“Technology Transfer of Greenhouse Aeroponic Lettuce Production Information to Alberta Growers”,

Nabeel Mohammed

Greenhouse Research & Production Complex (GRPC)

Lacombe - AB

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Introduction:

- Alberta's greenhouse industry (137 hectares) is ranked fourth in the country after Ontario(1,330 ha), BC (531 ha), and Quebec (262 ha).
- Lettuce is one of the most commonly grown greenhouse vegetables in Alberta after cucumbers, tomatoes, peppers with an area of 6,842 m2.
- According to Statistics Canada, Canadian production of lettuce in 2014 was 19.9 ha. Domestic consumption was 9.14 kg/ person. Import of 283,770 tonnes were required to meet this demand and there were no exports.
- Quebec (72%-14.37 ha) and British Columbia (10%- 2.07 ha) are the main production areas of lettuce in Canada.
- Alberta consumed 21,357 tonnes of lettuce in 2011 (20-30%) of Canadian production, yet only 5% are produced here (0.46 ha).
- There is an opportunity for Alberta greenhouse producers to increase lettuce production and replace imports.

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Project Purpose:

- To compare the performance of aeroponic production system designed (A shape) to optimize the yield, maturity and quality with the hydroponic floating raft technology using the same nutrient solutions at each growing stage according to their potentials and limitations for lettuce production.

- To provide producers with information to make business decisions related to greenhouse lettuce production.

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What is Aeroponics:
What is Hydroponics:

Aeroponics:

- **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.**

Hydroponics:

Hydroponics: is the method growing of plants using water and the essential nutrients required without the presence of soil.

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The Potential of the Aeroponics Technique:

Aeroponics is a research tool for nutrient uptake, monitoring of plant health and optimization of crops grown in closed environment.

Root Oxygenation (Role of Oxygen O2):

- **The plants are totally suspended in the air and access to 100% of the available oxygen in the air.**
- **Promoting root metabolism and plant growth.**
- **The plants in an aeroponics environment grow faster and absorb more nutrients.**
- **Lack of O2 can cause root- cell death-increase the risk of root disease such as Pythium.**
- **Nutrient solution carry dissolved oxygen greater than 7 ppm (DO- amount of oxygen O2 dissolved in water).**

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(Role of Oxygen O2):

- Fine droplets 20-100 microns produce excessive root hairs.
- Large droplets over 100 microns lead to less oxygen.
- Misting time:1-2 minutes at different interval times up to 5 minutes.
- Root formation, number of roots, root length increased as dissolved oxygen(increased.
- Root zone temperature:

(Cool nutrient solution hold more DO for root uptake).

- Plants grow longer and faster.
- Accelerates biomass growth and reduces rooting time.

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(Role of Oxygen O2):

Before

After

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Before

After

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Systems Component : How Does Aeroponics Work?

Automated Argus Control System.

Flow Confirm.
Water Tank 250 L.
Batch Tank High Level.
Batch Tank Low level.

Recirculation System.

Stock Tanks.

Low pressure water pump (1 HP).

Dan Foggers 4 & 2 Ways.
PVC Pipe ¾”.
Dan Plug.

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Advantages of an Aeroponics System.

- Decreased water use of 80-90% less hydroponics.
- Re-use of the nutrient solution.
- Space - plants stack vertically, roof topping greenhouses.
- Weight.
- Increase water uptake.
- Excellent aeration.

Disadvantages of an Aeroponics System.

- **Clogged foggers, Pump failure or breakdowns (pipe) going unnoticed may damage plants in a short time.**

Limitations:

- **Knowledge &Time**

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Growing Conditions & Nutrient Solution:

Nutrient Solution:

- pH= 5.8
- Electrical Conductivity (EC)= 1.9-2.2 (winter).
  1.6-1.8 (summer)

➢ Nutrient Solution (Target ppm): Ca 180-200 , P: 50, K:210, NO3:165, Fe: 3-5, Mn:0.5, Zn:0.1, B: 0.5, Mo:0.05.

Temperature:

➢ Day = 16-18 °C Night= 10-12 °C

➢ Depends on the Growth Stage.

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Different Growing Mediums & Cultivars:

Growing Mediums:

Rockwool, Peatfoam & BVB Sublime Plug

Cultivars :

Butterhaead, Red & Green Leaf & Oak Leaf.

Marketable Size:175 g and over.

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Cultivars

Butterhead Lettuce

- **Alexandria (RIJK ZWAAN):**

  It has good size and performance. Summer cultivar (long day).

- **Frank (BUYER):**

  A great shaped lettuce with a well filled head and a good balance of outer leaves.

