



Annual Status Report 2001 and Application for Continuation in 2002

For research projects financed by grants from
The Directorate for Food, Fisheries and Agro Business
under the Danish Ministry of Food, Agriculture and Fisheries

1. Research program

Research in organic farming 2000-2005 (DARCOF II)

2. Project title and number

I.3 Interactions between nitrogen dynamics, crop production and biodiversity in organic crop rotations analysed by dynamic simulation models –Acronym: BIOMOD

3. Head of project

Jørgen Aagaard Axelsen, Senior Scientist
Danish National Environmental Research Institute
Department of Terrestrial Ecology
Vejlssøvej 25, Box 314, 8600 Silkeborg.
Tlf. 89 20 14 38
Fax:89 20 14 13
e-mail:jaa@dmu.dk

4. Participating institutes

National Environmental Research Institute, Department of Terrestrial Ecology, Vejlssøvej 25, P.O. Box 314, DK-8600 Silkeborg, Denmark

National Environmental Research Institute, Department of Streams and Riparian Areas, P.O. Box 314, Vejlssøvej 25, DK-8600 Silkeborg, Denmark

Danish Institute of Agricultural Sciences, Department of Crop Physiology and Soil Science, P.O. Box 50, DK-8830 Tjele, Denmark.

Danish Institute of Agricultural Sciences, Department of Fruit, Vegetable and Food Science, Kirstinebjergvej 10, P.O. Box 102, DK-5792 Aarslev, Denmark.

The Royal Veterinary and Agricultural University, Department of Agricultural Sciences, Thorvaldsensvej 40, DK-1871 Frederiksberg C., Denmark.

Danish Institute of Agricultural Sciences, Department of Agricultural Systems, P.O.Box 50, DK-8830 Tjele, Denmark

I.3 Interactions between nitrogen dynamics, crop production and biodiversity in organic crop rotations analysed by dynamic simulation models

5. Contact persons

Jørgen Aagaard Axelsen, National Environmental Research Institute, Department of Terrestrial Ecology.

Jørgen Eivind Olesen, Danish Institute of Agricultural Sciences, Department of Crop Physiology and Soil Science.

Kristian Thorup-Kristensen, Danish Institute of Agricultural Sciences, Department of Fruit, Vegetable and Food Science.

Lars Stoumann Jensen, Department of Agricultural Sciences, The Royal Veterinary and Agricultural University.

Ruth Grant, National Environmental Research Institute, Department of Streams and Riparian Areas.

Ib Sillebak Kristensen, Danish Institute of Agricultural Sciences, Department of Agricultural Systems.

Bjørn Molt Petersen, Danish Institute of Agricultural Sciences, Department of Agricultural Systems

6. Other project staff

Jørgen Berntsen (JB), Danish Institute of Agricultural Sciences, Department of Crop Physiology and Soil Science.

Søren Hansen (SH), Anders Pedersen and Per Abrahamsen, The Royal Veterinary and Agricultural University, Department of Agricultural Sciences.

7. **Start of project: 2000**
End of project: 2003

8. Annual report/Application for continuation in 2001

A. Objectives and expected achievements (from application)

The idea behind the project is to apply dynamic simulation models to organic crop rotations. Before models can be applied to such complex systems as organic crop rotations, they have to be thoroughly validated against experimental data. Such a validation has to ensure that the models are reliable and trustworthy.

The project has three aims:

1. Expand and calibrate models on areas they do not currently have sufficient skill (WP1 to WP3)
2. Validation of the improved and calibrated models on independent experimental data (WP4 and WP5)
3. Scenario analyses of range of management options on different farm types (WP5.2).

The models will be extended in three areas that present models do not handle properly. These three areas, of great importance in organic crop rotations, are undersown crops, root growth and turnover of organic matter. Present experimental data on the two first areas are not of a sufficiently high quality to be used for a calibration, and the current project will thus initiate experiments to collect this kind of data. The obtained data sets will be used not only for model calibration but also as a supplement to other experimental research in organic farming. Existing high quality data on turnover of organic matter will be used to improve the organic matter module in the models.

- 1.3 *Interactions between nitrogen dynamics, crop production and biodiversity in organic crop rotations analysed by dynamic simulation models*

Validation of the improved models will be performed on independent data to ensure that the models are general and able to make prediction outside their calibration range. Existing data sets from previous and ongoing DARCOF projects will be used for this. These data do, however, not sufficiently cover the dynamics of grazed grass/clover pastures, which are essential for many organic farming systems. An independent data set will be obtained from two dairy farms on different soil types and focus on grazed clover/grass pasture in WP4.

Scenarios of selected features on three important organic farming systems (vegetables, arable, and dairy farms) will then be performed using the revised models. These scenarios will highlight effects of soil type and crop management, including catch crops, proportion of grass/clover pastures in the rotation, and manure application on selected parameters, i.e. nitrate leaching, crop yields, biodiversity and soil organic matter content. Both short-term and long-term trends will be evaluated.

