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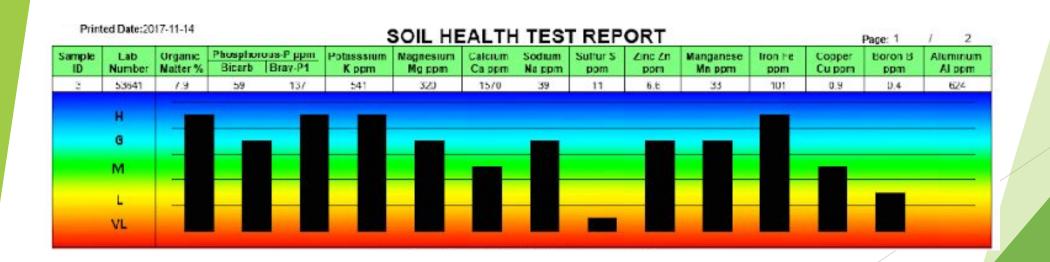
- Crop Consulting Soil Nutrient Recommendations
- Ag Coaching Services (annual retainer) Field Scouting
 Soil & Plant Tissue Sampling

Creating Growing Environments



Also tie in...

Soil sample interpretation



Acknowledgements:

- Some slides are borrowed from...
 - Greg Patterson President of A&L Labs
 - Geoff Doell Growth Agronomics
 - Abdelbasset El Hadrami OMEX Canada
 - Brent Tarasoff Fieldquest consulting
 - Mosaic fertilizer
 - IPNI photo library
 - Mike Dolinksi
 - Taurus

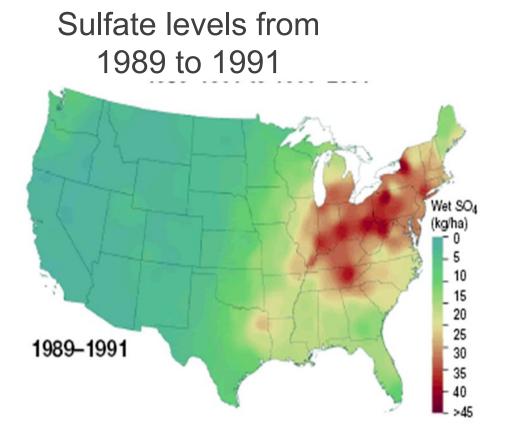
Discussion

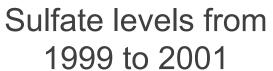
- "Experts" in Our Industry in the Dark Ages?
 - ► If it doesn't work, put more on...the "Moron principal"
 - City people don't get it!
 - ▶ Do WE get it?
- New Technology and Information
 - Seed & fertilizer placement?
 - Variability within a field?
 - Soil & Plant tissue sampling?

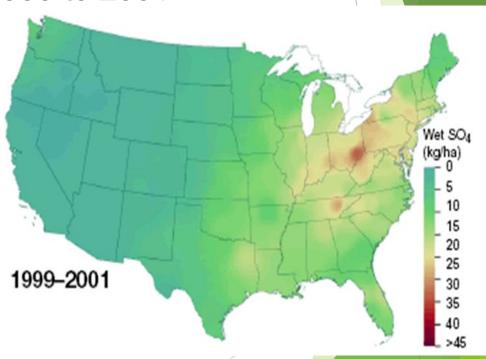
Discussion

- Soil test levels dropping
 - Rising cost of crop inputs
- Environmental pressures
 - What Can We Do What are the opportunities?
 - Can all soils be balanced?
 - Maybe not.

Why add nutrients...?







EVERY FIELD HAS SOMETHING LIMITING ITS YIELDS



Limiting Factors...

- Nutrients
- Excess water/Poor drainage

- er actions
- Climate



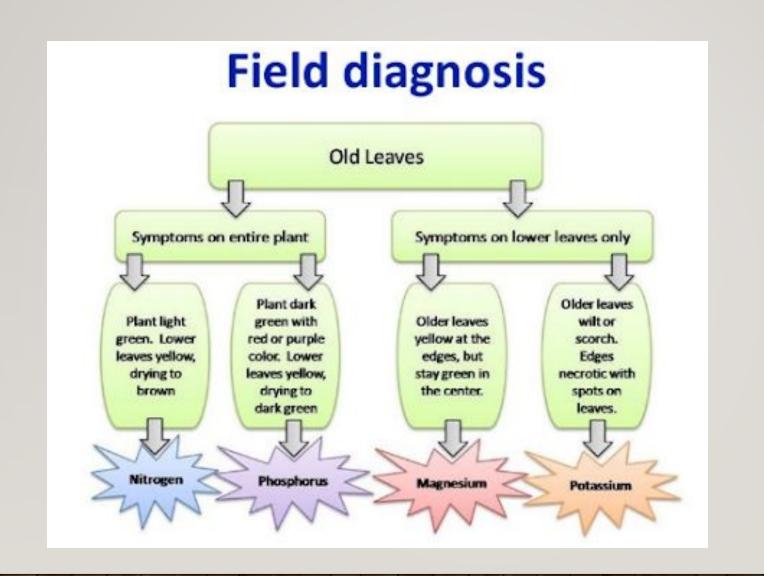
Law of the Minimum

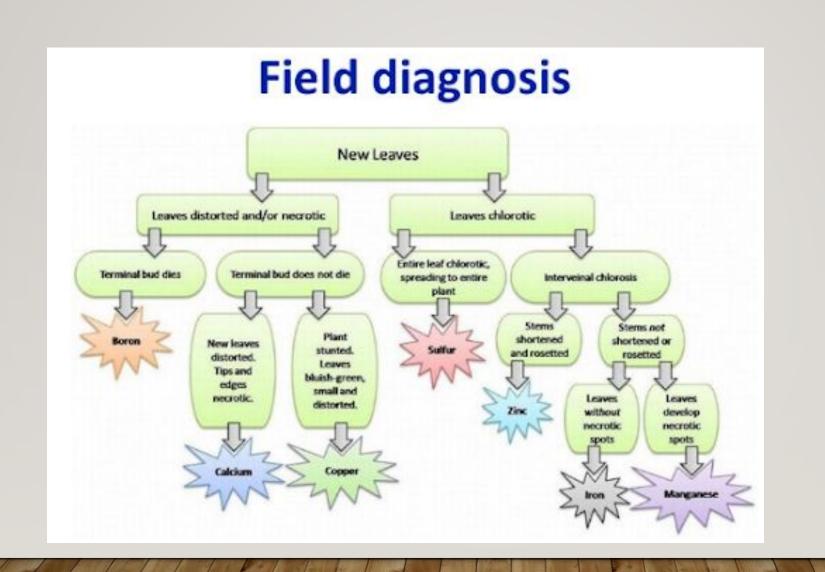


Which tools to use?

- Visual
 - ☐ Boots on the ground
- ☐ Plant Tissue
 - ☐ In-crop
 - ☐ Plan for next season
- ☐ Soil Sample
 - ☐ After Crop Removal

Field diagnosis young leaf tissue only Mn Mo Mg Old leaf tissue



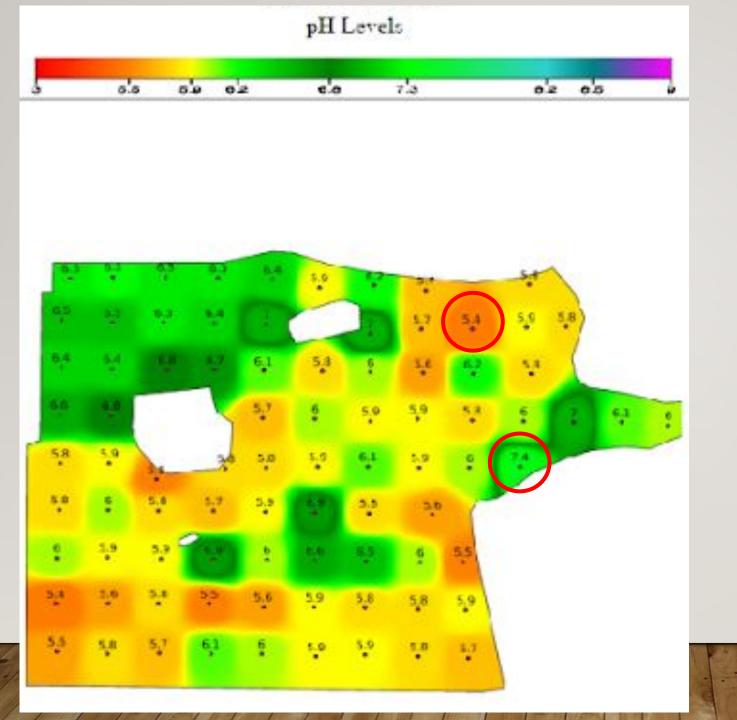


Perhaps a soil Test?

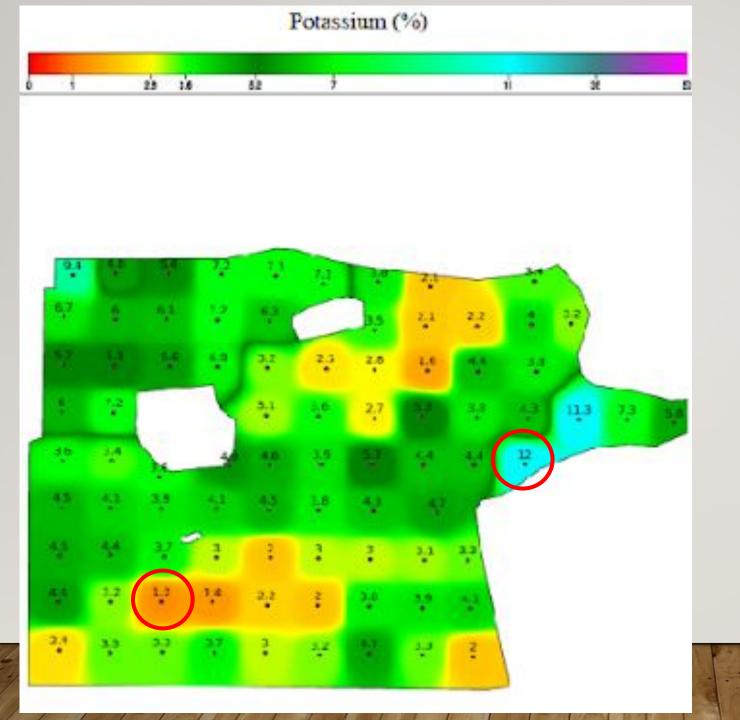
- Take Inventory!
- What's in your bank account?
- Your soil is your bank account!

You can't count what you don't measure!

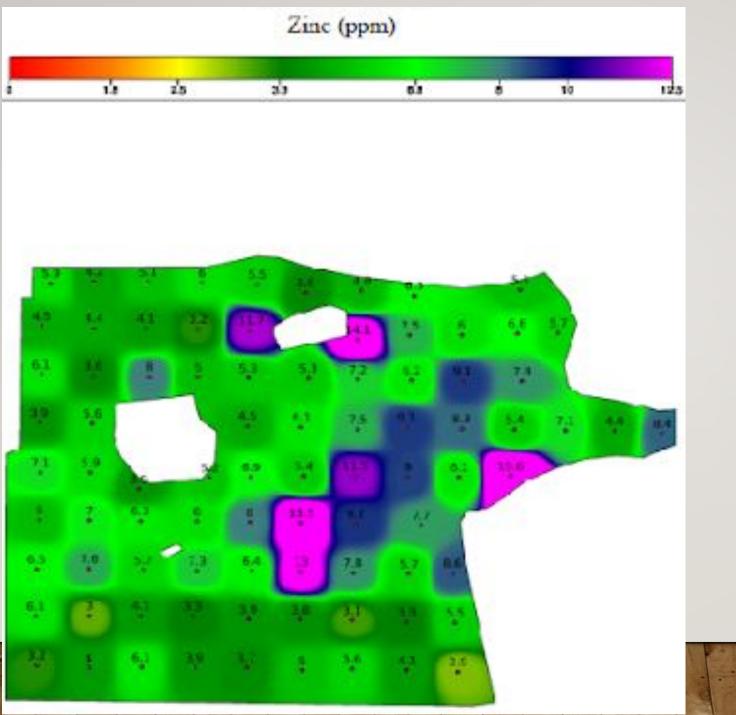




o Variability



o Variability



o Variability

ESSENTIAL ELEMENTS (PRIMARY)

Nitrogen	Phosphorus		Potassium	
N		P	S	K
Ca	Mg	Fe	Mn	Zn
В	Cu	Мо	CI	Со
Ni	Na	Se	Si	AI

ESSENTIAL ELEMENTS (SECONDARY)

Н		С		0
N		Р	S	K
Ca	Mg	Fe	Sulfur	Zn
Calcium N	lagnesium	Мо	CI	Со
Ni	Na	Se	Si	Al

Essential Elements (micronutrients)

Н		С		0
N		Iron M	anganese	Zinc
Ca Boron	Ma Copper	Fe	Mn	Zn
В	Cu	Мо	CI	Со
Ni	Na Nickel	lybdenum	Chloride	Cobalt

Beneficial Elements (micronutrients)

Н		С		0
N		Р	S	K
Ca	Mg	Fe	Mn	Zn
В	Cu	Мо	CI	Co
Ni	Sodjum	Selenium	Silicon	Aluminum
	Na	Se	Si	AI

HOW DO PLANTS UPTAKE NUTRIENTS?

