VERTICAL HYDROPONICS FARMING, THINGS YOU NEED TO KNOW

- What is a Hydroponics?
- What is a Vertical Farm?
- Planning a VF project?
- Systems set up
- Costs of productions
- Crops to grow
- Wrap up

FEW FACTS ABOUT MY EXPERIENCE

- You may have seen/read my bio
- My major introduction to your greenhouse industry is that I completed The New Brunswick CEA Economic Feasibility Assessment Nov 2020 BIONB
- Claude tells me that growers like the study?

HYDROPONICS DEFINED

- A method of plant production without soil
- Also called soilless cultivation
- It can be practiced Indoor or Outdoor
- Greenhouses use soil and soilless growing system
- Purely water based systems
  - Nutrient Film Technique
  - Deep Flow System
  - Aquaponics, Bioponics, Nutriponics
  - Nutrient recycling or drain to waste

VERTICAL FARM (VF)

- Production at different levels of a space
- In warehouses, in greenhouses, in towers, orbitals, rotating wheels
- It is a way of increasing production per unit area.

WHY THERE IS RENEWED INTEREST IN VF

- Empty warehouses available for renting “cheap”
- Year round production
- Locally grown
- Love of new technologies
- Hydroponics, aeroponcis, aquaculture
- Pesticide free possibilities
- LED lights
- Investors looking for new avenues

CAN SOIL BE USED IN VERTICAL FARMS

- Majority of existing VF are water based. These are commercial Farms
- I have seen soil being used by small growers
- I have seen one VF using chicken manure based medium with serious problems like poor drainage, fungus gnats, high salt levels.

GREENHOUSE VS VERTICAL FARMS

Greenhouse	Vertical Farm
Turn Key, hydroponics, double plastic roof with all systems set up $ 30 to $ 50/ft2	Complete inside a warehouse, 7 levels, LED lights, all electrical and HVAC system, ready to grow $ 86 to $ 100/ft2
Actual space utilization for production is 80% of floor square feet.	Space utilization 80%, One ft2 space is multiplied by number of levels e.g. in this case 1 ft2 to 7 ft2
Lettuce crops, 11 cycles/year	Similar number of cycles
30 to 50 kg/m2/year	30 to 50 kg/year
Climate control required, temperature, relative humidity, ventilation, CO2 enrichment	HVAC system is a must (Heating Ventilation and Air Conditioning)
Water/nutrients mostly drain to waste, some recycling	Recycling essential
Insect and disease pressure	More risk of diseases in recycled system

MY OWN EXPERIENCE WITH VF

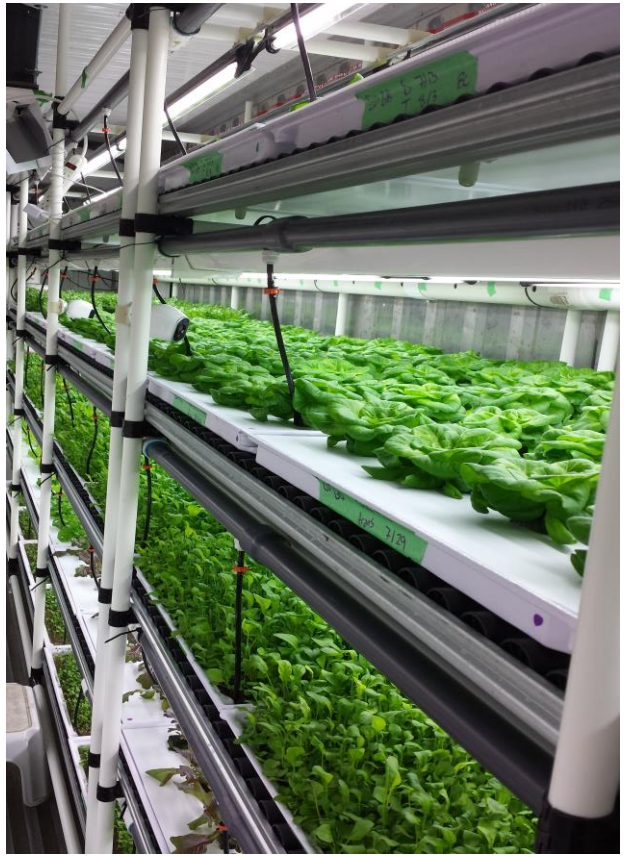
- 1985
- SunCountry Foods near Edmonton
- 5 levels for lettuce production
- Moveable troughs
- Very advanced, robot transplanting, automatic harvest
- Did not make it. Cost of production was $ 1.18/head and the wholesaler would not pay more than $0.80
- Tried to compete with field grown lettuce from US

TYPES OF VERTICAL FARMING

VF USING FERTILIZER FROM FISH - AQUAPONICS

- Simple starter unit to grow
- Leafy young plants
- Totally recycles
- No biofilters
- Danger of contamination
- From fish waste bacteria

