NUTRIENT MANAGEMENT AND PLANT DENSITY RECOMMENDATIONS FOR LA PAZ COUNTY ALFALFA GROWERS

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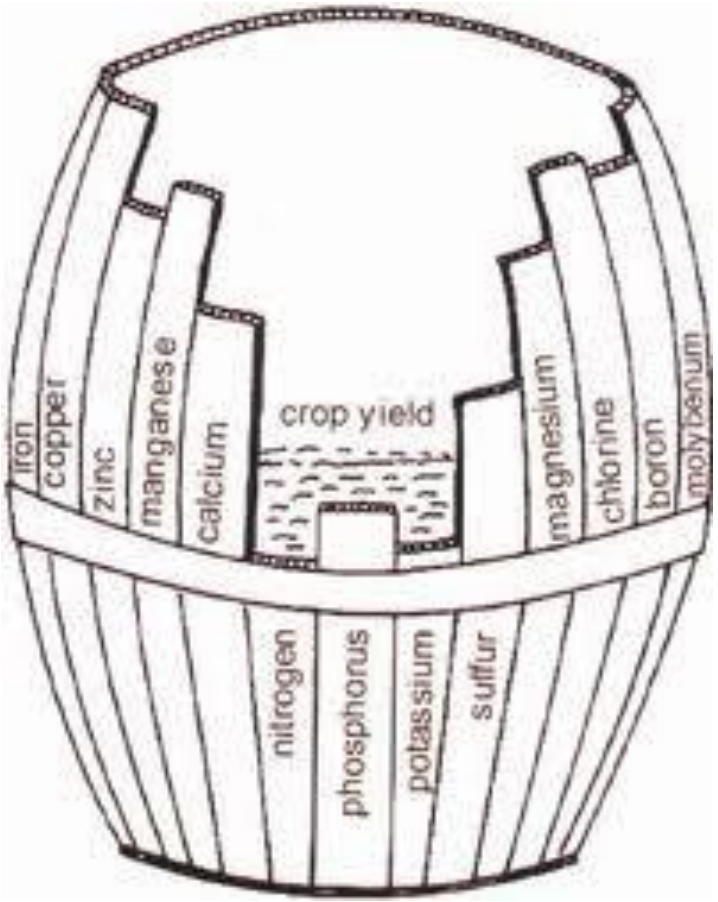
September 24, 2013

Parker, Arizona

ARIZONA
COLLEGE OF AGRICULTURE AND LIFE SCIENCES
COOPERATIVE EXTENSION

Law of the Minimum

- Plants will grow and produce only as much as the least available nutrient will allow them to.