Soil-water solution

•98% obtained in soil-water solution

•2% directly from soil

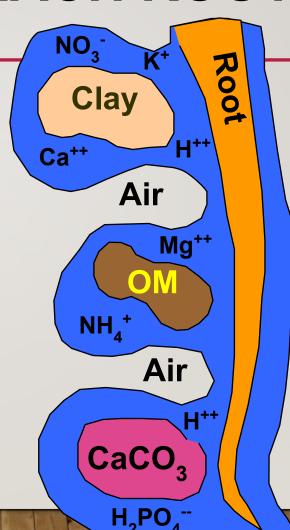


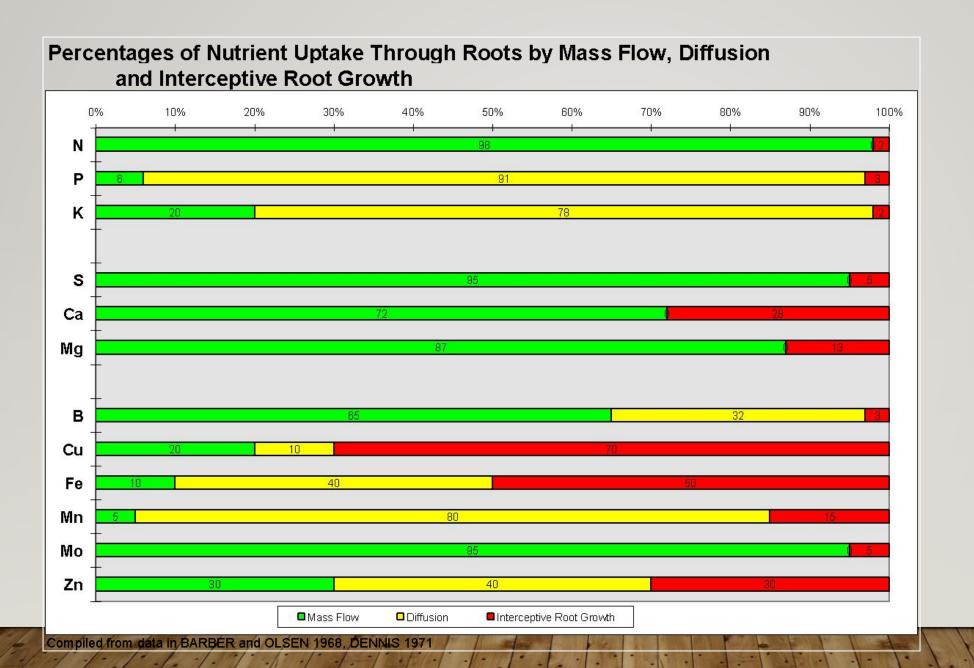
HOW NUTRIENTS REACH ROOTS

Mass flow with water

Diffusion from soil to roots

Root interception



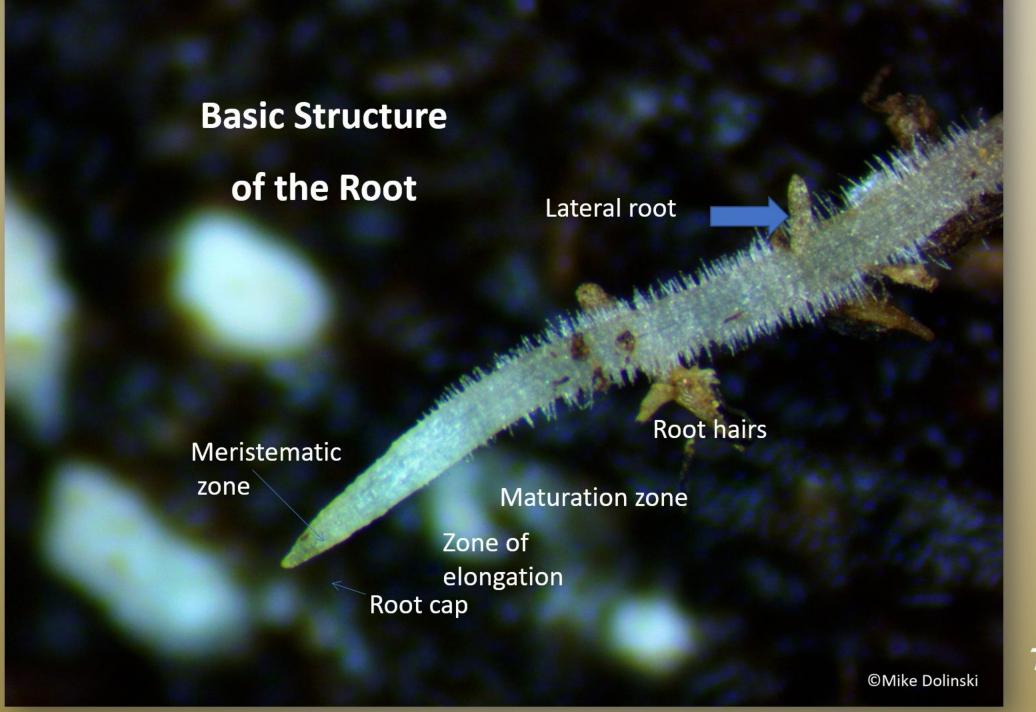


ROOT EFFICIENCY



- The root hair increases the surface area of the root by 20 times
- The root hair is the primary point of uptake of water and nutrients.
- Root hair lives for 3 6 days then dies
- Plant must constantly be producing new root hairs







KEY FACTORS...

- Base Saturation of cations
- K/Mg Ratio
- o Boron, Zinc & other micros
- CEC (Cation Exchange Capacity)
- o pH & Buffer pH

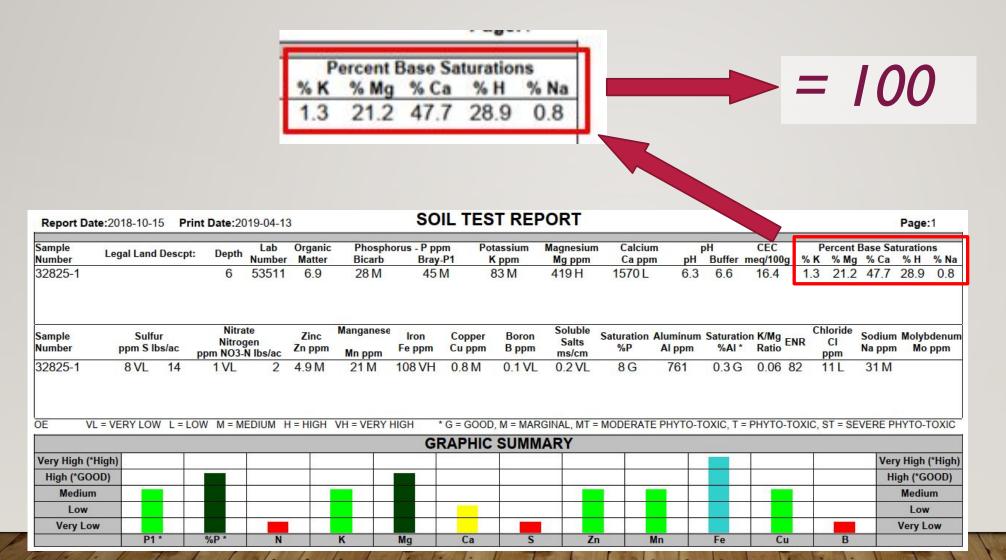
- Limited space on a soil particle
- o K, Mg, Ca, H & Na
- O How much of each is enough?
- o How much is too much?



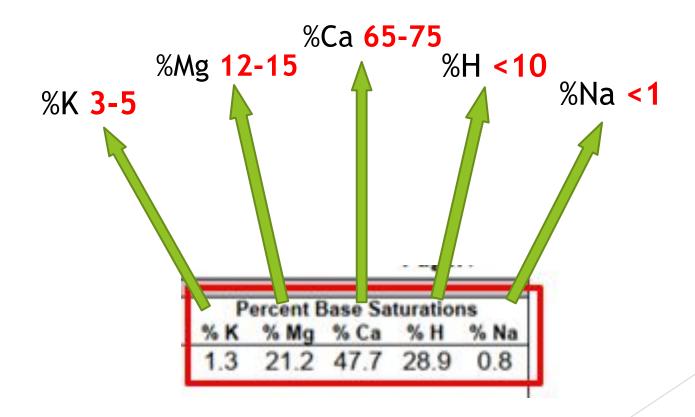
Who are your 'board' members?



- O Who is the dominant member?
- o Is the wrong member in charge?



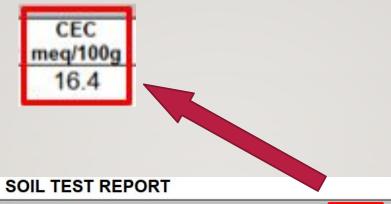
Ideal Ranges...



o C.E.C. (Cation Exchange Capacity)

%SATURATON CATIONS	0 - 6	7 - 15	16 - 25	25+
% K SAT	4 - 6	3-5	2 - 4	2 - 3
% Mg SAT	10 - 20	8 - 20	5 - 20	5 - 20
% Ca SAT	60 - 80	60 - 80	60 - 80	60 - 80

o C.E.C. (Cation Exchange Capacity)



Page:1

Sample	Land Land December	Danish	Lab	Organic	Phosphore	us - P ppm	Potassium	Magnesium	Calcium		Н	CEC	P	ercent E	Base Sa	turatio	ns
Number	Legal Land Descpt:	Depth	Number	Matter	Bicarb	Bray-P1	K ppm	Mg ppm	Ca ppm	pH	Buffer	meq/100g	% K	% Mg	% Ca	% H	% Na
32825-1		6	53511	6.9	28 M	45 M	83 M	419 H	1570 L	6.3	6.6	16.4	1.3	21.2	47.7	28.9	8.0

Sample Number	Sulfu ppm S lb		Nitrate Nitrogen ppm NO3-N lb	os/ac	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts ms/cm	Saturation %P	Aluminum Al ppm	Saturation %AI *	n K/Mg Ratio ENR	Chloride Cl ppm	Sodium I Na ppm	Molybdenum Mo ppm
32825-1	8 VL	14	1 VL	2	4.9 M	21 M	108 VH	M 8.0	0.1 VL	0.2 VL	8 G	761	0.3 G	0.06 82	11 L	31 M	

OE VL = VERY LOW L = LOW M = MEDIUM H = HIGH VH = VERY HIGH * G = GOOD, M = MARGINAL, MT = MODERATE PHYTO-TOXIC, T = PHYTO-TOXIC, ST = SEVERE PHYTO-TOXIC

					G	RAPHIC	SUMMAR	RY					
Very High (*High)			6	32									Very High (*High
High (*GOOD)	10.0												High (*GOOD)
Medium													Medium
Low			N.						-				Low
Very Low													Very Low
	P1 *	%P *	N	K	Mg	Ca	S	Zn	Mn	Fe	Cu	В	

o C.E.C. (Cation Exchange Capacity)

- Indicates soil texture
- High CEC more clay
- Low CEC more sand
- Helps determine nutrient holding capacity

o Hydrogen (H)

- Too much is NOT good
- Need small amount only <10%
- Torching effect on root tips
- Occurs naturally from rood growth & manure and fertilizer applications

o Sodium (Na)

- Too much is NOT good
- Need small amount only <1%
- Often associated with irrigation water or high water table

PRIMARY NUTRIENTS

Nitrogen (N) -

is needed for vegetative growth and dark green color. (easily leached out)

Nitrogen is the most important nutrient.

<u>Deficiency signs</u> –

reduced growth & yellowing of lower leaves.

Yellowing is called **Chlorosis**

NITROGEN BALANCED FERTILITY N:K RATIO

- Ratio N:K in Early season 1:3 progressing to a ratio through the season of 1:1
- Developed countries in the 60's and 70's fairly balanced at 1:0.8 to a current N:K use of 1:0.36
- Developing countries little change 1:0.10 –1:0.13 except South America has increased to 1:0.96 because of the response soybeans have to K

TOO MUCH **NITROGEN**

 Leaf Nitrogen level affects plant susceptibility.

 Pathogens such as mildew target plant cells with high Nitrate Nitrogo

 High N content produce walls & poor d:

Nit plar

• Ensu Sulpi



o Nitrogen (N)

Hands-On Agronomy... Neil Kinsey

Nitrogen drives out calcium. When the soil is open and nitrates leach out and go with the water, it is never a solo journey. It always takes along a passenger. If there is a cache of sodium, nitrogen may take sodium. Otherwise it takes calcium. Nitrogen never takes out magnesium, but as nitrogen leaches downward, the passenger status of calcium is assured. If calcium levels are excessive, this may be a solution of sorts. There is a corollary. For every percent calcium taken out by nitrogen, magnesium goes up 1%. Removal of 10% calcium by a nitrogen over-supply will increase the magnesium level by 10%. This is one reason nitrogen from anhydrous ammonia has a reputation for tightening soils.

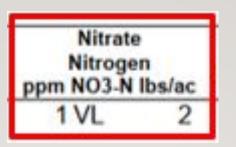
In the area where I live, some of the soils are light sands. Many farmers still use anhydrous. Anhydrous (NH₄) was introduced in the southeast Missouri area by 1955. By 1965 most farmers had quit using it on their heavy black soil. Farmers concluded that anhydrous use made the soils harder.

Hands-On Agronomy

o Nitrogen (N)

VL = VERY LOW L = LOW M = MEDIUM H = HIGH VH = VERY HIGH

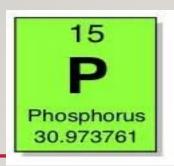
OE



* G = GOOD, M = MARGINAL, MT = MODERATE PHYTO-TOXIC, T = PHYTO-TOXIC, ST = SEVERE PHYTO-TOXIC

			A17 100	00000 000		A41.57			Control of the	No. of the latest		10000						
Sample Number	Legal Land Descr	t: Depth	Lab Number	Organic Matter	ospho	rus - P pp Bray		otassium K ppm	Magnesium Mg ppm	Calciui Ca ppr	5-200	pH Buffer	CEC meq/100g	% K		Base Sat % Ca	turation % H	ns % Na
32825-1		6	53511	6	28 M	451	M	83 M	419 H	1570 L	6.3	6.6	16.4	1.3	21.2	47.7	28.9	0.8
Sample Number	Sulfur ppm S lbs/ac	Nitra Nitro ppm NO3-	gen	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts ms/cm	Saturation %P	Aluminum Al ppm	Saturatio	on K/Mg Ratio	NR .	loride CI opm	Sodium Na ppm		denu ppm

GRAPHIC SUMMARY Very High (*High) Very High (*High) High (*GOOD) High (*GOOD) Medium Medium Low Low **Very Low** Very Low P1 * Ca Zn Fe Cu В



PHOSPHORUS

- Phosphorus plays a crucial role in the reproduction of seed plants.
- It promotes rapid root growth.
- Unlike nitrogen, phosphorus is very immobile in soil. However, since a large portion of a plant's phosphorus is found in seeds and fruit, the soil must be replenished annually.
- Deficiency symptoms include a purple tinge to the leaves.

