Alfalfa Fertility

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Goals?

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

Table 4.6 Soil Fertility Handbook.
Primary nutrient soil test calibration tables for legumes.

NITROGEN REQUIREMENTS

ALFALFA

10-20 lb/A for establishment.
None needed for maintenance.

PHOSPHORUS REQUIREMENT

P SOIL TEST INDEX	Percent Sufficiency	P_2O_5 lb/A
0	20	200
10	50	150
20	70	100
40	90	60
65+	100	none

POTASSIUM REQUIREMENT

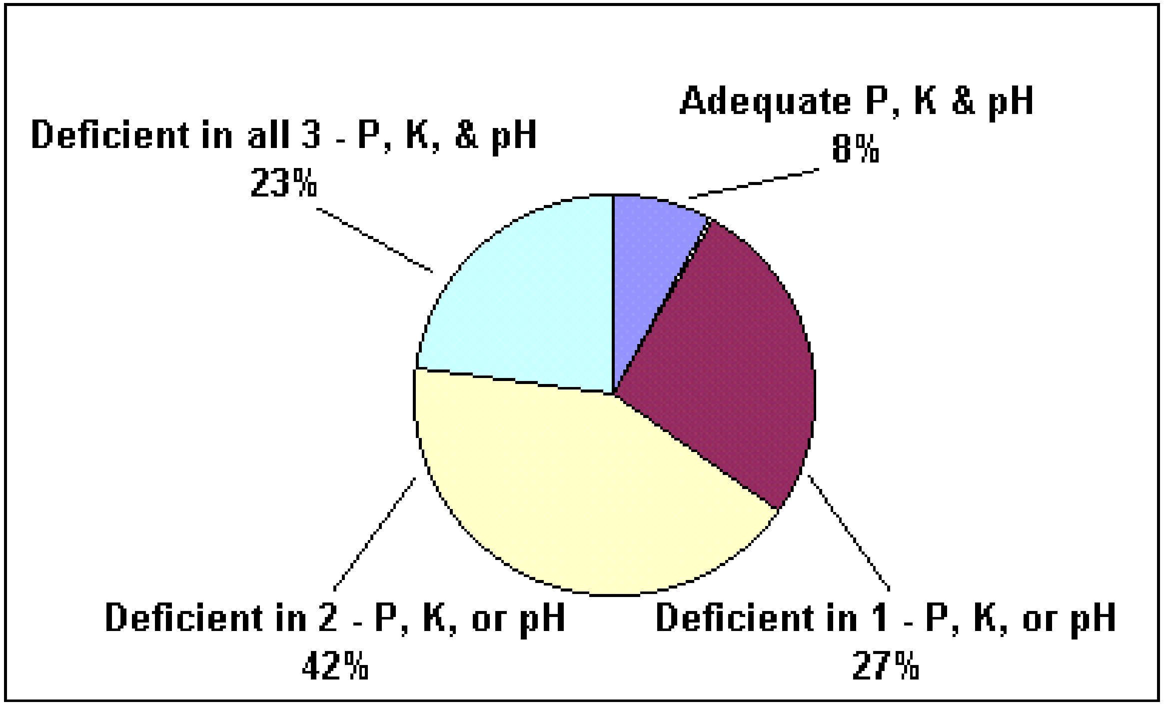
K SOIL TEST INDEX	Percent Sufficiency	K_2O lb/A
0	20	280
75	50	210
125	70	140
200	90	80
250-350	100	40
350+	100	none

