

**George Gobran**

**Course Plans for Ancona 2013 (3 ECTS)**

**Title: Soil-Plant Relationships**

**Course Overview:**

This course is intended for undergraduate and graduate (MSc. & PhD) students interested in developing their knowledge about the concept of the soil-plant system as an important component of ecosystems, such as forest and agricultural systems. The course will focus on the feedback processes controlling the reciprocal effects of soil and plant (rhizospheric effects). By the end of this course, students will realize the fact of life is that soils eat rocks to feed us. It will be clear that soil plays a vital role in sustaining human welfare and assuring future agricultural and forestry productivity and environmental stability. The role of soils in mitigating global warming through carbon sequestration will also be recognized.

The main topics covered in this course are:

- A) Fundamental processes controlling soil-plant relationships, and
- B) Case Studies on the importance of studying the Rhizosphere from Sweden, Italy, Canada, France, and USA

Course materials will include PowerPoint presentations and handout, web sites, CD, journals and books will all be available to students. There will be a rather lengthy discussion after each subtopic. At the end of the course teaching, there will be General discussions and concluding remarks.

## **Course Lectures and Time Plans**

### **A) Fundamental processes controlling soil-plant relationships**

#### **Introduction & Definitions:**

- a) Human perceptions and appreciation of soil by many cultures
- b) Soil as a vital natural resource and a part of the environment
- c) Energy Flow in the Soil
- d) Environmental Factors affecting soil mineral weathering:
- e) Interplay Factors of Soil Formation
- f) Climate change – can soil make a difference?
- g) Raising the profile of soil's essential contribution to society

#### **The concept of the soil-plant feedbacks:**

- A) Plant roles in soil development (Biotic interactions)
- B) Effect of soil reaction on plant growth and vice versa
- C) Root Modifications and Impact of Nutrient Acquisition
- D) Cation exchange capacity of soils and roots
- E) Reciprocal effects of soil and vegetation

#### **The Rhizosphere:**

- A) Rhizosphere as a natural link of Plant-Soil System
- B) Rhizodeposition, Root distribution and longevity, carbon flux, and root exudates
- C) Acid-base Changes in the rhizosphere influencing nutrient availability
- D) Regulating processes affecting elements bioavailability in the rhizosphere
- E) The conceptual model for nutrient availability in the soil-root system
- F) Methods of rhizospheric studies

**B) Case Studies on the importance of studying the Rhizosphere from Sweden, Italy, Canada, France and USA (Teaching 12 hours)**

**Case Study from Sweden:**

**Gobran**, G.R., S. Clegg and F. Courchesne. 1998. Rhizospheric Processes Influencing the of Forest Ecosystems. In "Plant-induced soil changes: processes and feedbacks" N van Breemen (ed.), Biogeochemistry, 42:107-120, Special Issue.

<http://www.springerlink.com/content/u0435222215h1575/>

**Case Study from Italy:**

Cocco, S, Agnelli, A., G. **Gobran** and G. Corti. 2012. Changes induced by the roots of Erica arborea L. to create a suitable environment in a soil developed from alkaline and fine-textured marine sediments. Plant Soil, DOI 10.1007/s11104-012-1501-3

<http://link.springer.com/article/10.1007%2Fs11104-012-1501-3?LI=true#page-1>

**Case Study from Canada:**

**Gobran**, G.R., M-P Turpault, and F. Courchesne. 2005. Contribution of rhizospheric processes to mineral weathering in forest soils. In: PM Huang and GR **Gobran** (Eds.), Biogeochemistry of Trace Elements in the Rhizosphere. Elsevier, pp 400.

[http://www.elsevier.com/wps/find/bookdescription.cws\\_home/705594/description#description](http://www.elsevier.com/wps/find/bookdescription.cws_home/705594/description#description)

**Gobran**, G.R., M-P Turpault, and F. Courchesne. 2005. Contribution of rhizospheric processes to mineral weathering in forest soils. In: PM Huang and GR **Gobran** (Eds.), Biogeochemistry of Trace Elements in the Rhizosphere. Elsevier, pp 400.

[http://www.elsevier.com/wps/find/bookdescription.cws\\_home/705594/description#description](http://www.elsevier.com/wps/find/bookdescription.cws_home/705594/description#description)

**Case Study from France:**

Turpault, M.-P., G.R. **Gobran** and P. Bonnaud. 2007. Temporal variations of rhizosphere and bulk soil chemistry in a Douglas fir stand. Geoderma, 137:490-496.

[http://www.sciencedirect.com/science?\\_ob=ArticleURL&\\_udi=B6V67-4M936RR-1&\\_user=10&\\_coverDate=01%2F15%2F2007&\\_rdoc=1&\\_fmt=high&\\_orig=browse&\\_sort=d&\\_view=c&\\_acct=C000050221&\\_version=1&\\_urlVersion=0&\\_userid=10&md5=fb199da7cf6dd9e052a5815b7163c4cc](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V67-4M936RR-1&_user=10&_coverDate=01%2F15%2F2007&_rdoc=1&_fmt=high&_orig=browse&_sort=d&_view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=fb199da7cf6dd9e052a5815b7163c4cc)

**Case Study from USA:**

Assadian, N. and L.B. Fenn. 2001. Rhizosphere Chemical Changes Enhance Heavy Metal Absorption by Plants Growing in Calcareous Soils. In: "Trace Elements in the Rhizosphere"

**Gobran**, G.R., W.W. Wenzel and E. Lombi, E (eds.), CRC Press, pp 321.

<http://www.crcpress.com/us/product.asp?sku=1535+++&dept%5Fid=1>

**General discussions and concluding remarks**