The Albrecht System and Study Results

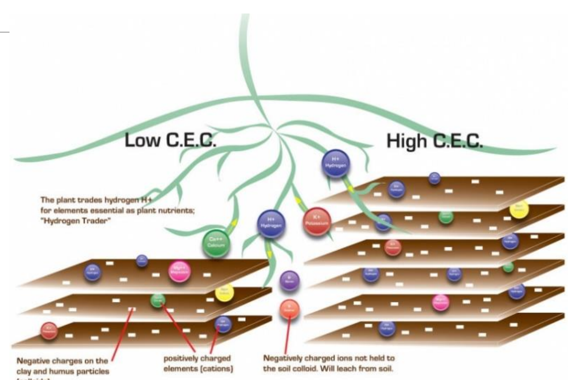
2ND TALK CODY WYOMING

1

Dr. Albrecht System

The Base Saturation of Cations is Key.

- The Cations: Ca^{+2}, Mg^{+2}, K^{+}, Na^{+}, H^{+}
  - Because the soil is negatively charged (clay and humus)
- Other Nutrients are Also Held But Are Negative
  - Phosphorus, Sulfur, Boron



2

Dr. Albrecht Found That the Ideal Base Saturation of Ca is 68% and Mg is 12%. Doesn't Mean That The Albrecht System Does Not Utilize Yield Response or Other Nutrients.

It Takes It One Step Further

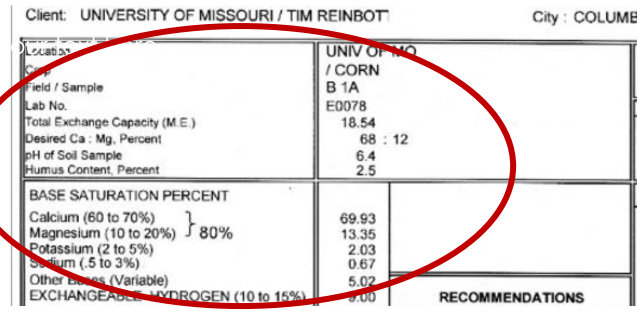
Takes Into Consideration The Cation

Base Saturation

In the Albrecht System The Ideal

Percent Base Saturation is 68% Ca

and 12% Mg

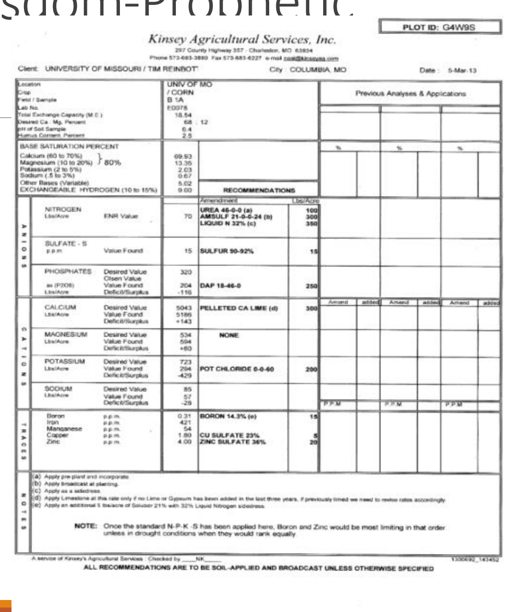

Client: UNIVERSITY OF MISSOURI / TIM REINBOTT City : COLUMB

Location	UNIV OF MO
Crop	/ CORN
Field / Sample	B 1A
Lab No.	E0078
Total Exchange Capacity (M.E.)	18.54
Desired Ca : Mg, Percent	68 : 12
pH of Soil Sample	6.4
Humus Content, Percent	2.5
BASE SATURATION PERCENT	
Calcium (60 to 70%) } 80%	69.93
Magnesium (10 to 20%)	13.35
Potassium (2 to 5%)	2.03
Sodium (.5 to 3%)	0.67
Other Bases (Variable)	5.02
EXCHANGEABLE HYDROGEN (10 to 15%)	9.00

RECOMMENDATIONS

Steve King-Words of Wisdom-Prophetic

"Start At The Top, Get That Corrected and Then Move Down"


PLOT ID: G4W9S

Kinsey Agricultural Services, Inc.

297 County Highway 357 · Charleston, MO 63834

Phone 573-683-3880 Fax 573-683-6227 e-mail

Client: UNIVERSITY OF MISSOURI / TIM REINBOTT City : COLUMBIA, MO Date : 5-Mar-13

Location	UNIV OF MO	Previous Analyses & Applications
Crop	/ CORN	
Field / Sample	B 1A	
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RECOMMENDATIONS

				Amendment	Lbs/Acre
ANIONS	NITROGEN Lbs/Acre	ENR Value	70	UREA 46-0-0 (a) AMSULF 21-0-0-24 (b) LIQUID N 32% (c)	100 300 350
	SULFATE - S p.p.m.	Value Found	15	SULFUR 90-92%	15
	PHOSPHATES as (P2O5) Lbs/Acre	Desired Value Olsen Value Value Found Deficit/Surplus	320 204 -116	DAP 18-46-0	250
CATIONS	CALCIUM Lbs/Acre	Desired Value Value Found Deficit/Surplus	5043 5186 +143	PELLETED CA LIME (d)	300
	MAGNESIUM Lbs/Acre	Desired Value Value Found Deficit/Surplus	534 594 +60	NONE	
	POTASSIUM Lbs/Acre	Desired Value Value Found Deficit/Surplus	723 294 -429	POT CHLORIDE 0-0-60	200
	SODIUM Lbs/Acre	Desired Value Value Found Deficit/Surplus	85 57 -28		
TRACES	Boron	p.p.m.	0.31	BORON 14.3% (e)	15
	Iron	p.p.m.	421		
	Manganese	p.p.m.	54		
	Copper	p.p.m.	1.80	CU SULFATE 23%	5
	Zinc	p.p.m.	4.00	ZINC SULFATE 36%	20

NOTES

(a) Apply pre-plant and incorporate.
(b) Apply broadcast at planting.
(c) Apply as a sidedress.
(d) Apply Limestone at this rate only if no Lime or Gypsum has been added in the last three years. If previously limed we need to revise rates accordingly.
(e) Apply an additional 5 lbs/acre of Solubor 21% with 32% Liquid Nitrogen sidedress.

NOTE: Once the standard N-P-K-S has been applied here, Boron and Zinc would be most limiting in that order unless in drought conditions when they would rank equally.

