



Quinoa

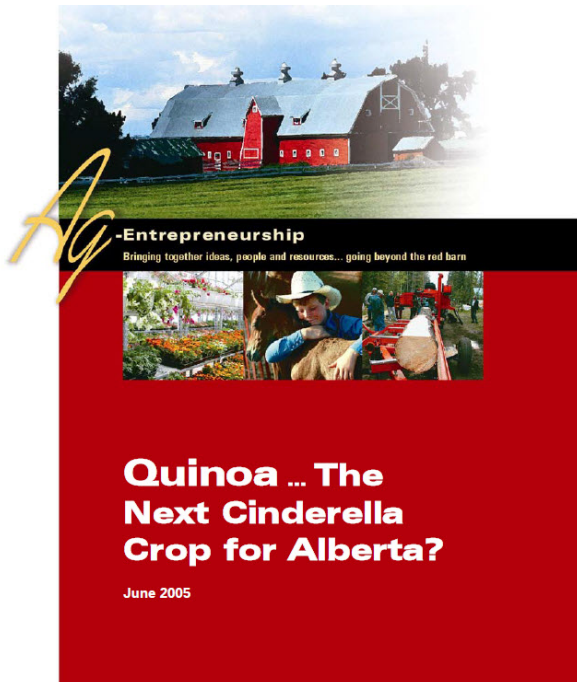
A potential crop for organic growers in Alberta

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Outline

1. Background on quinoa
2. Why organic growers might be interested in quinoa
3. What the market for quinoa looks like
4. CDC North variety and agronomic trials
5. How to grow quinoa

History of Quinoa at Alberta Agriculture



Seeds stored from 1977

2005 reports recommend when,

- yield consistency of at least 800 lbs/acre for conventional Quinoa and 400 lbs/acre for organic Quinoa
- price of at least \$0.27/lbs and \$0.22/lbs respectively for organic and conventional Quinoa can be achieved.

International Year of Quinoa 2013

- The United Nations declared 2013 as the "International Year of Quinoa", in recognition of ancestral practices of the Andean people, who have managed to preserve quinoa in its natural state as food for present and future generations, through ancestral practices of living in harmony with nature.



QUINOA the "mother grain"

- **Latin Name:** *Chenopodium quinoa*
- **Plant Family:** *Chenopodiaceae*
- **Close Relatives:** Lamb's-quarters
- Has been eaten continuously for 5,000 years by people who live on the mountain plateaus and in the valleys of Peru, Bolivia, Ecuador, and Chile.
- Quinoa means "mother grain" in the Inca language

Inflorescence (Panicle)



Flower



Fruit

QUINOA

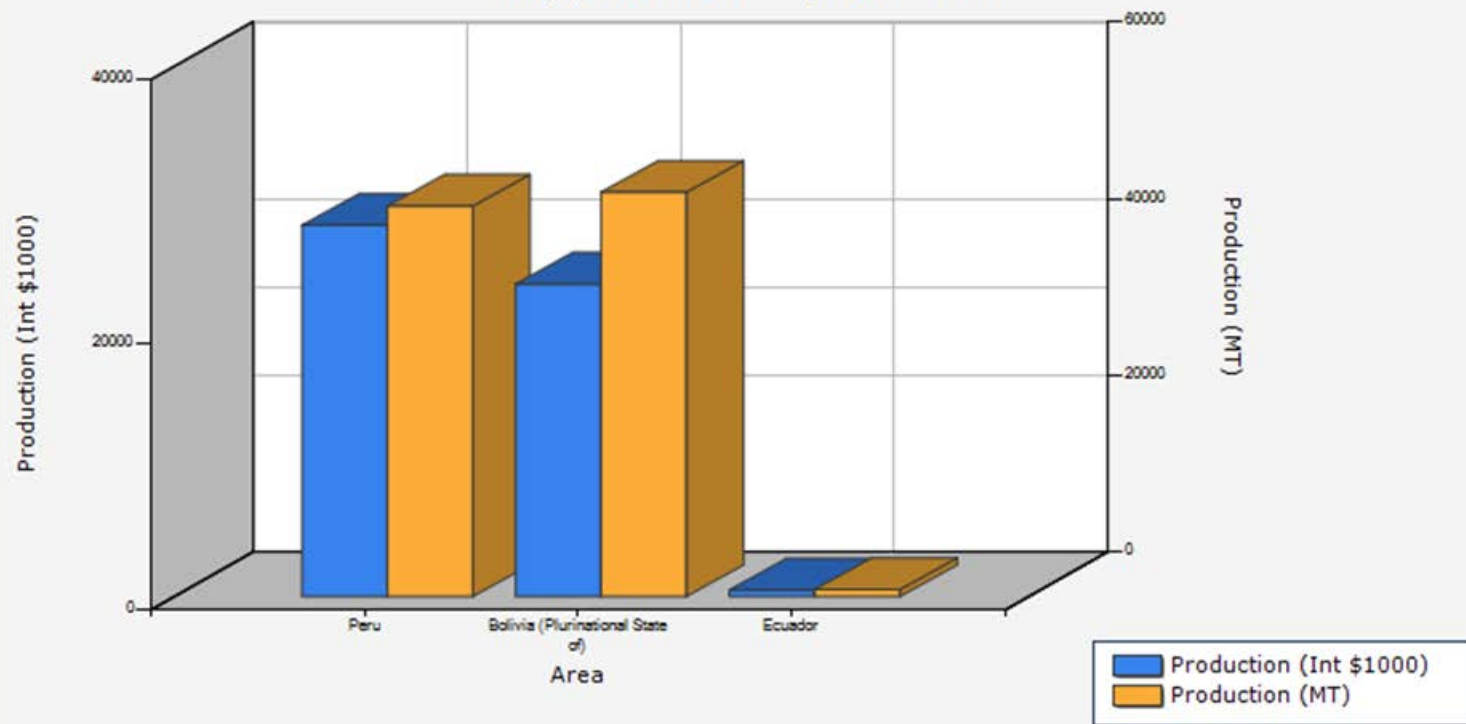
- Quinoa is also in the same botanical family as spinach
- Quinoa is sometimes referred to as a "pseudocereal" because it is a broadleaf non-legume that is grown for grain unlike most cereal grains which are grassy plants. It is similar in this respect to the pseudocereals buckwheat and amaranth.
- Seed coats are usually covered with bitter saponin compounds that is removed by abrasive dehulling or washing the grains with water.