INSIDE A TRAILER/SEACAN

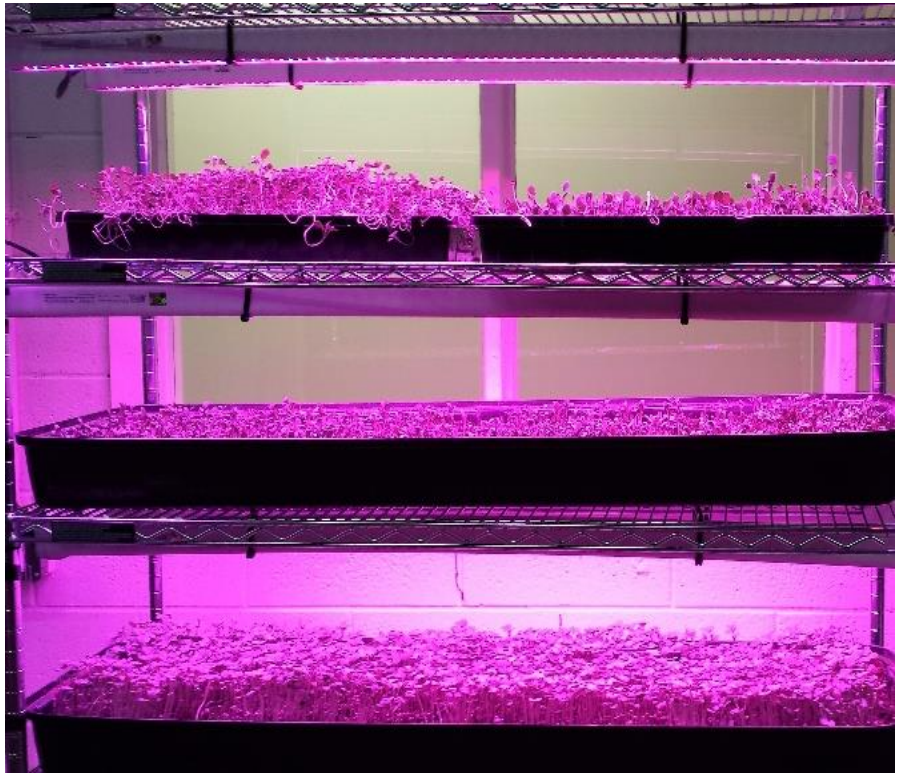


Dehumidification, proper temperature, automation for planting and harvest

INSIDE A GREENHOUSE

- This is from a cucumber greenhouse where some space is used to grow leafy vegetables for their own store.

INDOOR MICROGREENS



INSIDE A WAREHOUSE

Project Analysis of an Indoor Vertical Farm in Edmonton, Alberta 2018

Cost of 1 Pallet Rack	**49 trays of 32 ft2 Each, 1568 ft2**	**$ 8000.00**
Electrical & Plumbing		20,000.00
Trays	49	5,000.00
Water tanks	2	2,000.00
LED lights	392 @ $ 125 each	50,000.00
Meters, pumps, gauges		10,000.00
HVAC (Air handling and circulation system)		10,000.00
Total Capital Costs	Total for 1 rack, 1568 ft2	$105,000.00 ($ 67.00/ft2)
Total Capital Costs	Total of 4 racks, 6272 ft2	$ 420,000 ($ 67.00/ft2)

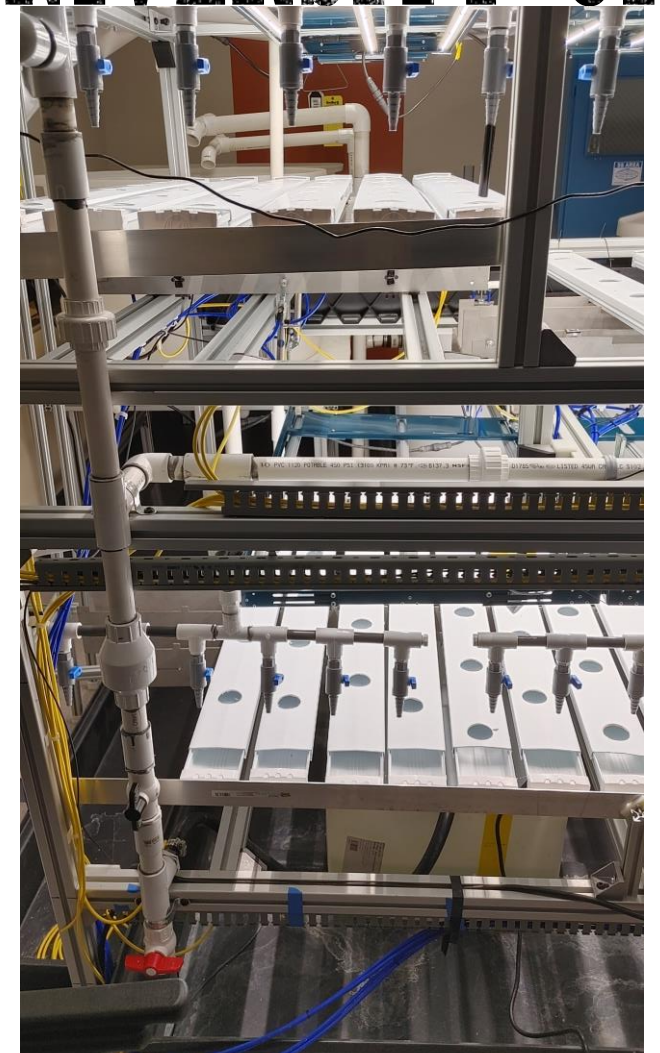
License and Fees	$ 5,000.00
Permits and drawings	$ 15,000.00
Consultancy and Training	$ 25,000.00
Warehouse Deposits	$ 10,000.00
Total	$ 55,000.00
Total of capital and other investments	$ 420,000 + $ 55,000.00 = $ 475,000.00 = $ 75.73/ft2
Working Capital for 2 months	$ 64,000.00
Total for the project, 6272 ft2	$ 539,900.00 ($ 86/ft2)
Owners equity	$ 53,900.00. Total Loan required $ 485,100.00

