



The Advantages of a Closed Hydroponic System in Commercial Greenhouses

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October 19,2017



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Introduction

- ❖ Canada's greenhouse industry produces tomatoes, cucumbers, peppers, lettuce and other greenhouse vegetables. Tomatoes are the main greenhouse vegetable crop grown in Canada.
- ❖ Alberta's greenhouse industry is 4th largest in Canada after Ontario, BC, and Quebec, totaling 338 acres.
 - ❑ Vegetables (46% or 157 acres)
 - ❑ Bedding plants and ornamentals (41% or 137).
 - ❑ Tree seedlings (13% or 45 acres).
- ❖ It is one of the most dynamic agricultural sectors in Alberta.
- ❖ Closed hydroponic systems are often used in commercial greenhouses to recirculate nutrient solutions through the crops.
- ❖ The closed hydroponic system helps to protect the environment by minimizing fertilizer emission and preserving surface water quality.



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Most greenhouse vegetables in Alberta are grown using a hydroponic system.

In 2014, Alberta's Ministry of Agriculture and Forestry in collaboration with Alberta Greenhouse Growers Association (AGGA) conducted a survey on greenhouse crop operations in Alberta. They indicated that:

- ✓ 29% recycled greenhouse water.
- ✓ 79% did not.
- ✓ Most of the small greenhouse growers did not recycle their water.
- ✓ 49% disposed their water on the ground or filed.
- ✓ 11% through sewerage.
- ✓ 40% had no waste water.

What are Hydroponics?

Hydroponics (soilless culture) means simply all techniques used for growing plants in a nutrient solution (water and nutrient elements without using the soil).

Growing medium
(substrate culture).



True hydroponics (water culture).



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Irrigation and nutrient management at the (GRPC).



Advanced irrigation-control technology (with fertilizer mixing pump, pressure gauges, filter and flow rate regulator) will improve water efficiency for each greenhouse zone.

Three types of irrigation water @GRPC:

City, Rain and Reverse Osmosis (RO).



Rain water: collected from greenhouses roofs without contacting the ground and held in a storage tanks.



City water: Keep clean water.

Water quality (lab analysis):



