Optimizing Management and Inputs for Top Yields

Agronomy Update – 2018

Red Deer, AB

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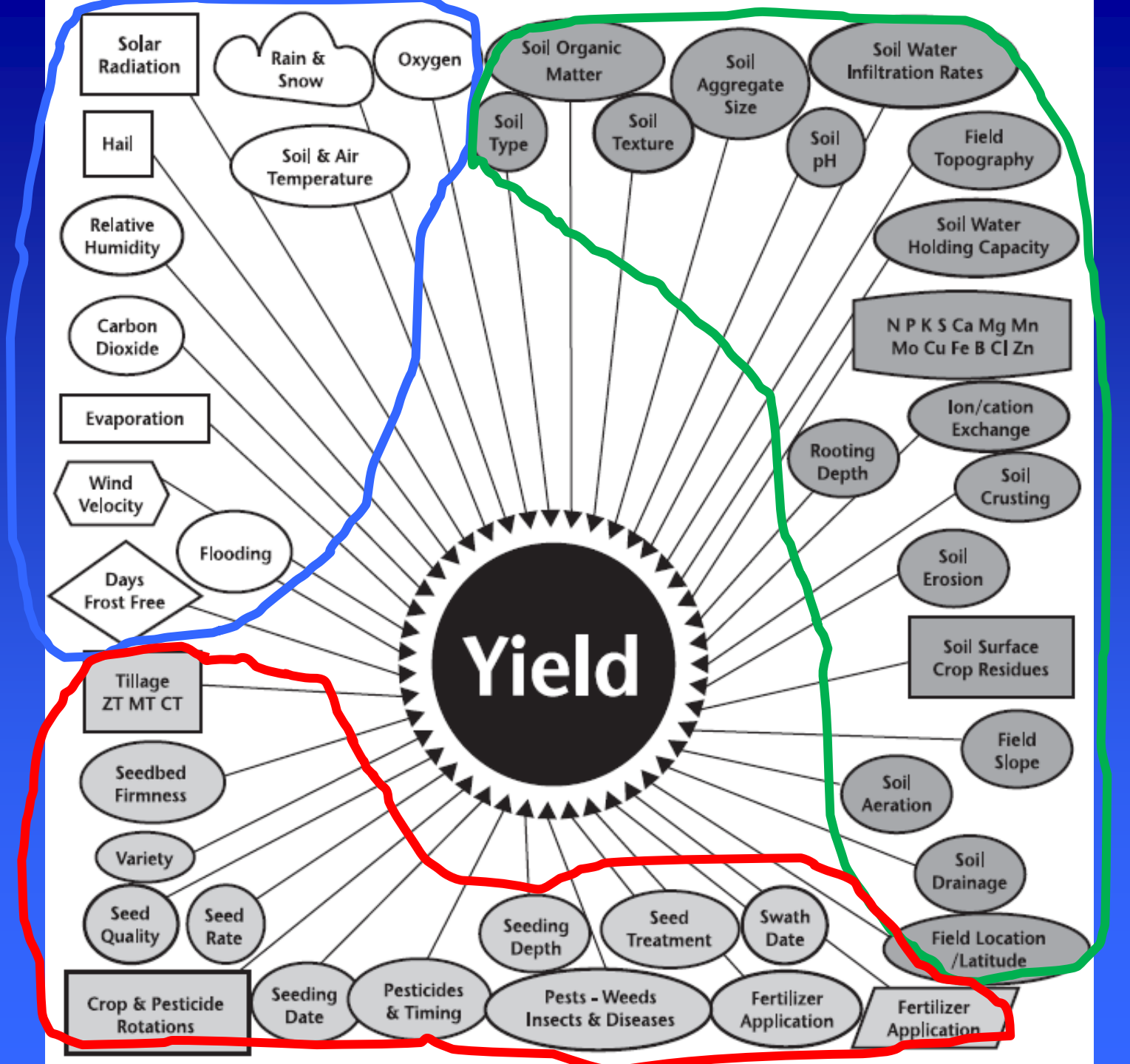

Yield
Solar Radiation
Rain & Snow
Oxygen
Hail
Soil & Air Temperature
Relative Humidity
Carbon Dioxide
Evaporation
Wind Velocity
Flooding
Days Frost Free
Tillage ZT MT CT
Seedbed Firmness
Variety
Seed Quality
Seed Rate
Crop & Pesticide Rotations
Seeding Date
Pesticides & Timing
Seeding Depth
Pests - Weeds Insects & Diseases
Seed Treatment
Fertilizer Application
Swath Date
Fertilizer Application
Field Location /Latitude
Soil Drainage
Soil Aeration
Field Slope
Soil Surface Crop Residues
Soil Erosion
Soil Crusting
Ion/cation Exchange
Rooting Depth
N P K S Ca Mg Mn Mo Cu Fe B Cl Zn
Soil Water Holding Capacity
Field Topography
Soil pH
Soil Texture
Soil Type
Soil Organic Matter
Soil Aggregate Size
Soil Water Infiltration Rates

Awareness Point #1

How has climate changed in your area since 1950?

On-line at:

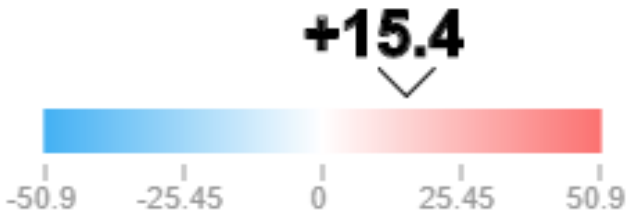
https://abrecords.cfapps.io/#

Location: **52.2759, -113.8512**

FROST FREE PERIOD

Trendline:

Trend difference from 1950 - 2010:

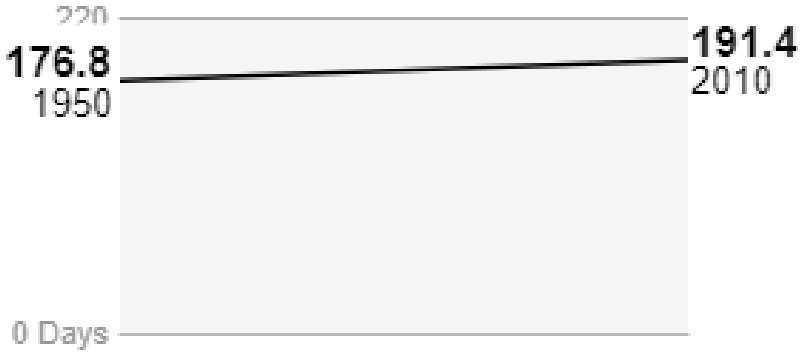


The trend indicates that the Frost Free Period has increased by 15.4 days per year since 1950.

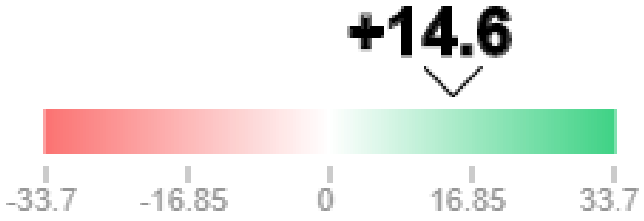
Location: **52.2759, -113.8512**

GROWING SEASON LENGTH

Trendline:



Trend difference from 1950 - 2010:

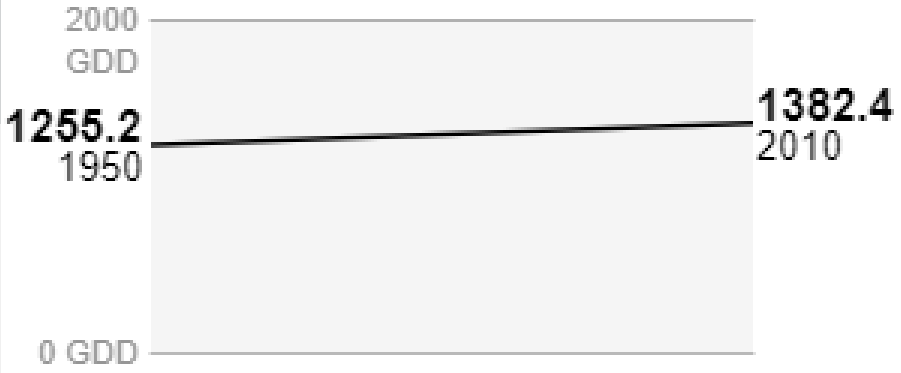


The trend indicates that the Growing Season Length has increased by 14.6 days per year since 1950.