Traditional areas of production Colombia Ecuador , Peru, Bolivia, Chile, Argentina. Canada 5,000 acre (Northern Quinoa Corp)



Top production - Quinoa - 2012



Quinoa Market

- Averaging \$3,115 per tonne in 2011, quinoa has tripled in price since 2006.
- The niche markets for organic and fair trade products offer interesting alternatives and better producer prices,

On 1 February 2015 quinoa prices were:

white quinoa was US\$3.21 per kg.

Red quinoa closed at US\$4.02 per kg.

The price for black quinoa was US\$2.89 per kg

Contract prices in Canada 2014 was US\$ 1.15 per kg

Quinoa the super food

- Quinoa is expected to make the transition from a niche product into a major commodity
- Gluten free, with a current prevalence of celiac disease 1 percent to 3 percent of the general population world.
- Of particular interest is the rapid growth of the population embracing a gluten-free diet.



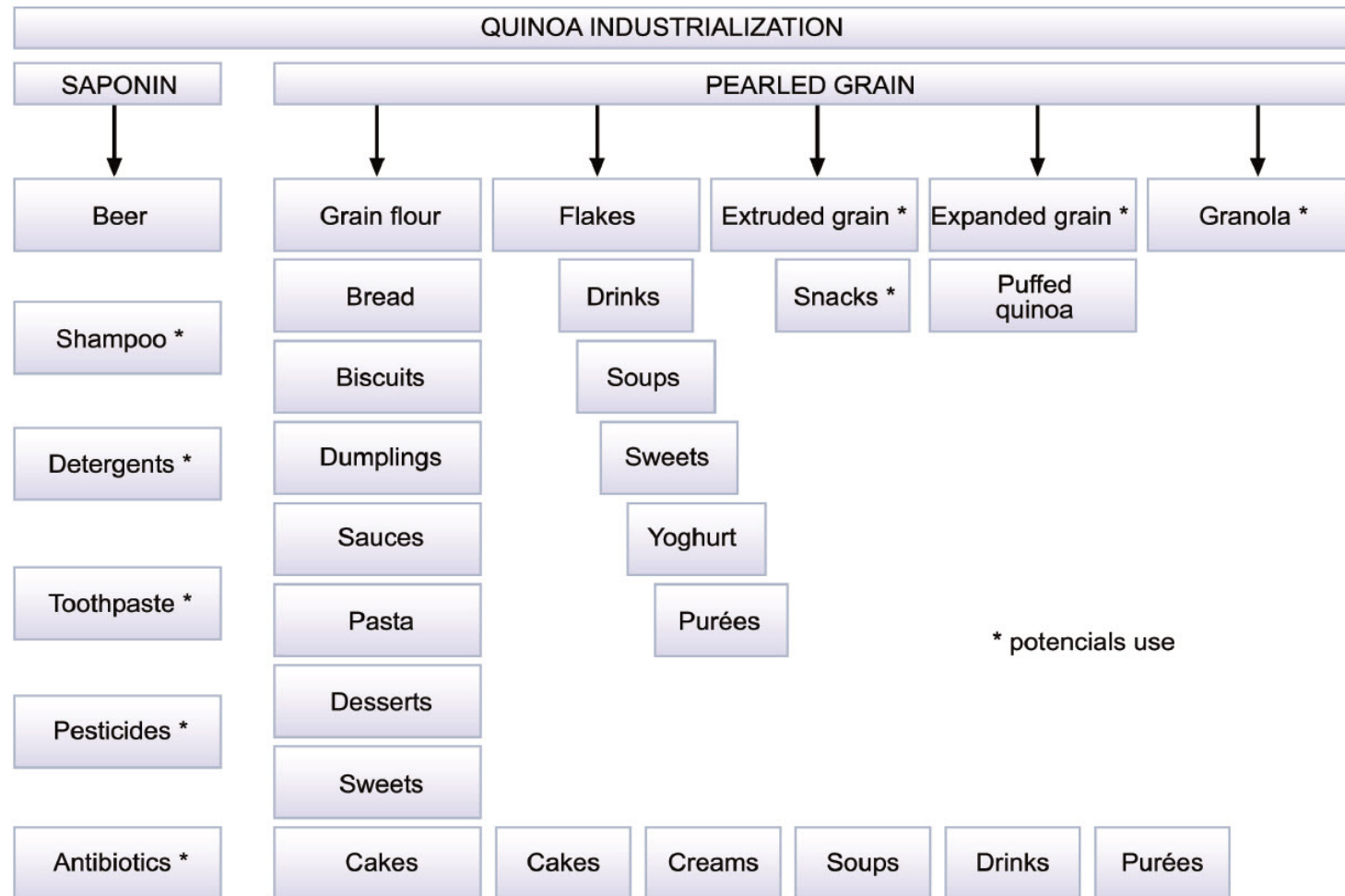
Increasing Global Demand

- In recent years, the global demand for quinoa has risen dramatically as a result of its identification as a healthy ‘super food’ and its desirable traits as a highly nutritious pseudo-cereal and gluten-free alternative.
- The cultivation of quinoa has spread to over seventy countries, and this number is growing.
- The demand in rich countries continues to grow, especially as quinoa fits in with “every recent health craze:
 - whole grain,
 - gluten-free,
 - fair trade,
 - Organic, locally grown”

An important feature is the absence of gluten of most quinoa varieties

- Quinoa is a highly nutritious food. The nutritional quality of this crop has been compared to that of dried whole milk by the Food and Agriculture Organization (FAO) of the United Nations
- The protein quality and quantity in quinoa seed is often superior to those of more common cereal grains.
- Quinoa is higher in lysine (5.1 g/100g) than wheat (2.5 g/100g) , and the amino acid content of quinoa seed is considered well-balanced for human and animal nutrition, similar to that of casein