Oak Leaf Lettuce

- **Pagero (ENZA ZADEN):**

  Has a highly attractive, nice fresh green color. This big sized cultivar has very regular heads.

Romaine Lettuce

- **Intred (BUYER):**

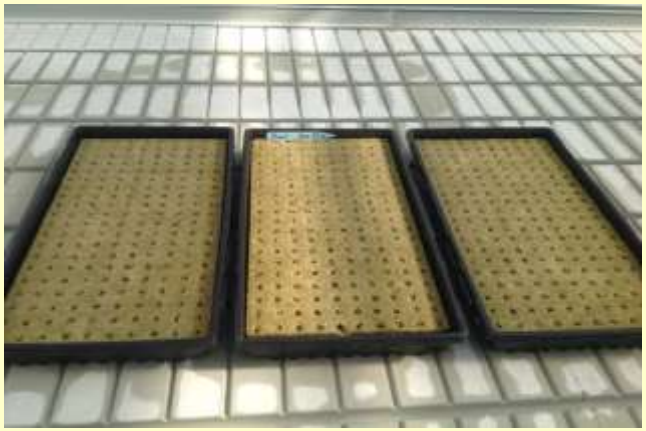
  Unique internal red color. Very nice heart shape, medium size, good shelf life.

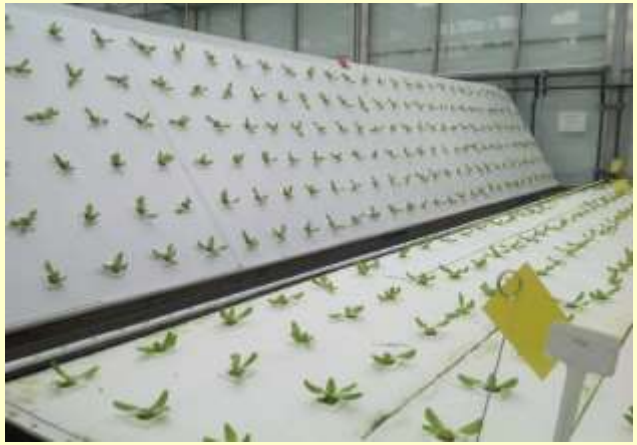
- **Thumper (BUYER):**

  Compact little lettuce with a good uniform head shape. It is very stable.

Trial

Cultivar: Frank (Butterhead).





Seeding date: June 27,2016.
Planting Out: July 12,2016.
Harvesting day : August 8,2016

