Soil Conditions Favoring Micronutrient Deficiencies and Responses in 2001

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Why micronutrients now:

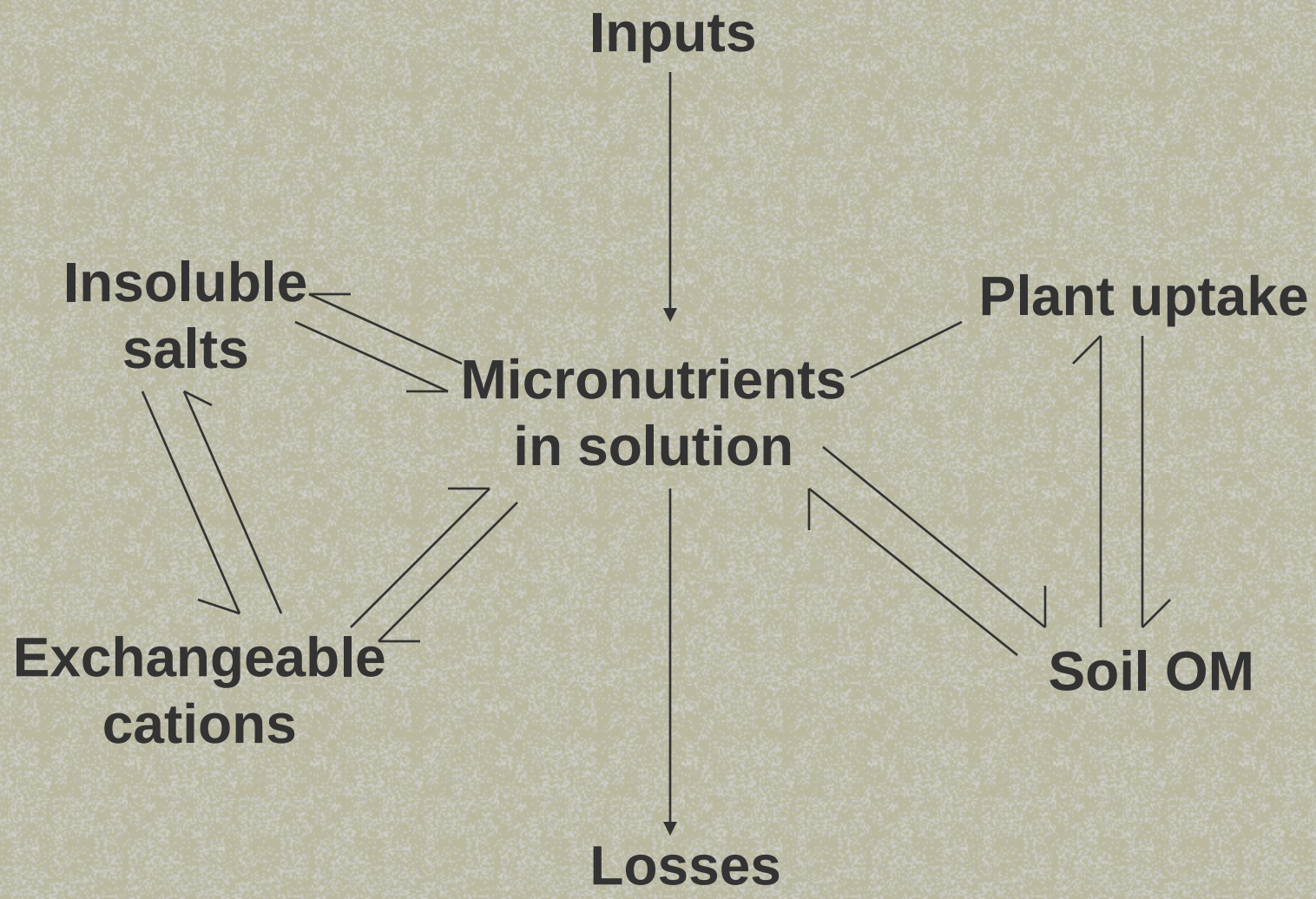
- Higher yield, therefore short stave
- Less widespread manure distribution
- Search for more profit margins

Cations

- Copper
- Manganese
- Nickel
- Iron
- Zinc

Anions

- Boron
- Chloride
- Molybdenum


Inputs
Insoluble salts
Micronutrients in solution
Plant uptake
Exchangeable cations
Soil OM
Losses

Factors affecting availability:

1. Soil organic matter
   - storehouse
   - chelation
2. Soil pH
   - Microbial activity
   - Solubility
3. Soil moisture content
   - Oxidation / reduction
   - Microbial activity
   - Root exploration

Factors affecting availability:

4. Soil exchange capacity / leachability
   - Retention vs. loss
5. Ion Interaction
   - Competition
   - Substitution
6. Weather
   - Nutrient absorption
   - Rate of growth

Conditions conducive to micronutrient deficiencies:

B	Sands; low organic matter; dry weather
Cl	Far from oceans; no use
Mo	Acid sands; high free iron
Mn	High pH; wet areas; burned peats; cool weather
Fe	High pH
Zn	Sands; high pH; eroded; cool weather
Cu	Acid organic soils; high soil zinc
Ni	High pH

Conditions conducive to micronutrient toxicities:

B	Seed placement
Cl	Arid, no leaching
Mo	Unlikely
Mn	Acid soils; waterlogged soils
Fe	Unlikely
Zn	Excessive application
Cu	Excessive application; sandy soils
Ni	Acid serpentine soils

2001 Experiments:

1. Composition evaluation
   - B, Ca, Mg, S, Fe, Mn, Cu, Zn

2. Micronutrient response / type
   - Manufactured vs. blended vs. liquid
   - + / – micronutrients

Experiment details:

- Hancock and Spooner
- 6 or 5 reps
- All plots received
  - 300 lb/a 0-0-60
  - 600 lb/a 2-2-10 and Admire
  - 200 lb N/a
- Micros added to 9-20-19 base applied at 500 lb/a

Initial soil tests

	Hancock	Spooner
pH	5.7	7.0
OM %	0.7	1.4
P ppm	117	52
K ppm	87	72
Ca ppm	230	790
Mg ppm	35	162
B ppm	0.1	0.4
Mn	20	21
Zn	3.2	1.7
SO_4-S	4.4	3.0

Composition of complete starter used:

	%	lb/a @ 500 lb/a
B	0.05	0.25
Fe	0.3	1.50
Ca	1.0	5.00
S	7.0	35.0
Mg	0.5	2.50
Zn	0.05	0.25
Cu	0.05	0.25
Mn	0.05	0.25

“Typical” UW micronutrient rec. if the nutrient is needed

Nutrient	Amount (lb/a)
B	0.5-1.0
Fe	0.5-2.0+
Cu	1.0-2.0*
Mn	3.0-5.0*
Zn	2.0-4.0*
Mo	0.0125‡

* Assumes land applied in sulfate form

+ As iron chelate

‡ Applied as seed treatment

Effect of micronutrient on potato tuber yield and quality at Hancock, 2001.

Starter†	Micronutrients	Total Yield	Grade A	> 6 oz Size Grade	Yield US#1 6-10 oz
		cwt/acre	----------%----------		cwt/acre
None	None	465	44	43	70
Manuf.	None	477	51	49	98
Manuf.	B, Fe	472	46	47	74
Manuf.	Ca, Fe, S	492	50	48	93
Manuf.	Ca, Fe, S, Mg	458	49	51	94
Manuf.	Ca, Fe, S, Mg, Zn	503	50	45	96
Manuf.	Ca, Fe, S, Mg, Zn, B	478	46	50	87
Manuf.	Ca, Fe, S, Mg, Zn, B, Cu	468	46	54	92
Manuf.	Ca, Fe, S, Mg, Zn, B, Cu, Mn	472	47	48	87
Statistical significance: Pr > F		0.84	0.49	0.30	0.05

† Starter was 500 lb/acre of 9-20-19.

Effect of micronutrient on potato tuber yield and quality at Spooner, 2001.

Starter†	Micronutrients	Total Yield	Grade A	> 6 oz Size Grade	Yield US#1 6-10 oz
		cwt/acre	----------%	----------	cwt/acre
None	None	462	53	60	117
Manuf.	None	506	50	63	125
Manuf.	B, Fe	507	53	60	119
Manuf.	Ca, Fe, S	502	55	72	123
Manuf.	Ca, Fe, S, Mg	487	53	60	118
Manuf.	Ca, Fe, S, Mg, Zn	494	54	68	133
Manuf.	Ca, Fe, S, Mg, Zn, B	533	57	68	148
Manuf.	Ca, Fe, S, Mg, Zn, B, Cu	489	54	62	118
Manuf.	Ca, Fe, S, Mg, Zn, B, Cu, Mn	460	51	64	108
Statistical significance: Pr > F		0.05	0.34	0.51	0.40

† Starter was 500 lb/acre of 9-20-19.

Effect of starter fertilizer type with and without micronutrients on potato tuber yield and quality at Hancock, 2001[+].

Starter	Micronutrients	Total Yield	Grade A	> 6 oz Size Grade	Yield US#1 6-10 oz
		cwt/acre	----------%----------		cwt/acre
None ‡		465	44	43	70
Blended	–	487	44	46	75
Liquid	–	495	46	48	87
Manuf.	–	477	51	49	98
Blended	+	457	46	44	74
Liquid	+	439	49	47	83
Manuf.	+	472	47	48	87

+ No differences between type of material or micronutrient addition at Pr≤0.05

‡ Not included in the statistical analysis.

Effect of starter fertilizer type with and without micronutrients on potato tuber yield and quality at Spooner, 2001[+].

Starter	Micronutrients	Total Yield	Grade A	> 6 oz Size Grade	Yield US#1 6-10 oz
		cwt/acre	----------%----------		cwt/acre
None ‡		462	53	68	117
Blended	–	507	53	64	132
Liquid	–	495	56	69	123
Manuf.	–	507	50	63	125
Blended	+	482	58	71	129
Liquid	+	488	51	67	122
Manuf.	+	460	51	64	108

+ No differences between type of material or micronutrient addition at Pr ≤ 0.05

‡ Not included in the statistical analysis.

Leaflet and petiole analyses for micronutrients at Hancock and Spooner, 2001.

Nutrient		Range detected		UW Sufficiency Range
		Hancock*	Spooner+	
Ca	%	1.06 - 1.22	0.91 - 1.04	0.6 - 2.5
Mg	%	0.69 - 0.95	0.60 - 0.74	0.25 - 1.25
S	%	0.30 - 0.46	0.38 - 0.44	0.2 - 0.5
Zn	ppm	11 - 12	19 - 26	20 - 70
B	ppm	21 - 25	26 - 28	5 - 40
Mn	ppm	483 - 585	96 - 256	20 - 200
Fe	ppm	185 - 229	94 - 110	11 - 300
Cu	ppm	16.3 - 18.5	8.7 - 10.5	5 - 30

* No statistically significant difference between treatments.

+ Difference in Ca, Mg and S detected but all where nutrient applied.

Summary:

- Micronutrient shortages can occur in Wisconsin
- No responses seen in Hancock or Spooner experiments
- Know need; apply enough to satisfy crop

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