

Soil – Water – Tissue Sampling for Lab Analysis

By
Clarence Chavez



Lab Test will be discussed individually

It time to get back to the Science behind Agriculture

Water

Tissue

Soil



Soil, Water & Tissue

- **Soil Management**

- Knowing what you have (Lab Analysis)
- Limitations to plant growth (Soil Characteristics)

- **Water Management**

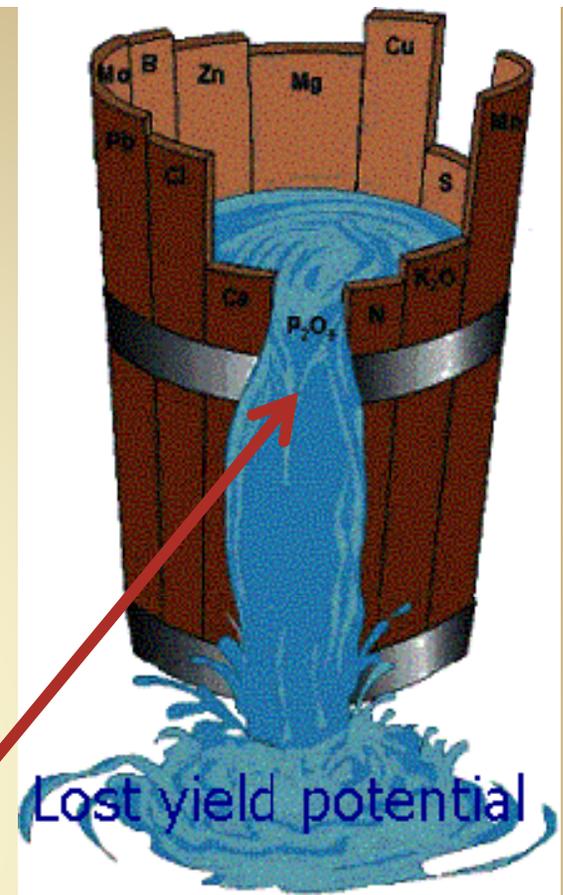
- Water Chemistry (Lab Analysis)
- Irrigation: Methods, Rates, and Timing

- **Crop Nutrition**

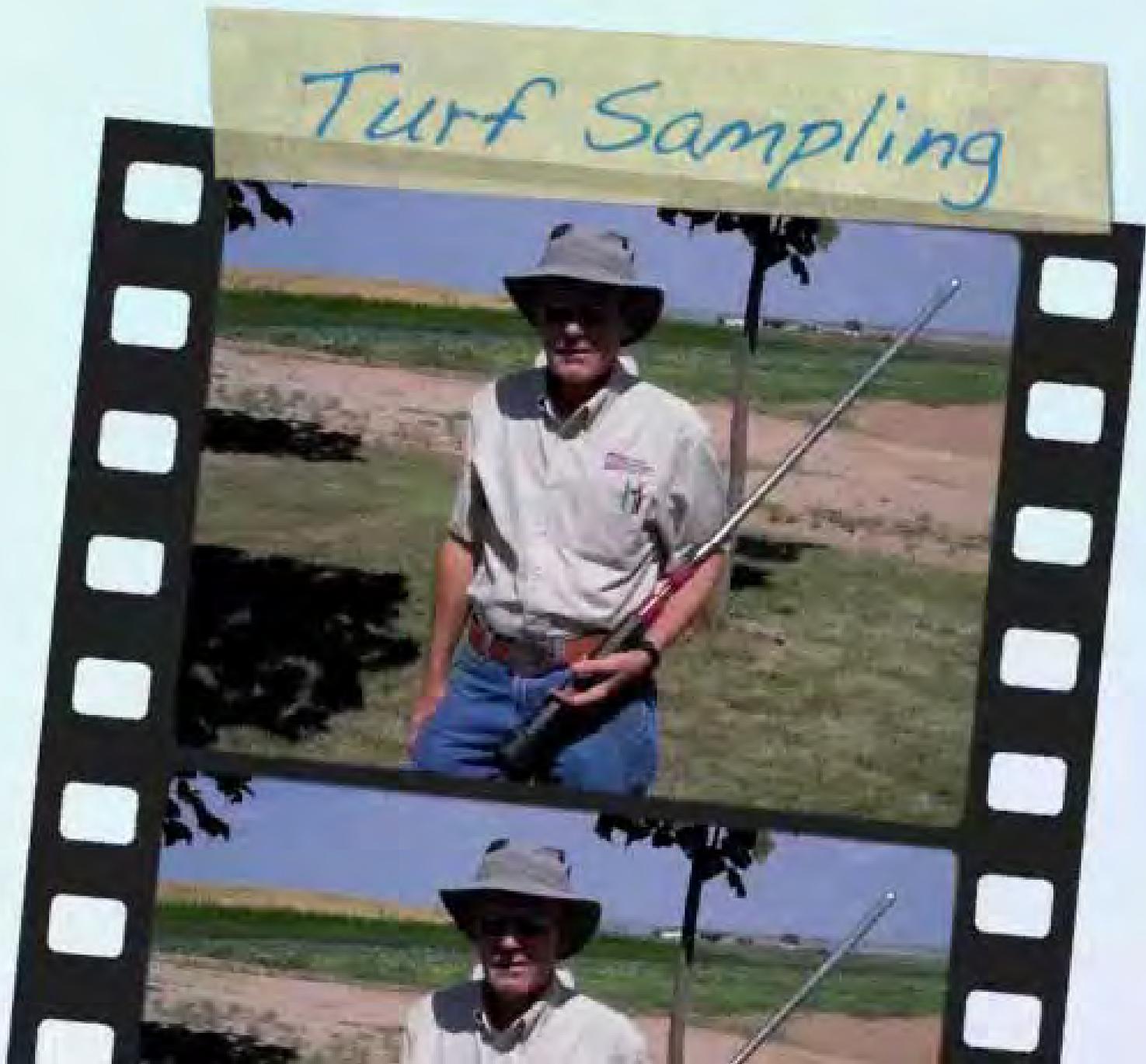
- Tissue Samples (Lab Analysis)