Production costs/6272 ft2	
Total production costs	$ 32,000.00 ($ 5.10/ft2)
Income	$ 48,000.00 ($7.65/ft2)
Cost of sales	$ 32,000.00
Gross Profit	$ 16,000.00
Loan Installment	$ 5000.00
Profit before tax	$ 11,000.00 ($ 1.75/ft2)

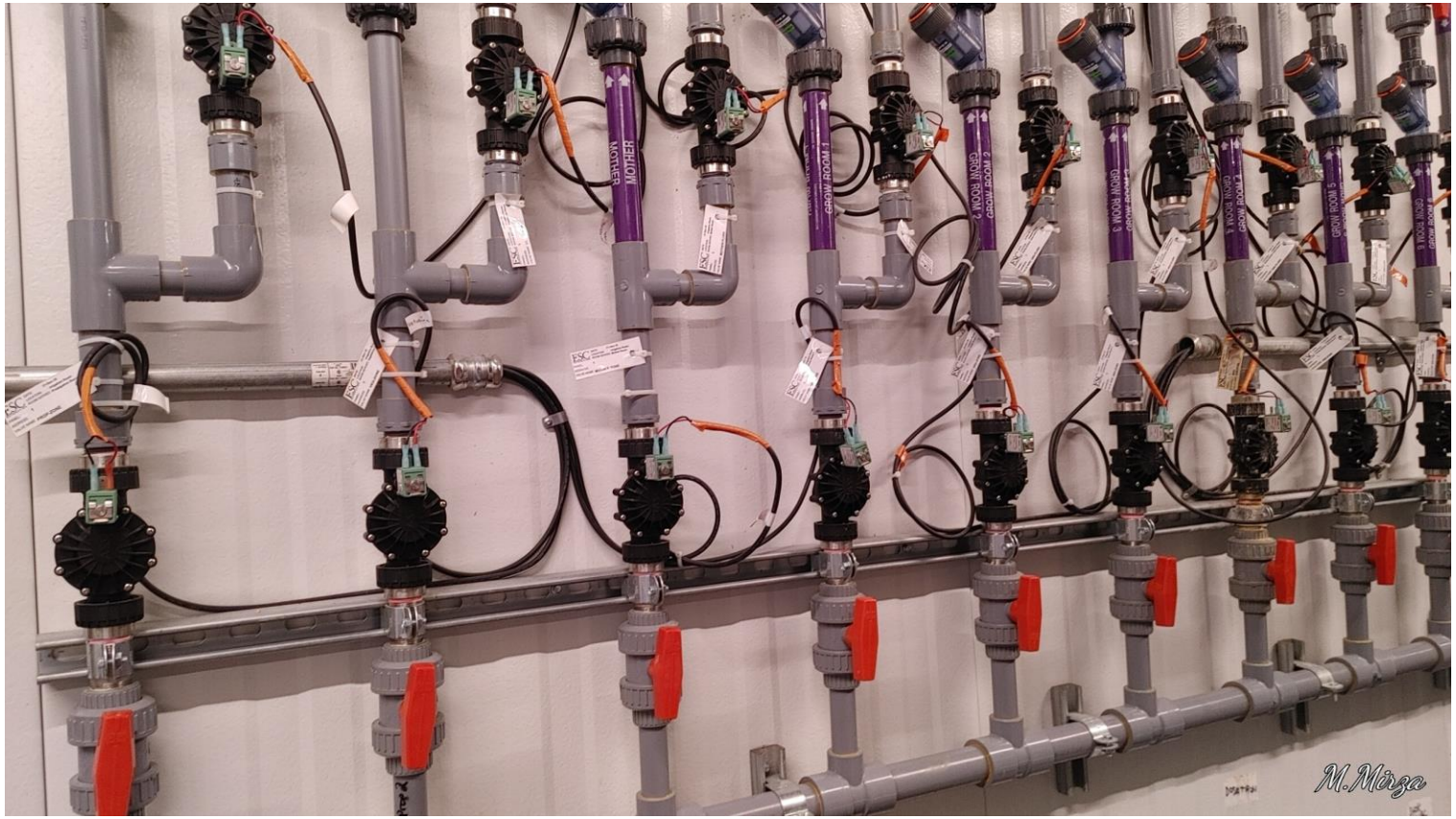
LARGE SCALE, HUGE VF

VERTICAL TOWER SYSTEM

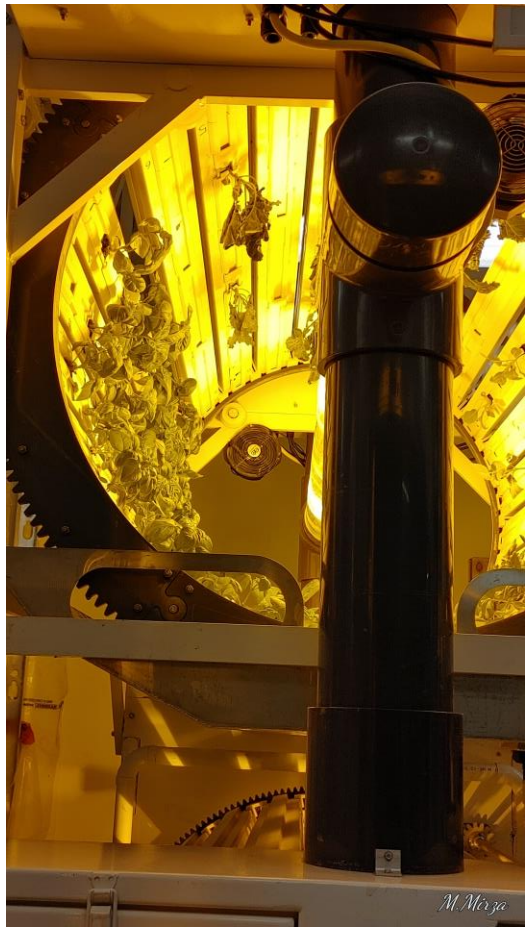
AN AUTOMATIC SYSTEM AT THE UNIVERSITY OF ALBERTA, EDMONTON



NUTRIENT DELIVERY SYSTEM



ORBITAL – 0 GROW SYSTEM



O.K. WHERE TO START

- Must have a business plan, simple and effective
- Where funds are going to come from, mom, dad, family, friends, investors
- Have good knowledge of terms you are going to use in your plan for the investors
- For example “organic”, natural, pesticide free
- Good cost of production data is needed which does not exist
- Crops to grow
- Market.

SELECTION OF A VF SYSTEM

- It appears that growers are selecting systems what they may have seen on internet, in magazines and sor
- In Alberta for example, One grower has settled