A service of Kinsey's Agricultural Services : Checked by ____NK_____

ALL RECOMMENDATIONS ARE TO BE SOIL-APPLIED AND BROADCAST UNLESS OTHERWISE SPECIFIED

The Most Balanced Soil? NW MO
Who Was From NW MO?
General Pershing
Walt Disney
Omar Bradley

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Symbiosis REGENERATIVE AGRICULTURE WHY COVER CROPS NATURES TEACHING CONTA

Key ratio	Target ratio	Description
Calcium (Ca) to Magnesium (Mg)	3:1 in sandy soil 7:1 heavy clay soil	The calcium to magnesium ratio is critical as it determines soil structure and associated gas exchange. Soil aeration is essential as oxygen is required for soil microbes and plant roots while carbon-dioxide is needed for photosynthesis. Calcium flocculates and helps to form stable aggregates, resulting to good spore space for water, roots and microbes.
Magnesium(Mg) to Potassium (K)	1:1	Mg to K ratio is almost as important as Calcium to Magnesium ratio. An ideal stimulates Phosphorus intake and ensures optimal plant availability of both Mg and K.
Phosphorus (P) to Sulfur (S)	1:1	An appropriate P to S ratio helps to optimize the performance of these two key anions. Sulfur is critical for healthy root growth, protein formation (plant immunity) and chlorophyll density.
Phosphorus (P) to Zinc (Zn)	10:1	An ideal P to Zn ratio will ensure maximum performance of both minerals. Too much either inhibits the other, however this should not be targeted in high P soils as Zn would tie up other elements
Potassium (K) to Sodium (Na)	4:1 or 5:1	The K to Na ratio is critical to ensure availability of the second most abundant mineral in plants (K). If Na exceeds K in terms of base saturation, then Na will become detrimental for plant health.
Iron (Fe) to Manganese (Mg)	1:1 or 2:1	The Fe to Mg ratio is important to ensure optimum uptake of both minerals. Ideally, Fe should be always higher than Manganese on a soil test.

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Brief Summary of The Role of Nutrients In the Plant.

Table 1. Essential plant nutrients.

Name	Chemical symbol	Relative % in plant*	Function in plant	Nutrient category
Nitrogen	N	100	Proteins, amino acids	Primary macronutrients
Phosphorus	P	6	Nucleic acids, ATP	
Potassium	K	25	Catalyst, ion transport	
Calcium	Ca	12.5	Cell wall component	Secondary macronutrients
Magnesium	Mg	8	Part of chlorophyll	
Sulfur	S	3	Amino acids	
Boron	B	0.2	Cell wall component	Micronutrients
Chlorine	Cl	0.3	Photosynthesis reactions	
Copper	Cu	0.01	Component of enzymes	
Iron	Fe	0.2	Chlorophyll synthesis	
Manganese	Mn	0.1	Activates enzymes	
Molybdenum	Mo	0.0001	Involved in N fixation	
Nickel	Ni	0.001	Component of enzymes	
Zinc	Zn	0.03	Activates enzymes	

*Relative amounts of mineral elements compared to nitrogen in dry shoot tissue. May vary depending on plant species.

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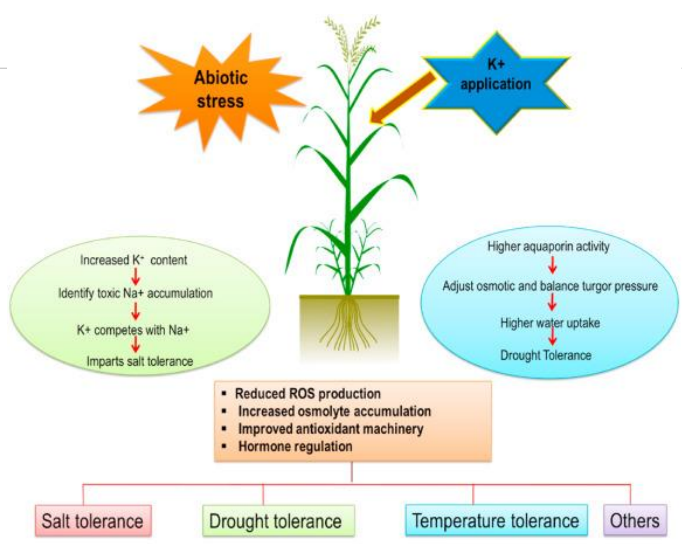
Potassium-Stress Reducer-Water, Temperature, Salt, etc



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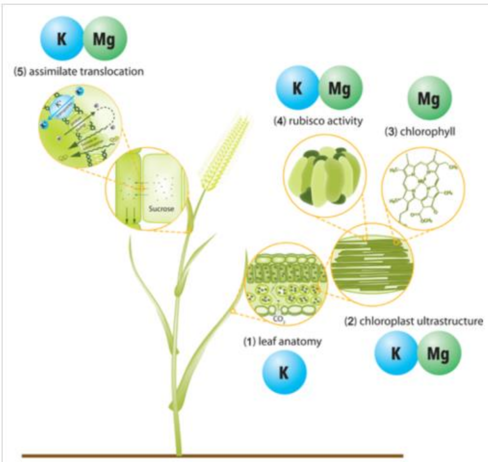
Role of K and Mg And How They Are Connected In Photosynthesis and Growth



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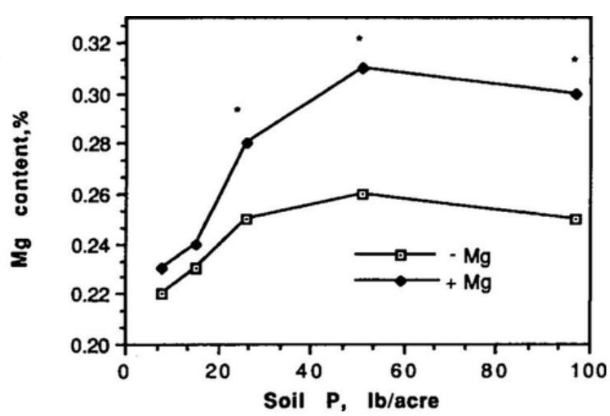
Nutrients Are Often Tied To One Another-Mg Uptake is Dependent Upon P



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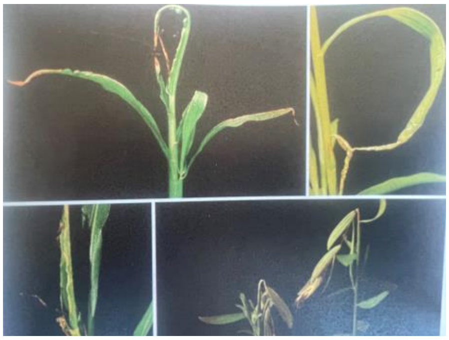
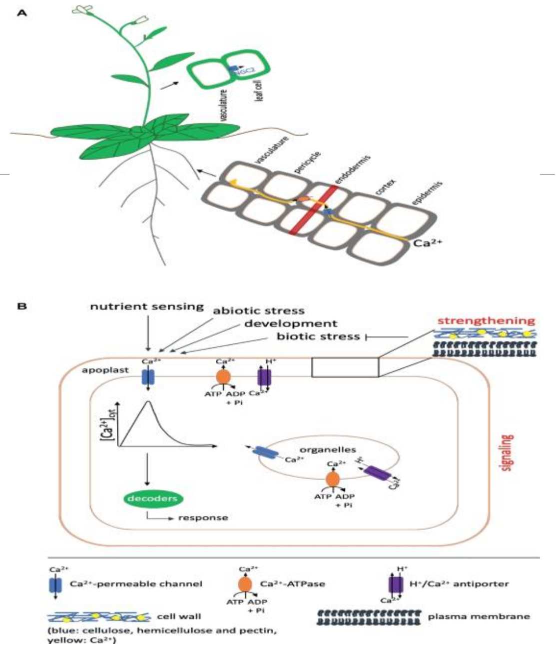
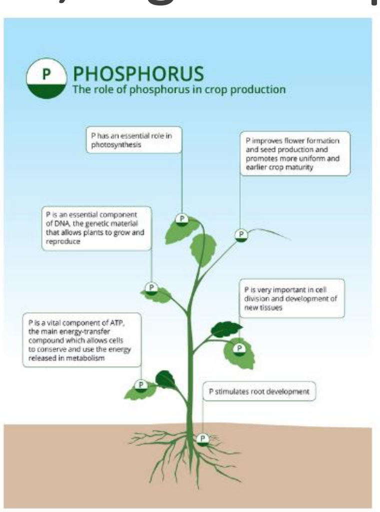
Calcium Although
A Secondary Nutrient
Is Critical: Cell Wall and
Signaling in the plant

