

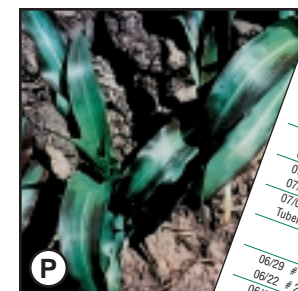
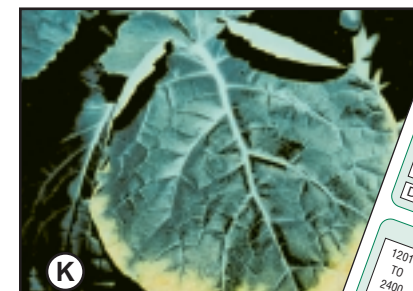
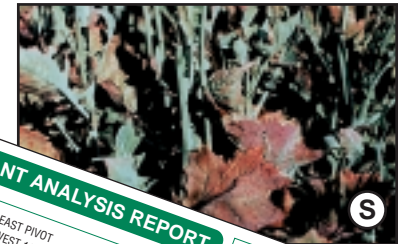
Interpreting Plant Analysis Reports



Highway 15
P.O. Box 510
Northwood, North Dakota 58267

Home page: agviselabs.com

PRESORTED
STANDARD
U.S. POSTAGE PAID
GRAND FORKS, ND
PERMIT NO. 317



AGVISE LABORATORIES
P.O. BOX 510, NORTHWOOD, ND 58267
(701) 587-6010

PLANT ANALYSIS REPORT

MR. POTATO GROWER

FIELD ID EAST PIVOT
SAMPLE ID WEST 1/2
COUNTY POLK SECTION 20
TWP NARROW OTR SE
VARIETY RUSSET BURBANK ACRES 126

DATE SAMPLED 08/09/99
CROP POTATO

DATE RECEIVED 08/10/99

JOHN LEE
803 GREAT PLAINS CT
GRAND FORKS ND

SUBMITTED BY: AG0002

DATE REPORTED 08/11/1999

REF # 1535
LAB # 224

GROWTH STAGE POTATOES-TUBER > 2"

| bpm | | Analysis In Percent | | | | | | | | | | Analysis in Parts Per Million | | | | | | | | | |
|---------------------------------|----------------------------|---------------------|--------------|-------------|----------|------------|--------------|-----------|---------|---------|--------------|-------------------------------|---------|--------------|--------|--|--|--|--|--|--|
| P ₂ O ₅ P | NO ₃ -N Nitrate | N Nitrogen | P Phosphorus | K Potassium | S Sulfur | Ca Calcium | Mg Magnesium | Na Sodium | Zn Zinc | Fe Iron | Mn Manganese | Cu Copper | B Boron | %Cl Chloride | ppm Al | | | | | | |
| 1600 | 8000 | 5.3 | 0.41 | 4.2 | 0.39 | 1.03 | 0.70 | 0.02 | 25 | 546 | 500 | 10 | 39 | | | | | | | | |
| S | S | H | S | S | S | S | S | S | S | VH | VH | S | S | | | | | | | | |

D = Deficient
L = Low
S = Sufficient
H = High
V = Very High

NUTRIENT SUFFICIENCY RANGE

| Element | Low | Sufficient | High | Very High |
|---------|------|------------|------|-----------|
| N | 1201 | 6001 | 2400 | 10000 |
| P | 3.1 | .21 | 2.6 | .6 |
| K | 5 | 2.6 | 4.5 | 2.5 |
| S | .5 | .5 | 2.5 | 1 |
| Ca | .21 | .6 | 1 | .5 |
| Mg | .5 | 1 | 1 | .1 |
| Na | 0 | 21 | 70 | 21 |
| Zn | 70 | 70 | 249 | 200 |
| Fe | 21 | 21 | 6 | 15 |
| Mn | 200 | 30 | 30 | 39 |
| Cu | 6 | 15 | 70 | 39 |
| B | 15 | 70 | 39 | |

