Syllabus
Course Designator: SOIL 316
Full Course Title: Nutrient Cycling in Agroecosystems
Term: Spring
Lecture Meeting Time: 9-9:50 am MWF
Lecture Location: ALS 3005
Lab Meeting Time: 1-3:50 pm R
Lab Meeting Location: CRPS 138
Course Credits: 4 credits.
Prerequisites: CH121; SOIL 205, CSS205, or CSS305

Instructor:
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Teaching Assistant:
Office:
Telephone:
Office Hours:
E-mail:

Course Description
Nutrients are a major limiting factor for the productivity of agricultural systems. This course addresses nutrient management principles and practices that are relevant to production of annual and perennial crops. Topics addressed include: Nutrient forms, transformations, and cycling; diagnosis and correction of nutrient deficiencies, pH and salinity; impact of nutrient management practices on crop production, soil health, nutrient use efficiency, and environmental quality; and organic and inorganic fertilization.

Suggested preparation (not enforced)
- Three quarters general chemistry
- Botany, horticulture, or other plant science
- Basic computer skills. Proficiency using spreadsheets (e.g. Excel) and word-processing (e.g. Word).

Blackboard
Most of the class materials (syllabus, readings, assignments, some quizzes etc.) will be delivered via Blackboard.
Course Objective
Students will demonstrate proficiency in making nutrient management decisions based on site-specific assessment of soil nutrient status, available technology, and crop management goals.

Measurable student learning outcomes
1. Describe major nutrient cycles. Identify key chemical and biological processes regulating nutrient input, output, transformation, and plant availability for each major nutrient.
2. Calculate quantities of nutrient input, available nutrient in soil, and crop nutrient removal, given raw data.
3. Identify appropriate nutrient management application practices (nutrient rate, timing, placement, and form) to utilize nutrients efficiently and economically, promote soil health, and maintain environmental quality.
4. Choose appropriate nutrient sources (organic or inorganic) to meet crop needs.
5. Diagnose and recommend corrective action for nutrient deficiency/excess, improper pH, and excessive salinity.
6. Choose appropriate nutrient monitoring/evaluation techniques (e.g. soil testing, plant tissue testing, other emerging technologies)

Evaluation of student performance

Grade distribution:

<table>
<thead>
<tr>
<th>Activity</th>
<th>% of grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online quizzes (4-6)</td>
<td>5</td>
</tr>
<tr>
<td>In-class quizzes (5-6)</td>
<td>30</td>
</tr>
<tr>
<td>HW Assignments (7)</td>
<td>30</td>
</tr>
<tr>
<td>Laboratory participation and assignments (8-9)</td>
<td>20</td>
</tr>
<tr>
<td>In-class final</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Online quizzes: A short (~5-question) online Blackboard quiz, based on assigned reading must be completed before class on Monday to receive credit.
In-class quizzes: Quizzes will usually be ~20 minutes at the beginning of class on Friday. They will be primarily qualitative and focus on concepts rather than calculations.
HW assignments: Assignments will focus on use of nutrient management resources (i.e. extension publications) and will be more quantitative (i.e. calculations) than the quizzes. They will be available on Blackboard and a hardcopy will be due at the beginning of class one week from the day they were assigned (i.e. if given on Monday, it will be due in class the following Monday). All calculations must be typed out using an equation editor (such as Equation Tools in Microsoft Word). Example:

\[
\left( \frac{2 \text{ lbs N}}{1000 \text{ ft}^2} \right) \left( \frac{100 \text{ lbs fertilizer}}{15 \text{ lbs N}} \right) = \left( \frac{13.3 \text{ lbs fertilizer}}{1000 \text{ ft}^2} \right)
\]
Laboratory participation and assignments:
The workload will vary with each lab and there will be significant crossover between the lab and HW assignments. Some labs will require a written report, which will be due at the beginning of the following lab.

In-class final: The final is comprehensive, and evaluates student mastery of “measurable student learning outcomes” in this Syllabus.

Grading Scale
Grades are based on the percentage of maximum points accumulated and assigned according to the following table:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A</td>
<td>93-100%</td>
</tr>
<tr>
<td>A-</td>
<td>90-92%</td>
</tr>
<tr>
<td>B+</td>
<td>88-89%</td>
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<tr>
<td>B</td>
<td>82-87%</td>
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<tr>
<td>C+</td>
<td>77-79%</td>
</tr>
<tr>
<td>C</td>
<td>72-76%</td>
</tr>
<tr>
<td>D+</td>
<td>67-69%</td>
</tr>
<tr>
<td>D</td>
<td>62-66%</td>
</tr>
<tr>
<td>C-</td>
<td>70-71%</td>
</tr>
<tr>
<td>D-</td>
<td>60-61%</td>
</tr>
<tr>
<td>F</td>
<td>&lt;60%</td>
</tr>
</tbody>
</table>

Required Course Supplies: None

Recommended Course Supplies: Many laboratory meetings are held outdoors. Students need to be dress appropriately for inclement weather and for working with wet soil/plants.

