Hydroponic Lettuce on a Budget

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Hydroponic Lettuce on a Budget

- Background of Growing Lettuce
- Outside Lettuce Problems
  - Wire Worms
  - Dirty Product
  - Susceptible to the whims of nature

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- Lettuce in Greenhouse
- Using Drip Irrigation
- Sterile peat moss mixture in pots

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- Use pelleted seed
- Plant into 105 trays to start then transplant into pots

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- Lots of work to set up
- Need to change out every four weeks
- Pick leaves individually and then bag @ 0.3 lbs
- Mix lettuce is popular - red, green and romaine

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- Growing 1392 pots of lettuce, 696 per month.
- Cycle once a month.
- Use 4.25 bales of soil mix per cycle at a cost of $535 per year
- High labour cost to change out each cycle - 1 person 2 days
- Issues with growing - inconsistent watering, high EC of water, tip burn an issue

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- Looked at different ways to grow lettuce.
- Hydroponics looked interesting with the following potential benefits.
    - clean product
    - consistent watering
    - consistent fertilization
    - more produce per plant
    - less labour intensive
    - smaller labour costs
    - little or no soil cost

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- In 2013 made up a test bench 10 ft long using the system we currently use.
- Rain water and fertilizer were continuously circulated 24/7.
- Net pots are partially immersed. The drain is set approx ⅔ up from the bottom of the pipe.
- Plants require oxygen to grow so the roots are partially exposed to air.
- Results were impressive. Each plant produced at least 50% more of what we were getting when planting in pots.

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- 3 inch diameter x 10 foot long Plastic Pipes were placed 6 inches apart on wooden tables for a total length of 60 ft.

- Levelling the table is important. Can be an issue with unloved floor. Used laser leveller initially then fine tuned by observing the water level in the pipes.

- There were 696 holes for net pots, 348 plants per cycle

- Holes were drilled to accept a 2 inch diameter net pot

- Holes are 8 inches apart and are alternated on every other pipe

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- A plastic tank held the water and the total amount of water in the system was twice the capacity of the pipes. The volume was calculated using the actual volume of water used.

- Rain water was used for the system throughout the year. The reasons for this will be explained later in the presentation.

- The lettuce was still started in 105 trays and then transplanted into the net pots.We used perlite as the planting medium the first year. The perlite, being so fine, caused issues with filtering with frequent cleaning required especially with a transplant session.

- The following year we used Hydrocorn 8-16 mm (sterilized baked clay particles) with a neutral PH. This eliminated the issues of constant cleaning of the filter.

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- The water was fed by a pump through a filter and the final version used Netafim 25 litre per hour emitters. Three emitters per run was used in the first year.

- Initially I used lower flow emitters the same as the test bench. This did not work well as the plants were being starved of oxygen from the low flow due to the longer length of the system.

- The longer runs depleted the water of oxygen sooner. Even with the higher flow rates the plants still experienced oxygen starvation especially at the drainage end of the system.

- I added air pumps and bluestone to add oxygen and increased the flow from 32 litres per hour to 75 litres per hour. There were still issues though.

- The following year we shortened the pipes to 40 ft lengths and the flow was increased to 100 litres per hour.

