Soil Testing, Soil Sampling, and Soil Fertility

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George Kuepper

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Self Diagnosis

- Plants
- Soil

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Nutrient Deficiencies

- **Nitrogen (N)**
  - **Light Green Leaves, Older Leaves**
- **Phosphorus (P)**
  - **Purple Leaves, Stunted Plants**
- **Potassium (K)**
  - **Yellow Margins on Older Leaves**

Nutrient Deficiencies

- **Micro Nutrients**
  - Stripes
  - **Mottling**
  - Chlorosis
  - **Bleached**

Excess N-P-K

- Nitrogen (N)
  - Dark Green Foliage, Poor Fruit Set
- Phosphorus (P)
  - Iron, Zinc Deficiencies
- Potassium (K)
  - Magnesium, Calcium Deficiencies

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Soil Test

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Soil, Water and Forage Analytical Laboratory

OKLAHOMA STATE UNIVERSITY

- General Lab Information
- Benefits of Testing
- Soil Test Interpretation Program
- Test Results
- Services & Price List
- Extension Fact Sheets
- Sensor - Based N Rate Calculator
- Lab News & Events
- Sweatless Soil Sampler
- Submitting a Sample
- Tour of Our Lab
- Order Supplies
- Frequently Asked Questions
- Other Useful Links
- Need More Help?
- Contact Us

General Lab Information

Laboratory User Guide Laboratory User's Guide

Turnaround Time:

Samples for routine analysis are normally analyzed and reported within 2 to 5 working days after they are received. Forage nitrate results are reported the next day by email and web. Results are usually returned via U.S. Mail or printed from the web, but can be returned by fax.

Submitting Samples:

A & L Laboratories

THE ONE SOURCE

Home | About Us | Analytical Services | Educational Services | GIS Mapping Services | A&L Publications | Sampling Supplies | Track Shipments | Sign In | Contact Us

The Memphis lab operates out of our state-of-the art facility in east Memphis. This 30,000 sq ft. facility has been expanded multiple times to better serve our clients, to develop more efficient systems and processes and to accommodate the 300% growth in agriculture, microbiology, and environmental testing. In 2004 we moved from our old 11,000 sq. ft. laboratory where we had resided since 1979, to our new facility.

Thank you for relying on A&L Labs to perform all of your analytical testing needs. **We appreciate your business**.

Fertility Management

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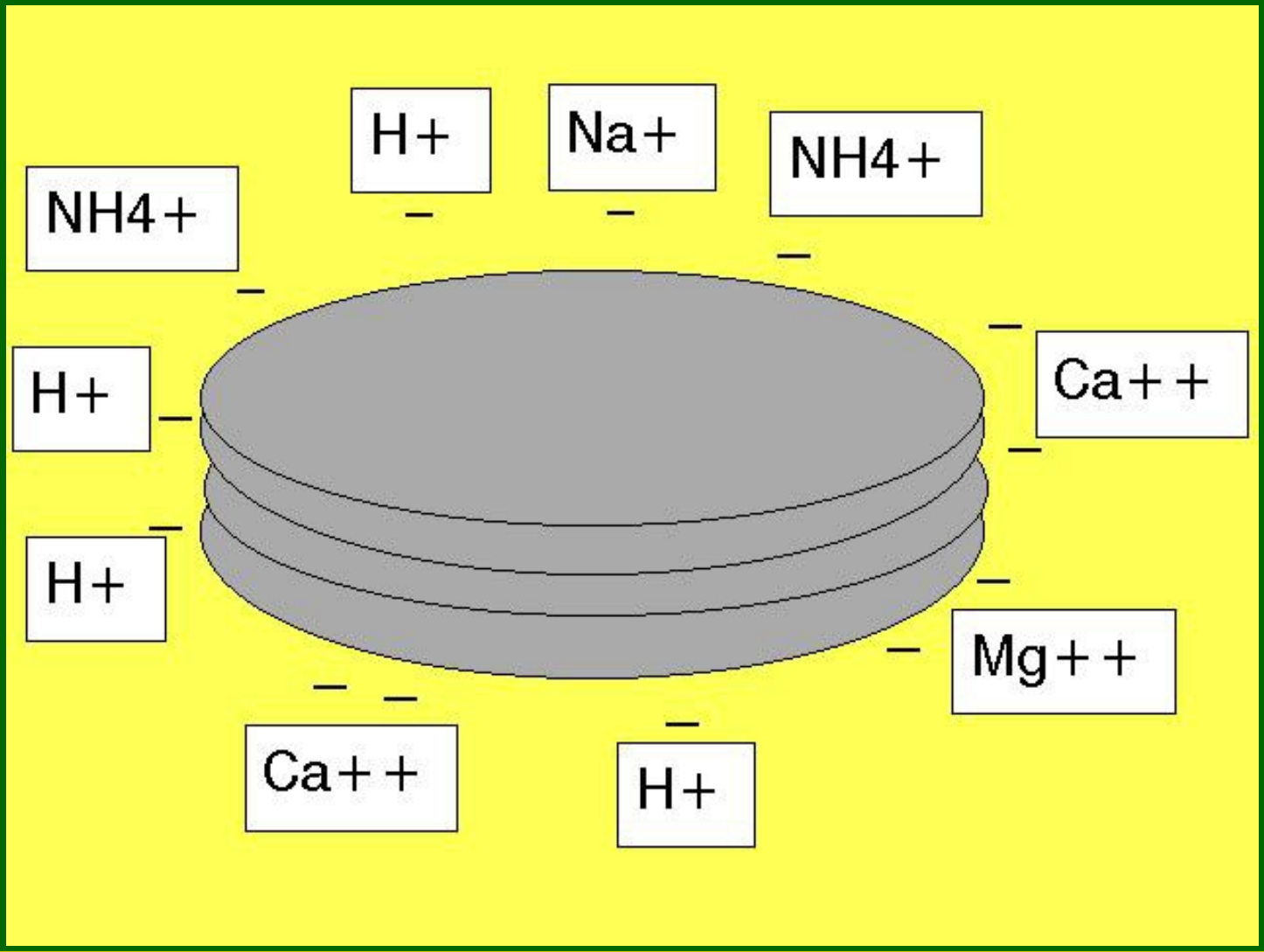
- **Nutrient Movement**
  - **Nitrogen**
  - **Phosphorus**
  - **Potassium**