Uses of quinoa grain



Quinoa Oil

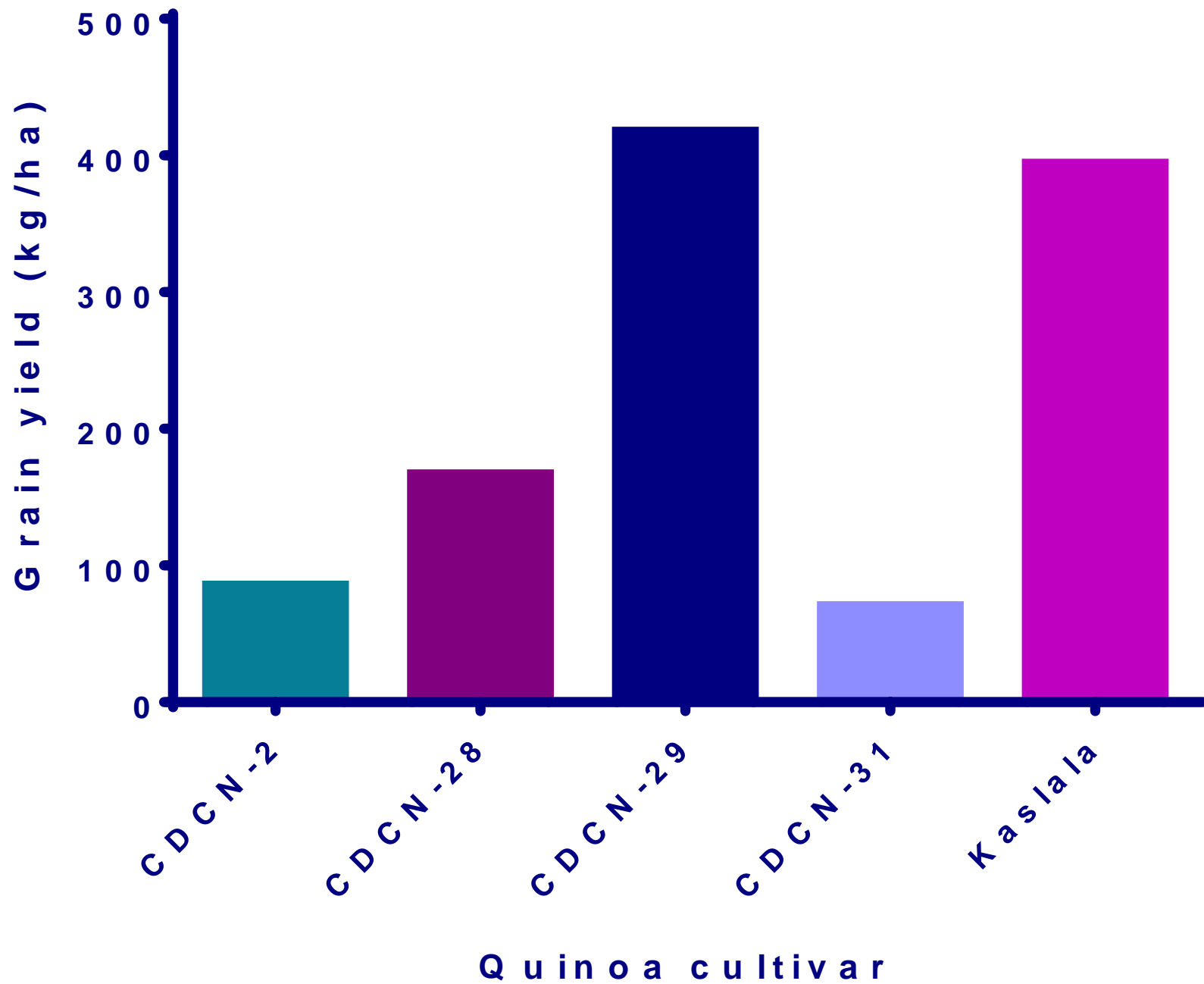
- Quinoa oil is most similar to corn oil, and is rich in essential fatty acids (linoleic acid and linolenic acid), linoleic being predominant
- Quinoa oil contains more essential fatty acids than corn oil.
- Quinoa yields an average of 5.8% oil by weight
- Most oils with high concentrations of unsaturated fatty acids spoil quickly, but quinoa and corn oil both have high quantities of natural antioxidants, specifically tocopherol

