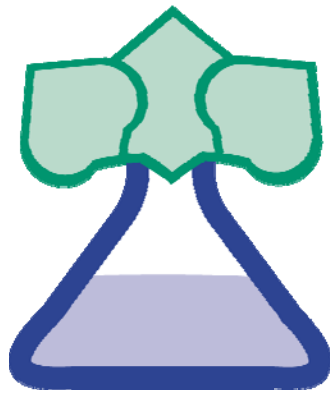


Plant Tissue Interpretative Guidelines



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ALFALFA

Stage of Maturity:

Upper 1/3 of plant sampled at 1/10 bloom stage.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.50	2.75 – 4.00	>4.00
Phosphorus, %	0.25	0.30 – 0.45	>0.45
Potassium, %	2.25	2.50 – 3.40	>3.40
Calcium, %	0.70	0.80 – 2.50	>2.50
Magnesium, %	0.25	0.30 – 0.70	>0.70
Sulfur, %	0.25	0.30 – 0.50	>0.50
Iron, ppm	30	50 – 250	>250
Manganese, ppm	20	25 – 100	>100
Zinc, ppm	20	25 – 60	>60
Copper, ppm	3	5 – 30	>30
Boron, ppm	25	30 – 60	>60
Molybdenum, ppm	1.20	2 – 5	>5

ALMONDS			
<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.0	2.0 – 2.2	2.2 – 2.7
Phosphorus, %	-	-	-
Potassium, %	1.0	1.0 – 1.4	1.4+
Calcium, %	2.0	2.0 – 2.1	2.1+
Magnesium, %	0.25	0.25 – 0.26	0.26+
Sulfur, %	-	-	-
Iron, ppm	-	-	-
Manganese, ppm	-	-	-
Zinc, ppm	18	18 – 19	19+
Copper, ppm	-	-	-
Boron, ppm	25	25 – 30	30 – 65

Comments:

1. N levels in August and September can be 0.2 – 0.3% lower and be equivalent to July samples.
2. Sodium, chloride, and boron in excess of 0.25%, 0.3%, and 85 ppm, respectively, may cause reduced growth.

APPLE

Stage of Maturity:

Leaves from non-fruiting spurs on spur-bearing trees.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.90	1.90 – 2.00	2.00 – 2.40
Phosphorus, %	0.08	0.08 – 0.10	0.10 – 0.30
Potassium, %	1.00	1.00 – 1.20	1.20 – 2.00
Calcium, %	0.20	0.20 – 1.00	1.00 – 3.00
Magnesium, %	0.10	0.10 – 0.25	0.25 – 0.75
Sulfur, %	0.10	0.10 – 0.15	0.15 – 0.30
Iron, ppm	20	20 – 50	50 – 250
Manganese, ppm	10	10 – 20	20 – 200
Zinc, ppm	15	15 – 18	18 – 40
Copper, ppm	2	2 – 4	4 – 25
Boron, ppm	20	20 – 25	25 – 70

BARLEY
Grain, Malting Barley

Stage of Maturity:
Seedling stage (less than 12 inches)

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	4.00	4.00 – 4.20	4.20 – 5.00
Phosphorus, %	0.25	0.25 – 0.28	0.28 – 0.50
Potassium, %	1.60	1.60 – 1.75	1.75 – 3.00
Calcium, %	0.12	0.12 – 0.20	0.20 – 1.00
Magnesium, %	0.10	0.10 – 0.12	0.12 – 0.80
Sulfur, %	0.15	0.15 – 0.18	0.18 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	10	10 – 15	15 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25

BARLEY
Grain, Malting Barley

Stage of Maturity:
Three to four uppermost leaves prior to heading.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.75	1.75 – 2.50	2.50 – 4.50
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.50
Potassium, %	1.50	1.50 – 1.60	1.60 – 3.00
Calcium, %	0.10	0.10 – 0.15	0.15 – 1.00
Magnesium, %	0.08	0.08 – 0.10	0.10 – 0.80
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	10	10 – 15	15 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25

BEANS

Black Turtle, Castor, Dry Edible, Field, Garbanzo, Kidney, Navy, Pinto, Soup

Stage of Maturity:

Most fully developed trifoliate leaf from top of plant prior to or during initial flowering.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.25	3.25 – 4.00	4.00 – 5.50
Phosphorus, %	0.15	0.15 – 0.25	0.25 – 0.50
Potassium, %	1.25	1.25 – 1.70	1.70 – 2.50
Calcium, %	0.20	0.20 – 0.35	0.35 – 2.00
Magnesium, %	0.10	0.10 – 0.25	0.25 – 1.00
Sulfur, %	0.15	0.15 – 0.25	0.25 – 0.35
Iron, ppm	15	15 – 25	25 – 350
Manganese, ppm	20	20 – 25	25 – 150
Zinc, ppm	15	15 – 20	20 – 70
Copper, ppm	2	2 – 4	4 – 10
Boron, ppm	10	10 – 20	20 – 50

BEANS – SNAP

Stage of Maturity:

Two or three fully developed leaves at top of plant.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.25	3.25 – 3.50	3.50 – 4.50
Phosphorus, %	0.15	0.15 – 0.25	0.25 – 0.50
Potassium, %	1.25	1.25 – 1.35	1.35 – 2.00
Calcium, %	0.20	0.20 – 0.35	0.35 – 4.00
Magnesium, %	0.10	0.10 – 0.25	0.25 – 1.50
Sulfur, %	0.15	0.15 – 0.25	0.25 – 0.50
Iron, ppm	15	15 – 25	25 – 350
Manganese, ppm	20	20 – 25	25 – 150
Zinc, ppm	15	15 – 20	20 – 70
Copper, ppm	2	2 – 4	4 – 20
Boron, ppm	10	10 – 20	20 – 100

BLACKBERRY

Stage of Maturity:
Mature leaves from new growth.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.25	1.25 – 1.45	1.45 – 3.00
Phosphorus, %	0.08	0.08 – 0.10	0.10 – 0.40
Potassium, %	0.35	0.35 – 0.40	0.40 – 0.90
Calcium, %	0.30	0.30 – 0.35	0.35 – 0.80
Magnesium, %	0.10	0.10 – 0.12	0.12 – 0.40
Sulfur, %	0.10	0.10 – 0.12	0.12 – 0.40
Iron, ppm	30	30 – 35	35 – 200
Manganese, ppm	35	35 – 40	40 – 600
Zinc, ppm	8	8 – 10	10 – 100
Copper, ppm	3	3 – 4	4 – 20
Boron, ppm	10	10 – 12	12 – 35

BLUEBERRY

Stage of Maturity:

Recent fully expanded leaves collected in July or August.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.50	1.50 – 1.75	1.75 – 2.50
Phosphorus, %	0.08	0.08 – 0.12	0.12 – 0.60
Potassium, %	0.35	0.35 – 0.40	0.40 – 0.90
Calcium, %	0.13	0.13 – 0.30	0.30 – 1.00
Magnesium, %	0.10	0.10 – 0.15	0.15 – 0.50
Sulfur, %	0.10	0.10 – 0.12	0.12 – 0.30
Iron, ppm	60	60 – 100	100 – 400
Manganese, ppm	25	25 – 50	50 – 450
Zinc, ppm	8	8 – 15	15 – 80
Copper, ppm	5	5 – 7	7 – 25
Boron, ppm	18	18 – 25	25 – 200

CANE

Stage of Maturity:
Seedling to 3 or 4 leaf stage.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.40	3.40 – 3.50	3.50 – 4.00
Phosphorus, %	0.25	0.25 – 0.30	0.30 – 0.60
Potassium, %	2.50	2.50 – 3.00	3.00 – 4.50
Calcium, %	0.10	0.10 – 0.15	0.15 – 0.90
Magnesium, %	0.15	0.15 – 0.35	0.35 – 0.50
Sulfur, %	0.20	0.20 – 0.25	0.25 – 0.50
Iron, ppm	15	15 – 25	25 – 350
Manganese, ppm	30	30 – 40	40 – 150
Zinc, ppm	15	15 – 30	30 – 60
Copper, ppm	3	3 – 5	5 – 15
Boron, ppm	5	5 – 10	10 – 25
Chloride, %	0.15	0.15 – 0.20	0.20 – 0.50

CANE

Stage of Maturity:
Fully expanded leaf sampled at 3 to 4 leaf stage prior to heading.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.00	3.00 – 3.20	3.20 – 4.20
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.60
Potassium, %	1.50	1.50 – 2.00	2.00 – 3.00
Calcium, %	0.10	0.10 – 0.15	0.15 – 0.90
Magnesium, %	0.10	0.10 – 0.20	0.20 – 0.50
Sulfur, %	0.15	0.15 – 0.20	0.20 – 0.30
Iron, ppm	15	15 – 25	25 – 350
Manganese, ppm	15	15 – 20	20 – 150
Zinc, ppm	10	10 – 20	20 – 40
Copper, ppm	3	3 – 5	5 – 15
Boron, ppm	2	2 – 4	4 – 20
Chloride, %	0.15	0.15 – 0.20	0.20 – 0.50