Fertility Management

- Soil Particles are Negatively Charged



Fertility Management

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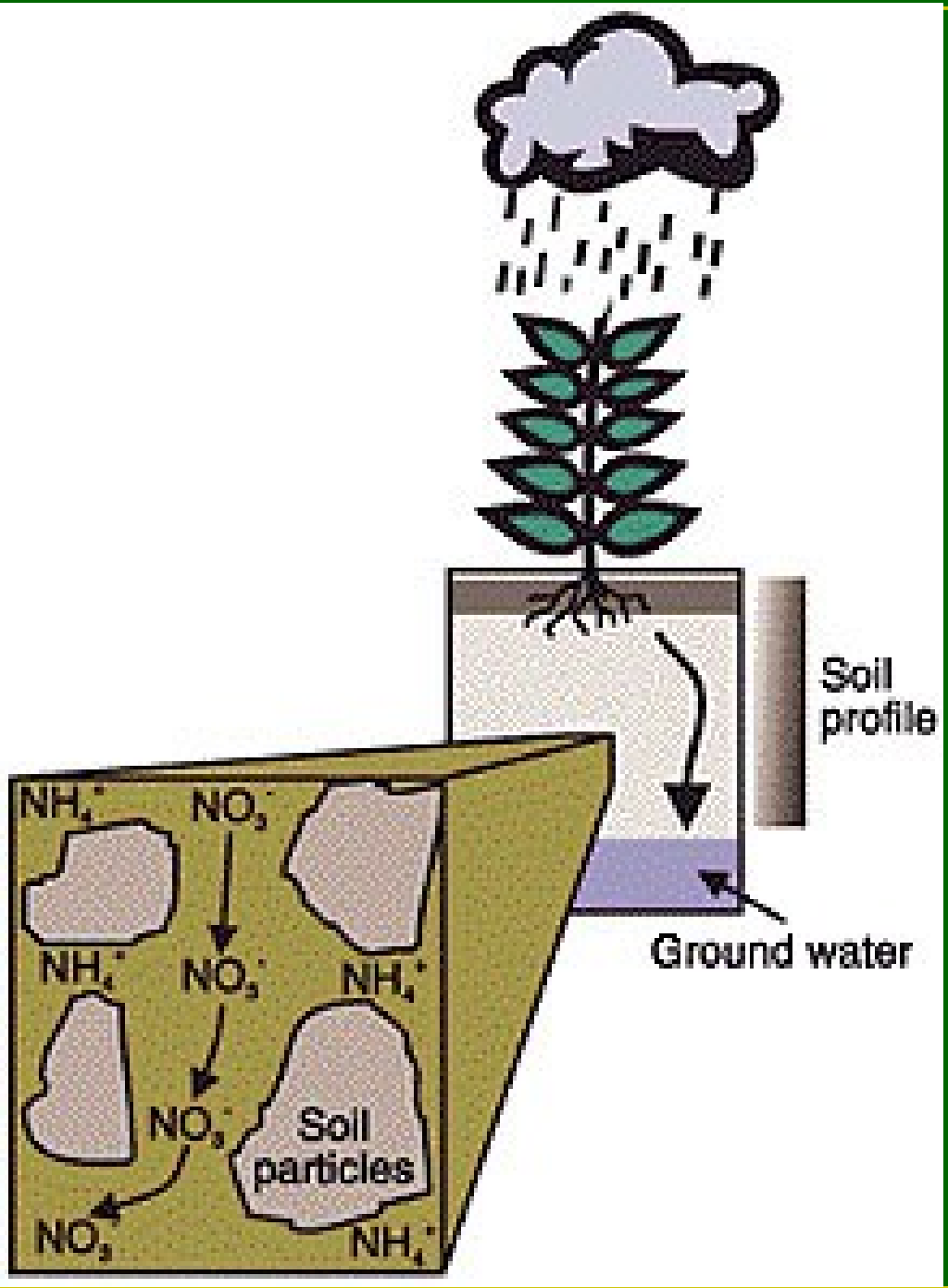
- **Nitrogen**
  - Exists as NO_3 Anion
    - (Negative Charge)
  - Does Not Bond with Soil Particles
  - Moves Rapidly in Water
  - Leaches Readily in Sandy Soils
  - Leaches More Slowly in Clay
  - Can be Lost in One Heavy Rain
- **Sulfur Behaves Similarly to Nitrogen**