Be aware of Liebig's Law of the Minimum

4R Nutrient Management Stewardship: apply the right source of nutrient, at the right rate, at the right time, and in the right place—but the implementation is knowledge-intensive and site-specific.

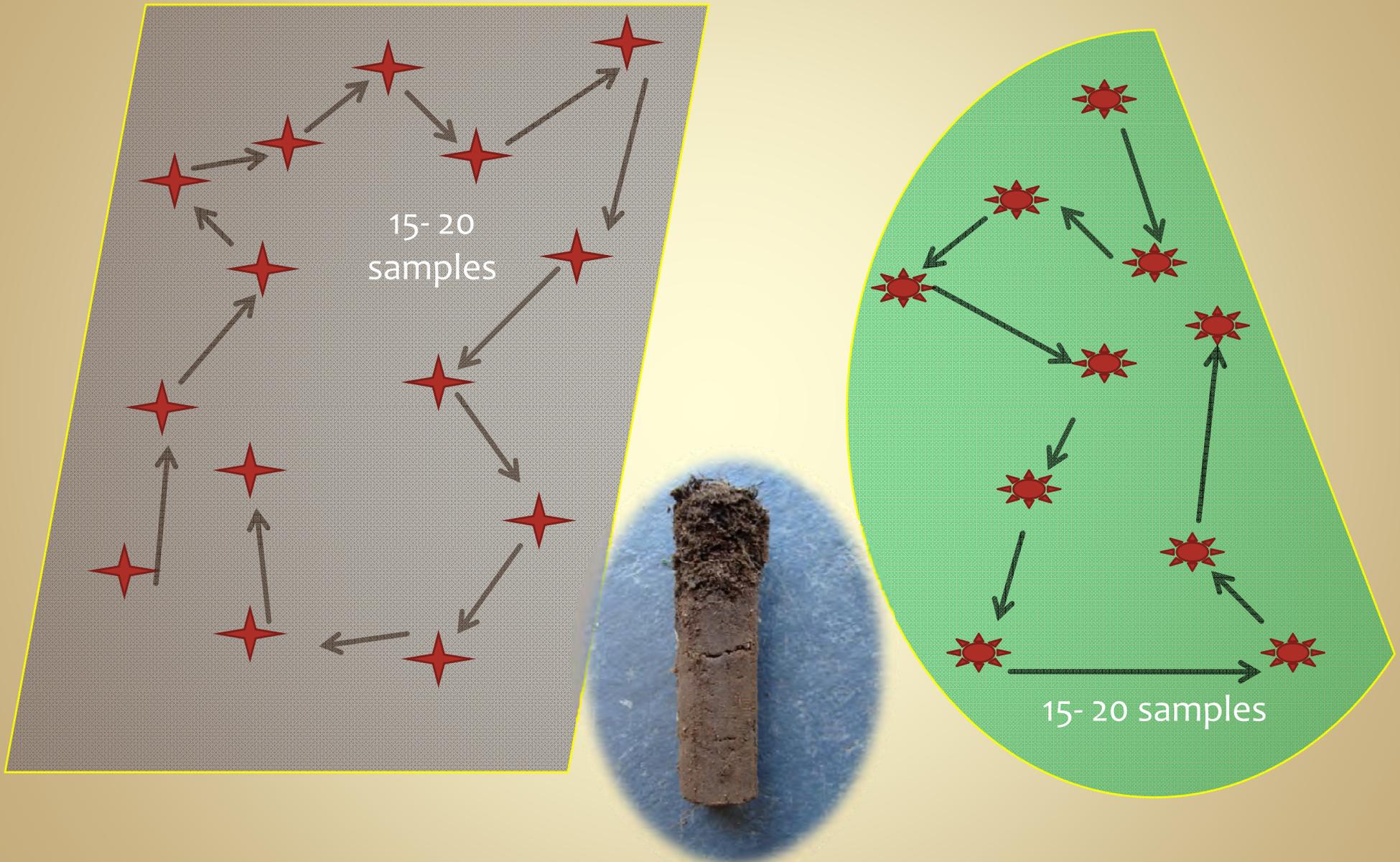


VIDEO FROM NMSU - DR. FLYNN



SOIL SAMPLING IN THE FIELD

Soil Sampling Procedures for Lab



16a-How_to_Collect_Soil_Samples(2)