Research at CDC North

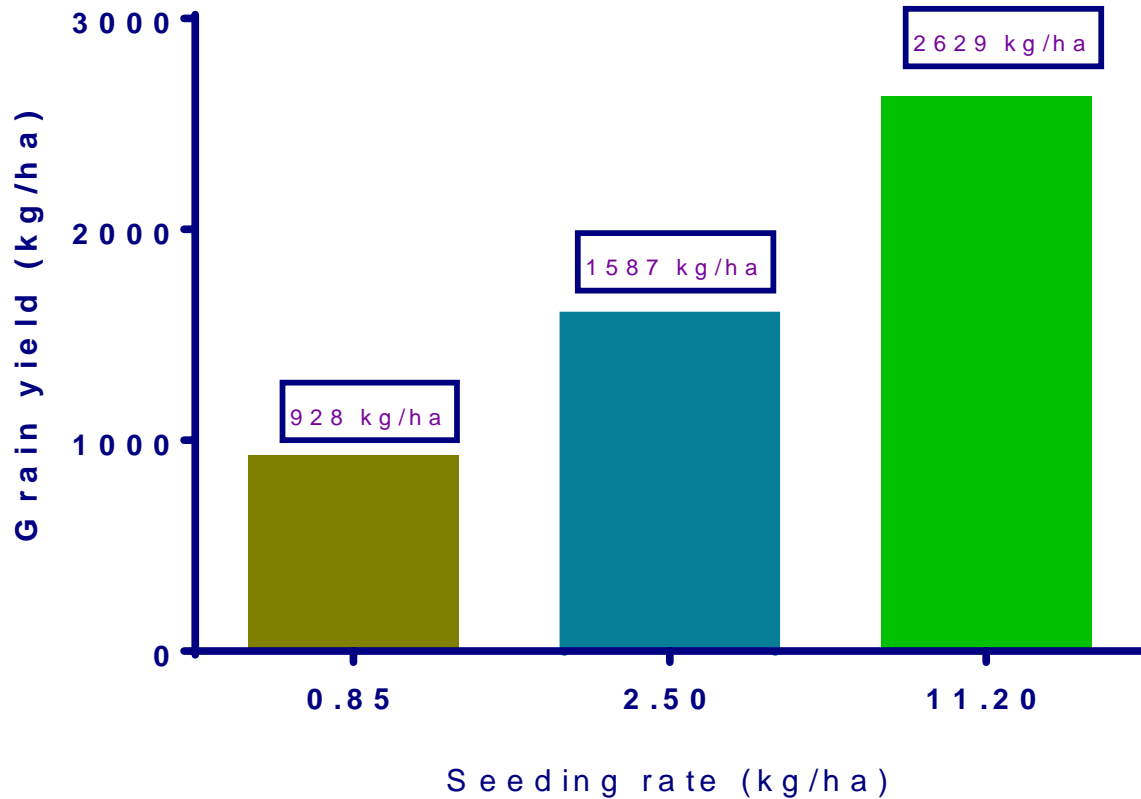


Varietal Evaluation

- 2013 Evaluated 35 lines received from USDA
- Three lines were selected. Due to the short growing season, North American cultivation requires short-maturity varieties Chilean origin
- These lines multiplied in the greenhouse in the winter



Potential yield of Quinoa CDCN 29 variety



Plant Biology - Flowering

- Flower induction is not a major problem for adaptation of quinoa to Northern latitudes conditions but that a very strong, day length sensitive, stay green reaction is the main cause of the late maturity of South American introductions.
- Quinoa short-day plants. Trials cultivars flowered between 20 July and 29 July
- The flowers are hermaphrodite (have both male and female organs) and are pollinated by Wind
- Quinoa is usually self pollinated, but cross pollination does occur at rates of up to 10 to 15%
- Its seeds do not exhibit dormancy and they germinate when conditions are suitable, even on the plant itself