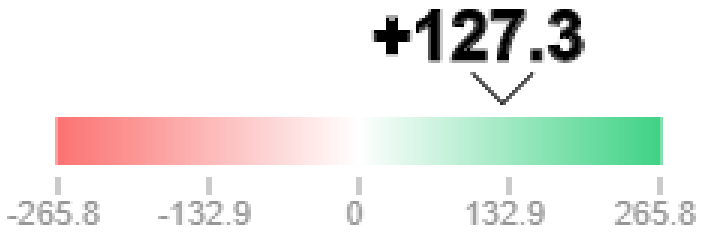
Location: **52.2759, -113.8512**

GROWING DEGREE DAYS OVER 5°C

Trendline:



Trend difference from 1950 - 2010:



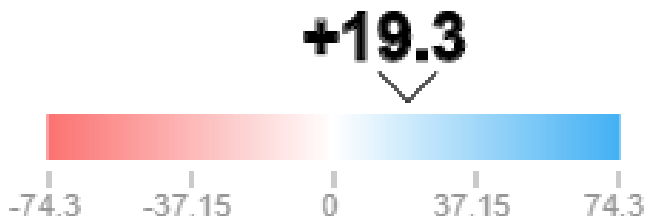
The trend indicates that there are 127.3 more Growing Degree Days over 5°C since 1950.

Location: **52.2759, -113.8512**

SPRING PRECIPITATION

Trendline:

Trend difference from 1950 - 2010:

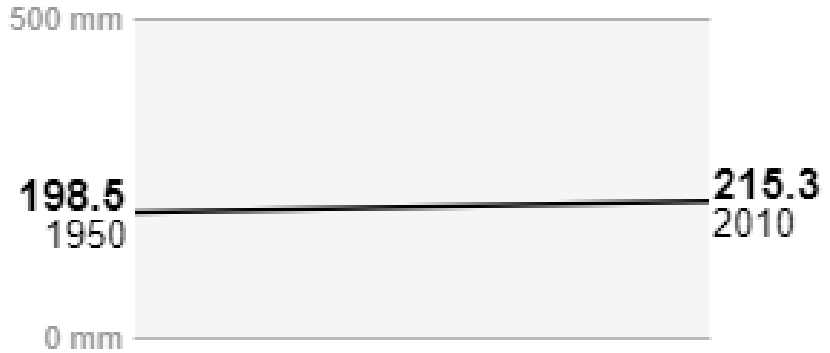


The trend indicates that Spring Precipitation has increased by 19.3mm since 1950.

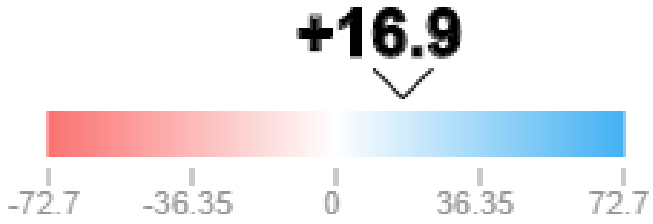
Location: **52.2759, -113.8512**

SUMMER PRECIPITATION

Trendline:



Trend difference from 1950 - 2010:



The trend indicates that Summer Precipitation has increased by 16.9mm since 1950.

Awareness Point #1 – Your Climate Now

- Frost Free Period & Growing Season are longer by ~2 weeks
- GDD have increased by ~10 %
- Spring + Summer Precipitation has increased total precipitation >10%

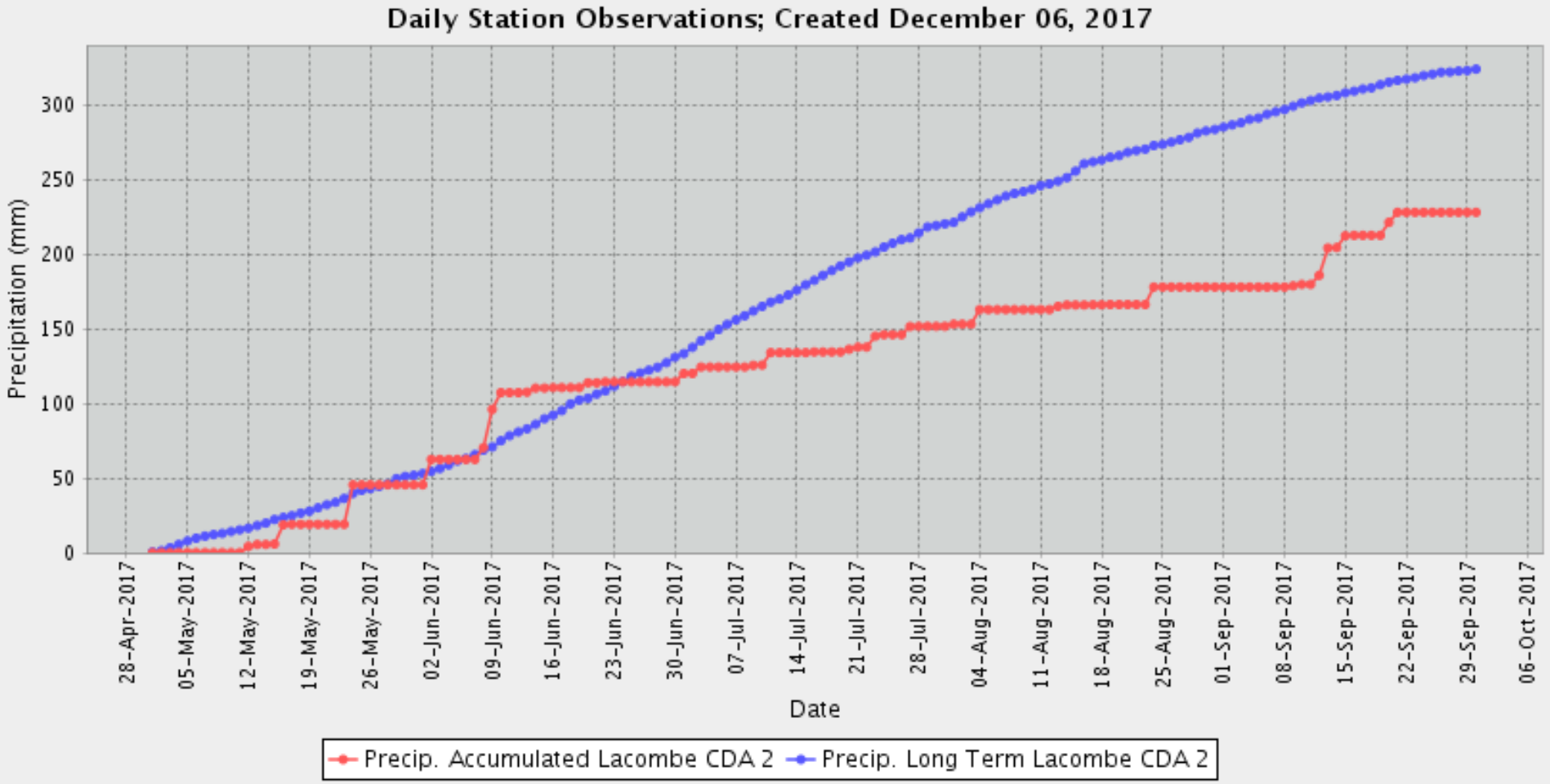
We need to set Yield Goals and Farm for the Climate we have Now!

Point #2

There can be a **BIG** difference between Climate Averages

And the Weather we **GET** each growing season!

Lacombe – Growing Season Precipitation 2017



Awareness Point #2 - Weather

- Plan your Crop rotations, Specific crops and Yield goals based on climate averages….

- BUT –
  - Be very flexible to adjust inputs to the weather you GET each growing season!

Point #3

How carefully do you look at your soil?