D.R.I.S. INDEX VALUES

| Date | Lab # | Petiole Nitrate Levels (ppm) | NO ₃ -N (ppm) |
|-------|-------|------------------------------|--------------------------|
| 08/10 | # 224 | xxxx | 8000 |
| 08/03 | # 223 | xxxx | 10000 |
| | | low | |
| 07/27 | # 222 | xxxx | 12,000 |
| 07/20 | # 221 | xxxx | 20,000 |
| 07/13 | # 220 | xxxx | 15,000 |
| 07/06 | # 219 | xxxx | 17,000 |
| | | low | |
| 08/29 | # 218 | xxxx | 13,000 |
| 08/22 | # 217 | xxxx | 15,000 |
| 08/15 | # 216 | xxxx | 13,000 |
| 06/08 | # 215 | xxxx | 17,000 |
| | | low | |
| | | 15,000 | 20,000 |
| | | adequate | 20,000 |
| | | 25,000 | 20,000 |
| | | high | 18,000 |
| | | | 22,000 |
| | | | 26,000 |

Interpreting a Plant Analysis Report

Plant nutrient analysis is a useful management tool. While it is helpful to know the visual symptoms of nutrient deficiencies on plants, determining nutrient deficiencies visually is very difficult. In many situations, an analysis of good and bad plant samples in addition to good and bad soil samples will provide the answer.

To gain the most information from plant nutrient analysis, it is important to become familiar with the plant analysis report. This guide helps explain where all of the information is located on the plant analysis report. There is also basic information about each nutrient and some information on visual deficiency symptoms. Please remember to follow accepted guidelines for collecting plant samples for nutrient analysis (see the plant sampling guide for additional information).

Information Located on the Plant Analysis Report

- Submitted for:** The name of the grower for whom the sample has been submitted. This may also be the name of the farm manager, consultant, etc. Some customers prefer to use a grower number instead of a grower name.
- Submitted by:** The name of the firm or individual who has submitted the sample to the laboratory. This is the person or business that will receive the plant analysis report and be billed for the laboratory analysis.
- Field ID:** Identifies the field or area where the plant sample was collected. The Field ID can be made up of any combination of letters or numbers (16 character limit).

- Sample ID:** Identifies each sample when there is more than one sample from each field (16 character limit).
- County:** Identifies the county where the plant sample was collected (16 character limit).
- Township:** Identifies the township where the plant sample was collected (30 character limit).
- Section:** Identifies the section of land where the plant sample was collected (2 character limit).
- Quarter:** Identifies which quarter of the section where the plant sample was collected (2 character limit).
- Acres:** Indicates the number of acres in the field where the plant sample was collected (3 character limit).
- Variety:** Identifies which variety the plant sample is from. This information is helpful when putting together a fertility management plan.
- Reference Number:** The reference number is used only for plant samples from potatoes. The same reference number is used to represent plant samples collected from the same field through the growing season.
- Laboratory Number:** A distinct laboratory number is assigned to each plant sample being tested. This number is used in quality control in the laboratory.
- Date Sampled:** Indicates the day the sample was collected.
- Date Received:** Indicates the day the sample was received at the laboratory.
- Date Reported:** Indicates the day the plant analysis results were printed.

Table 1

Expected Nutrient Level Declines Field Corn

| Plant Age | Total Nitrogen | Total Phosphorus | Total Potassium |
|-----------|----------------|------------------|-----------------|
| 30 days | 4.6% | .30% | 3.4% |
| 60 days | 3.9% | .26% | 2.4% |
| 80 days | 3.4% | .24% | 1.9% |
| 110 days | 3.0% | .20% | 1.8% |

Table 2

Plant Age vs Nutrient Ratios in Plants Field Corn

| Plant Age | N/P | N/K | P/K |
|-----------|-----|-----|-----|
| 30 days | 15 | 1.4 | 11 |
| 60 days | 15 | 1.6 | 9 |
| 80 days | 14 | 1.8 | 8 |
| 110 days | 15 | 1.7 | 9 |

DRIS indexes are shown as negative or positive numbers. A DRIS index for phosphorus with a value of -25 indicates that phosphorus is deficient. Any DRIS index with a value less than -15 indicates a deficiency. DRIS index values in the range of -15 to +15 are considered adequate. A DRIS index >15 indicates luxury consumption of that nutrient (see figure below).

DRIS Index Interpretation

| Deficient | Nutrient Ratio is adequate | | Luxury Consumption | |
|-----------|----------------------------|---|--------------------|-----|
| -30 | -15 | 0 | +15 | +30 |

University research on developing DRIS indexes for each nutrient on every crop has not been completed. Researchers have developed DRIS indexes for all of the nutrients on crops such as corn, soybeans and alfalfa, while research is very limited on establishing DRIS indexes for many other crops.