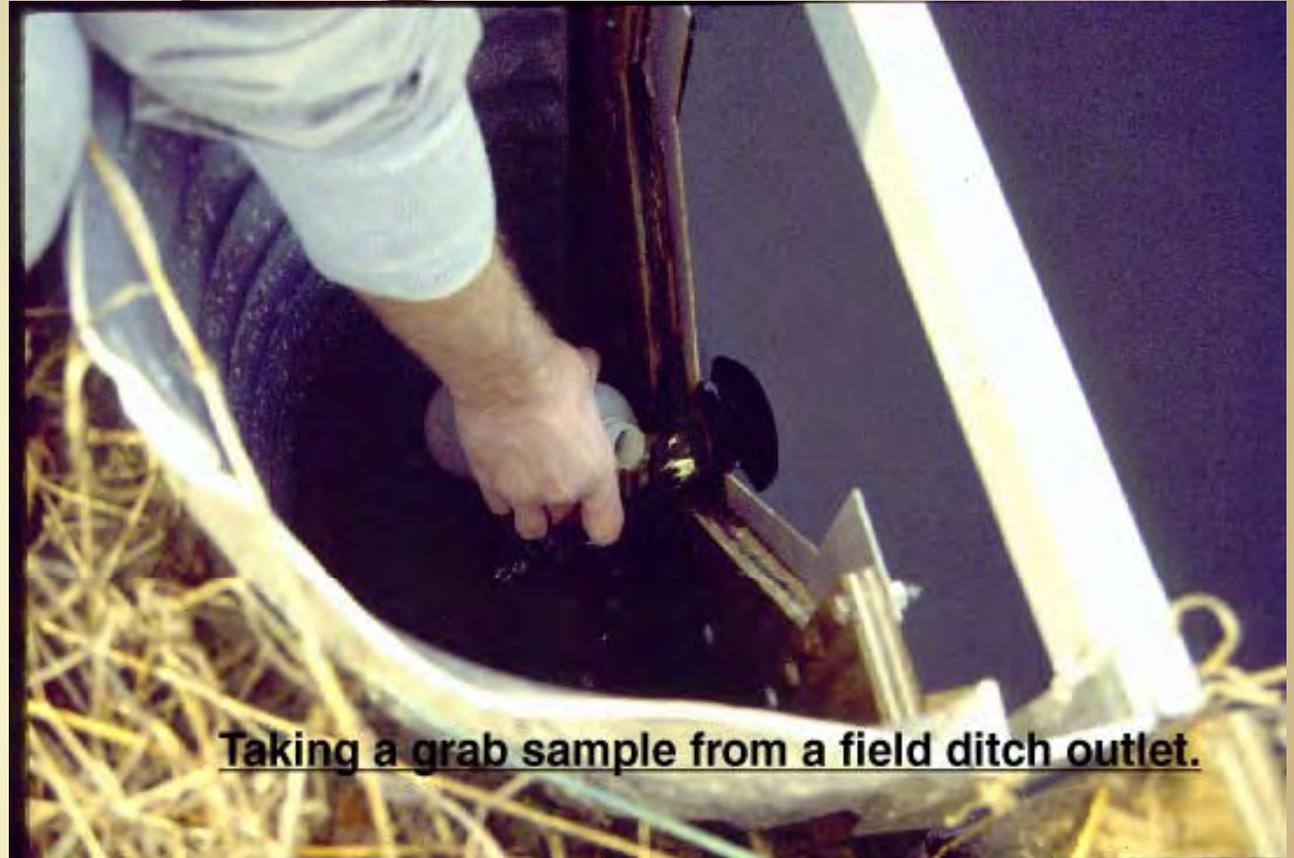
<http://www.nm.nrcs.usda.gov/technical/handbooks/iwm/nmiwm.html>

Irrigation Water Management

Why wait for problems?



Water Sampling for the Lab



Section 2h -Irrigation Water Quality Sampling

<http://www.nm.nrcs.usda.gov/technical/handbooks/iwm/nmiwm.html>

If the source is a pump let it operate twenty minutes to an hour before taking the sample to be sure the water is representative of what is being tested.