P and K

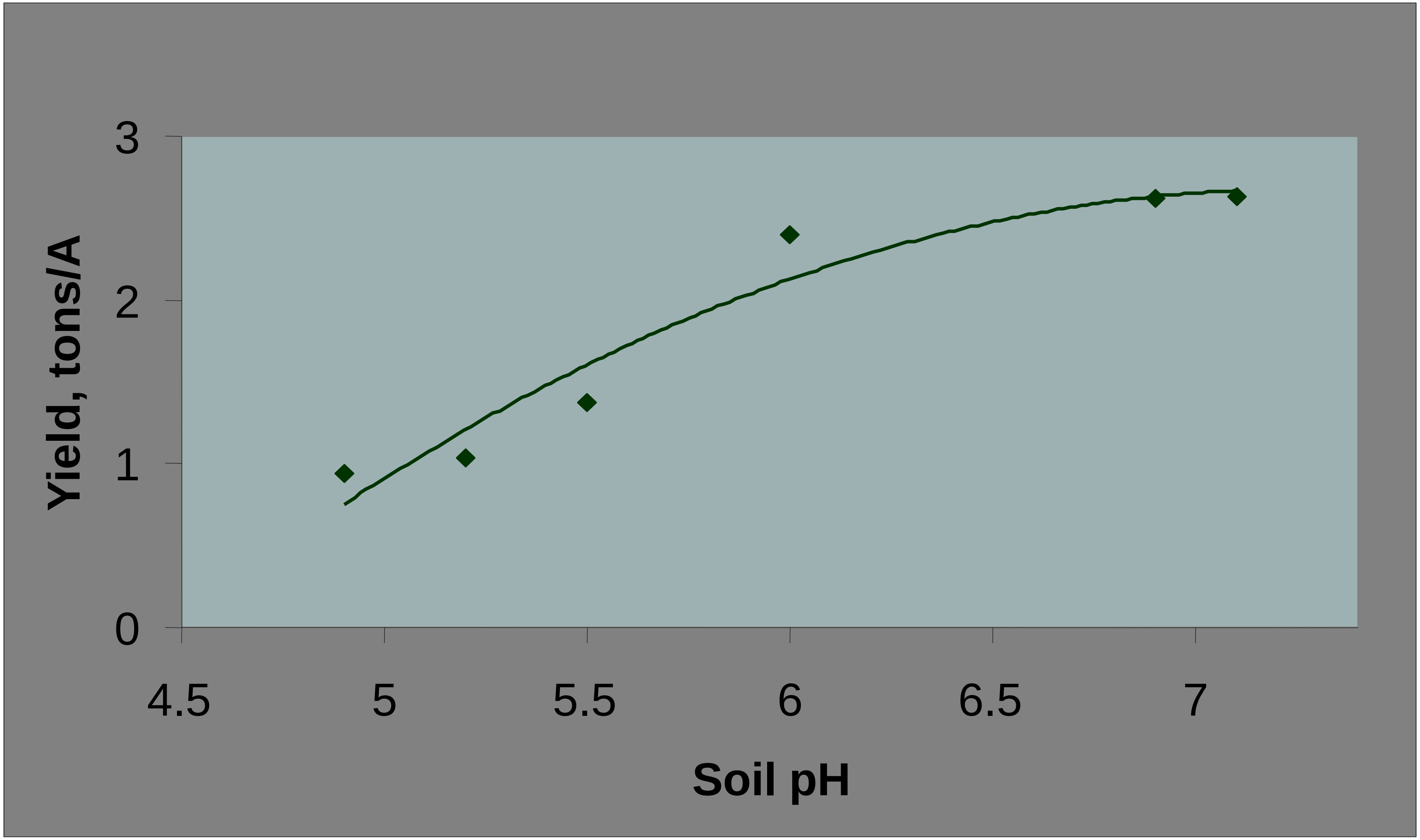
- Sufficiency = How much you can get.
- P and K both Deficient?
  - Multiplication Effect
- Example: 5 ton Potential
  - P is 80 %
    - 4 ton potential   Lost 1 ton
  - K is 80 %
    - 4 ton potential   Lost 1 ton
  - P and K :   .80 * .80 = .64%
    - 3.2 ton potential Lost 1.8 ton

Our Soils

- Survey in 1995 75 percent of the alfalfa fields in OK sampled had low pH or were deficient in P_2O_5 or K_2O, or both
- Survey repeated in 2000 (434 samples) 92 percent of the 434 soil samples analyzed for alfalfa production by the SWFAL at OSU needed <u>lime</u>, P, or K for good production