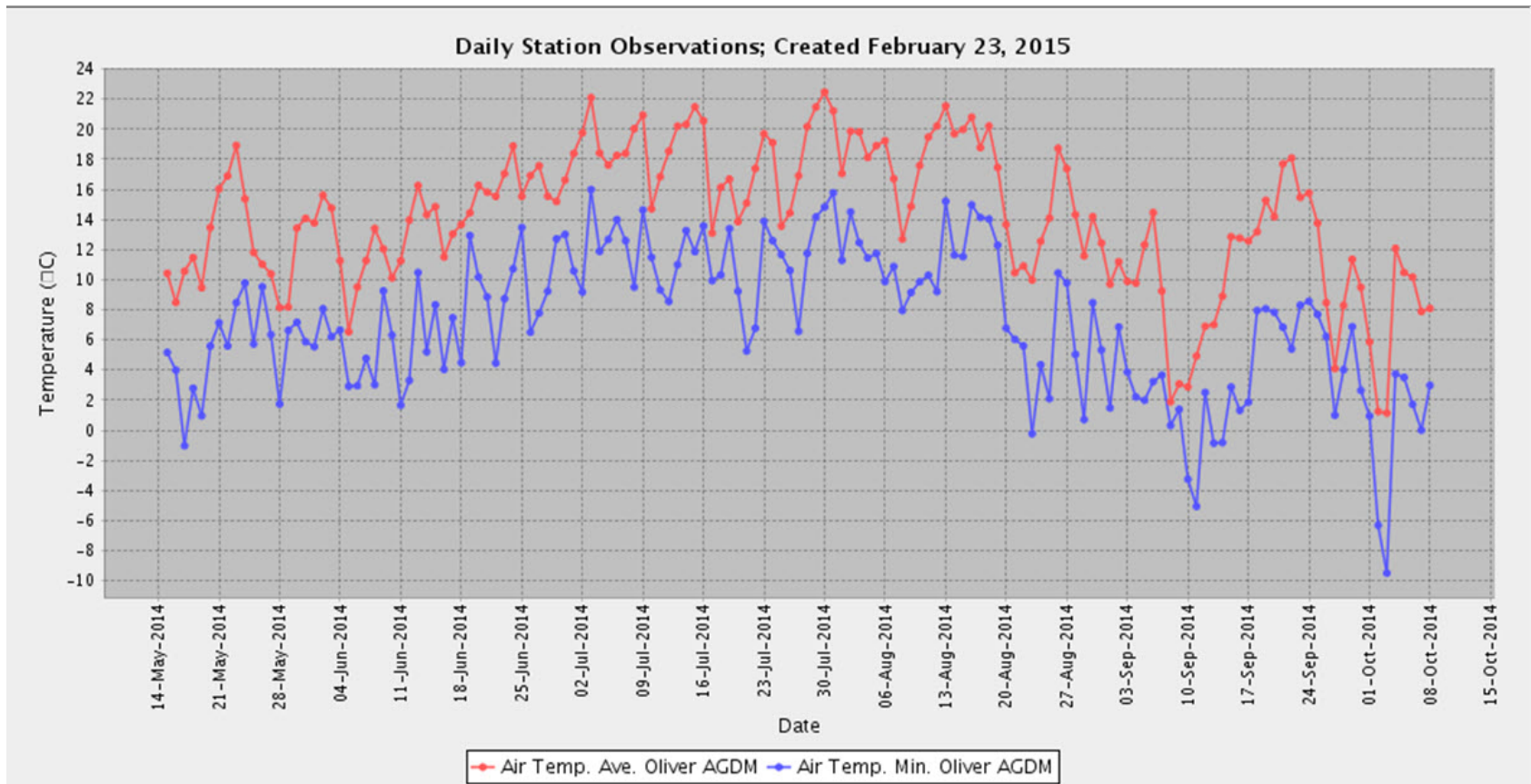
Resistance to adverse factors

- **Frost resistance** 100% germination even at 2°C, seems no effect on plant to -3°C.
- Plants should not be exposed to temperatures below -2°C in mid-bloom
- Plants are not affected by temperatures down to -7°C after the grain has reached the soft-dough stage.