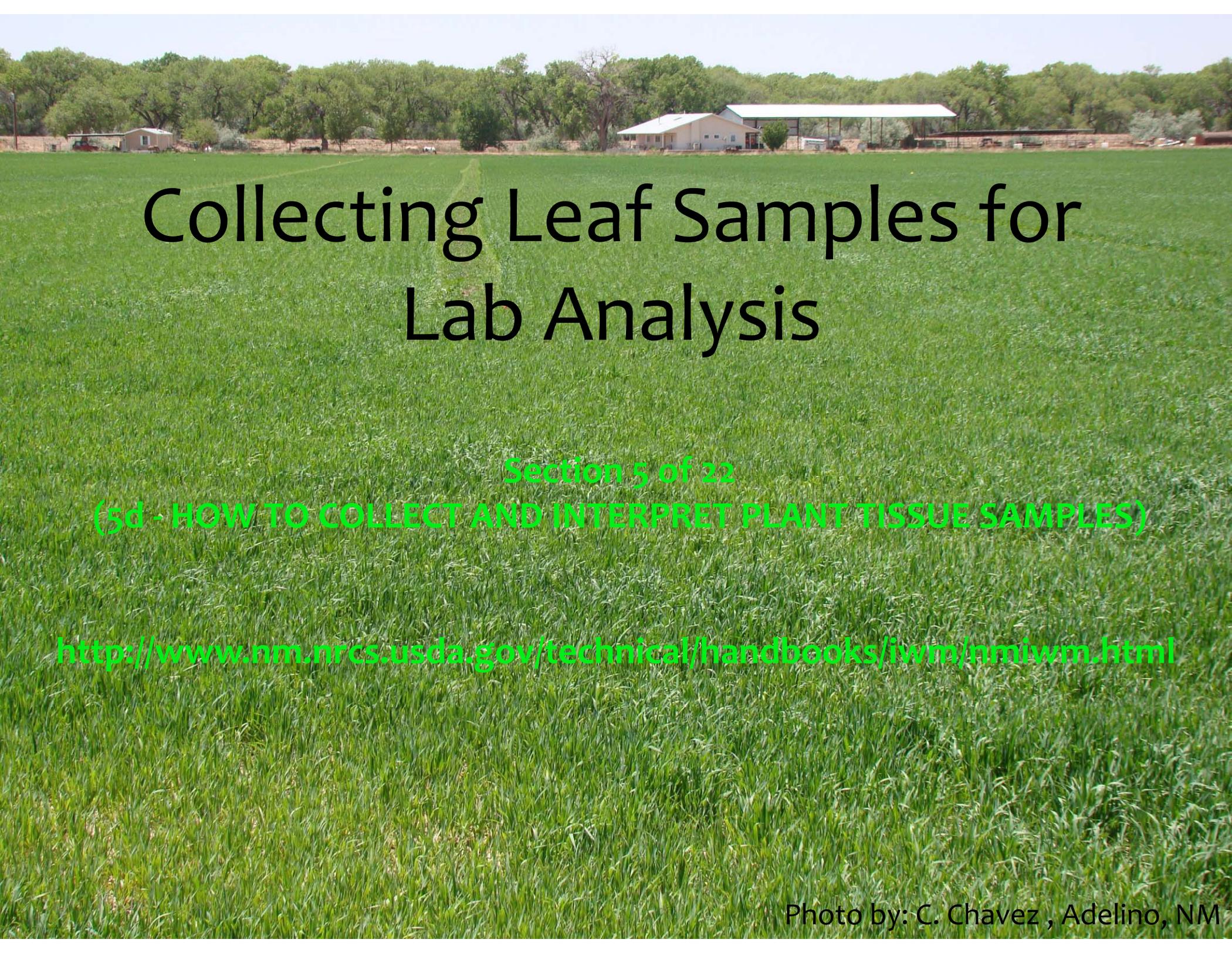
Sampling Irrigation Water

- Use a clean, triple rinsed plastic bottle of at least ½ gallon (2 liters) for all tests. 500 ml for basic tests
- Collect after well or system has run for at least 15 minutes
- Surface water (ditch water) should be collected below water surface
- Store below 40°F if sample can not be analyzed within 3 hours.
- Check with lab for appropriate forms

What are we looking for?

- **pH**
- **Salinity**
- **Specific Ion Effects**
 - **Sodium**
 - **Bicarbonate**
 - **Chloride**
 - **Boron**
- **Other**
 - **Manganese**
 - **Iron**



A large, vibrant green field of crops, likely alfalfa, stretches across the foreground and middle ground. In the background, a white farm building with a long roofline is visible, surrounded by a line of trees under a clear blue sky.

Collecting Leaf Samples for Lab Analysis

Section 5 of 22

(5d - HOW TO COLLECT AND INTERPRET PLANT TISSUE SAMPLES)

<http://www.nm.nrcs.usda.gov/technical/handbooks/iwm/nmiwm.html>

Photo by: C. Chavez , Adelino, NM

Laboratory Analysis

The most common elements analyzed in the leaf sample are:

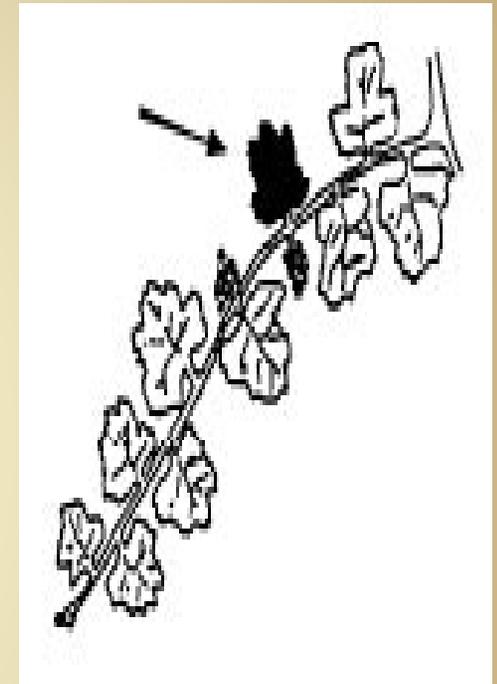
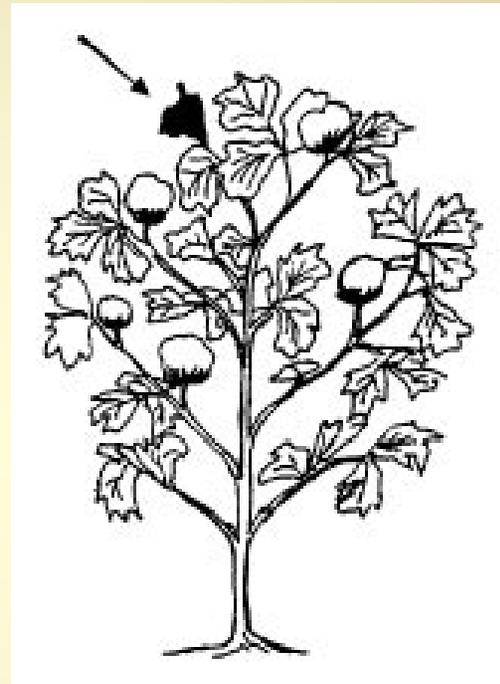
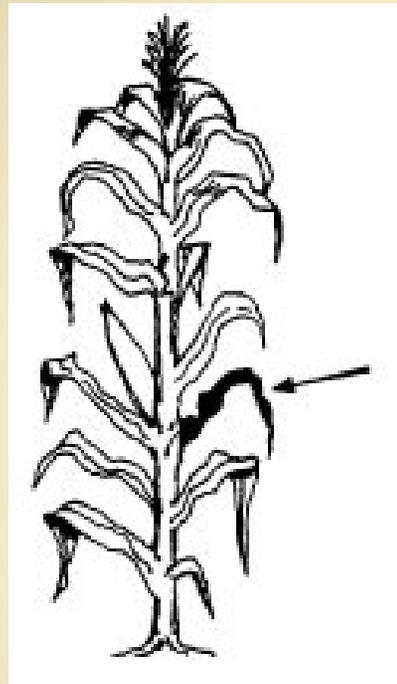
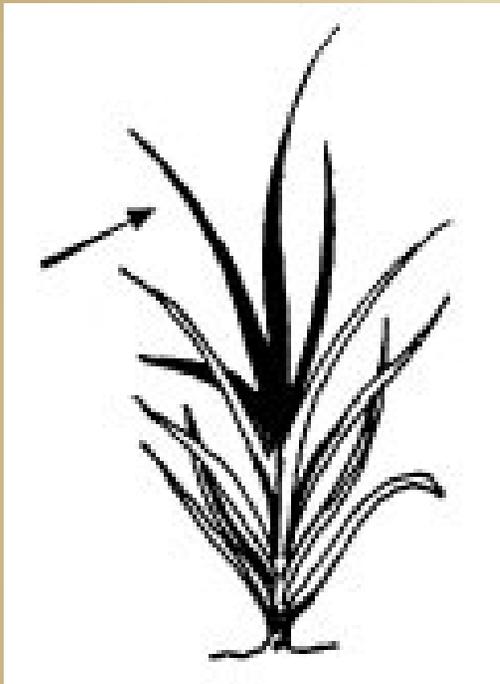
nitrogen (N)	phosphorus (P)	potassium (K)	calcium (Ca),
magnesium (M)	sulfur (S)	sodium (Na)	iron (Fe)
manganese (Mn)	boron (B)	copper (Cu)	zinc (Zn) and
aluminum (Al)			

Others that may be measured either routinely or upon request include:

molybdenum (Mo)	chloride (Cl)	cobalt (Co)	silicon (Si)
cadmium (Cd)	nickel (Ni)	lead (Pb)	chromium (Cr)
arsenic (As)	barium (Ba)	selenium (Se)	

Although some of these are not essential for plant growth, the results may be used to identify elemental toxicities.

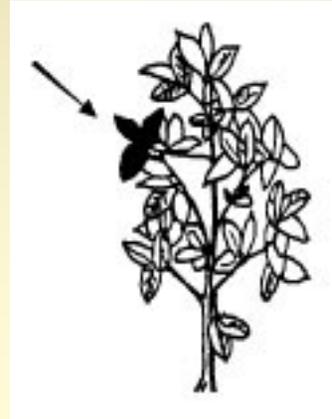
Collecting Leaf Samples for Lab



Sampling Considerations: Nutrient Deficiency ,
Nutrient Toxicity, Hidden Hunger (no visual symptoms),
Nutrient Imbalance , Fertility Monitoring/Effectiveness

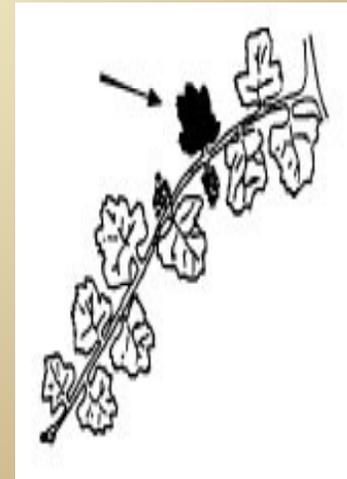
Collecting Leaf Samples for Lab

Alfalfa -- Collect the top 6 inches or upper third of the plant at early bloom.



Soybeans -- Collect recently mature trifoliate leaves from the top of 20–30 plants before or during bloom. (In the seedling stage, collect all of the above-ground portion of the plant.) Guide A-123 • Page 7

Pistachios and Walnuts -- Collect terminal leaflets/leaves from non-fruiting shoots at mid- to late season.



Grapes -- Collect the petioles or leaves adjacent to basal clusters at bloom.

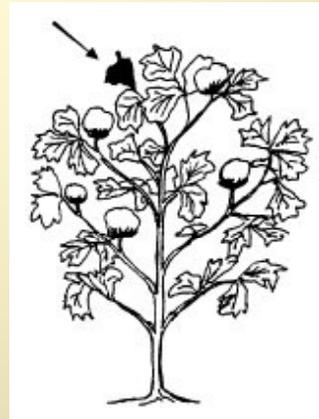
Collecting Leaf Samples for Lab

Pecans, Peaches, and Nectarines -- Collect the mid-shoot leaflets/leaves at midseason.