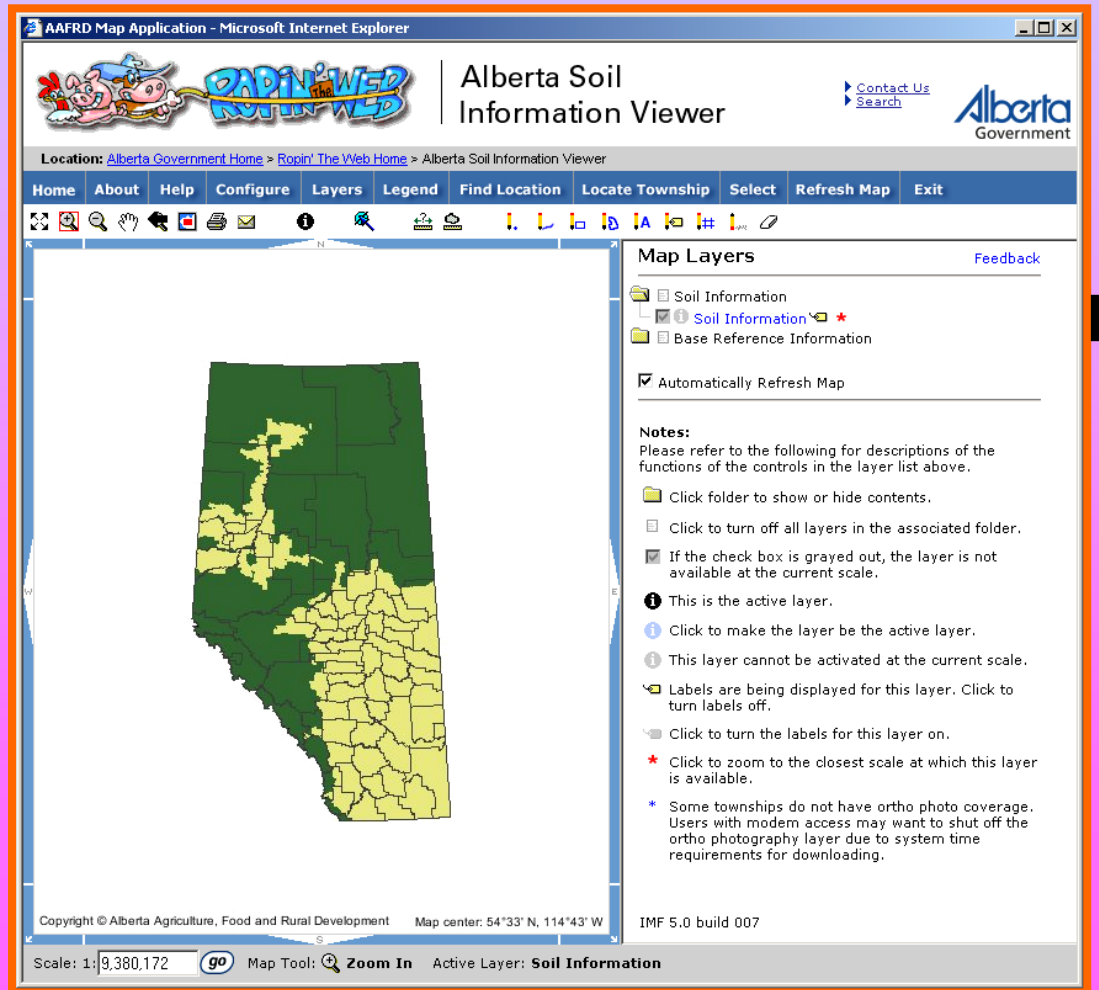
Soil series?

Soil horizons?

Soil texture changes?

AGRASID

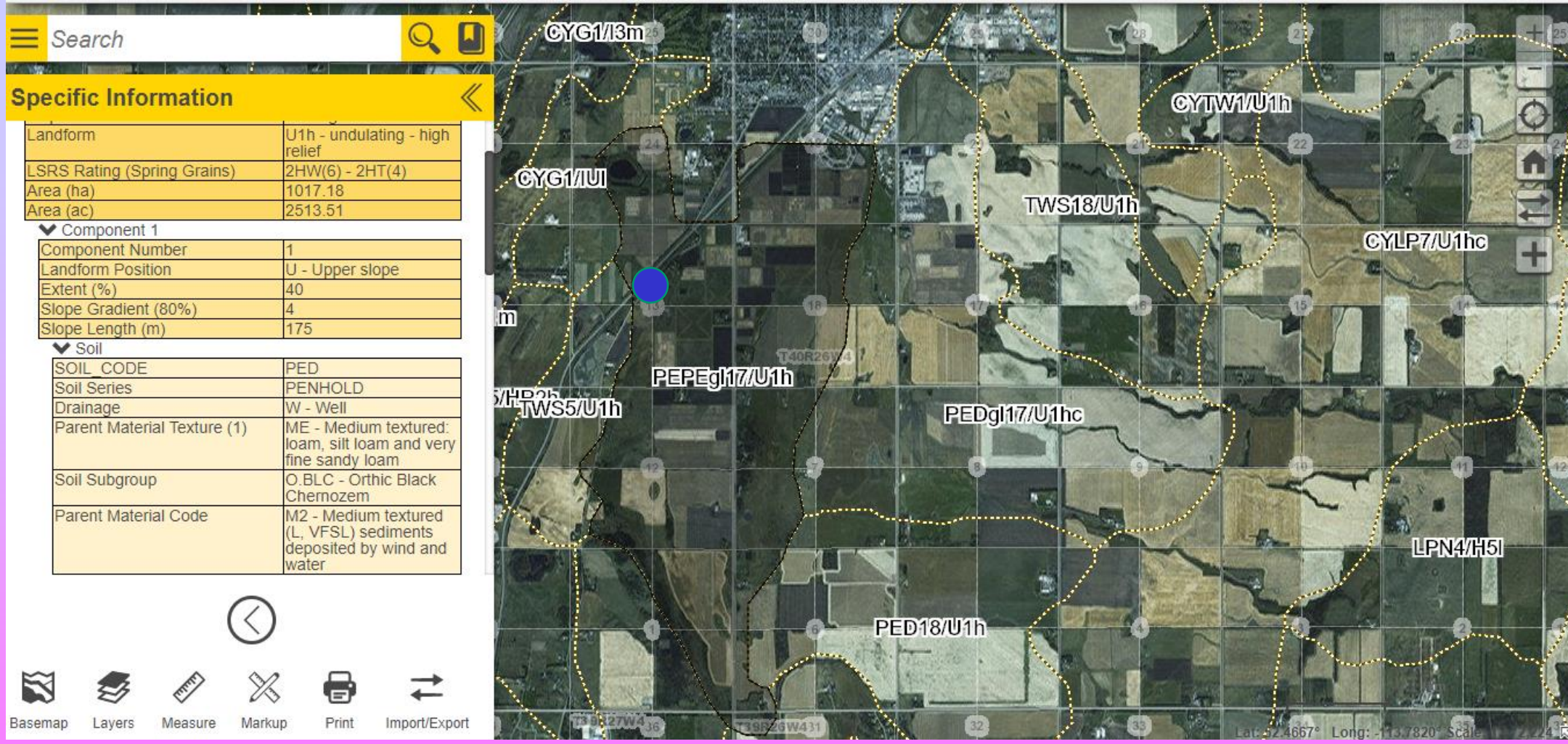
Agricultural Region of Alberta Soil Inventory Database



http://www.agric.gov.ab.ca/asic

Soil Series - Subdivisions of soil families based on soil properties

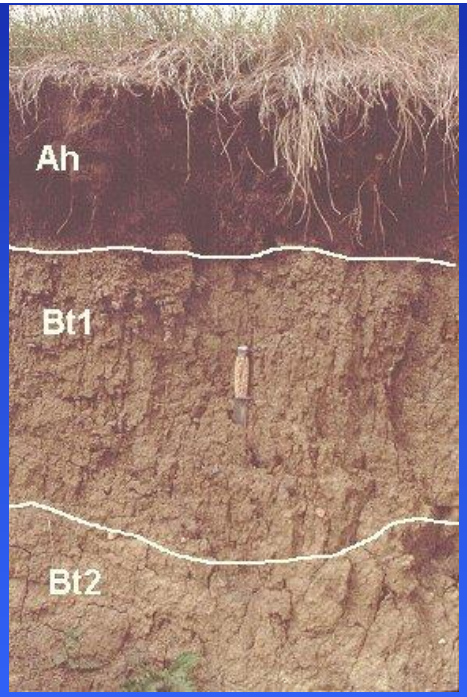
- Soil parent material
- Color
- Texture
- Structure
- Thickness and arrangement of horizons
- Abundance and size of Stones
- Depth to & concentration of carbonates
- Depth to & concentration of soluble salts
- Soil pH – how does it vary with depth
- Calcareousness
- Soil bulk density – glacial till soils have higher density
- Depth to a bedrock contact, or contrasting material