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Old Trial

Butterhead Lettuce, V. Alexandria

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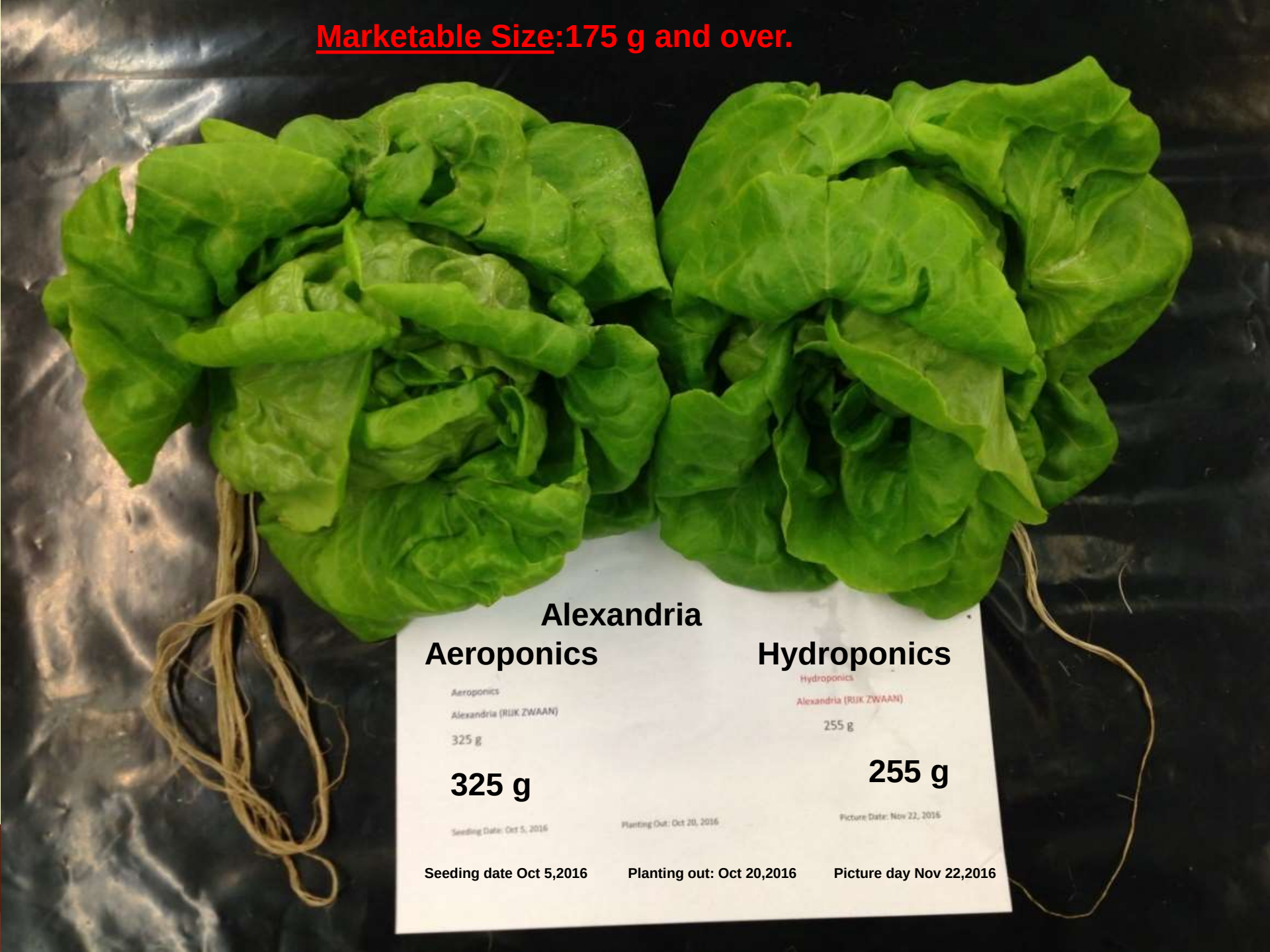
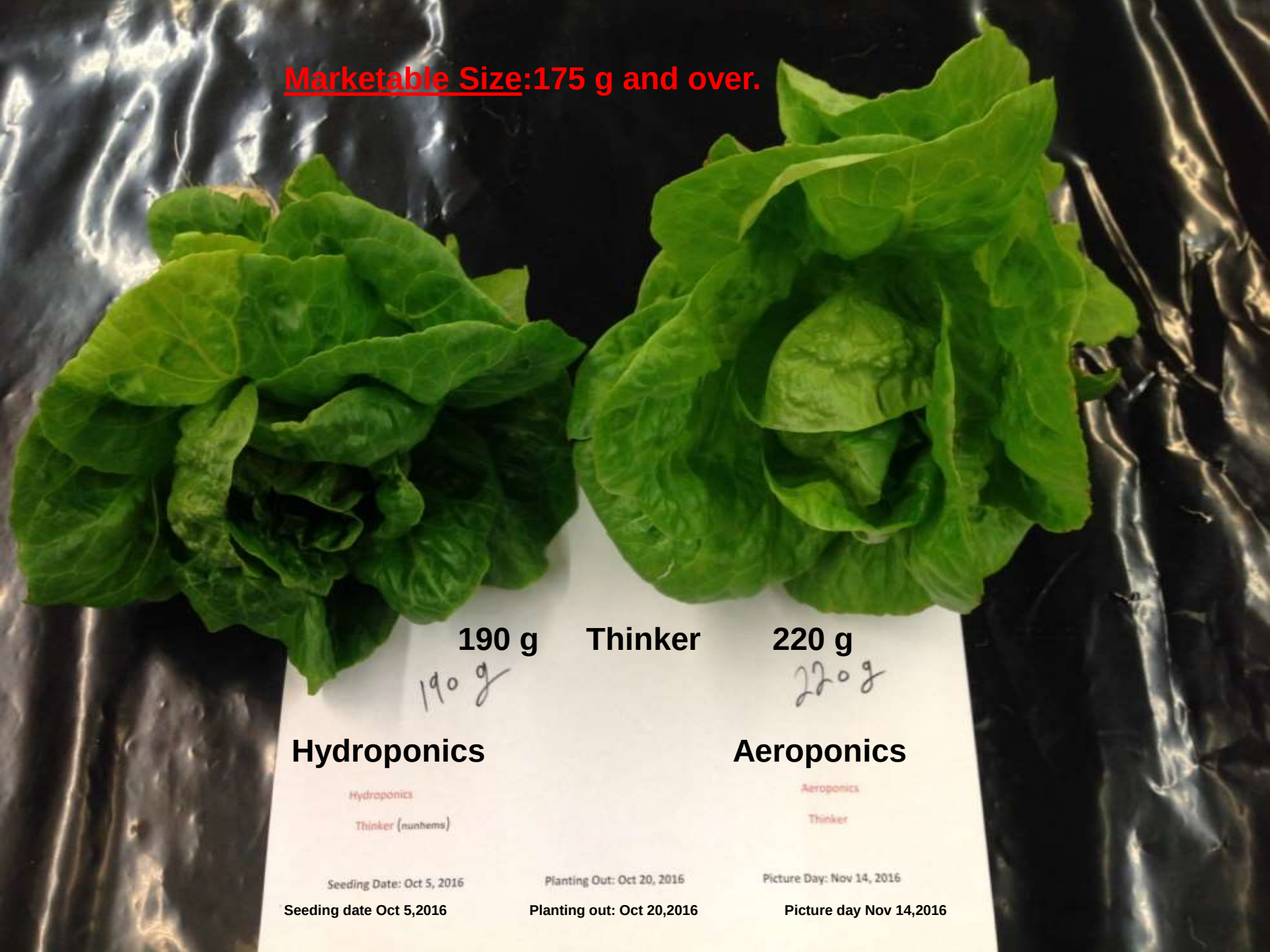
Marketable Size:175 g and over.