Apples, Pears, Almonds, Apricots, Cherries, Prunes, Plums -- Collect the leaves from the current season's non-fruiting, nonexpanding spurs at midseason.

Small grains -- Collect the four uppermost leaf blades from the top of 25-40 plants. Sample should equal 2 cups. (In the seedling stage, collect all of the above-ground parts)



Cotton --- Collect recently mature leaves from the main stem on 40 to 50 plants selected at random at full bloom.



Is it in the fruit



Is it in the seed

What do Plant Nutrient Deficiencies Look Like?



Is it the way the plant is growing

What do Deficiencies Look Like?

General symptoms of nutrient deficiency in plants.

- **Nitrogen:** Plant light green, lower leaves yellow to light brown, stalks short and slender, plants stunted.

Notice: no residue cover, poor plant spacing, tillage improper chemical application etc...



- **Iron:** Young leaves are chlorotic, with principal veins typically green; stalks short and slender.

General symptoms of nutrient deficiency in plants.

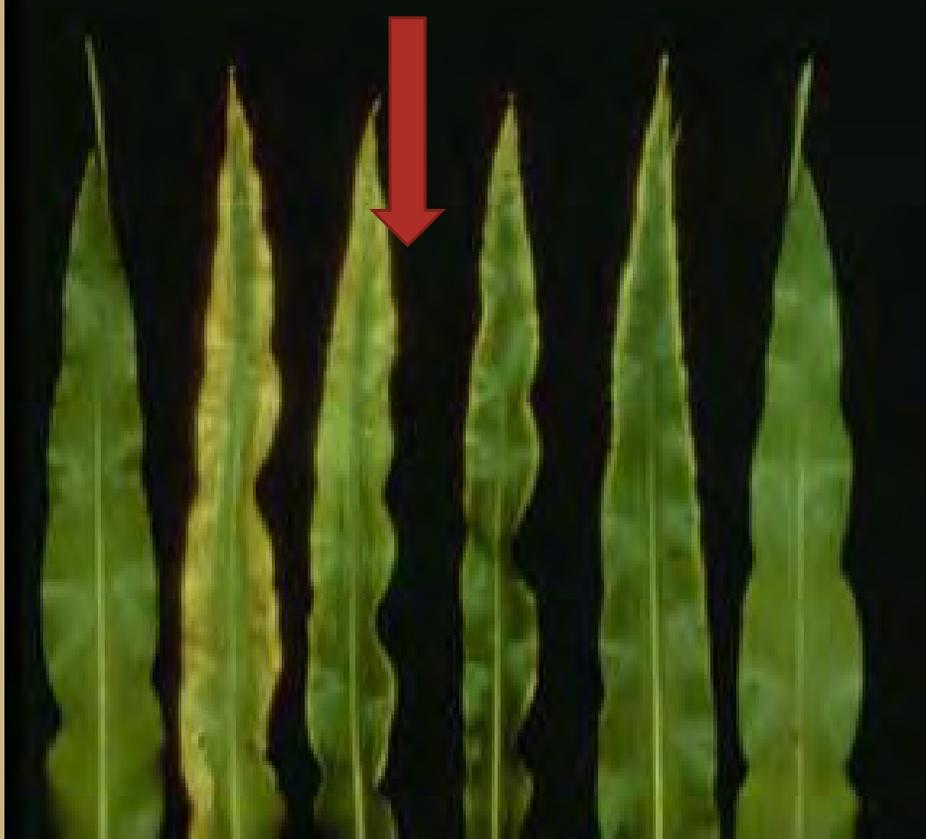
- **Phosphorus:** Plants dark green, often developing red and purple pigments; lower leaves sometimes yellow; plants stunted.



- **Zinc:** Leaf spots on older leaves, with spots rapidly enlarging and generally involving the area between the veins; thick leaves; stalks with shortened internodes.

General symptoms of nutrient deficiency in plants.

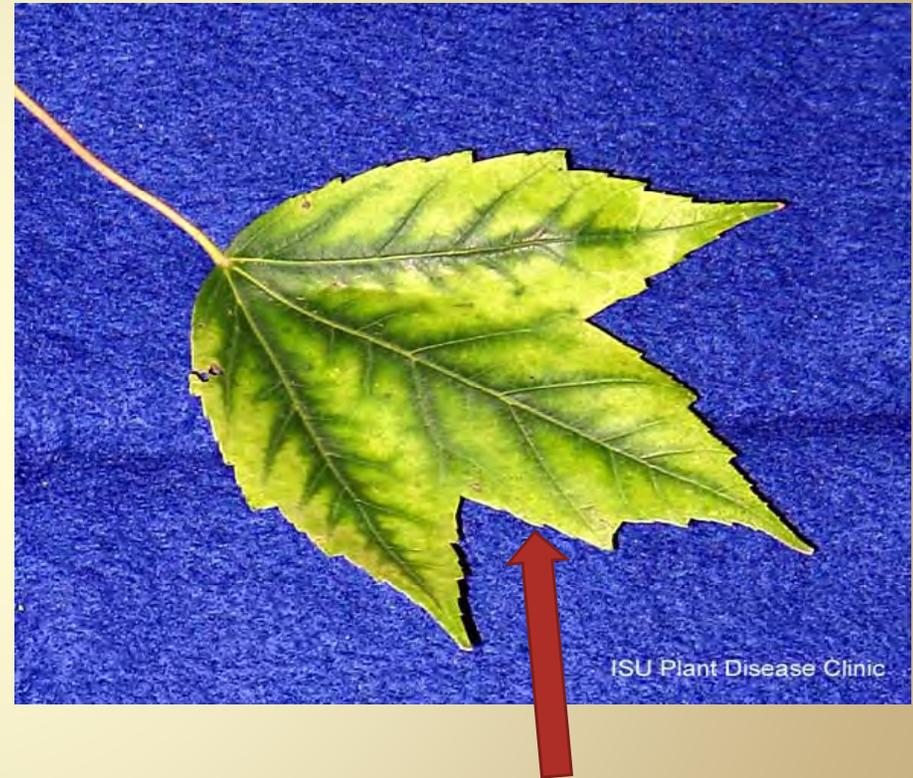
- **Potassium:** Spots of dead tissue, usually at the tips and between the veins; marked margins of leaves.