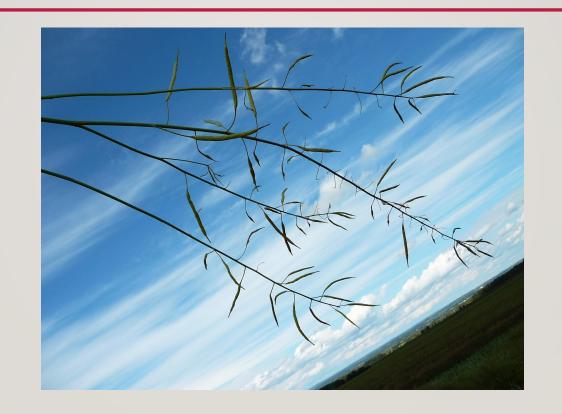
PRIMARY NUTRIENTS IN AGRICULTURE

- 2. Phosphorus (P) important for seedling and young plant growth and develop good root system. (not easily leached out)
- AKA Party Animal
- Deficiency signs reduced growth, poor
 root systems, reduced
 flowering. Also thin
 stems and browning or
 purpling of foliage.





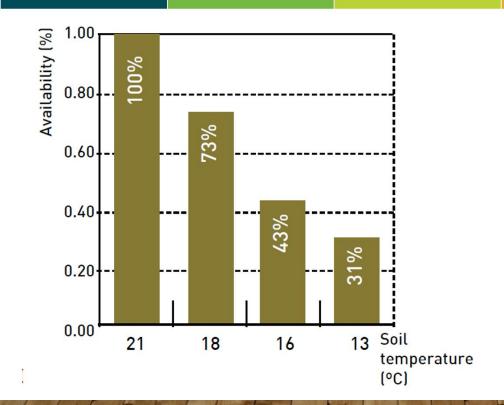
LOW MG, HIGH K ADDITION LEADING TO PHOS DEFICIENCY



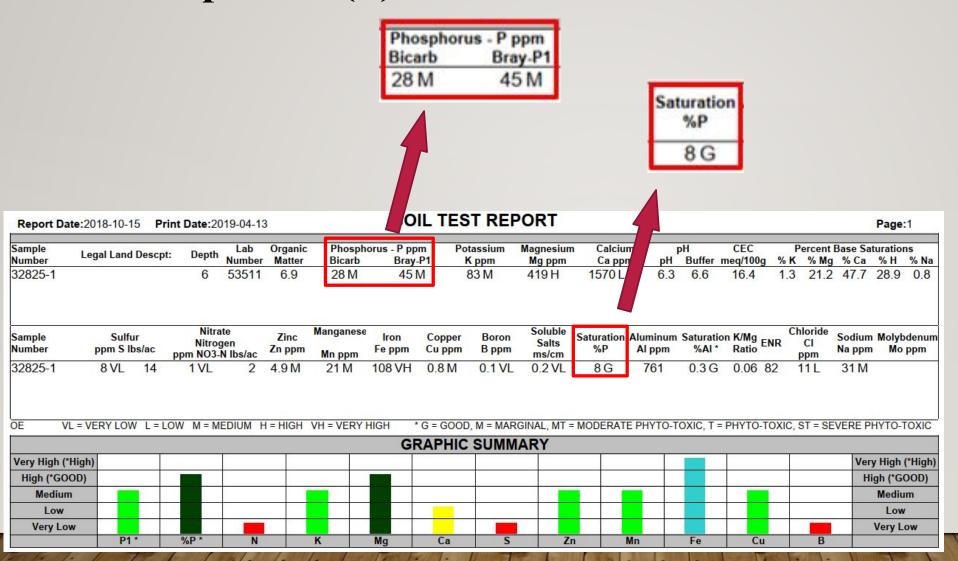
PHOSPHATE



A Drop from 21 Degree's C to 13 Degree's C Reduces Phosphorus Availability by almost 70%



o Phosphorus (P)



Potassium (K)

BENEFITS

- 1. Yield potential
- 2. Stalk strength, lodging resistance
- 3. Improves winter hardiness
- 4. Protein production
- 5. Carbohydrate production; sugar translocation
- 6. Enzyme functions
- 7. Cell division

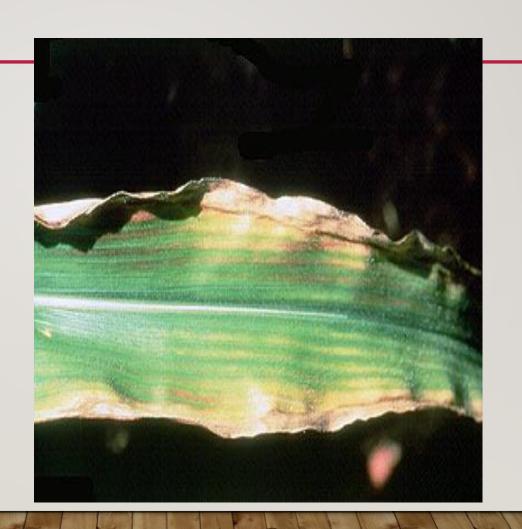
IDEAL BALANCE

3-5% Saturation

Potassium (K)

 can be leached (if sandy, acid soils)

- Deficiency signs
 - reduced growth, shortened internodes and some burn, scorched marks (brown leaves).
- Too Much (K) can cause nitrogen or Mg deficiency.

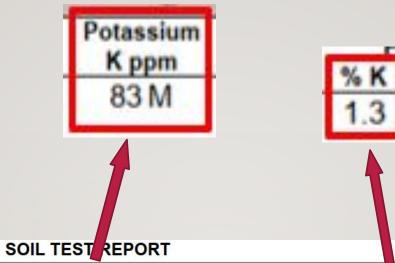


POTASSIUM DEFICIENCY

- Determines rate of chemical reactions
- High K in soilsolution = High K inplants
- Deficiency appears in older leaves first



o Potassium (K)



Report Da	ate:2018-10-15 Print	Date:2	019-04-13	3		SOILT	ESTRE	PORT								Page:	:1
Sample	Legal Land Descpt:	Depth	Lab	Organic	Phosphoru	ıs - P ppm	Potassium	Magnesium	Calcium		Н	CEC	-			aturation	ns
Number	Legal Land Descht.	Deptil	Number	Matter	Bicarb	Bray-P1	K ppm	Mg ppm	Ca ppm	pН	Buffer	meq/100g	% K	% Mg	% Ca	% H	% Na
32825-1		6	53511	6.9	28 M	45 M	83 M	419 H	1570 L	6.3	6.6	16.4	1.3	21.2	47.7	28.9	8.0

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32825-1	8 VL	14	1 VL	2	4.9 M	21 M	108 VH	M 8.0	0.1 VL	0.2 VL	8 G	761	0.3 G	0.06 82	11 L	31 M	

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					G	RAPHIC	SUMMAF	RY					
Very High (*High)					Ĭ.								Very High (*High
High (*GOOD)													High (*GOOD)
Medium													Medium
Low													Low
Very Low													Very Low
	P1 *	%P *	N	K	Mg	Ca	S	Zn	Mn	Fe	Cu	В	

Magnesium

BENEFITS

- 1. Key element in chlorophyll
- 2. Protein production
- 3. Enzyme functions
- 4. Energy release in cells
- 5. Aids phosphorus uptake
- 6. Oil formation
- 7. Starch translocation

IDEAL BALANCE

12-15% Saturation

(240 X C.E.C. X %saturation/200 = ppm)

BEST SOURCES

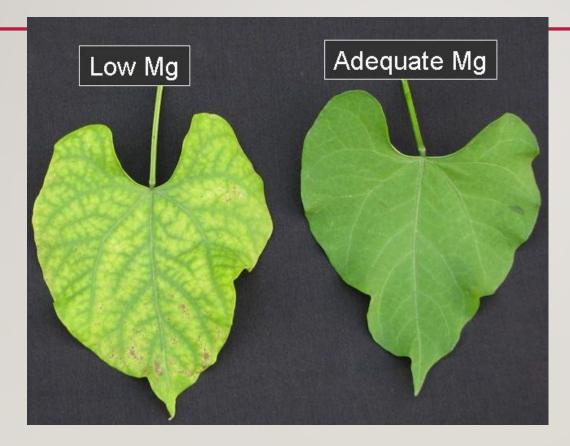
Magnesium Sulfate (Mg 9%, S 12%)

Sul-Po-Mag (0-0-22-22S -11Mg)

COMMENTS

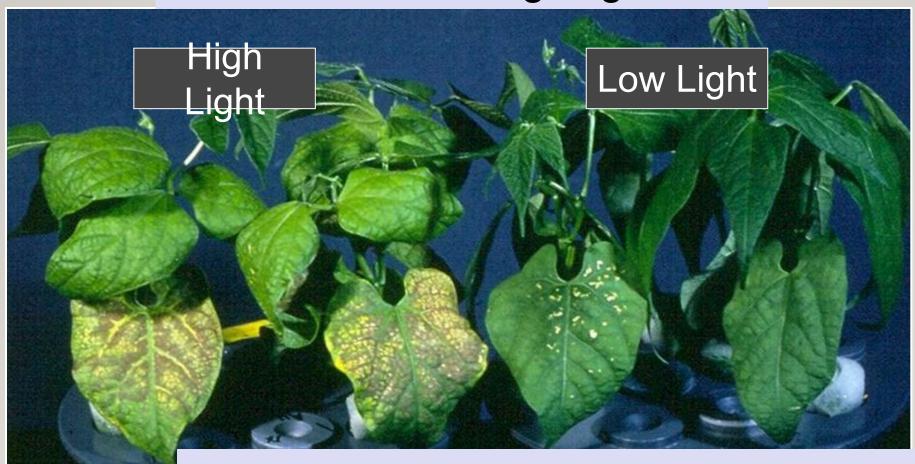
- An excess can cause problems:
 - Tightens soil
 - Hard to balance soil
 - Ties up potassium
 - Reduces nitrogen utilization

LEAF YELLOWING IN THE FORM OF INTERVEINAL CHLOROSIS ON OLDER LEAVES IS VERY CHARACTERISTIC FOR MG DEFICIENCY IN CROPPLANTS



Up to 35% of the total Mg in plants is bound in chloroplasts

Mg-deficient plants highly sensitive to high light



Bean plants grown at low Mg supply

o Magnesium (Mg)

Report Date:	2018-10-1	15 Pri	nt Date:20	019-04-1	3		SO	L TES	ST REP	PORT							Page:1
Sample Number	Legal Land	Descpt	Depth	Lab Number	Organic Matter	Phospho Bicarb	orus - P ppi Bray-		otassium K ppm	Magnesium Mg ppm	Calciui Ca ppr	9.329	pH Buffer n	CEC neq/100g	Percent % K % Mg		turations % H % Na
32825-1			6	53511	6.9	28 M	45 N	И	83 M	419 H	1570 L	6.3	6.6	16.4	1.3 21.2	47.7	28.9 0.8
Sample Number	Sulfu ppm S II		Nitro Nitro ppm NO3-	gen	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts ms/cm	Saturation %P	Aluminum Al ppm	Saturation %Al *	n K/Mg Ratio	Chloride R Cl ppm	Sodium Na ppm	Molybdenu Mo ppm
32825-1 DE VL=	8 VL	14 N 1 = 10	1 VL	2 IEDIUM I	4.9 M	21 M VH = VERY I	108 VH	0.8 M	0.1 VL	0.2 VL	8 G	761	0.3 G	0.06 82	2 11 L	31 M	HYTO-TOXIC
	72111 201								SUMM								
Very High (*Hig	jh)				2											Ver	y High (*High
High (*GOOD)													40.00		Hi	gh (*GOOD)
Medium																	Medium
Low					î î						1						Low
Very Low																	Very Low
	P1	*	%P *	N		K	Ma	Ca	S	7r		Mn	Fe	Cu	B		

Calcium

BENEFITS

- 1. Improves soil structure
- 2. Stimulates soil microbes & earthworms
- 3. Mobilizes nutrients into plant
- 4. Increases nitrogen utilization, protein content
- 5. Root & leaf growth
- 6. Cell division
- 7. Builds cell walls
- 8. Enzyme function
- 9. Increases sugar content of plant
- 10. Promotes overall plant health
- 11. High quality grain or fruit

IDEAL BALANCE

70-80% Saturation

(400 X C.E.C. X %saturation/200 = ppm)

Side note...