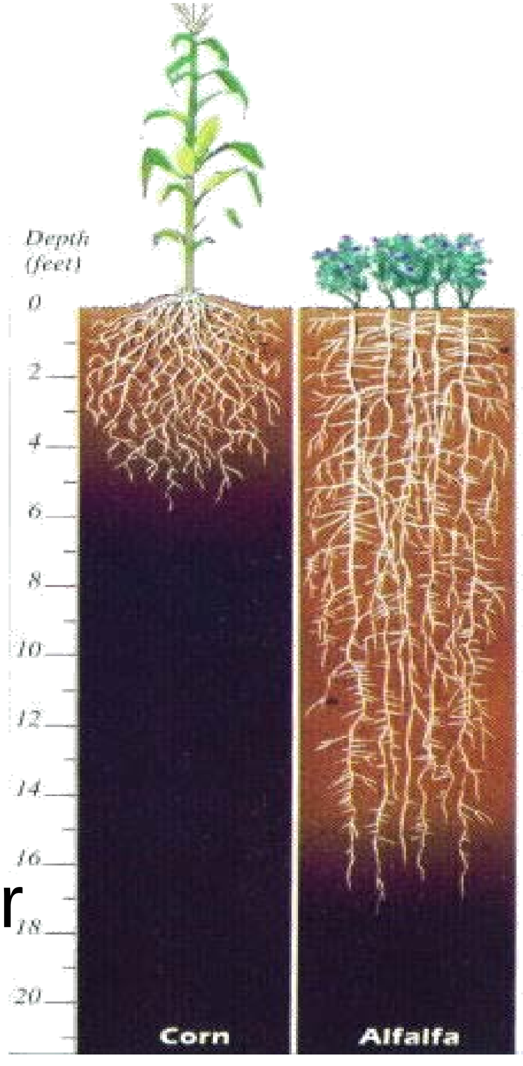
Alfalfa Response to Soil pH



Follet and Wilkinson, 1995

Alfalfa Root Development

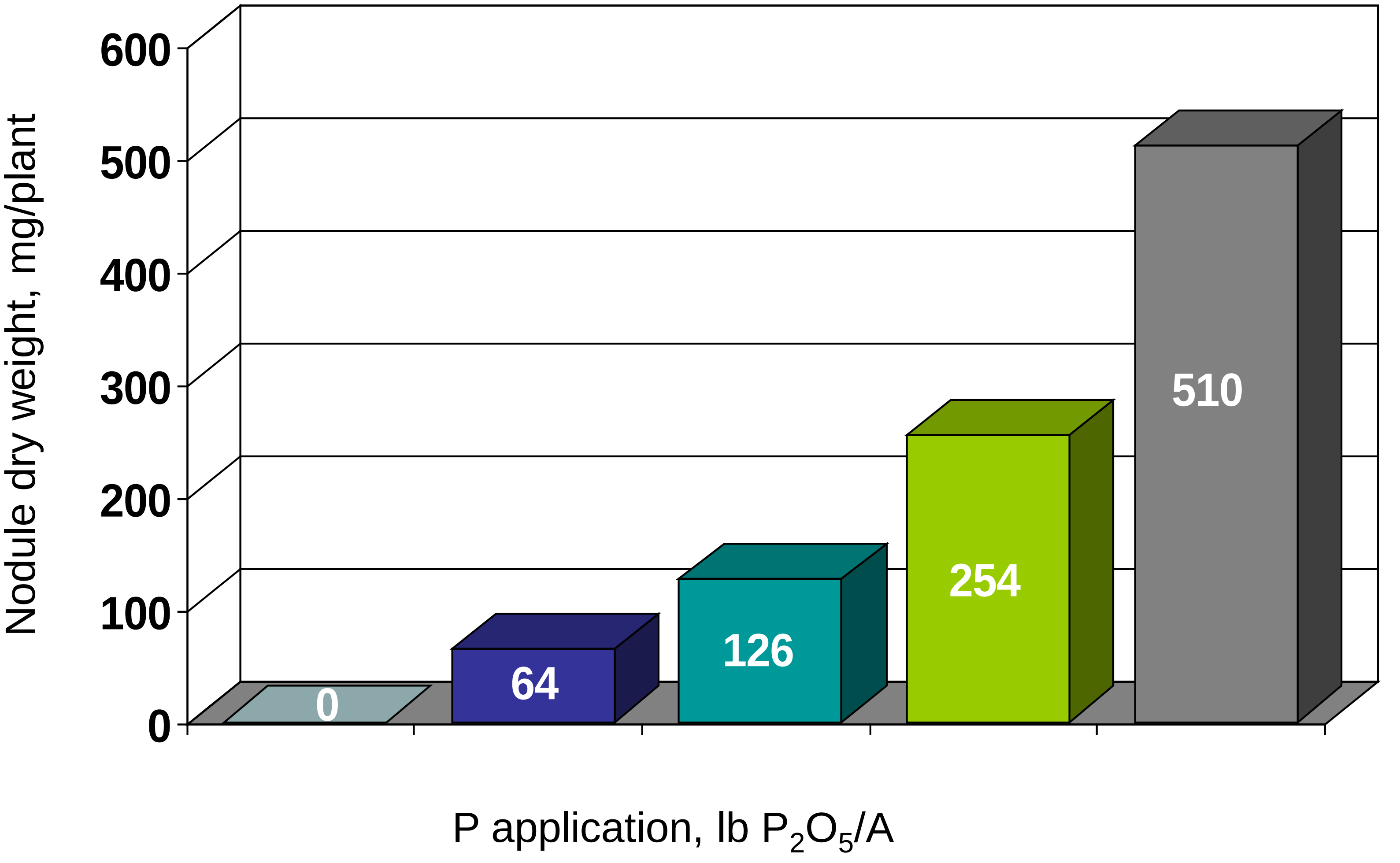
- Most lateral roots are near the soil surface for the first year, but more deep lateral roots develop as the plant ages
- Alfalfa has lower root density than many grasses and a deeper rooting zone
- P and K application increase root growth, enabling roots to obtain moisture and nutrients from greater volume of soil