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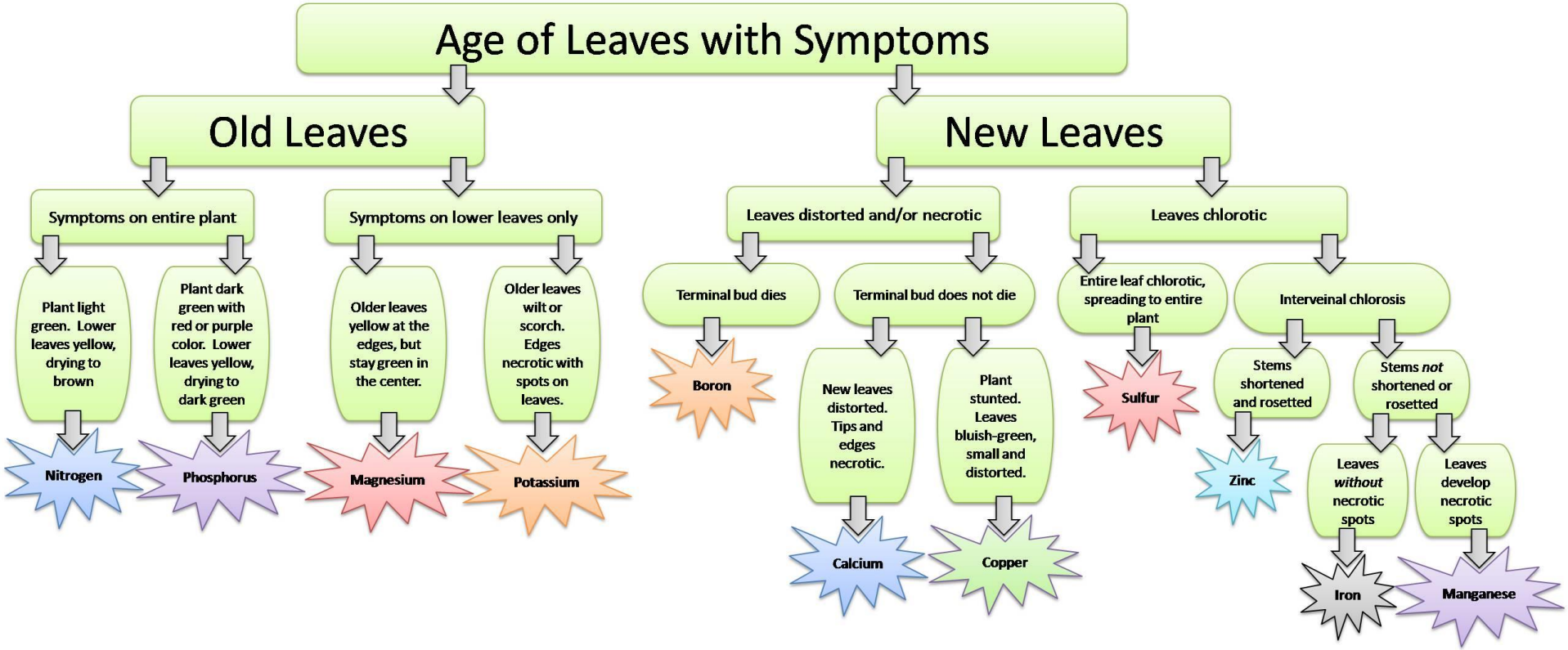