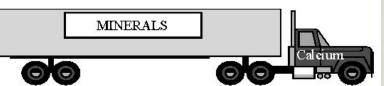
Ca = cement

Cu = rebar

B = mortar

COMMENT

The trucker of all nutrients



CALCIUM

- 4pH
- 4 Cell Division and Elongation
- 4 Cell Wall
- 4 Proper Working and Permeability of Cell Membranes
- 4 Root Growth/and root function
- **4** Storage Quality and Disease resistance
- 4 Healthy Soils Require Calcium

o Calcium (Ca)

Report Da	te:2018	-10-1	5 P r	rint Date	2019-04-1	3		so	IL TE	ST REF	PORT							1	Page:	1
Sample Number	Legal	Land	Descp	t: Dep	th Lab	Organic Matter	Phospho Bicarb	orus - P pp Bray-		otassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	pH pH Bi	uffer n	CEC neq/100g			Base Sati		
32825-1				6	53511	6.9	28 M	451	M	83 M	419 H	1570 L	6.3	6.6	16.4	1.3	21.2	47.7	28.9	8.0
Sample Number	pp	Sulfu m S lb		Nit	trate rogen 3-N Ibs/ac	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Coppe Cu ppr		Soluble Salts ms/cm	Saturation Alu %P A	uminum Sa	turation %Al *	n K/Mg Ratio	IR		Sodium Na ppm		denur ppm
32825-1 DE VI	8 L = VER	VL	14	1 VI	2	4.9 M	21 M VH = VERY H	108 VH	0.8 M		0.2 VL	8 G MODERATE P).3 G	0.06 8		1L	31 M	IVTO T	OVIC
JL VI	L - VLR	LOW	L - L	OW W -	WILDIOW	II = IIIGII	VII - VERTI			C SUMM		- WODERATE P	11110-1081	10, 1 -	FIII 10-10	JAIC, 3	1 - 3L	VLKL FI	1110-1	OXIC
Very High (*	High)													7		1		Very	High ((*High
High (*GO	OD)	400																Hig	gh (*GC	OOD)
Medium	1																		Mediu	m
Low										Ĭ									Low	23.
Very Lov	w																	1	ery Lo	ow

Sulfur

Main Function in Plants

- Constituent of proteins
- Involved in respiration
- Involved in nodule formation

Primary Sources

Soil organic matter & Rainwater

Sulfur

BENEFITS

- 1. More useable protein (high quality, complete)
- 2. Makes soil nitrogen more available
- 3. Loosens, aerates soil
- 4. Reduces excess soil magnesium
- Lowers soil pH
- 6. Energy release in cells
- 7. Part of vitamin B₁ & biotin

IDEAL BALANCE

50 ppm or 100#per acre

BEST SOURCES

Bio-Cal (5%S)

Ferti-Cal (5%S)

Huma-Cal (5%)

Ammonium Sulfate (21-0-0-24S)

Calcium Sulfate (gypsum) (Ca 23%, S 17%)

Potassium Sulfate (0-0-50-17S)

Sulfate Trace Minerals

COMMENTS

- Sulfur builds humus
- Needs to be present in a 10:1 ratio of N:S
- Sulfur helps make deep green plants

o Sulphur (S)

Report Dat	te:2018-10-15 Pri	nt Date:20	019-04-13	3		SO	IL TE	ST REF	PORT							Page:	1
Sample	Legal Land Descpt	Depth	Lab	Organic Matter	Phospho	orus - P pp		otassium	Magnesium		0.000	pH	CEC		Base Sa		
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Sample Number	Sulfur ppm S lbs/ac	Nitro Nitro ppm NO3-	gen	Zinc Zn ppm	Manganese	Iron Fe ppm	Copper Cu ppm		Soluble Salts ms/cm	Saturation A	Aluminum Al ppm	Saturatio %Al *	n K/Mg Ratio EN	Chloride R Cl	Sodium Na ppm	Molybo Mo	
32825-1	8 VL 14								0.2 VL	8 G	DUNTO T	0.3 G			31 M		
DE VL	. = VERY LOW L = LO	JW M=M	EDIUM F	H = HIGH	VH = VERY	HIGH *	G = GOC	D, M = MAR	GINAL ML =								.)X(
						GF	RAPHI	C SUMM		WODERATE	PHT10-1	OXIC, I =	PH110-10	/AIC, ST = SI	LVLKL	1110-11	
Very High (*I	ligh)		I	- E		GF	RAPHI	CSUMM		MODERATE	PH110-1	OXIC, I -	PH110-10)XIC, S1 - Si		y High (
Very High (*I High (*GOO						GF	RAPHI	CSUMM		MODERATE	PHT 10-1	OXIC, 1 -	PHT10-10	JAIC, 51 - 5	Ver		Hig
	OD)	ī				GF	RAPHI	CSUMM		WODERATE	PHYTO-I	OXIC, T -	PHT10-10	JAIC, 51 – 5	Ver	y High ('	Hig OD)
	OD)	I				GF	RAPHI	CSUMM		WODERATE	PHYTO-I	OXIC, T =	PHT10-10	7410, 31 – 31	Ver	y High (* gh (*GO	Hig OD)

KEY MICRO-NUTRIENTS...

Zinc

- Is important for early root development.
- No zinc = plant cannot complete life cycle
- Very important in human health!

Crop	No. of Experiments	Range of Response (bu/A)	Average Response (bu/A)
Wheat	686	0-28.8	5.34
Rice	250	0-107.70	18.83
Corn	257	0-54.17	11.31
Barley	7	2.04-15.02	6.31
Oats	3	2.79-22.89	10.6

ZINC – FOR GROWTH, HEALTH & REPRODUCTION

Insufficient uptake

- Chlorosis of mid-leaf region, leading to grey-white patches.
- Stunted plants, short internodes, few tillers.
- Poor root development & microbial colonisation (PGPRb).
- Poor flowering, seed set & finishing.

Induced by

- Excessive Ca, P, Cu
- Deficient Mg, S, Zn

Action

- Soil applied as oxysulphate with carrier
- Foliar Mn (with Zn, Mg, S)



coilcolutiona @man co

ZINC

- •Zinc deficiencies typically show up on poorly drained, sandy, low organic matter, very high organic matter or badly eroded soils.
- Typically as pH increases Zinc availability decreases.
- High applications of phosphorous can cause deficiencies
- •Plays an important role in plant growth regulation and root formation.



Terminal growth areas are effected first.

Zinc

BENEFITS

- 1. Contributes to test weight
- 2. Increases ear size in corn
- 3. Promotes silking in com
- 4. Hastens maturity
- 5. Chlorophyll formation
- 6. Enzyme functions
- 7. Regulates plant growth
- 8. Increases plant leaf size.

IDEAL BALANCE

5+ppm or 10#per acre

COMMENT

Extremely important in phosphorus uptake and utilization within the plant.

o Zinc...

High (*GOOD)

Medium

Low Very Low

Report D	Date:2018-10-15	Print Date:2	2019-04-1	3		SO	IL IE	ST REF	OKI								Page:	1
Sample Number	Legal Land Des	scpt: Dept	Lab Number	Organic Matter	Phospho Bicarb	orus - P pp Bray		otassium K ppm	Magnesium Mg ppm	Calciun Ca ppm	9,900	pH Buffer	CEC meq/100g	% K	1 72 5 5 5	Base Sat	77.00	s % Na
32825-1		6	53511	6.9	28 M	451	M	83 M	419 H	1570 L	6.3	6.6	16.4	1.3	21.2	47.7	28.9	0.8
Sample Number	Sulfur ppm S lbs/a	Nitro	rate ogen 3-N lbs/ac	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm		Soluble Salts ms/cm	Saturation %P	Aluminum Al ppm	Saturatio	on <mark>K/Mg</mark> Ratio	C NR	hloride Cl ppm	Sodium Na ppm	-	
32825-1	8 VL 1	4 1VL	2	4.9 M	21 M	108 VH	M 8.0	0.1 VL	0.2 VL	8 G	761	0.3 G	0.06 8	32	11 L	31 M		
DE	VL = VERY LOW L	= LOW M=1	MEDIUM H	H = HIGH	VH = VERY I			Á	GINAL, MT =	MODERATE	PHYTO-T	OXIC, T =	PHYTO-T	OXIC,	ST = SE	VERE PI	HYTO-T	OXIC
						C	уурыг	SUMM	NDV									

Zn

Mn

Fe

Cu

High (*GOOD)

Medium Low

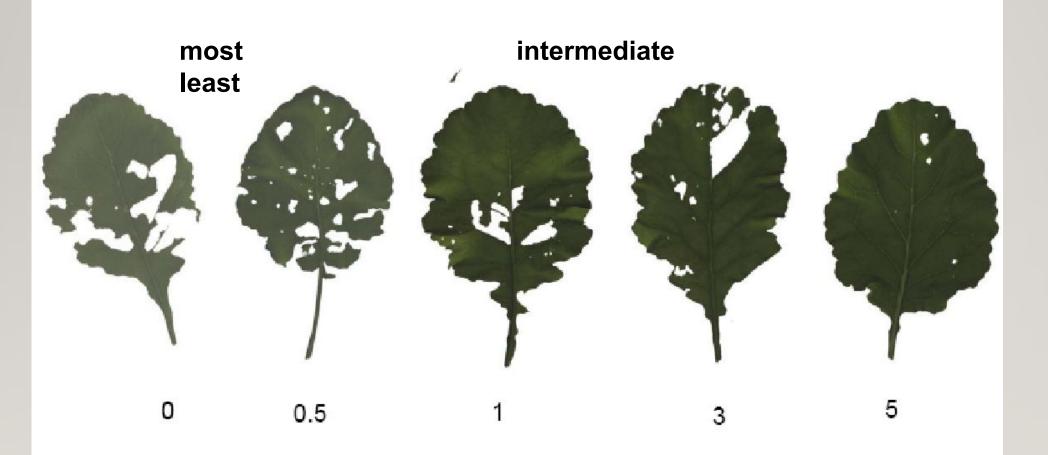
Very Low

KEY MICRO-NUTRIENTS...

Boron

- Key role in nodulation.
- o Plays structural role in cell wall
- Low boron limited Ca uptake
- o If Ca is the truck, boron is the driver
- Crucial during seed-set
- O Moves sugars in plant!

Herbivory



Boron in animal & human health...

Recent research has shown that boron plays a role in animal metabolism and it has been predicted that it is only a matter of time before boron's essentiality in animals is completely established (Nielsen, 1996) Research has shown a link between higher boron consumption and lower prostate cancer in men. When men were divided into quartiles based on their consumption of boron, the men in the highest quartile of boron consumption had a 61% lower risk of developing prostate cancer." Boron has also been shown in vitro to inhibit certain breast cancers and prostate cancers (Zhang, 2001).

Boron's role in plant physiology

Root elongation and Nucleic acid metabolism

One of the most rapid responses to boron deficiency is inhibition or cessation of root elongation, giving the roots a stubby and bushy appearance. Timing studies showed that cessation of root elongation occurs as soon as 3 hours after the boron supply is interrupted and becomes more severe after 6 hours and finally comes to a halt after 24 hours. After the boron supply is restored root elongation becomes rapid again. Between 6-12 hours there is a dramatic increase in the activity of IAA oxidase in the roots which falls rapidly when boron is resupplied (Marschner, 1995).

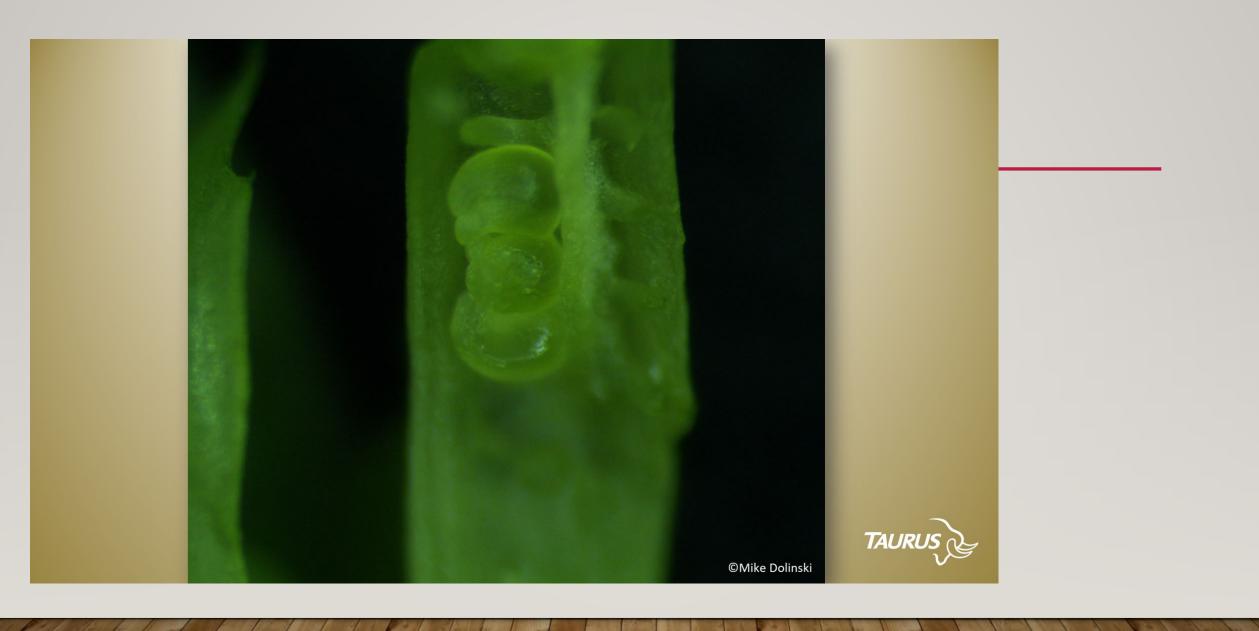
There is a general agreement among scientists that when boron is withdrawn there is both a decrease in the rate of cell division and an inhibition in elongation growth.