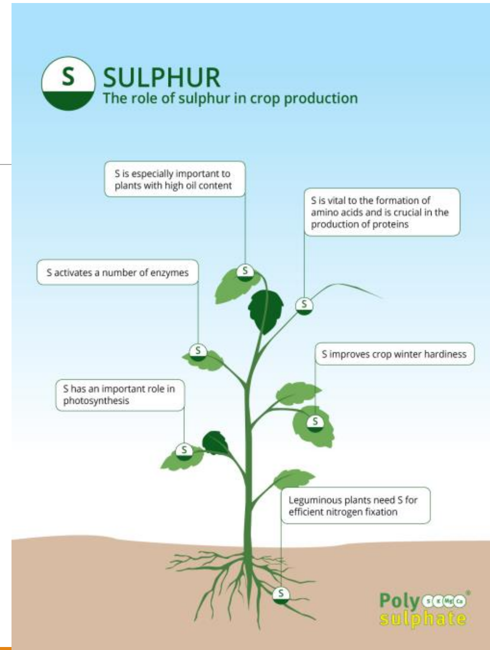




Role of Phosphorus-Energy Currency, DNA, Sugar Transport



Sulfur-Critical in Proteins and Photo-Synthesis



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Micronutrients: Boron In Reproduction

Functions of Mineral Nutrients: Micronutrients

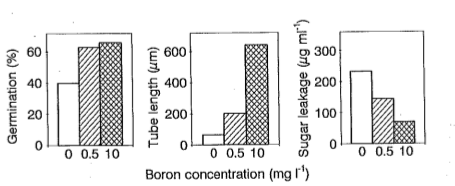

Fig. 9.32 Effect of boron concentrations on lily (*Lilium longiflorum* L.) pollen germination, tube growth, and leakage of sugar to the medium. (Redrawn from Dickinson, 1978.)

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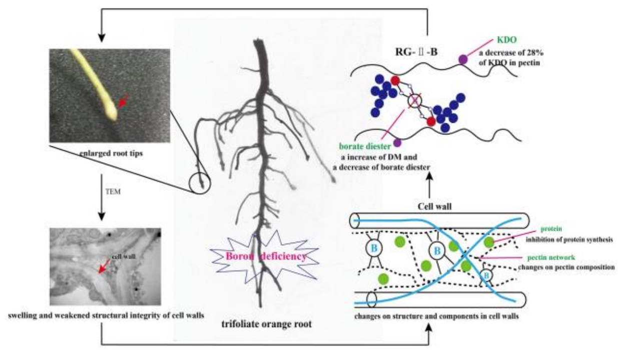
Boron Is Key To Root Growth, Cell Wall Expansion



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Copper-Needed in Plants For Reproduction, Cell Walls-Critical In Human Health

Table 9.14
Relationship between Copper Supply and Growth and Dry Matter Distribution in Red Pepper[a]

Copper supply (µg per pot)	Dry weight (g per plant)			
	Roots	Leaves and stem	Buds and flowers	Fruits
0.0	0.8	1.7	0.16	None
0.5	1.6	3.3	0.28	None
1.0	1.5	3.2	0.38	0.87
5.0	1.4	3.0	0.36	1.81
10.0	1.2	2.0	0.28	1.99

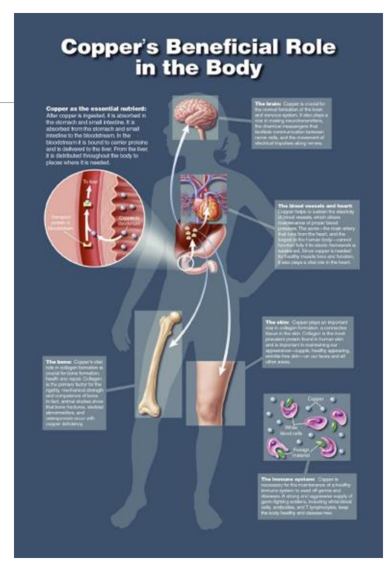
[a]From Rahimi (1970).

Skin

Reproduction

Kidneys

Heart



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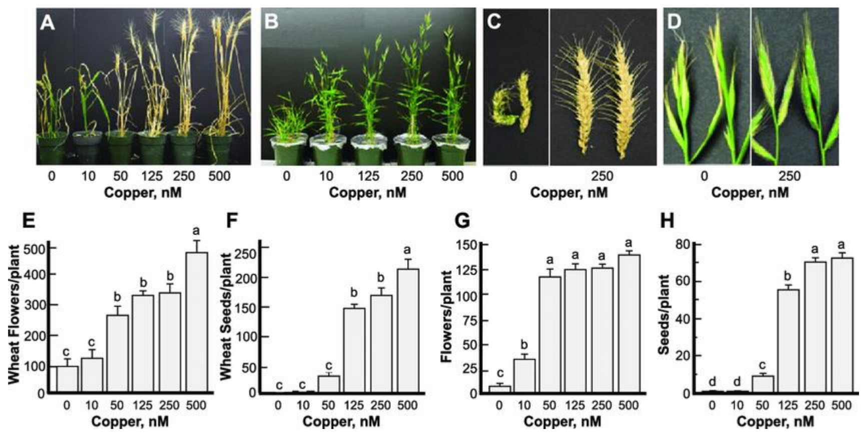
Copper Influence on Reproduction in Wheat



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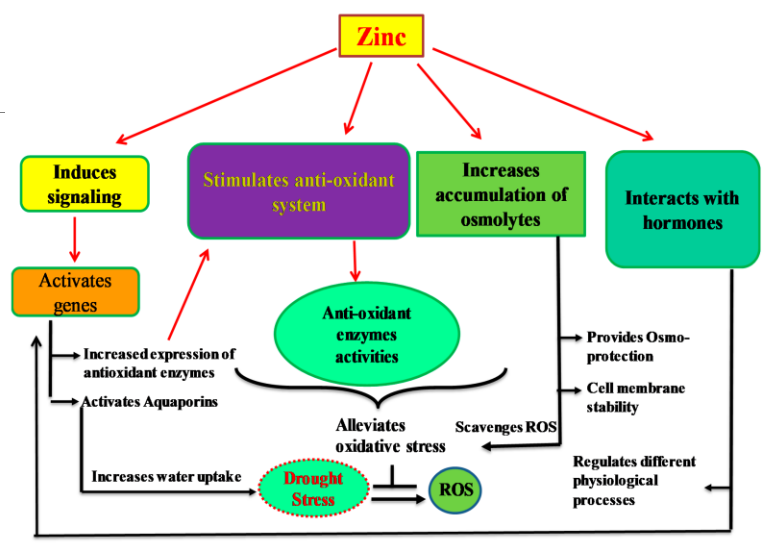
Zinc Activates The 2nd Most Enzymes In The Plant Behind Iron



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It Can Not Be Stressed Enough That You Don't Always See A Nutrient Deficiency Symptom To Have A Deficiency.

