

## ENVS-6400: SOIL NITROGEN FERTILITY AND CROP PRODUCTION 2026

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**Office Hours:** by appointment

### Objective

To obtain a better understanding of the concepts and principles related to and including:

### Course Content

- (a) **Discussion topic:** The course will include one discussion period per week. Each participant will work with a second course participant to co-lead two discussion topics. It is the responsibility of the students leading the discussion of the weekly topic to fully review the topic, develop a slide presentation on it, and lead the discussion in class. All other students are responsible for reviewing the topic of the week, being prepared to fully discuss the topic, and evaluate the student presentation. Table 1 includes a list of topics. Note that the topics numbers 1 – 6, are required and need to occur in the order given. The second column of topics are suggestions of additional topics relevant to the course which could be selected from.

**Table 1. Discussion topics:**

Topics that will be covered in order	Selection of other potential topics to pick from
1. N mineralization and immobilization	Manure N
2. N <sub>2</sub> fixation	Crop N requirement
3. Nitrification/ inhibition	<sup>15</sup> N / Cl tracer use
4. Denitrification and volatilization	Temporal spatial variation of soil N tests
5. Leaching, preferential flow and runoff	Cover crop N management
6. N transport and root uptake	N fertilizers and placements/ reactions

For each of the topics, students should consider.

1. Our current understanding of the process.
2. The factors, which affect the process (**detailed**).
3. Methods that are used to evaluate the process.
4. How the process could be used in managing nitrogen for crop production.
5. Other areas of importance to the topic.

- (b) **Group project:** There are some crops grown in Ontario where the N requirement has not been adequately determined using field trials. The objective is to do an assessment of the N management practices of a selected crop from the points of view of N requirement, N placement, N source, N uptake (as well as "harvested" N) and N losses. The assessment should account for environmental aspects. This assessment should include a literature review and potentially consulting with individuals working in the subject matter area. Should your assessment indicate that improvements in current practices are required to manage N more efficiently, suggest practices that may be used to do so and indicate how and to what extent they would be effective in improving N management. You may also suggest what is missing from the literature that is required to make adequate nitrogen recommendations for the specific crop.
- (c) **Class participation:** Although there will be a specific group leading the discussion, It is expected that each participant will be prepared to join in on the discussion of the weekly topics. In addition, you will also be responsible for Completing a rubric that evaluates the performance of each individual leading the weeks discussion. So, if there are two people leading the discussion you will evaluate each one separately. You will also provide comments and suggestions for the individuals as part of the rubrics.

#### **GRADING:**

#### **% of Grade**

- |                                   |  |
|-----------------------------------|--|
| • Seminar topic of your choice    | 45                                       |
| • Group project                   | 40 (Due March 27)                        |
| • Class discussions/participation | 15 (due one week after the presentation) |

#### **Textbooks that may be useful. Note that these are only suggestions as there are many more:**

Bacon, P.E. 1995. Nitrogen fertilization in the environment. Marcel Dekker, Inc. N.Y.

Bothe, H, S.J. Ferguson, W.E. Newton. 2007. Biology of the Nitrogen Cycle. Elsevier. Available online <https://www.sciencedirect.com/book/9780444528575/biology-of-the-nitrogen-cycle>

Barber, S.A. 1984. Soil Nutrient Bioavailability - A Mechanistic Approach. John Wiley & Sons, Inc. Toronto.

Barber, S.A. 1995. Soil Nutrient Bioavailability - A Mechanistic Approach. 2<sup>nd</sup> ed. John Wiley & Sons, Inc. Toronto.

Black, C.A. 1993. Soil Fertility Evaluation and Control. Lewis Publishers, Ann Arbor, Mich. (e.g. pp 383-404).

Burt, T.P., A.L. Heathwaite and S.T. Trudgill. 1993. Nitrate: Processes, patterns and management. John Wiley & Sons, Toronto.

Carter, M.R. and E.G. Gregorich. 2008. Soil Sampling and Methods of Analysis, Second Edition. CRC Press.

