MINERAL NUTRITION and SOIL FERTILITY
PLSS-0525 COURSE OUTLINE

Monday, Wednesday, and Friday 11:00-12:00 Noon

Instructor: Kokoasse Kpomblekou-A, Ph.D.
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Office hours: Monday 1:00 – 2:00 p.m. Friday 3:00 – 5:00 p.m.
Textbook:

Soil Fertility and Fertilizers: An Introduction to Nutrient Management. by John L. Havlin (Author), Samuel L. Tisdale (Author), Werner L. Nelson (Author), James D. Beaton (Author), 8th edition, Prentice Hall, 2013.

Useful Reference Books:

Mineral Nutrition of Higher Plants. Marschner, H. 3rd edition, Academic Press, 2011.
Principles of Plant Nutrition. Mengel, Konrad, Kirkby, and Mengel K.. 5th edition, International Potash Institute, 2001.

Course Goal and Objectives

The goal of this course is to train students who can understand complex interactions between biological processes in soil and plant root environment and nutrient availability to plants. Use this knowledge to comprehend how these complex relationships between soil chemical and physical properties and their interactions make nutrients available for plant uptake. The course will also give a student a contemporary and relevant perspective on the interplay between energy production and agricultural systems.

The course objectives are:

1) To help students understand the functions of nutrients in plants,
2) To help students identify and correct nutrient deficiency symptoms,
3) To help students understand how soil basic properties (organic matter, CEC, pH, …) influence nutrient availability, and
4) To apply this knowledge to comprehend soil fertility and nutrient management.
5) To introduce the concept of agrivoltaics (land is used for both solar energy generation and cropping). Discussions on considering its impacts on soil microclimate (temperature, moisture, shading…), soil compaction from panel installation and maintenance, and potential impacts on soil biota.

I. Introduction, Historical notes, relation to other disciplines, background knowledge, goals of course
II. Growth Factors
III. Essential Elements and their functions
IV. Soil and Plant Relationships
    1. Ion exchange
    2. Sources of exchange sites and their advantages
    3. Movement of nutrients to roots
    4. Soil acidity and liming
    5. Soil pH buffering mechanisms
    6. Soil Acidulation

V. Soil nitrogen and nitrogen fertilizers
    1. Functions of N in plants

2. Forms of soil N and N transformations in soil
3. Atmospheric N
4. Nitrogen fertilizers: organic and inorganic
5. Nitrogen application methods
6. Nitrification inhibitors
7. Nitrogen visual deficiency symptoms

VI. Agrivoltaics and soil health

1. Fundamentals of solar energy: Solar radiation and photosynthesis in plant growth and development
2. Long-term impact of solar farms on soil health: soil N and C
3. Comparison of soil chemical and physical parameters: bulk density, soil moisture, soil C, and N on a conventional Vs. a re-vegetated solar farm site
4. Agrivoltaics and its benefits: Increased yields, increased biodiversity, and reduced water consumption
5. Potential risks associated with solar panel components and their potential to leach metals into the soil, particularly in cases of damage, improper disposal, or corrosion.

VII. Soil phosphorus and phosphate fertilizers

1. Functions of P in plants
2. Forms of soil P, P sources, and organic P transformations
3. Phosphate fertilizers: organic and inorganic
4. Mycorrhiza and P nutrition
5. Phosphorus application methods
6. Phosphorus visual deficiency symptoms

VII. Soil potassium and potassium fertilizers

1. Functions of K in plants
2. Forms of soil K and K sources
3. Factors affecting K equilibrium
4. Factors affecting K availability
5. Potassium fertilizers: organic and inorganic
6. Potassium visual deficiency symptoms

VIII. Soil sulfur and sulfur fertilizers

1. Functions of S in plants
2. Forms of soil S and S sources
3. Sulfur transformations
4. Sulfate fertilizers: organic and inorganic
5. Factors affecting S availability
6. Sulfur visual deficiency symptoms

IX. Micronutrients: Fundamentals

1. Functions in plants
2. Forms in soil
3. Plant availability
4. Fertilizers
5. Factors affecting their availability

X. Soil and environmental quality

XI. Economic Yields

XI. Soil energy application in soil fertility:

1. Solar composting and biofertilizers

2. Soil solarization to control soil-borne diseases
3. Solar-powered irrigation systems

Grading:

Exam	% of grade	Tentative Exam Dates
Exam 1	15	February 22/23
Exam 2	15	March 31/23
Exam 3	15	April 24/23
Term Paper (Greenhouse experiment)	20	Announced
Final	25	Announced
Quizzes	10	Announced & Unannounced
Total	100	

Make-up exams will be given only for valid reasons.
Tentative grading (grades may be adjusted at term end)

A 90-100; B 80-89; C 70-79; D 60-69; E <60