P Functions in Plants

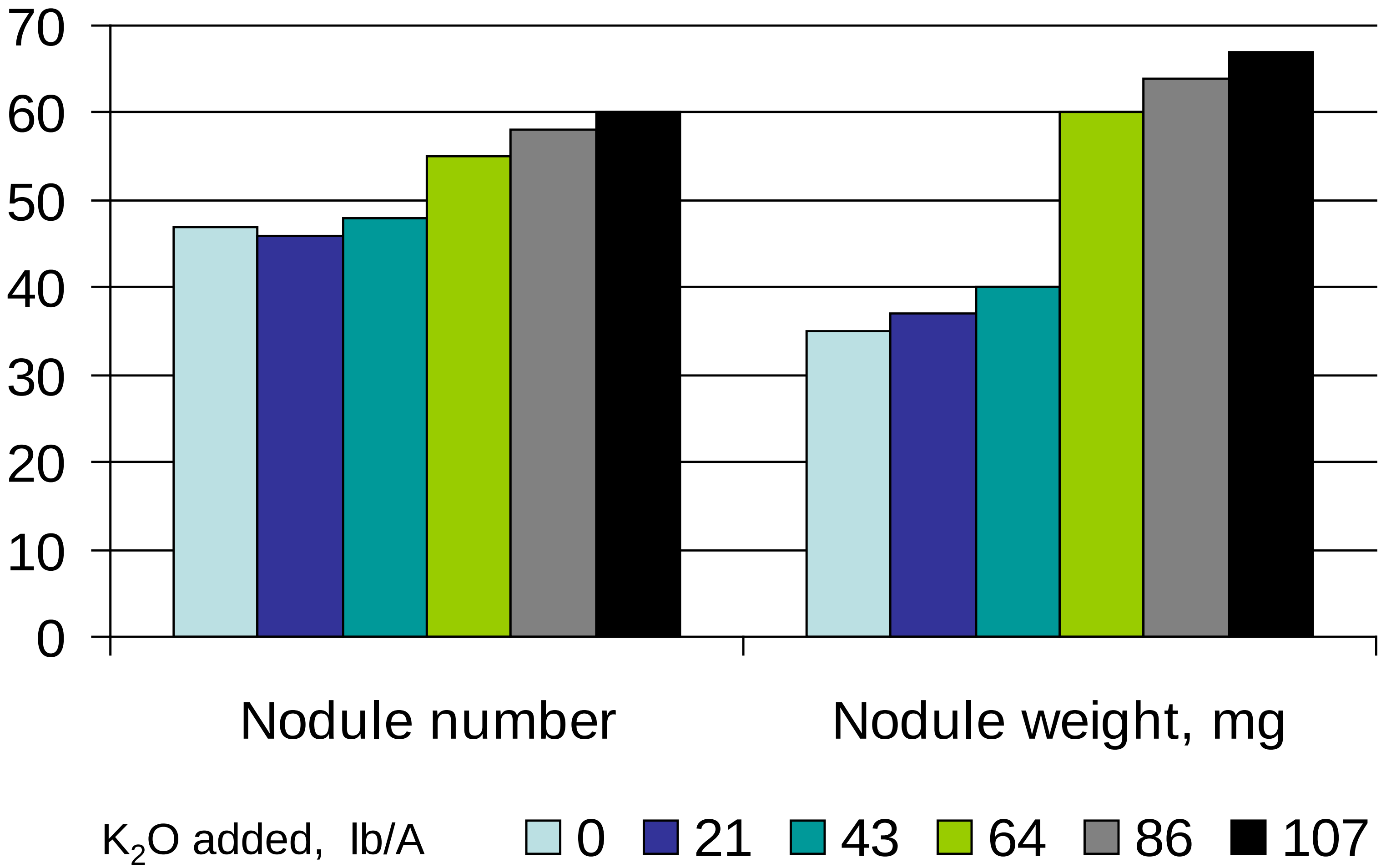
- Energy storage and transfer
  - Phosphate compounds are “energy currency”
  - (such as ADP and ATP)
- Structural component of biochemicals
  - Seed formation
  - Calcium and magnesium phytate
- Maintenance and transfer of genetic code
- Root growth, rapid crop establishment
- Early maturity, quicker recovery