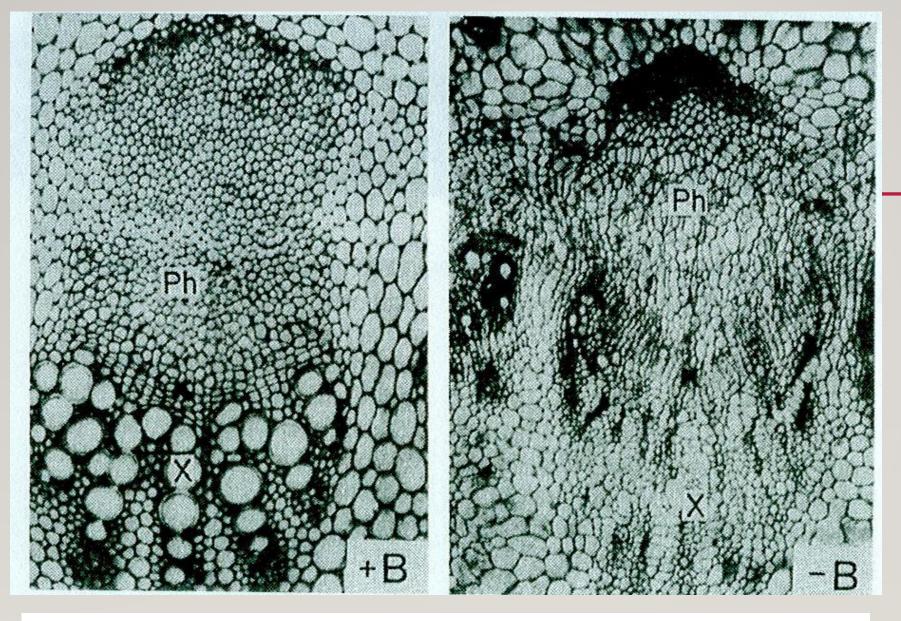
It is well documented that there is a decrease in DNA content and rate of DNA synthesis when boron is withheld (Marschner, 1995).

o Boron...

o Need to be over 1ppm...over 2 is better

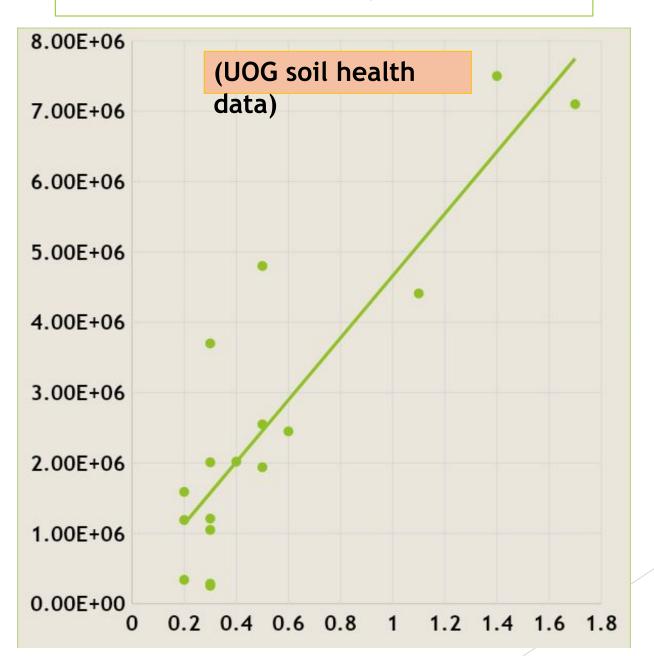
Report Date	:2018-10-15 Pri	nt Date:20	019-04-13	3		SOI	IL TES	TREP	ORT								Page:	1
Sample	Legal Land Descpt:	Depth	Lab	Organic		orus - P ppr		assium	Magnesium			H	CEC	TOURS SHEET TO	cent Ba	100000		100000000000000000000000000000000000000
Number 32825-1		6	53511	Matter 6.9	Bicarb 28 M	Bray-I 45 N		ppm 3 M	Mg ppm 419 H	Ca ppm 1570 L	рН 6.3	6.6	16.4		6 Mg 9 21.2			0.8
Sample Number	Sulfur ppm S lbs/ac	Nitra Nitrog ppm NO3-	gen	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts ms/cm	Saturation Al	uminum Al ppm	Saturatio	n K/Mg Ratio	Chlo	N.	odium a ppm	-	
32825-1	8 VL 14	1 VL	2	4.9 M	21 M	108 VH	0.8 M	0.1 VL	0.2 VL	8 G	761	0.3 G	0.06 8	2 11	L 3	31 M		
OF VL=	= VERY LOW L = LC	DW M = M	EDIUM H	H = HIGH	VH = VERY H	IIGH *	G = GOOD	M = MAR	GINAL MT =	MODERATE F	НҮТО-Т	OXIC. T =	PHYTO-T	OXIC ST	= SEVE	ERE PH	IYTO-T	OXIC
DE VL =	= VERY LOW L = LO	DW M=M	IEDIUM F	H = HIGH	VH = VERY H		G = GOOD,			MODERATE F	НҮТО-Т	OXIC, T =	РНҮТО-Т	OXIC, ST	= SEVE	ERE PH	IYTO-T	OXIC
		OW M = M	IEDIUM F	H = HIGH	VH = VERY H					MODERATE F	РНҮТО-Т	OXIC, T =	PHYTO-TO	OXIC, ST	= SEVE		HYTO-T	
Very High (*High (*GOOD	igh)	OW M = M	IEDIUM F	H = HIGH	VH = VERY I					MODERATE F	PHYTO-T	OXIC, T =	РНҮТО-Т	OXIC, ST	= SEVE	Very		High
Very High (*Hi	igh)	OW M = M	IEDIUM F	H = HIGH	VH = VERY I					MODERATE F	PHYTO-T	OXIC, T =	РНҮТО-Т	OXIC, ST	= SEVE	Very	High (High
Very High (*High High (*GOOD	igh)	M = M WC	TEDIUM F	H = HIGH	VH = VERY F					MODERATE F	PHYTO-T	OXIC, T =	PHYTO-To	OXIC, ST	= SEVE	Very	High (High





In boron-sufficient plants (left) vs boron-deficient plants (right) cell expansion continues in the phloem and xylem but not cell differentiation

Rhizobium vs Soil Boron



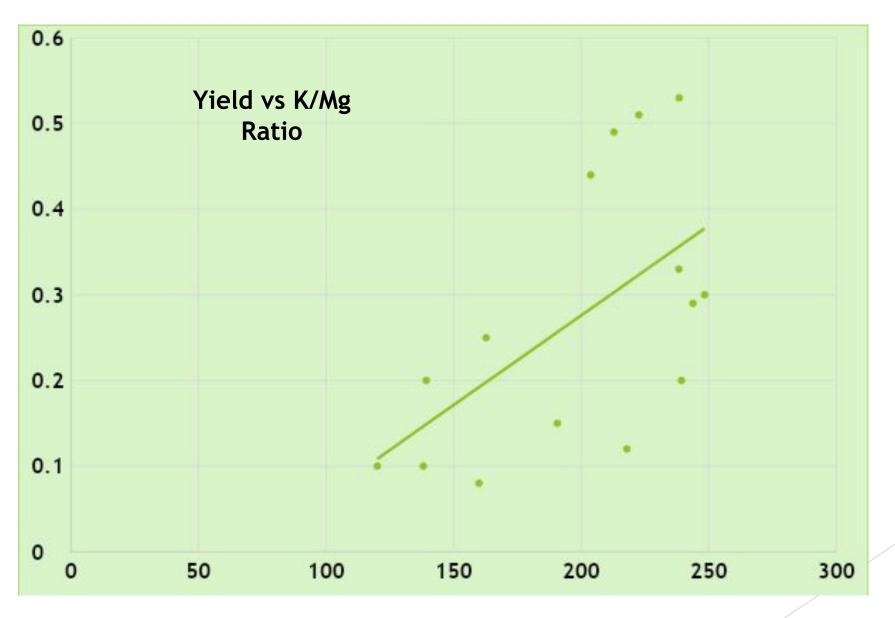
o K/Mg Ratio

- o % K divided by % Mg
- o Ideal... 0.25 to 0.35

SOIL TEST REPORT Report Date:2018-10-15 Print Date:2019-04-13 Page:1 Sample Organic Phosphorus - P ppm Potassium Magnesium Calcium Percent Base Saturations Legal Land Descpt: pH Buffer meq/100g %K %Mg %Ca %H %Na Number Number Matter Bray-P1 Bicarb K ppm Mg ppm Ca ppm 32825-1 53511 6.9 28 M 45 M 83 M 419 H 1570 L 16.4 1.3 21.2 47.7 28.9 0.8 Soluble **Nitrate** Chloride Saturation Aluminum Saturation K/Mg Zinc Sodium Molybdenum Sulfur Boron Sample Copper CI Nitrogen Salts %AI * Na ppm Mo ppm Number ppm S lbs/ac Ratio Zn ppm Fe ppm Cu ppm B ppm ppm NO3-N lbs/ac ms/cm ppm 32825-1 8 VL 14 4.9 M 108 VH 0.8 M 0.1 VL 0.2 VL 8 G 761 0.3 G 0.06 82 11 L 31 M

					(RAPHIC	SUMMAR	?Y					
Very High (*High)				3					45				Very High (*High
High (*GOOD)													High (*GOOD)
Medium													Medium
Low													Low
Very Low													Very Low
	P1 *	%P *	N	K	Mg	Ca	S	Zn	Mn	Fe	Cu	В	

Identified low producing sites of 2015, based on NDVI



o Manganese...

- Natural disease fighter
- Plays key role during early stages of disease pressure

Report Dat	te:2018-10-15	Print Date:2	019-04-1	3		SO	IL TE	ST REF	ORT							Pag	e :1
Sample Number	Legal Land Des	scpt: Depth	Lab Number	Organic Matter	Phospho Bicarb	orus - P ppi Bray-		Potassium K ppm	Magnesium Mg ppm	Calciu		pH Buffer	CEC meg/100g		rcent Base		
32825-1		6	53511	6.9	28 M	45 N		83 M	419 H	1570 L	6.3	6.6	16.4		21.2 47		
Sample Number	Sulfur ppm S lbs/a	Nitro Nitro	gen	Zinc Zn ppm	Manganese	Iron Fe ppm	Coppe Cu ppr		Soluble Salts	Saturation %P	Aluminum Al ppm	Saturatio	n K/Mg Ratio	Chle		ium Moly	/bdenun o ppm
32825-1	8 VL 1	ppm NO3	-N lbs/ac 2	4.9 M	Mn ppm 21 M	108 VH	0.8 M		0.2 VL	8 G	761	0.3 G	0.06	•	1 L 31	1100	- Pp
	<u> </u>																
OE VL	. = VERY LOW L	= LOW M = N	IEDIUM F	H = HIGH	VH = VERY F			OD, M = MAR		MODERATI	E PHYTO-T	OXIC, T =	РНҮТО-Т	roxic, s	T = SEVER	E PHYTO	-TOXIC
Very High (*H	High)	T	I							1			1		T	Very Hig	h (*High)
High (*GOO																High (*	
Medium									1					1		Med	ium
																	ium
Low																Lo	

o pH

- Soil pH measures hydrogen ion activity
- It indicates acidity of the soil solution (active acidity)
- Or, the total amount of Hydrogen in the soil solution

o Buffer pH

- Buffer pH is a measurement of the amount of hydrogen ions which must be replaced and neutralized by liming
- It indicates the total acidity (active + reserve) of the soil
- o Or, the amount of Hydrogen on the soil particle

o pH & buffer pH

Very High (*High)

High (*GOOD)

Medium

Low

Very Low

Sample	Landline	1 D	Danath	Lab	Organic	Phosph	orus - P pp	m Po	tassium	Magnesium	n Calcium		Н	CEC		Percent	Base Sa	turation	ıs
Number	Legal Land	a Descpi	: Depth	Number		Bicarb	Bray-	P1 1	K ppm	Mg ppm	Ca ppm	pН	Buffer	neq/100	9 % K	% Mg	% Ca	% H	% N
32825-1			6	53511	6.9	28 M	451	M	83 M	419 H	1570 L	6.3	6.6	16.4	1.3	3 21.2	47.7	28.9	8.0
Sample	Sulf	fur	Nitra		Zinc	Manganese	Iron	Copper	Boron	Soluble Salts	Saturation Al	uminum	Saturatio	n K/Mg	END	Chloride Cl	Sodium	Molybo	denu
Number	ppm S	lbs/ac	Nitrog ppm NO3-		Zn ppm	Mn ppm	Fe ppm	Cu ppm	B ppm	ms/cm	%P	Al ppm	%AI *	Ratio	LINK	ppm	Na ppm	Mo	ppm
32825-1	8 VL	14	1 VL	2	4.9 M	21 M	108 VH	0.8 M	0.1 VL	0.2 VL	8 G	761	0.3 G	0.06	82	11 L	31 M		

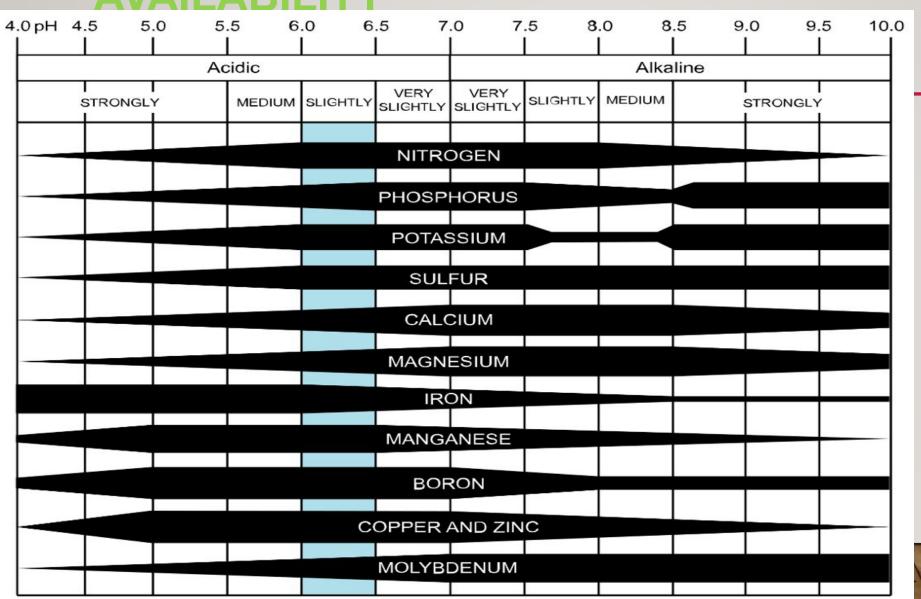
GRAPHIC SUMMARY

Very High (*High)