Soil Fertility



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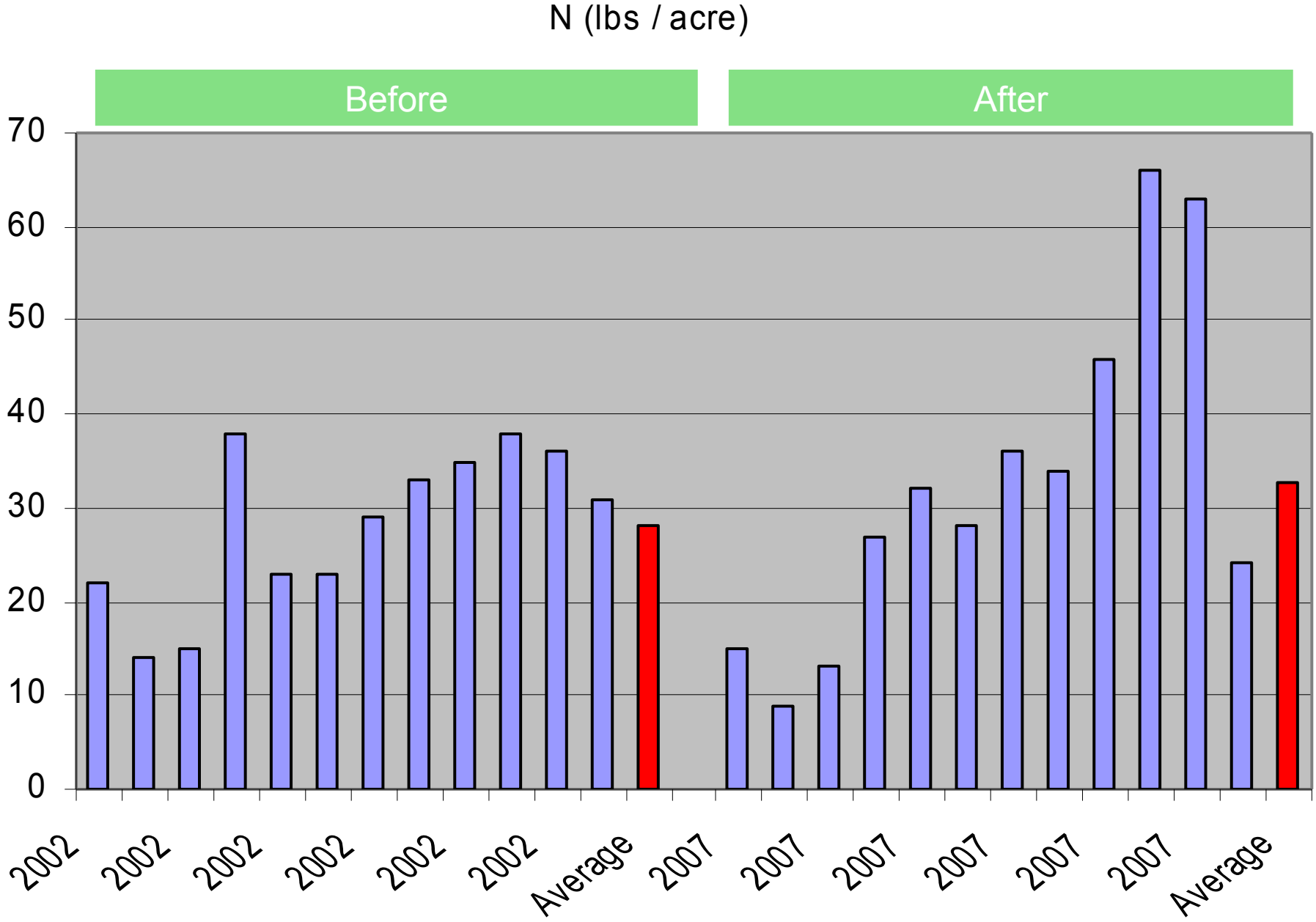
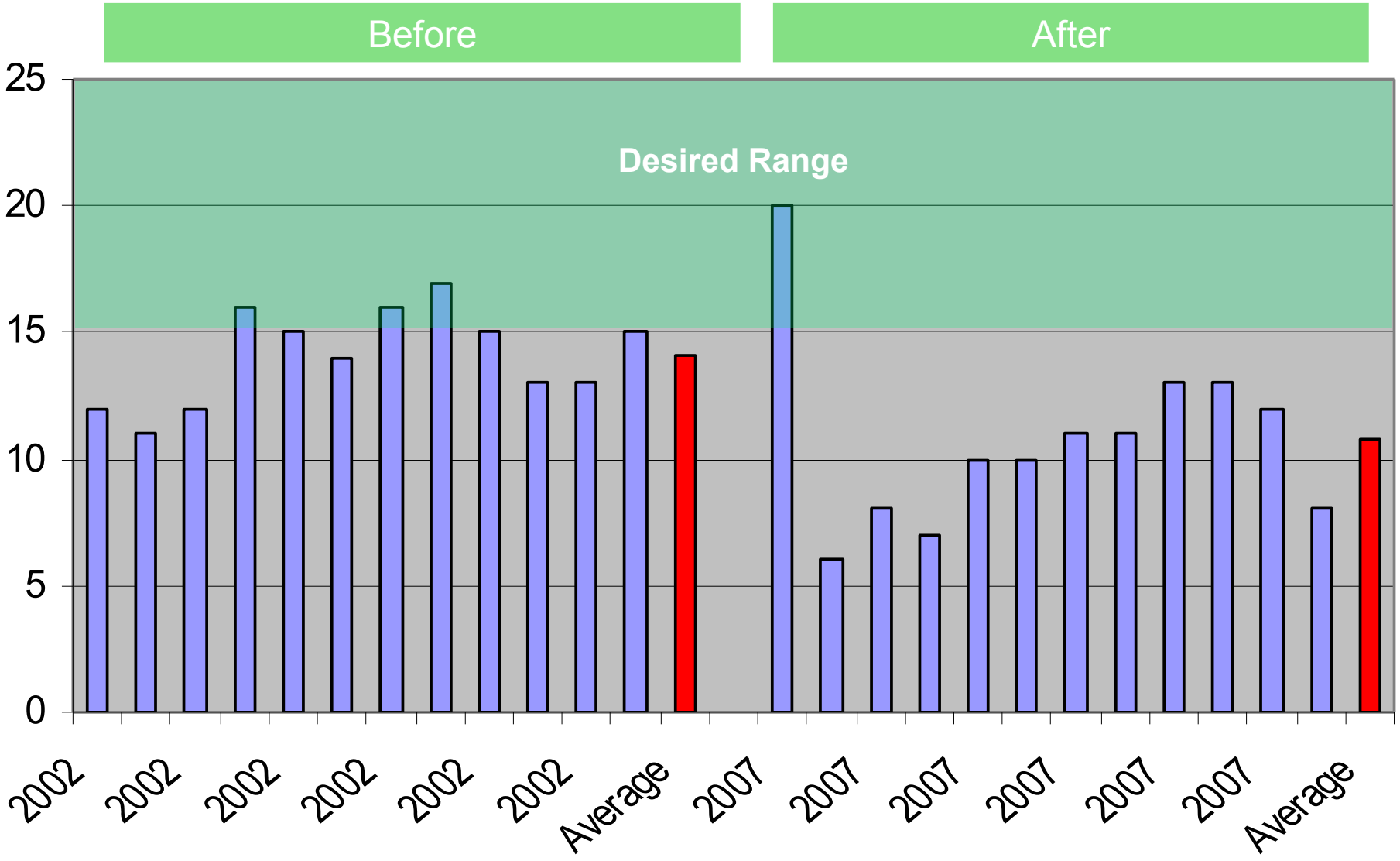

