



Tamera SolarVillage Technology Brief

Biaponics

Purpose: To build a low-tech test system for growing plants in gravel (without soil) using a recirculating solution of water and effluent from a BioGas production system.



Process Details:

We started with the idea to recycle common 5 liter plastic containers cut in half like so:



We realized that although this solution was cheap and easy, the plant roots would be always submerged and be at risk of rot and lack of oxygen.

Thus, we built a new frame and decided to reuse an old plastic liner and scrap pieces of water resistant plywood blocks to contain the rocks and control the water flow.



The nutrient solution tank is filled with material to support bacterial life (gravel, leca, and shredded fiber insulation). The effluent (water overflow) from the BioGas system is mixed with water and pumped 10 times daily to the top of the cascade for 5-20 minutes.

notes:

- 1) the biogas digester for this investigation was fed only chopped vegan kitchen waste.



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2) a Bohemian truffle (*Pisolithus tinctorius*, a widespread earth-ball like fungus, pioneer plant in Portugal) was also added to the nutrient tank with the intention to spread spores and create a beneficial mini-ecosystem between plants, mushrooms, and bacteria

3) the initial concentration of the nutrient solution is 1 part effluent to 30 parts water. This concentration was later increased to 1 to 10 and the mature plants seemed to respond favorably (no measurements were taken to solidify this perception and future studies will need to be more rigorous before making any claims about the effects of nutrient solution concentration)

Clearly, this has not been a classical experiment with control groups and isolated variables. The intention has been to give it a first try and the results are very encouraging.

The above images were taken on November 9, 2012. Two months later you can see quite impressive growth and delicious edible radishes and lettuce:



side by side - left: lettuce planted in earth in the same greenhouse right bioponics lettuce



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First Harvest: Two Radishes and lettuce with roots

A simple zoomable collection of images is available here: <http://ahead.com/begreen/biaponics>

Background Thoughts and Motivations:

The main motivation for this ongoing line of investigation is the wish to manifest a realistic urban solution that is low-tech, low-impact, and possible without any exploitation of animals (such as the typical use of animal manure or high density fish tanks).

Additionally, we have the wish to come in contact with life in soil, to explore the questions “what is soil?”, and to honor the immense power of bacteria and the crucial role they play in the family of life.

We had the question if the biogas digester could be coupled with urban gardening techniques to create a solution for both energy and food. The question of “What is Biogas fertilizer” is essential, and the following quotes shed some light on this question:

“I don't have any technical information, just anecdotal. Dr. Karve in India, who taught me about urban biogas, is an agronomist and horticulturalist first and got into biogas secondarily. He told me that the fertilizer from biogas is the richest there is because it has lost no ammonia (nitrogen) to the atmosphere and because the food waste feedstock has all the micronutrients (unlike commercial operations that use single high energy crops that can be deficient). As for the bacteria -- they are all there, coming in from the manures, from the foodstuffs, from everything we put in, and they are alive.” - T.H. Culhane

“Biogas effluent is a living, complex microbial community -- it has not been sterilized and so it not just a mix or organic nutrients. It is living compost tea that has not lost its nitrogen or been cooked thermophilically to the extent that many of the life forms have died. Yet it apparently has a low to nonexistent e coli or pathogen content. So it is compost, just without the effects of the air (although to be fair, it starts aerobic using dissolved oxygen in the foodwaste and water, as



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there is a BOD for the hydrolytic bacteria, then goes anaerobic and then, when you pour the effluent into the garden it aerobically composts once again as the facultative aerobes get the O₂ they need. So I think you get the best of both worlds.” - T.H. Culhane

Next steps:

Soon we will build two systems with bigger planting beds for side by side studies.

Some ideas for comparisons and questions include:

- is adding mushrooms helpful?
- alternative growth media (eg. gravel vs. broken glass)
- nutrient solution concentrations
 - what will the optimum concentration be?
 - will that change over the life of the plants? over changes in the feedstock for the digester?
- Is it possible to grow rice for the full life cycle?