CANE

Stage of Maturity:
Third leaf below head from heading to soft dough stage.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.50	2.50 – 2.70	2.70 – 3.50
Phosphorus, %	0.15	0.15 – 0.20	0.20 – 0.30
Potassium, %	1.25	1.25 – 1.60	1.60 – 2.00
Calcium, %	0.10	0.10 – 0.15	0.15 – 0.30
Magnesium, %	0.08	0.08 – 0.12	0.12 – 0.20
Sulfur, %	0.13	0.13 – 0.18	0.18 – 0.30
Iron, ppm	15	15 – 25	25 – 350
Manganese, ppm	15	15 – 20	20 – 150
Zinc, ppm	10	10 – 12	12 – 20
Copper, ppm	1	1 – 2	2 – 5
Boron, ppm	2	2 – 4	4 – 20
Chloride, %	0.15	0.15 – 0.20	0.20 – 0.50

CANOLA

Stage of Maturity:
Uppermost recently mature leaf blade prior to flowering.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.60	3.60 – 4.00	4.00 – 6.40
Phosphorus, %	0.37	0.37 – 0.42	0.42 – 0.69
Potassium, %	2.15	2.15 – 3.50	3.50 – 5.10
Calcium, %	1.60	1.60 – 2.10	2.10 – 3.00
Magnesium, %	0.10	0.10 – 0.15	0.15 – 0.62
Sulfur, %	0.47	0.47 – 0.65	0.65 – 0.90
Iron, ppm	82	82 – 100	100+
Manganese, ppm	20	20 – 30	30 – 250
Zinc, ppm	28	28 – 33	33 – 49
Copper, ppm	4	4 – 5	5 – 25
Boron, ppm	20	20 – 25	25 – 54

CANTALOUPE

Stage of Maturity:
Petiole of 6th leaf from growing tip at flowering.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
<u>Early Growth</u>			
Nitrate-N, ppm	8,000	8,000 – 10,000	10,000 – 15,000
Phosphate-P, ppm	2,000	2,000 – 3,000	3,000 – 6,000
Potassium, %	4	4 – 5	5 – 7
<u>Early Fruit</u>			
Nitrate-N, ppm	5,000	5,000 – 7,000	7,000 – 12,000
Phosphate-P, ppm	1,500	1,500 – 2,000	2,000 – 4,000
Potassium, %	3	3 – 4	4 – 6
<u>1st Mature Fruit</u>			
Nitrate-N, ppm	2,000	2,000 – 3,000	3,000 – 6,000
Phosphate-P, ppm	1,000	1,000 – 1,500	1,500 – 2,500
Potassium, %	2	2 – 3	3 – 5

CANTALOUPE

Stage of Maturity:
6th leaf from growing tip at flowering.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.00	3.00 – 3.50	3.50 – 5.50
Phosphorus, %	0.20	0.20 – 0.30	0.30 – 0.80
Potassium, %	3.00	3.00 – 4.00	4.00 – 5.00
Calcium, %	1.75	1.75 – 2.3	2.30 – 3.20
Magnesium, %	0.20	0.20 – 0.35	0.35 – 0.80
Sulfur, %	0.20	0.20 – 0.25	0.25 – 1.40
Iron, ppm	20	20 – 50	50 – 300
Manganese, ppm	20	20 – 50	50 – 250
Zinc, ppm	15	15 – 20	20 – 200
Copper, ppm	3	3 – 7	7 – 30
Boron, ppm	20	20 – 25	25 – 60

CHERRIES – SWEET

Stage of Maturity:

Mature leaves from new growth in summer.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.90	1.90 – 2.10	2.10 – 3.00
Phosphorus, %	0.12	0.12 – 0.16	0.16 – 0.50
Potassium, %	1.50	1.50 – 1.60	1.60 – 3.00
Calcium, %	1.40	1.40 – 1.50	1.50 – 3.00
Magnesium, %	0.20	0.20 – 0.30	0.30 – 0.80
Sulfur, %	0.08	0.08 – 0.10	0.10 – 0.50
Iron, ppm	50	50 – 100	100 – 250
Manganese, ppm	20	20 – 40	40 – 200
Zinc, ppm	15	15 – 20	20 – 60
Copper, ppm	2	2 – 5	5 – 30
Boron, ppm	15	15 – 20	20 – 100

CLOVER

Stage of Maturity:
Mature leaves prior to flowering.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.00	3.00 – 4.00	4.00 – 5.50
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.70
Potassium, %	1.75	1.75 – 2.00	2.00 – 3.50
Calcium, %	1.00	1.00 – 1.30	1.30 – 2.00
Magnesium, %	0.15	0.15 – 0.25	0.25 – 0.50
Sulfur, %	0.20	0.20 – 0.25	0.25 – 0.50
Iron, ppm	20	20 – 25	25 – 250
Manganese, ppm	20	20 – 25	25 – 150
Zinc, ppm	15	15 – 20	20 – 70
Copper, ppm	2	2 – 4	4 – 10
Boron, ppm	20	20 – 30	30 – 80

CORN

Stage of Maturity:

1. Whole plant from seedling to 6th leaf stage.
2. Fully expanded leaf prior to tasseling.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.75	2.75 – 3.00	3.00 – 3.50
Phosphorus, %	0.22	0.22 – 0.25	0.25 – 0.50
Potassium, %	2.25	2.25 – 2.50	2.50 – 4.00
Calcium, %	0.12	0.12 – 0.15	0.15 – 0.50
Magnesium, %	0.10	0.10 – 0.12	0.12 – 0.40
Sulfur, %	0.15	0.15 – 0.18	0.18 – 0.35
Iron, ppm	10	10 – 20	20 – 250
Manganese, ppm	40	40 – 50	50 – 160
Zinc, ppm	18	18 – 20	20 – 40
Copper, ppm	3	3 – 5	5 – 15
Boron, ppm	2	2 – 5	5 – 20
Chloride, %	0.15	0.15 – 0.20	0.20 – 0.50
Molybdenum, ppm	0.10	0.10 – 0.80	0.80 – 5.00

CORN

Stage of Maturity:

Ear leaf at early silk.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.50	2.50 – 2.70	2.70 – 3.25
Phosphorus, %	0.20	0.20 – 0.22	0.22 – 0.30
Potassium, %	1.60	1.60 – 1.75	1.75 – 2.50
Calcium, %	0.10	0.10 – 0.12	0.12 – 0.30
Magnesium, %	0.08	0.08 – 0.12	0.12 – 0.25
Sulfur, %	0.13	0.13 – 0.15	0.15 – 0.22
Iron, ppm	10	10 – 20	20 – 250
Manganese, ppm	15	15 – 20	20 – 150
Zinc, ppm	15	15 – 18	18 – 25
Copper, ppm	2	2 – 3	3 – 10
Boron, ppm	2	2 – 3	3 – 10
Chloride, %	0.15	0.15 – 0.20	0.20 – 0.50
Molybdenum, ppm	0.10	0.10 – 0.80	0.80 – 5.00

CORN – SEED

Stage of Maturity:

1. Whole plant from seedling to 6th leaf stage.
2. Fully expanded leaf prior to tasseling.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.75	2.75 – 3.00	3.00 – 3.50
Phosphorus, %	0.22	0.22 – 0.25	0.25 – 0.50
Potassium, %	2.25	2.25 – 2.50	2.50 – 4.00
Calcium, %	0.12	0.12 – 0.15	0.15 – 0.50
Magnesium, %	0.10	0.10 – 0.12	0.12 – 0.40
Sulfur, %	0.15	0.15 – 0.18	0.18 – 0.35
Iron, ppm	10	10 – 20	20 – 250
Manganese, ppm	40	40 – 50	50 – 160
Zinc, ppm	18	18 – 20	20 – 40
Copper, ppm	3	3 – 5	5 – 15
Boron, ppm	2	2 – 5	5 – 20
Chloride, %	0.15	0.15 – 0.20	0.20 – 0.50

CORN – SEED

Stage of Maturity:

Ear leaf at early silk.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.50	2.50 – 2.70	2.70 – 3.25
Phosphorus, %	0.20	0.20 – 0.22	0.22 – 0.30
Potassium, %	1.60	1.60 – 1.75	1.75 – 2.50
Calcium, %	0.10	0.10 – 0.12	0.12 – 0.30
Magnesium, %	0.08	0.08 – 0.12	0.12 – 0.25
Sulfur, %	0.13	0.13 – 0.15	0.15 – 0.22
Iron, ppm	10	10 – 20	20 – 250
Manganese, ppm	15	15 – 20	20 – 150
Zinc, ppm	15	15 – 18	18 – 25
Copper, ppm	2	2 – 3	3 – 10
Boron, ppm	2	2 – 3	3 – 10
Chloride, %	0.15	0.15 – 0.20	0.20 – 0.50

CORN – SILAGE

Stage of Maturity:

1. Whole plant from seedling to 6th leaf stage.
2. Fully expanded leaf prior to tasseling.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.75	2.75 – 3.00	3.00 – 3.50
Phosphorus, %	0.22	0.22 – 0.25	0.25 – 0.50
Potassium, %	2.25	2.25 – 2.50	2.50 – 4.00
Calcium, %	0.12	0.12 – 0.15	0.15 – 0.50
Magnesium, %	0.10	0.10 – 0.12	0.12 – 0.40
Sulfur, %	0.15	0.15 – 0.18	0.18 – 0.35
Iron, ppm	10	10 – 20	20 – 250
Manganese, ppm	40	40 – 50	50 – 160
Zinc, ppm	18	18 – 20	20 – 40
Copper, ppm	3	3 – 5	5 – 15
Boron, ppm	2	2 – 5	5 – 20
Chloride, %	0.15	0.15 – 0.20	0.20 – 0.50

CORN – SILAGE

Stage of Maturity:

Early leaf at early silk.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.50	2.50 – 2.70	2.70 – 3.25
Phosphorus, %	0.20	0.20 – 0.22	0.22 – 0.30
Potassium, %	1.60	1.60 – 1.75	1.75 – 2.50
Calcium, %	0.10	0.10 – 0.12	0.12 – 0.30
Magnesium, %	0.08	0.08 – 0.12	0.12 – 0.25
Sulfur, %	0.13	0.13 – 0.15	0.15 – 0.22
Iron, ppm	10	10 – 20	20 – 250
Manganese, ppm	15	15 – 20	20 – 150
Zinc, ppm	15	15 – 18	18 – 25
Copper, ppm	2	2 – 3	3 – 10
Boron, ppm	2	2 – 3	3 – 10
Chloride, %	0.15	0.15 – 0.20	0.20 – 0.50

COTTON – LEAF BLADE

Stage of Maturity:

Leaf from most fully expanded leaf on main stem, usually third or fourth from the terminal.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.50	2.50 – 3.00	3.00 – 4.50
Phosphorus, %	0.20	0.20 – 0.30	0.30 – 0.60
Potassium, %	0.70	0.70 – 1.00	1.00 – 2.50
Calcium, %	1.50	1.50 – 1.90	1.90 – 3.50
Magnesium, %	0.20	0.20 – 0.30	0.30 – 0.75
Sulfur, %	0.20	0.20 – 0.30	0.30 – 0.80
Iron, ppm	20	20 – 30	30 – 300
Manganese, ppm	20	20 – 30	30 – 300
Zinc, ppm	10	10 – 20	20 – 100
Copper, ppm	2	2 – 4	4 – 20
Boron, ppm	15	15 – 20	20 – 60
Sodium, %	-	-	0.1 – 0.2 (> 0.5 excessive)
Lithium, ppm	-	-	<5

COTTON – PETIOLE

Stage of Maturity:

Petiole from most recent fully expanded leaf on main stem, usually third or fourth leaf from the terminal.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
<u>First Square</u>			
Nitrate-N, ppm	12,000	12,000 – 15,000	15,000 – 18,000
Phosphate-P, ppm	1,500	1,500 – 1,900	1,900 – 5,000
Potassium, %	4	4 – 5	5 – 7
<u>First Bloom</u>			
Nitrate-N, ppm	10,000	10,000 – 12,000	12,000 – 18,000
Phosphate-P, ppm	1,250	1,250 - 1,500	1,500 – 4,000
Potassium, %	3.30	3.30 – 4.00	4.00 – 5.50
<u>Peak Bloom</u>			
Nitrate-N, ppm	2,500	2,500 – 3,000	3,000 – 7,000
Phosphate-P, ppm	1,000	1,000 – 1,200	1,200 – 3,000
Potassium, %	2.50	2.50 – 3.00	3.00 – 4.00
<u>First Open Boll</u>			
Nitrate-N, ppm	1,250	1,250 – 1,500	1,500 – 3,500
Phosphate-P, ppm	800	800 – 1,000	1,000 – 2,000
Potassium, %	1.70	1.70 – 2.00	2.00 – 3.00
<u>Maturity</u>			
Nitrate-N, ppm	0	0	0 – 2,000
Phosphate-P, ppm	650	650 – 800	800 – 1,500
Potassium, %	0.80	0.80 – 1.00	1.00 – 2.00
<u>All Maturity Stages</u>			
Calcium, %	1.50	1.50 – 1.90	1.90 – 3.50
Magnesium, %	0.20	0.20 – 0.30	0.30 – 0.75
Sulfur, %	0.20	0.20 – 0.30	0.30 – 0.40
Iron, ppm	20	20 – 30	30 – 300
Manganese, ppm	20	20 – 30	30 – 300
Zinc, ppm	10	10 – 20	20 – 100
Copper, ppm	2	2 – 4	4 – 20
Boron, ppm	15	15 – 20	20 – 60

COWPEAS

Stage of Maturity:

Leaves from the third node from top of plant.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	4.00	4.00 – 4.25	4.25 – 5.50
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.50
Potassium, %	1.25	1.25 – 1.35	1.35 – 2.00
Calcium, %	0.20	0.20 – 0.35	0.35 – 4.00
Magnesium, %	0.10	0.10 – 0.25	0.25 – 1.50
Sulfur, %	0.25	0.25 – 0.35	0.35 – 1.25
Iron, ppm	15	15 – 25	25 – 500
Manganese, ppm	20	20 – 25	25 – 150
Zinc, ppm	15	15 – 20	20 – 70
Copper, ppm	2	2 – 4	4 – 20
Boron, ppm	10	10 – 20	20 – 50

CUCUMBER

Stage of Maturity:

Petiole of the 6th leaf from the growing tip at flowering.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrate-N, ppm	5,000	5,000 – 9,000	9,000+
Phosphate-P, ppm	1,500	1,500 – 2,500	2,500+
Potassium, %	3	3 – 5	5+

Nutrient guidelines based on concentrations present in petioles of the 6th leaf from the growing tip.

CUCUMBER

Stage of Maturity:

6th leaf from growing tip at flowering.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.40	3.40 – 4.00	4.00 – 6.00
Phosphorus, %	0.30	0.30 – 0.40	0.40 – 1.25
Potassium, %	3.00	3.00 – 3.50	3.50 – 5.00
Calcium, %	1.50	1.50 – 1.75	1.75 – 3.50
Magnesium, %	0.25	0.25 – 0.30	0.30 – 2.00
Sulfur, %	0.25	0.25 – 0.30	0.30 – 1.50
Iron, ppm	40	40 – 50	50 – 300
Manganese, ppm	40	40 – 50	50 – 300
Zinc, ppm	15	15 – 20	20 – 200
Copper, ppm	3	3 – 5	5 – 25
Boron, ppm	20	20 – 25	25 - 75

Nutrient guidelines based on concentrations present in 6th leaf from growing tip.

FLAX

Stage of Maturity:
Seedling stage (less than 12 inches)

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	4.00	4.00 – 4.20	4.20 – 5.00
Phosphorus, %	0.25	0.25 – 0.28	0.28 – 0.50
Potassium, %	1.60	1.60 – 1.75	1.75 – 3.00
Calcium, %	0.12	0.12 – 0.20	0.20 – 1.00
Magnesium, %	0.10	0.10 – 0.12	0.12 – 0.80
Sulfur, %	0.15	0.15 – 0.18	0.18 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	10	10 – 15	15 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25

FLAX

Stage of Maturity:
Three to four uppermost leaves prior to heading.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.75	1.75 – 2.50	2.50 – 4.50
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.50
Potassium, %	1.50	1.50 – 1.60	1.60 – 3.00
Calcium, %	0.10	0.10 – 0.15	0.15 – 1.00
Magnesium, %	0.08	0.08 – 0.10	0.10 – 0.80
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	10	10 – 15	15 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25

GRAPEFRUIT

Stage of Maturity:

Fully mature leaves five to seven months into growing season

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.75	1.75 – 2.00	2.00 – 2.60
Phosphorus, %	0.10	0.10 – 0.13	0.13 – 0.50
Potassium, %	0.70	0.70 – 0.80	0.80 – 2.20
Calcium, %	1.25	1.25 – 1.50	1.50 – 5.50
Magnesium, %	0.20	0.20 – 0.30	0.30 – 0.60
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.50
Iron, ppm	50	50 – 60	60 – 200
Manganese, ppm	15	15 – 25	25 – 200
Zinc, ppm	15	15 – 25	25 – 150
Copper, ppm	3.50	3.50 – 5	5 – 20
Boron, ppm	20	20 – 30	30 – 100
Sodium, %	-	-	0.01 – 0.25
Chloride, %	-	-	0.01 – 0.30

GRAPES

Stage of Maturity:
Petiole taken opposite of bunch cluster.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrate-N, ppm	350	350 – 500	500 – 1200
Phosphate-P, ppm	1000	1000 – 1500	1500 – 6000
Potassium, %	1.00	1.00 – 1.50	1.50 – 2.50
Calcium, %	0.30	0.30 – 0.40	0.40 – 2.50
Magnesium, %	0.20	0.20 – 0.30	0.30 – 0.80
Sulfur, %	0.15	0.15 – 0.18	0.18 – 0.50
Iron, ppm	40	40 – 50	50 – 300
Manganese, ppm	20	20 – 25	25 – 75
Zinc, ppm	15	15 – 20	20 – 50
Boron, ppm	25	25 – 30	30 – 60
Chloride, %	0.02	0.02 – 0.05	0.05 – 0.25

GRAPES			
Stage of Maturity: Leaf taken opposite of bunch cluster.			
<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.75	1.75 – 2.00	2.00 – 3.00
Phosphorus, %	0.25	0.25 – 0.30	0.30 – 0.40
Potassium, %	1.20	1.20 – 1.30	1.30 – 2.00
Calcium, %	0.75	0.75 – 1.00	1.00 – 2.00
Magnesium, %	0.20	0.20 – 0.25	0.25 – 1.00
Sulfur, %	0.15	0.15 – 0.18	0.18 – 0.50
Iron, ppm	40	40 – 50	50 – 300
Manganese, ppm	20	20 – 30	30 – 300
Zinc, ppm	15	15 – 18	18 – 100
Copper, ppm	2	2 – 5	5 – 50
Boron, ppm	12	12 – 15	15 – 75
Chloride, %	0.02	0.02 – 0.05	0.05 – 0.25

Comments:

1. Values are based on the analysis of leaf petioles taken from opposite clusters at full bloom.
2. Boron in excess of 300 ppm in blades is toxic to grapes.
3. Chloride in excess of 0.8% in petioles and 0.5% in blades is toxic.
4. Sodium in excess of 0.5% in petioles and 0.25% in blades is toxic. High sodium levels may aggravate a chloride problem.