N (lbs / acre)
Before
After
70
60
50
40
30
20
10
0
2002
2002
2002
2002
2002
2002
Average
2007
2007
2007
2007
2007
2007
Average


S (lbs / acre)
Before
After
25
20
15
10
5
0
Desired Range
2002
2002
2002
2002
2002
2002
Average
2007
2007
2007
2007
2007
2007
Average

Fertility Management

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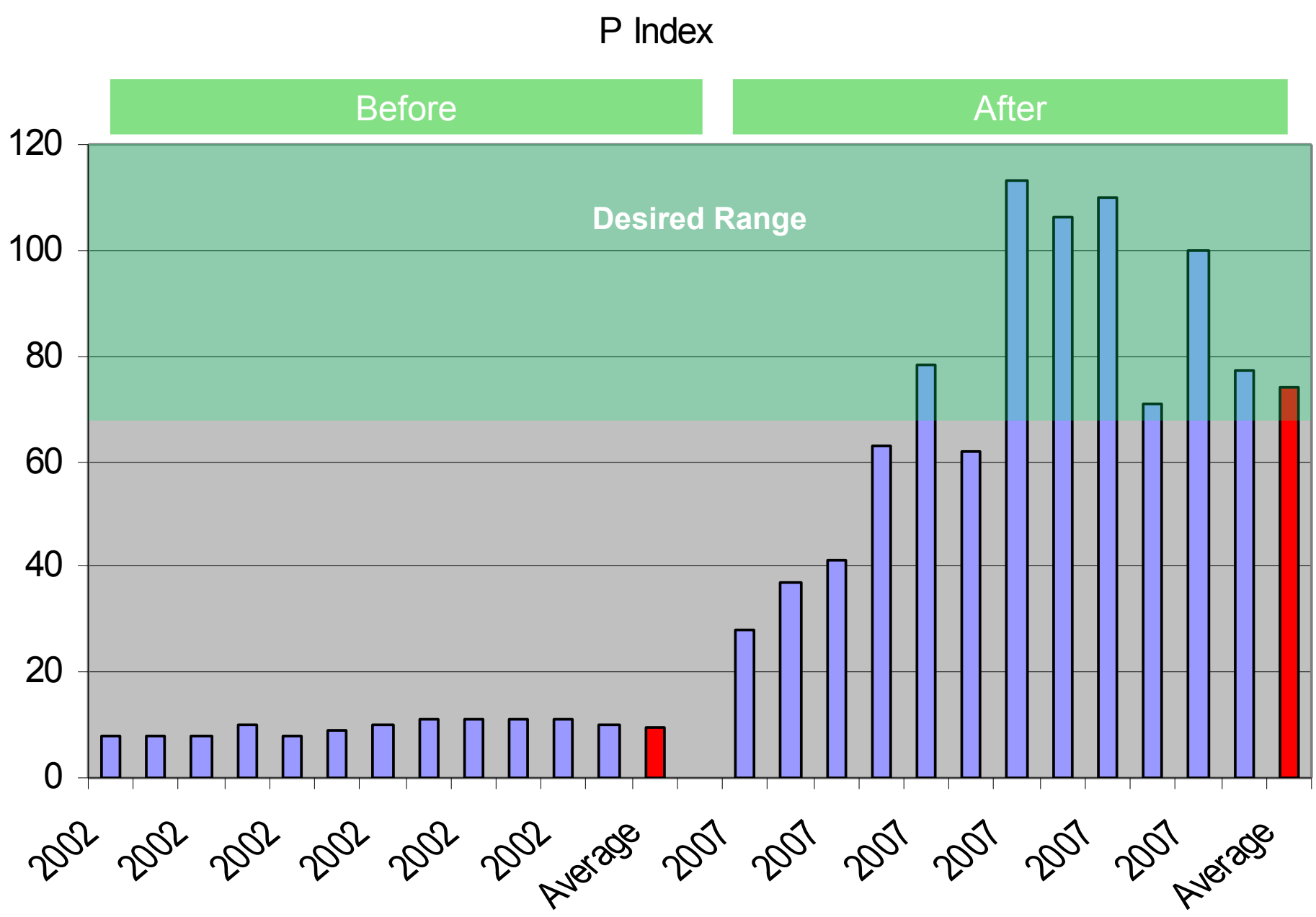
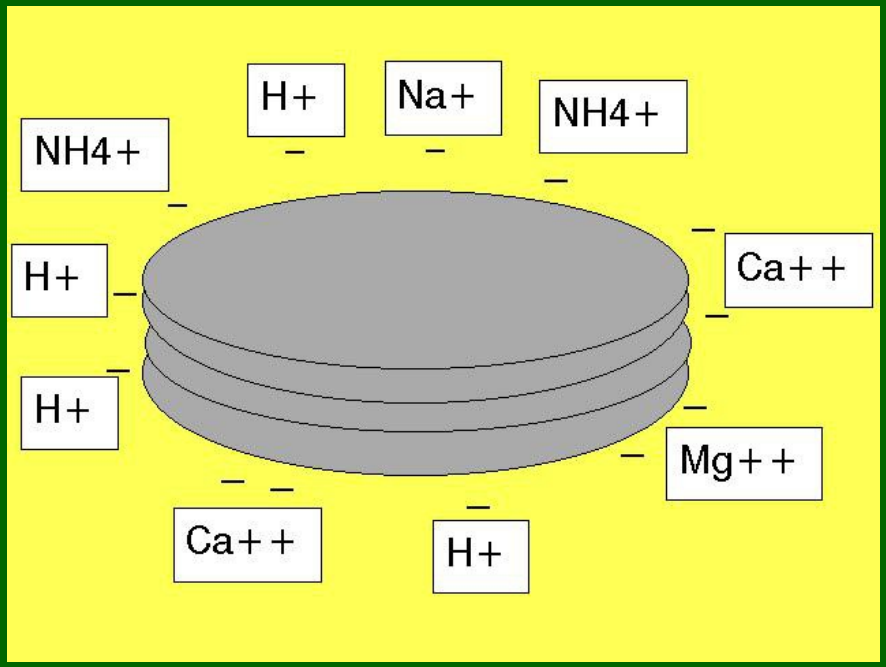
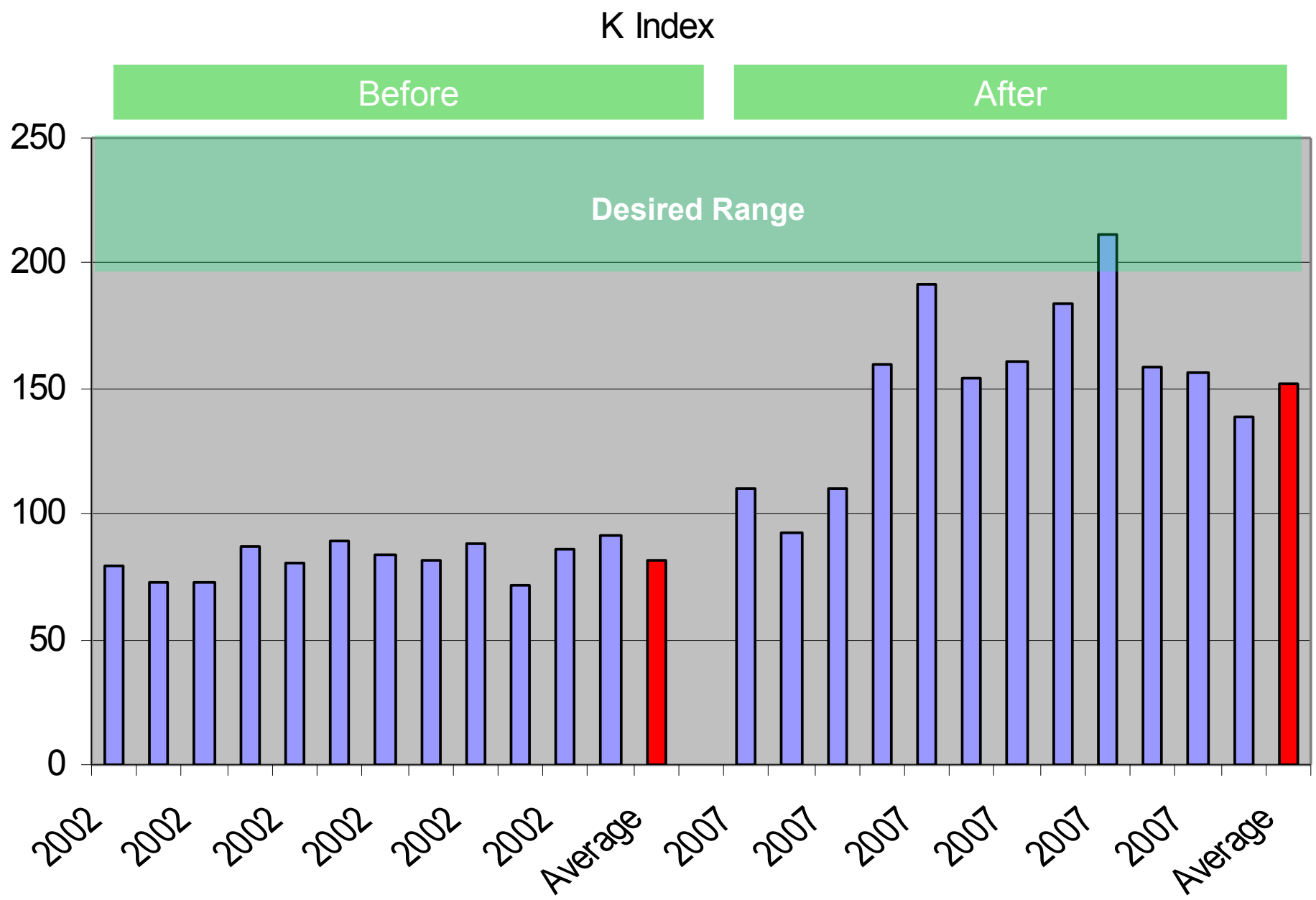
- Phosphorus
  - Bonds with Soil Iron, Aluminum
  - Movement is Very Limited
  - Movement is Very Slow
    - Takes Months or Years to Move

