systems. A hydroponic system can produce 40% more lettuce yield than lettuce grown with soil. Varieties of lettuce grown with hydroponic systems include Romaine Lettuce, loose-leaf lettuce, butterhead lettuce and others. Lettuce can be grown aeroponically using an A-frame shaped aeroponic system in which the roots of the lettuce are suspended in air and sprayed with the nutrients. This system can save 80 to 90% more water and can produce a higher yield than a hydroponic system but is more susceptible to mechanical failures.



Figure 1: A-Frame aeroponic structure

Lettuce requires cool temperatures to grow which is in the range of 17°C to 24°C with the ideal temperature being 18°C. Lettuce grown in a hydroponic system requires a slightly acidic pH in the range of 5.5 to 6.5 and the nutrient solution concentration

must have an EC of 1.2 to 1.9. The main nutrients required by lettuce are calcium, magnesium and potassium. They require 14 to 18 light hours a day. Pests that usually affect lettuce crops include aphids, leaf miners and powdery mildew. These pests can be controlled using neem oil or diatomaceous earth.

II. SPINACH

Spinach is another crop that grows very well in hydroponic systems and can grow quickly when using the nutrient film technique. They require cool temperatures to grow in the range of 18°C to 21°C. Excessive lighting should be avoided as best results are obtained with 12 hours of light a day. Using sunlight offers better results but fluorescent or other lightings can also be used with blue light being the ideal colour as it promotes leaf growth. The main nutrients required by spinach are calcium and magnesium and they require a pH in the range of 6 to 7.5. Spinach plants in a hydroponic system are vulnerable to the plant parasite pythium which can cause the roots of a plant to rot. While it is difficult to completely remove pythium from a hydroponic system, it can be controlled by regularly sanitising surfaces that come in contact with the plants and maintaining sufficient levels of dissolved oxygen in the nutrients solutions.

III. STRAWBERRIES

A major problem with farming strawberries using traditional methods is their seasonal nature which can be avoided using a hydroponic system. Strawberries are best grown using an ebb and flow hydroponic system but can also be grown using deep water culture and nutrient film technique. It is preferred to grow strawberries from rootstocks instead of seeds as they provide faster results. Strawberries grow best in the temperature range of 18°C to 24°C and require 14 to 18 hours of light. The main nutrients required by strawberries are nitrogen, potassium and phosphorous. The nutrient solution must have an EC of 0.8 to 1.4 and a pH in the range of 5.5 to 6.5. Some of the pests that affect strawberries include spider mites, thrips and gnats which can usually be prevented using neem oil.

IV. MUSHROOMS

Some of the types of mushrooms that can be grown hydroponically include nameko, oyster, shiitake, lion's mane and others. Mushrooms require a temperature in the range of 27°C to 29°C and the humidity of their environment needs to be around 70 to 90%. Since mushrooms lack chlorophyll, they do not perform photosynthesis and only require around 5 to 6 hours of light making them a cheaper option when it comes to lighting. Unlike plants, mushrooms are unable to produce their

own food which is why they need to be provided with sugar, fat, lignin and starch along with other nutrients. There are two methods of growing mushroom the first one is by using a mushroom grow kit which is a block of supplemented sawdust which already contains the mycelium from which the mushrooms will grow. Using this method, the mushrooms can be harvested after 3 to 5 days. The second method is to first grow some mycelium until they sprout mushrooms and to then transfer the mushrooms to the hydroponic system. This process is much longer and can take up to 4 weeks.

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V. TOMATO

Despite botanically being some fruit, it's generally eaten and prepared like a vegetable. growing tomatoes is possible vertically in a small area is cheap!

Tomatoes are the major dietary source of the antioxidant lycopene, which has been linked to many health benefits, including reduced risk of heart disease and cancer. This fruit is also beneficial for skin health, as it may protect against sunburns.

They are also a great source of vitamin c, potassium, folate, and vitamin k. The water content of tomatoes is around 95%. The other 5% consists mainly of carbohydrates and fibre. Carbs comprise 4% of raw tomatoes.

NUTRITION FACTS

Calories: 18 grams	Sugar: 2.6 grams
Water: 95%	Fibre: 1.2 grams
Protein: 0.9 grams	Fat: 0.2 grams
Carbs: 3.9 grams	

NUTRITION REQUIRED

Tomatoes require three nutrients in particular: nitrogen, phosphorus, and potassium. These are the nutrients that our plants will utilize the most and that are contained in many fertilizers. While each nutrient serves a different purpose, all three are necessary for photosynthesis. Calcium, sulphur, and magnesium are other macronutrients required for tomato plant development. Calcium is necessary for cell structure, whereas magnesium is a component of chlorophyll, which is necessary for photosynthesis.

Tomato plants will require varying quantities of these nutrients at various phases of development and fruiting. Tomato plants, for example, require more nitrogen as they begin to bloom and fruit. As the plants develop, their calcium and potassium requirements rise as well.

LIGHTING CONDITIONS

We require 12 hours of bright light; artificial lighting may be a viable alternative. Fluorescent bulbs are a gardener's favourite. They are perfect for beginning tomato seedlings since they

produce very little heat while emitting a high intensity of light. Furthermore, they are not costly. Tomato plants require the entire spectrum of light for photosynthesis. The term "full spectrum" refers to light that contains all the colours of the rainbow. Even though red and blue are the most significant colours. Tomato seedlings require a lot of light.