[https://eclass.uoa.gr/modules/document/file.php/GEOL105/%CE%91%CE%A3%CE%9A%CE%97%CE%A3%CE%97\\_%CE%95%CE%94%CE%91%CE%A6%CE%9F%CE%A3%20%CE%9B%CE%91%CE%A5%CE%A1%CE%99%CE%9F%CE%A5\\_2018%20%28%CE%A7%20%CE%A3%CF%84%CE%BF%CF%85%CF%81%CE%B1%CF%8A%CF%84%CE%B7%29/Soil%20Sampling%20and%20analysis\\_Canadian%20Society%20of%20soil%20science.pdf](https://eclass.uoa.gr/modules/document/file.php/GEOL105/%CE%91%CE%A3%CE%9A%CE%97%CE%A3%CE%97_%CE%95%CE%94%CE%91%CE%A6%CE%9F%CE%A3%20%CE%9B%CE%91%CE%A5%CE%A1%CE%99%CE%9F%CE%A5_2018%20%28%CE%A7%20%CE%A3%CF%84%CE%BF%CF%85%CF%81%CE%B1%CF%8A%CF%84%CE%B7%29/Soil%20Sampling%20and%20analysis_Canadian%20Society%20of%20soil%20science.pdf)

Chesworth, W., 2008. Encyclopedia of soil science. Springer

Clark, F.E. and T. Rosswell. 1981. Terrestrial Nitrogen Cycles. Ecol. Bulletin No. 33. Swed. Nat. Sci. Res. Council., Stockholm.

Colwell, J.D. 1994. Estimating Fertilizer Requirements. A quantitative approach. CAB International, Wallingford, U.K.

Drury, C.F., W. Smith, B. Grant, D. Reynolds, X. Yang, and L. Phillips, 2024. 'Pipes & Valves': Managing crop production and environmental impact by mitigating ammonia, nitrous oxide, and nitrate losses. Field Crops Research V 307.

Emerich, D.W. and H.B. Krishnan. 2009. Nitrogen Fixation in Crop Production. American society of Agronomy.

Follett, R.F., D.R. Kesney and R.M. Cruse. 1991. Managing nitrogen for groundwater quality and farm profitability. Soil Sci. Soc. Am., Inc., Madison, Wisc.

Gasser, J.K.R. 1979. Modelling nitrogen from farm wastes. Applied Science Publishers Ltd., London.

Germon, J.C. 1989. Management systems to reduce impact of nitrates. Elsevier Appl. Science, N.Y.

Hansen, J.A.A. and K. Henniksen. 1989. Nitrogen in organic wastes applied to soils. Acad. Press, Toronto

Hatfield, J.L. and R.F. Follett. 2008. Nitrogen in the Environment, Sources, Problems, and Management. Second edition. Academic Press.  
<https://www.sciencedirect.com/book/edited-volume/9780123743473/nitrogen-in-the-environment>

Hargrove, W.L. 1988. Cropping strategies for efficient use of water and nitrogen. ASA Spec. Publ. No. 51, Am. Soc. Agron., Inc., Crop Sci. Soc. Am. Inc., Soil Sci. Soc. Am. Inc., Madison, Wisc.

Hauck, R.D. (ed) 1984. Nitrogen in Crop Production. Am. Soc. Agron., Madison, Wisc.

Hauck, R.D. and R.W. Weaver. 1986. Field measurement of dinitrogen fixation and denitrification. Soil Sci. Soc. Am. Spec. Publ. No. 18, Soil Sci. Soc. Am. Madison, Wisc.

Havlin, J.L., J.D. Beaton, S.L. Tisdale, and W.L. Nelson.. Soil Fertility and Fertilizers. 8th edition 2014. Prentice-Hall inc. New Jersey.

Haynes, R.J. 1986. Mineral Nitrogen in the Plant-Soil System. Acad. Press., Inc., Toronto.