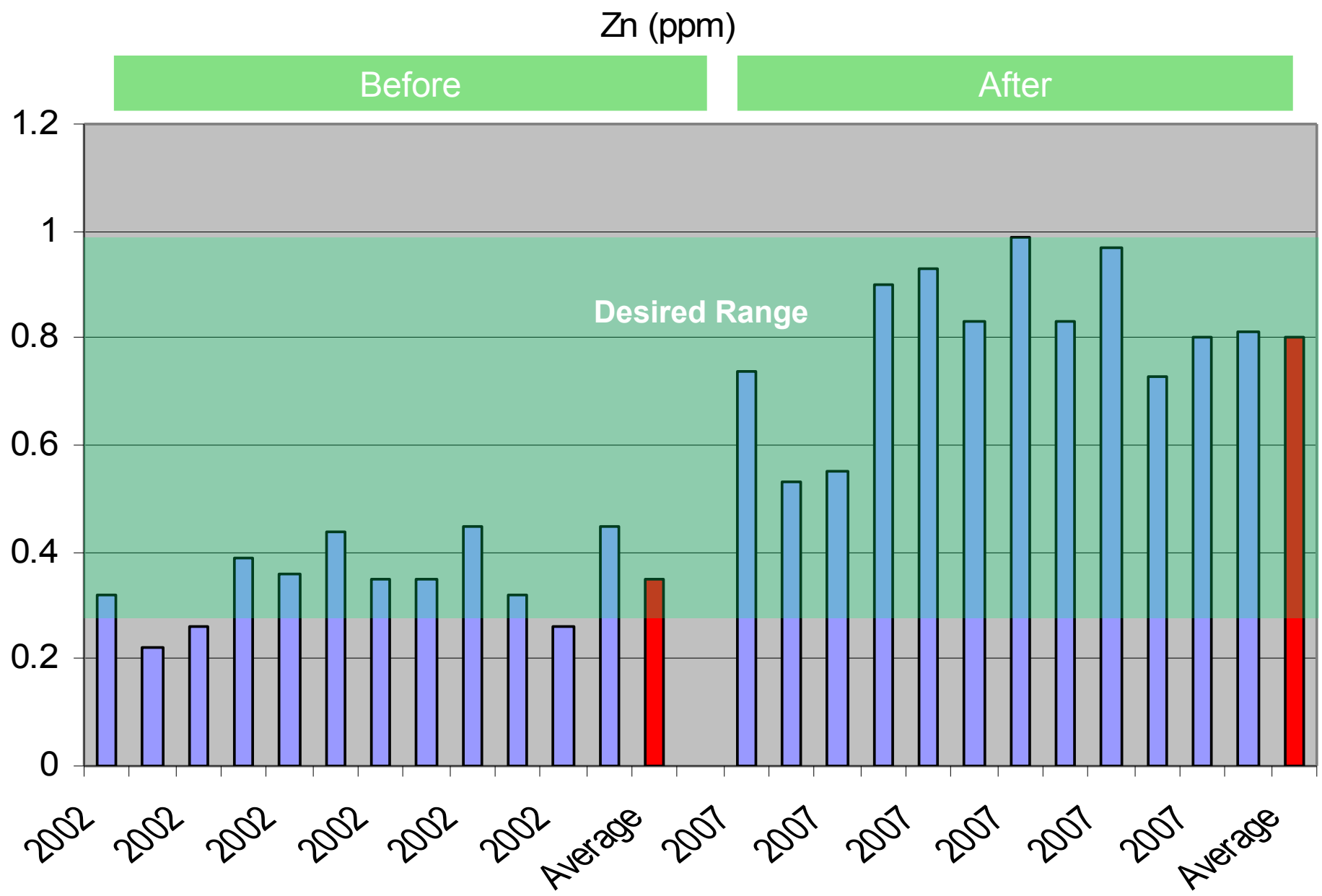

P Index
Before
After
120
100
80
60
40
20
0
Desired Range
2002
2002
2002
2002
2002
2002
Average
2007
2007
2007
2007
2007
2007
Average