GRASS (COOL SEASON)

Bentgrass, Bluegrass, Bromegrass, Orchardgrass, Ryegrass, Tall Fescue

Stage of Maturity:

Four uppermost leaf blades sampled prior to seed head emergence or at optimum stage for best quality forage.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.50	2.50 – 3.20	3.20 – 4.00
Phosphorus, %	0.20	0.20 – 0.23	0.23 – 0.40
Potassium, %	2.00	2.00 – 2.50	2.50 – 3.50
Calcium, %	0.20	0.20 – 0.25	0.25 – 1.00
Magnesium, %	0.08	0.08 – 0.10	0.10 – 0.30
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.30
Iron, ppm	10	10 – 15	15 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	10	10 – 15	15 – 70
Copper, ppm	1	1 – 3	3 – 25
Boron, ppm	2	2 – 5	5 – 25

LEMONS

Stage of Maturity:
Mature leaves from non-fruiting branches.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.00	2.00 – 2.10	2.10 – 2.50
Phosphorus, %	0.09	0.09 – 0.12	0.12 – 0.16
Potassium, %	0.40	0.40 – 0.70	0.70 – 1.09
Calcium, %	1.60	1.60 – 3.00	3.00 – 5.50
Magnesium, %	0.16	0.16 – 0.26	0.26 – 0.60
Sulfur, %	0.14	0.14 – 0.20	0.20 – 0.30
Iron, ppm	36	36 – 60	60 – 120
Manganese, ppm	16	16 – 25	25 – 100
Zinc, ppm	16	16 – 25	25 – 100
Copper, ppm	3.60	3.60 – 5	5 – 16
Boron, ppm	21	21 – 31	31 – 100

MILLET

Stage of Maturity:
Seedling Stage (less than 12 inches)

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	4.00	4.00 – 4.20	4.20 – 5.00
Phosphorus, %	0.25	0.25 – 0.28	0.28 – 0.50
Potassium, %	1.60	1.60 – 1.75	1.75 – 3.00
Calcium, %	0.12	0.12 – 0.20	0.20 – 1.00
Magnesium, %	0.10	0.10 – 0.12	0.12 – 0.80
Sulfur, %	0.15	0.15 – 0.18	0.18 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	15	15 – 18	18 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25

MILLET

Stage of Maturity:
Three to four uppermost leaves prior to heading.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.75	1.75 – 2.50	2.50 – 4.50
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.50
Potassium, %	1.50	1.50 – 1.60	1.60 – 3.00
Calcium, %	0.10	0.10 – 0.15	0.15 – 1.00
Magnesium, %	0.08	0.08 – 0.10	0.10 – 0.80
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	10	10 – 15	15 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25

OATS

Stage of Maturity:
Seedling Stage (less than 12 inches)

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	4.00	4.00 – 4.20	4.20 – 5.00
Phosphorus, %	0.25	0.25 – 0.28	0.28 – 0.50
Potassium, %	1.60	1.60 – 1.75	1.75 – 3.00
Calcium, %	0.12	0.12 – 0.20	0.20 – 1.00
Magnesium, %	0.10	0.10 – 0.12	0.12 – 0.80
Sulfur, %	0.15	0.15 – 0.18	0.18 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	15	15 – 18	18 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25

OATS

Stage of Maturity:
Three to four uppermost leaves prior to heading.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.75	1.75 – 2.50	2.50 – 4.50
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.50
Potassium, %	1.50	1.50 – 1.60	1.60 – 3.00
Calcium, %	0.10	0.10 – 0.15	0.15 – 1.00
Magnesium, %	0.08	0.08 – 0.10	0.10 – 0.80
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	10	10 – 15	15 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25

ONIONS

Stage of Maturity:
Tallest leaf at early season.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.00	3.00 – 3.50	3.50 – 5.00
Phosphorus, %	0.25	0.25 – 0.30	0.30 – 0.50
Potassium, %	3.00	3.00 – 3.50	3.50 – 5.00
Calcium, %	0.75	0.75 – 1.00	1.00 – 3.50
Magnesium, %	0.20	0.20 – 0.25	0.25 – 0.50
Sulfur, %	0.25	0.25 – 0.50	0.50 – 1.00
Iron, ppm	25	25 – 50	50 – 300
Manganese, ppm	25	25 – 50	50 – 250
Zinc, ppm	25	25 – 30	30 – 100
Copper, ppm	5	5 – 10	10 – 50
Boron, ppm	5	5 – 20	20 – 75

ONIONS

Stage of Maturity:
Tallest leaf at mid season.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.50	2.50 – 3.00	3.00 – 4.50
Phosphorus, %	0.22	0.22 – 0.27	0.27 – 0.45
Potassium, %	2.50	2.50 – 3.50	3.50 – 5.00
Calcium, %	0.75	0.75 – 1.00	1.00 – 3.50
Magnesium, %	0.20	0.20 – 0.25	0.25 – 0.50
Sulfur, %	0.25	0.25 – 0.50	0.50 – 1.00
Iron, ppm	25	25 – 50	50 – 300
Manganese, ppm	25	25 – 50	50 – 250
Zinc, ppm	20	20 – 25	25 – 100
Copper, ppm	5	5 – 10	10 – 50
Boron, ppm	5	5 – 20	20 – 75

ONIONS

Stage of Maturity:
Tallest leaf at late season.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.00	2.00 – 2.50	2.50 – 4.00
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.40
Potassium, %	2.00	2.00 – 3.00	3.00 – 4.50
Calcium, %	0.75	0.75 – 1.00	1.00 – 3.50
Magnesium, %	0.20	0.20 – 0.25	0.25 – 0.50
Sulfur, %	0.25	0.25 – 0.50	0.50 – 1.00
Iron, ppm	25	25 – 50	50 – 300
Manganese, ppm	25	25 – 50	50 – 250
Zinc, ppm	15	15 – 20	20 – 100
Copper, ppm	5	5 – 10	10 – 50
Boron, ppm	5	5 – 20	20 – 75

ORANGES
Fairchild, Minneola, Navel

Stage of Maturity:
 Mature leaves (30) from non-fruiting shoots between growth flushes.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.20	2.20 – 2.40	2.40 – 3.00
Phosphorus, %	0.10	0.10 – 0.12	0.12 – 0.30
Potassium, %	0.50	0.50 – 0.70	0.70 – 2.30
Calcium, %	1.50	1.50 – 2.00	2.00 – 5.50
Magnesium, %	0.16	0.16 – 0.25	0.25 – 0.70
Sulfur, %	0.15	0.15 – 0.20	0.20 – 0.35
Iron, ppm	40	40 – 60	60 – 120
Manganese, ppm	20	20 – 25	25 – 200
Zinc, ppm	15	15 – 25	25 – 100
Copper, ppm	3.5	3.5 – 5.0	5.0 – 20
Boron, ppm	20	20 – 30	30 – 100

PEACHES

Stage of Maturity:

Leaves from non-fruiting spurs on spur-bearing trees, fully expanded basal to mid-shoot leaf.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.30	2.30 – 2.40	2.40 – 3.30
Phosphorus, %	0.08	0.08 – 0.10	0.10 – 0.30
Potassium, %	1.00	1.00 – 1.20	1.20 – 2.00
Calcium, %	0.20	0.20 – 1.00	1.00 – 3.00
Magnesium, %	0.10	0.10 – 0.25	0.25 – 0.75
Sulfur, %	0.10	0.10 – 0.15	0.15 – 0.30
Iron, ppm	20	20 – 50	50 – 250
Manganese, ppm	10	10 – 20	20 – 200
Zinc, ppm	15	15 – 18	18 – 40
Copper, ppm	2	2 – 4	4 – 25
Boron, ppm	18	18 – 20	20 - 80

PEANUTS

Stage of Maturity:

Whole tops prior to, or at, bloom stage.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.00	3.00 – 3.50	3.50 – 4.50
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.50
Potassium, %	1.50	1.50 – 1.70	1.70 – 3.00
Calcium, %	1.00	1.00 – 1.25	1.25 – 2.00
Magnesium, %	0.15	0.15 – 0.25	0.25 – 0.80
Sulfur, %	0.15	0.15 – 0.20	0.20 – 0.35
Iron, ppm	20	20 – 60	60 – 300
Manganese, ppm	20	20 – 100	100 – 350
Zinc, ppm	15	15 – 20	20 – 60
Copper, ppm	2	2 – 5	5 – 50
Boron, ppm	15	15 – 20	20 – 60
Molybdenum, ppm	0.08	0.08 – 0.10	0.10 – 5.00

PEARS

Stage of Maturity:

Leaves from non-fruiting spurs on spur-bearing trees.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.20	2.20 – 2.30	2.30 – 2.80
Phosphorus, %	0.08	0.08 – 0.10	0.10 – 0.30
Potassium, %	0.70	0.70 – 1.00	1.00 – 2.00
Calcium, %	0.20	0.20 – 1.00	1.00 – 3.00
Magnesium, %	0.10	0.10 – 0.25	0.25 – 0.75
Sulfur, %	0.10	0.10 – 0.15	0.15 – 0.30
Iron, ppm	20	20 – 50	50 – 250
Manganese, ppm	10	10 – 20	20 – 200
Zinc, ppm	15	15 – 18	18 – 40
Copper, ppm	2	2 – 4	4 – 25
Boron, ppm	15	15 – 20	20 – 70