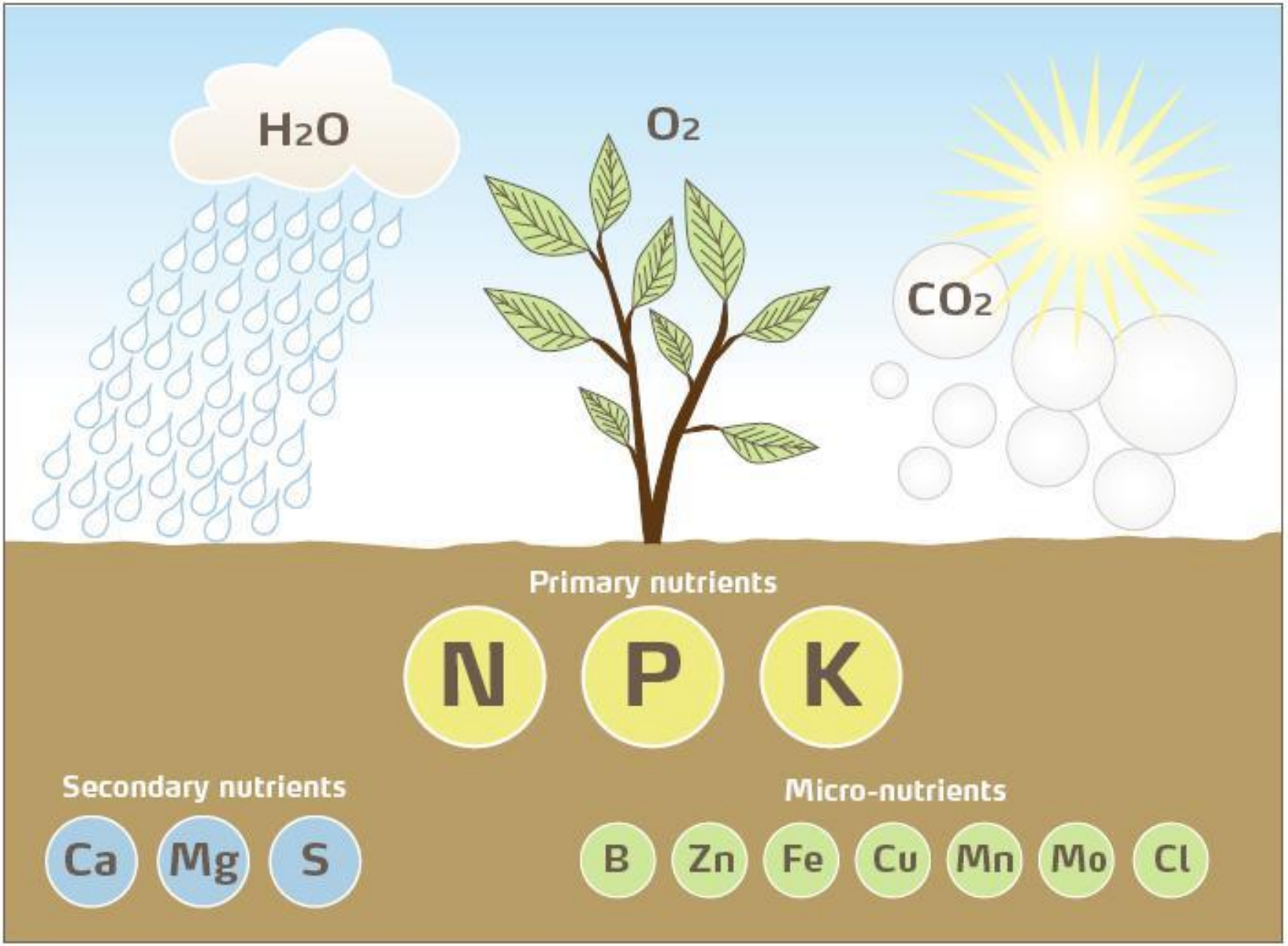
Diagnosing a Nutrient Deficiency