- **PEPE – two types of Penhold – Fluvial Lacustrine (Black Chernozem)**
- **PED- Penhold & Wetaskiwin – Fluvial Lacustrine (Solodized Solonetz)**
- **TWS – Tweedsmuir – Fluvial/Aeoline (Black Chernozem)**
- **CYTW – Cygnet & Tweedsmuir – Glacial till / Fluvial (Eluviated Black)**

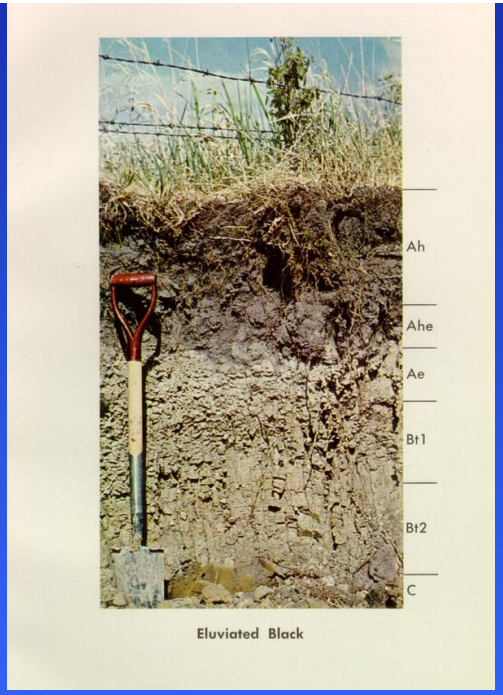
- **What are the Soil Series and Soil Horizons in fields on your farm?**

- **What are the characteristics of each horizon?**

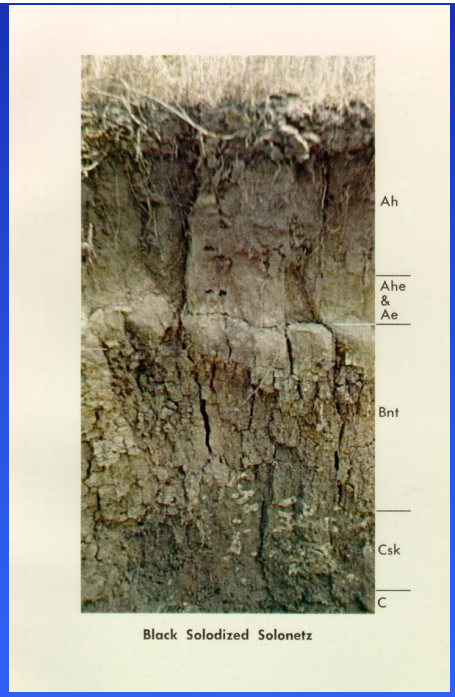


Penhold

Tweedsmuir



Cygnet



Wetaskiwin

What you know?

- Soil Test – N, P, K, S
- Soil pH, Org Matter

What should you know?

- Parent material of your soils?
- Physical characteristics
  - Soil texture – how variable
  - Water holding capacity
- Chemical characteristics
  - How did these change with depth?

Awareness Point #3 – Your Soils

- Learn as much as you can about your soils –
  - Set Yield Goals based on the Soils you have!
- What are the Soil Series and Soil Horizons on your farm
  - Do you have VRF management zones on your farm?
  - How should different soil areas be managed?
- Have your agronomist show you in the field!!

Point #4

Soil Texture & Water Holding Capacity

- How much water will your soils hold??

- If a crop takes up 10” of water from soil over a growing season:
- >2,200,000 lb water/ac

Soil Texture	Approximate Available Water-Holding Capacity
	(mm water/ 100 cm of soil)
Loamy sand	100
Sandy loam	140
Loam	180
Sandy clay loam	160
Silt loam	200
Clay loam	200
Silty clay loam	220
Sandy clay	170
Silty clay	210
Clay	190

Awareness Point #4 – Soil Water

- Stored soil water + precipitation are major factors controlling crop yield
- Check your moisture during the growing season
  - Use to make decisions on in-season inputs