PEAS

Stage of Maturity:

Leaves from the third node from top of plant.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	4.00	4.00 – 4.25	4.25 – 5.50
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.50
Potassium, %	1.25	1.25 – 1.35	1.35 – 2.00
Calcium, %	0.20	0.20 – 0.35	0.35 – 4.00
Magnesium, %	0.10	0.10 – 0.25	0.25 – 1.50
Sulfur, %	0.25	0.25 – 0.35	0.35 – 1.25
Iron, ppm	15	15 – 25	25 – 500
Manganese, ppm	20	20 – 25	25 – 150
Zinc, ppm	15	15 – 20	20 – 70
Copper, ppm	2	2 – 4	4 – 20
Boron, ppm	10	10 – 20	20 – 50

PECANS

Stage of Maturity:
Leaf pairs from new growth.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.20	2.20 – 2.50	2.50 – 3.00
Phosphorus, %	0.15	0.15 – 0.20	0.20 – 0.30
Potassium, %	0.70	0.70 – 0.90	0.90 – 1.20
Calcium, %	0.40	0.40 – 0.70	0.70 – 1.20
Magnesium, %	0.10	0.10 – 0.20	0.20 – 0.40
Sulfur, %	0.10	0.10 – 0.15	0.15 – 0.25
Iron, ppm	20	20 – 50	50 – 300
Manganese, ppm	20	20 – 30	30 – 100
Zinc, ppm	50	50 – 60	60 – 100
Copper, ppm	5	5 – 10	10 – 40
Boron, ppm	40	40 – 100	100 – 200
Molybdenum, ppm	0.05	0.05 – 0.10	0.10 – 0.75

Values based on leaflet sampled from middle of current terminal shoots.

Comments:

1. Boron in excess of 300 ppm may be toxic.
2. Sodium in excess of 0.10% may be toxic.
3. Chloride in excess of 0.30% may be toxic.

PEPPER – CHILI AND JALAPENO

Stage of Maturity:
Petiole from mature leaf of new growth.

Nutrient	Critical Level	Low Range	Sufficient Range
<u>Early Growth</u>			
Nitrate-N, ppm	5,000	5,000 – 7,000	7,000 – 15,000
Phosphate-P, ppm	2,000	2,000 – 2,500	2,500 – 5,000
Potassium, %	3	3 – 4	4 – 8
<u>Early Fruit Set</u>			
Nitrate-N, ppm	1,000	1,000 – 1,500	1,500 – 4,000
Phosphate-P, ppm	1,500	1,500 – 2,000	2,000 – 4,000
Potassium, %	2	2 – 3	3 – 5
<u>All Maturity Stages</u>			
Calcium, %	0.50	0.50 – 0.75	0.75 – 2.00
Magnesium, %	0.15	0.15 – 0.20	0.20 – 0.75
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.40
Iron, ppm	50	50 – 75	75 – 100
Manganese, ppm	20	20 – 25	25 – 100
Zinc, ppm	15	15 – 20	20 – 70
Copper, ppm	2	2 – 4	4 – 30
Boron, ppm	15	15 – 20	20 – 150

PEPPER – CHILI AND JALAPENO

Stage of Maturity:
Leaf blades from mature leaf of new growth.

Nutrient	Critical Level	Low Range	Sufficient Range
<u>Full Bloom</u>			
Nitrogen, %	2.00	2.00 – 2.50	2.50 – 4.00
Phosphorus, %	0.15	0.15 – 0.20	0.20 – 0.40
Potassium, %	1.50	1.50 – 1.75	1.75 – 4.00
<u>Full Bloom, Fruit ¾ size</u>			
Nitrogen, %	1.50	1.50 – 1.75	1.75 – 3.00
Phosphorus, %	0.12	0.12 – 0.15	0.15 – 0.30
Potassium, %	1.00	1.00 – 1.25	1.25 – 3.50
<u>All Maturity Stages</u>			
Calcium, %	0.50	0.50 – 0.75	0.75 – 2.00
Magnesium, %	0.15	0.15 – 0.20	0.20 – 0.75
Sulfur, %	0.15	0.15 – 0.20	0.20 – 0.75
Iron, ppm	10	10 – 20	20 – 500
Manganese, ppm	10	10 – 20	20 – 300
Zinc, ppm	15	15 – 20	20 – 150
Copper, ppm	3	3 – 5	5 – 50
Boron, ppm	2	2 – 5	5 – 75

PEPPER – SWEET

Stage of Maturity:

Petiole from most recent mature leaf.

Nutrient	Critical Level	Low Range	Sufficient Range
<u>Early Growth</u>			
Nitrate – N, ppm	8,000	8,000 – 12,000	12,000 – 20,000
Phosphate – P, ppm	2,000	2,000 – 4,000	4,000 – 8,000
Potassium, %	4	4 – 6	6 – 8
<u>Early Fruit Set</u>			
Nitrate – N, ppm	3,000	3,000 – 5,000	5,000 – 10,000
Phosphate – P, ppm	1,500	1,500 – 2,500	2,500 – 5,000
Potassium, %	3	3 – 5	5 – 7
<u>All Maturity Stages</u>			
Calcium, %	0.50	0.50 – 0.75	0.75 – 2.00
Magnesium, %	0.15	0.15 – 0.20	0.20 – 0.75
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.40
Iron, ppm	50	50 – 75	75 – 100
Manganese, ppm	20	20 – 25	25 – 100
Zinc, ppm	15	15 – 20	20 – 70
Copper, ppm	2	2 – 4	4 – 30
Boron, ppm	15	15 – 20	20 – 150

PEPPER – SWEET

Stage of Maturity:

Blades of fourth leaf from growing tip.

Nutrient	Critical Level	Low Range	Sufficient Range
<u>Full Bloom</u>			
Nitrogen, %	2.00	2.00 – 2.50	2.50 – 4.00
Phosphorus, %	0.15	0.15 – 0.20	0.20 – 0.40
Potassium, %	1.50	1.50 – 1.75	1.75 – 4.00
<u>Full Bloom to Fruit ¼ Size</u>			
Nitrogen, %	1.50	1.50 – 1.75	1.75 – 3.00
Phosphorus, %	0.12	0.12 – 0.15	0.15 – 0.30
Potassium, %	1.00	1.00 – 1.25	1.25 – 3.50
<u>All Maturity Stages</u>			
Calcium, %	0.50	0.50 – 0.75	0.75 – 2.00
Magnesium, %	0.15	0.15 – 0.20	0.20 – 0.75
Sulfur, %	0.15	0.15 – 0.20	0.20 – 0.75
Iron, ppm	10	10 – 20	20 – 500
Manganese, ppm	10	10 – 20	20 – 300
Zinc, ppm	15	15 – 20	20 – 150
Copper, ppm	3	3 – 5	5 – 50
Boron, ppm	2	2 – 5	5 – 75

PISTACHIO

Stage of Maturity:

Leaflets from leaves located midway along flushes on non-bearing branches 1 month before harvest.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.20	2.20 – 2.50	2.50 – 3.00
Phosphorus, %	0.10	0.10 – 0.15	0.15 – 0.25
Potassium, %	0.80	0.80 – 1.00	1.00 – 2.00
Calcium, %	0.90	0.90 – 1.30	1.30 – 4.00
Magnesium, %	0.40	0.40 – 0.60	0.60 – 1.70
Sulfur, %	0.15	0.15 – 0.20	0.20 – 0.30
Iron, ppm	30	30 – 50	50 – 200
Manganese, ppm	15	15 – 30	30 – 80
Zinc, ppm	5	5 – 10	10 – 30
Copper, ppm	2	2 – 5	5 – 15
Boron, ppm	15	15 – 55	55 – 230

Values based on leaflet sample from leaves in the middle shoot on non-bearing branches.

NOTE: Changes in nutrient levels occur during the growing season. These levels represent a “normal” level during the four month sampling period.

Comments:

1. Sodium in excess of 0.05% may be toxic.
2. Chloride in excess of 0.30% may be toxic.

POINSETTIA

Stage of Maturity:

Recently matured fully expanded leaves.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.00	3.00 – 4.00	4.00 – 6.00
Phosphorus, %	0.20	0.20 – 0.30	0.30 – 0.70
Potassium, %	1.00	1.00 – 1.50	1.50 – 3.50
Calcium, %	0.50	0.50 – 0.70	0.70 – 2.00
Magnesium, %	0.20	0.20 – 0.40	0.40 – 1.00
Sulfur, %	0.20	0.20 – 0.30	0.30 – 0.80
Iron, ppm	50	50 – 100	100 – 300
Manganese, ppm	40	40 – 80	80 – 300
Zinc, ppm	15	15 – 25	25 – 60
Copper, ppm	1	1 – 2	2 – 10
Boron, ppm	20	20 – 30	30 – 300

POPCORN

Stage of Maturity:

1. Whole plant from seedling to 6th leaf stage.
2. Fully expanded leaf prior to tasseling.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.75	2.75 – 3.00	3.00 – 3.50
Phosphorus, %	0.22	0.22 – 0.25	0.25 – 0.50
Potassium, %	2.25	2.25 – 2.50	2.50 – 4.00
Calcium, %	0.12	0.12 – 0.15	0.15 – 0.50
Magnesium, %	0.10	0.10 – 0.12	0.12 – 0.40
Sulfur, %	0.15	0.15 – 0.18	0.18 – 0.35
Iron, ppm	10	10 – 20	20 – 250
Manganese, ppm	40	40 – 50	50 – 160
Zinc, ppm	18	18 – 20	20 – 40
Copper, ppm	3	3 – 5	5 – 15
Boron, ppm	2	2 – 5	5 – 20
Chloride, %	0.15	0.15 – 0.20	0.20 – 0.50

POPCORN

Stage of Maturity:

Ear leaf at early silk.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.50	2.50 – 2.70	2.70 – 3.25
Phosphorus, %	0.20	0.20 – 0.22	0.22 – 0.30
Potassium, %	1.60	1.60 – 1.75	1.75 – 2.50
Calcium, %	0.10	0.10 – 0.12	0.12 – 0.30
Magnesium, %	0.08	0.08 – 0.12	0.12 – 0.25
Sulfur, %	0.13	0.13 – 0.15	0.15 – 0.22
Iron, ppm	10	10 – 20	20 – 250
Manganese, ppm	15	15 – 20	20 – 150
Zinc, ppm	15	15 – 18	18 – 25
Copper, ppm	2	2 – 3	3 – 10
Boron, ppm	2	2 – 3	3 – 10
Chloride, %	0.15	0.15 – 0.20	0.20 – 0.50

POTATO

Stage of Maturity:

Petiole of the fourth leaf from the growing tip.