	City Water	Rain Water
pH	8.43	5.60
EC (mS/cm)	0.41	0.02
Sodium (ppm)	22	0

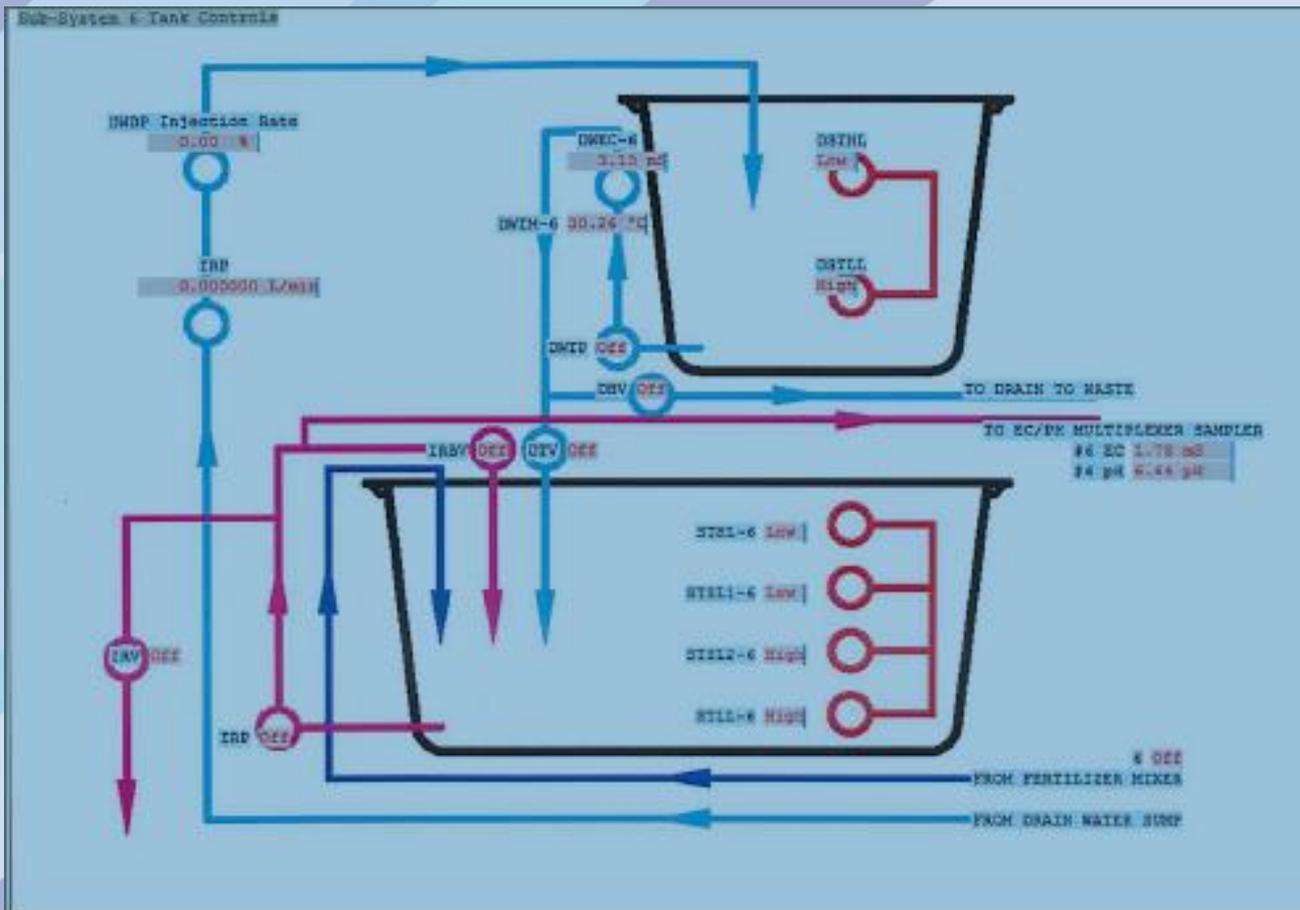


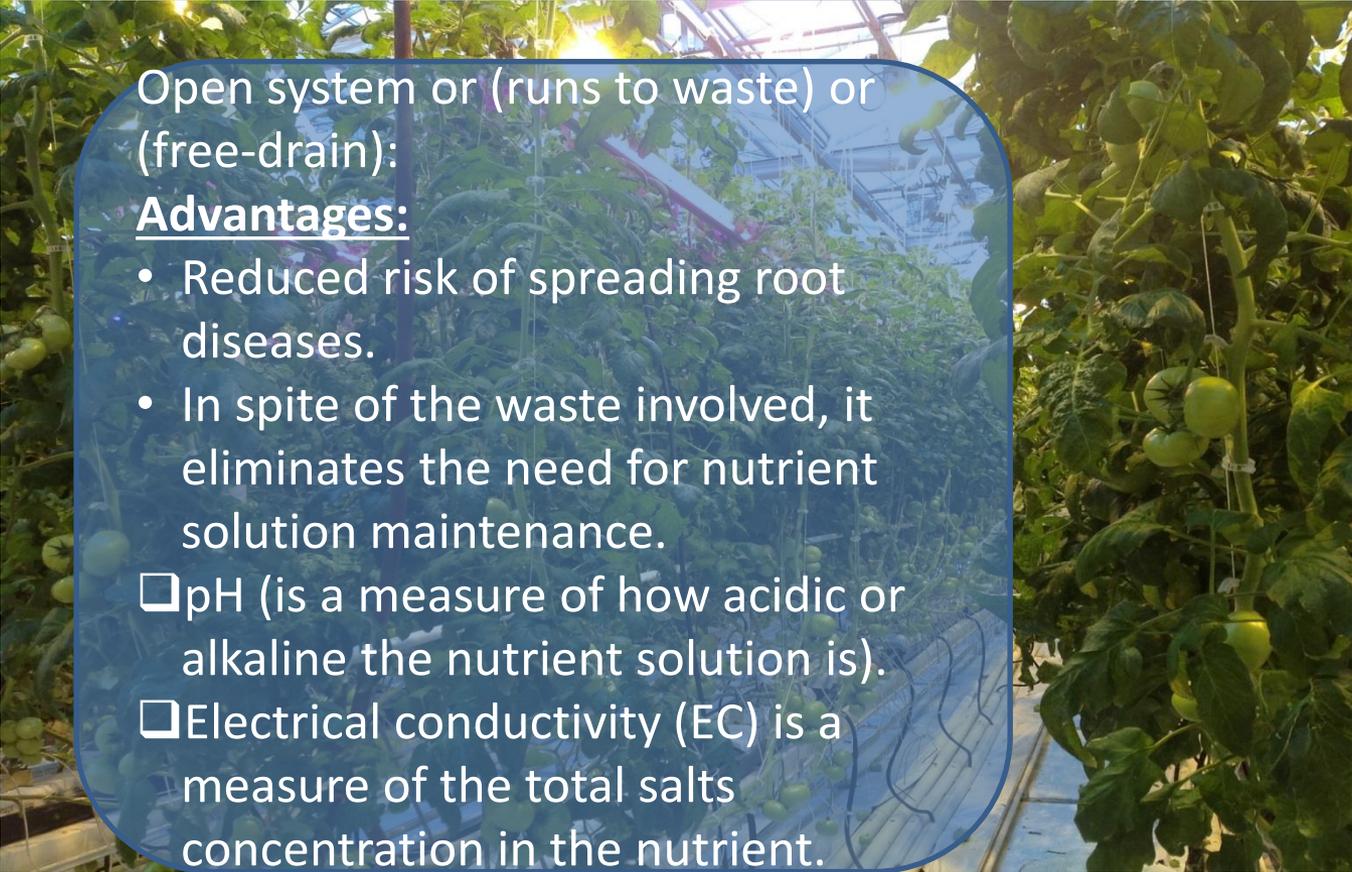
There are two main hydroponic systems for growing plants at the (GRPC).