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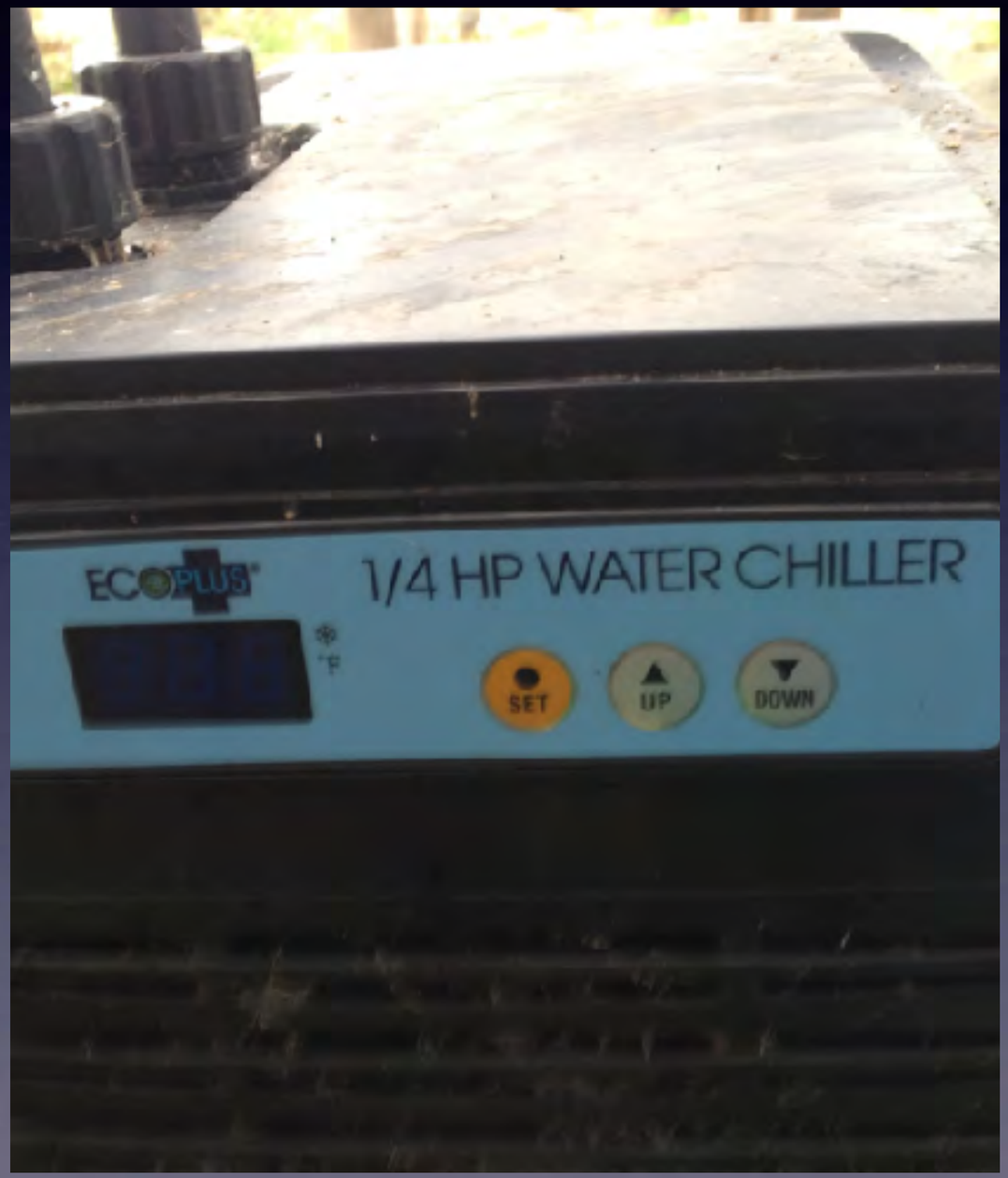
- The reasons for changing to 40 ft sections for this are as follows:
  - Oxygen depletion is still a concern.
  - Heat gain is an issue especially during the long days of summer. Ideal growing temperature is 21 degrees celsius.
  - The warmer the water temperature the less oxygen in suspension in the water.
  - Water flow is reduced by the roots of the plants particularly so when the plants are mature. Causing overflow at the rear 20 ft of the system. Lifting the tables from horizontal was the only way around this.
  - I added a water chiller in July to keep the temperature more consistent. A separate pump is required to feed the chiller. I used a MAG submersible pump and restricted the flow so maximum chilling resulted. However with the 60 ft long system heat gain was still an issue because the water did not cycle back through the chiller fast enough.