Seeding date Oct 5,2016 **Planting out: Oct 20,2016** **Picture day Nov 22,2016**


Marketable Size:175 g and over.
190 g
Thinker
220 g
190 g
220 g
Hydroponics
Aeroponics
Hydroponics
Thinker (nunhems)
Aeroponics
Thinker
Seeding Date: Oct 5, 2016
Planting Out: Oct 20, 2016
Picture Day: Nov 14, 2016
Seeding date Oct 5,2016
Planting out: Oct 20,2016
Picture day Nov 14,2016

Marketable Size:175 g and over.

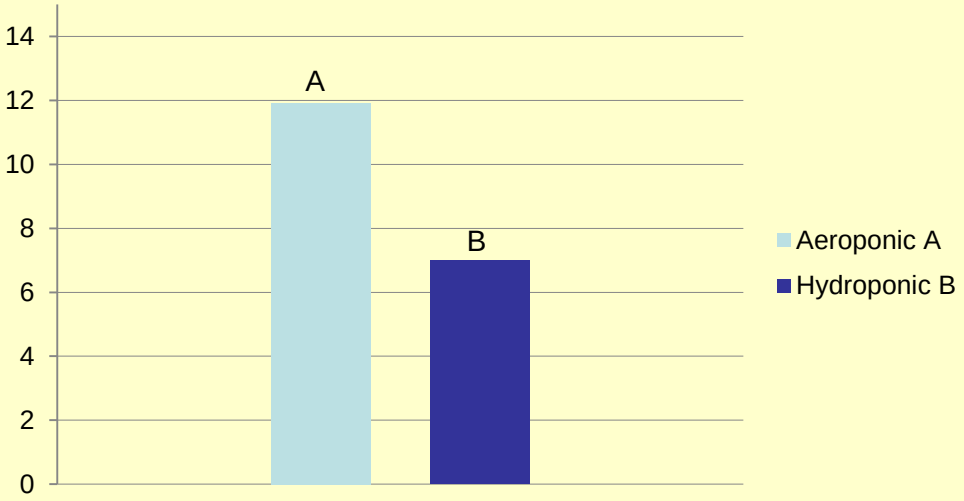
Seeding date Oct 5,2016

Planting out: Oct 20,2016

Picture day Nov 14,2016


Intred
Hydroponics
110 g
Aeroponics
145 g
Seeding date Oct 5,2016
Planting out: Oct 20,2016
Picture day Nov 14,2016
Marketable Size:175 g and over.

Yield(Kg/m^2):



Productivity:

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

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Physiological Disorder:

Tip burn happened in both systems & cultivars under supplemental winter lighting.

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Tip burn

The physiological disorder tip burn remains a constant threat for growers. Tip burn of young, inner leaves of lettuce is caused by a calcium deficiency, environmental factors that reduce the transpiration rate such as:

- **High relative humidity (RH).**
- **Sudden temperature changes.**
- **Low light or low temperature.**

In the older and outer leaves can develop as a result of insufficient water, high salts or excessive transpiration due to low RH.

Symptoms : browning of the edges and tips of the leaves.

