

**Project title: Simulation of root growth with mechanistic crop models to improve a better prediction of nitrogen use efficiency in organic vegetable production**

**Name:** Anders Pedersen  
**University:** The Royal Veterinary and Agricultural University  
**Department:** Plant Nutrition and Soil Fertility Laboratory, Department of Agricultural Sciences  
**Supervisor:** Lars Stoumann Jensen  
**Co-Department:** Danish Institute of Agricultural Sciences, Department of Horticulture  
**Co-Supervisor:** Kristian Thorup-Kristensen  
**Timescale:** 01/09 2003 – 28/02 2007  
**E-mail/phone:** anders@kvl.dk / +45 3528 3494 (RVAU) – [anders.pedersen@agrsci.dk](mailto:anders.pedersen@agrsci.dk) / +45 8999 3222 (DAIS) /  
**Masteres degree:** Master of Agronomie, RVAU

### **Background**

Plant soil and atmosphere models are commonly used to predict crop yield and environmental consequence. Such models often include complex modelling modules for water movement, soil organic matter turnover and, above ground plant growth. However, the root modelling in these models are often very simple, partly due to a limited access to experimental data.

### **Objective**

The aim of the Ph.D.-project is to improve the modelling of root growth. The focus is to investigate organic vegetable crop rotations, and open up for a better understanding in nitrogen use and to avoid leaching of nitrate into the environment. The main thing to study will be, root penetration rate and root proliferation in different soil layer, and modelling the ability of different root systems to take up nitrogen from different places in the soil profile.

In this project we will improve model for root growth and proliferation. The model focuses on annual crops, and attempt to model root growth of the crops and its significance for N uptake from different parts of the soil volume. At DJF Aarslev we have access to experimental data for root growth, root proliferation, and crop production from a range of cereals and vegetables. Those data will be used to evaluate the model. The model will be used for constructing a decision support system for N utilization in cropping systems, to ensure high nitrogen use efficient and avoid nitrogen leaching.

### **Work:**

Implement a new root model in N-able crop model for EU-rotate\_N project. In close co-operation among the European countries, where others made submodels for organic matter turn over, water and soil nitrogen movement, here I will contribute with knowledge of root growth into width and depth for row crops. Scenario simulations for typical vegetable rotations in Europe will be going on for next year to validate the model. A validation of the model is in preparation and will end up with a draft in spring before submission of PhD. theses.

Field experiments from DJF Aarselv will be used together with Daisy simulations to analyse nitrate fluctuation to analyse the relation to depth of root growth and annual precipitation.

Developing a decision support system for crop rotations in different regions in Denmark is in progress. This work will end up with a publication this autumn to "Soil use and management" (*Simulating retention in soils and effect of catch crops use and root growth*). By simulations in the crop soil model Daisy I will analyse the effect of climate regions, soil type and using of catch crop in crop rotations. The effect will be the

amount of nitrogen leaching below root zone. The root zones will be split up in low (Leek, onion), middle (Spring Barley, red beet) and deep (Cabbage, oil radish).

### **Plans – 2006 - 2007**

Waiting for evaluation of the last Ph.D. course, else all courses passed.

Finish and submit manuscript about nitrate retention and catch crop use.

Write a manuscript about modelling root density in deeper soil layer.

Finish introduction for Ph.D. Thesis.

### **Meetings and presentations 2003/2006**

- November 13 – 14. 2003: Flakkebjerg, Danish Institute of Agricultural Sciences, **Biannual seminars in SOAR**.

- December 03. 2003: Forskningscenter Foulum, **FØJO**. Integritet i økologisk jordbrug – og i forskningen.

- February 02 – 04. 2004: Valencia, Project meeting in **EU-rotate\_N project**.

- April 29 – 30. 2004: Tine Landboskole, **DINA workshop**, XML technologies for storing and exchanging data.

- September 12 – 17. 2004: Munich, Germany. International Congress, **Rhizosphere and Challenges, A Tribute to Larenz Hiltner**.

- September 19 – 24. 2004: **SwOFF**. Alnarp, SLU, Sweden. Ph.D. Summer School. Agro ecology with emphasis on horticultural cropping systems, Part 1.

- November 13 – 15. 2004: **SwOFF**. Alnarp, SLU, Sweden. Ph.D. Summer School. Agroecology with emphasis on horticultural cropping systems, Part 2.

- January 17. 2005. **Team Horticultura** seminar at KVL.

- March 1.-3rd 2005. Meeting in Napoli, **EU-rotate\_N project**.

- April 28- 29. 2005: DMU Roskilde, Biannual seminars in **SOAR**.

- June 6 – 8. 2005. **Intro-Course on Mathematical Modelling**, Freshwater biological Laboratory, University of Copenhagen. (2.5 ECTS).

-October 12-13-2005: Oral presentation at: Fertilization Strategies for Improved use of plant nutrients in Potato and field Vegetable production. **NJF seminar no. 371**. Malmö Börshus 12-13 October 2005.

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-October 24-26-2005: **14th N WORKSHOP** "N management in agrosystems in relation to the Water Framework Directive" be held 24-26 October 2005, Maastricht, The Netherlands. If modelling with Daisy. Oral presentation in WG5 "Catch crops and buffer strips".

- January 6.th. 2006. **Status seminar** at KVL.

-August 10.th. and 16.th. **Two field demonstrations** in Fyn and Jylland. Demonstration of a desition support system for mineral N soil samples.

## Publications:

Pedersen, Anders (2005) [If modelling modelling with Daisy](#). [oral] Presentation at *14th N WORKSHOP "N management in agrosystems in relation to the Water Framework Directive"*, Maastricht, The Netherlands, 24-26 October 2005.

Pedersen, Anders; Stoumann Jensen, Lars and Thorup-Kristensen, Kristian (2005) [A model analysis on nitrate leaching under different soil and climate conditions and use of catch crops](#). Poster presented at at 14th N WORKSHOP "N management in agrosystems in relation to the Water Framework Directive", Maastricht, The Netherlands, 24-26 October 2005,

Pedersen, Anders and Thorup-Kristensen, Kristian (2006) [Hvornår kan udtagning af Nmin prøver betale sig?](#) [When will it be valuable to make mineral N samples?]. In *Frugt og Grønt*, September, No 9, page pp. 378-379. Frugt og Grønt Rådgivningen, Skejby, Århus.\*\*

Pedersen, Anders and Thorup-Kristensen, Kristian (2004) [Modelling root distribution and nitrogen uptake](#). Poster presented at International Congress Rhizosphere, Perspective and Challenges - A tribute to Lorenz Hiltner, Munich, Germany, 12-17 september 2004.