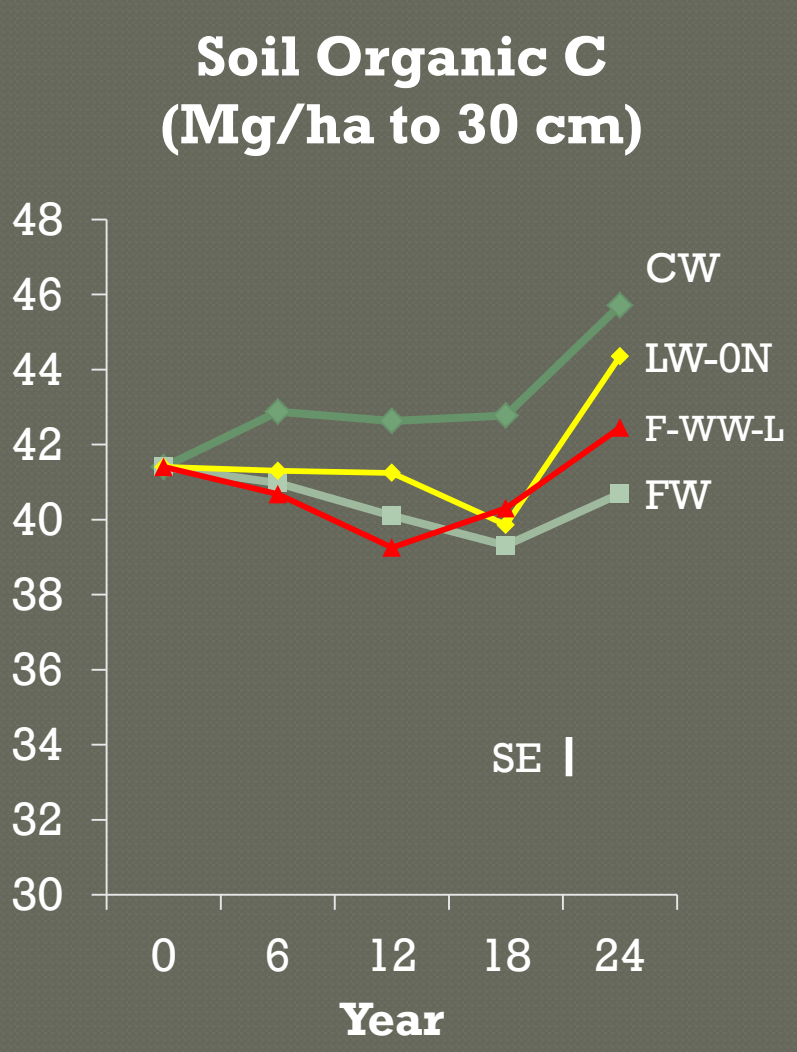
Point #5 Crop Rotations

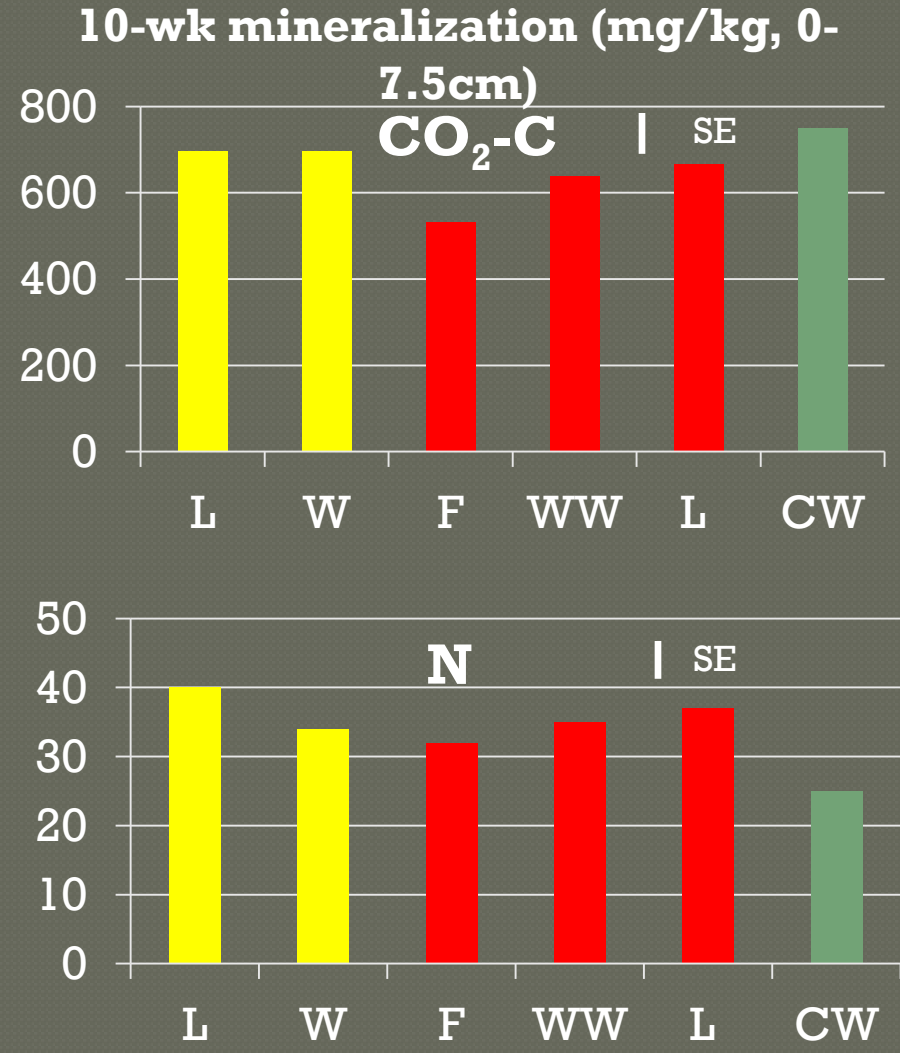
- Past crops and crop rotations have a huge affect on crop yield potential each year
- Example: 24 yr Long-term trials at Bow Island – then all treatments cropped to wheat

GM ('92-'95), Pea ('96-'12), Lentil ('13-15)

Chickpea ('04-06), lentil ('07-15)

Pulse in Rotation (LW, F-WW-L)





Awareness Point #5 – Influence of Past Crop Rotations

- **Good rotations increase crop yield potential:**
  - Improved soil quality benefits
  - Improve weed control and reduce disease problems

- **Use at least a 4 yr rotation including cereals, oilseed and pulse crop in your rotation**
- **If include a forage crop – even better!!**

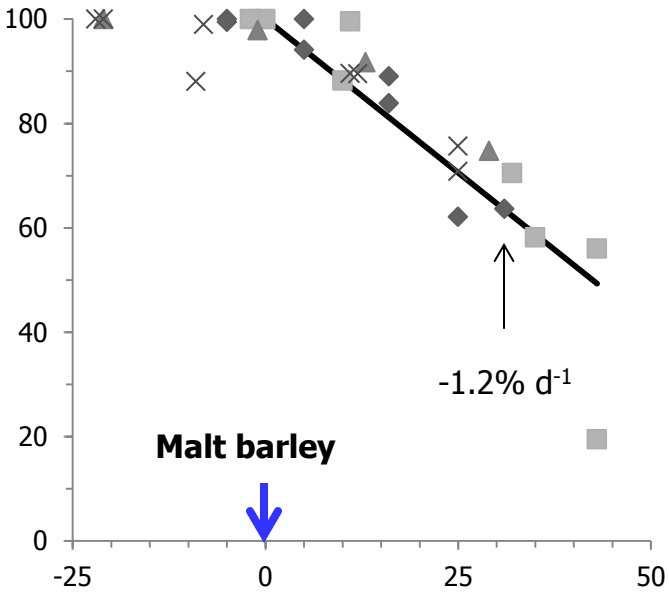
Awareness Point #6
Understand Agronomic Requirements

- GOAL- to achieve Best Yield –
  - must achieve **Best Stand Establishment!**

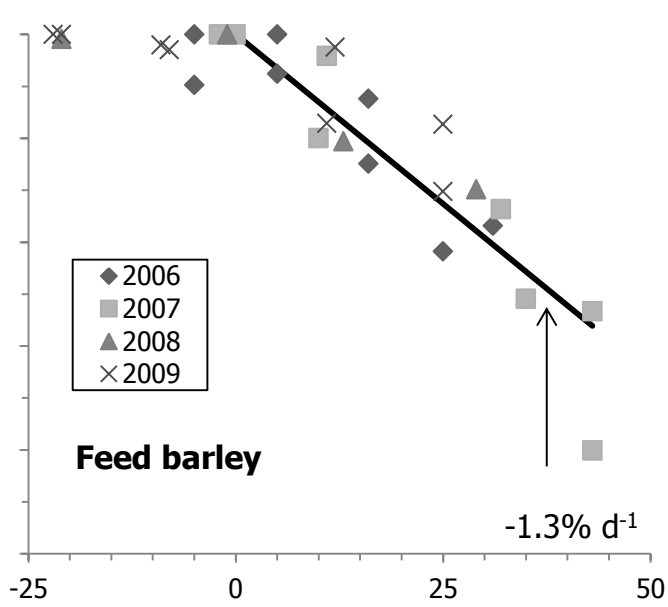
- **Important:**
  - Use the **best crop varieties** available
  - Use **best quality seed**!
  - When should your **crops be seeded**?
  - Know the
    - optimum seeding rate
    - seeding depth
    - seed treatments

