"Ebb And Flow" Garden Beds

Jason Diehl waters and feeds the plants in his gravel-filled grow beds from a fish tank on an "ebb and flow" basis. Grow beds and fish tank were fabricated from 275-gal., food grade plastic totes.

"I modeled my setup after the CHOP system developed by Murray Hallam, an Australian aquaculturist," says Diehl (https://blog.aquaponics.net.au/).

CHOP stands for Constant Height, One Pump. Diehl uses one food-grade tote with its top cut off for a fish tank. He cut 2 other totes in half and trimmed the sides to 14 in. to make 3 gravel-filled grow beds with a common sump. The grow beds rest on cedar boards placed on standing concrete blocks.

A single pump maintains a constant flow of water from the sump through flexible pipe to the 3 grow beds and the fish tank. Bell siphons in the grow beds placed around the sump drain the beds into the sump about twice an hour, creating the ebb and flow effect in the beds. Meanwhile, the constant flow into the fish tank creates an overflow into the sump.

"Ball valves on the flexible pipes from the sump to the grow beds restrict the flow so the beds fill to the top of the bell siphon about every 25 to 30 min.," explains Diehl.

The bell siphons are 7-in. tall, 1-in. pvc pipes inside a capped, 10-in. tall, 2-in. pvc pipe. Holes near the bottom of the bell allow water to fill it as the bed fills.

"Once the water overflows the 1-in. pipe, a suction is created that drains water out of the bed to the level of the holes," says Diehl. "At that point, air enters breaking the siphon."

The flow bathes plant roots in nutrient-rich water from the fish tank, and the ebb exposes them to air.

At the same time the pump floods the grow beds, it is pumping water through a spray bar across the width of the fish tank. It works with bubblers to oxygenate the water.

Overflow from the fish tank drains back into the sump via a system of hard pvc pipe. Diehl used two, 2-in. pvc pipes that run from near the bottom of the fish tank where the fish waste settles to T-fixtures at the top of the tank. One outlet open to the air prevents suction from being created. Pipe on the second outlet runs over the side of the tank to merge into a single, 3-in. dia., return pipe.

"I used a twin pipe overflow system to provide backup," says Diehl. "Holes drilled in caps on the ends of the pipes screen out larger particles, but should one plug up, the other will continue to flow."

After several years of use, Diehl now has the confidence to build a more permanent system with 4 by 16-ft. beds inside a 20 by 32-ft. greenhouse. He hopes to apply the lessons learned with his outdoor system.

Although designed to harvest both fish and plants, Diehl found his worked well for plants, but not for fish.

"I decided to look at them as a source of plant food," says Diehl. "I found the system was economically viable even without fish sales."

Cucumbers, lettuce and other greens do particularly well, as does zucchini. "I harvested zucchini in half the time of soil beds," says Diehl.

With his mild Oklahoma winters, Diehl's beds usually produce vegetables from March through Thanksgiving. At that point he drains the beds and disconnects the flexible pipes. However, he keeps the pump circulating water between the sump and fish tank.

He admits the process has had a definite learning curve. "If you try a tomato variety and it doesn't do well, don't give up on tomatoes," he says. "Try other varieties to find ones that fit your system."

Jason Diehl waters and feeds the plants in his gravel-filled grow beds from a fish tank on an "ebb and flow" basis. A single pump maintains a constant flow of water.

Diehl added red wiggler worms to the grow beds. "They help mineralize the fish waste," he says. "The plants get nutrients from the fish waste, but they need available minerals too."

Another important step is selection of rock for the 12-in. deep grow beds. "I used thicker river rock at the bottom and thinner smaller particles on the upper layer to help hold the plants upright," says Diehl.

Even how the rock is delivered can be important. While the river rock had been washed, it picked up enough lime dust to create pH problems for the fish.

Other lessons learned include careful selection of food-grade totes. Diehl notes that the plastic can soak up whatever is stored in it, and fish tend to be sensitive.

Diehl initially painted his tote exteriors to discourage excess algae growth on the interiors. He used a flexible, black plastic paint on the fish tank and less expensive primer on the grow beds. It's something he will avoid in his new larger system.