P Fertilization Increases Nodule Growth



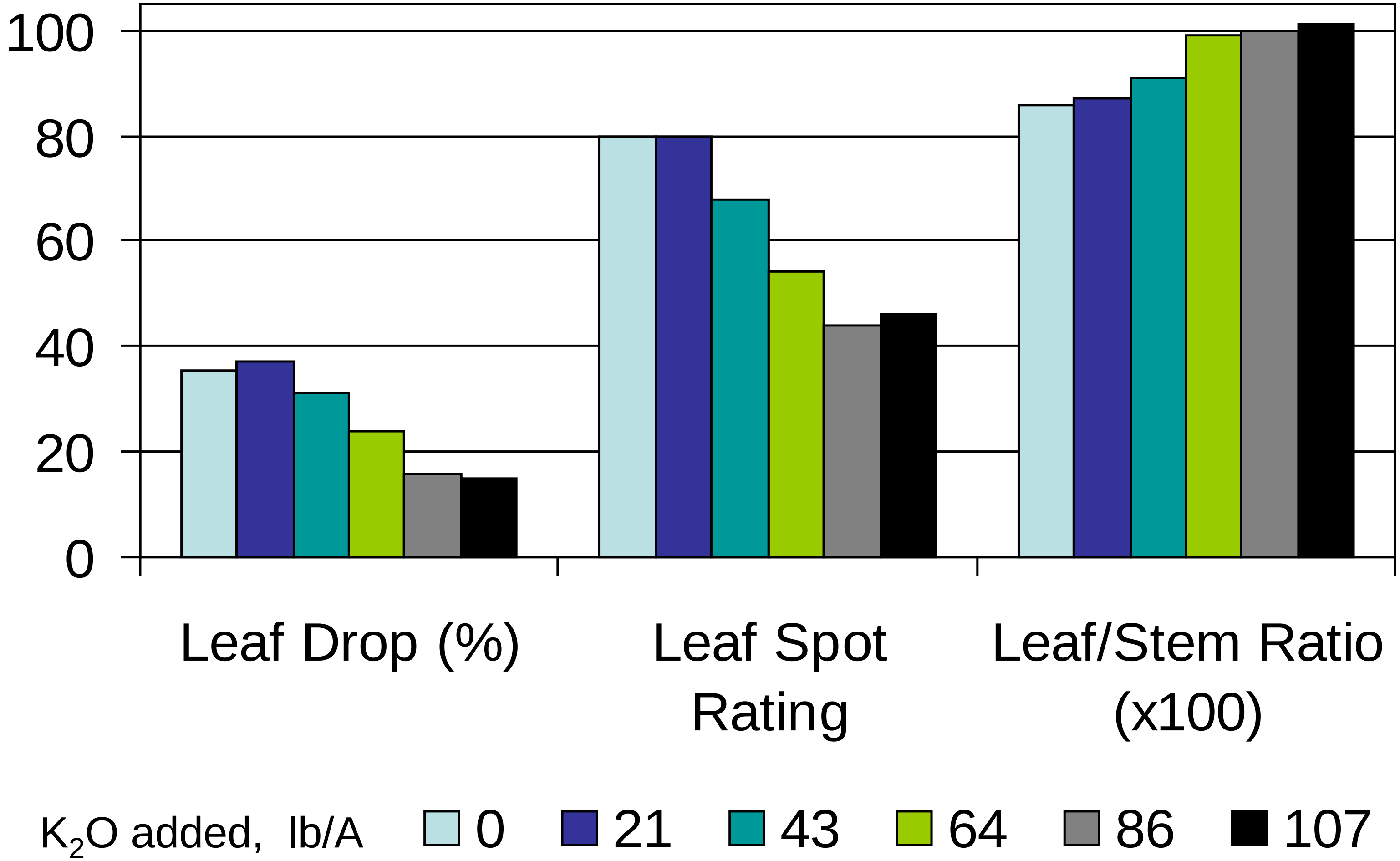
Gates, 1974

K Fertilization Increases Nodule Activity



Grewal and Williams, 2002 (Australia)