The main achievement will be model predictions on different organic farming systems, predictions that can help the development of recommendations for organic farmers. This will assist in design of crop rotations, i.e. choice of main crop, catch crops or green manure, animal manure application, management of grass/clover pastures and grazing intensity. Another potential use will be evaluation of environmental effects as nitrate leaching, biodiversity and trends in organic matter contents. It is thus expected that the models in the future will help both to improve organic farming and to support the national administration and political system in evaluating the effects of organic farming on several indicators, including productivity, biodiversity and nitrogen losses to the environment. Last but not least the models will also be of great value in future organic farming research as they can be used for initial testing of new hypotheses, or help the generation of new hypotheses, thereby contributing to the goal orientation and proper focussing of experimental and empirical research.

In 2001 the project was given extra volume by including the project NITMOD as three new work packages (WP 6 – WP) and integrating a part of NITMOD with BIOMOD WP3. Therefore, the objectives of NITMOD is mentioned here. The aim of NITMOD is to develop a strongly improved model to describe the degradation of organic matter in the soil, and to develop a simple and robust model for the transportation of water and matter. The objectives can be summarised in four points:

1. to speed up the development of an improved model of the turnover of C and N in the soil, and provide a broader data foundation for the development and calibration of this model.
2. to parameterise the modules describing the decay of dead roots through the available and relevant data from the continuous release of C and N from the roots of different crops.
3. to develop , calibrate and validate a simple, empirical model for the transport of solutes, mainly through literature data on the leaching of conservative tracers.
4. to improve the data foundation for the calibration and validation of the model for turnover of C and N in BIOMOD by supplementary measurements in organic crop rotations.

B. Project summary (from application)

The challenge in organic farming is to optimise short-term productivity while maintaining long-term soil fertility, increasing recycling of nutrients and resources, reducing nutrient losses to the surrounding environment and increasing natural control of pests and diseases. The organic farming system is very complex, with multiple interactions and hence holistic research is essential, but often very difficult. One way to analyse the behaviour of whole systems is to integrate the process-based knowledge and analytical studies of system components in mechanistic and dynamic simulation models. Such models may also be powerful tools in generalising results of both short and long-term experiments. This may enable predictions about other treatments, but only if the models are general, reliable and validated against experimental data for whole organic crop rotations. Furthermore, valid and extensive models may be used not only to analyse consequences for the organic farm production, but also for environmental impact and biodiversity.

Three simulation models have been used in different ongoing DARCOF-I projects, namely DAISY, FASSET and the Food Web Model. Although different in approach and degree of detail, they supplement each other on several important aspects (scope, processes, balances, environmental impact and nature content). The models have shown a general capability for simulating important aspects of organic farming systems, but areas where they are not capable of simulating organic crop rotations

adequately have also been identified: i) competition between undersown crops and main crops, ii) root development of main and catch crops and iii) nitrogen turn-over in grazed grass/clover pastures both before and after incorporation.

Therefore, his project has been designed with three major aims:

- i) Expand and calibrate the models on areas where they do not have sufficient skills.
- ii) Validation of the improved and calibrated models on independent experimental data.
- iii) Scenario analyses for different crop rotations (dairy, arable and vegetable).

The idea behind the project is to use simulation models to make predictions on different organic farming systems that can help the development of recommendations for organic farmers. This will assist in design of crop rotations, i.e. choice of main crop, catch crops or green manure, animal manure application, management of grass/clover pastures and grazing intensity, and help the evaluation of environmental effects as nitrate leaching, biodiversity and trends in organic matter contents. It is thus expected that the models in the future will help both to improve organic farming, protect the environment and to support the national administration and political system. The models will also be of great value in future organic farming research as they can be used for initial testing of new hypotheses, or to generate new hypotheses, thereby contributing to the goal orientation and proper focussing of experimental and empirical research.

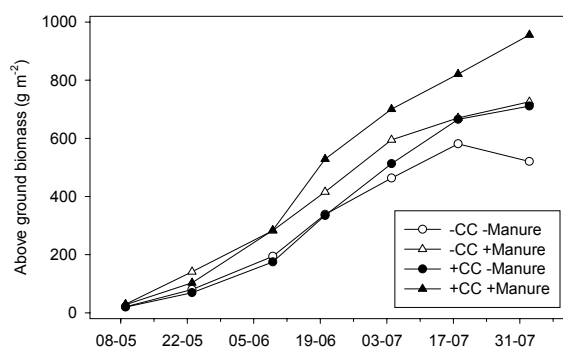
All three models mentioned above have been included in the project, due to their differences in focus and strengths, and to enable a model comparison where the required degree of model detail can be evaluated. This will optimise the quality and range of the simulation output. The project will draw extensively on data sets from both ongoing DARCOF-I and future DARCOF-II projects, but within the project an additional comprehensive data set from two dairy farms on different soil types with special focus on grazed clover/grass pastures will be generated for independent validation.