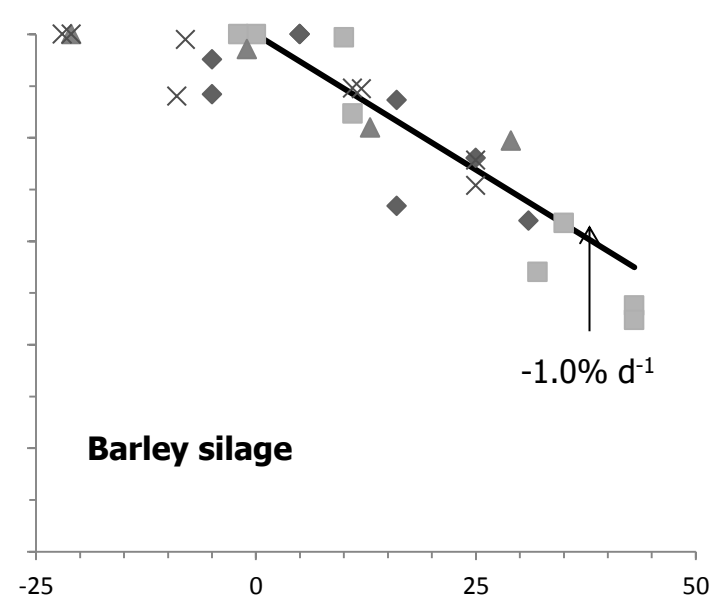

Seeding Date and Rate trials at Lethbridge
1st
3rd
4th
2nd
Seeding Dates

Barley Response to Seeding Date



May 1



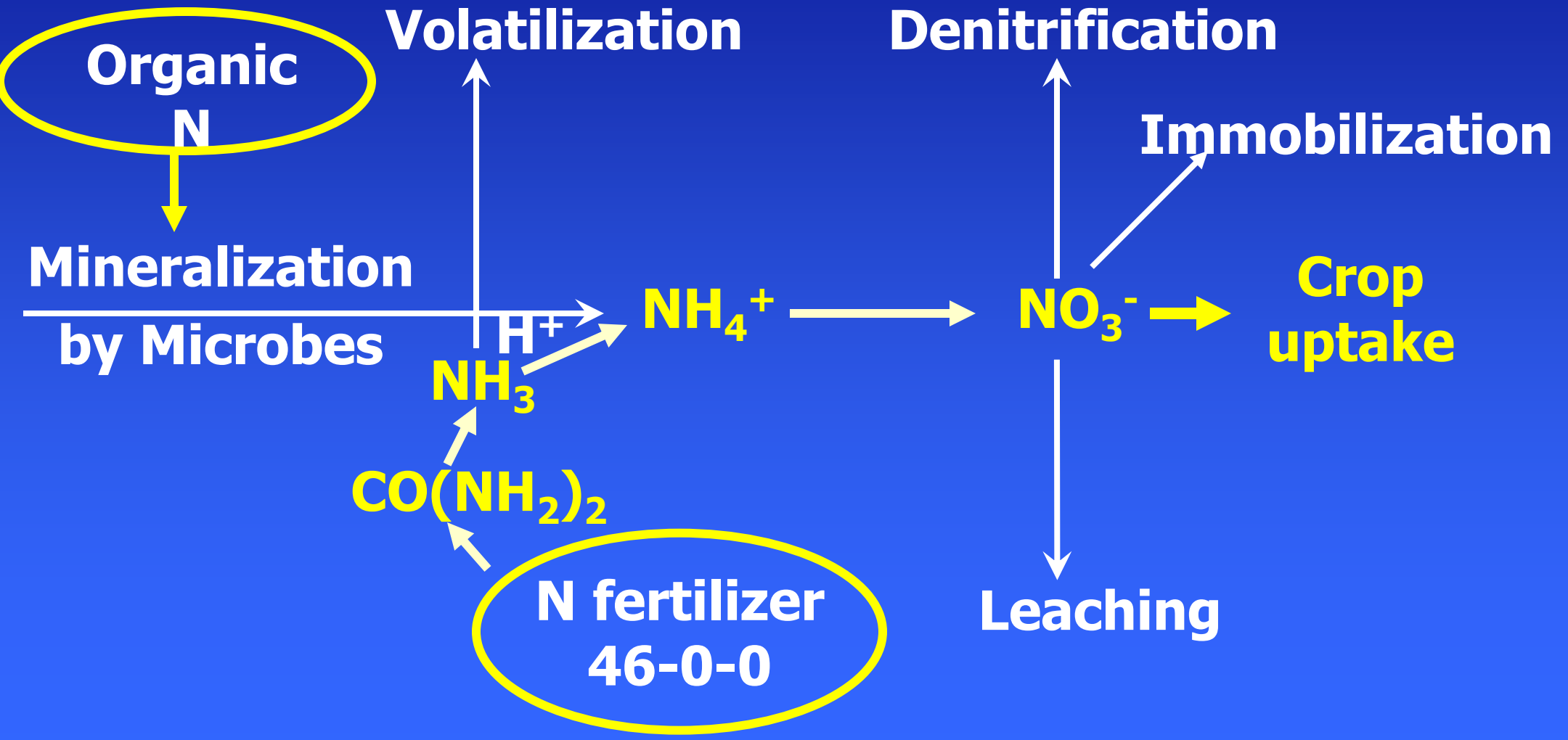


Awareness Point #6 – Benefits of Earlier Seeding?

- Earlier seeding allows capture of more sunlight energy!
- Most crops we grow are cool season crops – seeding earlier gets crops through the vegetative stages before the summer heat!
- Improved water use efficiency!
- Crops can get a head start on weeds!
- The more advanced crops are when diseases or insect pests move in – the less the effect on crop yield!

Awareness Point #7
Soil Nitrogen & Nitrogen Fertilizer

Nitrogen Dynamics:



When you understand soil N dynamics

- better understand BMP's of N fertilizer

N Fertilizer - BMP Choices

- **Choice 1**
  - **Side band N at seeding (60-70% efficiency)**
  - **Seed-place some N – BUT only at safe rate!**

N Fertilizer - BMP Choices

- **Choice 2**
  - Band N in early spring before seeding
    - About 60% efficiency
  - **Concern**: seed bed is compromised & loss of critical seed bed soil moisture

- **Choice 3**
  - Band N in late fall - at Soil Temp < 7˚C
  - **Concern**: N must remain in NH_4^+ form over winter to minimize losses

BMP Choice 4

- **Broadcast 46-0-0 before or just after seeding –**
  - **Protect N - Best to use urease inhibitor**
  - **DON'T Broadcast ESN – release is too slow**

  <u>Concerns</u>:
  - **Moderate to Very Inefficient – subject to gas off**
  - **Depend on rain to move fertilizer into soil**

BMP Choice 5 – In-crop N

- **In-crop N using 28-0-0 with spray jet nozzles:**
  - 20-40% efficient

  - **Concerns: need moisture to move N into soil and then must convert to an available form**
  - **Must apply in early crop stage to be effective**

BMP Choice 6 - Foliar N application

- Very inefficient – <5% N uptake via leaves!
  - 1 lb of 20 lb/ac application
- Leaf burn at > 20 lb N/ac
- Leaves are designed to capture the energy of the sun – NOT to absorb Nitrogen

BMP Choice 7 - ESN – Environmentally Smart Nitrogen

- **Under wet soil conditions banded or side-banded ESN fertilizer is protected by releasing slowly to reduce denitrification or leaching losses!**

- **Using a Urea:ESN blend can banded at seeding can replace need for in-crop N application**

Awareness Point #7: N Management

- For most crops – side or mid row band N at time of seeding
- If N losses are a concern – consider using a slow release product for part of N fertilizer
- Use in-crop N with great caution
  - Use to replace lost N fertilizer
  - When growing conditions and yield potential are very good

Point #8 Phosphorus Nutrition

Phosphorus (P)

Phosphate (P_2O_5)

Ortho Phosphate (H_2PO_4)

- **About 80% of Alberta soils are P deficient!**

Agdex has up-to-date information and recommendations

Revised January 2013 Agdex 542-3

Phosphorus Fertilizer Application in Crop Production

Phosphorus (P) is an essential plant nutrient required for optimum crop production. Phosphorus deficiencies can be corrected with phosphate fertilizer (P_2O_5). Generally, P is the second most limiting soil nutrient in crop production in Alberta. With respect to fertilizer use, it is second only to nitrogen (N) in Alberta.

Effect on crop growth

Plants need phosphorus for growth, utilization of sugar and starch, photosynthesis, nucleus formation and cell division. Phosphorus compounds are involved in the transfer and storage of energy within plants. Energy from photosynthesis and the metabolism of carbohydrates is stored in phosphate compounds for later use in growth and reproduction.

Phosphorus is readily translocated within plants, moving from older to younger tissues as the plant forms cells and develops roots, stems and leaves.

Adequate P results in rapid growth and early maturity, which is important in areas where frost is a concern. Frequently, P will enhance the quality of vegetative crop growth.

An adequate supply of available P in soil is associated with increased root growth, which means roots can explore more soil for nutrients and moisture. Phosphorus occurs in most plants in concentrations between 0.1 and 0.4 per cent, on a dry weight basis. A deficiency of P will slow overall plant growth and delay crop maturity.

Content and crop requirements

In young, actively growing plants, P is most abundant in the actively growing tissue. By the time plants have attained about 25 per cent of their total dry weight, they may have accumulated as much as 75 per cent of their total phosphorus requirements. Therefore, most crops require significant quantities of P during the early stages of growth. For example, cereal crops will often take up to 75 per cent of their P requirements within 40 days after crop emergence.

Phosphorus requirements for optimum yields vary with different crops (see Table 1). For example, wheat requires less P than canola due to the lower protein content of the seed. A 2,700 kg/ha (40 bu/ac) wheat crop requires about 33 kg/ha (29 lb/ac) of phosphate as indicated in Table 1.