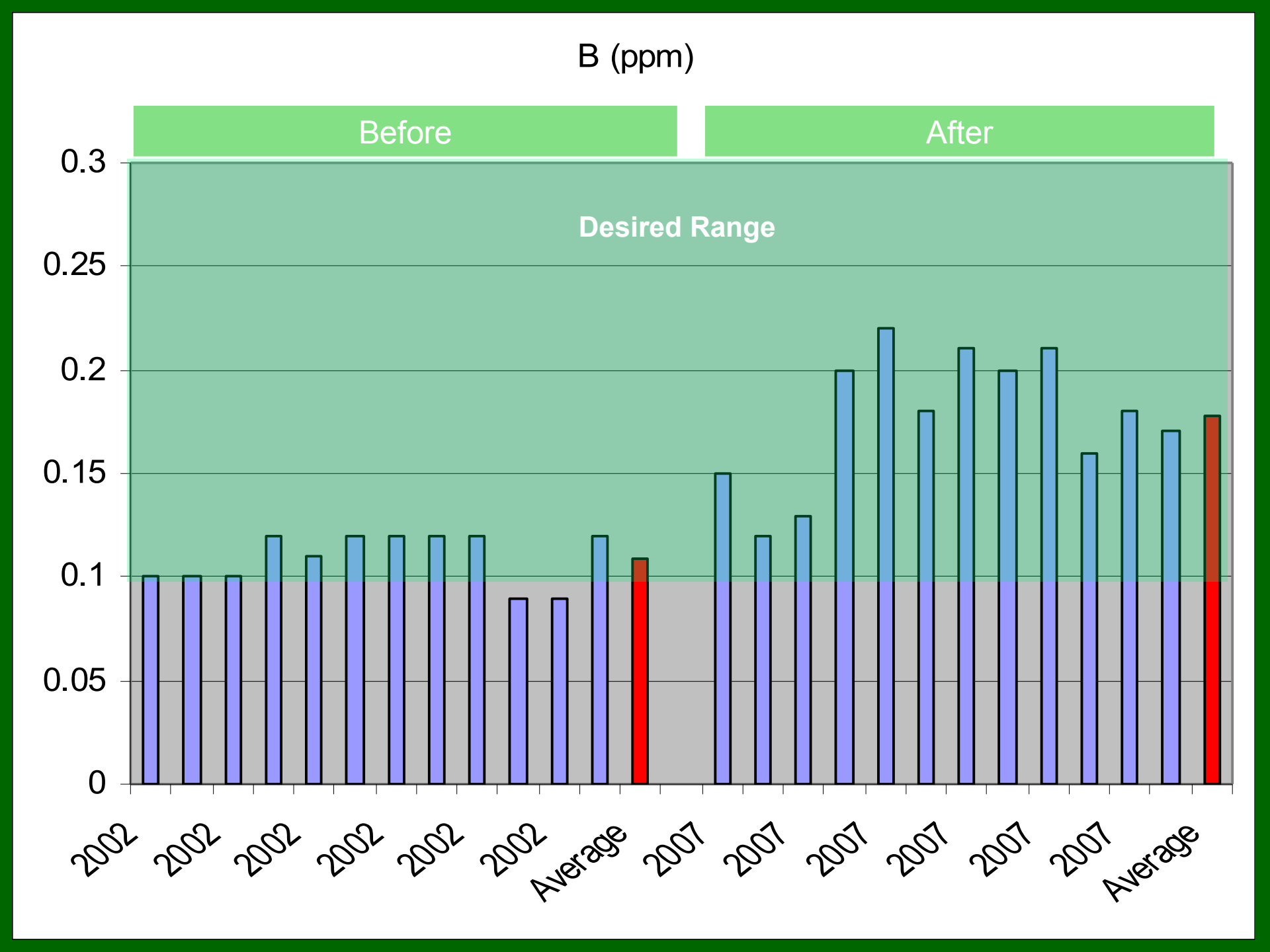
Fertility Management

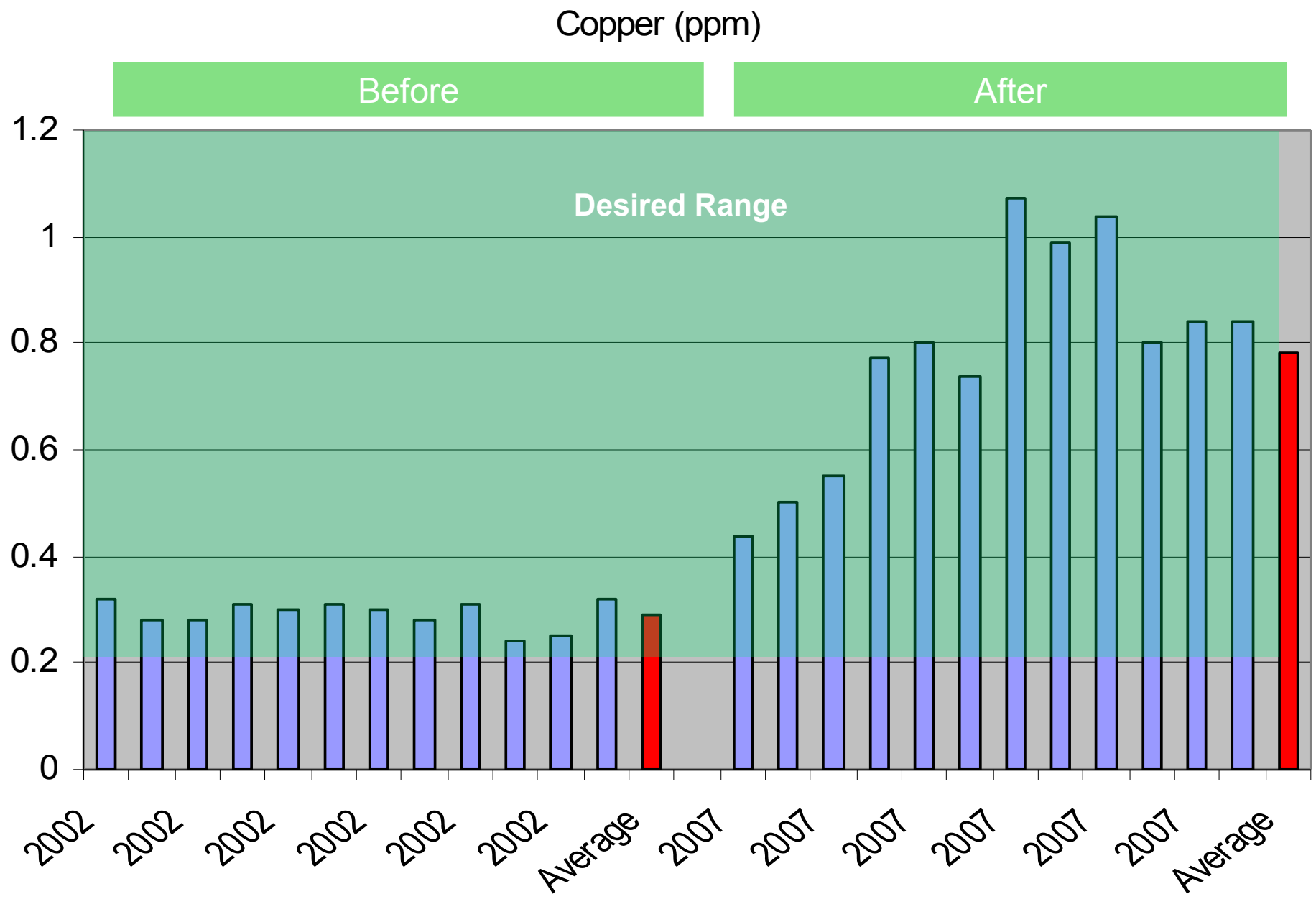
- Potassium
  - Has a Positive Charge
  - Bonds to Negatively Charged Soil
  - Moves Slightly Due to Water




K Index
Before
After
250
200
150
100
50
0
Desired Range
2002
2002
2002
2002
2002
2002
Average
2007
2007
2007
2007
2007
2007
Average


Zn (ppm)
Before
After
1.2
1
0.8
0.6
0.4
0.2
0
Desired Range
2002
2002
2002
2002
2002
2002
Average
2007
2007
2007
2007
2007
2007
Average


B (ppm)
Before
After
0.3
0.25
0.2
0.15
0.1
0.05
0
Desired Range
2002
2002
2002
2002
2002
2002
Average
2007
2007
2007
2007
2007
2007
Average


Copper (ppm)
Before
After
1.2
1
0.8
0.6
0.4
0.2
0
Desired Range
2002
2002
2002
2002
2002
2002
Average
2007
2007
2007
2007
2007
2007
Average

Soil Sampling

- Results are Only as Good as the Sample

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Soil Sampling

- Random Variability

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F-2207

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How to Get a Good Soil Sample

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Director, Soil, Water and Forage Analytical laboratory

Gordon Johnson
Nutrient Management Specialist

Oklahoma Cooperative Extension Fact Sheets are also available on our website at:
http://www.osuextra.com

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Table 1. Variability of an 80 Acre Field Based on Soil Tests of 40 Individual Soil Cores .

	Soil Test Values	
Analysis	*Range*	*Average*
pH	4.9-6.3	5.6
BufferIndex	7.1-7.4	7.3
Nitrogen	1-34	11
Phosphorus	23-114	36
Potassium	149-770	306

