How to choose the best hydroponic bucket system for you

You can use simple buckets to create versatile hydroponic systems. You can create a system to grow a few plants at home or thousands of plants in a commercial facility. However, there are several types of bucket systems to choose from, and making the correct choice is vital to success. In this post, we are going to take a look at the different types of bucket systems. We will examine their pros and cons so that you can better understand them and choose the hydroponic bucket system that best suits your needs.

The Kratky bucket

The simplest system is the Kratky bucket system. In this setup, you have a bucket with one or several holes on the lid. You put plants in net pots with media and then fill the bucket with a nutrient solution so that it is barely touching the bottom of the media. The media initially draws water through capillary action, while the roots reach the nutrient solution. After that, the roots draw nutrients from the water and an air gap is created between the plant and the water as the crop evaporates water. The roots use this air gap to get the oxygen they need for respiration. For this reason, you don’t need any air pumps.

Kratky system using mason jars. I would advice to avoid transparent containers to reduce algae growth.

This completely passive system is easy to build and cheap. You only fill the bucket once with nutrient solution, and you don't need to check the pH, EC, or other variables through the crop cycle. However, this system requires careful determination of the bucket's volume, the nutrient solution concentrations, and the crops grown. You can read this post I wrote, for more tips to successfully grow using this bucket system.

However, you cannot easily grow large productive flowering plants in this system. This is because large plants consume too much water and nutrients throughout their life, and will require either a very big volume or complete changing of the nutrient solution at several points. For large flowering plants, it is more convenient to use other types of bucket systems that make solution changes easier. If you would like more information and data regarding the culture of large plants using Kratky hydroponics, please read this post.

The Kratky bucket system is ideal if you need a system with no power consumption, your environmental conditions don't have extremes, and you want to grow leafy greens or other small plants on a small scale. For larger scales, Kratky systems to grow leafy greens on rafts do exist, although large-scale

systems do involve pumps, at least to change solution between crop cycles.

The bucket with and air pump

The Kratky system has zero power consumption, but does require the grower to carefully manage the initial nutrient level and is not very tolerant to strong variations in environmental conditions. For this reason, a more robust method to grow is the bucket with an air stone. This is exactly the same as a Kratky system, except that air is constantly pumped into the nutrient solution and the nutrients are generally maintained at a specific level inside the bucket.

Constantly pumping air into the solution creates several advantages. The first is that air oxygenates the solution, which means the solution’s level is not critical. This is because plant roots have access to oxygen, even if more than the ideal percentage of the root mass is submerged in the solution. The second is that air will help regulate the temperature of the nutrient solution. As air bubbles through and evaporates water, it helps keep the solution cool. Kratky systems can suffer from unwanted temperature spikes if the air temperature gets too hot. This is a common reason for disease and failure in Kratky systems.

A typical air-pump bucket system growing kit

Systems with an air pump are usually easier for people who are just starting. The low cost and low failure rates are the main reason why this is a very popular choice for first-time hydroponic enthusiasts. However, since water evaporates more, there is a need to at least replenish water through the crop cycle. You are also limited to smaller plants unless you're willing to fully change the nutrient solution several times per crop cycle, which is inconvenient with a bucket system like this. It is also uncommon to see systems like this on a larger scale, as changing and cleaning hundreds of buckets manually and having hundreds of airlines going into buckets is not practical.

Note that air pumps bring substantial amounts of algae into solutions that will thrive if any light can get into your buckets. For hydroponic systems that use air pumps, make sure you use buckets made of black plastic so that no light gets in. White plastic will allow too much light to get in and algae will proliferate.

You can buy several ready-made hydroponic systems of this type. For example this one or this one for multiple small plants.

The Dutch bucket system

A Dutch bucket system is great to grow large plants. In this setup, buckets are connected to drain lines at the bottom. This allows you to pump the nutrient solution into the buckets and allow it to drain several times per day. The constant cycling of solution exposes roots to large amounts of oxygen between irrigation cycles, making this a great setup for highly productive crops.