Advantages of DRIS Index Interpretation

- DRIS indexes help show which nutrient is most limiting (see table below). The nutrient with the largest negative number is the most limiting.

DRIS Interpretation Identifying the Most Limiting Nutrient

| Nutrient | Example 1 DRIS Index | Example 2 DRIS Index | Example 3 DRIS Index |
|------------------|----------------------|----------------------|----------------------|
| Nitrogen | -36 | -10 | 7 |
| Phosphorus | -25 | -25 | 5 |
| Potassium | 10 | 15 | -8 |
| Calcium | 24 | 25 | 3 |
| Magnesium | 27 | -5 | -7 |
| Total of Indexes | 0 | 0 | 0 |

- Crop growth stage is less important because the ratio of one nutrient to another through the season is fairly stable (see table 2).

Disadvantages of the DRIS Index System for Interpretation of Plant Analysis

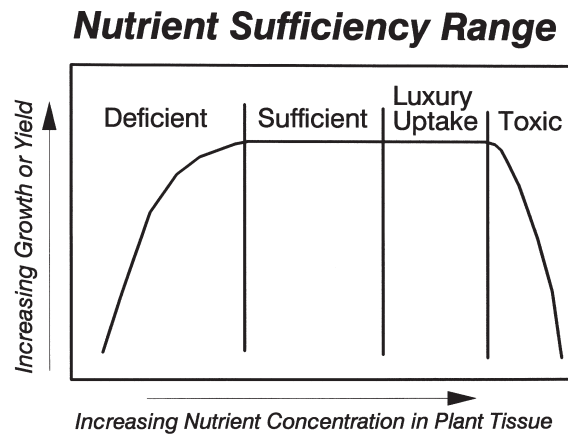
- DRIS indexes are not yet established for many crops.

Using the Sufficiency Range System and the DRIS System Together

While the Sufficiency Range System and the DRIS System each have their strengths and weaknesses, used together they provide more information. In a situation where a nutrient is rated as low by the sufficiency system and the DRIS index is very negative (-30), you can be very confident that the nutrient in question is deficient in the plant. In a situation where the sufficiency range system indicates a nutrient is adequate and the DRIS index shows the nutrient is deficient, you may need to get additional information from a soil test.

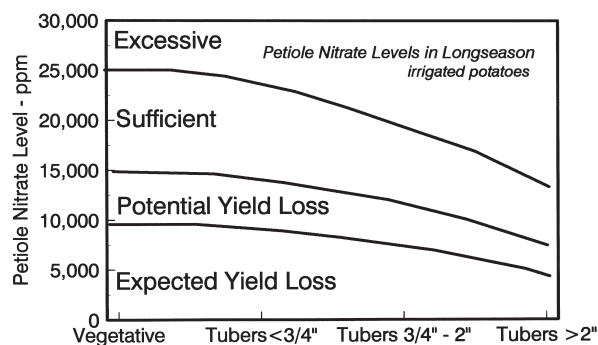
Nutrient Sufficiency Range Interpretation

32. The sufficiency range for each nutrient has been determined primarily by university research. The sufficiency range for each nutrient is based on a particular stage of growth and a specific plant part for each crop. Example: A plant sample of wheat at the tillering stage (whole plant) has a sufficiency range of 3.8% to 5.0% for total nitrogen. If the total nitrogen level is below 3.8%, the wheat crop is “deficient” in nitrogen. If the nitrogen content is between 3.5% and 5.0%, the nitrogen status of the crop is “sufficient”. If the nitrogen content is >5.0%, luxury uptake of nitrogen is occurring (see figure).



As plants go from the vegetative growth stage to the reproductive growth stage, the concentration of most nutrients decrease. Example: The sufficiency level for nitrate nitrogen for potato petioles early in the season ranges from 15,000 ppm to 25,000 ppm. Later in the season when potato tubers are bulking, the sufficient range for petiole nitrates is 8000 ppm to 12,000 ppm (see figure).

Sufficiency Range Changes with Plant Age



Advantages of Sufficiency Range System when Interpreting Plant Analysis

1. Sufficiency ranges for each nutrient at various growth stages are available for most crops in the world.
2. Contamination of the plant sample with one nutrient does not affect the interpretation of the level of the other nutrients.

Disadvantages of the Sufficiency Range System when Interpreting Plant Analysis

1. Sufficiency ranges are unable to rank which nutrient is most limiting. If more than one nutrient is found to be deficient, it is difficult to know which nutrient is the most limiting.
2. Sufficiency ranges are available only for specific stages of growth. If the growth stage of a crop is in between those established, interpretation is more difficult.