Primary, secondary and micro-nutrients

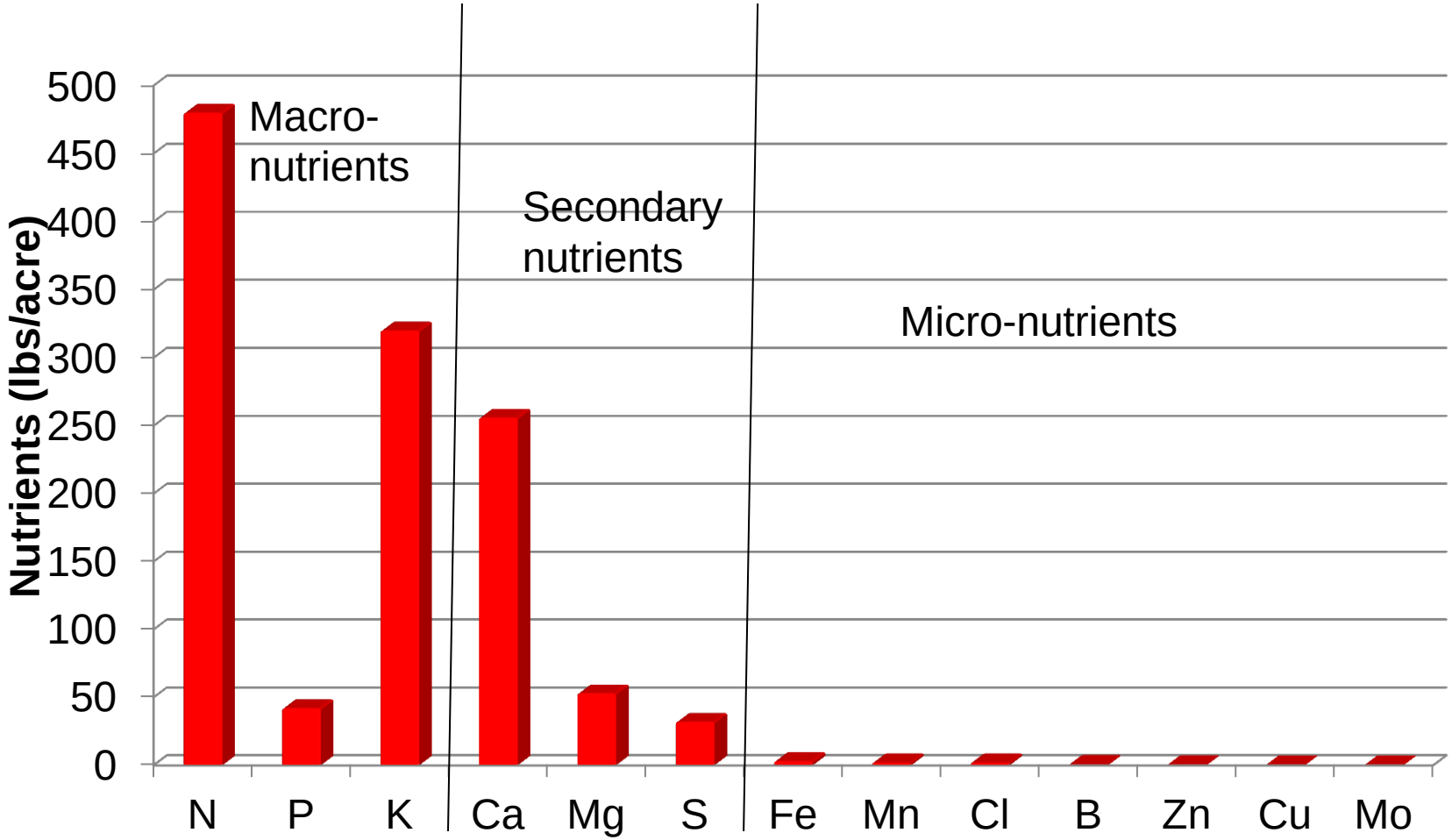


Alfalfa fertilizer requirements in arid regions

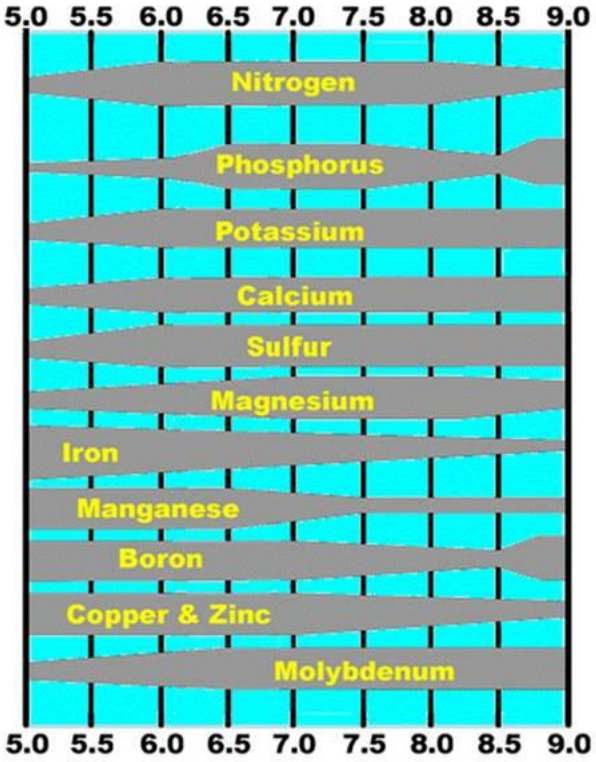
Element	Symbol	Fertilizer required
Phosphorus	P	More than 25% of acreage
Potassium	K	Less than 25% of acreage
Magnesium	Mg	Less than 25% of acreage
Sulfur	S	Less than 25% of acreage
Molybdenum	Mo	Less than 25% of acreage
Nitrogen	N	Less than 1% of acreage
Boron	B	Less than 1% of acreage
Other	--	Never

(Source: Meyer et al., 2008)

Nutrients in 8 T/A Alfalfa



pH and Nutrient Availability



- Maximum nutrient availability: 6.0 > pH > 7.0
- Nutrient toxicity at low pH
- Nutrient deficiency at high pH