Jenkinson, D.S. and K.A. Smith. 1988. Nitrogen efficiency in agricultural soils. Elsevier Appl. Science, N.Y.

Knowles, R. And T.H. Blackburn. 1993. Nitrogen isotope techniques. Acad. Press, Inc., Toronto.

Meisinger, J.J., G.W. Randall and M.L. Vitosh. 1980. Nitrification inhibitors-potentials and limitations. ASA Spec. Publ. No. 38. Am. Soc. Agron., Soil Sci. Soc. Am., Madison, Wisc.

Nielsen, D.R. and J.G. Macdonald. 1978. Nitrogen in the Environment. Vol. 1: Nitrogen behaviour in field soil. Vol. 2: Soil-plant-nitrogen relationships. Acad. Press, N.Y.

Paul, E.A. and F.E. Clark. 2007. Soil Microbiology, ecology, and Biochemistry 3<sup>rd</sup> edition. Academic Press, inc. Toronto.

Paul, E.A. 2015. Soil Microbiology, ecology, and Biochemistry 4<sup>th</sup> edition. Academic Press, inc. Toronto <https://www.sciencedirect.com/book/9780124159556/soil-microbiology-ecology-and-biochemistry> <https://www.sciencedirect.com/book/9780124159556/soil-microbiology-ecology-and-biochemistry>

Scharf. P. 2015. Managing Nitrogen in Crop Production. American Society of Agronomy. Madison, WI

- Schepers, J.S. and W.R. Raun. 2008. Nitrogen in Agricultural Systems. American Society of Agronomy. Available online at Google books ([http://books.google.ca/books?id=an-LKuRRmwoC&printsec=frontcover&dq=Nitrogen+in+agricultural+systems.&source=bl&ots=oxM5W-WHn7&sig=XNq\\_cgy40\\_LUEdl14cfZ2wifTE&hl=en&ei=yOJGTaCJBYOClAfkl7AW&sa=X&oi=book\\_result&ct=result&resnum=3&ved=0CCwQ6AEwAg#v=onepage&q&f=false](http://books.google.ca/books?id=an-LKuRRmwoC&printsec=frontcover&dq=Nitrogen+in+agricultural+systems.&source=bl&ots=oxM5W-WHn7&sig=XNq_cgy40_LUEdl14cfZ2wifTE&hl=en&ei=yOJGTaCJBYOClAfkl7AW&sa=X&oi=book_result&ct=result&resnum=3&ved=0CCwQ6AEwAg#v=onepage&q&f=false))
- Shaffer, M.J., L. Ma, S. Hansen. 2001. Modeling Carbon and Nitrogen Dynamics for Soil Management. CRC Press. New York.
- Sparks, D.L. 1996. Methods of Soil Analysis. Part 3. Chemical Methods. American Society of Agronomy. <https://acsess.onlinelibrary.wiley.com/doi/book/10.2136/sssabookser5.3>
- Stevenson, F.J. (ed) 1982. Nitrogen in Agricultural Soils. Agron. No. 22. Am. Soc. Agron., Madison, Wisc.
- Verstegen, M.W.A., L.A. den Hartog, G.J.M. van Kempen and J.H.M. Metz. 1993. Nitrogen flow in pig production and environmental consequences. Pudoc Scientific Publishers, Wageningen.
- Weaver, R.W., S. Angle, and P. Bottomley. 1994. Methods of Soil Analysis. Part 2. Microbiological and Biochemical Properties. American Society of Agronomy.
- Weil R.R., and N.C. Brady. 2017. The nature and properties of soils. 15th ed. Prentice Hall. Upper Saddle River, New Jersey.
- West, N.E. and J. Skujins. 1978. Nitrogen in Desert Ecosystems. Dowden, Hutchison & Ross, Inc., Stroudsburg, Penn.
- Wilson, J.R. 1987. Advances in nitrogen cycling in agricultural systems. Proc. Symp. Advances in Nitrogen Cycling in Agricultural Ecosystems. Brisbane, Aust. C.A.B. International, Oxon, U.K.