DRIS Indexes for Interpreting Plant Analysis

33. The Diagnosis Recommendation Integrated System (DRIS) interpretation of plant nutrient analysis was developed through university research. This system for interpreting the nutrient status of plants is based on comparing the ratio of each nutrient in the plant to all other nutrients. Those ratios are then compared to the ratios for high yielding plants. For example, the nitrogen level is compared to the level of phosphorus, potassium, zinc, etc. University research has shown that the ratio of one nutrient to another does not change appreciably through the season. In the tables below you can see that even though the level of nutrients in field corn declines as the plants age (table 1), the ratio of one nutrient to the other changes very little (table 2).

P.O. BOX 510, NORTHWOOD, ND 58267
(701) 587-6010

PLANT ANALYSIS REPORT

| | | | |
|-----------|--------------------------|---------|--------------|
| FIELD ID | EAST PIVOT 3 | SECTION | 20 7 |
| SAMPLE ID | WEST 1/2 4 | QTR | SE 8 |
| COUNTY | POLK 5 | ACRES | 126 9 |
| TWP | NARROW 6 | | |
| VARIETY | RUSSET BURBANK 10 | | |

SUBMITTED FOR: **1**

MR. POTATO GROWER

SUBMITTED BY: **2**

JOHN LEE
803 GREAT PLAINS CT
GRAND FORKS ND 58201

REF # 1535 **11**

LAB # 224 **12**

DATE SAMPLED 08/09/99 **13**

DATE RECEIVED 08/10/99 **14**

DATE REPORTED 08/11/1999 **15**

CROP POTATO **16**

GROWTH STAGE POTATOES-TUBER > 2" **17**

NUTRIENT LEVEL IN CROP

| ppm | | Analysis in Percent | | | | | | | Analysis in Parts Per Million | | | | | | |
|--|----------------------------|---------------------|-----------------|---------------|----------------|----------------|----------------|----------------|-------------------------------|---------------|---------------|--------------|--------------|--------------|-----------|
| P ₂ O ₅ -P Phosphate | NO ₃ -N Nitrate | N Nitrogen | P Phosphorus | K Potassium | S Sulfur | Ca Calcium | Mg Magnesium | Na Sodium | Zn Zinc | Fe Iron | Mn Manganese | Cu Copper | B Boron | %Cl Chloride | ppm Al |
| 1600 19B | 8000 18B | 5.3 18A | 0.41 19A | 4.2 20 | 0.39 21 | 1.03 22 | 0.70 23 | 0.02 24 | 25 25 | 546 26 | 500 27 | 10 28 | 39 29 | 30 | 31 |
| S | S | H | S | S | S | S | S | S | S | VH | VH | S | S | | |

D = Deficient L = Low S = Sufficient H = High V = Very High

32 NUTRIENT SUFFICIENCY RANGE

| | | | | | | | | | | | | | | | |
|------|-------|-----|-----|-----|-----|-----|----|----|----|-----|-----|----|----|--|--|
| 1201 | 6001 | 3.1 | .21 | 2.6 | .21 | .6 | .5 | 0 | 21 | 70 | 21 | 6 | 15 | | |
| TO | TO | TO | TO | TO | TO | TO | TO | TO | TO | TO | TO | TO | TO | | |
| 2400 | 10000 | 5 | .5 | 4.5 | .5 | 2.5 | 1 | .1 | 70 | 249 | 200 | 30 | 39 | | |

33 D.R.I.S. INDEX VALUES

| | | | | | | | | | | | | | | | |
|--|--|----|-----|----|--|---|---|--|--|--|--|--|--|--|--|
| | | -9 | -15 | 10 | | 9 | 5 | | | | | | | | |
|--|--|----|-----|----|--|---|---|--|--|--|--|--|--|--|--|