Raising Soil pH

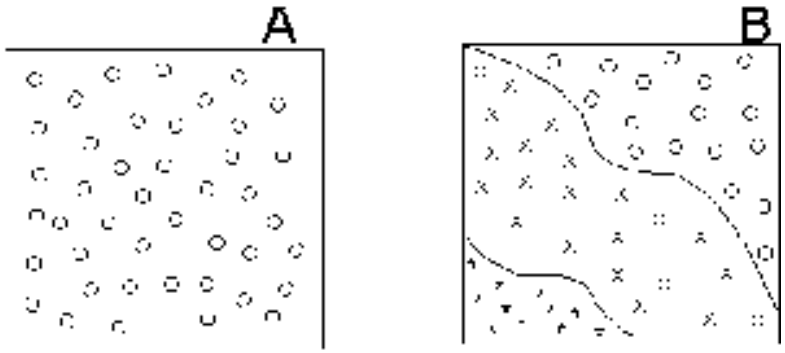
- Add lime (usu. calcium carbonate)
- Neutralizes acidity & supplies calcium

Lowering Soil pH

- If the high (alkaline) soil pH is a natural condition, little can be done to lower it
- Marginally-alkaline soils can be acidified with elemental sulfur

Pre-plant Soil Sampling

- Uniform field:
  - 25 soil cores for a composite soil sample per field
  - 6-8 inch depth (2 ft?)
- Non-uniform field



(A) Soil sampling pattern within a relatively uniform field, and (B) soil sampling pattern within three distinct zones of a field, each having unique characteristics warranting a separate sample (approximately 25-30 cores/sample).

Reading the Soil Test Report

IAS Laboratories

2515 East University Drive
Phoenix, Arizona 85034
(602) 273-7248

SOIL ANALYSIS REPORT

Page 1

Today's Date: 4/20/2012
Grower: Cotton Manure Study
Submitted By: Shawna Loper
Send Report To: UA Cooperative Extension Pinal
Report Number: 6642585
Crop: No Interpretive Levels
Date Received: 4/17/2012

VL = Very Low
L = Low
M = Medium
H = High
VH = Very High

Sender Sample Id	Depth	Lab #	pH	Calcium (Ca) PPM	Magnesium (Mg) PPM	Sodium (Na) PPM	Potash (K) PPM	Iron (Fe) PPM	Zinc (Zn) PPM	Manganese (Mn) PPM	Copper (Cu) PPM	Salinity (EC x K) dS/m	Nitrate Nitrogen (NO3-N) PPM	Phosphorus (Bicarb - Soluble P) PPM	Computed % Sodium (ESP)	Sulfur (SO4-S) PPM	Boron (B) PPM	Free Lime Level
#1	0-15cm	672	8.5	3400 VH	250 H	250 H	290 VH	5.9 H	.42 L	9.8 VH	1.2 VH	.8 L	7.3 L	5.7 L	5.2	18 H	.97 L	Medium
#2	15-30cm	673	8.6	4500 VH	260 VH	250 H	230 H	6.0 H	.56 L	7.4 VH	1.2 VH	1.0 L	6.0 L	3.7 VL	4.1	20 VH	.77 L	High
#3	30-45cm	674	8.5	6200 VH	310 VH	280 H	210 H	5.8 H	.22 L	4.9 VH	1.1 VH	1.0 L	5.0 VL	3.4 VL	3.4	24 VH	.72 L	High
#4	45-60cm	675	8.4	7300 VH	350 VH	340 VH	200 H	5.7 H	.14 VL	3.4 H	1.1 VH	1.2 L	4.9 VL	2.8 VL	3.6	39 VH	.75 L	High
#5	60-90cm	676	8.5	7200 VH	360 VH	370 VH	200 H	5.4 H	.10 VL	2.6 H	.77 H	1.4 L	4.8 VL	3.1 VL	3.9	46 VH	.78 L	High

Levels of N, P, K, Mg and Ca are reported here. Also pH and lime results.

Nutrient levels reported in parts per million (ppm)

Can be doubled to approximate nutrient levels on pounds per acre basis

Probable responses to soil test rating

Soil Test Rating	Probability of Response (%)
L= Low	95 to 100
M= Medium	65 to 95
H= High	30 to 65
VH= Very High	10 to 30

International Soil Fertility Manual. 1995. Potash and Phosphate Institute.