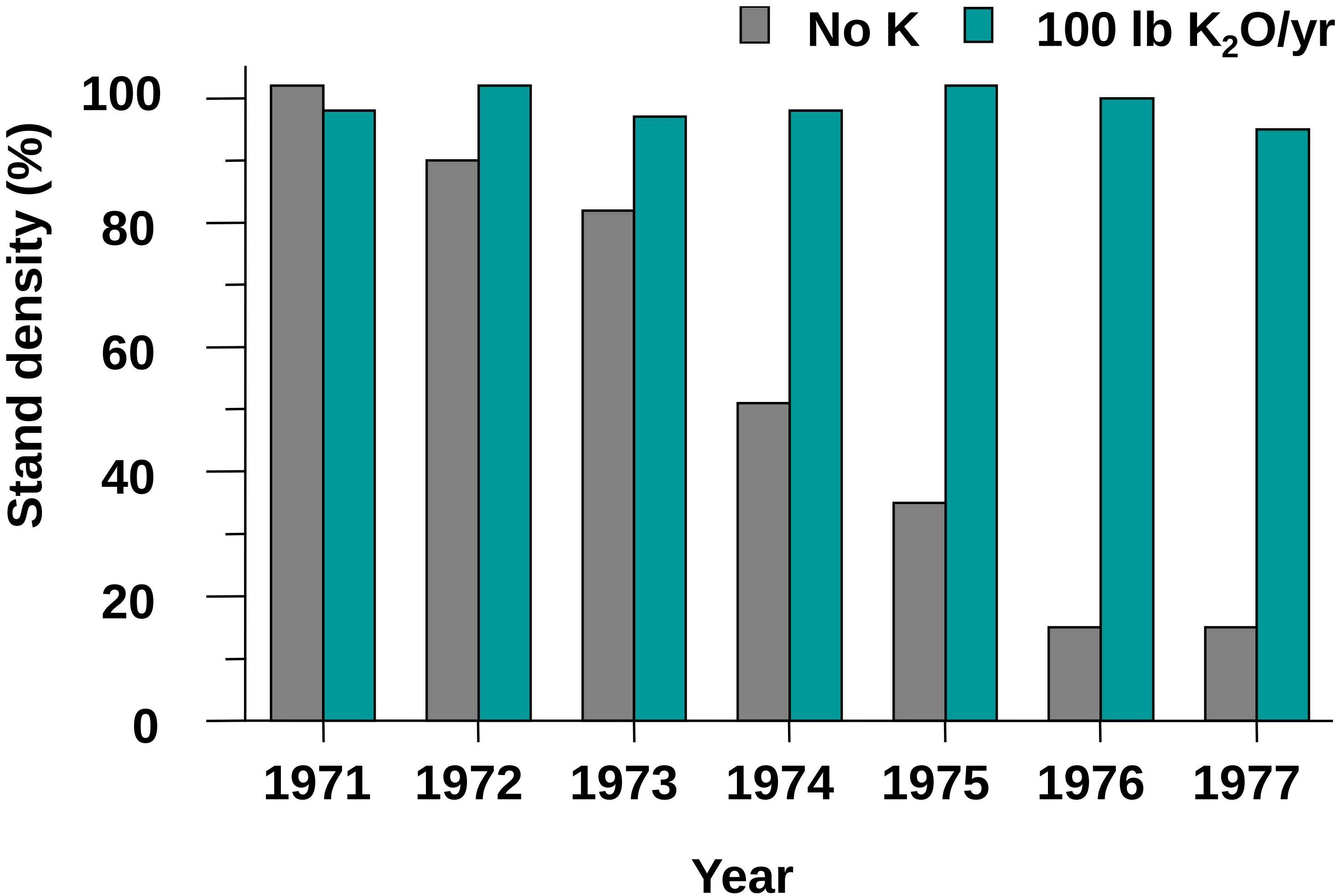
K Fertilization Improves Hay Quality



Grewal and Williams, 2002 (Australia)