Learning Resources

Required Software
Top Hat. This software will be used in lieu of clickers and is accessible through smart phones, tablets, or computers. This technology will be used to assess retention and mastery of concepts and will not be used as part of the grade.

Required textbook
Soil Fertility and Fertilizers: An Introduction to Nutrient Management, 8th Ed. Havlin, J.L., et al., 2013. Pearson Prentice Hall, Upper Saddle River, NJ. Traditional soil fertility text. Covers soil fertility management practices across many cropping systems. Several options available: 1) Buy a hardcopy (can find discounts online), 2) Book rental from Amazon (~$52+ shipping), 3) Electronic rental from CourseSmart (~$60 for the quarter), and 4) a hardcopy will be available in the library for short-term checkout.

Supplemental resources:

**Western Fertilizer Handbook.** There is an agronomic version and a horticultural version of this handbook. Contains useful tables giving details on common fertilizer materials, and gives a brief introduction to broad range of nutrient management/diagnosis topics.

**Growing Media for Ornamental Plants and Turf.** Kevin Handrek and Neil Black. Especially useful for container-grown plants in “soil-less” media. A horticulturalist’s version of a general soil fertility text. From Australia so you can expand your vocabulary.


**Course Content**

**LECTURE**

**Week 1 and 2: Nutrients in agroecosystems: the big picture**
- History of soil fertility.
- Perspectives on nutrient management as global resource limitation.
- Soils review.
- Soil/Plant relationships. Chemical, physical and biological processes that determine nutrient “availability.”
- Categories of nutrient management decisions: rate, placement, timing, source, monitoring.
- Fertilizer basics and calculations.

**Weeks 3-7: Nutrient cycling: assessing inputs, outputs and balance.**
- Causes and implications of soil acidity and alkalinity and how to change.
- Micronutrients.
- Nutrient cycling of macronutrients: N, P and K. Inputs, outputs, transformations, nutrient forms, susceptibility to environmental loss.
- Fertilizer sources: organic and inorganic. Nutrient input effects on soil pH, salts, applicator safety, and potential for environmental loss.
- Assessment of farm or field scale nutrient balance: inputs vs. outputs.

**Weeks 8-10. Nutrient management tools.**
- Using Extension fertilizer and nutrient management guides to create nutrient recommendations.
- Soil and plant tissue testing as monitoring and decision-making tools in nutrient management.
- Crop nutrient response and economics. Determining appropriate site-specific fertilization requirements.
- Emerging technologies for nutrient assessment.
LABORATORY
The laboratory component of the course will include:

- One major field experiment conducted at OSU’s Vegetable Research Farm over the course of the quarter.
- Observational trials/field trips

Laboratory: Major experiment
Field experiment. A fertilizer and cover crop trial was set-up in Oct 2013 at OSU’s Vegetable Research Farm. Students will conduct field experiments evaluating plant and soil nutrient status and response to organic and inorganic fertilizers applied in the fall and spring. Results from field testing will be used in a computer model to predict nutrient availability. Soil sampling will be used to validate the computer model. Objectives: Get hands-on experience in answering soil fertility questions.

Laboratory: Transportation
Transportation to field sites provided. We will meet in the regular laboratory meeting space before heading out to the field.

Laboratory: Observational trials/field trips
Observational trials will be customized to student backgrounds and interests. Each term we will conduct lab sessions on selected topics, according to student/instructor interests, and resource availability. Potential topics:

- Site evaluation: soil quality and its relation to soil fertility
- Fertilizer materials: analysis, solubility, handling options
- Fertilizer application/calibration of fertilizer spreader
- Fertilizer placement (banding), effects on seedling emergence
- Timing and rate of N application
- Soil biology: rhizobia and mycorrhizal fungi.
- Field trip: organic farm or fertilizer dealer
- Quick test methods for nutrient monitoring
- Soil solution vs. cation exchange measurements (lysimeter vs. ion exchange resin)
- Effects of abiotic factors (e.g. temperature, moisture, compaction) on plant growth
- Ammonia loss from surface applied urea
- Other topics of special interest

Course Policies: Must inform me well in advance if you will miss a quiz. No late homework accepted.

Statement Regarding Students with Disabilities
Accommodations are collaborative efforts between students, faculty and Disability Access Services (DAS). Students with accommodations approved through DAS are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DAS should contact DAS immediately at 737-4098.
Expectations for Student Conduct: http://oregonstate.edu/admin/stucon/achon.htm