- for plants being grown vertically in tubes
- and light is also vertical
- He visited facilities in US and thought it was
- best for his project

PERMITS AND LICENCES

- First you need a Development Permit if in an Urban area. Many growers actually want to move out to Rural areas.
- The development officer may not have an idea of what you are talking about, so you may have to educate them.
- Then comes the Building Permit and you need drawings for that.
- Stamped drawing by a certified architect
- Permit for waste/nutrients disposal

SELECTION OF A PLUMBING SYSTEM

PLUMBING SYSTEM

- Size of the pipes
- Input must match output
- Stop valves if a tray need to be isolated

CLOSE UP OF PLUMBING

PLUMBING DESIGNED FOR YOUR SYSTEM

PLUMBING WILL BE DONE ACCORDINGLY

PLUMBING

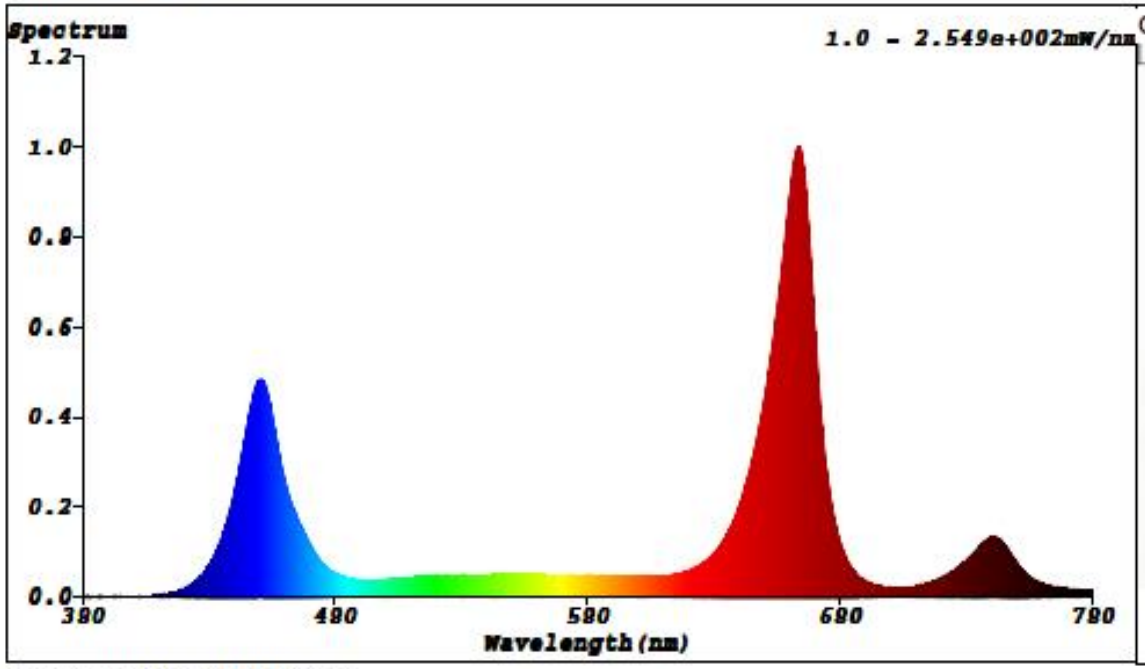
- Tanks
- Pumps
- How the water is going to be delivered and recycled
- Dosing pumps and injectors
- In line pH and EC meters plumbing and sensors