Table 1: Work package list (from application)

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| Work-package No | Work package title | Responsible participant | Budget | Start | End | Deliverable No |
|-----------------|---|-------------------------|--------------------|---------|---------|----------------|
| 1 | Adaptation of a model for competition between undersown crops and main crops | JB | 693,849 | 2000/04 | 2003/06 | D1-D3 |
| 2 | Improvement of root growth model | KTK | 858,092 | 2000/10 | 2003/06 | D3-D6 |
| 3 | Parameterisation of the soil organic matter turnover sub-modules of DAISY and FASSET | BMP | 653,685+ 594030 | 2000/10 | 2002/12 | D7-D10 |
| 4 | Crop production, nitrogen balance, nitrate leaching and biodiversity in crop rotations on private farms | JEO | 2,244,174 | 2000/04 | 2003/10 | D11-D14 |
| 5 | Whole model calibration, validation inter-comparison and scenario analyses | JAA | 2,978,203 | 2000/10 | 2003/12 | D15-D18 |
| 6 | Parameterisation of the release from the roots | JB | 220951 | 2001/03 | 2002/06 | |
| 7 | Validation and further development of a solute transport model | JB | 227361 | 2001/06 | 2002/12 | |
| 8 | Measurements in field experiments | JEO | 357660 | 2001/03 | 2002/03 | |

C. Progress



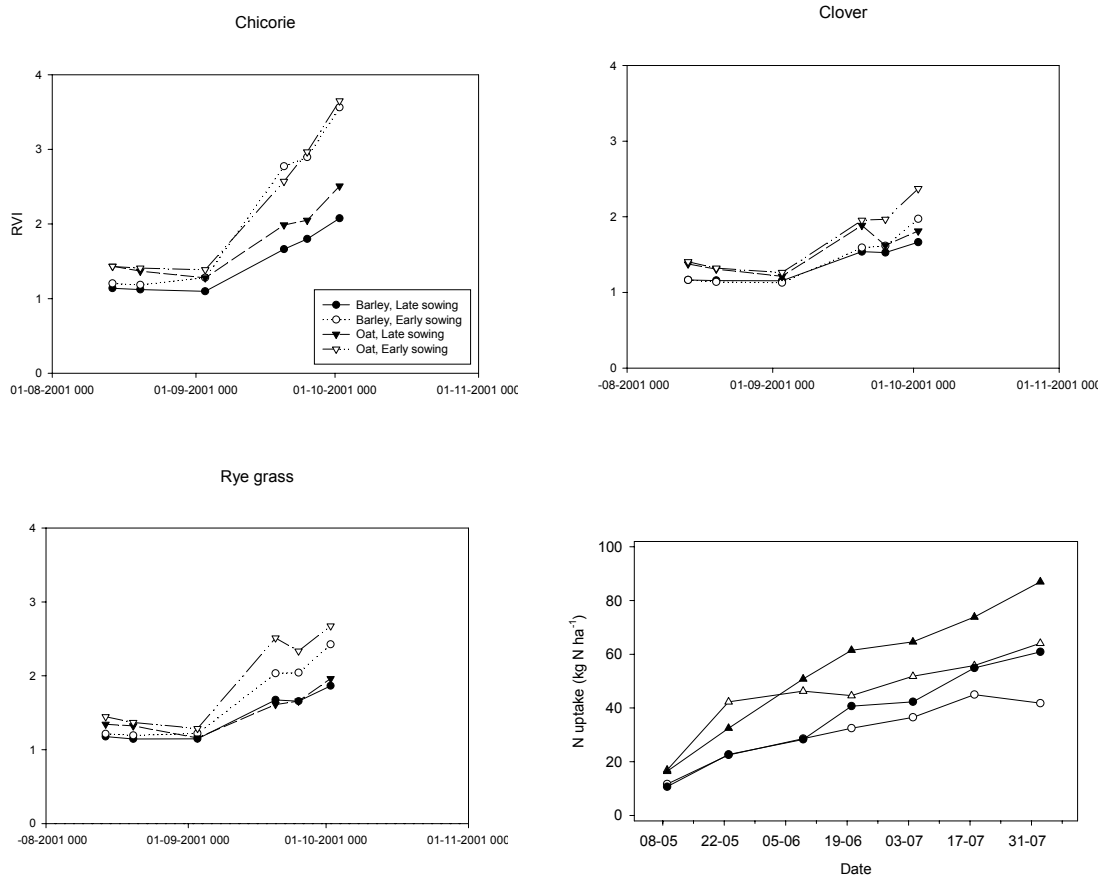
C.1 Annual description (resume) of main results and conclusions

The new sub-project (NITMOD) has been included in this project. This has been done by:

1. complete integration of BIOMOD WP3 and NITMOD DP1.
2. adoption of DP2-DP4 in NITMOD as WP6 - WP8 in BIOMOD.

WP1: Adaptation of a model for competition between undersown crops and main crops.

An experiment on the growth of undersown crops has been conducted in an organic crop rotation at Foulum. Growth of two main crops (barley and oat) and three different undersown crops (ryegrass, white clover and chicory) have been measured at 8 different times during the growing season. On each date measurements of soil water, plant dry matter, green/yellow leaf area indexes, nitrogen uptake, reflectance (RVI), photosynthetic light (PAR) in the canopy were performed. The figure below shows reflectance of the undersown crops after harvest of main crop. These data clearly shows that the sowing data was of great importance, whereas the effect of the main crop apparently was smaller.