Fluorescent bulbs should be put as near to the plants as possible, no more than three inches from the soil surface or leaves. Each week, check the location of the lights and elevate them as needed to keep the gap between plants and lights to no more than 3 inches. Tomatoes are day-length plants that require 14-18 hours of light per day. Tomato seedlings sprout and thrive best in temperatures ranging from 65°-85°F.

PROCESS

It is quite simple to grow tomatoes in a vertical garden. We may grow the tomatoes in the ground or in a big container and train them to climb a trellis.



Figure 2:Trellising & Crop Support Systems for Tomatoes

Tomatoes come in two varieties: determinate and indeterminate. Tomatoes that grow on vines are known as indeterminate tomatoes. There are those that are semi-determinate, meaning they fall somewhere in the middle. Because the vines may be tied to a trellis, indeterminate varieties are perfect for vertical gardens. As the plants develop and produce tomatoes, this helps to spread their weight. A single regular tomato plant can yield between 4 and 9 kilograms, whereas cherry tomatoes yield roughly 3 kilograms.

To ensure that they receive all the light they require, we will need to add grow lights. To simulate the light emitted by the sun, grow lights use fluorescent light. T5 Fluorescents with a high output are ideal for nurturing established plants indoors. It's critical that we keep our tomato plants spaced correctly, especially if they're planted in the ground, because if they're too close together, they'll compete for resources. Because indeterminate tomato plants tend to spread, a reasonable rule of thumb is to space them four feet apart.

When we first plant them, we should fertilize them with a good grade tomato fertilizer, and then we shouldn't fertilize them again till they begin to set fruit. We'll have to fertilize them gently every one to two weeks afterwards.

As the plants grow, we'll have to cut out any crowded branches to ensure that light reaches the entire plant, and that air can move freely between the branches.

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VI. EGGPLANTS

In Germany, eggplant is highly popular. It's known as Aubergine in Germany. The optimum period to harvest eggplant is from March through May. Eggplant may be grown in a variety of methods, including hydroponically. Hydroponically growing eggplant is a fantastic method to create nutritious, local, and organic fruit right in our own backyard. Because it takes little maintenance and can be produced in almost any system, eggplant is one of the easiest plants to cultivate hydroponically.

NUTRIENTS

Eggplants require nitrogen (N), phosphorus (P), potassium (K), and a few other trace elements, among other things. On the market, we can get ready-to-use fertilizers that will work perfectly for eggplants or whatever we're producing. Start by mixing in a lot of compost and 2 to 3 pounds of a complete fertilizer like 15-5-10 per 100 square feet. An organic fertilizer such as blood meal, well-rotted manure, cottonseed meal, or bat guano can also be used.

TEMPERATURE

The temperature required to grow an eggplant tree varies depending on its stage of development. The ideal temperature for the seed stage is between 70°F and 90°F. The necessary temperature ranges from 75°F to 85°F as the plant reaches the vegetative and blooming stages.



Figure 3: Temperature ranges

Growing an eggplant, it appears, need various temperature variations depending on the stage of the plant. As a result, investing in a heater to be able to regulate the temperature to the ideal degrees is a good idea.

Depending on the stage of the plant, it appears that growing eggplant need a variety of temperature changes. Consequently, purchasing a heater to control the temperature to the desired levels is a smart option.

LIGHTS

To get the best results, almost every hydroponic system uses grow lights. Eggplant trees will need to be exposed to grow lights for at least 8 to 10 hours. Our best and most cost-effective alternative will be LED growth lights.

It's important to remember that growing lights generate heat, which might harm our eggplant tree if the temperature rises too high.

As our tree grows, try utilizing additional grow lights. Light becomes more difficult to reach specific sections of our tree as it becomes larger and more branching. Because this problem can't be handled with just an overhead grow light, the plant's development must be stunted, which necessitates the use of peripheral lights.



Figure 4: LED

VII. PEPPERS

Peppers are one of the most frequent vegetables to grow vertically. Peppers are one of our favorite summer crops since they are simple to raise and entertaining to watch mature. Because the GreenStalk Vertical Planter is soil-based, we don't need anything extra to get started. We use the same potting mix that we use for all of our crops, but we make sure to add extra fertilizer (like Tomato Tone) to help them get started.



Figure 5: GreenStalk

NUTRIENTS

Peppers, like tomatoes and other veggies, require nitrogen for robust plant growth, phosphorus for increasing the plant's ability to store energy, and potassium to help the plant resist disease. Depending on the soil content, peppers also might need

a fertilizer that contains calcium, magnesium, or iron. For most pepper varieties, fertilizing should begin about 2 weeks after seeds have sprouted.



Figure 6: Pepper

LIGHTS

Peppers are full-sun plants that require a lot of light. That implies they require 6 to 8 hours of direct sunshine every day. Most home pepper growers can meet these criteria with two types of lighting: fluorescent grow lights and LED grow lights.



Figure 7: Lighting

Grow lights generally need to be 2 to 4 inches away from the tops of our plants. Some LED lights may need to be placed 12" or higher. If we pick an LED, be sure to verify how far away it needs to be from our plants and that we have the space to accommodate this positioning.

There are a wide range of LED grow light options for growing peppers. LED lighting elements can last for thousands of hours, making them the perfect light source longevity. Considering our lights may run for 16 hours a day, all year long, having a long-lasting light is essential.

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