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- Sizing of the pump to feed the hydroponic system is important as it needs to match the total amount required by the emitters. If using a larger pump then bleeding off a portion of the flow is better than not bleeding. Not bleeding off the flow can result in early pump failure.

- A pump with minimum operating pressure of 20 psi is needed as the emitters need pressure of 14 psi to open.

- This pump has an automatic control on it so that if it runs dry it will shut down automatically.

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- There is more general maintenance with this system. Adding 220 litres of water and fertilizer every two days at the height of summer.

- I used rainwater because I thought that the tip burn we experienced in the pots was primarily due to the water having a relatively high EC of 1100 um/cm (microsiemens/ centimetre). This EC level is close to being termed as brackish water. Then on top that you have to add the fertilizer effect, conversely rainwater has EC of 55 um/cm (sweet water).

- High EC's prevent the transportation of the nutrients within the plant. Some plants are more tolerant than others, lettuce not being one of them.

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- I kept the EC of the water solution at around 1250 um/cm. So the fertilizer effect was 1195um/cm.

- The fertilizer used was the same ratios as used for the tomato plants but with half the amount of potassium. This worked out to approx 100 parts/million of nitrogen.

- I kept the PH at 6.1 by adding nitric acid - very small amounts only 50ml maximum. Small amounts made a huge difference in readings. The slightly acidic PH value allows the plant to maximize the uptake of nutrients.

- Readings and fertilizer added were taken every time I added water. Once every two days when the days are long and it is warm outside.

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- One of the biggest issues with hydroponics is the occurrence of algae. In this case algae grows in the pipes and in the tank even though the tank is enclosed.

- It was one of the biggest issues I had and it took some time to find out what would work without damaging the plant and was also organic.

- Ideally if the pipes were black then algae would be less prevalent, however the downside is the much larger heat gain of the water.

- The final solution I found is to add concentrated food grade hydrogen peroxide at the rate of 3ml per 4 litres of water. So I added hydrogen peroxide every time I added water. You can purchase the food grade concentrated hydrogen peroxide at most health food stores.

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- The final result is, a cost effective, less labour intensive lettuce crop.

- In the end despite all our issues the hydroponic system effectively produced the same amount of finished product as a pot and drip system that is twice the size.

- The modified system, which we have used for the past two years, is 40 ft long and only has six lengths of pipe as opposed to eight initially used. The plant spacing is now 8 inch x 8 inch using the same overall width as the first iteration.

- The lettuce yield even with the latest modifications is better than the yields experienced with the first iteration. Over twice as much as an equivalent sized pot and drip system on aper plant basis.

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- Over a five year period there are the potential for a minimum of $5845 savings assuming no increases in labour and soil costs.
- This does not include the additional income from the extra space saved as the Hydroponic system produces 1.65 times the yield compared to a pot and drip system.
- Going forward we need to address the clean out of the system. Looking at using NFT channels and modifying to follow the same water depth as we currently use.

	Drip System	1st Hydroponic System	2nd Hydroponic System
Capital Expense	Pots $320 Trays $150 Drip $625	Pipes $650 Tank $240 Pumps $750	Pipes $360 Tanks $440 Pumps $750
		Chiller $525 Air Pumps $120	Chiller $525 Air Pumps $120
		Filter $50 Net Pots $300	Filter $50 Net Pots $200
Total capital	$1095	$2635	$2445
Annual Labour	2 days per change @ $20/hr $1920	½ day per change @ $20/hr $480	3 hours per change @ $20/hr $360
		Maintaining pH & EC @$20/hr $911	Maintaining pH & EC @$20/hr $911
Soil Cost	$535	$15	$15
Total Annual Operating Costs	$2455	$1391	$1286
Space Used	816 sq ft	434 sq ft	296sq ft
Annual Sales per sq ft	$10.31	$12.30	$17.62