The Dutch bucket system is therefore an active system, requiring water pumps to keep the plants alive. This dramatically increases the energy consumption needs of the crop and makes the pumps and timers fundamental components of the hydroponic system. An active bucket system like this will usually give the grower 12-24 hours, depending on conditions, to fix critical components in case of failure before plants start to suffer irreversible damage. To prevent damage in commercial operations, drains will usually allow for some amount of water to remain at the bottom of the buckets so that large plants have a buffer to survive more prolonged technical issues.

A commercial Dutch bucket hydroponic system

The need to support the plants without water also means you need to use a lot more media, as the bucket themselves need to be filled with it. Since multiple flood and drain cycles are desirable this also means that the media needs to dry back relatively quickly, reason why media like rice husks, perlite or expanded clay, are used. Media costs of Dutch bucket systems are significantly larger than those of other systems because of this. You can run Dutch bucket systems with netpots as well, but this tends to make the system much less robust to pump failure.

Dutch bucket systems are a good choice if you want to grow highly productive large plants. They offer more robustness when compared with NFT systems – which have more critical points of failure – and the large amount of media provides a good temperature buffer and a great anchoring point for large plants. Several small-scale kits to grow using Dutch buckets also exist (see this one for example). However, they take significantly more space than the alternatives we described before. They require access to power and space for pumps, a large nutrient reservoir, and the supporting infrastructure for the plants. They also require nutrient solution management skills.

Conclusion

Bucket systems are very popular in hydroponics. They can be as simple as a bucket with a hole and a net pot or as complex as Dutch bucket systems with interconnected drain systems and full nutrient solution recirculation.

The easiest system to start with is a hydroponic bucket system with an air pump, as this eliminates the need to gauge the container volume and nutrient level precisely and allows for healthier growth, fewer disease issues, and easier temperature control.

A Kratky system can be great to grow small plants at a low cost with no power, but some experimentation with the nutrient level and concentration is usually required to get a satisfactory crop.

For large plants, the Dutch bucket system is a great choice, if you have the space and power availability. Dutch bucket kits for small-scale growers are also readily available.

Have you ever grown using buckets? Which type of system have you used and why? Let us know in the comments below!

Never fail with ebb and flow hydroponic systems

Ebb and flow or “flood and drain” systems, are some of the most popular systems built in hydroponics. These are low cost, can host a large number of plants, and can generate good results, reason why they are a preferred choice for both new and experienced hydroponic growers. However, there are a substantial number of issues that can come up in these systems, both due to the different ways they can be built and because of failures in their management. In this post, I am going to give you some tips on the construction and management of ebb and flow systems so that you can minimize the chances of failure when building your own hydroponic setup of this kind. For some basics of how an ebb and flow system is set up, I advise you to watch this video.

Ensure full drainage

A common mistake when building a flood and drain system is to have incomplete drainage of the nutrient solution. Make sure you have a setup that allows for complete drainage of the solution as soon as a certain level is reached, and always stop pumps as soon as the return of the solution starts. It is quite important to also ensure that as little solution as possible remains at the bottom of your flood and drain trays or buckets, as plants sitting in puddles of water can be a recipe for disease and a very good environment for pests to develop. A very simple system I built in 2010 had the problem of never being able to efficiently drain, which caused substantial issues with the plants as root oxygenation was never as good as it should have been.

Typical flood and drain table with plants in media on top of the table.

Fast cycle speed

Ideally, you would want the flood and drain cycle of an ebb and flow system to be as fast as possible. Also, the cycles should not take more than 15 minutes, from starting to flood the growing table to completely draining the system. For this, you need to have an adequately sized pump for the volume of your table that needs to be filled (total volume minus volume taken up by plants and media). If you want to use a smaller pump, you can always add some rocks to the table in order to take up volume and ensure you require to add less volume to fully flood the reservoir. Time your cycles and make sure these are as short as possible, adequately saturate the media and completely drain, as mentioned above.

The right media

A common reason why flood and drain systems are less productive is because of a suboptimal choice of media. Ebb and flow systems periodically flood the media with nutrient solution, completely saturating it with water, so media that retains too much moisture will require infrequent cycles and will be harder to time. Media like peat moss and coco are often inadequate for ebb and flow systems due to this fact, as over-saturation of the media will lead to periods of low oxygen availability for the plants. Media that drain fast generally do much better, choices such as rockwool or perlite can give much better results when compared with media that have much higher moisture retention. Since this is a recirculating setup, perlite and rockwool also have the advantage of being more chemically inert. I however do not like media that drain too fast, such as clay pellets, as these can require too frequent cycling.