"The grow beds will have wood sides and be lined with heavy plastic," he says. "I'll line the tote cage with a low cost tarp and slide the tote back in. It should have the same benefit, last longer and be easier to do."

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Grain Bin Robot Designed To Eliminate Trips Into Bins

The Grain Weevil robot weighs in at only 26 lbs. and is just 18 in. long, but turn it loose inside a grain bin and it will do the work of a couple of men. It can tear up a crust or level grain as it is augered into a bin or truck, and it will also work alongside a sweep auger when emptying a bin.

"We tested it out in a semi trailer under a 250 bushels per minute flow rate," says Chad Johnson, JLI Robotics. "It drives in under the stream of grain and levels it out while loading."

Johnson's son Ben came up with the idea at the request of a farmer friend. The farmer was all too aware of the dangers of entering a grain bin, something he did dozens of times a year. He knew that Ben, a University of Nebraska electrical engineering student, had experience with robotics. The question was could he come up with something that could eliminate some if not all bin entries.

The 2 Johnsons came up with the Grain Weevil, a compact robot in a box with two 6-in. drive augers mounted under the box. "Figuring out how to build a robot that could drive across grain was our biggest challenge," recalls Ben. "After many months of trial and error, we came up with the auger solution. You should have seen our faces the first time we saw it move across a pile of grain!"

As the auger churns through the grain, it breaks up crusts and spreads the grain out. Once they had the Grain Weevil moving across the grain, the next big challenge was extending battery life for more working time in the bin. They are now up to more than 2 hrs., have increased the motor power, and have more aggressive augers.

Remote-controlled robot is equipped with two 6-in. drive augers, allowing it to drive across grain and level it or tear up the crust.

A continuing challenge is to make what is now a remote-controlled device autonomous. "We need to get to where the farmer in his truck can hit the 'easy' button and have the Grain Weevil do its job," says Ben.

The Johnsons have been demonstrating the Grain Weevil to farmers and getting feedback. They are working on the next prototype. In the next stage, they will be getting Grain Weevils out to farms and into grain bins.

They have been working with 2 new product incubator programs. Ag Launch Incubator Program 365 out of Memphis, Tenn., is helping them design the on-farm trials. Nebraska's Combine Incubator program is helping them find farmers to work with and gather feedback.

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Refrigerator Seed Starter

Michael Kilpatrick made a seed starter using an old refrigerator and a couple of Crockpots. When the water-filled Crockpots heat up, they release heat and humidity into the fridge chamber, giving the seeds what they need to germinate. Kilpatrick is a market gardener and consultant who offers online video courses on a multitude of market gardening ideas, including his germination chamber idea.

Kilpatrick suggests Crockpots for simple and low-cost heat and humidity sources. In his video on germination chambers, he puts Crockpots in a bottom freezer compartment. He cuts a hole in the refrigerator floor to let the heat and humidity through. He uses a 6-quart crockpot to provide humidity and a 4-quart one to provide heat.

"Pour a layer of vegetable oil over the water in the Crockpot used for heat or leave the cover on to reduce water loss," says Kilpatrick.

Preparing the chamber is easy. Kilpatrick uses a knife to slice away the plastic shelving in the door, creating more room for trays. He also drills holes for each of the Crockpot cords.

"Be careful not to damage the rubber seal around the door," he warns. "Drill holes in the side wall for the cords, but be careful to avoid puncturing any coolant lines."

Existing shelving can be used, but that will limit the number of seedling trays. Kilpatrick suggests removing them, cutting away the supports and putting in a racking system with cross arms to hold the trays.

The final step in setting up the germination chamber is humidity and temperature controls. Available options include dual sensors in one device or separate temperature and humidity sensors.

Water-filled Crockpots release heat and humidity into refrigerator chamber, helping seeds to germinate.

His video is available for $47 on his website. It includes detailed instructions on the build, as well as a review of 3 different monitoring tools, a germination guide for common vegetables, and an unreleased Cornell University study on larger scale, stand-alone germination chambers.

"We will be adding a new one shortly on building a barrel washer for potatoes and other root crops," say Kirkpatrick.

Kirkpatrick consults with a large number of farms and organizations. His Thriving Farmer Podcast and Thriving Farmer Summit series has had more than 50,000 views. Contact is preferred through the website.

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