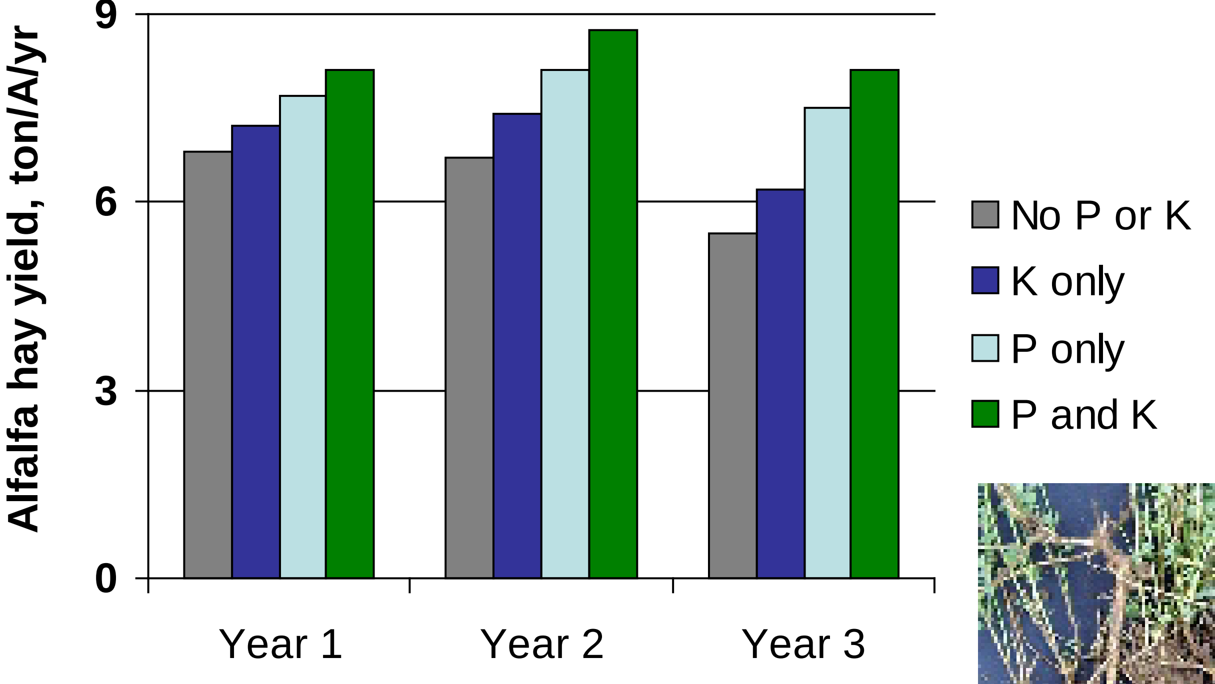
K Helps Reduce Winterkill in Alfalfa

Plant counts taken in May as % of those previous September



Bailey, 1983 (MB)

Balanced P and K Nutrition Is Essential for Optimal Yields and Stand Maintenance



Berg et al., 2005; IN

From Table 4-1. Alfalfa Guide: Approximate Nutrient Content and Removal in 1 Ton of Alfalfa Hay.		
Nutrient	**Average Composition (%)**	**Pounds in 1 ton of Hay**
N (Nitrogen)	3	60
P_2O_5 (Phosphorus)	0.55	10.8
K_2O (Potassium)	2.5	50
Ca (Calcium)	1.2	24
Mg (Magnesium)	0.4	8.4
S (Sulfur)	0.28	5.6

Guide to Nutrient Deficiency Symptoms

Diagnosis of P Deficiencies

- **Visual Observation:**
  - Distinct P deficiencies are seldom observable on alfalfa – not an effective diagnostic method!
- **Soil Testing**
  - Soil test prior to planting and regularly afterwards
- **Tissue Analysis**
  - Best way to monitor plant performance and prevent hidden hunger and yield loss
- **Recommended tissue concentration:**
  - 0.25 to 0.40% P in top third of plant

In K-deficient alfalfa, small white or yellowish spots
first appear around the
outer edges of older leaves

K Deficiency in Alfalfa

Moderate K Deficiency

Severe K Deficiency

Micro Nutrients

- **Secondary and Micronutrients**—Deficiencies of the secondary elements (calcium, magnesium, and sulfur) and micronutrients (iron, zinc, manganese, copper, boron, molybdenum, and chlorine) are usually not a problem with alfalfa production in Oklahoma. Some magnesium, boron, sulfur, and zinc deficiencies have been reported in the extreme southeastern part of Oklahoma. Response to sulfur-containing fertilizers can only be expected under high-yielding dryland production.
- Special fertilizers containing secondary and micronutrients should not be applied to alfalfa unless there is strong evidence of a deficiency. However, it is critical that soil pH and levels of phosphorus and potassium have been corrected before trying to confirm a secondary or micronutrient deficiency.

Sulfur

- Especially in
  - High yielding
  - Sandy soil
  - Irrigated land
- Soil sample to 18” for first year.
- Fields history.
- May or may not respond until stand is older.

Fertilization Strategy

- One lump sum vs little each time.
- Spreading the $, or getting it over with.

Table 4-4. Alfafla Guide: Alfalfa response to surface broadcast phosphorus fertilizer as diammonium phosphate, 18-46-0.