SELECTION OF LED LIGHTS

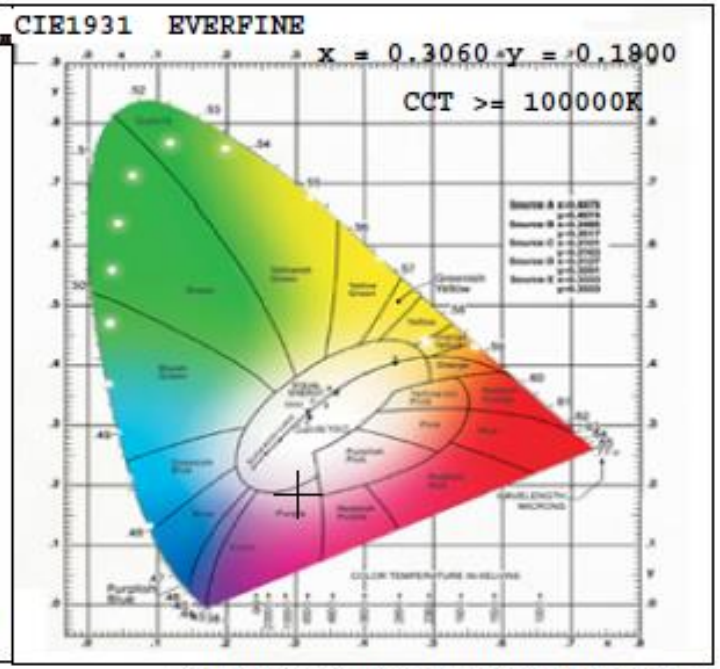
- That will the most costly part of the system
- How to select proper lights
- Spectrum and intensity
- Micromoles/sq.m/second
- Moles/day
- Red to blue ratios
- Trend is to have a white light for human eye

SPECTRUM

Spectrum

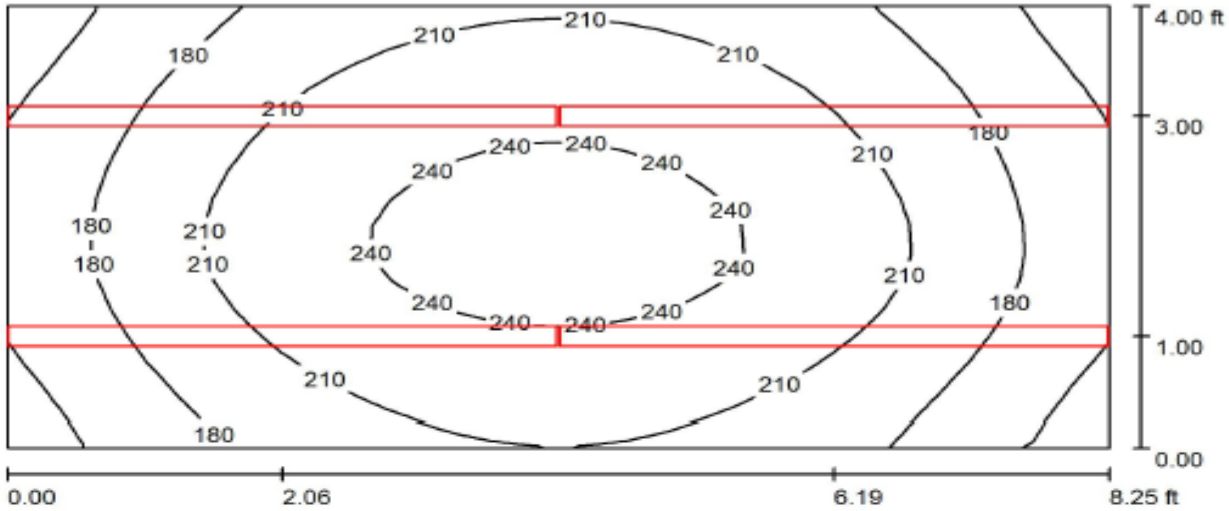


Spectral Distribution



CIE1931 Chromaticity Diagram

Many companies provide this type of information as to light distribution



Height of Room: 5.200 ft, Mounting Height: 5.200 ft, Light loss factor: 1.00 Values in Lux, Scale 1:18

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0
Workplane	/	204	133	253	0.652
Floor	0	199	131	246	0.659
Ceiling	0	0.00	0.00	0.00	0.000
Walls (4)	0	124	0.04	1663	/

Workplane:
Height: 0.100 ft
Grid: 32 x 16 Points
Boundary Zone: 0.000 ft
Illuminance Quotient (according to LG7): Walls / Working Plane: 0.609, Ceiling / Working Plane: 0.000.
Proportion of points with less than 400 lx (for IEQ-7): 100.00%.