High (*GOOD) Medium

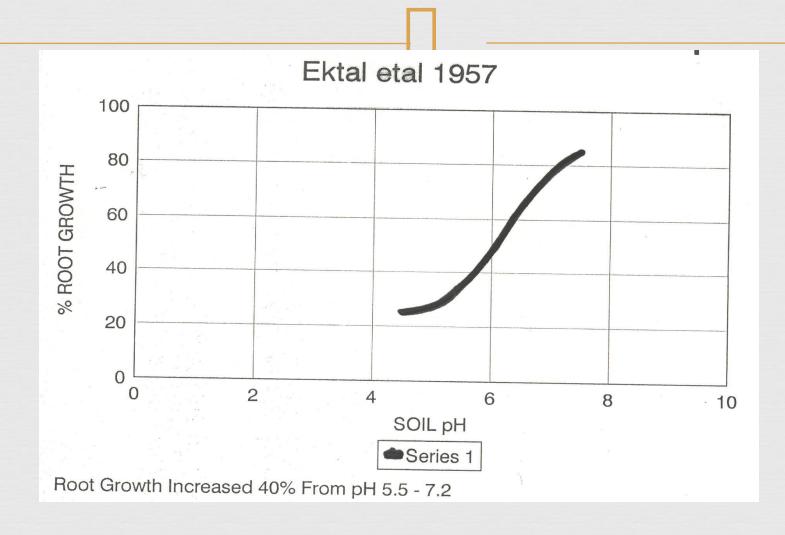
Low

PH EFFECT ON NUTRIENT AVAILABILITY



ROOT GROWTH AND SOIL pH





FERTILIZER EFFICIENCY

Soil pH		Fertiliz fficienc		% Fertilizer
	N	Р	K	Wasted
5.0	53	34	52	54
5.5	77	48	77	33
6.0	89	52	100	20
7.0	100	100	100	0

Dr. Cliff Snyder

OTHER ROLE PLAYERS...

Organic Matter (OM)

High (*GOOD)

Medium

Low

Very Low

Report	Date: 201	8-10-15	Pri	nt Date:20	19-04-1	3		SO	IL TE	ST REF	PORT								Page:	1
Sample Number	Lega	l Land (Descpt:	: Depth	Lab Number	Organic Matter	Phospho Bicarb	orus - P pp Bray		otassium K ppm	Magnesium Mg ppm	Calciur	9.70	pH Buffer	CEC meq/100g	, F		Base Sat	uration	ıs % Na
32825-1				6	53511	6.9	28 M	45	M	83 M	419 H	1570 L	6.3	6.6	16.4	1.3	21.2	47.7	28.9	8.0
Sample Number	pį	Sulfur om S lbs	clac	Nitra Nitrog ppm NO3-	jen	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Total Control of the	Soluble Salts ms/cm	Saturation %P	Aluminum Al ppm	Saturatio	on K/Mg Ratio	IR.	nloride Cl ppm	Sodium Na ppm	-	denum ppm
32825-1	8	3 VL	14	1 VL	2	4.9 M	21 M	108 VH	0.8 M	0.1 VL	0.2 VL	8G	761	0.3 G	0.06 8		11 L	31 M		
ŌE	VL = VER	RY LOW	L = L(OW M = M	EDIUM H	H = HIGH	VH = VERY I			Š.	RGINAL, MT =	MODERATE	PHYTO-T	OXIC, T =	PHYTO-TO	OXIC,	ST = SE	VERE PI	НҮТО-Т	OXIC
								GI	RAPHI	C SUMN	IARY									
Very High	(*High)																	Very	High (*High)

High (*GOOD)

Medium

Low Very Low

o Iron (Fe)

Medium

Low

Very Low

o Below 80ppm ideal

Report Date	e:2018-10-15 Pri	nt Date:20	19-04-13	3		SO	IL TE	ST REF	PORT								Page:	1
Sample Number	Legal Land Descpt	: Depth	Lab Number	Organic Matter	Phosph Bicarb	orus - P pp Bray		otassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	9.20	oH Buffer r	CEC neq/100g			Base Sat		s % Na
32825-1		6	53511	6.9	28 M	45	М	83 M	419 H	1570 L	6.3	6.6	16.4	1.3	21.2	47.7	28.9	8.0
Sample Number	Sulfur ppm S lbs/ac	Nitra Nitrog	gen	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm		Soluble Salts ms/cm	Saturation A	Aluminum Al ppm	Saturatio %Al *	n K/Mg Ratio	IR	(Sodium Na ppm	-	
32825-1	8 VL 14	1 VL	2	4.9 M	21 M	108 VH	0.8 M	0.1 VL	0.2 VL	8 G	761	0.3 G	0.06 8		1 L	31 M		
OE VL	= VERY LOW L = LO	OW M = M	EDIUM H	I = HIGH	VH = VERY			D, M = MAR		MODERATE	РНҮТО-Т	OXIC, T =	PHYTO-TO	OXIC, S	T = SE	VERE PH	т-оту	OXIC
Very High (*H	ligh)					0.	VAI IIII	COMM	IAIXI					T		Very	High (*High
High (*GOO	(D)															Hie	ah (*GC	IODI

Medium

o Copper (Cu)

Very High (*High)

High (*GOOD)

Medium

Low

Very Low

Sample	94 THE 224 L	_	4	Lab	Organic	Phosph	orus - P pp	m Po	tassium	Magnesium	Calcium	12 12	оН	CEC	P	ercent	Base Sa	turatio	ns
Number	Legal Land	Descpt	: Depth	Number	Matter	Bicarb	Bray-		(ppm	Mg ppm	Ca ppm	9.50		meq/100g	% K		% Ca	% H	% N
32825-1			6	53511	6.9	28 M	451	M	83 M	419 H	1570 L	6.3	6.6	16.4	1.3	21.2	47.7	28.9	8.0
Sample	Sulfi	ır	Nitra		Zinc	Manganese	Iron	Copper	Boron	Soluble	Saturation A	Muminum	Saturation	on K/Mg	Ch	loride	Sodium	Molyb	odeni
Number	ppm S I	os/ac	ppm NO3-		Zn ppm	Mn ppm	Fe ppm	Cu ppm	B ppm	Salts ms/cm	%P	Al ppm	%AI *	Ratio		CI	Na ppm	Mo	ppm
32825-1	8 VL	14	1 VL	2	4.9 M	21 M	108 VH	0.8 M	0.1 VL	0.2 VL	8 G	761	0.3 G	0.06 8		11 L	31 M		

GRAPHIC SUMMARY

Very High (*High)

High (*GOOD)

Medium

o Aluminum (Al)

Very Low

○ Over 400ppm – toxic to roots

Report D	Date:20	18-10-1	5 Pri	int Date:20	19-04-13	3		SO	IL TE	ST REF	PORT							Page:1
Sample Number	Leg	jal Land	Descpt	: Depth	Lab Number	Organic Matter	Phospho Bicarb	orus - P pp Bray		otassium K ppm	Magnesium Mg ppm	Calciur Ca ppr		pH Buffer	CEC meq/100g	STATE OF THE PARTY	t Base Sa g % Ca	turations % H % N
32825-1				6	53511	6.9	28 M	451	M	83 M	419 H	1570 L	6.3	6.6	16.4	1.3 21.3	2 47.7	28.9 0.8
Sample Number	-	Sulfu ppm S lb		Nitra Nitrog ppm NO3-	gen	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Coppe Cu ppn		Soluble Salts ms/cm	Saturation %P	Aluminum Al ppm	Saturatio %Al *	on K/Mg Ratio EN	Chloride R Cl ppm	Sodium Na ppm	Molybdenu Mo ppm
32825-1		8 VL	14	1 VL	2	4.9 M	21 M	108 VH	0.8 M	0.1 VL	0.2 VL	8 G	761	0.3 G	0.06 82	-	31 M	
DE	VL = VE	RY LOW	V L=L	OW M = M	EDIUM H	I = HIGH	VH = VERY H				GINAL, MT =	MODERATI	E PHYTO-T	OXIC, T =	РНҮТО-ТС	XIC, ST = S	EVERE P	нүто-тохіо
	(*11!L)				Į:			GI	KAPHI	C SUMM	ARY	1		_	1		14-	. 112-1- (*112-1
Very High		e.	-		6	35							1.5				A STATE OF THE PARTY OF THE PAR	y High (*High
High (*G				-								_					H	gh (*GOOD)
Mediu	ım																	Medium

o ENR (estimated N release)

Medium Low

Very Low

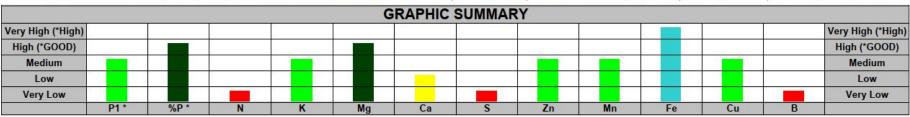
Report Da	ite:2018-10-15 P	rint Date:20	019-04-13	3		SO	IL TE	ST REF	PORT								Page:	1
Sample Number	Legal Land Descp	t: Depth	Lab Number	Organic Matter	Phosph Bicarb	orus - P pp Bray		otassium K ppm	Magnesium Mg ppm	Calcium	9.72	pH Buffer	CEC meq/100g			Base Sat		s % Na
32825-1		6	53511	6.9	28 M	451	M	83 M	419 H	1570 L	6.3	6.6	16.4	1.3	21.2	47.7	28.9	8.0
Sample Number	Sulfur ppm S lbs/ac	Nitra Nitro ppm NO3-	gen	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm		Soluble Salts ms/cm	Saturation A	Aluminum Al ppm	Saturation %AI *	on K/Mg Ratio	NR		Sodium Na ppm		
32825-1	8 VL 14	1 VL	2	4.9 M	21 M	108 VH	0.8 M	0.1 VL	0.2 VL	8 G	761	0.3 G	0.06		1 L	31 M		
OE V	L = VERY LOW L = I	LOW M = M	EDIUM H	H = HIGH	VH = VERY I			- 5		MODERATE	PHYTO-T	OXIC, T =	PHYTO-T	OXIC, S	T = SE\	VERE PI	НҮТО-Т	OXIC
			T.	F-1		GI	RAPHI	CSUMM	IARY				_					
Very High (*					-											A STATE OF THE PARTY OF THE PAR	High (
High (*GO	OD)							Į.								Hi	gh (*GC	(GO)

Medium

Low Very Low

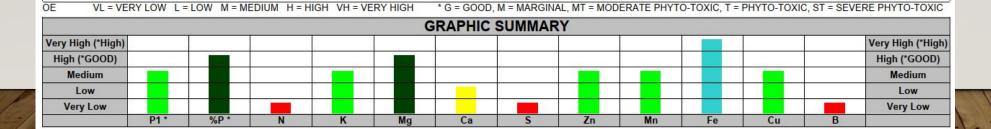
o Chloride (Cl)

Report I	Date:2018	3-10-1	5 Pri	nt Date:20	19-04-13	3		SO	IL TE	ST REF	PORT								Page:	:1
Sample Number	Lega	Land	Descpt:	Depth	Lab Number	Organic Matter	Bicarb	orus - P pp Bray		otassium K ppm	Magnesium Mg ppm	Ca ppn	n pH		CEC meq/100g	% K	% Mg	Base Sat	% H	% Na
32825-1				6	53511	6.9	28 M	45	M	83 M	419 H	1570 L	6.3	6.6	16.4	1.3	21.2	47.7	28.9	8.0
Sample Number	pp	Sulfu m S lb	oloo	Nitra Nitroo ppm NO3-	gen	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm		Soluble Salts ms/cm	Saturation %P	Aluminum Al ppm	Saturatio	on K/Mg Ratio	IR (oride Cl pm	Sodium Na ppm	-	denum ppm
32825-1	8	VL	14	1VL	2	4.9 M	21 M	108 VH	M 8.0	0.1 VL	0.2 VL	8G	761	0.3 G	0.06 8	2 1	1 L	31 M		
OE	VL = VER	Y LOW	' L = L(DW M = M	EDIUM H	I = HIGH	VH = VERY H			D, M = MAR	GINAL, MT =	MODERATE	PHYTO-T	OXIC, T =	PHYTO-TO	OXIC, S	T = SE	VERE PI	НҮТО-Т	OXIC



o Molybdenum (Mo)

Sample Sulfur Nitrate Zinc Manganese Iron Copper Boron Soluble Saturation Aluminum Saturation K/Mg Chloride Sodium Mc	
32825-1 6 53511 6.9 28 M 45 M 83 M 419 H 1570 L 6.3 6.6 16.4 1.3 21.2 47.7 28	STATE OF THE STATE
Sample Sultur Zinc Zinc Lopper Boron Saturation Aluminum Saturation K/Md Sodium Md	8.9 0.8
Number ppm S lbs/ac ppm NO3-N lbs/ac Zn ppm Mn ppm Fe ppm Cu ppm B ppm ms/cm %P Al ppm %Al * Ratio ppm Nog ppm	



PLANT TISSUE TESTING...

- O Why tissue test?
 - It compliments soil test
 - o Can confirm what soil is saying
 - o Inexpensive
 - Can expose hidden hunger

Barley - yellowing



PLANT TISSUE TESTING...