Data obtained from this experiment will be used to verify FASSET's interspecies competition sub-model and to calibrate the simulation of the growth of undersown species.

Data from establishment of a clover/grass ley undersown in barley in 2000 has been collected in a database (Deliverable D1). The figure below shows the dry matter and nitrogen accumulation in barley in the four different treatments: \pm catch crop and \pm manure. Part of this dataset has been presented at the 11th Nitrogen Workshop in France.

WP2

We have studied the root growth of winter wheat, spring barley and sugar beets at two different sites (Årslev and Foulum) with different soil types. The measurements have been made with minirhizotrons. Minirhizotrons with two different lengths have been used, most of them reaching a depth of, but one third of the minirhizotrons in each crop was longer and extended to 2.4 meter. Based on the data obtained, the long minirhizotrons will be used for all of the winter wheat and sugar beet plots next year.

Winter wheat was found to reach a rooting depth of approx. 60 cm during the autumn, and reached its final rooting depth of 160 cm in Foulum and 190 cm in Årslev by July. Spring barley also reached its final rooting depth by July, with depths of 85 cm in Foulum and 110 cm in Årslev. The data indicates site differences in rooting depth, which is most likely due to differences in soil types, but differences in temperature could also be important. Measurements on the sugar beets is still going on, but by September we found large differences among the two sites with a rooting depth of 95 cm in Foulum and 170 cm in Årslev, indicating larger differences for this crop, but it is too early for any conclusions. In next years experiment only long minirhizotrons extending to 2.4 meter will be used both for the sugar beet crop and for winter wheat.

Work on the modelling of root growth and N uptake has started, but is in an initial phase with no specific results yet.

WP3 (and NITMOD DP1)

A calibration tool is presently fully developed, consisting of C-TOOL extended with N and ¹⁵N simulation ("CN-TOOL"). CN-TOOL is integrated with a numerical library, which allows for non-linear parameter optimisation. A database engine is also employed, allowing CN-TOOL directly to use of data from ACCESS databases.

Early in the year 2001, all project participants discussed and agreed on a common database structure, in which all the collected historic literature data as well as current project datasets can be accommodated. This will greatly facilitate future data sharing and exchange in the project. All the long-term data series proposed in BIOMOD and NITMOD have by now been incorporated into this database, as have most of the short-term data-series (see also C.3).

Principles for the model development and parameterisation have been thoroughly discussed and agreed upon via e-mail and at several meetings during the year between WP participants at DJF and KVL. Especially methodology for reducing model complexity and for estimating initial pool sizes has been discussed.

The model structure in the NITMOD proposal (structure can also be seen at www.agrsci.dk/c-tool) could, provided with proper parameters, simulate all long-term data series very satisfactory. A few examples are given in figures 1 - 4.

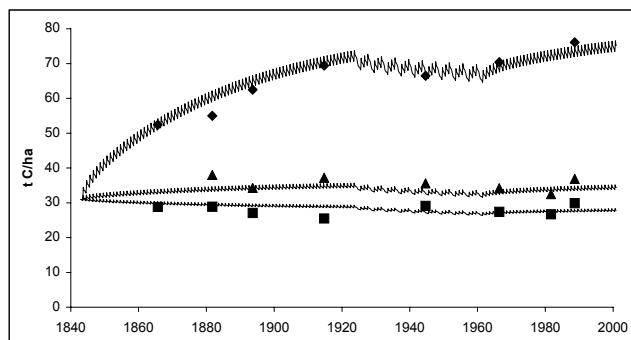


Figure 1 Calibration data series. Measured and simulated soil carbon content at the Broadbalk continuous wheat experiment (0-23 cm). Diamonds: Annual application of farmyard manure. Triangles: Annual NPK fertiliser. Squares: No fertiliser added.

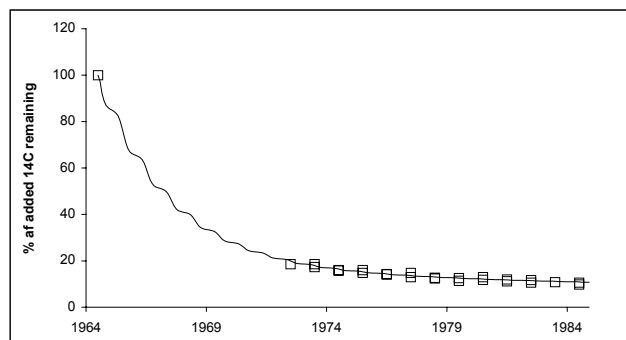


Figure 2 Calibration data series. Measured and simulated ^{14}C soil content (0-20 cm) following application of ^{14}C labelled barley straw at Risø, Denmark.

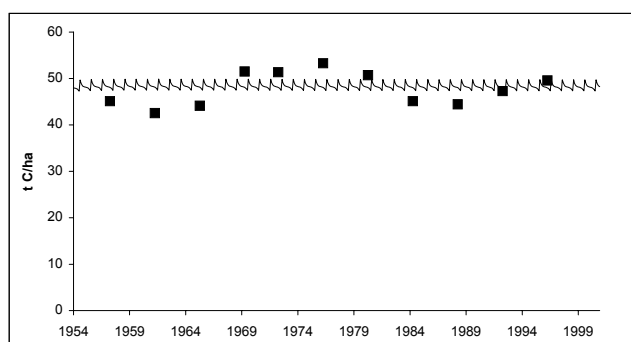


Figure 3 Validation data series. Measured and simulated soil carbon content at the Askov Experimental Station, Lermarken B2, 1NPK (0-20 cm).