| Date | Lab # | Petiole Nitrate Levels (ppm) | | | NO3-N (ppm) |
|-------|-------|------------------------------|------------------|------------|-------------|
| 08/10 | # 224 | xxxxxxxxxxxx | xxxx | | 8000 |
| 08/03 | # 223 | xxxxxxxxxxxx | xxxxxxxx | 18c | 10000 |
| | | low | adeq | high | |
| | | 6,000 — 10,000 | | | |
| 07/27 | # 222 | xxxxxxxxxxxxxxxxxxxxxxxx | xx | | 13000 |
| 07/20 | # 221 | xxxxxxxxxxxxxxxxxxxxxxxx | xxxx | | 15000 |
| 07/13 | # 220 | xxxxxxxxxxxxxxxxxxxxxxxx | xx | | 13000 |
| 07/06 | # 219 | xxxxxxxxxxxxxxxxxxxxxxxx | xxxxxxxx | | 17000 |
| | | low | adequate | high | |
| | | 12,000 — 20,000 | | | |
| 06/29 | # 218 | xxxxxxxxxxxxxxxxxxxxxxxx | xxxxxxxx | | 20000 |
| 06/22 | # 217 | xxxxxxxxxxxxxxxxxxxxxxxx | xxxxx | | 18000 |
| 06/15 | # 216 | xxxxxxxxxxxxxxxxxxxxxxxx | xxxxxxxxxxxx | | 22000 |
| 06/08 | # 215 | xxxxxxxxxxxxxxxxxxxxxxxx | xxxxxxxxxxxxxxxx | xx | 26000 |
| | | low | adequate | high | |
| | | 15,000 — 25,000 | | | |

- 16. Crop:** Indicates which crop the plant sample represents.
- 17. Growth Stage:** Indicates the growth stage of the crop when the plant sample was collected. Stage of growth is critical for interpreting the nutrient analysis properly.

Plant Nutrient Information

- 18A. Total Nitrogen (total N):** Nitrogen is a critical part of proteins in the plant. It is also an important part of chlorophyll and plays a key role in photosynthesis. Nitrogen deficient plants usually have a pale green or yellow color. In grasses, the yellowing usually starts at the leaf tip and goes down the middle of the leaf. Because nitrogen is mobile in the plant, the older leaves will show the symptoms first. The total N content of a plant includes all forms of nitrogen in the plant tissue. The total N content represents the nitrogen status of a crop up to that point in the growing season, but does not predict the nitrogen status of the crop in the future.
- 18B. Nitrate-N (NO_3):** The nitrate (NO_3)-N content of a plant is a measure of only the nitrate form of nitrogen. Potato petioles are commonly tested each week for their nitrate (NO_3) content. The nitrate content of a petiole is a good indicator of the nitrogen status of the crop in the past 2-3 days. The petiole nitrate content is very useful in predicting nitrogen needs in irrigated potatoes.
- 18C. Graph of Nitrate-N Weekly Samples:** The petiole nitrate level for each weekly sample is shown as a graph on the bottom of the report.
- 19. (19A and 19B)**
Phosphorus (total P & P_2O_5 -P): Phosphorus is important for root growth, seed production and crop maturity along with many other functions. Symptoms of plants deficient in phosphorus include stunted growth, delayed maturity and reduced seed production. In young plants, phosphorus deficiency may appear as purple coloring of the older leaves. Phosphorus is mobile in the plant, so deficiency symptoms appear first on the older leaves. The total

phosphorus content of a plant includes all forms of phosphorus in the plant tissue. The phosphate (P_2O_5)-P content of the plant is a measure of only the phosphate form of phosphorus, and is routinely tested on potato petioles.

- 20. Potassium:** Potassium is involved in many physiological processes including protein synthesis and maintaining the water balance in the plant. Potassium deficiency symptoms include reduced growth and yellowing or burning of the leaf edges. Other symptoms include reduced straw or stalk strength, reduced disease resistance and reduced winter hardiness of perennial crops. Since potassium is mobile in the plant, the symptoms appear on the older leaves first. Sandy soils are more likely to be deficient in potassium.
- 21. Sulfur:** Sulfur is a component of plant proteins. Symptoms of sulfur deficiency can look similar to a mild nitrogen deficiency. The only difference is a sulfur deficiency appears sooner on the newer growth because sulfur is not very mobile in the plant. Sulfur deficiencies are more common on sandy soils with low organic matter. In high rainfall years, sulfur deficiencies can occur on most soil types due to leaching of sulfur. Sulfur deficiency is more common in crops such as canola and alfalfa due to higher sulfur requirements.
- 22. Calcium:** Calcium is an important part of cell walls. Calcium deficiency in field crops is rare in the Midwest. When a soil is limed to an acceptable pH (6.0), calcium is usually adequate. Agricultural lime is composed of calcium and magnesium carbonates (CaCO_3 & MgCO_3). The Ag lime applied has enough calcium supplied by the calcium carbonate (CaCO_3) for good plant growth. Areas where calcium deficiencies may occur are sandy irrigated soils with a low soil pH (<6.0). Symptoms of calcium deficiency include black scorched leaf tips and die-back of growing points because calcium is not mobile in the plant. Boron can cause the same symptoms, but calcium deficiency does not promote lateral shoot development like boron deficiency does.
- 23. Magnesium:** Magnesium is a key component of chlorophyll and is essential for photosynthesis. Magnesium deficiencies are rare in the Midwest.