- **Boron:** Young leaves of the terminal bud are light green at the base; the bud eventually dies.

General symptoms of nutrient deficiency in plants.

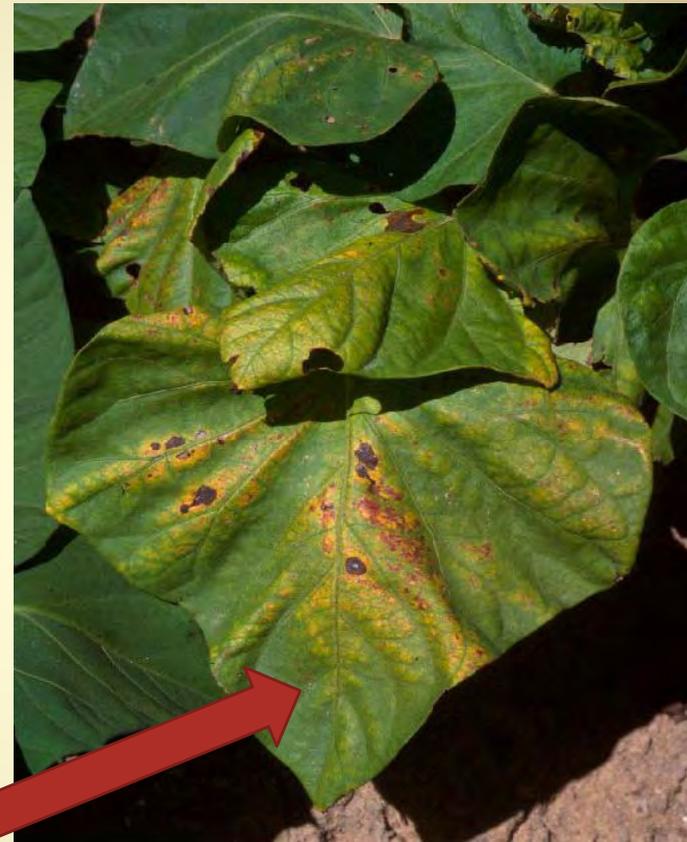
- **Iron:** Young leaves are chlorotic, with principal veins typically green; stalks short and slender. pH



- **Magnesium:** Mottled or chlorotic leaves, which typically redden; leaf tips and margins turned or cupped upward.

General symptoms of nutrient deficiency in plants.

- **Magnesium:** Mottled or chlorotic leaves, which typically redden; leaf tips and margins turned or cupped upward.



- **Copper:** Young leaves are permanently wilted, with spotty or marked chlorosis.

General symptoms of nutrient deficiency in plants.

- **Calcium:** Young leaves of terminal bud hooded; with severe deficiency, dying buds; dying back at the tips and margins of the leaf.



- **Sulfur:** In young leaves, veins and tissue between veins are light green.

Special note:

Not Just Nutrient Deficiencies Cause Symptoms in plants.

Plant and Leaves can show symptoms that look like nutrient deficiencies:

Compaction	Bulk Density	Saline Soil
Sodic soil	Water Quality	Wind
Insects	Water Quantity etc...	