ENGINE EXAMPLE

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Does This Corn Have Enough Of All Its Nutrients?

20

Studies To Examine the Albrecht System

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Original Questions That I Had About The Albrecht System:

Does The Level of Base Saturation of Ca and Mg Really Make A Difference?
- **Is the 68% Ca and 12% Mg Base Saturation really important?**

Aren't proper levels of P and K enough?
- **Some don't think that we can get a response from P and K**

Do We Need "Fresh" Calcium

Are Micros Really That Important

Sulfur?

22

Original Soil Test

Ca Base Saturation: 70% Base Saturation

Mg Base Saturation-13% Base Saturation

K-2.03% Base Saturation

P- minus 113 lb/acre

Ca- Plus 143 lb/care

Mg-plus 60 lb/acre

K-minus 429 lb/acre

Need Sulfur, B, Cu, and Zn

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Recommendations

P-250 lb/acre DAP

K-200 lb/acre KCl

S-15 lb/acre

Ca-Pell Lime-300 lb/acre

Mg-0 lbs/acre

B-15 lb/acre Borate

Cu-5 lb/acre CuSO4

Zn-20 lb/acre ZnSO4

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Setup Treatments

No P, K, S, Micros or anything else except N for Corn

Full Recommendations

NPKS only no micros

Recommendations except KMg used

Recommendations except KMg and no Pell lime

Micros only

P and K only

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Soybean Yield, wet and dry in the late summer. Note That Added $MgSO_4$ Had Higher Yield

	Wet Year	Dry Year
Treatment	Yield	Yield
	bu/acre	bu/acre
Control	42	54
Recommendations	45*	63*
PKS only	43	52
Recom.+Mg	41	61
Recom. No lime +Mg	39	65*
Micros only	40	57
P and K only	35	

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Corn Yield

Treatment	Dry Year Yield (bu/acre)	Wet Year Year bu/acre
N only	161 c	178 b
Recommendations	203 a	190 a
PKS only	183 a	193 a
Recom+Mg	174 bc	179 b
Recommendations: No Lime+Mg	185 ab	173 b
N and Micros only	178 bc	179 b
P and K only	-	175 b

Letters indicate significance at the 0.10 probability level

27

Corn Yield: Another Hot and Dry Summer

Treatment	Yield (bu/acre)
Control	169 c
Recommendations	199 ab
PKS only	203 a
Recom.+Mg	190 ab
Recom. No lime+Mg	185 abc
Micros only	162 c
PK only	201 a

Different Letters indicate significantly different-0.10 level

28

Soybean Yield-How Long Does the Fertilizer Last?

Without Additional Fertilizer-One Year

Treatment	Bu/acre
Control	61 b
Recommendations	69 a
Recom. Without Pell Lime	58 b
Recom.+Mg and Lime	69 a
Recom+Mg no lime	60 b
Micros Only	64 ab
P and K only	61 b

Different letters indicate significance at the 0.10 level Treatment

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Soybean Yield after P, K, S treatment in May of Different Ca/Mg Treatments

Treatment	Yield	Test Weight
	Bu/acre	lb/bu
Natural	44	49
68/20	50	50
?/20	49	51
?25	59*	51*
?/30	59*	52*
?/35	56*	52*
68/10	57*	51*
68/12	59*	52*
80/10	56*	51*

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How pH Soil

Soils High Ca (over 80% Base saturation) Low Sulfur (1 lb/acre) Corn and Soybean

Treatment	Corn	Soybean
	bu/acre	bu/acre
Control	111 b	62 b
Recommendations	142 a	69 a
Recommendations w/o S	118 b	63 b
Recommendations w/Mg	145 a	68 a
Micros Only	124 ab	63 b

Different Letters Indicate Significant Differences at the 0.05 level

Study When pH is over 7.0 in 2023

Treatment	Ca/Mg	CC	Yield	Dry Matter
			Bu/acre	g/5 plants
Low P and K	77/16	-	171	272
		+	172	183
Recommendations	74/15	-	181*	332*
		+	189*	204*
Rec P and K no S	82/12	-	184	298
		+	166	204
Rec+Gypsum	81/12	-	180	270
		+	179	167
Rec+MgSO4	74/18	-	194*	287*
		+	165*	200*
Rec P and K and S	79/14	-	183	272
		+	166	205

What About Nutrient and Protein Concentration?

Nutrient Dilution in Raspberry When Fertilizer Added

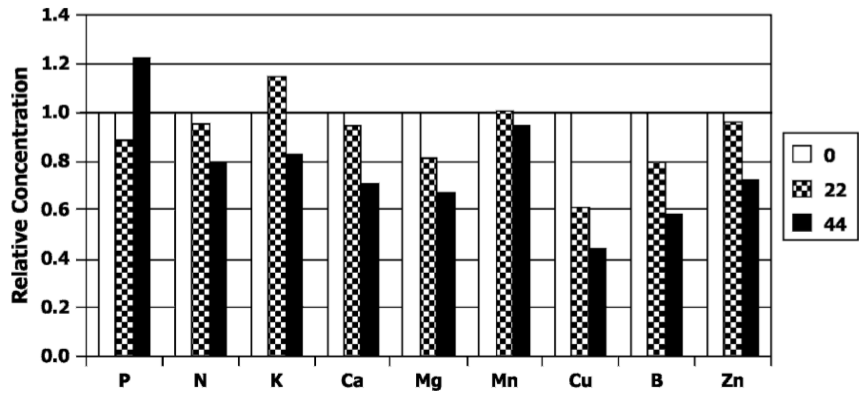

Fig. 1. Dilution effects of phosphorus fertilization in red raspberry plants; 0, 22, and 44 ppm added to soil containing 12 ppm (Hughes et al., 1979; dry weight basis). The relative plant dry weight was, respectively, 1:1.4:2.2.

