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## ***MICRO NUTRIENTS AND SECONDARY NUTRIENTS***

Trace elements or micronutrients and secondary nutrients are absolutely essential for plant growth. The need for these nutrients varies widely with crop, soil conditions, and farm management, and the levels of Nitrogen Phosphate and Potassium.

For all crops, micronutrients are equally as vital as the primary NPK plant foods. The only difference is the amount--plants need relatively small quantities of micronutrients. The quantity of a micronutrient that a particular crop will require varies. Corn will require nitrogen and zinc in the ratio of about 100 to 1. But, the lack of zinc can make the difference between a 100-bushel per hectare harvest and a crop failure. The deficiency of one or more micronutrients or secondary nutrients can be very costly in the long run.

Constant attention should be given to micronutrient levels and needs. A crop can suffer from nutrient deficiency without showing a specific symptom. If the symptom is evident, the crop is already suffering a deficiency and a yield reduction will result. It would be an economic safeguard to check-and-avoid or, at least, check-and-remedy any yield-robbing problems.

The following table is a guide to the factors that affect micronutrient and secondary nutrient deficiencies -and the crops most susceptible to these deficiencies.

## Micronutrients and Secondary Nutrients.

<b>Micronutrient</b>	<b>Functions within the plant</b>	<b>Soil type and condition where deficiency may occur</b>	<b>Crops most susceptible to this nutrient deficiency</b>
<b>Boron (B)</b>	Essential to actively growing tissue in the new growth; necessary for pollen viability and good seed set.	Occurs in acid-leached soils, coarse textured sandy soils, peats and mucks, drought conditions, over-limed soils, alkaline or low organic matter soils,	Alfalfa, apples, beets, clovers, citrus, cotton, cauliflower, cabbage, celery, corn, sweet potatoes, tomatoes, tree crops, sugar beets, and tobacco.
<b>Copper (Cu)</b>	A major part of a necessary photosynthesis enzyme. Very important during the plant's reproductive stage.	Occurs in sandy soils, peats and mucks, over limed soils, and in high concentrations of iron and manganese.	Small grains, corn, vegetables, tree fruits, wheat, carrots, onions.
<b>Iron (Fe)</b>	Promotes formation of chlorophyll.	Occurs in alkaline soils, in calcareous soils when cold and wet, in soils where phosphate has been excessively applied.	Beans, soybeans, corn, sorghum, tree fruits, ornamentals, grasses, milo, lemons, limes and rice.
<b>Manganese (Mn)</b>	A part of important enzymes involved in respiration and protein synthesis.	Occurs in acid soils (low pH) and in highly-weathered acid leached soils. And in soils with low phosphate levels.	Soybeans, small grains, tree fruits, cotton, leafy vegetables, dry beans, and sugar beets.
<b>Molybdenum (Mo)</b>	Essential for nitrogen fixation by nodule bacteria in legumes. Essential for nitrogen reductase performance nitrate to amine form.	Occurs in acid soils (low pH) and in highly-weathered acid leached soils. And in soils with low phosphate levels.	Cauliflower, citrus, tobacco, and all legumes.
<b>Zinc (Zn)</b>	Important as a catalyst for plant growth regulators in plants and the use of other nutrients. Affects maturity .	Occurs in calcareous soils (pH of 6.0 or above) after leaching and erosion; in acid leached soils; in coarse sands; and in soils where phosphate has been excessively applied. Also in low-organic matter, or over limed soils.	Beans, soybeans, citrus, corn, sorghum, onions, potatoes, tree fruits, flax, sugar beets, wheat, cotton, milo, rice, sweet corn.

<b>Calcium (Ca)</b>	A secondary nutrient found in greatest amount in cell walls. Utilized in Cell division and involved in nitrogen metabolism.	Occurs in low pH soils. Also in areas of high nitrogen applications, and high potassium levels, Particularly prevalent in the upland soils of the old cotton belt.	Alfalfa, vegetable crops, tree fruits cotton, potatoes, tomatoes, sugar beets, celery, citrus, soybeans, most other legumes.
<b>Magnesium (Mg)</b>	A secondary nutrient and is a part of chlorophyll. Participates in the activity of enzymes. Assists in translocation of phosphorus in the plant.	Occurs in low pH soils. Also in soils where excessive potash has been applied, or in areas of high calcium-lime use.	Cotton, cabbage, roots, celery, corn, cucumbers, melons, squash, snapbeans, Tree fruits, small Grains, onions, potatoes, tobacco, sugar cane, tomatoes, turnips, corn, and citrus.
<b>Sulfur(S)</b>	A secondary nutrient necessary for the formation of several amino acids which are used to form protein. Also, influences sugar metabolism.	In areas of low soil sulfate level, and where there is excessively available nitrogen on low organic matter soils. (There should be one pound of sulfur for every 10 lbs.of available nitrogen.)	Citrus, corn, sorghum, cotton, small grains, legumes, sugar beets, sugar cane, tomatoes, potatoes, and many other vegetables.