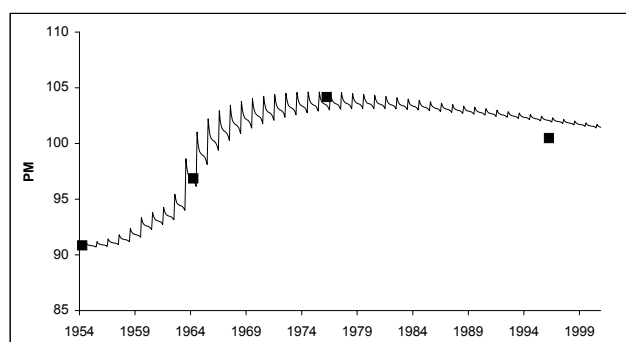


Figure 4 Validation data series. Measured and simulated soil radiocarbon content (percent modern) at the Askov Experimental Station, Lermarken B2, 1NPK (0-20 cm).

Initial long-term turnover parameters have now been determined, which is the first step in an iterative process, where short and long-term parameters are determined in separate optimisation procedures. The short-term parameters may have some effect on the long-term parameterisation, so this iterative process is to be repeated until stabilisation.

A new functionality for the effect of clay on soil organic matter turnover has been developed, and is incorporated into CN-TOOL.

Stored soil samples from long-term experiments in Askov have been processed, and sent to the AMS laboratory at Aarhus University for determination of ^{13}C and ^{14}C .

WP4

Two sites, one on sandy soil (Brørup) and one on loamy soil (Assentoft), including clover grass in rotation have been selected for detailed measurements of a large number of parameters. On each site a grass-clover field have been selected and this field has been split in two giving the following two rotations which are used for measurements:

| Field | 2000 | 2001 | 2002 |
|-------|--------------|--------------|--------|
| 1 | grass/clover | cereal | cereal |
| 2 | grass/clover | grass/clover | cereal |

The cereal fields are split into three plots at each site, two plots are given manure in either normal or double normal rate and one is not given manure. The nitrate leaching is only measured in the plot, which has been given normal manure rate.

The measurement programme has been set up in collaboration with the DINO project under DARCOF-II. This measurement programme is outlined below. Several institutions and departments participate in the measurement and a detailed protocol of the measurements and agreements with the involved organic farmers have therefore been set up.

General farm data (DJF-JBS)

The feed production, feed use and production of milk, meat and manure at the farm level is recorded.

Manure (DJF-JBS)

The amount of manure applied is recorded and samples of the manure are taken for analysis.

Initial characterisation of the sites (DJF-PVJ)

The soil and the soil profile at the two sites were characterised in spring 2001. This included measurements of soil texture, content of N and C and of water retention. There was a slope at Assentoft, and here two soil profiles were characterised.

Climate (DJF-PVJ)

A climate station is located at each site for measuring temperature, rainfall and PAR. At the sandy site measurements are also taken of soil water content.

Spectral reflectance (DJF-PVJ)

Spectral reflectance measurements are measured over both the grass-clover and cereal plots at weekly intervals during the growing season.

Urine patches (DJF-PVJ)

A recording of urine patches were performed in a 2 m grid on a 10x10 m square. The measurements were done both by visual assessment and by spectral reflectance. Measurements were taken at monthly intervals from April to September.

N-fixation and denitrification (DJF-PVJ in DINO)

N-fixation and nitrous oxide emissions were measured 3-4 times during the season in 2001. This includes measurements of spatial heterogeneity in these processes.

Soil mineral nitrogen and microbial biomass (DMU-VAF)

Measurements of soil mineral nitrogen from 0-25 cm, 25-50 cm and 50-100 cm is taken on 5 dates during autumn and winter. Three times per year samples are taken for measurements of soil microbial biomass.

Above-ground crop biomass and yield in cereals (DJF-JBS)

Samples of above ground biomass in the cereals in each of the three manure treatments are taken twice during the growing season and at harvest. Grain yield and nitrogen content is measured. The grain yields (t/ha) for year 2001 are shown below. There were no yield benefits from manure application on the sandy soil, but a small yield increase on the sandy loam.

| Site | No manure | Normal rate | Double rate |
|------------------------|-----------|-------------|-------------|
| Brørup (sand) | 5.0 | 4.5 | 4.8 |
| Assentoft (sandy loam) | 4.9 | 6.0 | 6.3 |

Below-ground and above-ground biomass in grass-clover (DMU-VAF)

Samples of above- and below-ground biomass of the grass-clover crop is taken prior to ploughing of the grass-clover sward. The samples are analysed for dry matter, lignin and total N and C.