Nutrient	Critical Level	Low Range	Sufficient Range
<u>Early Season (vegetative growth/tuber formation)</u>			
Nitrate-N, ppm	12,500	12,500 – 16,500	16,500 – 30,000
Phosphate-P, ppm	1,200	1,200 – 2,000	2,000 – 4,000
Potassium, %	9	9 – 11	11 – 13
<u>Mid Season (tuber growth)</u>			
Nitrate-N, ppm	9,000	9,000 – 13,500	13,500 – 25,000
Phosphate-P, ppm	800	800 – 1,600	1,600 – 3,200
Potassium, %	7	7 – 9	9 – 11
<u>Late Season (maturation)</u>			
Nitrate-N, ppm	3,000	3,000 – 5,000	5,000 – 8,000
Phosphate-P, ppm	500	500 – 1,000	1,000 – 2,000
Potassium, %	4	4 – 6	6 – 8
<u>All Maturity Stages</u>			
Calcium, %	0.50	0.50 – 0.75	0.75 – 2.00
Magnesium, %	0.15	0.15 – 0.20	0.20 – 0.75
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.40
Iron, ppm	50	50 – 75	75 – 200
Manganese, ppm	20	20 – 25	25 – 100
Zinc, ppm	15	15 – 20	20 – 70
Copper, ppm	2	2 – 4	4 – 30
Boron, ppm	15	15 – 20	20 – 150

POTATO

Stage of Maturity:

Blades of the fourth leaf from the growing tip.

Nutrient	Critical Level	Low Range	Sufficient Range
<u>Early Season (vegetative growth/tuber formation)</u>			
Nitrogen, %	4.00	4.00 – 6.00	6.00 – 8.00
Phosphorus, %	0.30	0.30 – 0.60	0.60 – 0.90
Potassium, %	3.50	3.50 – 5.00	5.00 – 7.00
<u>Mid Season (tuber growth)</u>			
Nitrogen, %	3.00	3.00 – 5.00	5.00 – 7.00
Phosphorus, %	0.20	0.20 – 0.40	0.40 – 0.60
Potassium, %	2.50	2.50 – 3.50	3.50 – 5.00
<u>Late Season (maturation)</u>			
Nitrogen, %	2.00	2.00 – 4.00	4.00 – 6.00
Phosphorus, %	0.10	0.10 – 0.20	0.20 – 0.40
Potassium, %	1.50	1.50 – 2.50	2.50 – 3.50
<u>All Maturity Stages</u>			
Calcium, %	0.50	0.50 – 1.50	1.50 – 2.50
Magnesium, %	0.20	0.20 – 0.25	0.25 – 0.75
Sulfur, %	0.15	0.15 – 0.20	0.20 – 0.40
Iron, ppm	10	10 – 20	20 – 750
Manganese, ppm	10	10 – 20	20 – 400
Zinc, ppm	15	15 – 20	20 – 150
Copper, ppm	3	3 – 5	5 – 50
Boron, ppm	2	2 – 5	5 – 50

PUMPKIN

Stage of Maturity:
Petiole of 6th leaf from growing tip at flowering.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrate-N, ppm	5,000	5,000 – 9,000	9,000+
Phosphate-P, ppm	1,500	1,500 – 2,500	2,500+
Potassium, %	3	3 – 5	5+

PUMPKIN

Stage of Maturity:
6th leaf from growing tip at flowering.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.40	3.40 – 4.00	4.00 – 6.00
Phosphorus, %	0.30	0.30 – 0.40	0.40 – 1.25
Potassium, %	3.00	3.00 – 3.50	3.50 – 5.00
Calcium, %	1.50	1.50 – 1.75	1.75 – 3.50
Magnesium, %	0.25	0.25 – 0.30	0.30 – 2.00
Sulfur, ppm	0.25	0.25 – 0.30	0.30 – 1.50
Iron, ppm	40	40 – 50	50 – 300
Manganese, ppm	40	40 – 50	50 – 300
Zinc, ppm	15	15 – 20	20 – 200
Copper, ppm	3	3 – 5	5 – 25
Boron, ppm	20	20 – 25	25 - 75

RYE

Stage of Maturity:
Whole plant prior to second joint.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	4.00	4.00 – 4.20	4.20 – 5.00
Phosphorus, %	0.25	0.25 – 0.28	0.28 – 0.50
Potassium, %	1.60	1.60 – 1.75	1.75 – 3.00
Calcium, %	0.12	0.12 – 0.20	0.20 – 1.00
Magnesium, %	0.10	0.10 – 0.12	0.12 – 0.80
Sulfur, %	0.15	0.15 – 0.18	0.18 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	15	15 – 18	18 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25

RYE

Stage of Maturity:
Three to four uppermost leaves prior to heading.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.75	1.75 – 2.50	2.50 – 4.50
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.50
Potassium, %	1.50	1.50 – 1.60	1.60 – 3.00
Calcium, %	0.10	0.10 – 0.15	0.15 – 1.00
Magnesium, %	0.08	0.08 – 0.10	0.10 – 0.80
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	10	10 – 15	15 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25

SAINFOIN

Stage of Maturity:

Upper 1/3 of plant sampled at 10% flowering.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2	2.00 – 2.50	2.50 – 4.50
Phosphorus, %	0.40	0.40 – 0.55	0.20 – 0.55
Potassium, %	2.75	2.75 – 3.70	1.20 – 3.70
Calcium, %	0.60	0.60 – 0.80	0.80 – 1.50
Magnesium, %	0.12	0.12 – 0.15	0.15 – 1.20
Sulfur, %	0.15	0.15 – 0.20	0.20 – 0.35
Iron, ppm	20	20 – 25	25 – 250
Manganese, ppm	20	20 – 25	25 – 150
Zinc, ppm	15	15 – 20	20 – 70
Copper, ppm	2	2 – 4	4 – 15
Boron, ppm	20	20 – 30	30 – 80
Chloride, %	0.20	0.20 – 0.30	0.30 – 0.45
Molybdenum, ppm	0.30	0.30 – 1.00	1.00 – 5.00

SORGHUM
(Same as milo)
Sudan, Sudax

Stage of Maturity:
Seedling to 3 or 4 leaf stage.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.40	3.40 – 3.50	3.50 – 4.00
Phosphorus, %	0.25	0.25 – 0.30	0.30 – 0.60
Potassium, %	2.50	2.50 – 3.00	3.00 – 4.50
Calcium, %	0.10	0.10 – 0.15	0.15 – 0.90
Magnesium, %	0.15	0.15 – 0.35	0.35 – 0.50
Sulfur, %	0.20	0.20 – 0.25	0.25 – 0.50
Iron, ppm	15	15 – 25	25 – 350
Manganese, ppm	30	30 – 40	40 – 150
Zinc, ppm	15	15 – 30	30 – 60
Copper, ppm	3	3 – 5	5 – 15
Boron, ppm	5	5 – 10	10 – 25
Chloride, %	0.15	0.15 – 0.20	0.20 – 0.50

SORGHUM
(Same as milo)
Sudan, Sudax

Stage of Maturity:
Fully expanded leaf sampled at 3 to 4 leaf stage prior to heading.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.00	3.00 – 3.20	3.20 – 4.20
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.60
Potassium, %	1.50	1.50 – 2.00	2.00 – 3.00
Calcium, %	0.10	0.10 – 0.15	0.15 – 0.90
Magnesium, %	0.10	0.10 – 0.20	0.20 – 0.50
Sulfur, %	0.15	0.15 – 0.20	0.20 – 0.30
Iron, ppm	15	15 – 25	25 – 350
Manganese, ppm	15	15 – 20	20 – 150
Zinc, ppm	10	10 – 20	20 – 40
Copper, ppm	3	3 – 5	5 – 15
Boron, ppm	2	2 – 4	4 – 20
Chloride, %	0.15	0.15 – 0.20	0.20 – 0.50