Soil Test Interpretations

	Alfalfa
NO_3-N	
Deficient	0 – 5
Sufficient	6 – 10
High	> 10
P	
Deficient	< 5
Sufficient	5 – 15
High	>15
K	
Deficient	50 - 100
Sufficient	100 - 175
High	> 175

Tissue Testing

- Minimum of 10 whole plants- prefer 30 or more from field

- Collect at early bloom
- Sample healthy plants
- Keep samples cool and transport to lab ASAP

Nitrogen

- Utilizes about 56 lb N/ton of yield
- Seldom Recommended
- New Stand-
  - 15-25 lbs/ac
- Inhibit Rhizobium activity

Nitrogen Deficiency

- Conditions
  - Poor nodulation
- Diagnosis
  - Few nodules on roots
  - Small yellow planted mixed with tall green plants
- Correction
  - Adjust pH>6.3
  - N fertilizer <50 lbs N/acre/cutting
  - Inoculate
    - Top-dress: Drill (3-5 lbs N/acre) 205x inoculated seed
    - Inoculant in irrigation water

Fertilizer Form	Maximum Nutrient Rate
UAN32, urea	50 lbs/a per cutting

Conditions Favoring N Deficiency

- Seedling alfalfa
- Cold weather
- Problem soils
  - Low pH
  - Waterlogged
  - Shallow
  - Sandy

Nitrogen Deficiency

Phosphorus

- Alfalfa contains approximately 12 lbs/ton of P
- P fertilizer rate based on soil testing

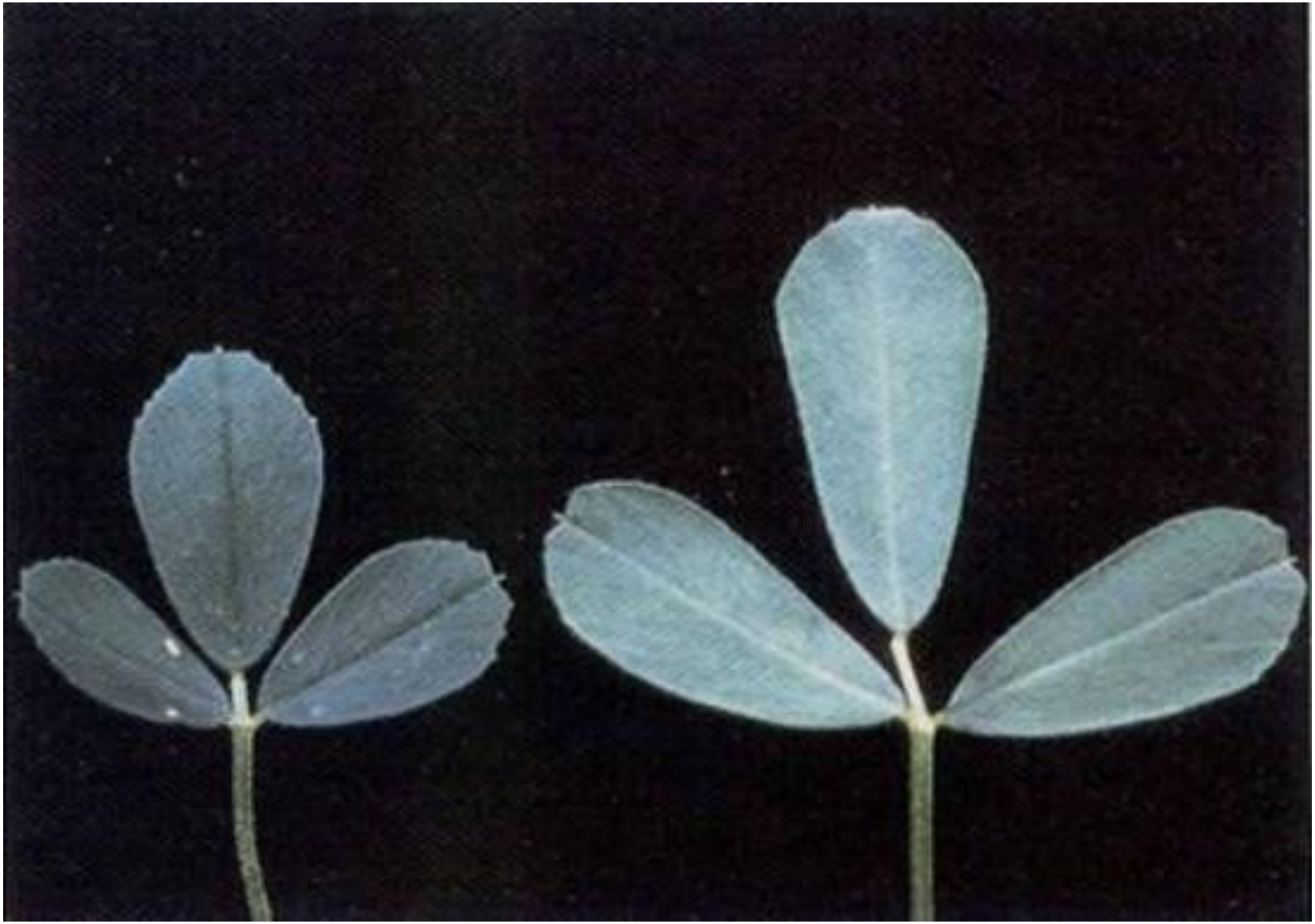
Soil test values-extractable P	P_2O_5 lbs/acre
> 15 ppm	0
11-15	50-150
6-10	140-250
<6	200-300