Nitrate leaching (DMU-VAF)

Soil water sampling stations were established at each field in December 2000 – January 2001. Each sampling station consists of 12 suction cups (teflon type) installed at a depth of 100 cm and covering an area of approximately 100 m². In the field with continuous clover grass in 2001, the grass growth did not recover sufficiently after the installation of suction cups. Therefore additional 6 suction cups (ceramic type) were installed in June 2001 using a more sensitive installation technique. Thus we continue with two soil water stations in the grass-clover field: one site with good grass growth and one site with poor grass growth.

Water samples have been taken every week during the main period of percolation through the root zone and every second week during the summer period 2001. Water samples from the individual suction cups of the soil water stations are analysed for nitrate-N, whereas pooled samples from each station are analysed for NH₄-N and total-N. Pooled samples are also analysed for ortho-P and K as an indicator of preferential flow, and for TOC with the purpose of describing organic matter conversion. Baseline data sets for the period Feb.-March 2001, representing the conditions prior to the crop growth in 2001/02 have been established. Data for the crop season 2001/02 are in the process of being collected. Baseline data for nitrate concentrations in the root zone are shown table below.

Nitrate concentrations (mg N/l) in the soil water and in the soil samples prior to the crop season 2001/02 (Feb.-March 2001)

| | Field 1 (cereal) | Field 2 (grass) |
|-------------------------------------|---------------------|--------------------|
| Assentoft | | |
| Suction cups, soil water 100 cm | 6.3 | 11.9 |
| Soil samples, soil water, 50-100 cm | 8.3 | 7.8 |
| Brørup | | |
| Suction cups, soil water 100 cm | 9.4 | 9.9 |
| Soil samples, soil water, 50-100 cm | 2.3 | 4.4 |

Microarthropods (DMU-TERI)

Soil samples for microarthropods will be collected on 3 dates during the season. The two have been carried out in May and June, and the last sample will be taken in november. The arthropods have been extracted but not yet counted and identified. The earthworms from the first sampling date have been washed out and identified. This was rather labour intensive, which forced us to omit the earthworm sampling in June. The earthworm density in May was at a rather normal level in Brørup (about 175 m⁻²) and relatively low in Assentoft (about 70 m⁻²).

WP5

The calibration of the food web model in relation to data from Research Centre Bygholm (from DARCOF I, project VI,3) has been started and this process revealed that the simulation of the interactions in different horizons had to be improved. This was a rather complicated and time consuming process, which involved the programming of routines that were able to handle the activity of the different organisms in relation to the soil pore structure (which changes with time after a tillage event). Furthermore, the demand for an improved simulation of the degradation of organic matter required an improvement of the part of the food web model taking care of the “organic matter – degrader” simulation.

The model has been built into a program with a well-suited user interface. This program makes it easy to change model ecosystem, input parameters and climate files. The simulations take about 15 seconds and the results are easily visualised graphically, and if wanted, together with experimental/field data for validation or calibration. Thus the model has been built into a swift modelling tool that is now ready for use.

Data for calibration of the FASSET model has been collected by the DARCOF project IV (EXUNIT) and stored in a database. An interface in Excel has been developed, so that FASSET directly can retrieve data from this database. As a calibration of FASSET is meaning less without the new parameters obtained in WP2, WP3, WP6 and WP7, the actual calibration has been postponed.

In preparation for the scenario modelling and to allow the incorporation of results from WP2 and WP3 in the Daisy model, some limited restructuring and reprogramming of the plant root module and the soil organic matter module of Daisy model has been initiated at KVL. This regards the dynamic modelling of root growth characteristics and the possibility for differing abiotic functions between the various processes of the SOM module.

Due to the incorporation of new activities on nitrogen turnover in form of the NITMOD project in the years 2001-2002, the initialisation of the overall model calibration and comparison activities in WP5 have been postponed until 2002-2003.

WP6 (NITMOD- DP2)

Existing rhizodeposition studies have been reviewed and an initial general outline for carbon translocation to root and rhizosphere for wheat, winter barley, spring barley and pea have been made. In addition the model approach has been determined including equations for carbon translocation, carbon to root growth, root death and exudation to the rhizosphere.

WP7 (NITMOD-DP3)

Existing solute transport model has been reviewed and the TETRANS model has been chosen for further testing.

WP8 (NITMOD - DP4)

Measurements of soil C and N turnover are taken in the organic crop rotation experiment at Foulum. This experiment was initiated in 1994 and is comprised of two 4-course rotations with varying proportions of green manure crops. The experiment has treatments with/without catch crops and with/with manure application. The measurements are performed in cereal crops in two systems corresponding in one case to a crop rotation with green manure with catch crop and without manure, and in the other case without green manure without catch crop and without manure. Measurements have taken in 2001 in two cereal crops in both rotations and in two replicates.

The following measurements have been taken in each plot:

- Samples of above-ground plant biomass for determination of dry matter and N at two week intervals during the growing season.
- Samples of soil mineral N at three times during spring.
- Weekly measurements of spectral reflectance from the plots during the growing season.
- Bi-weekly measurements of soil water nitrogen in bare soil from one of the plots.
- Soil respiration (CO₂) from bare soil from three mini-plots within each plots taken at intervals of 1-2 weeks.
- In-situ measurement of soil N mineralisation several times during the growing season.
- Soil microbial biomass in spring and autumn.