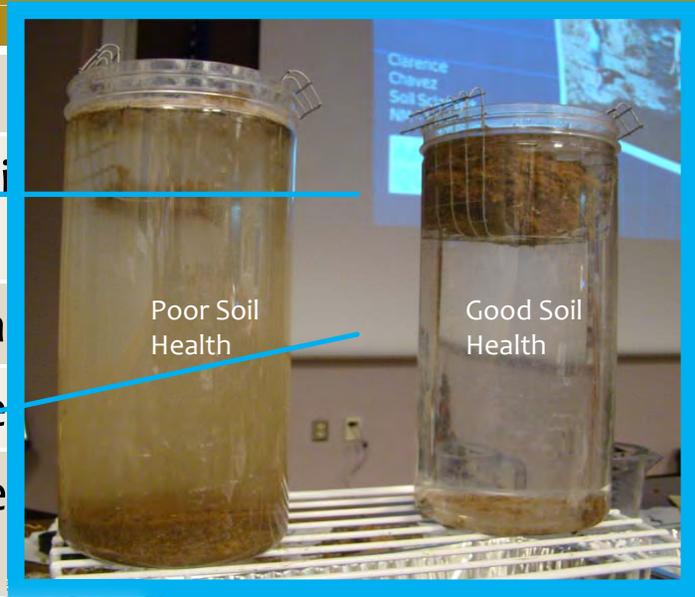
Conditions that Affect Nutrient's

Conditions	Nutrients Likely to be Deficient				
Cold Soils	Nitrogen	Phosphorus	Sulfur	Iron	Zinc
Saturated Soils	Nitrogen	Phosphorus	Potassium	Iron	Zinc
High pH	Copper	Iron	Manganese	Zinc	
Low pH	Sulfur	Calcium	Magnesium	Molybdenum	
Compacted soils	Phosphorus	Potassium	Magnesium	Boron	
Dry Soils	Phosphorus	Potassium	Sulfur		
High OM	Potassium	Copper	Manganese		
Sandy Soils	Sulfur	Magnesium	Potassium	Boron	Manganese
High Calcium	Phosphorus	Iron			
Low OM	Sulfur	Potassium	Phosphorus	Boron	Zinc
High Magnesium	Calcium				
High Potassium	Calcium	Magnesium			

Note: However other factors may give the same symptoms – pH, soil compaction, bulk density etc.

How to Interpret Soil Health Management System

Conditions	Nutrients Likely to be Deficient		
Cold Soils	Nitrogen	Phosphorus	Sulfur
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High OM	Potassium	Copper	
Sandy Soils	Sulfur	Magnesium	Boron
High Calcium	Phosphorus	Iron	Manganese
Low OM	Sulfur	Potassium	Boron
High Magnesium	Calcium		Zinc
High Potassium	Calcium	Magnesium	



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How to Interpret Soil Health Management System

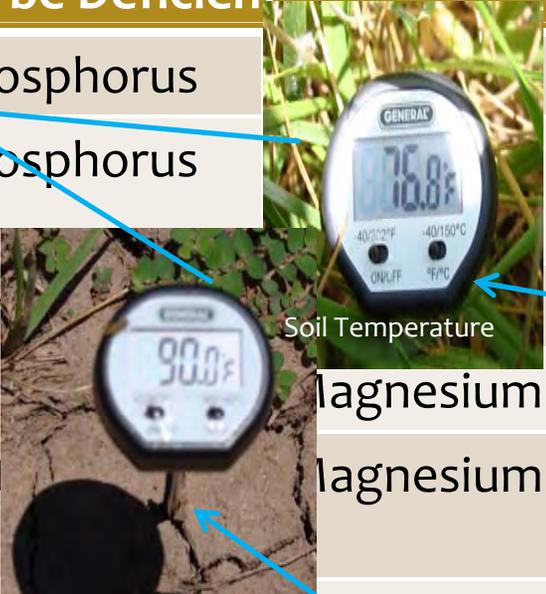
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High Calcium	Phosphorus	Iron			
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High Calcium	Phosphorus	Iron			
Low OM	Sulfur	Potassium	Phosphorus	Boron	Zinc
High Magnesium	Calcium				
High Potassium	Calcium	Magnesium			

Nutrient Uptake is not an issue if you implement Soil Health Management System.

Note: However other factors may give the same symptoms – pH, soil compaction, bulk density

Soil, Water & Tissue Number Crunching Worksheet

Section 9 of 22 (9b - Irrigation Water, Soil and Plant Tissue Analysis Interpretation Guide – Blank Copy)

1	Producer:		Crop:		Yield:		Irrigation Water:				
2	Tillage Operations:										
3	Soil Texture:		Soil Structure:		Aggregate Stability:						
4	Nutrients ON = Organic Nitrogen mineralized	Irrigation Water Analysis (ppm x 0.23 x " = lb./ac.)		Soil Analysis 0-6" depth ppm x " = lb/ac (6" depth)		Nutrient Inputs (recommendations)	Plant Tissue Analysis Note: N is kjeldahl nitrogen & Sulfur is total Sulfur		Should I Apply Nutrients? - Yes (Y) No (N) - Maintenance (M) - Not Sure (?) - Other (O)	Conservation Practices to consider for achieving sustainability ♥ Cover Crops ♥ Crop Rotations ♥ Manure or Compost ♥ Minimum-Till (No-Till); Residue mgmt. ♥ IWM ♥ Soil Amendments (e.g. gypsum) ♥ IPM	
		ppm or mg/l	Pounds per Acre	ppm or mg/Kg	Pounds per Acre (VL, L, M, H, & VH)	Pounds per Acre	% or ppm & Rating (low - high)	Sufficiency Range (leaf: middle of terminal shoot)			
5		Organic Matter		%							
6		N mineralized		ON		Manure?					
7		Nitrate-Nitrogen				N	%	%			
8		Phosphorus				P ₂ O ₅	%	%			
9		Potassium				K ₂ O	%	%			
10		Sulfate-Sulfur				none	%	%			
11		Calcium				none	%	%			
12		Magnesium				none	%	%			
13		Zinc				none	ppm	ppm			
14		Iron				none	ppm	ppm			
15		Manganese				none	ppm	ppm			
16		Copper				none	ppm	ppm			
17		Boron				none	ppm	ppm			
18		Molybdenum				none					
19		Sodium				use SAR					
20		Chloride									
21		Bicarbonate									
22		Carbonate									

Additional Assessments to Consider in evaluating your Cropping System (soil pH, free lime & CEC)

**For more information Please
Contact Your Local Office of the:**

**Natural Resources Conservation
Service**

or

Soil and Water Conservation District



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