SORGHUM
(Same as milo)
Sudan, Sudax

Stage of Maturity:
 Third leaf below head from heading to soft dough stage.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.50	2.50 – 2.70	2.70 – 3.50
Phosphorus, %	0.15	0.15 – 0.20	0.20 – 0.30
Potassium, %	1.25	1.25 – 1.60	1.60 – 2.00
Calcium, %	0.10	0.10 – 0.15	0.15 – 0.30
Magnesium, %	0.08	0.08 – 0.12	0.12 – 0.20
Sulfur, %	0.13	0.13 – 0.18	0.18 – 0.30
Iron, ppm	15	15 – 25	25 – 350
Manganese, ppm	15	15 – 20	20 – 150
Zinc, ppm	10	10 – 12	12 – 20
Copper, ppm	1	1 – 2	2 – 5
Boron, ppm	2	2 – 4	4 – 20
Chloride, %	0.15	0.15 – 0.20	0.20 – 0.50

SOYBEANS

Stage of Maturity:

Most fully developed trifoliate leaf from top of plant prior to or during initial flowering.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.25	3.25 – 4.00	4.00 – 5.50
Phosphorus, %	0.15	0.15 – 0.25	0.25 – 0.50
Potassium, %	1.25	1.25 – 1.70	1.70 – 2.50
Calcium, %	0.20	0.20 – 0.35	0.35 – 2.00
Magnesium, %	0.10	0.10 – 0.25	0.25 – 1.00
Sulfur, %	0.15	0.15 – 0.25	0.25 – 0.35
Iron, ppm	15	15 – 25	25 – 350
Manganese, ppm	20	20 – 25	25 – 150
Zinc, ppm	15	15 – 20	20 – 70
Copper, ppm	2	2 – 4	4 – 10
Boron, ppm	10	10 – 20	20 – 50
Molybdenum, ppm	0.50	0.50 – 1.00	1.00 – 5.00

SPINACH

Plant Part:
Petiole of youngest mature leaf at mid-season.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrate-N, ppm	4,000	4,000 – 5,000	5,000 – 8,000
Phosphate-P, ppm	2,000	2,000 – 2,500	2,500 – 4,000
Potassium, %	2.00	2.00 – 2.50	2.50 – 5.00

SPINACH

Plant Part:
Fully mature leaf from new growth at mid-season.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
<u>Flowering to small fruit</u>			
Nitrogen, %	3.00	3.00 – 3.50	3.50 – 5.50
Phosphorus, %	0.20	0.20 – 0.30	0.30 – 0.60
Potassium, %	3.00	3.00 – 4.00	4.00 – 5.50
Calcium, %	0.20	0.20 – 0.60	0.60 – 1.50
Magnesium, %	0.20	0.20 – 0.60	0.60 – 1.50
Sulfur, %	0.20	0.20 – 0.25	0.25 – 1.40
Iron, ppm	20	20 – 50	50 – 250
Manganese, ppm	20	20 – 30	30 – 250
Zinc, ppm	15	15 – 25	25 – 100
Copper, ppm	3	3 – 5	5 – 25
Boron, ppm	20	20 – 25	25 – 60

SPRING WHEAT

Stage of Maturity:

Whole plant prior to second joint.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	4.00	4.00 – 4.20	4.20 – 5.00
Phosphorus, %	0.25	0.25 – 0.28	0.28 – 0.50
Potassium, %	1.60	1.60 – 1.75	1.75 – 3.00
Calcium, %	0.12	0.12 – 0.20	0.20 – 1.00
Magnesium, %	0.10	0.10 – 0.12	0.12 – 0.80
Sulfur, %	0.15	0.15 – 0.18	0.18 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	15	15 – 18	18 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25

SPRING WHEAT

Stage of Maturity:

Three to four uppermost leaves prior to heading.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.75	1.75 – 2.50	2.50 – 4.50
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.50
Potassium, %	1.50	1.50 – 1.60	1.60 – 3.00
Calcium, %	0.10	0.10 – 0.15	0.15 – 1.00
Magnesium, %	0.08	0.08 – 0.10	0.10 – 0.80
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	10	10 – 15	15 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25

STRAWBERRY

Stage of Maturity:

Mature leaves from new growth at flowering (25 leaves minimum).

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.75	1.75 – 2.10	2.10 – 4.00
Phosphorus, %	0.15	0.15 – 0.20	0.20 – 0.45
Potassium, %	1.00	1.00 – 1.10	1.10 – 2.50
Calcium, %	0.50	0.50 – 0.60	0.60 – 2.50
Magnesium, %	0.20	0.20 – 0.25	0.25 – 0.70
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.30
Iron, ppm	40	40 – 50	50 – 250
Manganese, ppm	25	25 – 30	30 – 350
Zinc, ppm	15	15 – 20	20 – 50
Copper, ppm	5	5 – 6	6 – 20
Boron, ppm	15	15 – 25	25 – 60

SUGAR BEETS

Stage of Maturity - petioles

Petioles from fully expanded and mature leaves midway between youngest center leaves and oldest outside leaves.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrate – N, ppm (thinning)	1,000	1,000 – 10,000	10,000+
Nitrate – N, ppm (mid season)	1,000	1,000 – 5,000	5,000+
Nitrate – N, ppm (late season)	*	-	-
Phosphate – P, ppm	750	750 – 1,000	1,000 – 4,000
Potassium, %	2.00	2.00 – 2.50	2.50 – 9.00
Calcium, %	0.10	0.10 – 0.20	0.20 – 2.50
Magnesium, %	0.05	0.05 – 0.10	0.10 – 0.70
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.40
Zinc, ppm	10	10 – 15	15 – 100
Iron, ppm	50	50 – 75	75 – 200
Manganese, ppm	10	10 – 25	25 – 360
Copper, ppm	2	2 – 5	5 – 15
Boron, ppm	15	15 – 20	20 – 150

*The petiole nitrate-N concentration should be less than 1,000 ppm 30 days before harvest.

SUGAR BEETS

Stage of Maturity - blades

Blades from fully expanded and mature leaves midway between youngest center leaves and oldest outside leaves.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.50	2.50 – 3.00	3.00 – 4.50
Phosphorus, %	0.10	0.10 – 0.15	0.15 – 0.80
Potassium, %	1.00	1.00 – 1.25	1.25 – 6.00
Calcium, %	0.50	0.50 – 0.60	0.60 – 1.50
Magnesium, %	0.10	0.10 – 0.20	0.20 – 2.50
Sulfur, %	0.15	0.15 – 0.18	0.18 – 0.25
Iron, ppm	55	55 – 60	60 – 140
Manganese, ppm	10	10 – 25	25 – 360
Zinc, ppm	9	9 – 10	10 – 80
Copper, ppm	2	2 – 5	5 – 15
Boron, ppm	21	21 – 35	35 – 200

SUNFLOWERS

Stage of Maturity:

Fully matured upper leaf at flower initiation.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.50	1.50 – 2.00	2.00 – 3.50
Phosphorus, %	0.15	0.15 – 0.25	0.25 – 0.50
Potassium, %	1.00	1.00 – 1.50	1.50 – 3.00
Calcium, %	0.20	0.20 – 0.30	0.30 – 2.00
Magnesium, %	0.10	0.10 – 0.20	0.20 – 1.50
Sulfur, %	0.15	0.15 – 0.20	0.20 – 0.40
Iron, ppm	15	15 – 20	20 – 250
Manganese, ppm	10	10 – 15	15 – 100
Zinc, ppm	12	12 – 15	15 – 70
Copper, ppm	3	3 – 5	5 – 25
Boron, ppm	10	10 – 20	20 – 100

TANGELOS

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.00	2.00 – 2.10	2.10 – 2.50
Phosphorus, %	0.09	0.09 – 0.12	0.12 – 0.16
Potassium, %	0.40	0.40 – 0.70	0.70 – 1.09
Calcium, %	1.60	1.60 – 3.00	3.00 – 5.50
Magnesium, %	0.16	0.16 – 0.26	0.26 – 0.60
Sulfur, %	0.14	0.14 – 0.20	0.20 – 0.30
Iron, ppm	36	36 – 60	60 – 120
Manganese, ppm	16	16 – 25	25 – 100
Zinc, ppm	16	16 – 25	25 - 100
Copper, ppm	3.6	3.6 – 5	5 – 16
Boron, ppm	21	21 – 31	31 – 100
Sodium, %	-	-	0.01 – 0.16
Chloride, %	-	-	0.01 – 0.30

TANGERINE

Stage of Maturity:

Mature leaves from vegetative shoots 5 – 7 months into growing season.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.20	2.20 – 3.00	3.00 – 4.00
Phosphorus, %	0.10	0.10 – 0.15	0.15 – 0.30
Potassium, %	0.50	0.50 – 0.70	0.70 – 1.10
Calcium, %	1.50	1.50 – 2.00	2.00 – 5.50
Magnesium, %	0.16	0.16 – 0.25	0.25 – 0.45
Sulfur, %	0.15	0.15 – 0.20	0.20 – 0.35
Iron, ppm	40	40 – 60	60 – 120
Manganese, ppm	20	20 – 25	25 – 200
Zinc, ppm	15	15 – 25	25 – 100
Copper, ppm	3.5	3.5 – 5.0	5.0 – 20
Boron, ppm	20	20 – 30	30 – 100

TOBACCO

Stage of Maturity:
Mature leaves from new growth.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.50	3.50 – 4.00	4.00 – 5.75
Phosphorus, %	0.15	0.15 – 0.18	0.18 – 0.50
Potassium, %	1.75	1.75 – 2.00	2.00 – 3.50
Calcium, %	1.25	1.25 – 1.50	1.50 – 2.50
Magnesium, %	0.40	0.40 – 0.50	0.50 – 1.00
Sulfur, %	0.15	0.15 – 0.25	0.25 – 0.50
Iron, ppm	50	50 – 75	75 – 500
Manganese, ppm	20	20 – 30	30 – 400
Zinc, ppm	15	15 – 30	30 – 70
Copper, ppm	5	5 – 8	8 – 30
Boron, ppm	15	15 – 18	18 – 30

TOMATO – FIELD

Stage of Maturity:
 Petiole of 4th leaf from growing tip at early bloom.