When a soil is limed to an acceptable pH (>6.0), magnesium is usually adequate. Agricultural lime is composed of calcium and magnesium carbonates (CaCO_3 & MgCO_3). When magnesium deficiencies occur, they are usually associated with irrigated sandy soils with a low soil pH (<6.0). Symptoms of magnesium deficiency include mottling of older leaves which proceeds to the younger leaves. The interveinal chlorosis starts in the middle of the leaf, with the margins becoming chlorotic last. In some crops the chlorotic areas of the leaf die and the leaf margins become scorched.

- 24. Sodium:** High levels of sodium are toxic to plant growth. Healthy plant tissue contains very little sodium (except sugarbeets). Symptoms of sodium toxicity include severe stunting and stand loss. A high level of sodium in plant tissue is caused by excessive sodium levels in the soil.
- 25. Zinc:** Zinc is essential in the production of many plant enzymes. It is also important in balancing hormone levels in the plant. Zinc is moderately mobile in the plant. In some plants the interveinal mottling appears first on the older leaves and in others it appears on the new leaves first. The interveinal chlorosis may be the same as iron and manganese except that zinc deficient plants usually develop exceptionally small leaves. Zinc deficiencies are common on sandy low organic matter soils. Crops which are sensitive to zinc include edible beans, corn, flax and potatoes.
- 26. Iron:** Iron is a component of many enzymes in the plant and is essential for photosynthesis. Iron deficiency starts with interveinal chlorosis of the newer leaves and in severe cases all leaves show symptoms. Soybeans are susceptible to iron chlorosis with some varieties being more sensitive than others. Iron deficiencies are common on soils that have high pH (>7.5), high soluble salts (>0.7 mmhos/cm) and high carbonate content (>1.0%). Plant analysis is not a very useful tool for confirming iron deficiency in field crops. The dust that normally occurs on plant tissue contains enough iron to contaminate plant samples. Visual symptoms are used to confirm iron deficiency.

- 27. Manganese:** Manganese is essential for many reactions in the plant and is essential for chloroplast production. Manganese deficiency symptoms include interveinal chlorosis on the newer leaves. These symptoms are difficult to distinguish from symptoms of iron deficiency.
- 28. Copper:** Copper is essential in forming enzymes involved in photosynthesis. In wheat, copper deficiency symptoms include a twisting or whitening of the leaf tip. In later stages of growth, a melanosis or browning of the upper stem and head may occur. Copper deficiencies are common on peat soils (>15% organic matter). Mineral soils which are coarse textured and low in organic matter (<3.0%) may also have copper deficiencies. A history of manure application increases the chance of copper deficiency. Crops most sensitive to copper deficiency include spring wheat, barley and winter wheat.
- 29. Boron:** Boron is important in cell division and is essential for the production of amino acids. Boron deficiency symptoms include browning or blackening of new leaf tips and die-back of growing points similar to calcium deficiency. Growth of lateral shoots can occur on boron deficient plants. Soils likely to be boron deficient are sandy and low in organic matter (<3.0%). Crops most sensitive to boron deficiency include alfalfa and clover.
- 30. Chloride:** Chloride is involved in balancing ion charges within the plant, regulating turgor pressure and reducing susceptibility to some diseases. Chloride is also involved in photosynthesis. A minor chloride deficiency will show few if any symptoms. When chloride deficiency becomes severe, small necrotic areas will appear on the upper leaves of crops such as wheat. Crops most sensitive to chloride include spring wheat, barley and winter wheat.
- 31. Aluminum:** High levels of aluminum are toxic to plant growth. Plants which experience aluminum toxicity will have limited root growth reducing uptake of phosphorus and several other nutrients. Applying lime to bring soil pH to 6.0 or higher will eliminate aluminum toxicity. Aluminum is only tested by special request on plant tissue.