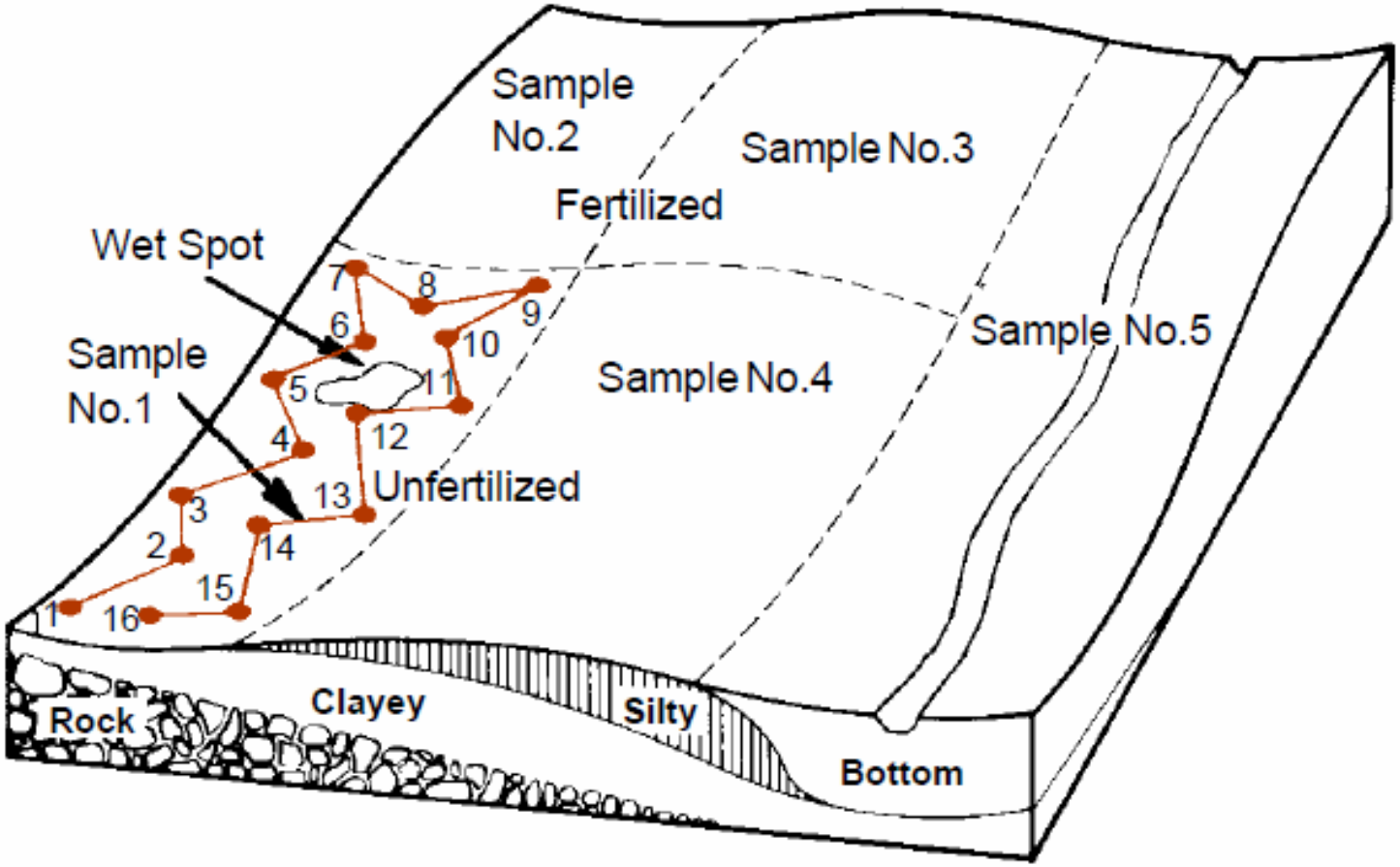

Figure 2. Divide field into uniform sampling areas and follow a random pattern when sampling. Avoid unusual spots and try to obtain a representative sample.

Number of Samples

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- Depends on Soil
- Depends on Soil History
- Depends on Soil Treatments

- Usually 20 or more samples per field

Sampling Depth

- Root Zone
- Plow Layer

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Eastern Oklahoma

- Acid pH in Soil
- Add Lime

Bentley, Oklahoma

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Nitrogen	Phosphorus	Potassium	ph	Organic matter
3	45	174	5.5	1.14
2	27	147	5.4	0.76
2	13	176	5.2	1.01
3	20	130	5.5	0.98
4	17	171	5.7	1.48
9	15	417	4.8	1.34

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OKLAHOMA COOPERATIVE EXTENSION SERVICE HLA-6036

Soil Test Interpretations For Vegetable Crops

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Extension/Research Vegetable Crops

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Research/Extension Vegetable Crops

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Oklahoma Cooperative Extension Fact Sheets are also available on our website at:
http://osufacts.okstate.edu

Soil test interpretation is an important part of nutrient management for crop production. The following tables include soil test interpretations for nitrogen (N), phosphorus (P), and potassium (K) the three most commonly deficient plant nutrients used by vegetable crops. The suggested interpretations are valid for results from the OSU Soil, Water, and Forage Analytical Laboratory, but should not be utilized directly for interpreting results tested with different methods by other soil testing laboratories. Nitrogen requirements are based on crops and yield goals. The actual amount of N needed is the N requirement minus soil nitrate-N. Requirements for P and K are based on soil test values. Keep in mind that vegetable crop yield goals are based on the potential yield achievable in the state. Actual yield may vary due to other conditions.

Determining Fertilizer Needs by Soil Testing

The starting point for vegetable crop fertilization is determining the residual fertility available in the soil by soil testing. Soil tests are only as good as the soil sample that represents the field and proper sampling is a key part of obtaining reliable soil test results. Extension Fact Sheet PSS-2207 explains proper soil sampling techniques.

County Extension offices throughout Oklahoma have soil pH. Buffer index (BI) is a measure of the soil's ability to resist changes in pH and will be listed on the OSU soil test report. Lime is applied according to the Buffer Index (Table 1) which is further explained in fact sheet PSS-2229. Vegetable crops differ in their ability to take up nutrients at a given pH. Matching crops to soils with the appropriate pH is important because vegetable crops have different tolerance levels to soil pH (Table 2).

Vegetable fertilizer recommendations

Nitrogen, phosphorous, and potassium fertilizer recommendations are given on the soil test report. The recommendations are in pounds of N, P_2O_5, and K_2O per acre as listed on a fertilizer analysis. Soil test interpretations for various vegetable crops are given in Tables 3 through 7. Table 8 provides timing suggestions for nitrogen fertilization of various vegetable crops. Crop requirements for nitrogen will vary due to differences in plant populations i.e. where higher population plantings will require more nitrogen than lower plant populations. Phosphorus and potassium are generally applied pre-plant or at planting.

Table 1. Tons of ECCE* lime required to raise soil pH of a 6-7 inch furrow slice to pH 6.8.

Buffer index	*Lime required*

Points to Remember

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- Don’t Guess – Soil Test
- Sample thoroughly – 20 or more samples per field
- Sample root zone – normally 6 – 7 inches

Soil Aspects of Organic Farming

Warren Roberts