PETIOLE

<u>Nutrient</u>	<u>Maturity</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrate – N, ppm	Early bloom	8,000	8,000 – 12,000	12,000 – 25,000
	Fruit 1"	6,000	6,000 – 10,000	10,000 – 20,000
	First color	2,000	2,000 – 4,000	4,000 – 8,000
Phosphate – P, ppm	Early bloom	2,000	2,000 – 3,000	3,000 – 6,000
	Fruit 1"	2,000	2,000 – 3,000	3,000 – 6,000
	First color	2,000	2,000 – 3,000	3,000 – 6,000
Potassium, %	Early bloom	3	3 – 4	4 – 8
	Fruit 1"	2	2 – 3	3 – 6
	First color	1	1 – 2	2 – 4

TOMATO – FIELD

Stage of Maturity:
 4th leaf from growing tip at early bloom.

LEAVES

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.25	2.25 – 2.50	2.50 – 6.00
Phosphorus, %	0.20	0.20 – 0.30	0.30 – 0.80
Potassium, %	2.00	2.00 – 2.50	2.50 – 4.00
Calcium, %	0.25	0.25 – 0.50	0.50 – 4.00
Magnesium, %	0.20	0.20 – 0.40	0.40 – 1.00
Sulfur, %	0.15	0.15 – 0.30	0.30 – 1.20
Iron, ppm	40	40 – 50	50 – 300
Manganese, ppm	40	40 – 50	50 – 100
Zinc, ppm	15	15 – 20	20 – 30
Copper, ppm	3	3 – 5	5 – 10
Boron, ppm	20	20 – 30	30 – 100

**TOMATO
(HYDROPONICS)**

Stage of Maturity:
Young

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.00	3.00 – 3.25	3.25 – 4.50
Phosphorus, %	0.70	0.70 – 0.80	0.80 – 1.20
Potassium, %	2.50	2.50 – 2.75	2.75 – 5.00
Calcium, %	1.50	1.50 – 1.75	1.75 – 3.50
Magnesium, %	0.40	0.40 – 0.50	0.50 – 0.80
Sulfur, %	0.40	0.40 – 0.50	0.50 – 0.80
Iron, ppm	70	70 – 80	80 – 150
Manganese, ppm	70	70 – 80	80 – 150
Zinc, ppm	20	20 – 25	25 – 40
Copper, ppm	10	10 – 12	12 – 15
Boron, ppm	40	40 – 50	50 – 80

**TOMATO
(HYDROPONICS)**

Stage of Maturity:
Mature

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	3.50	3.50 – 3.75	3.75 – 6.00
Phosphorus, %	0.60	0.60 – 0.70	0.70 – 1.20
Potassium, %	3.50	3.50 – 3.75	3.75 – 6.00
Calcium, %	2.00	2.00 – 2.25	2.25 – 6.00
Magnesium, %	0.50	0.50 – 0.60	0.60 – 1.00
Sulfur, %	0.50	0.50 – 0.60	0.60 – 1.20
Iron, ppm	80	80 – 100	100 – 200
Manganese, ppm	100	100 – 125	125 – 250
Zinc, ppm	20	20 – 30	30 – 60
Copper, ppm	10	10 – 15	15 – 30
Boron, ppm	40	40 – 50	50 – 100

TRITICALE

Stage of Maturity:

Seedling Stage (less than 12 inches)

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	4.00	4.00 – 4.20	4.20 – 5.00
Phosphorus, %	0.25	0.25 – 0.28	0.28 – 0.50
Potassium, %	1.60	1.60 – 1.75	1.75 – 3.00
Calcium, %	0.12	0.12 – 0.20	0.20 – 1.00
Magnesium, %	0.10	0.10 – 0.12	0.12 – 0.80
Sulfur, %	0.15	0.15 – 0.18	0.18 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	15	15 – 18	18 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25

TRITICALE

Stage of Maturity:

Three to four uppermost leaves prior to heading.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	1.75	1.75 – 2.50	2.50 – 4.50
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.50
Potassium, %	1.50	1.50 – 1.60	1.60 – 3.00
Calcium, %	0.10	0.10 – 0.15	0.15 – 1.00
Magnesium, %	0.08	0.08 – 0.10	0.10 – 0.80
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	10	10 – 15	15 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25

WALNUTS

Stage of Maturity:

Middle pair of leaflets from mature shoots 6 to 8 weeks after bloom.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.25	2.25 – 2.50	2.50 – 3.25
Phosphorus, %	0.10	0.10 – 0.12	0.12 – 0.30
Potassium, %	1.00	1.00 – 1.20	1.20 – 3.00
Calcium, %	0.65	0.65 – 0.75	0.75 – 2.50
Magnesium, %	0.25	0.25 – 0.30	0.30 – 1.00
Sulfur, %	0.08	0.08 – 0.10	0.10 – 0.25
Iron, ppm	40	40 – 50	50 – 300
Manganese, ppm	25	25 – 30	30 – 400
Zinc, ppm	15	15 – 20	20 – 200
Copper, ppm	2	2 – 4	4 – 20
Boron, ppm	15	15 – 35	35 – 200

Sodium, chloride, and boron in excess of 0.1%, 0.3%, and 300 ppm, respectively, can cause reduced growth.

WATERMELON

Stage of Maturity:
Petiole of 6th leaf from growing tip at flowering.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrate-N, ppm	5,000	5,000 – 9,000	9,000+
Phosphate-P, ppm	1,500	1,500 – 2,500	2,500+
Potassium, %	3	3 – 5	5+

WATERMELON

Stage of Maturity:
6th leaf from growing tip at flowering.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.00	2.00 – 4.00	4.00 – 5.50
Phosphorus, %	0.18	0.18 – 0.30	0.30 – 0.75
Potassium, %	2.50	2.50 – 3.75	3.75 – 5.00
Calcium, %	1.50	1.50 – 1.75	1.75 – 3.25
Magnesium, %	0.25	0.25 – 0.40	0.40 – 0.80
Sulfur, %	0.20	0.20 – 0.25	0.25 – 1.00
Iron, ppm	40	40 – 50	50 – 300
Manganese, ppm	40	40 – 50	50 – 250
Zinc, ppm	15	15 – 20	20 – 100
Copper, ppm	3	3 – 5	5 – 20
Boron, ppm	20	20 – 25	25 – 75

WHEAT
Continuous, Ecofallow, Grain, Pasture

Stage of Maturity:

Whole plant, excluding roots, prior to second joint formation.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	4.00	4.00 – 4.20	4.20 – 5.00
Phosphorus, %	0.22	0.22 – 0.25	0.25 – 0.50
Potassium, %	1.60	1.60 – 2.00	2.00 – 3.00
Calcium, %	0.12	0.12 – 0.20	0.20 – 1.00
Magnesium, %	0.08	0.08 – 0.10	0.10 – 0.80
Sulfur, %	0.15	0.15 – 0.25	0.25 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 20	20 – 100
Zinc, ppm	15	15 – 25	25 – 70
Copper, ppm	1	1 – 3	3 – 25
Boron, ppm	1	1 – 3	3 – 25
Molybdenum, ppm	0.08	0.08 – 0.10	0.10 – 0.20
Chloride, %	0.15	0.15 – 0.40	0.40 – 1.00

Note: Aluminum concentrations greater than 200 ppm may be toxic to wheat.

NITROGEN RECOMMENDATIONS FOR WHEAT

Stage of Maturity:

Whole plant, excluding roots, prior to second joint.

<u>Total Nitrogen</u> %	<u>Yield Goal, bu/A</u>		
	<70	70 – 100	>100
<2.20	60	90	120
2.20 – 2.60	50	75	100
2.60 – 3.00	40	60	80
3.00 – 3.40	30	45	60
3.40 – 3.80	20	30	40
3.80 – 4.20	10	15	20
>4.20	0	0	0

WHEAT
Continuous, Ecofallow, Grain, Pasture

Stage of Maturity:
 Two upper leaves prior to or at heading.

<u>Nutrient</u>	<u>Critical Level</u>	<u>Low Range</u>	<u>Sufficient Range</u>
Nitrogen, %	2.50	2.50 – 3.00	3.00 – 4.50
Phosphorus, %	0.20	0.20 – 0.25	0.25 – 0.50
Potassium, %	1.50	1.50 – 1.60	1.60 – 3.00
Calcium, %	0.10	0.10 – 0.15	0.15 – 1.00
Magnesium, %	0.08	0.08 – 0.10	0.10 – 0.80
Sulfur, %	0.12	0.12 – 0.15	0.15 – 0.50
Iron, ppm	5	5 – 10	10 – 250
Manganese, ppm	10	10 – 25	25 – 100
Zinc, ppm	10	10 – 15	15 – 70
Copper, ppm	1	1 – 2	2 – 25
Boron, ppm	1	1 – 2	2 – 25
Molybdenum, ppm	0.08	0.08 – 0.10	0.10 – 0.20
Chloride, %	0.15	0.15 – 0.40	0.40 – 1.00

Note: Aluminum concentrations greater than 200 ppm may be toxic to wheat.