# Average values and critical levels

## Average values and critical levels for CI

	Percent										Parts per million				
	N	S	P	K	Ca	Na	Fe	Al	Mn	B	CU	Zn	Mo		
Alfalfa (whole tops at early bloom)															
Average values	4.3	.28	.38	2.6	.40	1.8		65	60	44	11	35	2.2		
Critical levels	2.5	.10	.15	1.4	.18	.65	.031		25	20	5	13	.6		
Apples (mature leaves)															
Average values	2.3	.19	.30	2.0	.40	2.0	.021	90	40	140	60	20	60	.8	
Critical levels	1.7	.08	.18	1.2	.25	1.3		15		35	35	5	20	.05	
Barley (leaf blades)															
Average values	1.2	.24	.33	1.5	.14	.36		23	35	10	7	26	0.6		
Critical levels	.4	.05	.8	.75			.031		18	4	4	14	.3		
<u>Cabbage</u> (leaves)															
Average values	3.3	1.05	.63	4.8	.36	2.1	.07	1185	180	70	40	8	38		
Celery (outer leaves and stems)															
Average values	4.0	1.15	.75	5.0	.45	2.8	.18	1125	105	90	40	11	36	3	
Cherry (mature leaves)															
Average values	3.3	.20	.38	1.9	.74	2.6		50	150	54	28	50	1.2		
Critical levels	2.3		.23	1.0	.49	1.6	.021	45		120	38	8	17		
Citrus (mature leaves)															
Average values	2.6	.28	.28	1.4	.38	3.9	.051	85	45	45	36	12	24		
Clovers (various whole tops)															
Average values	3.15	.25	.34	2.35	.28	1.55	.041	65	60	45	30	11	34	2.0	
Critical levels		.14	.4	.85	.11	.40		25		25	15	5	11	.7	
Com (leaves at tasseling)															
Average values	2.80	.26	.33	2.4	.28	.50	.03	130	105	80	13	10	33	1.1	
Critical levels	1.40	.12	.20	1.2	.09	.20		25		30	4	4	15		
Whole plant (dent stage)															
Average values	1.45	.13	.28	1.3	.20	.30	.02	140	75	50	9	8	26	.8	
Cotton (leaves and petioles)															
Average values	3.3	.46	.50	2.9	.60	2.8	.12	1120	95	85	50	12	35	3	
Critical levels	1.8	.18	.18	1.0	.28	1.2	.12	70		25	20	6	15		
Cucumbers (leaves)															
Average values	2.9	.30	.52	2.9	.54	2.2	.08	140	90	115	45	16	35		