D.R. Davis, 2009

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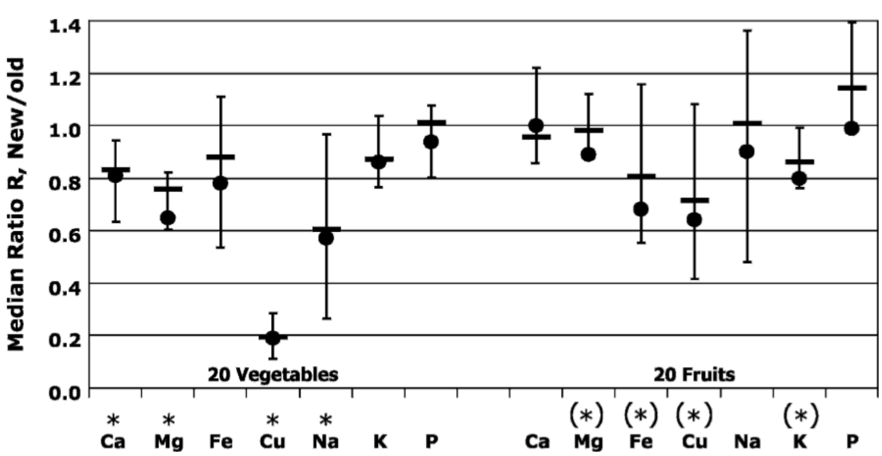
Dilution of Vegetables and Fruits from the 1930's-1990's



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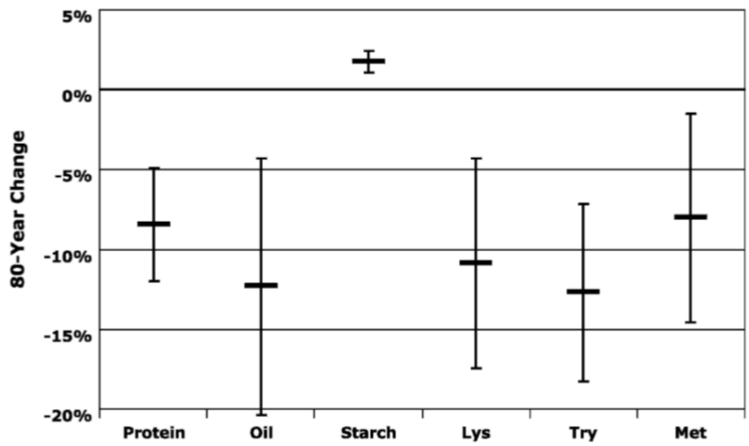
Change in Nutrient Concentration in Corn Over 80 Years.



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Corn Grain-Nutrient Content

Treatment	Crude Protein	Ca	P	Mg	K	S
			%			
Control	7.5	0.013	0.26	0.113	0.39	0.09
Recommendations	8.2*	0.020*	0.27	0.115	0.42*	0.09
Rec No Pell Lime	7.7	0.010	0.26	0.115	0.42*	0.09
Rec Mg+Pell Lime	8.3*	0.018	0.27	0.118	0.42*	0.09
Rec Mg no Pell Lime	7.7	0.015	0.25	0.108	0.41	0.09
Micros only	7.5	0.015	0.24	0.105	0.40	0.09
P and K only	7.2	0.018	0.24	0.105	0.38	0.09

*indicate Significant difference at the 0.05 level

38

Lysine and Methionine Are The Two Most Limiting in Animal Production

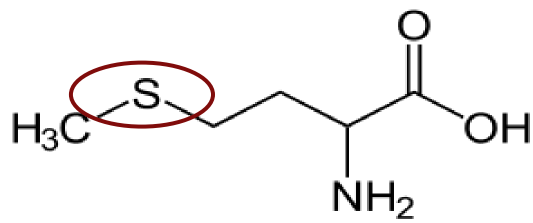
Lysine: Very high in legumes, very low in grasses and grains

-synthesized from Vitamin C

-not synthesized by animals

Methionine-very low in many food stuffs

- **Sulfur is essential in synthesis**



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Corn Grain-Amino Acid Content

Treatment	Lysine	Methionine
	%	%
Control	0.21	0.16
Recommendations	0.23*	0.18*
Rec No Pell Lime	0.22	0.16
Rec Mg+Pell Lime	0.24*	0.18*
Rec Mg no Pell Lime	0.22	0.16
Micros only	0.21	0.17
P and K only	0.21	0.16

*indicate Significant difference at the 0.05 level

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What Increases Protein Content?

Nitrogen Utilization

- **Protein is 6.25% N**

Increased Protein Synthesis

- **K**
- **Mg, Zn, S**

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Conclusions-Grain Production

Following The Albrecht System-Higher Soybean and Corn grain yield-especially in dry years

Adding Mg without Ca nullifies most positive responses from other NPKS and micronutrient treatment

Additive effects of PKS and Micronutrients

Increase in Grain Quality-Protein, Amino Acid Profile and Nutrient Content

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Forages

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Treatments

Control-N only-Urea-otherwise testing adequate

Recommendations-NH_4SO_4+Urea, P, K, Micros, Pell Lime

Recommendations-no pell lime

P and K only

Recommendations-no lime plus Mg

Recommendations-no sulfur

Recommendations-no micros

P and K and S only

Micros only

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Forage-Harvested In Vegetative Stage, Before Stem Elongation

45

Following Full Recommendations Had The Greatest Forage Yield. With The Treatments Additive-P, K, Micros, Sulfur

	Year 1	Year 3
	lb/acre	lb/acre
N only	3500 b	3841 b
Recommendations	4578 a	5058 a
Recom. No pell lime	3820 ab	3841 b
Recom. No sulfur	3607 b	3937 b
Recom. No micros	3436 b	4369 ab
P and K only	3937 ab	4433 ab
PKS only	3831 ab	4177 ab
Micros only	3745 b	3697 b

Different letters indicate significance at the 0.10 probability

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Forage Nutrient Analysis-Again Sulfur Makes a Tremendous Difference

Late April Harvest

	P	Mg	K	S
	%			
N only	0.31	0.16	2.4	0.26
Recommendations	0.42*	0.28*	3.3*	0.34*
Recom. No pell lime	0.41*	0.26*	3.2*	0.34*
PKS only	0.40*	0.28*	3.1*	0.31*
P and K only	0.36*	0.26*	2.8	0.29
Recom. No sulfur	0.34	0.24	2.7	0.27
Recom. No micros	0.37*	0.24	2.7	0.29
Micros only	0.38*	0.22	2.8	0.32*

*Indicate significance at the 0.05 level

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Forage Quality Analysis-Sulfur Makes A Tremendous Difference

Late April Harvest

	CP	Lysine	Methionine
	%		
N only	15	0.53	0.20
Recommendations	21*	0.73*	0.27*
Recom. No pell lime	20*	0.71*	0.27*
PKS only	19*	0.66*	0.25*
P and K only	18*	0.63*	0.24*
Recom. No sulfur	16	0.56	0.21
Recom. No micros	17	0.59	0.22
Micros only	18*	0.63*	0.23

*Indicate significance at the 0.05 level

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Conclusions on Forage Yield and Quality

Balancing The Soil and Supplying Adequate P, K, and Micronutrients Results in Greater Yield

Sulfur is Extremely Important For Protein and Amino Acid Profile

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What About Sulfur?