Another typical ebb and flow table setup

Time irrigations with water content sensors

Your flood and drain system requires good timing of irrigation cycles in order to have optimal results. If you irrigate based on a timer, you will over irrigate your plants when they are small and will under irrigate them when they are big. Overwatering can be a big problem in these systems and it can be completely solved by both choosing the right media – as mentioned above – and using capacitive water content sensors for the timing of your irrigations. If you're interested in doing this, check out this post I wrote about how to create and calibrate your own simple setup for using a capacitive water content sensor using an Arduino. This will allow you to flood your table only when it is needed and not risk over watering just because of a timed event happening.

Oversize the reservoir

The nutrient reservoir contains all the nutrition that is used by the plants, this means the bigger this is relative to the number of plants you have, the lower the impact of the plants per irrigation event will be. Having a reservoir that has around 5-10 gallons per plant – if you're growing large flowering plants – or 1-3 gallon per plant, for leafy greens, will give you enough of a concentration buffer so that problems that develop do so slowly and are easier to fix. A large reservoir can fight the effects of plants more effectively and make everything easier to control.

Add inline UV sterilization

Disease propagation is one of the biggest problems of this type of system. Since recirculation continuously redistributes any fungal or bacterial spores among all the plants, it is important to ensure you have a defense against this problem. A UV filter can help you maintain your reservoir clean. You can run the solution through the inline UV filter on every irrigation event, ensuring that all the solution that reaches the plants will be as clean as possible. Make sure you use a

UV filter that is rated for the gallons per hour (GPH) requirements of your particular flood and drain system. Also read my post about getting read of algae, to learn more about what you can do to reduce the presence of algae in a system like this.

Typical UV in-line filter used to sterilize a nutrient solution in a hydroponic setup. These are sold in aquarium shops as well.

Run at constant nutrient EC, not reservoir volume

One of the easiest ways to manage a recirculating system, especially with an oversized reservoir, is to keep it at constant EC instead of constant volume. This means you will only top it off with water in order to bring the EC back to its starting value, but you will never add nutrients to the reservoir. This will cause your total volume to drop with time as you will be adding less volume each time to get back to the original EC. When the volume drops to the point where you have less than 50% of the original volume, completely replace your reservoir with new nutrients. This gives you a better idea of how “used up” your solution really is and how close to bad imbalances in the nutrient solution you might be. A large flowering plant will normally uptake 1-2L/day, meaning that with a reservoir sized at around 5 gallons per plant, it will take you around 2-3 weeks to replace the water.

Note that more efficient and complicated ways to manage a nutrient reservoir exist, but the above is a very safe way to do so without the possibility of toxic over accumulations of nutrients from attempts to run at constant volume by attempting to add nutrients at a reduced strength to compensate for plant uptake. Topping off with nutrients without regard for the changes in the nutrient solution chemistry can often lead to bad problems. The above approach is simple and gives good results without toxicity problems.

Change your pH according to the return pH values

Instead of watering at the normal 5.8-6.2 range, check the pH of the return on a drain cycle to figure out where you should feed. Since a flood and drain system is not a constantly recirculating system, the solution conditions do not necessarily match the root zone conditions and trying to keep the solution at 5.8-6.2 might actually lead to more basic or acidic conditions than desired in the root zone. Instead, check for the return pH to be 5.8-6.2, if it is not, then you need to adjust your reservoir so that it waters at a higher or lower pH (always staying in the 5-7 range) in order to compensate for how the root zone pH might be drifting. This can take some practice, but you can get significantly better results if you base your pH value on what the return pH of your solution is, rather than by attempting to set the ideal pH at the reservoir. You will often see that you will be feeding at a consistently lower pH 5.5-5.6, in order to accommodate nutrient absorption.

Finally

The above are some simple, yet I believe critical things to consider if you want to succeed with an ebb and flow system. The above should make it much easier to successfully run a setup of this kind and grow healthy and very productive plants. Let me know what you think in the comments below!