Change Food for Good.

Standard Operating Procedure

System Type: NFT and DWC system

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Objective/Purpose

Food insecurity is a systemic issue that can happen to anyone, and has been on the rise in recent years. It is a result of a number of social, economic, and environmental factors including: poverty, unemployment/ underemployment, lack of access to affordable/ nutritious food etc. Ultimately, this has an effect on one's overall well-being as the consumption of adequate food supply is a necessity for all beings.

Specifically in my neighborhood Woodside, Queens, 9.3% of the population was food insecure in 2023. In general, people will have to turn to churches, food pantries or food distribution centers to access food for daily consumption. In these centers, they distribute a variety of foods ranging from grains to packaged meat to canned goods. Most of these services are offered throughout the week and help alleviate food challenges that people may face. While these services help serve communities and are better than the absence of food, I noticed that there is a lack of fresh fruits and vegetables from these distributions. That can be a result of a variety of factors, such as not enough supply, economic support etc.,

The purpose of this case study is to introduce the possibilities of soilless growing systems within small spaces at home. What begins as a simple neighborhood observation can evolve into something accessible and healthier, while also fostering opportunities for community-building and collaboration. This approach brings us one step closer to a closed-loop food system—one garden and one system at a time.

Given this, I decided that I will be building a DWC and NFT system that grows Bloomsdale spinach and Alpine strawberries as my choice of crops. This was primarily the main deciding

factor when thinking of a system design. These two crops are among the lower maintenance groups and the combination of two systems balances simplicity and complexity.

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System Build

For my DWC system, I will be growing four Alpine strawberry crops, held in net pots—two in each 7-gallon water reservoir. The net pots will consist of the Alpine Strawberry seeds in the rockwool, a growing medium that supports plant growth. The plant roots, after the germination stage, will be submerged in nutrient-rich water inside the reservoir. Additionally, to provide the necessary oxygen, an airstone connected to an air pump will oxygenate the water. Lastly, above the setup, LED light strips will serve as a substitute for natural light, another crucial element for plant growth.

Above the DWC system is the NFT system, where I will be growing Bloomsdale spinach crops. These will also be placed in net pots with rockwool, but they will be submerged in an NFT channel. Each channel holds a thin film of nutrient-rich water, which the plant roots absorb. Nutrients circulate through the system, flowing into the grow channel, and any unused nutrients return to the water reservoir, completing the cycle. This process uses an air pump, airstone, water pump, irrigation lines, and PVC pipes. Lastly, as with the DWC system, the NFT system will also require artificial LED lighting for this system build.

Procedures

Seeding/ Germination :

Alpine Strawberries

Alpine strawberries require 4 - 6 weeks or 28 - 42 days to germination. The first couple steps would be to gather the seeds and place them in a moist growing medium, in this case rockwool. These small seeds should just be lightly covered as they need to be exposed to light in the germination stage. Lastly, we need to maintain a high humidity for germination, at temperatures ranging from 65°F - 75°F.

Bloomsdale Spinach

Bloomsdale spinach requires 1 - 2 weeks or 7 - 14 days to germination. The first couple steps would be to gather the seeds and place them in a moist growing medium, in this case rockwool. Sow the seeds, by placing 1 - 2 seeds onto each growing medium cube at about ½ inches deep. Then lightly cover the seeds. Lastly, Bloomsdale spinach prefers cooler conditions and can be sensitive to temperature.

Transplanting:

Alpine Strawberries

Alpine strawberries require 7 - 10 days to transplant. Firstly, it should have 2 - 3 mature leaves, a developed and visible root system, and a sturdy plant structure. Before transplant, the water reservoir should be filled with a nutrient solution, and the pH should be around 5.5 - 7.0. Then insert the seedlings into net pots with the rockwool growing medium in the pot and filling around the roots. Afterwards, place the net pots in the system and make sure the roots can reach the nutrient solution.

Bloomsdale Spinach

Bloomsdale spinach requires 3 - 4 weeks or 21 - 28 days to transplant. Firstly, it should have some mature leaves which generally appear within 2 - 4 weeks and have healthy white roots. Before transplant, the water reservoir should be filled with a nutrient solution, and the pH should be around 5.5 - 7.0. Also, make sure all equipment are connected and functioning properly. Then insert the seedlings into net pots with the rockwool growing medium in the pot and filling around the roots. Lastly, place the net pots in the NFT channel and make sure that the roots are touching the thin film of nutrient solution flowing in the channels.