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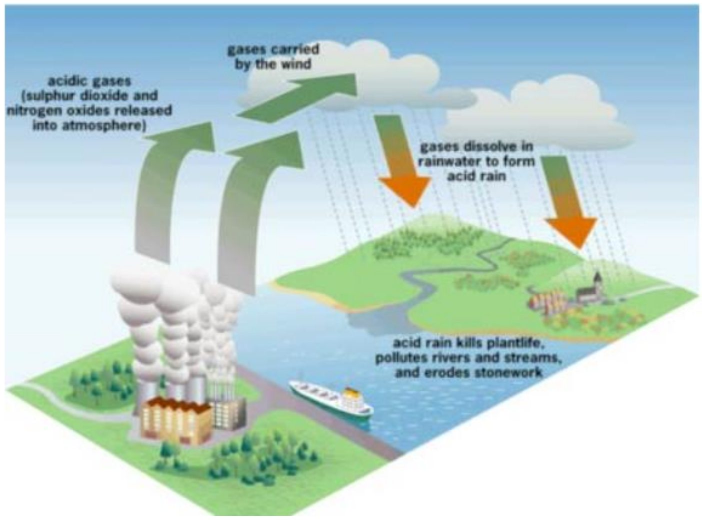
High Sulfur Coal-Prior to 2000 A Lot of Concern About Acid Rain-H_2SO_4-Sulfuric Acid



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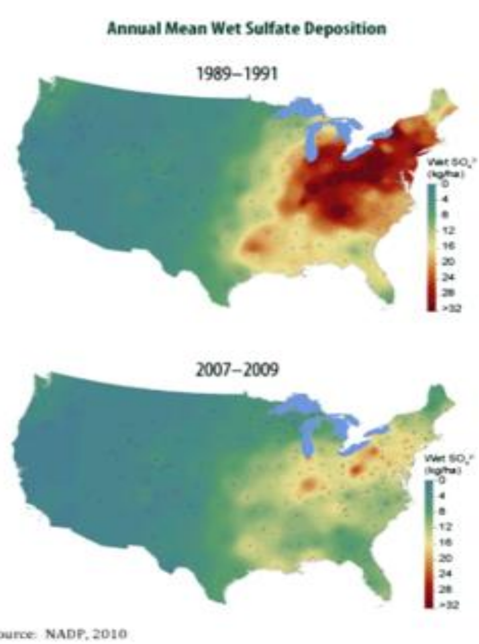
Sulfur Deposition from Coal In The United States



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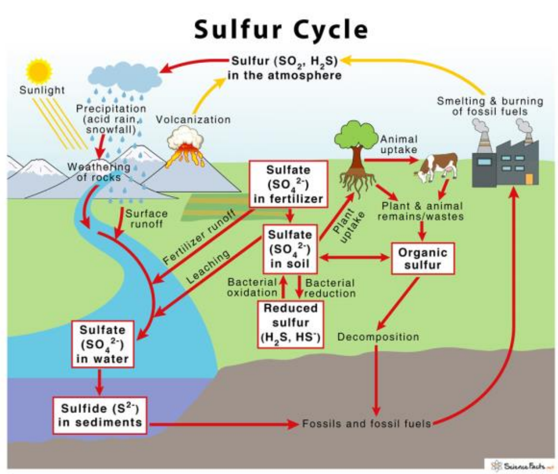
Reducing Sulfur In Diesel

53

Sulfur Cycle- Elemental Has To Go Through Soil Microorganisms



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Many University Recommendations of No Sulfur Applied If CEC is Above 6.5

Sulfur (S). Crops may respond to sulfur applied on coarse-textured soils low in organic matter that have been producing high yields. As the soil sulfate-sulfur level or cation exchange capacity increases in soils, the potential response to sulfur decreases. Table 8 outlines sulfur interpretations, based on soil sulfate-sulfur and cation exchange capacity. When these tests show a need for fertilizer sulfur, 10 to 20 pounds of sulfur is suggested for row crops, small grains and alfalfa. In Missouri, most other forages do not require sulfur, even on soils testing low in sulfur.

Table 8. Ratings of extractable soil sulfur test.

Soil sulfate-sulfur (ppm SO_4-S)	Cation exchange capacity (meq/100 g)	
	0 to 6.5	6.5+
0 to 7.5	Low	Adequate
7.5 +	Adequate	Adequate

55

Older Data Is Often Cited As the Reason For Not Applying Sulfur

Table 1. Grain yields averaged across sites for 1991 and 1992.

Year	S rate, lb/acre			
	0	15	30	60
	------------------- bu/acre -------------------			
1991	159	160	160	158
1992	184	184	181	184
1991–1992	174	174	172	174

56

Albrecht vs University:
Base Saturation Albrecht-75/15
University 82/10.5

Analysis

	P	K	Ca	Mg	S
	lb/acre				ppm
Albrecht	131	476	5399	646	15
MU	34	361	5921	457	3.8

Recommendations

	lb/acre	lb/acre			lb/acre
Albrecht	115	95	-	-	25
MJ	40	30			0

57

Sulfur Deficiency in Corn?

58

Following Full Recommendations Had The Greatest Forage Yield. With The Treatments Additive-P, K, Micros, Sulfur

	Year 1	Year 3
	lb/acre	lb/acre
N only	3500 b	3841 b
Recommendations	4578 a	5058 a
Recom. No pell lime	3820 ab	3841 b
Recom. No sulfur	3607 b	3937 b
Recom. No micros	3436 b	4369 ab
P and K only	3937 ab	4433 ab
PKS only	3831 ab	4177 ab
Micros only	3745 b	3697 b

Different letters indicate significance at the 0.10 probability

59

Forage Nutrient Analysis-Again Sulfur Makes a Tremendous Difference

Late April Harvest

	P	Mg	K	S
	%			
N only	0.31	0.16	2.4	0.26
Recommendations	0.42*	0.28*	3.3*	0.34*
Recom. No pell lime	0.41*	0.26*	3.2*	0.34*
PKS only	0.40*	0.28*	3.1*	0.31*
P and K only	0.36*	0.26*	2.8	0.29
Recom. No sulfur	0.34	0.24	2.7	0.27
Recom. No micros	0.37*	0.24	2.7	0.29
Micros only	0.38*	0.22	2.8	0.32*

***Indicate significance at the 0.05 level**

60

Forage Quality Analysis-Sulfur Makes A Tremendous Difference

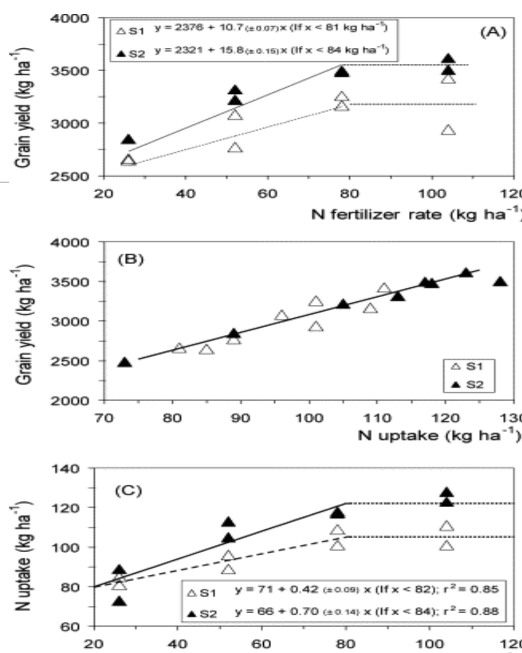
Late April Harvest

	CP	Lysine	Methionine
	%		
N only	**15**	**0.53**	**0.20**
Recommendations	**21***	**0.73***	**0.27***
Recom. No pell lime	**20***	**0.71***	**0.27***
PKS only	**19***	**0.66***	**0.25***
P and K only	**18***	**0.63***	**0.24***
Recom. No sulfur	**16**	**0.56**	**0.21**
Recom. No micros	**17**	**0.59**	**0.22**
Micros only	**18***	**0.63***	**0.23**

***Indicate significance at the 0.05 level**

61

Sulfur Tied To N Efficiency



62

Question: Is Potassium Sulfate a Better Source of Potassium Than Potassium Chloride?