**Average values and critical levels for**

**crops**

**Parts per million**

	N	S	Percent				Ca	Na	Fe	Al	Parts <u>per</u> million				
			P	K							Mn	B	Cu	Zn	Mo
<b>Grass, Bahia</b> (leaf blades)															
Average values	2.5	.40	.40	1.45	.32	.52		.01	11	60	125	9	11	31	.8
Critical levels			.12	.55	.15							3	5		
<b>Grass, Brome</b> (leaf blades)															
Average values	1.5	.14	.25	2.0	.20	.39		.01	50	30	45	11	5	22	
<b>Grass, Coastal</b>															
Bermuda (leaf blades and stems)															
Average values	2.6	.35	.27	1.65	.22	.39		.03	1	88	55	7	6	23	.7
Critical levels	.85	.20	.14	.85	.08	.17					20	2	2	14	
<b>Grass, Fescue</b> (leaf blades)															
Average values	1.6	.23	.34	2.4	.28	.48		.01	85	80	70	10	8	24	
<b>Grass, Pangola</b>															
(whole tops)															
Average values	2.10	.25	.50	2.0	.14	.55		.15	75	60	110	.10	10	35	.7
<b>Grass, St. Augustine</b>															
(whole tops)															
Average values	1.95	.35	.40	2.2	.24	.50		.2	.55	35	45	8	13	33	.8
<b>Grass, HybrId Sudan</b>															
(leaf blades)															
Average values	2.3	.18	.35	2.8	.35	.56		.02	1115	80	85	12	10	29	.7
<b>Grasses, Various</b>															
Average values	2.00	.28	.35	2.2	.23	.45		.03	1115	95	75	9	9	27	.6
<b>Lettuce</b> (whole tops)															
Average values	4.3	.48	.55	5.4	.42	1.5		.15	1120	85	120	32	14	45	.8
<b>Oats</b> (leaf blades)															
Average values	2.2	.21	.33	2.6	.22	.38				80	65	9	9	23	.9
Critical levels	1.0	.11	.13	1.0	.11	.16		.02			20	4	5	12	.4
<b>Oranges</b> (leaves)															
Average values	2.4	.34	.20	1.35	.35	4.4		.07	11:	150	120	54	15	60	.6
Critical levels	1.2	.12	.09	.45	.15	1.0					15	8	6	10	
<b>Peach</b> (leaves)															
Average values	3.40	.28	.30	3.0	.54	2.5		.03	1130	130	150	43	12	50	.7
Critical levels	2.50		.15	2.1	.44	1.9					120	28	7	17	
<b>Peanuts</b> (leaves)															
Average values	3.2	.28	.32	2.4	.40	2.0		.04	1130	120	95	32	8	27	2.0
<b>Pears</b> (leaves)															
Average values	2.4		.25	2.0	.60	1.90		I				47	40	60	

Average values and critical levels for  
crops

	N	Percent					Parts per million							
		S	P	K	Mg	Ca	Na	Fe	Al	Mn	B	Cu	Zn	Mo
Pecan (leaves)														
Average values	2.6	.15	.20	1.35	.33	1.2	.02	1100	140	115	55	20	42	3
Peppers (leaves and petioles)														
Average values		.55	.52	5.8	.56	1.5	.101	245	150	115	46	17	43	
Potatoes, Irish (leaves and petioles)														
Average values	5.8	.33	.70	4.5	.48	1.5	.051	200	500	120	35	18	44	5
Critical levels	3.1	.18	.36	2.2	.20	.55		75		30	9	6	15	
Rice (leaf blades)														
Average values	3.2	.25	.33	1.65	.13	.29	.031	1120		60145	5	6	19	.9
Critical levels	1.2	.13	.15	.85	.07	.14		70		50		2	15	
Rye (leaf blades)														
Average values	1.50	.20	.45	2.15	.19	.55	.02	1120	100	80	10	9	35	1.0
Sorghum, Milo (leaf blades)														
Average values	2.3	.24	.38	2.1	.19	.42		85	80	50	12	8	27	1.1
Critical levels	1.4	.11	.21	1.2	.09	.17	.021	30		18	4	3	10	.3
Soybeans (leaves)														
Average values	4.2	.37	.35	2.0	.45	1.6	.021	1130	60	95	35	11	36	2.2
Critical levels	3.0	.20	.16	1.2	.12	.3		25		20	15	6	15	.6
Sugar Beets (leaves and petioles)														
Average values	3.5	.36	.34	3.0	.38	1.2	.081	180	100	105	35	14	35	1.1
Critical levels	2.1	.12	.21	1.3	.18	.4		.95		30	18	5	14	.5
Sugar Cane (leaves)														
Average values	2.4	.18	.26	2.1	.15	.30	.01	185	25	45	7	8	20	.9
Critical levels					.07	.12		25		17	3		7	
Tobacco (leaves)														
Average values	3.9	.70	.55	3.8	.85	3.2			125	190	31	15	36	1.1
Critical levels	2.0	.32	.24	2.1	.37	1.7	.10	1200		35	16	5	18	
Tomatoes (mature leaves and petioles)														
Average values	5.1	.80	.65	3.2	.41	2.9			115	130	52	20	36	1.0
Critical levels	2.2	.24	.18	1.1	.17	.9	.061	11		40	20	3	15	
Turnips (tops)														
Average values			.80	3.8	.24	2.3	.1-4	230	450	140	45	13	65	2.4
Wheat (leaf blades)														
Average values	2.6	.25	.36	2.6	.16	.45	.02	80	50	60	8	8	32	.8
Critical levels								20			4	4		