

Nutrient Management and Fertilization

Raymond C. Ward
 President
 Ward Laboratories, Inc
 Kearney, Nebraska

Nutrient Crop Removal, lbs/Bu

Nutrient		Corn	Milo
• Nitrogen	N	0.75	0.85
• Phosphorus	P2O5	0.33	0.35
• Potassium	K2O	0.23	0.25
• Sulfur	S	0.07	0.05
• Zinc	Zn	0.001	0.001

Nutrient Crop Removal, lbs/Bu

Nutrient		Wheat	Millet
• Nitrogen	N	1.2	1.0
• Phosphorus	P2O5	0.52	0.38
• Potassium	K2O	0.26	0.25
• Sulfur	S	0.08	0.07
• Zinc	Zn	0.002	0.001

Crop Nutrient Removal, lbs/Ton

Nutrient		Alfalfa	Grass
• Nitrogen	N	54	33
• Phosphorus	P2O5	12	10
• Potassium	K2O	44	40
• Sulfur	S	5.0	2.6
• Zinc	Zn	0.04	0.04

Nutrient Removal

Nutrient		Cotton lbs/500 lbs	Sunflowers lbs/100 lbs
• Nitrogen	N	17	3.6
• Phosphorus	P2O5	10	1.2
• Potassium	K2O	6.7	1.1
• Sulfur	S	1.4	0.4
• Zinc	Zn	0.01	0.003

Soil Test Values, ppm

Soil Test	Medium
• Nitrate, N	9-19
• Phosphorus, P	13-25
• Potassium, K	81-120
• Sulfur, S	5-7
• Zinc, Zn	.51-1.0

Plant Uptake of Nutrients

- Mass flow of nutrient to roots
- Diffusion of nutrient from high to low levels
- Contact exchange
- Exchange of nutrient with H ion from the root
- Extension of root into nutrient source

Plant Use of Nitrogen

- NO_3 and NH_4
- Amino acids and Proteins
- DNA and RNA
- Essential for cell division
- Mobile in the plant meaning that nitrogen moves from older tissue to new growth
- Firing of older leaves

Plant use of Phosphorus

- HPO_4 and H_2PO_4
- ATP the energy and growth compound
- DNA
- Phospholipids --- for membrane integrity
- Deficiency best described as stunted growth and dark green to blue green color

Plant Use of Potassium

- K (exchangeable and water soluble)
- Enzyme activator
- Maintenance of osmotic potential
- Vital role in photosynthesis
- Mobile in the plant so deficiencies show on lower leaves

Plant use of Sulfur

- SO_4
- Constituent of amino acids
- Vitamins
- Some plant oils are rich in Sulfur
- Sulfur deficiency is yellowing of upper leaves

Plant use of Zinc

- Zn
- Essential for enzymes
- IAA --- essential for plant growth
- Deficiency shows as chlorosis of middle and upper part of the plants

Response to Micronutrients

	Corn	Grain Sorghum	Wheat
Zinc	High	High	Low
Iron	Medium	High	Low
Manganese	Low	High	High
Copper	Medium	Medium	High
Boron	Low	Low	Low

Nitrogen Requirement

- Corn 1.33 lbs N/Bu
- Wheat 2.4 lbs N/Bu
- Milo 1.3 lbs N/Bu
- Cotton 60 lbs N/500 lbs
- Grass 40 lbs N/Bu

Nitrogen Recommendation

- An Example
- Corn after Soybeans
- $200 \text{ bu/A} \times 1.33 = 266 \text{ lbs of N required}$
- Subtract the following
- Soil nitrate = 50 lbs of N
- Past soybeans = 40 lbs of N
- Amount of N to apply = 176 lbs of N/A

Phosphorus Recommendations lbs P₂O₅ per acre

- Medium P soil test

	13 ppm P	25 ppm P
• Corn, 200 bu/A	60	35
• Milo, 150 bu/A	45	25
• Cotton, 3 bales/A	50	30
• Wheat, 100 bu/A	60	40
• Alfalfa, 8 ton/A	75	50

Several Factors Influence Phosphorus Placement

- **Soil fertility levels**
- **Crop(s) to be grown**
- **Tillage methods, equipment and timing**
- **P fixing capacity of the soil**

Potassium Recommendations lbs K₂O per acre

- Medium soil K test

	81 ppm K	120 ppm K
Corn, 200 bu/A	80	55
Milo, 150 bu/A	50	35
Cotton, 3 bales/A	55	35
Wheat, 100 bu/A	50	35
Alfalfa, 8 ton/A	100	70

Sulfur Recommendations

lbs S per acre

- Medium soil S test and 1 % organic matter

	5 ppm S	7 ppm S
Corn, 200 bu/A	14	8
Milo, 150 bu/A	6	1
Cotton, 3 bales/A	3	0
Wheat, 100 bu/A	13	8
Alfalfa, 8 ton/A	25	20

Documented sulfur deficiencies are increasing because of:

- Increased crop yields
- Use of high analysis fertilizers containing little incidental S
- Less use of high S fuels
- Fewer S - containing pesticides
- Slower organic matter breakdown with conservation tillage

Zinc Recommendations

lbs Zn per acre

- Medium Zn soil test

	0.51 ppm	0.75 ppm
Corn	5	2
Milo	2	0
Cotton	0	0
Wheat	0	0
Alfalfa	0	0

Factors Contributing to Soil Acidity

Loss of Ca and Mg by leaching and erosion

Crop Removal of Ca and Mg

CO₂ Release by roots; microorganism

Acid-forming plant residues; fertilizers

In Furrow Fertilizer

Pounds N + K₂O

Crop	30 " rows	7 " rows
• Corn	8	32
• Milo	4	16
• Sunflowers	4	16
• Soybeans	0	6
• Wheat	8	32