63

2022 Data Compares Using KCl vs K_2SO_4 In the Recommendations

Treatment	lbs/acre
Control	3116
Rec.w/KCl	3351
Rec w/K2SO4	4098*
P and K only	3180
P, K, elemental S	3681
P,K, elemental S+MgSO4	2935

64

Crude Protein Higher With K_2SO_4 vs KCl

Treatment	CP	S	Lysine	Methionine
Control	14.8	0.22	0.52	0.19
Rec.w/KCl	14.2	0.24	0.49	0.19
Rec w/K2SO4	15.5	0.24	0.54	0.20
P and K only	14.3	0.23	0.50	0.19
P, K, elemental S	15.1	0.22	0.53	0.20
P,K, elemental S+MgSO4	14.7	0.22	0.51	0.19

65

Forage Yield and Quality Following Albrecht Recommendations Using KCl or K_2SO_4

Forage KCl vs $K_2 2O_4$

	Yield	CP	Lysine	Methionine
	lb/acre	%	%	%
Control	3521 c	17.7 c	0.62 c	0.23 c
KCl	4073 b	19.8 b	0.69 b	0.26 b
K_2SO_4	5026 a	21.9 a	0.76 a	0.29 a

Different letters indicate significance at the 0.1 probability level

66

Forage Nutrient Content Following Albrecht Recommendations Using KCl or K_2SO_4

Forage KCl vs K_22O_4

	P	Mg	K	S
	%	%	%	%
Control	0.37 b	0.21 b	3.21 b	0.28 c
KCl	0.38 b	0.23 b	3.28 b	0.33 b
K_2SO_4	0.45 a	0.26 a	3.78 a	0.37 ab

Different letters indicate significance at the 0.05 probability level

67

When N as Urea, P and K are Applied with Different Sources of K

Sulfur Source 2022

Treatment	lbs/acre
Control	3063
KCl	3511
K2SO4	3756*
KCl+Elemental S	3265
K2S04+Elemental S	3938*

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With Sulfur Either as Sulfate or Elemental Then Crude Protein is Greater

Treatment	CP	S	Lysine	Methionine
	%			
Control	15.1	0.25	0.52	0.20
KCl	16.4	0.27	0.57	0.21
K2SO4	17.4*	0.30*	0.60	0.23*
KCl+Elemental S	18.0*	0.28*	0.62*	0.23*
K2SO4+Elemental S	18.0*	0.28	0.63*	0.24*

*=Signficantly different at the 0.05 level

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Conclusions-Forage Yield and Quality

Following Recommendations Increased Yield and Crude Protein
- Importance of sulfur for yield and nutrient quality

Lysine and Methionine Increased Following Recommendations

There Was An Advantage Using K2SO4 Rather Than KCl
- Yield
- Quality

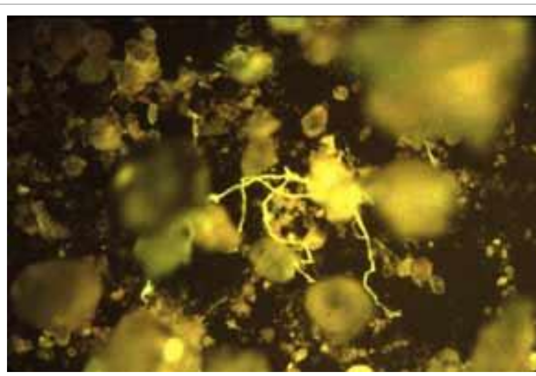
70

How Do Nutrients Affect Root And Shoot Growth And Ultimately Yield

AND WHY EACH NUTRIENT IS SO IMPORTANT

71

Living Plant Roots Exudates Feeds The Bacteria, Fungi, and other Life-
20-40% of Carbon Fixed By The Leaves Is Exuded By the Roots



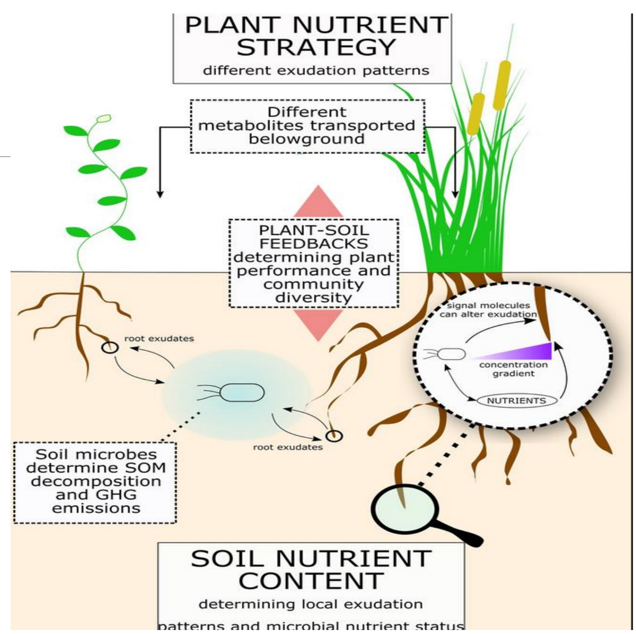
72

Plants Can Even Regulate What Compounds That They Exudate From the Roots Depending Upon What Microorganism Or Nutrient That They Need.