Open system or (runs to waste) or (free-drain):
The nutrient solution is applied to the plants only once and then drained off as waste.

Closed (recirculating water) system:
Re-cycling and reusing the excess of the nutrient solution that drains off after each irrigation cycle.





Open system or (runs to waste) or (free-drain):

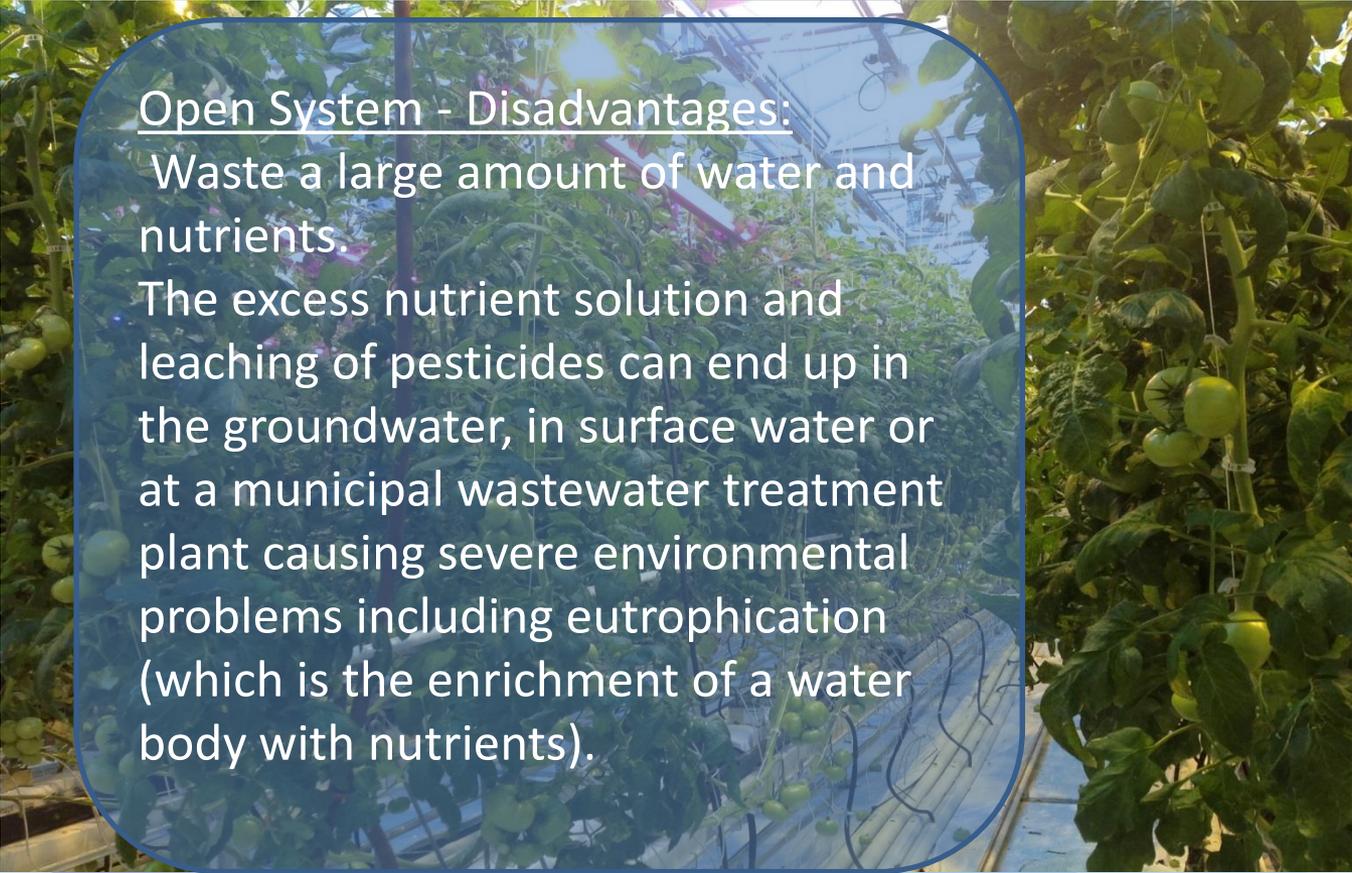
Advantages:

- Reduced risk of spreading root diseases.
- In spite of the waste involved, it eliminates the need for nutrient solution maintenance.
- pH (is a measure of how acidic or alkaline the nutrient solution is).
- Electrical conductivity (EC) is a measure of the total salts concentration in the nutrient.

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Open System - Disadvantages:

Waste a large amount of water and nutrients.

The excess nutrient solution and leaching of pesticides can end up in the groundwater, in surface water or at a municipal wastewater treatment plant causing severe environmental problems including eutrophication (which is the enrichment of a water body with nutrients).

Closed System - Advantages:

- ❖ Recirculating water and nutrient solutions in a closed hydroponic system saves water and fertilizers, and mitigates environmental pollution.
- ❖ 20-40% reduction in water use and a 40-50% savings in fertilizer costs over open systems.
- ❖ Less pressure on the environment than open systems.



Recirculation; reason to discharge

- Sodium accumulation.
 - High salt concentration in the substrate and the recycled nutrient solution can depress plant growth: (Productivity, water stress, toxic effects and fruit quality (physiological orders)).
 - Salinity build up reduced by diluting the nutrient solution with fresh water.
 - The goal is to keep the nutrient balance of the root zone solution steady.
- Nutrient ion imbalances of NO_3 , Po_4 , K , Ca , SO_4 , Mg , Cl , Fe , Mn , Zn , Cu , B and Mo .
 - Adjust the nutrient balance of the fertilizer input (Feed recipe).
 - Leachate lab analysis---2-3 weeks.
- Root pathogen proliferation. 
disinfection system.





Boron Toxicity.

Blossom end rot.





Remarks:

- ❖ Legislation is now in place in Europe mandating the implementation of nutrient circulation to optimize fertilizer use, improve water use efficiency, and approach a zero discharge of nutrient solution into the environment .
- ❖ Positive aspects (Environmental Sustainability) & negative aspects (Disease Perpetuation).
- ❖ In Ontario, Canada, the “greenhouse nutrient feedwater,” or GNF, is the regulation helps greenhouse growers to recycle the nutrient solution that cannot be recirculated by applying it to crops grown on agricultural lands.

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Aeroponic Lettuce System.



Aeroponics: is a system which the roots are suspended in the air and saturated with a fine mist nutrient solution at designated time intervals to minimize water consumption.

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Automated Hydroponic and Aeroponic Systems:

An economic advantage to Alberta-based greenhouse production by improving:

- Water use efficiency (80-90% less water use in Aeroponics vs. Hydroponics).
- Re-use of the nutrient solution, excellent aeration & increase water uptake.
- More growing cycles per year & space, plants stack vertically, good for roof topping greenhouses.
- Computerized control system monitor watering spraying intervals (time between spray applications) and spray duration (length of time for each spray application).



	Aeroponic System	Hydroponic System
Nutrient Solution.	Nutrients in mist of water droplets.	Nutrients in H2O solution.
Water Use efficiency.	Low recirculating mist of droplets.	High recirculating flow of water.
Yield.	360 lettuce heads in 9 square meters.	180 lettuce heads in 9 square meters.
Risk Factor.	High.	Medium.



Productivity: Depending upon the cultivar, time of the year and supplemental winter lighting.

Greenhouse Strawberries:



Strawberry
production
moves from
field to the
greenhouse.

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- ❖ Strawberries are grown in greenhouses in many parts of the world.
- ❖ Strawberries are very sensitive to many diseases and thus pesticide inputs are higher.
- ❖ According to the Environmental Working Group (EWG), based on the USDA pesticide Data Program report in 2016, strawberry claims the top spot on this year's (Dirty Dozen) list of produce containing pesticide.
- ❖ World-wide, soil grown strawberry production relies heavily on the use of fumigation chemicals (methyl bromide) to control soil borne pests, disease and weeds.



Bumble Bees



- Soil-less culture (Coconut fiber).
- Day neutral strawberries (Albion and Seascape).
- The system (A-shape) or triple rows frame.

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Thank You



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