C.2 Fulfilment of tasks and deadlines in individual work packages

| WP1: Adaptation of a model for competition between undersown crops and main crops. | Time schedule according to application | Deviations, if any* |
|---|--|---------------------|
| Deliverables | | |
| 1 A data set for adaptation of FASSET's simulation of establishment of clover grass | 2001/10 | 1. |
| 2 A data set for adaptation of FASSET's interspecies competition sub-model | 2002/10 | |
| 3 A calibrated interspecies competition sub-module of FASSET | 2003/2 | |
| 4 An paper on modelling competition between main crops and undersown crops | 2003/6 | |
| Milestones | | |
| 1 Data on establishment of clover/grass ley | 2001/10 | 1. |
| 2 Preliminary version of undersown crop module for FASSET available | 2002/6 | |
| 3 Data on growth of catch crops | 2002/10 | |
| 4 FASSET's interspecies competition sub-model calibrated and tested by use of the experimental data | 2003/2 | |

WP2: No tasks, deliverables or milestones fulfilled yet, but that is according to plan!

| WP3 + NITMOD DP3. Parameterisation of the soil organic matter turnover submodules of DAISY and FASSET (New dates taken from NITMOD application) | Time schedule according to application | Deviations, if any* |
|--|--|---------------------|
| Deliverables | | |
| Database consisting of C/N experiments | 2001/06 | 1) |
| Poster with preliminary results at the 11. N workshop i Reims | 2001/09 | 2) |
| Artikel om ny C-N model | 2002/03 | |
| Milestones | | |
| Model structure determined | 2001/08 | |
| Kalibreret C-N model | 2002/01 | |

| WP4: Crop production, nitrogen balance, nitrate leaching and biodiversity in crop rotations on private farms | Time schedule according to application | Deviations, if any* |
|---|--|---------------------|
| Deliverables | | |
| 1. Data sets from two dairy farms for validation of models. | 05/2001 | done |
| 2. Data sets from two dairy farms for validation of models. | 05/2002 | |
| 3. Data sets from two dairy farms for validation of models. | 05/2003 | |
| 4. A report on nitrogen turnover on two dairy farms | 10/2003 | |
| Milestones | | |
| 1. Selection of two farms, establishment of farms as Pilot Farms, installation of field equipment | 09/2000 | 11/2000 |
| 2. End of measurement campaign | 08/2003 | |

| WP5: Whole-model calibration, validation, inter-comparison and scenario analyses | Time schedule according to application | Deviations, if any* |
|---|--|---------------------|
| Deliverables | | |
| 1. Papers on calibration and validation of the models for different crop rotations | 2003/10 | |
| 2. A paper on inter-model comparison of the three models for a dairy crop rotation | 2003/12 | |
| 3. Papers on scenario analyses for three different crop rotation types | 2003/12 | |
| 4. A report with tables of results of scenario analyses for use in advisory work | 2003/12 | |
| Milestones | | |
| 1. Compilation and set-up of calibration data sets completed. | 2001/10 | 1) |
| 2. Preliminary whole-model calibration completed. | 2002/04 | |
| 3. Final whole-model calibration completed | 2003/04 | |
| 4. Model validation runs completed. | 2003/06 | |
| 5. Model scenario runs completed | 2003/10 | |

| WP6 (NITMOD-DP2). Parameterisation of rhizodeposition | Time schedule according to application | Deviations, if any* |
|--|--|---------------------|
| Deliverables | | |
| Rhizodeposition model | 2002/6 | |
| Milestones | | |
| Database with experiments | 2001/11 | |
| Crop parameters | 2002/6 | 1) |

| WP7 (NITMOD-DP3). Validation and development of a solute-transport model | Time schedule according to application | Deviations, if any* |
|---|--|---------------------|
| Deliverables | | |
| New solute-transport model | 2002/10 | |
| Article or conference contribution of simulation of solute transport. | 2002/12 | |
| Milestones | | |
| Database with experiments | 2001/11 | 1) |
| New solute-transport model | 2002/10 | |
| Article or conference contribution of simulation of solute transport. | 2002/12 | |

| WP8 (NITMOD-DP4). Field data on C and N-turnover in organic crop rotations | Time schedule according to application | Deviations, if any* |
|---|--|---------------------|
| Deliverables | | |
| Database with all data for use in modelling | 2002/03 | |
| Report/article on experimental data | 2002/12 | |
| Milestones | | |
| Experiments completed | 2001/10 | Delivered |
| Data stored in database for use by modelling | 2002/03 | |
| Article on experimental data | 2002/12 | |

C.3 Discussion on the progress, incl. deviations and achievements in the project as a whole and in the individual work packages and

WP1

Is proceeding satisfactory, and is expected to follow the schedules in the application.

Remarks to C.2

Ad. 1. Due to the initial reduction in the budget, the measurements were only carried out during 2000 and not in 2001.

WP2

The work in WP2 has followed the original plans. The data show quite large differences in root growth and rooting depth among the crops, and show that some of the crops can reach rooting depths of more than 1.5 meter. Thus the results until now confirms that improvement of the description of the root systems in the simulation models is necessary.