Table 1. Approximate range of phosphate requirements of wheat, barley, canola and pea

Crop	Crop part	Phosphate kg/ha	Phosphate lb/ac
Wheat 2,690 kg/ha (40 bu/ac)	Seed	23 - 28	21 - 26
	Total Uptake	32 - 38	29 - 35
Barley 3,226 kg/ha (80 bu/ac)	Seed	33 - 40	30 - 37
	Total	44 - 53	40 - 49
Canola 1,960 kg/ha (35 bu/ac)	Seed	36 - 44	33 - 40
	Total	50 - 61	46 - 57
Pea 3360 kg/ha (50 bu/ac)	Seed	34 - 41	31 - 38
	Total	41 - 50	38 - 46

Deficiency symptoms

A mild P deficiency results in somewhat stunted crop growth, which can be difficult to see. In severe cases of P deficiency, symptoms include characteristic stunting, purpling or browning, appearing first on the lower leaves and base of the stem and working upward on the plant, particularly on cereal crops. The effect is first evident on leaf tips, and then progresses toward the base. Eventually, the leaf tip dies. However, visual diagnosis of

Alberta Government

Use the Right Soil Test P Method

- **Best soil P test method for Alberta soils:**
  - **Modified Kelowna:** NH_4F + HOAc + NH_4OAc
  - **All P soil test calibration in Alberta is with this method, since 1991 !**

- **Other methods that used:**
  - **Olson (Bicarb method): designed for higher (pH >7) soils**
  - **Bray-1: designed for low pH soils – Not calibrated for AB**
  - **Mehlich 3 - Not calibrated to AB soils**

Phosphate fertilizer –
What is the probability of response?

Table 7. Approximate probability of a greater than 2 bu/ac and 5 bu/ac barley response to phosphate fertilizer when following recommendations

Soil test P (lb/ac)	Brown		Dark Brown		Thin Black		Black		Gray Wooded		Irrigated
	>2	>5	>2	>5	>2	>5	>2	>5	>2	>5	
	%										
0 - 10	95	80	95	85	95	95	95	95	95	90	80
10 - 20	90	70	90	80	95	90	95	90	95	85	70
20 -30	90	60	90	70	90	80	90	80	90	80	60
30 -40	80	55	80	60	85	70	85	70	85	70	55
40 - 50	70	50	70	50	80	60	80	60	80	60	50
50 - 60	60	35	60	35	70	50	70	50	70	50	35
60 - 70	50	30	50	30	50	30	50	30	50	30	30
70 - 80	40	30	40	30	40	30	40	30	40	30	30
>80	35	25	35	25	35	25	35	25	35	25	25

Awareness Point #8: P fertilizer

- Use the modified Kelowna P soil test –
  - apply recommended P_2O_5 rate
- Seed-placed P provides a starter or pop-up effect – especially in cool, wet soils
  - Seed-place the safe rate of phosphate & side band remaining P
- When soil P is adequate – consider applying P_2O_5 to match crop removal to maintain soil levels

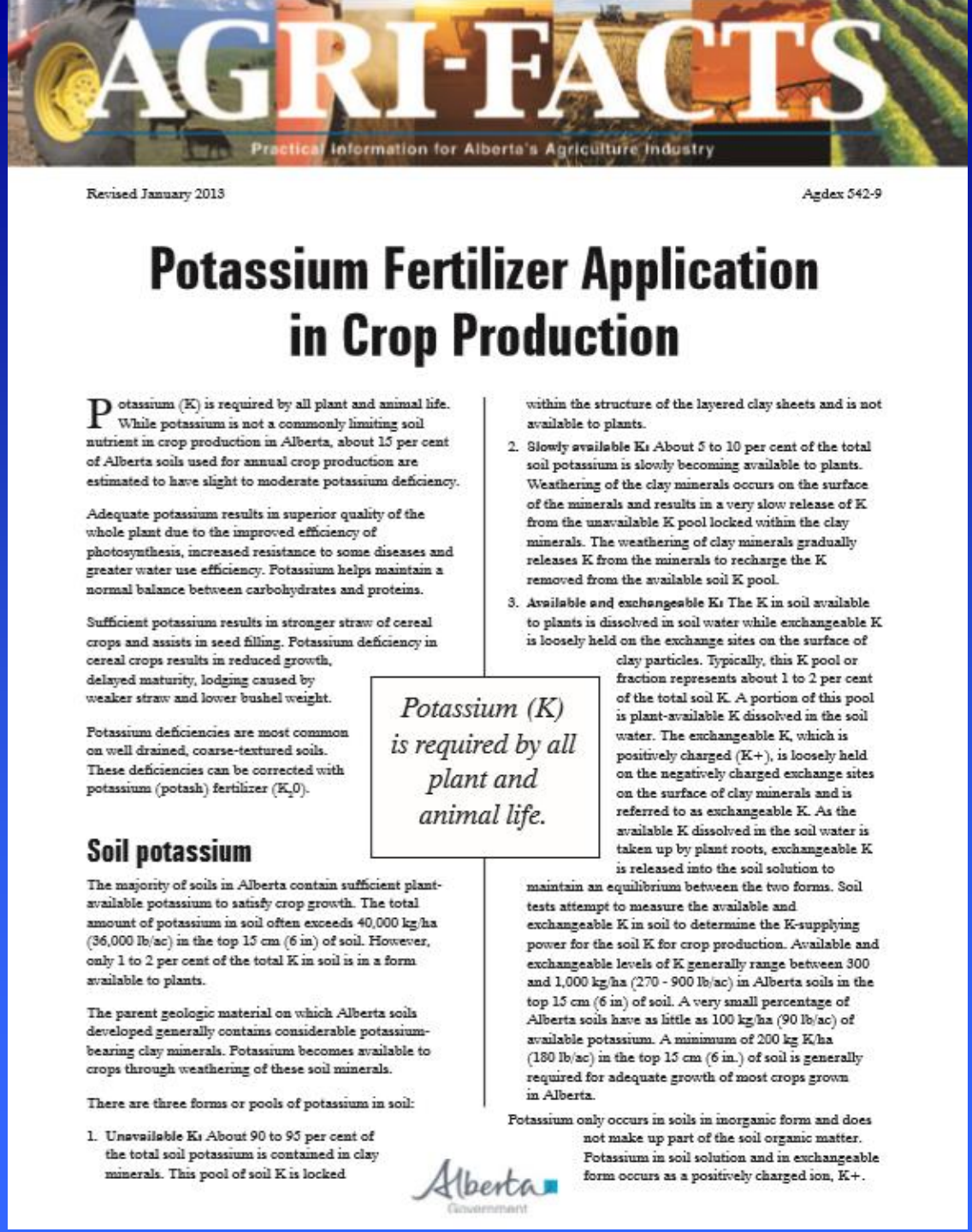
Potassium

Agdex has up-to-date information and recommendations

Soil test K determined as: K+

K fertilizer recommendation: K_2O

About 20% of Alberta soils are K deficient



AGRI-FACTS

Practical information for Alberta's Agriculture Industry

Revised January 2013 Agdex 542-9

Potassium Fertilizer Application in Crop Production

Potassium (K) is required by all plant and animal life. While potassium is not a commonly limiting soil nutrient in crop production in Alberta, about 15 per cent of Alberta soils used for annual crop production are estimated to have slight to moderate potassium deficiency.

Adequate potassium results in superior quality of the whole plant due to the improved efficiency of photosynthesis, increased resistance to some diseases and greater water use efficiency. Potassium helps maintain a normal balance between carbohydrates and proteins.

Sufficient potassium results in stronger straw of cereal crops and assists in seed filling. Potassium deficiency in cereal crops results in reduced growth, delayed maturity, lodging caused by weaker straw and lower bushel weight.

Potassium deficiencies are most common on well drained, coarse-textured soils. These deficiencies can be corrected with potassium (potash) fertilizer (K_2O).

Potassium (K) is required by all plant and animal life.

Soil potassium

The majority of soils in Alberta contain sufficient plant-available potassium to satisfy crop growth. The total amount of potassium in soil often exceeds 40,000 kg/ha (36,000 lb/ac) in the top 15 cm (6 in) of soil. However, only 1 to 2 per cent of the total K in soil is in a form available to plants.

