Fall 2000

AGRI 311: Soil Fertility

Ronald Vos
Dordt College, ronald.vos@dordt.edu

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Prerequisites: Agriculture 101, 201; Chemistry 101, 102

Course Description and Overview:
This course uses previously studied basic soil science concepts and applies them to the understanding of crop nutrition and growth. Concepts that will be integrated include nutrient cycles of uptake, utilization, and release while considering the roles of plants, animals, soil organisms, organic matter, and the inputs of inorganic and organic fertilizers. Fertility will be studied in the context of Christian stewardship of soil and environmental resources.

Objectives:
1. Gain an understanding of soil chemistry and soil biology as it affects soil fertility.
2. Learn about the sources and application of organic and inorganic fertilizers.
3. Understand the concept of soil quality and how it can be quantified.
4. Develop the skills necessary to understand and utilize scientific literature.
5. Develop skills in basic field techniques of soil fertility.
6. Develop soil fertility plans for farms with different crop-animal enterprises using current soil fertility information.
7. Learn to critically analyze soil fertility recommendations.
8. Strive to become self-learners by understanding current changes in fertilization strategies by use of the case study approach.
9. Demonstrate verbal and written skills by giving presentations before the class and writing papers.

Required Texts:
Soil Fertility Management for Sustainable Agriculture by Prasad and Power
Soil Fertility Manual by Potash & Phosphate Institute

Material on Reserve in Library:
Soil Fertility and Fertilizers by Tisdale

Various peer reviewed scientific journal articles are on reserve on different topics. You should peruse these. You will be assigned or may pick an article that you will summarize orally in front of your peers. who also be involved in your evaluations. In order to do a good summary, it is expected that you will become thoroughly familiar with the material presented in the article.

Grading: (provisional)
Exams: #1 - 20%, #2 - 20%, Final - 20% 60%
Project 20%
Homework assignments 10%
Oral scientific paper summation presentation 5%
Discussion/participation 5%
Total 100%

Methods of Instruction:
Instructional techniques will include:
1. Classroom lecture, demonstration, and discussion.
2. Field experience.
3. Projects using case study interaction and development done in a team format.
4. Student oral presentations. There will be on average one student presentation per week.
General Outline of Topics Covered with Tentative Time Line

I. Introduction
   a) Historical Perspective  PP&I  Tisdale  Soil Fertility
   b) Factors Affecting Plant Growth  1  1  1-5
   c) Plant Assimilation of Nutrients  1  2
   d) Soil Factors Involved in Nutrition  1  3

II. Diagnosis of Nutrient Sufficiency
    a) Soil Testing  PP&I  Tisdale  Soil Fertility
    b) Field Techniques for Deficiency Diagnosis  8  11  2
    c) Site Specific Management

III. Soil Acidity and Liming
    a) Soil pH  PP&I  Tisdale  Soil Fertility
    b) Effects and Causes of Soil Acidity  2  10  6
    c) Changing Soil pH

VI. Nitrogen (N)
    a) Contribution to Plant Nutrition  PP&I  Tisdale  Soil Fertility
    b) N Forms Useful to Plant, N Cycle  3  5  8
    c) Biological Fixation
    d) Mineralization and Nitrification
    e) Immobilization
    f) Soil Retention, Fixation
    g) Volatilization, Denitrification, Leaching
    h) Management of N Fertilizers

Additional Items:
1. Know how to work problems in soil chemistry, moles, equivalents, milliequivalents, fertilizers, cation exchange capacity, base saturation.
2. Late spring nitrate test, fall test for excess nitrogen application, field diagnosis of nutrient deficiencies.
3. Introduction to GPS and GIS equipment at Dordt College

Exam #1: Tuesday, February 22, 2000.

V. Phosphorus (P)
   a) Contribution to Plant Nutrition  PP&I  Tisdale  Soil Fertility
   b) P Cycle  4  6  9
   c) Soil P Forms and Reactions
   d) Management of P Fertilizers

VI. Potassium (K)
    a) Contribution to Plant Nutrition  PP&I  Tisdale  Soil Fertility
    b) K Cycle  5  7  10
    c) Soil Reactions
    d) Management of K Fertilizers
VII. **Fertilizer Amendment Forms/Use**
   a) Dry Fertilizer Blends
   b) Fluid Fertilizers
   c) Fertilizer Placement and Calculations

VIII. **Secondary Nutrients (Ca, Mg, S)**
   a) Contribution of Plant Nutrition
   b) Soil Forms
   c) Management of Fertilizers

IX. **Micronutrients (Fe, Mn, Zn, Cu, Cl, B, Mo, Co)**
   a) Contribution to Plant Nutrition
   b) Soil Forms
   c) Management of Fertilizers

Additional Items:
1. Crop residues, soil quality, and RUSLE.
2. How to take a good soil sample, possible tour of liquid fertilizer plant.

**Exam #2**: Thursday, April 6, 2000.

X. **Alternative Nutrient Sources/Concepts**
   a) Plant Sources - Green Manures
   b) Animal Waste Amendments

XI. **Salinity and Salt Problems in Soils**

Additional Items:
1. Group project presentations.
2. Readings from *The Land: Soil Defense* by Wallace and *How Much Conservation Can We Afford?* by Hall (on reserve in library). These will be covered if there is class time remaining.

**Final Exam**: Thursday May 4, 2000, 8:00-10:00.

Team Project ideas
- Visit with turkey, hog, chicken (wet and dry), and dairy producers. Find out how they handle the manure produced. Evaluate the manure based on samples. Assess the economic value of the manure based on content. This project will involve four teams, one for each of the enterprises mentioned.

- Assume that you have $1000 to invest in GPS equipment for Dordt. Which company/equipment would you recommend? Why? This project will involve one team.