Report Number: 018192-50052 Account Number: 07219

Date Received:2018-07-11 Date Reported:

To: HEARTLAND SOIL SSG 560 SPRUCE ST

VANDERHOOF, BC YOU SAC

Attn: NORM DUECK

Actual Ratio

Expected Ratio

A & L Canada Laboratories Inc

2136 Jetstream Hoad, London, Ontaro, NoV 3H5 Telephone: (519) 457-2575 Fax: (519) 457-2664

PLANT ANALYSIS REPORT

For: Dupek, Norm

heid: MAIN 85 - LIANK

25.3

11.3

Farm: MAIN

Date Printed: 2018-07-12

Sample ID: 1

Flant Type, Barley

Growth Stage: Early - Pre Boot Stage

Plant Part Leaf

250-964-3775 Grawer Cade: 07219044

0.9

1.1

1.2

111

10.9

110

Date Sampled	Lab Number	Nitrogen (%)	Nitrate Vitragen	Sufur (%)	Phosphorus	Fotassium [%]	Nagnesium (%)	Calcium (%)	Socium (%)	Boson (ppm)	Zinc (ppm)	Hanganese (ppm)	iron (ppmi	(spm)	Aluminum (ppm)	Chlorida (%)
2018-07-07	1920143	5.02	0.4048	0.46	0.50	5.52	0.22	0.98	0.09	11,11	53	40	152	7.08	22	-
Normal 5	lange	2.50 5.50		0.30	0.35	3.00 5.50	0.20	0.30		7 20	20 60	30 100	50 150	7 15		
		N/S	N/K	P.S	9/Z1	K/Mg	K/Wn	Fe/Ma	Ca/B							

Nutrient Sufficiency Ratings

882

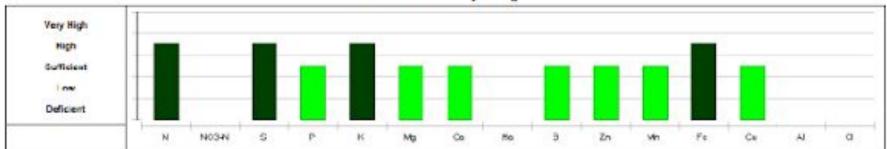
500

3.8

1.1

1387

825



- A&L recommends a foliar application when Mg, B, P, Zn or Mn are low or deficient at this plant stage. Follow the recommended product label rates.
- A&I. Recommends a followup tissue sample "4 days after foliar treatment to monitor progress.

PLANT TISSUE TESTING...

Report Number: 010192-50052 Account Number: 07219 A & L Canada Laboratories Inc

2130 Jeistream Road, London, Omaro, NSV 3P5 Telephone. (519) 457-2575 hax: (519) 457-2564



Date Received: 2018-07-11 Date Reported:

PLANT ANALYSIS REPORT

For: Dueck, Norm

Field, MAIN 85 - LIGHT Farm: MAIN Sample ID: 2

Plant Type: Barley

Growth Stage: Early - Pre Boot Stage

Date Frieted: 2018-07-12

Plant Part: Leaf

To: HEARTLAND SOIL SSG 560 SPRUCE ST

VANDERHOOF, BC VOJ 3AC

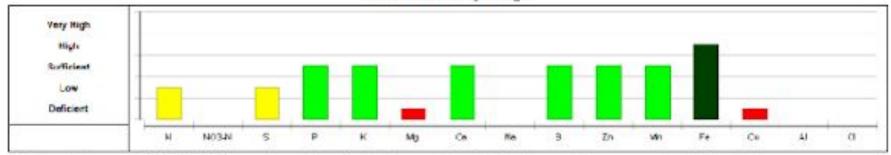
Attn: NORM DUECK 250 984-0775

Grawer Cade: 07219044

Date Sampled	Lab Number	Nitrogen (%)	Nitrate Mitrogen NC	Sufur (%)	Phosphorus (%)	Potassium [%]	Nagnesium (%)	Calcium (%)	Socium (%)	Boson (ppm)	Zinc (ppm)	Manganese (ppm)	Iron (ppm)	Copper (ppm)	Aluminum (ppm)	Chloride (%)
2016 07 07	1020141	2.33	0.0127	0.28	0.36	3.76	0.12	33.0	0.04	14.73	31	32	153	4.87	15	
Normal I	lenge	2.50 5.50		0.30	0.35 0.60	3.00 5.50	0.20	0.30		7 20	20 60	30 100	50 150	7 15		

	N/S	N/K	P/S	PIZn	K/Mg	K/Mn	Fe/Ms	Ca/B			
Actual Ratio	82	0.6	1.3	119	32.1	1187	4.8	462			
Expected Ratio	11.0	1.1	1.2	111	11.3	625	4.1	500			

Nutrient Sufficiency Ratings



These plants are low in NITROGEN. This condition could be due to inadequate nitrogen fertilization, poor drainage, excessive rainfall or leaching.

These plants are deficient in MAGNESIUM. This condition may be due to low soil magnesium, excess soil potassium, low soil pH or poor drainage. A&L recommends

IN SUMMARY...

• Why is soil nutrition important?

- Healthier, nutrient-dense crop
- Increases ROI with better fertilizer utilization
- Long-term health of soil...future generations
- Image do city folks care?
- Sustainable what are you leaving your kids?

IN SUMMARY...

• Why soil Sample?

 Knowing your soil, allows for balanced fertility, which provides consistent yields and quality while at the same time builds a more sustainable Ecology of the soil and ultimately improves soil Health

Questions... Discussion...

Norm Dueck, CCA

Agronomy and Business
Development Representative



A & L Canada Laboratories Inc.

2136 Jetstream Road

London, ON N5V 3P5

Cell: 250-570-1798 A & L Office: 519-457-2575

www.alcanada.com

A & L Canada Laboratories Inc.

2136 Jetstream Road, London, Ontario, N5V 3P5 Telephone: (519) 457-2575 Fax. (519) 457-2664 C17291-10312



Page: 1 / 2

To: RACHAEL ROUSSIN PO BOX 1232

Account Number: 95000

ROSSLAND, BC V0G 1Y0

Report Number: C17201-10312

For: JAMIE HAYNES

Farm: JAMIE HAYNES

Reported Date: 2017-10-20 Printed Date: Oct 24, 2017 SOIL T

SOIL TEST REPORT

Sample	Legal Land Descpt:	Donth	Lab	Organic	Phosphoi	rus - P ppm	Potassium	Magnesium	Calclum		pH	CEC	Pe	rcent B	Base Sa	turatio	ns
Number	Legal Land Descht.	Depth	Number	Matter	Bicarb	Bray-P1	K ppm	Mg ppm	Ca ppm	pH	Buffer	meq/100g	% K	% Mg	% Ca	% H	% Na
JH1	JH FIELD 1	15	01340	4.0	22 M	43 M	363 VH	305 L	4330 VH	7.5		25.5	3.7	10.0	85.1		1.4
JH2	JH FIELD 1B	15	01341	4.2	39 M	84 G	481 VH	185 M	1650 M	6.4	6.9	12.3	10.0	12.5	67.1	9.6	0.7
JH3	JH FIELD 1C	15	01342	4.5	24 M	30 L	145 M	465 H	3150 M	8.3		21.6	1.7	18.0	73.0		7.5
JH4	JH FIELD 1C ALK	15	01343	5.3	14 M	21 M	150 M	1180 H	4110 VL	8.1		45.9	8.0	21.4	44.8		33.2

Sample Number	ppn	Sulf S	ur Ibs/ac		03	trogen -N bs/ac	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts mmhos/cm	Saturation %P	Aluminum Al ppm	Saturation %AI	K/Mg Ratio	ENR	Cl ppm	Sodium Na ppm
JH1	26	VL	117	2 \	VL	9	0.8 VL	28 M	52 VH	0.9 M	0.9 M		3L	391	0.0 G	0.37	52		84 H
JH2	14	VL	63	2 \	VL	9	1.8 L	24 M	68 VH	1.0 M	0.6 M		12H	883	0.3 G	0.80	54		21 M
JH3	92	VH	414	6 L	L	27	1.2 L	52 VH	61 VH	1.7 H	0.9 M		8 H	513	0.0 G	0.09	57		374 VH
JH4	2038	VH	9171	7 L	L	32	0.8 VL	45 H	88 VH	2.1 H	1.4 H		7 H	391	0.0 G	0.04	66		3504 VH

Report Number: C17291-10313

Account Number: 95000

To: RACHAEL ROUSSIN PO BOX 1232

ROSSLAND, BC V0G 1Y0

A & L Canada Laboratories Inc.

2136 Jetstream Road, London, Ontario, N5V 3P5 Telephone: (519) 457-2575 Fax. (519) 457-2664

For: GREG MCDONALD



C17291-10313



Page: 1 / 1

Reported Date: 2017-10-20 Printed Date: Oct 30, 2017

SOIL TEST REPORT

Sample	Legal Land Descpt:	Donth	Lab	Organic	Phosphor	rus - P ppm	Potassium	Magnesium	Calclum	1	рН	CEC	Pe	rcent B	Jase Sa	turatio	ons
Number	Legal Land Descht.	Depth	Number	Matter	Bicarb	Bray-P1	K ppm	Mg ppm	Ca ppm	pH	Buffer	meq/100g	% K	% Mg	% Ca	% H	% Na
GM1	GM FIELD 1	15	01346	5.4	31 G	62 H	495 VH	400 M	4250 H	7.3		26.3	4.8	12.7	80.8		1.9
GM2	GM FIELD 2	15	01347	5.3	47 G	103 H	726 VH	240 L	3160 H	6.8	6.9	21.0	8.9	9.5	75.4	5.6	0.6

Sample Number	ppn	Suh S	fur Ibs/ac		Nitrogen 3-N Ibs/ac	Zine Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts mmhos/cm	Saturation %P	Aluminum Al ppm	Saturation %AI	K/Mg Ratio	Chloride ENR Cl ppm	Sodium Na ppm
GM1	28	VL	126	7 L	32	1.5 L	38 H	58 VH	1.5 H	1.1 M		5 M	686	0.0 G	0.38	67	116 VH
GM2	15	VL	68	5 L	23	3.1 M	34 H	67 VH	1.3 H	0.8M		19H	693	0.1 G	0.94	66	28 L

A & L Canada Laboratories Inc.

2136 Jetstream Road, London, Ontario, N5V 3P5 Telephone: (519) 457-2575 Fax. (519) 457-2664





To: KOOTENAY + BANDERY FARM ADVISO

Reported Date: 2018-10-23 Printed Date: Oct 23, 2018

PO BOX 1232

Account Number: 95000

ROSSLAND, BC V0G 1Y0

Report Number: C18202-10232

DX 1232 For: JAMIE HAYNES

Attn: RACHAEL ROUSSIN

Field: BARB+FLOYD

Farm: HAYNES FARM

SOIL TEST REPORT

Page: 1 / 1

Sample	Legal Land Descpt:	Donth	Lab	Organic	Phosphor	us - P ppm	Potassium	Magnesium	Calclum	1	pH	CEC	Pe	rcent B	lase Sa	turatio	ns
Number	Legal Land Descht.	Depth	Number	Matter	Bicarb	Bray-P1	K ppm	Mg ppm	Ca ppm	pH	Buffer	meq/100g	% K	% Mg	% Ca	% H	% Na
BARB1		0	67928		28 M	50 M	192 H	162 M	1380 M	6.3	6.9	10.0	4.9	13.5	69.0	11.8	0.7
FLOYD1		0	67929	2.8	31 M	50 M	258 VH	131 M	1240 M	6.4	6.9	9.2	7.2	11.9	67.4	12.9	0.7

Sample Number	ppm	Sulfur S Ibs/ac	Nitrate NO: ppm	 Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts mmhos/cm	Saturation %P	Aluminum Al ppm	Saturation %AI	K/Mg EN	Chloride R Cl ppm	Sodium Na ppm
BARB1	10	VL	8 L	3.0 M	22 M	60 VH	1.2 H	0.2 VL		10 G	664	0.4 G	0.36 5	1	17 M
FLOYD1	11	VL	7 L	3.8 M	22 M	54 VH	1.0 M	0.3 VL		12 H	561	0.3 G	0.61 40)	14 M

A & L Canada Laboratories Inc.

AL

Report Number: C19277-10159 Account Number: 00495

To: OKANAGAN FERTILIZER LTD.

Report Date: 2019-10-08 Print Date: 2019-12-03

P.O. BOX 770

603 OLD VERNON RD

ENDERBY, BC V0E 1V0

Attn:KEN CLANCY 250-838-6968 2136 Jetstream Road, London, Ontario, N5V 3P5 Telephone: (519) 457-2575 Fax: (519) 457-2664

For: PA-VAN RANCH

SOIL TEST REPORT

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Sample	Lab	Organic	Phosphor	us - P ppm	Potassium	Magnesium	Calcium	Sodium		H	CEC		Percent I	Base Sa	turations	s
Number N	umber	Matter	Blcarb	Bray-P1	K ppm	Mg ppm	Ca ppm	Na ppm	pH	Buffer	meg/100g	% K	% Mg	% Ca	% H	% Na
SOUTHALF# 0	5487	2.7	42 M	112 G	62 L	180 H	950 M	24 H	6.3	6.9	7.7	2.1	19.5	61.7	15.3	1.4
PIVOTSOUT 0	5488	2.6	51 M	151 H	33 L	117 H	690 M	20 H	6.0	6.9	5.8	1.5	16.9	59.6	20.5	1.5
PIVOTNORT 0	5489	3.3	53 G	145 H	62 L	86 L	520 VL	16 M	5.5	6.6	8.3	1.9	8.6	31.2	57.5	0.8

Sample Number	Sulfur S ppm	Zinc Zn ppm	Manganese Mn ppm	lron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts ms/cm	Saturation %P	Aluminum Al ppm	Saturation %Al*	Nitrate Nitrogen NO3-N ppm	K/Mg Ratio	ENR	Field ID	Chloride Cl ppm	Molybdenum Mo ppm
SOUTHALF!	8 VL	2.0 L	28 M	122 VH	0.7 M	0.1 VL	0.2 VL	12 G	1239	0.9 G	6 L	0.11	39			
PIVOTSOUT	7 VL	3.3 M	22 M	162 VH	0.4 L	0.1 VL	0.2 VL	28 H	703	1.1 M	4 VL	0.09	38			
PIVOTNORT	7 VL	3.4 M	26 M	142 VH	0.5 M	0.1 VL	0.2 VL	25 H	730	1.7 M	12 M	0.22	45			

A & L Canada Laboratories Inc.