The parent geologic material on which Alberta soils developed generally contains considerable potassium-bearing clay minerals. Potassium becomes available to crops through weathering of these soil minerals.

There are three forms or pools of potassium in soil:

1. **Unavailable K:** About 90 to 95 per cent of the total soil potassium is contained in clay minerals. This pool of soil K is locked within the structure of the layered clay sheets and is not available to plants.
2. **Slowly available K:** About 5 to 10 per cent of the total soil potassium is slowly becoming available to plants. Weathering of the clay minerals occurs on the surface of the minerals and results in a very slow release of K from the unavailable K pool locked within the clay minerals. The weathering of clay minerals gradually releases K from the minerals to recharge the K removed from the available soil K pool.
3. **Available and exchangeable K:** The K in soil available to plants is dissolved in soil water while exchangeable K is loosely held on the exchange sites on the surface of clay particles. Typically, this K pool or fraction represents about 1 to 2 per cent of the total soil K. A portion of this pool is plant-available K dissolved in the soil water. The exchangeable K, which is positively charged (K+), is loosely held on the negatively charged exchange sites on the surface of clay minerals and is referred to as exchangeable K. As the available K dissolved in the soil water is taken up by plant roots, exchangeable K is released into the soil solution to maintain an equilibrium between the two forms. Soil tests attempt to measure the available and exchangeable K in soil to determine the K-supplying power for the soil K for crop production. Available and exchangeable levels of K generally range between 300 and 1,000 kg/ha (270 - 900 lb/ac) in Alberta soils in the top 15 cm (6 in) of soil. A very small percentage of Alberta soils have as little as 100 kg/ha (90 lb/ac) of available potassium. A minimum of 200 kg K/ha (180 lb/ac) in the top 15 cm (6 in.) of soil is generally required for adequate growth of most crops grown in Alberta.

Potassium only occurs in soils in inorganic form and does not make up part of the soil organic matter. Potassium in soil solution and in exchangeable form occurs as a positively charged ion, K+.

Alberta Government

Probability of Barley Response to Potassium (K) in Alberta

Soil test level (lb K/ac)	% of Responsive sites
<50	100%
50-100	75
100-150	66
150-200	24
200-250	18
>250	3

Potassium recommendations for wheat & canola in Alberta (lb/ac):

Soil K: 0-6” (lb/ac)	K_2O (lb/ac)	
<100	100	K IS Recommended
150-100	80	
200-150	40 - 60	
250-200	20 - 40	
300-250	20-30	K maintenance application
>300	0	K NOT Required unless K is variable in field

Sulfate Sulfur (SO_4^{-2} – S)

Elemental Sulfur (S)

Agdex has up-to-date information and recommendations

Revised February 2013

Agdex 542-10

Sulphur Fertilizer Application in Crop Production

Sulphur (S) is an essential plant nutrient required by all crops for optimum production. Plants take up and use S in the sulphate (SO_4-S) form, which like nitrate (NO_3-N), is very mobile in the soil and is prone to leaching in wet soil conditions, particularly in sandy soils.

Sulphur deficiencies are becoming increasingly common in Alberta. Deficiencies can be easily corrected with fertilizers containing sulphate (SO_4). Generally, S is the third most limiting soil nutrient in cereal, oilseed and forage crop production in Alberta. It is third only to nitrogen (N) and phosphorus (P) in fertilizer use in Alberta.

Background

Oilseed crops, particularly canola, and forage crops, have a higher S requirement than cereal crops. Table 1 provides examples of nutrient uptake and removal by wheat, canola, pea and alfalfa. Sulphur is required in the development of fertile canola flowers and must be present for good nodule development on legume forages such as alfalfa and pulse crop roots such as pea and faba bean.

In Alberta, an estimated 6 to 8 million acres are considered potentially S deficient for optimum canola production, and the potentially deficient areas are increasing due to increased crop yields and increased canola production, which is drawing down S soil reserves.

Soil organic matter is the primary source of plant-available SO_4-S in surface soil. Soils that are sandy, low in organic matter and found in upper to mid-slope field positions are particularly prone to S deficiency since only a small amount of SO_4-S is released from organic matter and is susceptible to leaching loss.

The subsoil of Brown and Dark Brown soils in southern and south central Alberta often have an abundance of gypsum, which is calcium sulphate ($CaSO_4$). This mineral is an important source of plant-available S in these soils.

Table 1. Nutrient levels taken up and removed by average yields of canola, wheat and alfalfa in Alberta

Crop	Yield	Crop Part	Nitrogen N	Phosphate P_2O_5	Potassium K_2O	Sulphur S
			(lbs/acre)			
Canola	35 bu/ac	Seed	60-75	30 - 35	15 - 20	10 - 12
		Seed/straw	100 - 115	45 - 50	75 - 85	17 - 20
Wheat	50 bu/ac	Seed	60 - 75	24 - 28	70 - 85	10 - 12
		Seed/straw	85 - 110	32 - 36	15 - 22	5 - 6
Pea	50 bu/ac	Seed	100 - 120	30 - 35	30 - 35	6 - 7
		Seed/straw	130 - 150	35 - 45	120 - 140	10 - 14
Alfalfa	5 tons/ac	Total	260 - 320	60 - 75	270 - 330	27 - 33

Alberta Government

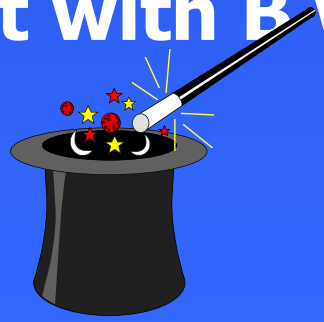
Sulfur in Soil:

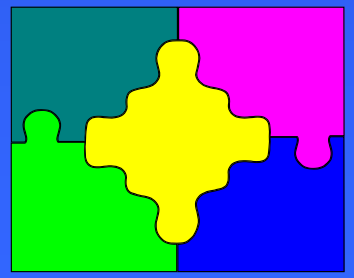
- Soil test: 0-6, 6-12 and 12-24 inch depths
- S in surface soil (0 to 6”) is often low.
- But S is often adequate in sub soil
  - SO - do you need S fertilizer?
- If surface soil is LOW– YES need S fertilizer to get crop through vegetative growth until roots are into sub-soil!

Micronutrients:

- Copper is needed for cereal crops on Black and Gray sandy soils when:
  - Cu is < 0.5 ppm

- Boron is often over recommended !
  - Soil testing for B is NOT reliable
  - Most field research in AB has not shown a benefit with B when soil test B is < 0.5 ppm





Point #9: K, S and Micro's

- Review Alberta Agdex publications on fertilizers
  - Educate yourself!

- Consult with a well qualified agronomist –

  AND
  - Take the lead on your farm to develop your fertilizer recommendations

Awareness: In-Crop Products

- When do you need to apply:
  - Herbicides
  - Fungicides
  - Insecticides
  - Plant Grow Regulators

- Starting Point –
  - Regular Field Scouting to Make Important Decisions

Awareness Point #10
Conditions for Insecticide Application

- Monitor fields with sweep nets/visual inspection
  - Know your insects and how to scout for each!

- Researchers have established economic thresholds for various insects to assist with spraying decisions.
  - Know the threshold when to spray!
  - Is the yield potential of your crop worth protecting

- **Spray based on Level of Risk versus Benefit!**

Awareness Point #11
Conditions for Foliar Fungicide Application

- **A healthy crop is worth protecting –**
  - Often has higher risk conditions for disease development
- **Moisture –**
  - If a field has very good soil moisture, higher relative humidity and/or long range forecast calls for rain - Infection risk increases.
- **Short Rotation –**
  - With short rotations, there is a higher likelihood of crop residue harboring disease - crop at higher risk.
- **What is your Level of Risk vs Benefit?**

Concluding Comment:

There is a CLASH between Scientific Knowledge and Promotion & Marketing!

- **Inputs for Optimum Yield –**
  - **Seek advice from unbiased experts !**

- **USE CRITICAL THINKING!!**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Questions ?