73

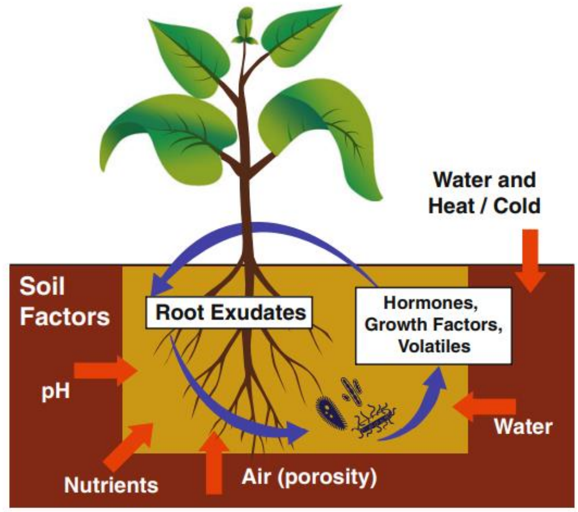
The Feedback Between The Plant and Soil Microbes Determines Plant Performance And Microbe Composition

Canarini et al, 2019



74

Root Exudates Interact With Soil Factors and Changes Soil Structure. Also, Release Hormones and Growth Factors



75

What Affects Root Growth? Nutrients

76

The Largest Affect on Root Growth Is Phosphorus: Followed Closely By Ca, Mg, and Boron

The Role of Mineral Nutrition on Root Growth of Crop Plants 279

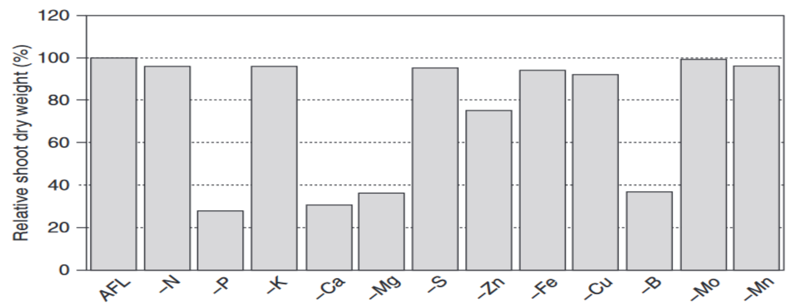


Figure 12 Relative shoot dry weight of dry bean as influenced by adequate fertility level (AFL) and other nutrients were not applied or omitted from the Oxisol.

amount of reduction depended on the nutrient. The impacts of deficiencies on growth were in the order of P > Ca > Mg > N = K > S among macronutrients and B > Zn > Cu > Fe > Mn > Mo among micronutrients. Similarly, the influence of N, P, and K on shoot and root growth of

77

N and P Deficiency Affect Root Growth More Than Shoot Growth.

Figure 12 Relative shoot dry weight of dry bean as influenced by adequate fertility level (AFL) and other nutrients were not applied or omitted from the Oxisol.

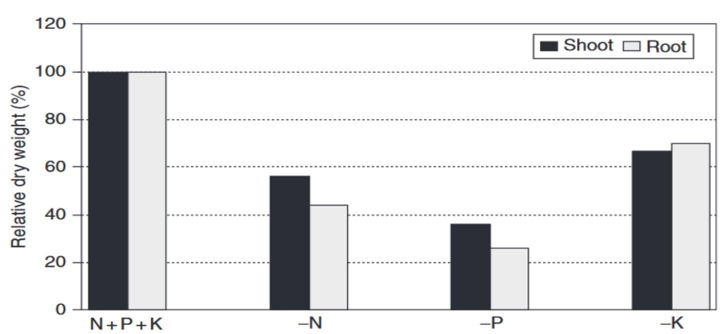


Figure 13 Relative dry weight of shoot and root of dry bean as influenced by N, P, and K fertilization.

78

Shoot Growth and Grain Yield Directly Related to Root Growth- If You Reduce Root Growth Then You Will Reduce Yield

The Role of Mineral Nutrition on Root Growth of Crop Plants 271

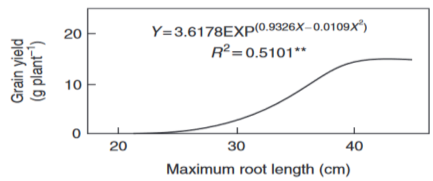


Figure 7 Relationship between maximum root length and grain yield of upland rice. Not the root dry weight.

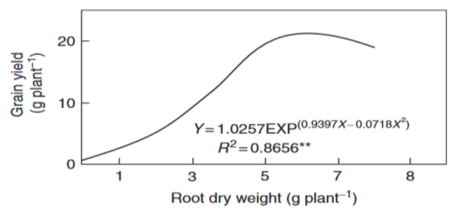


Figure 8 Relationship between root dry weight and grain yield of upland rice.

79

But Can You Have Too Much Of A Good Thing?

80

Rice Root Growth Related to P Nutrition-But Too Much Reduces Growth

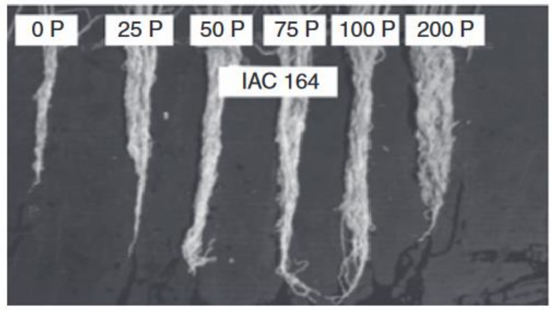


Figure 30 Root growth of upland rice cultivar IAC 164 at different P levels.

The Role of Mineral Nutrition on Root Growth of Crop Plants.
Fagerial and Moreia, 2011.

81

Soybean Root Growth Responds to Zn Nutrition to a Point-Remember Zn and P Negative Interaction

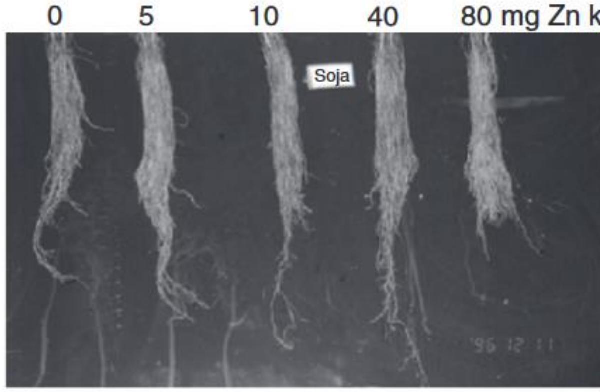
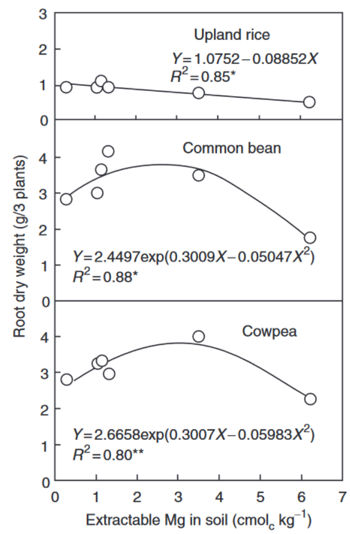


Figure 41 Root growth of soybean at different Zn levels.

82

Mg Is Important To Root Growth To A Point. Why?



gure 38 Root dry weights of upland rice, common bean, and cowpea grown with fferent Mg levels in an Oxisol (adapted from Fageria and Souza, 1991).

83

Soil Physical Properties From the Ca/Mg Base Saturation Percentage

84

Planter Marker-Near Plot is Recommendations, Far Plot is Magnesium Added

85

As the Soil Dried a Crack Appeared In the 4 ton/a Dolomitic Lime Plot But Ended At the Recommendation Plot

86

Conclusion

Following the Albrecht System Results in Greater Grain and Forage Yield

The Albrecht System Results in Greater Crude Protein Content

Sulfur Is Extremely Important (more on that Wednesday)

Root and Shoot Growth are Affected Differently By Nutrients

Root and Shoot Growth are Dependent Upon Each Other