Preventions:

- **Increasing ventilation and air movement around the plants.**
- **Altering the nitrogen and potassium balance to increase calcium uptake.**
- **Calcium levels in the nutrient solution must be high enough during the growing season.**
- **Use low temperature and low light with the formation of lettuce head.**

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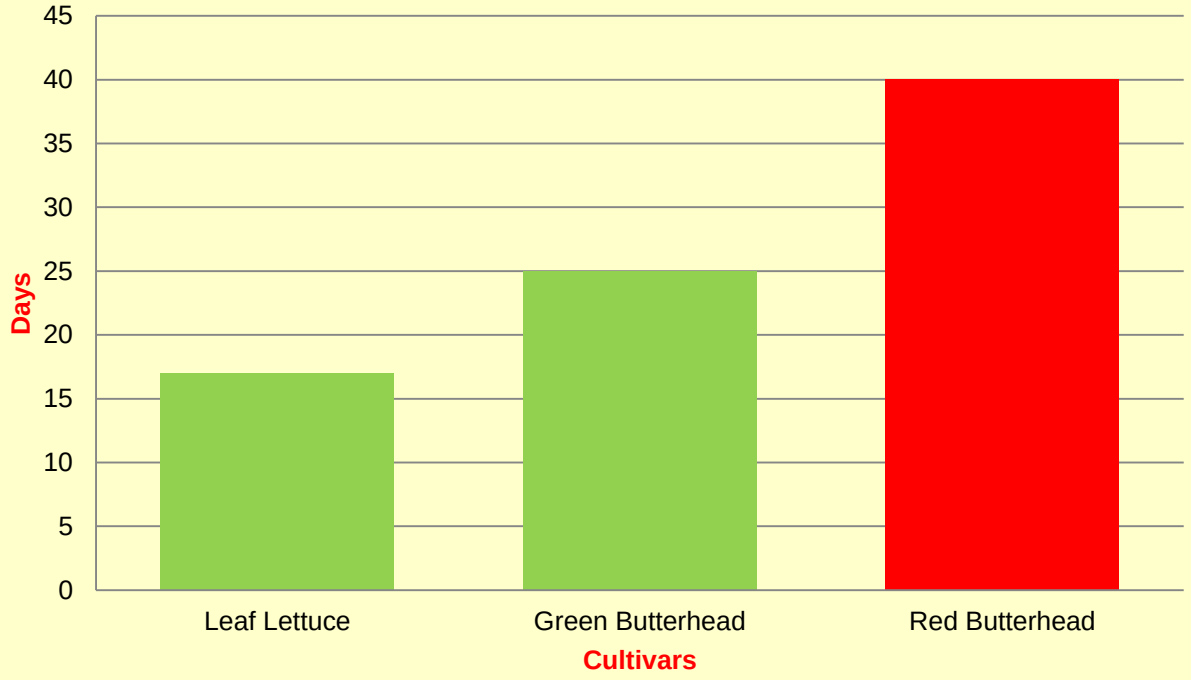
Cost Effectiveness and Productivity.

- **The initial cost of building an Aeroponics system is higher than the initial cost required to build a Hydroponics system.**
- **Aeroponics – Butterhead Lettuce produces 360 heads/cycle 12 cycles per year this will produce 4320 heads per year.**
- **Hydroponics for the same conditions will provide you with 1980 heads per year.**

Timing.

Average weight from planting out until harvest / Aeroponics



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Aeroponic vs. Hydroponic

	Aeoponic (A Shape)	Hydroponic
Nutrient Solution	Nutrients in mist of water droplets	Nutrients in H_20 solution
Water Use Efficiency	Low recirculating mist of droplets	High recirculating flow of water
Yield	360 lettuce heads in 9 Square Meter	180 lettuce heads in 9 square Meter
Risk Factor	High	Medium

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Conclusion:

- Major attraction of aeroponics is the ability to watch the root system grow and develop.
- Regular maintenance schedule, filter needs to be kept clean.
- No blocked foggers- kept clear and function correctly.
- No commercial greenhouse aeroponics lettuce production in Alberta.

Suppliers:

- **Southern drip Irrigation: Lethbridge.**
  Pumps, Fittings, Foggers, Pipe—etc.

- **Seeds: Canada.**
  RIJK ZWAAN, ENZA ZADEN, BUYER & VITALIS.

- **Growing Mediums:**
  Grodan – Red Cliff.
  Peatfoam-Mexico & Calgary-CPS.
  BVB plugs- Ontario.

- **Lettuce Raft 18:**
  Beaver Plastics-Edmonton.

Future Considerations:

Aeroponic System?

- **Development & Adaptation- Commercial Greenhouses, Rooftop & Vertical Farming ?**
- **Automated Harvesting System?**

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Thank you