2136 Jetstream Road, London, Ontario, N5V 3P5 Telephone: (519) 457-2575 Fax: (519) 457-2664

For: PA-VAN RANCH





Report Number: C15266-10138 Account Number: 00495

To:OKANAGAN FERTILIZER LTD. P.O. BOX 770

603 OLD VERNON RD ENDERBY, BC V0E 1V0

Attn:KEN CLANCY 250-838-6968

Report Date: 2015-09-25 Print Date: 2018-06-22

SOIL TEST REPORT

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Sample	Lab	Organic	Phosphorus	- P ppm	Potassium	Magnesi	um (Calcium	Sodium	pH	1	CEC	M 4000 - 2000	P	ercent F	Base Sat	uration	s
Number	Number	Matter	Blcarb	Bray-P1	K ppm	Mg ppr	n (Ca ppm	Na ppm	рН	Buffer	meq/10	0g %	K	% Mg	% Ca	% H	% Na
NW	53057	2.8	52 G	130 H	48 L	125 M	9	920 M	23 H	6.6	6.9	7.1	1	.7	14.8	65.2	16.8	1.4
SW	53058	2.8	42 M	92 M	27 VL	115 H	6	510 M	20 H	6.2	6.9	5.4	1	.3	17.9	57.0	22.2	1.6
NE	53059	2.4	58 G	181 H	43 L	95 M	6	680 L	21 H	6.2	6.8	6.8	1	.6	11.7	50.1	35.2	1.3
SE	53060	3.3	59 G	151 H	45 L	135 H	9	060 M	22 H	6.3	6.9	7.3	1	.6	15.4	65.6	16.2	1.3
Sample Number	Sulfur S ppm	Zine Zn ppm	Manganose Mn ppm	iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts ms/cm	Saturation %P	Aluminum Al ppm	Saturatio %Al *	n N	litrate trogen 3-N ppm	K/Mg Ratio	ENR	Field	Chloric	Moly	/bdenum o ppm
NW	6 VL	2.9 L	17 M	181 VH	0.5 M	0.1 VL	0.2 VL	22 H	742	0.4 G		3 VL	0.11	40				
SW	6 VL	2.0 L	20 M	175 VH	0.5 M	0.1 VL	0.1 VL	17 H	708	0.9 G		2 VL	0.07	40				
NE	6 VL	3.5 M	26 M	193 VH	0.3 L	0.1 VL	0.1 VL	27 H	865	0.8 G		2 VL	0.14	36				
SE	8 VL	2.9 L	30 H	148 VH	0.7 M	0.1 VL	0.2 VL	15 G	1293	1.0 G		6L	0.10	45				
CE	VL = VERY LC	W L = LOW	M = MEDIUM	H = HIGH V	VH = VERY HIGH	H *G=G	OOD, M =	MARGINAL, M	IT - MODER	ATE PHYTO	D-TOXI	C, T = Ph	TOTY	OXIC	, ST = S	EVERE	PHYTO	TOXIC

A & L Canada Laboratories Inc.

2136 Jetstream Road, London, Ontario, N5V 3P5 Telephone: (519) 457-2575 Fax: (519) 457-2664 C19294-10630



To: KOOTENAY AND BOUNDARY FARM ADV

PO BOX 1232

Reported Date:

Account Number: 95000

ROSSLAND, BC V0G 1Y0

Report Number: C10204-10630

For: JAMIE HAYNES

SOIL TEST REPORT Printed Date:Oct 23, 2019

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Sample	Legal Land Descpt:	Donth	Lab	Organic	Phosphor	us - P ppm	Potassium	Magnesium	Calclum	1	H	CEC	Pe	rcent B	lase Sa	turatio	ns
Number	Legal Land Descht:	Depth	Number	Matter	Bicarb	Bray-P1	K ppm	Mg ppm	Ca ppm	pH	Buffer	meq/100g	% K	% Mg	% Ca	% H	% Na
JHNOR		12	27926	3.2	52 G	108 G	405 VH	129 M	1080 M	6.2	6.9	8.8	11.9	12.3	61.6	13.5	0.7
JHR		12	27927	4.4	45 M	90 G	451 VH	187 M	1420 M	6.2	6.9	11.1	10.4	14.1	64.1	10.6	0.7

Sample Number	ppm	Sulf	ur Ibs/ac		Nitrogen 03-N Ibs/ac	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts mmhos/cm	Saturation %P	Aluminum Al ppm	Saturation %AI	K/Mg Ratio	ENR	Chloride Cl ppm	Sodium Na ppm
JHNOR	24	H	86	8 L	29	2.9 L	20 M	64 VH	1.1 M	0.4 L		16 H	874	0.7 G	0.97	44		14 M
JHR	33	H	119	10 M	1 36	4.1 M	20 M	68 VH	1.1 M	0.2 VL		16H	731	0.4 G	0.74	56		19 M

A & L Canada Laboratories Inc.

2136 Jetstream Road, London, Ontario, N5V 3P5 Telephone: (519) 457-2575 Fax: (519) 457-2664

For: PA-VAN RANCH



Report Number: C19277-10159 Account Number: 00495

To: OKANAGAN FERTILIZER LTD.

P.O. BOX 770

603 OLD VERNON RD

ENDERBY, BC V0E 1V0

Attn:KEN CLANCY

250-838-6968

Report Date: 2019-10-08 Print Date: 2019-12-03

SOIL TEST REPORT

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Sample	Lab	Organic	Phosphor	us - P ppm	Potassium	Magnesium	Calcium	Sodium		H	CEC	0.000000	Percent I	Base Sat	turation	s
Number N	Number	Matter	Blcarb	Bray-P1	K ppm	Mg ppm	Ca ppm	Na ppm	pH	Buffer	meg/100g	% K	% Mg	% Ca	% H	% Na
SOUTHALF!	05487	2.7	42 M	112 G	62 L	180 H	950 M	24 H	6.3	6.9	7.7	2.1	19.5	61.7	15.3	1.4
PIVOTSOUT O	05488	2.6	51 M	151 H	33 L	117 H	690 M	20 H	6.0	6.9	5.8	1.5	16.9	59.6	20.5	1.5
PIVOTNORT (05489	3.3	53 G	145 H	62 L	86 L	520 VL	16 M	5.5	6.6	8.3	1.9	8.6	31.2	57.5	0.8

Sample Number	Sulfur S ppm	Zinc Zn ppm	Manganese Mn ppm	Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts ms/cm	Saturation %P	Aluminum Al ppm	Saturation %Al *	Nitrate Nitrogen NO3-N ppm	K/Mg Ratio	ENR	Field ID	Chloride Cl ppm	Molybdenur Mo ppm
SOUTHALF!	8 VL	2.0 L	28 M	122 VH	0.7 M	0.1 VL	0.2 VL	12 G	1239	0.9 G	6 L	0.11	39			
PIVOTSOUT	7 VL	3.3 M	22 M	162 VH	0.4 L	0.1 VL	0.2 VL	28 H	703	1.1 M	4 VL	0.09	38			
PIVOTNORT	7 VL	3.4 M	26 M	142 VH	0.5 M	0.1 VL	0.2 VL	25 H	730	1.7 M	12 M	0.22	45			

A & L Canada Laboratories Inc.

2136 Jetstream Road, London, Ontario, N5V 3P5 Telephone: (519) 457-2575 Fax: (519) 457-2664

For:PA-VAN RANCH





Report Number: C18249-10187 Account Number: 00495

To:OKANAGAN FERTILIZER LTD. P.O. BOX 770

603 OLD VERNON RD

ENDERBY, BC V0E 1V0

Attn:KEN CLANCY 250-638-6968

CE

Report Date: 2018-09-08 Print Date: 2018-09-10

SOIL TEST REPORT

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Sample	Lab	Organic	Phosphorus	- P ppm	Potassium	Magnesium	n Calcium	Sodium	р	Н	CEC		Percent I	Base Sa	turation	s
Number	Number	Matter	Blcarb	Bray-P1	K ppm	Mg ppm	Ca ppm	Na ppm	рН	Buffer	meq/100g	% K	% Mg	% Ca	% H	% Na
NORTHFAR	09121	3.9	50 G	126 H	81 M	75 VL	1300 VL	21 L	5.8	6.4	14.6	1.4	4.3	44.5	49.2	0.6
NORTHFAR	09122	4.4	48 G	122 H	115 M	88 VL	950 VL	18 L	5.7	6.2	15.4	1.9	4.7	30.8	62.1	0.5
HOMENEWS	09123	3.2	38 M	91 G	66 L	218 H	1300 M	29 H	6.4	6.9	9.8	1.7	18.6	66.4	12.0	1.3
HOMENEWS	09124	2.2	58 G	153 H	88 M	109 M	810 L	28 H	6.1	6.8	7.7	2.9	11.8	52.6	31.0	1.6
Sample	Sulfur	Zine	Manganose	Iron	Copper	Boron	Soluble Saturation	Aluminum	Saturati	on	iltrate trogen	/Mg EN	Field	Chlori	de Moly	/bdenu

Sample Number	Sulfur S ppm	Zine Zn ppm	Manganose Mn ppm	iron Fe ppm	Copper Cu ppm	Beron B ppm	Soluble Salts ms/cm	Saturation %P	Aluminum Al ppm	Saturation %Al *	Nitrate Nitrogen NO3-N ppm	K/Mg Ratio	ENR	Field	Chloride Cl ppm	Molybdenum Molppm
NORTHFAR	13 M	2.9 L	17 M	76 VH	0.6 M	0.2 VL	0.2 VL	9 G	1720	1.4 M	7 L	0.33	51			
NORTHFAR	9 L	3.2 M	18 M	90 VH	0.6 M	0.1 VL	0.2 VL	11 H	1468	1.4 M	5 L	0.40	56			
HOMENEWS	12 VL	2.7 L	18 M	110 VH	0.8 M	0.2 VL	0.2 VL	16 H	722	0.4 G	8 L	0.09	44			
HOMENEWS	10 VL	3.1 M	23 M	153 VH	0.5 M	0.2 VL	0.2 VL	28 H	706	0.7 G	4 VL	0.25	34			

VL = VERY LOW L = LOW M = MEDIUM H = HIGH VH = VERY HIGH

^{*} G = GOOD, M = MARGINAL, MT = MODERATE PHYTO TOXIC, T = PHYTO TOXIC, ST = SEVERE PHYTO TOXIC

A & L Canada Laboratories Inc.

2136 Jetstream Road, London, Ontario, N5V 3P5 Telephone: (519) 457-2575 Fax: (519) 457-2664

For:PA-VAN RANCH





Report Number: C15266-10138 Account Number: 00495

To:OKANAGAN FERTILIZER LTD.

P.O. BOX 770 603 OLD VERNON RD ENDERBY, BC V0E 1V0

Attn:KEN CLANCY 250-838-6968

CE

Report Date: 2015-09-25 Print Date: 2018-06-22

SOIL TEST REPORT

Page:1

Sample	Lab	Organic	Phosphorus	- P ppm	Potassium	Magnesiur	m Calcium	Sodium	P	Н	CEC		Percent I	Base Sa	uration	s
Number	Number	Matter	Blcarb	Bray-P1	K ppm	Mg ppm	Ca ppm	Na ppm	рН	Buffer	meq/100g	% K	% Mg	% Ca	% H	% Na
NW	53057	2.8	52 G	130 H	48 L	125 M	920 M	23 H	6.6	6.9	7.1	1.7	14.8	65.2	16.8	1.4
SW	53058	2.8	42 M	92 M	27 VL	115 H	610 M	20 H	6.2	6.9	5.4	1.3	17.9	57.0	22.2	1.6
NE	53059	2.4	58 G	181 H	43 L	95 M	680 L	21 H	6.2	6.8	6.8	1.6	11.7	50.1	35.2	1.3
SE	53060	3.3	59 G	151 H	45 L	135 H	960 M	22 H	6.3	6.9	7.3	1.6	15.4	65.6	16.2	1.3
Sample	Sulfur	Zine	Manganose	Iron	Copper	Boron	Soluble Saturation	Aluminum	Saturation	on N	trogen	/Mg EN	R Field	Chlorie	Moly	bdenur

Sample Number	Sulfur S ppm	Zine Zn ppm	Manganose Mn ppm	iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts ms/cm	Saturation %P	Aluminum Al ppm	Saturation %Al*	Nitrate Nitrogen NO3-N ppm	Patio	ENR	Field	Chloride Cl ppm	Molybdenum Mo ppm
NW	6 VL	2.9 L	17 M	181 VH	0.5 M	0.1 VL	0.2 VL	22 H	742	0.4 G	3 VL	0.11	40			
sw	6 VL	2.0 L	20 M	175 VH	0.5 M	0.1 VL	0.1 VL	17 H	703	0.9 G	2 VL	0.07	40			
NE	6 VL	3.5 M	26 M	193 VH	0.3 L	0.1 VL	0.1 VL	27 H	865	0.8 G	2 VL	0.14	36			
SE	8 VL	2.9 L	30 H	148 VH	0.7 M	0.1 VL	0.2 VL	15 G	1293	1.0 G	6 L	0.10	45			

Aluminum (al) Toxicity

Tip of Root Hair