- Tolerates ice formation in the cell wall

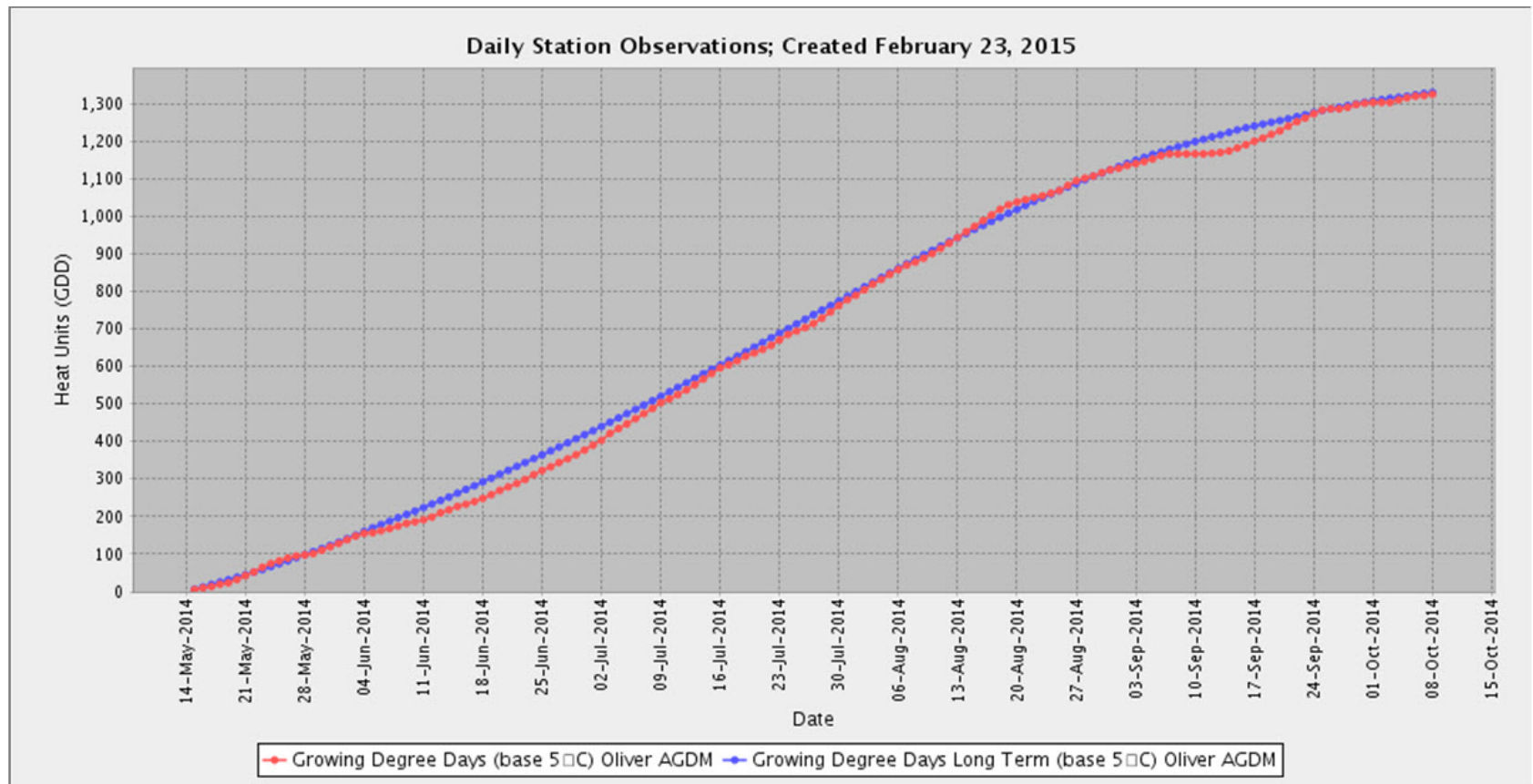
Hail and Snow- causes irreversible damage esp. when crop near to maturity



Minimum air temperature growing season 2014 CDC North



Growing Degree days 2014 CDC North (base 5 oC)