- At 10% of bloom stage of growth, leaves and stem should contain 0.18% P or more

Phosphorus Deficiency

- Conditions
  - Cold soil, high pH soil
- Diagnosis
  - Soil test
  - Tissue Test
  - Small, dark blue-green leaves

Phosphorus Deficiency



Phosphorus Application

- Timing- before spring growth
- High P rates
- Spoon feeding a problem if always borderline deficient
- Split applications for long growing season
- Banding

Fertilizer Form	Maximum Nutrient Rate
11-52-0 10-34-0	100 lbs P_2O_5/a per year

Potassium

- Soil content usually adequate

- K applications to alkaline soils in AZ did not increase yield
  - When plant contains 1.5% or more K, application of K does not increase yield

Potassium Deficiency

- Conditions
  - Sandy Soil
- Diagnosis
  - Soil or tissue test
  - White spots on leaf margins

Fertilizer Form	Maximum Nutrient Rate
Potassium chloride or sulfate	300 lbs K_20/a

Potassium Deficiency

Sulfur

- Conditions
  - Low S in irrigation water, sandy soil, low OM soil
- Diagnosis
  - Tissue or soil test
  - Yellow, stunted plants
- Fertilizer
  - Gypsum (15-17% S)
  - Max.= 15 to 50 lbs S/acre/year

Fertilizer Form	Maximum Nutrient Rate
Sulfur, gypsum	15 to 50 lbs S/a per year

Sulfur Deficiency

Boron

- Seldom Observed
- Conditions
  - Low OM, sandy, high pH soil
- Diagnosis
  - Tissue or soil test
  - Yellow and reddish top
- Fertilizer
  - Solubor (18%B)
  - Max.= 1 to 3 lbs B/acre/year

Fertilizer Form	Maximum Nutrient Rate
Borax, borosilicate, boric acid	1 to 3 lbs B/a

Boron Deficiency

Zinc

- Conditions
  - Sandy, low OM soil
- Diagnosis
  - Tissue or soil test
  - Light green leaves, rosette top
- Fertilizer
  - Zinc sulfate (36% Zn)
  - Max.= 2 to 16 lbs Zn/acre/life of stand

Zinc Deficiency

Molybdenum Deficiency

- Conditions
  - Low pH soil
- Diagnosis
  - Tissue test
  - Yellow, stunted plants
- Fertilizer
  - Sodium Molybdate (40% Mo)
  - Max.= 0.1 to 0.5 lbs Mo/acre/life of stand

Fertilizer Form	Maximum Nutrient Rate
Ammonium or sodium molydate	0.1 to 0.5 lbs Mo/a

Molybdenum Deficiency

Electrical Conductivity (EC)

EC (dS/m)	Soil Salinity Tolerance
0 to 1.5	Very sensitive plants can tolerate
1.6 to 3.0	Moderately sensitive plants must be used
3.1 to 6.0	Moderately tolerant plants must be used
6.1 to 10.0	Tolerant plants must be used
Above 10.0	Very tolerant plants must be used