First Year P_2O_5 Rate (lb/acre)	Year-1 Yield (tons/acre)	6-year P_2O_5 Applied (lb/acre)	Year-6 (tons/acre)	Average over 6 years (lb/acre)
0	4.9	0	3.6	4.9
100	5.4	600	4.4	5.5
200	4.9	600	4.4	5.7
600	6.1	600	3.8	5.7

Table 4-5. Alfalfa Guide: Alfalfa yield response to P_2O_5 application timing, placement, and form of phosphorus to check plots that received no P_2O_5 during the study and total of 29.7 tons/acre).

P_2O_5 Fertilizer Application (lb/acre)	Application Method	Yield Increase During 6 Years (tons/acre)
100 lb/acre/year	Broadcast as DAP	3.4
200 lb/acre/2 years	Broadcast as DAP	4.2
600 lb/acre/6 years	Broadcast as DAP	4.7
200 lb/acre/2 years	Knifed as APP	5.8
600 lb/acre/6 years	Knifed as APP	6.8

DAP = diammonium phosphate, 18-46-0.
APP = ammonium polyphosphate, 10-34-0.

Fertilization Strategy

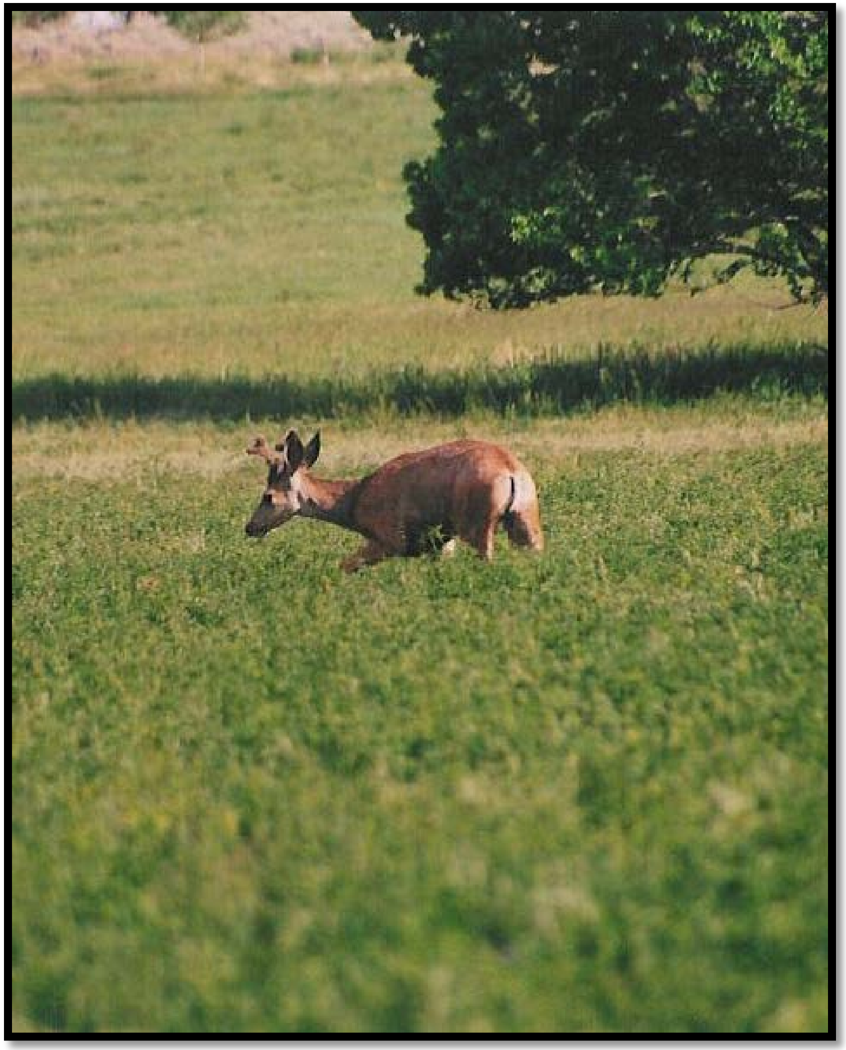
- P as one lump sum
  - Good at first
  - P ties up over time.
  - Ex. Check of STP15, annually applied STP 80, one time 600lbs STP 40
- Surface app less efficient but often needed to maintain Max yield and qaul.
- Best to apply P and K Nov to Jan.

Years 3-6

- Thinning Stand Fertilization?

- Beware, if you fertilize a thin stand the competition may respond more!!!

Thank you!!!



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434 Alfalfa Soil samples (2000)