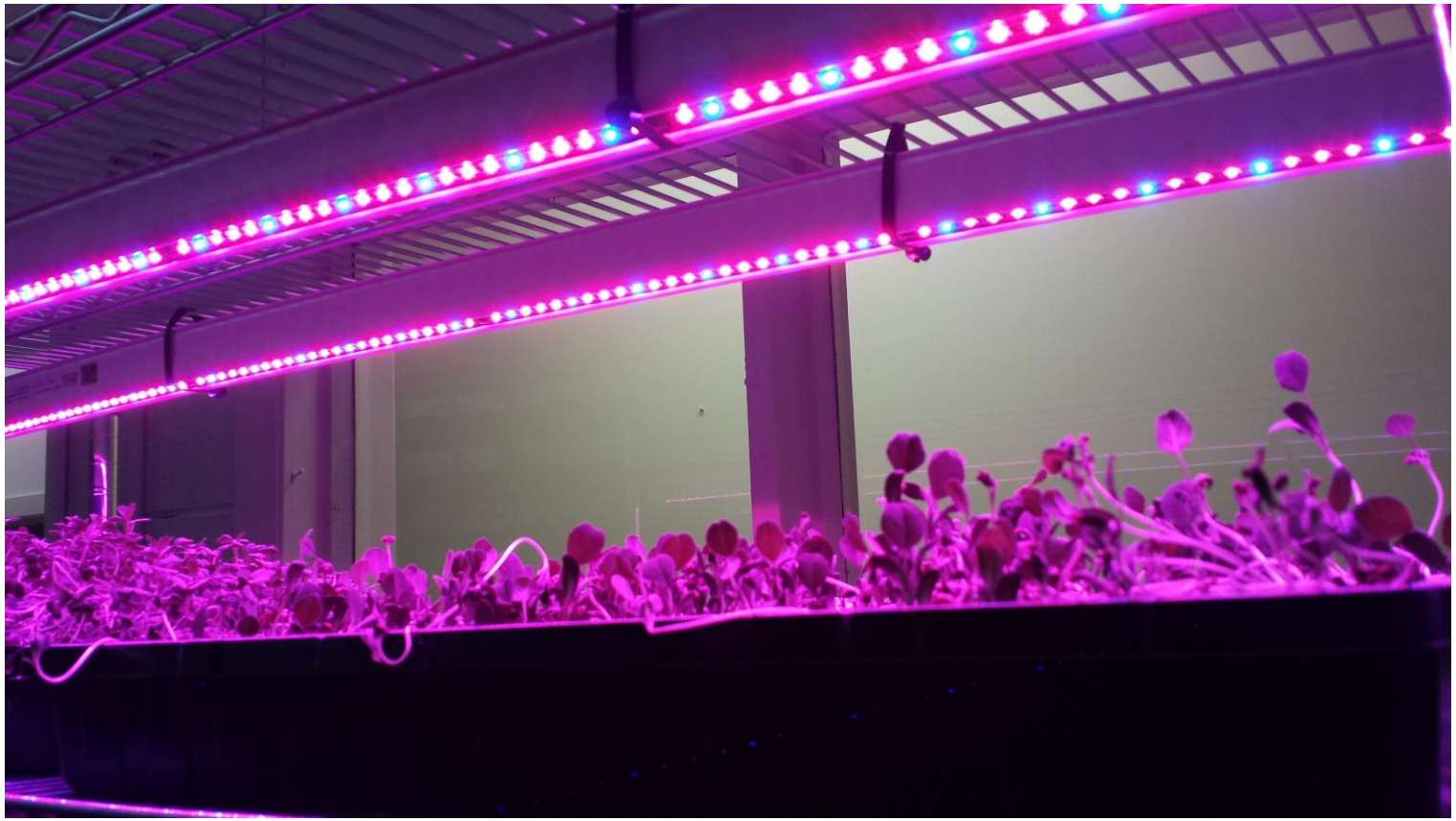
Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	4	Philips TO-DRWMBNAM GreenPower LED toplighting module (1.000)	520	520	200.0
			Total: 2079	Total: 2080	800.0

Specific connected load: 24.24 W/sq ft = 11.90 W/sq ft/100 lx (Ground area: 33.00 sq ft)

CHOSE DESIGN ACCORDING TO YOUR SET UP

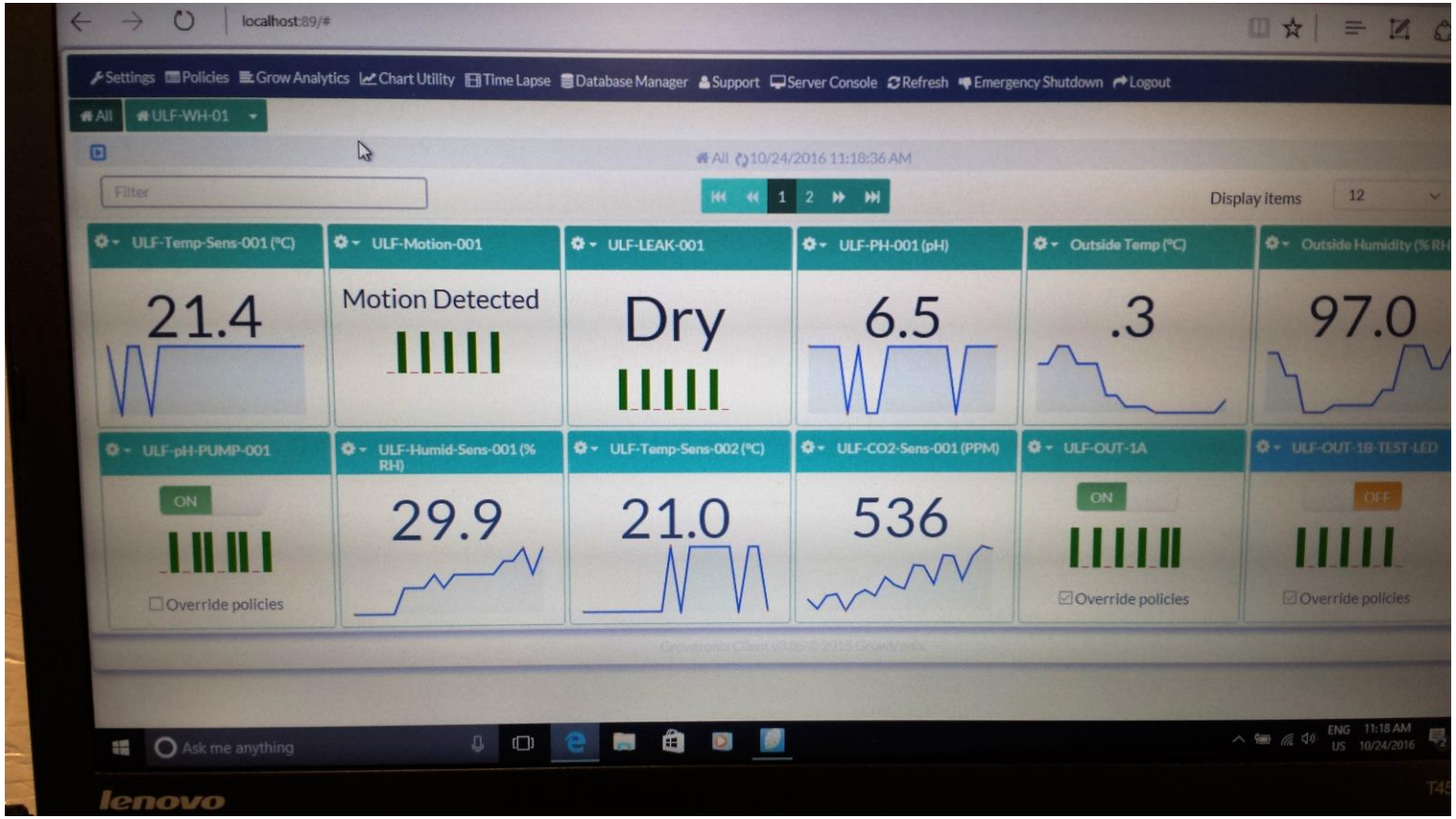
- I got headache when looked at these lights for one minute
- Make sure that you have got white light blended with red, blue and green