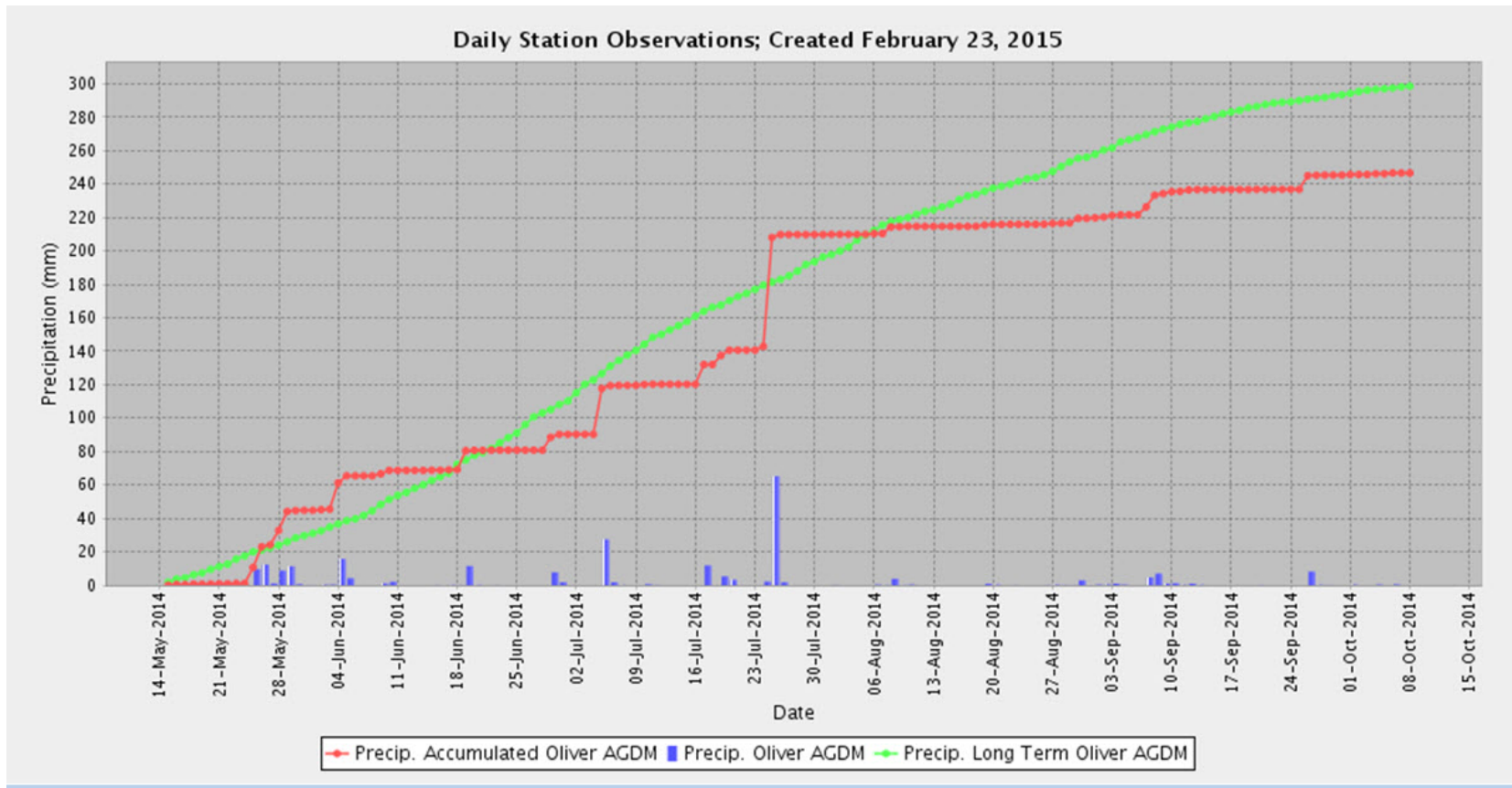


Water Requirements

- Quinoa is somewhat drought tolerant with a water requirement of 250 mm to 380 mm per season
- 2014 at CDCN rainfall was 225 mm
- Crops planted during mid-May when the soil was near field capacity at planting time did not need irrigation



Precipitation growing season 2014 CDC North



Soil Conditions

- Soil. Quinoa requires a level, well-drained seedbed in order to avoid waterlogging.
- This crop grows well on sandy-loam to loamy-sand soils. Marginal agricultural soils are frequently used in South America to grow quinoa. These soils have poor or excessive drainage, low natural fertility, or very acidic (pH of 4.8) to alkaline (8.5) conditions
- It prefers easily worked, semi-deep soils, with good drainage and a supply of nutrients. It is suited to acid soils with a pH of 4.5 (in Cajamarca, Peru) and alkaline soils with a pH of up to 9.5 (in Uyuni, Bolivia), depending on the ecotype. Acceptable production is also obtained both on sandy and clayey soils.