Maintenance:

Alpine Strawberries

Testing and Dosing

- Monitor pH levels - the ideal pH is 5.5 - 7.0 for these strawberries. Therefore, it is important to check the pH daily or at least a few times a week using a pH meter.

- Check the electrical conductivity (EC) - the ideal EC is 1.0 - 1.5 mS/cm. Just like the pH it is also important to check the EC daily using an EC meter and adjusting the EC levels accordingly.
- Oxygenation - make sure the water is well-oxygenated by using the air stones, in the water reservoir, and air pumps to ensure the roots get enough oxygen.

Temperature and Humidity

- The optimal temperature - during the growing season, alpine strawberries grow and produce best when temperatures range between 60°F and 80°F. In addition to the LED lights, using a fan helps to maintain good air circulation and regulate temperature.

Pruning and Plant Care

- Pollination - in this case manual pollination is needed when they are in bloom using a soft brush or your fingers to transfer pollen between flowers.
- Pruning - remove any old dead or yellowing leaves and runners

Root Maintenance

- Root inspection - healthy roots should be white or light tan. If they turn brown or slimy, that could be a result of root rot or poor aeration.

Bloomsdale Spinach

- Monitor pH levels - the ideal pH is 5.5 - 7.0 for this crop. Therefore, it is important to check the pH daily or at least a few times a week using a pH meter.
- Check the electrical conductivity (EC) - the ideal EC is 1.5 - 2.5 mS/cm. Just like the pH it is also important to check the EC daily using an EC meter and adjusting the EC levels accordingly.
- Oxygenation - make sure the water is well-oxygenated by using the air stones, in the water reservoir, and air pumps to ensure the roots get enough oxygen.

Temperature and Humidity

- The optimal temperature - during the growing season, Bloomsdale spinach grows and produces best when temperatures range between 60˚F and 70˚F. In addition to the LED lights, using a fan helps to maintain good air circulation and regulate temperature.

Pruning and Plant Care

- Bloomsdale spinach is a flowering crop but it does not require any trellises, pollination or pruning

Root Maintenance

- Root inspection - healthy roots should be white or light tan. If they turn brown or slimy, that could be a result of root rot or poor aeration.

Harvesting:

Alpine Strawberries

There will be multiple harvests for strawberry crops, it takes about 85 - 100 days to harvest. There is a serving size of ½ cup of strawberries per person, one alpine strawberry plant could produce enough fruit for about 2 to 3 servings in a season. Therefore, for my four strawberry plant crops it will take multiple harvests. They produce small but frequent yields. Some tools that you would need are: harvesting scissors or pruners, containers or baskets, towels for wiping the strawberries.

Bloomsdale Spinach

There will be multiple harvests for spinach crops, it takes about 40 - 48 days to harvest. A standard serving size of cooked spinach is about 1 cup, which weighs approximately 6 - 7 ounces. With 4 pounds (64 ounces) of spinach per square foot, that will equal to feeding about 10-11 people. Some tools that you would need are: harvesting scissors or pruners, containers or baskets, gloves.

Cleaning/Maintenance Schedule:

DWC System

Daily (Or at minimum every three days)

- Inspect the reservoir for any algae growth - make sure there is no light entering into the water reservoir as algae can stump plant growth
- Inspect plants for health - check the leaves and roots for any discoloration/ pests management
- Inspect and clean air pump and air stones - check if there's any algae growth or blockage for oxygen
- Check nutrient levels - ensure that the EC is in the ideal range for optimal growth
- Monitor pH levels - ensure the pH of the nutrient solution is in the ideal range for optimal growth
- Check water levels - plants should be submerged leaving only the top part of the root

Monthly

- Full system cleaning
- Check if all equipment is still functioning or repair/ replace them as needed

Six Monthly

- Full system deep cleanout
- Inspect/ replace equipment and growing medium as needed

NFT System

Daily (Or at minimum every three days)

- Check the pumps = ensure that it is working correctly so that there is a consistent flow of nutrients
- Inspect plants for health - check the leaves and roots for any discoloration/ pests management
- Check nutrient levels - ensure that the EC is in the ideal range for optimal growth

- Monitor pH levels - ensure the pH of the nutrient solution is in the ideal range for optimal growth
- Check water levels - make sure that the nutrient film covers the roots but not entirely

Monthly

- Replace the nutrient solution
- Deep clean the entire system
- Check/ replace the equipment as needed
- Adjust nutrients accordingly to the growth stage

Six Monthly

- Full system deep cleanout
- Inspect/ replace equipment and growing medium as needed