WP3

Is proceeding satisfactory, and this work package is expected to follow the schedules in the application.

Remarks to C.2

- 1) Due to unforeseen difficulties with recruitment of staff for the KVL-part of WP3 (the allocated research assistant obtained a different Ph.D. scholarship), the KVL-part has been somewhat delayed. In Sept. 2001 a Research Assistant, Anders Pedersen was employed and currently the few remaining short-term data sets are being incorporated into the common experimental database.
- 2) This poster has been presented at the COST 627 workshop instead of the originally proposed ¹¹N workshop in Reims.

WP5

Has just been initiated this year, and the progress is partly delayed primarily due to inclusion of the NITMOD project.

- 1) The calibration of FASSET has been postponed due to inclusion of the new NITMOD project. This implied that the calibration is done during 2002.

Due to unforeseen difficulties with recruitment of staff for the KVL-part of WP5 (the allocated research assistant obtained a different Ph.D. scholarship), the KVL-part has been somewhat delayed. In Sept. 2001 a Research Assistant, Anders Pedersen, was employed and will initiate work on tasks 1 and 2 during the rest of 2001.

The food web model has already been combined with the soil and winter wheat modules of FASSET, and an integration of the two models to a level where the simulation of the degradation of organic matter in FASSET is dependent on the biological activity will be tried in the coming year.

WP6 (NITMOD-DP2)

Is proceeding satisfactory

Remarks to C.2

- 1) In order to improve the coherence between WP3 and DP2/DP3, two deliverables are proposed to be adjusted. The deliverable no. 4 (NITMOD) "Parameters for crops" in DP2 should be achieved earlier, proposed time 2002/01. In term, the deliverable no. 6 (NITMOD) "Database with solute transport" should be moved to 2002/04.

WP7 (NITMOD-DP3)

No milestones in WP7 (NITMOD-DP3) has been passed yet.

WP8

1) see WP6 (NITMOD-DP2)

D. Description of plans and future work in the project as a whole and in the work package (Including plans for publication and communication)

WP1

The work for the rest of 2001 and 2002 will mainly focus on data treatment and development of an undersown crop module in FASSET.

WP2

There are no specific plans for publication of results from WP2 for the next year. The experimental data will not be ready until early 2003.

WP3 (and NITMOD-DP1)

In order to improve the coherence between WP3 and DP2, two deliverables are proposed to be adjusted. The deliverable no. 4 (NITMOD) "Parameters for crops" in DP2 should be achieved earlier, proposed time 2002/01. In term, the deliverable no. 6 (NITMOD) "Database with solute transport" should be moved to 2002/04.

The results from further determinations of ^{13}C and ^{14}C are expected in November or December 2001, and will then become part of the data set for calibration and validation.

The work for the rest of 2001 will mainly focus on the short-term turnover of C and N, in order to have a fully developed model in the beginning of 2002. Thereafter an article with description and results of the model will be submitted.

WP4

The second field of grass-clover will be ploughed in winter/spring 2002, and the measurements will be continued in two spring cereal crops at both sites during the season 2002/2003.

WP6 (NITMOD-DP2)

The work for the rest of 2001 will mainly focus on testing the proposed framework for rhizodeposition. A proper calibration can not be performed as there are insufficient data to do this, but the model will be compared to both ^{14}C pulse experiments and carbon development in longterm experiments.

WP7 (NITMOD-DP3)

The work for the rest of 2001 will mainly focus on implementation and testing of the TeTrans model.

WP8 (NITMOD-DP4)

The data will be analysed and stored in a database for use in model validation. In addition the data will be published in a scientific paper.

E. Project publications

1. Articles in international, scientific journals with review procedures

Petersen, B.M., Olesen, J.E. & Heidmann, T. In press. A flexible tool for simulation of soil carbon turnover. *Ecological Modelling*. **(WP3)**

2. Presentations at congresses, symposiums etc.

Berntsen, J., Petersen, B.M. & Olesen, J.E. (2001). Simulating effects of nitrogen on green leaf area index and dry matter. 11th Nitrogen Workshop. Book of abstracts. 9-12 September 2001, INRA, Reims, France. p. 417-418. **(WP1)**

Petersen, B.M. 2001. Using C-Tool to simulate soil carbon and radiocarbon development. In: COST 627. Carbon storage in European Grasslands. Danish Institute of Agricultural Sciences, Research Centre Foulum, Denmark. pp 22. (Poster can be viewed at www.agrsci.dk/c-tool). **(WP3)**

Pedersen A., Bruun S., Jensen L.S. and Hansen S. 2001. Simulating Soil Organic Matter Transformations with the New Implementation of the Daisy Model. Poster at 11th Nitrogen Workshop, 9-12 September 2001, Reims, France **(WP3)**

Olesen, J.E.; Simonsen, S.L.; Berntsen, J. Effects of incorporation of a ryegrass cover crop on nitrogen uptake and growth in spring barley. 11th Nitrogen Workshop, 9-12 September 2001, Reims, France **(WP4)**