From Carrow and Duncan. 1998. Salt Affected Turf Sites

Salinity tolerance of alfalfa

- Crop tolerance and yield potential of selected crops as influenced by irrigation water salinity (EC_W) and soil salinity (Ec_e)

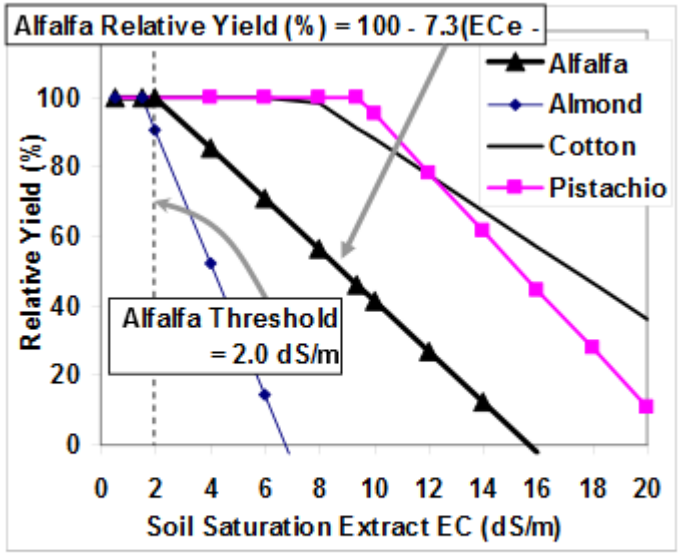


Fig. 4. Salinity tolerance curves for alfalfa, almond, cotton and pistachio. (Ayers and Westcott, 1985. Sanden, et. al., 2004)

	100%		90%		75%		50%		0%	
	Ec_e	EC_W	Ec_e	EC_W	Ec_e	EC_W	Ec_e	EC_W	Ec_e	EC_W
Alfalfa	2.0	1.3	3.4	2.2	5.4	3.6	8.8	5.9	16	10

Misdiagnosis

- Can exhibit symptoms that mimic nutrient deficiencies
- Insects
  - Three cornered leaf hopper can girdle stems and cause leaves to turn purple (P deficiency)
- Diseases
  - Alfalfa mosaic virus can cause leaf yellowing that may be confused with micronutrient decency
- Weather
  - Cold weather can also cause some purpling or yellowing

Manure

- Advantages
  - Soil improvement
  - Nutrients
- Disadvantages
  - Salt
  - Weeds
  - Not a balanced fertilizer
  - Nutrients not immediately available
  - High K in alfalfa
  - Manure in bales
  - Pre-plant primarily
  - Effluent needs dilution (salt, Cu_2SO_4, BOD, ammonia)

Table 4.1. Average Nutrient Values for Various Manures

Manure Type	Total N	NH4+	P2O5	K2O	Ca	Mg	% H2O
Liquid Dairy [1]	22.61	9.57	12.07	18.92	10.90	4.55	94.30
Dry Broiler Litter	62.58	11.75	62.12	28.57	40.97	8.44	28.43
Dry Turkey Litter	61.75	15.18	63.68	24.36	43.11	7.02	34.72
Layer or Breeder	36.46	8.98	65.06	24.22	123.38	7.67	43.28
Liquid Poultry	51.08	32.95	41.01	30.53	40.05	5.19	93.49
Semi Solid Dairy	10.54	3.16	6.12	8.67	6.90	2.50	82.56
Semi Solid Beef	12.79	2.57	6.67	11.30	7.43	2.69	73.08
Swine Lagoon	10.04	5.34	5.68	5.72	2.49	0.89	99.01
Mixed Swine	1.13	26.93	29.75	18.18	16.44	4.86	94.97

1 Values presented in lbs/1000 gallons. All other values in lbs/ton.

The above table is a compilation of average values for 1090 manure samples.

Planting Rate

- General Recommendation

  15-20 pounds per acre

- Broadcast vs. drill

  Increase 10-20%

- Higher seeding = higher yields??

Replanting?

- Left: One year old alfalfa stand; Right: Four year old alfalfa stand.
- Thickening declining or thin stands seldom successful
- Autotoxicity

Questions?