POWER SUPPLY

- Calculate KW or MW you need and make sure that you have that power supply
- Lights can be used at any time you want, if peak rate apply, then use it at low rates
- The power rates are available on minute by minute basis.
- Plan the circuits in such a way that you can turn lights off and on in groups if needed.
- Are dimmers useable

CLIMATE CONTROL



SIMPLE SYSTEM

WATER

- Water quality, the same as in the case of normal greenhouses
- Low EC
- Quantities, 75% less then normal greenhouse. The only loss of water is through transpiration.
- Recycling is a must.
- If you are topping up the nutrient solution based on EC, then you don't have to discard the nutrient solution.
- Oxygen levels of 8 ppm should be maintained

WATER TREATMENT

- Water disinfection system, Hydrogen per oxide, Ozone, bleach.
- Handling recirc water
- Mixing nutrients properly
- Algae control right from the seedling stage

MANAGING NUTRIENTS

- The same principle as in greenhouse crops
- Mix your own from individual fertilizers or buy ready made
- pH and EC for different crops.
- Understanding deficiencies and toxicities
- Diagnosing and correcting problems

NUTRIENT DELIVERY SYSTEM

TIP BURN, EDGE BURN, EDEMA

All related to climate control

SEEDLINGS

- Germination area
- Seed handling especially disinfection and soaking
- Getting uniform germination
- Transplanting