Rotation

- Quinoa following cereals that contain gluten (Wheat, barley, rye, triticale, kamut, spelt) is not recommended, which means they can be contaminated
- Organic quinoa is best preceded by perennial alfalfa, green-manure fields, canola, pulses, potatoes, buckwheat, corn, oats

Seedbed Preparation and Planting

- The seedbed should be firm, and relatively fine; similar to that prepared for canola .
- Seeds should be planted at a depth of 1.2 cm to 2.5 cm depending on soil type and available soil moisture.
- The small size of the seed makes it susceptible to both dehydration and waterlogging when planted too shallow, or deep, respectively.
- Quinoa is normally sown using standard seeding equipment such as air drills being used for other crops.

Propagation method

- Direct seed to a depth of 1.5-2.5 cm.
- Seeding Date: Mid May
- Between row spacing 30 cm
- In-row spacing drill
- Seeding rate 2.5 – 11 kg/ha

**Quinoa on June 20,
seeded 15 May**



Quinoa cultivars

- CDCN 29 (experimental)
- QN 100A West Coast Seeds Ltd
- Red Head QN101 West Coast Seeds Ltd
- French Vanilla West Coast Seeds Ltd
- Cherry Vanilla West Coast Seeds Ltd
- Oro De Valle West Coast Seeds Ltd

It grows well in BC and in the Pacific Northwest
100 days

Fertilizer Requirements

- Quinoa responds well to nitrogen fertilizer
- maximum yields are possible when 150 to 180 lbs N/acre are available (Johnson Colorado State University, 1983)
- Yields declined when greater levels of available nitrogen were present due to a slower maturity and more intense lodging.
- No effect on yield was observed when 30 lb of phosphorus per acre was applied

Weed Control

- In early stages quinoa growth is slow doesn't compete well with weeds.
- After canopy closure it is competitive with most weeds
- seed into a clean field
- One properly timed inter row cultivation during the early stages is necessary



Quinoa on June 20, seeded 15 May

Disease and Pest Management

- Sclerotinia and fusarium in but neither disease is a major problem.
- Flea beetles and bertha armyworms will chew on quinoa once they've exhausted their preferred crops.
- Stem boring maggots sometimes blow in on strong south winds,
- Beet webworms migrate when alfalfa is being cut, and will gnaw on quinoa seeds.

Foliar diseases of quinoa

- Downy mildew (caused by *Peronospora variabilis*)
- Ascochyta leaf spot (caused by *Ascochyta* sp.)
- Cercospora-like leaf spot



Harvesting Quinoa



- When leaves and stems start changing from yellow to brown get your combine ready
- Combine settings are almost identical to canola
- Farmers can straight cut.
- Farmers with straight cutters can cut high, harvesting the ripe seed

Incomes and profits of quinoa production Northern Quinoa Corp

- 5000 acres seeded to quinoa in 2014
 - Yield 600 LB/acre
 - Contract cost \$40 per acre
 - selling price of \$ 0.65 per LB
-
- Alister Muir, Natural Product Chemist with Northern Quinoa Corp
 - <https://www.realagriculture.com/2014/07/working-quinoa-prairie-crop-rotation/>

Crop Enterprise Cost and Return (based on industry averages)

	Quinoa	Argentine Canola	Feed Peas	Spring Wheat	Laird Lentils
Revenue					
Yield Per Acre	600 LB	25.00 bu	35 bu	38 bu	950 LB
Market Price (\$/Unit)	0.65	7.50	5.0	4.60	0.18
Total Crop Sales(\$)	390	187.5	175	174.8	171
Total Direct Expenses	160	118.12	105.01	102.01	96.91
Contribution Margin	230.0	69.38	70.0	72.79	74.09

- **It is important to note that anyone considering growing quinoa commercially should secure market contracts before planting the crop**
- Identify buyers for quinoa production.
- Understand the technical requirements for different quinoa products and ensure that they have the necessary systems in place to produce for these different products.
- Become informed about certifications, such as organic or environmental, to determine cost-benefit to their business.
- Ensure that they have the proper data collection methods to meet buyer(s)' and/or certifier(s)' requirements.

Quinoa future studies

1. Agronomic work to enhance and stabilize yield, enhance quality, and further adaptation to Alberta conditions.
2. Start a coordinated on-farm testing of traits of interest in quinoa to select varieties with wide adaptability over diverse farming environments prior to varietal recommendation
3. Perform a cost/price/market economic analysis to determine if Alberta quinoa is profitable
4. Quantify quality attributes of quinoa for end use products Seeds of the cultivars grown on-farm will be subjected to nutritional composition analysis
5. Develop quinoa production marketing chain