FEW PICTURES, WHAT TO GROW

- Mini tomatoes – failed
- Water spinach

WATER CRESS, CHINESE SPINACH. MINTS

SPINACH

DIFFERENT TYPE OF SALAD CROPS

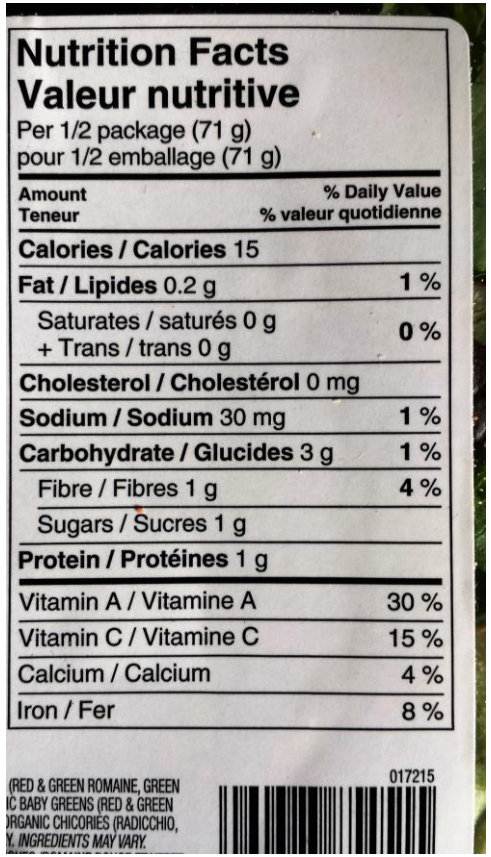
BASIL

INSECTS

Thrips will be a big challenge

- Strict sanitation and monitoring
- Fast growing cycles

PACKAGING

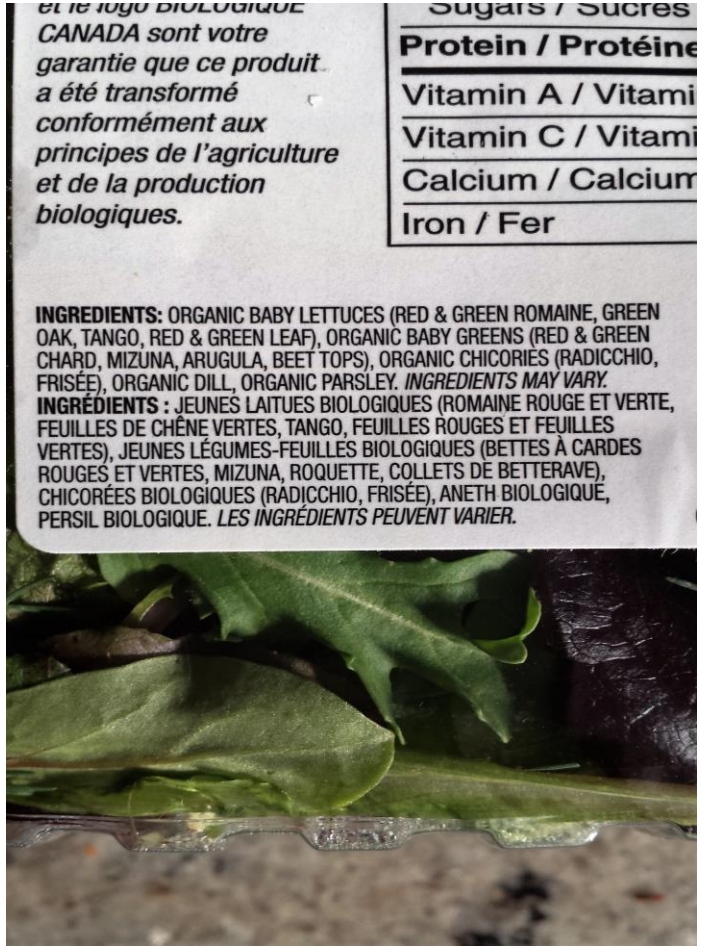


Nutrition Facts
Valeur nutritive
Per 1/2 package (71 g)
pour 1/2 emballage (71 g)

Amount / Teneur	% Daily Value / % valeur quotidienne
Calories / Calories 15	
Fat / Lipides 0.2 g	1 %
Saturates / saturés 0 g + Trans / trans 0 g	0 %
Cholesterol / Cholestérol 0 mg	
Sodium / Sodium 30 mg	1 %
Carbohydrate / Glucides 3 g	1 %
Fibre / Fibres 1 g	4 %
Sugars / Sucres 1 g	
Protein / Protéines 1 g	
Vitamin A / Vitamine A	30 %
Vitamin C / Vitamine C	15 %
Calcium / Calcium	4 %
Iron / Fer	8 %

017215

(RED & GREEN ROMAINE, GREEN
IC BABY GREENS (RED & GREEN
ORGANIC CHICORIES (RADICCHIO,
Y. *INGREDIENTS MAY VARY.*



et le logo BIOLOGIQUE CANADA sont votre garantie que ce produit a été transformé conformément aux principes de l'agriculture et de la production biologiques.

Sugars / Sucres
Protein / Protéine
Vitamin A / Vitami
Vitamin C / Vitami
Calcium / Calcium
Iron / Fer

INGREDIENTS: ORGANIC BABY LETTUCES (RED & GREEN ROMAINE, GREEN OAK, TANGO, RED & GREEN LEAF), ORGANIC BABY GREENS (RED & GREEN CHARD, MIZUNA, ARUGULA, BEET TOPS), ORGANIC CHICORIES (RADICCHIO, FRISÉE), ORGANIC DILL, ORGANIC PARSLEY. *INGREDIENTS MAY VARY.*
INGRÉDIENTS : JEUNES LAITUES BIOLOGIQUES (ROMAINE ROUGE ET VERTE, FEUILLES DE CHÊNE VERTES, TANGO, FEUILLES ROUGES ET FEUILLES VERTES), JEUNES LÉGUMES-FEUILLES BIOLOGIQUES (BETTES À CARDES ROUGES ET VERTES, MIZUNA, ROQUETTE, COLLETS DE BETTERAVE), CHICORÉES BIOLOGIQUES (RADICCHIO, FRISÉE), ANETH BIOLOGIQUE, PERSIL BIOLOGIQUE. *LES INGRÉDIENTS PEUVENT VARIER.*

FOOD SAFETY AND SECURITY – LOT MORE FOCUS

- CFIA approved HACCP (Hazard Analysis Critical Control points)
- Canada GAP (Good Agricultural Practices) program implementation
- Following biosecurity program
- A recall plan
- Testing for total coliform and E.Coli in water and on produce

A POST ON THE LINKDIN FEB6, 2023

- Don’t be fooled by the hype. Indoor Farming is not an overnight success story!
- In today’s fast-paced world, we are often bombarded by stories of overnight riches and instant success. But in the world of indoor farming, the reality is much different. It takes hard work, dedication and a willingness to learn and make mistakes to succeed.
- Beware of gurus and online courses that promise quick riches but have no real world experience. Watch out for scammers..
- The truth is, indoor farming is a complex and challenging industry that requires a solid understanding of many disciplines,
- Overnight success is rare in indoor farming but with knowledge, persistence and determination, you can succeed.

CONCLUSIONS

- A good business plan
- Knowledge of plants you are growing
- A good marketing plan
- A good consultant is worth the investment
- Don’t be afraid to pay a consultant like a good baby sitter
- Like any other industry there will be successes and failures