The Daisy Model Newsletter
Department of Plant and Environmental Sciences
University of Copenhagen

Daisy Newsletter no. 11

The Daisy code

Version 5.32 is still the last official release.

PhD-course "Applied Agrohydrology II"

The intensive week of this course in the use of Daisy was held from 28th August to 1st September. Participants were a mix of MSc- and PhD-students, staff members and a person from the private sector. The plan is that this course will run every year, and we hope that the structure makes it possible for people from "outside KU" to join in. The students now have to prepare a report on their own topic.

New staff member in the Daisy group

We are happy to announce that Efstathios Diamantopoulos will join us as Associate Professor from 1st October, 2017. In addition Maja Holbak and Jeanne Vuaille have joined as scientific assistants and Jacob Gudbjerg as hydrologist/IT-support at least for a year.

Modelling the decline in protein content in grain from 1990 to 2015

The main objective of this project was to investigate whether the declining protein content observed in Danish grain can be explained on the basis of the processes described in Daisy, and if not, to investigate the assumptions, process descriptions and parameterisations in order to obtain a better description.

The data sets used were very unusual for crop calibration. We had about 1000 fertilizer experiments in winter wheat and around 500 experiments for spring barley, carried out from 1987 to 2015, each with 5-6 fertilizer levels. On the other hand, the description of the soils was limited and weather data were not measured locally.

Old and New varieties of winter wheat and spring barley were calibrated on the basis of the experiments to produce the yields and N-uptake responses observed in the two periods. The root model described in Newsletter no. 9 was used.

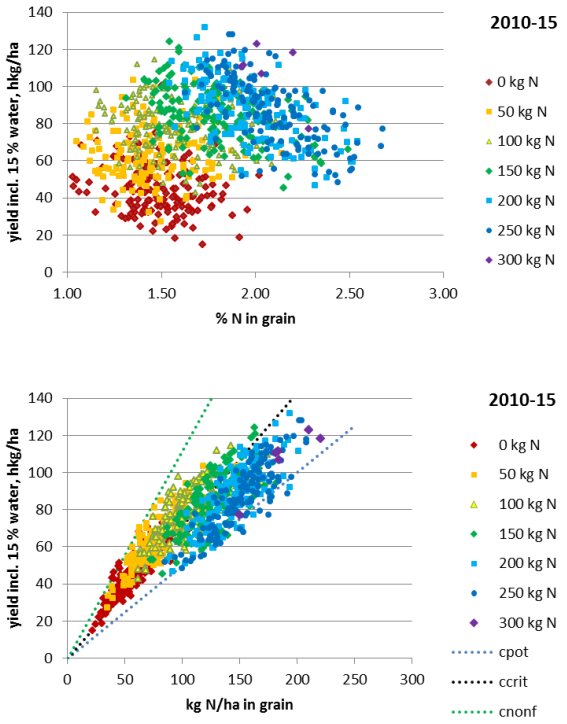

Fig. 1. Results from SEGES' fertilizer trials in winter wheat from the period 2010-15. Yields plotted as a function of % N in grain and kg N in grain. The potential, critical and non-functional N-concentration was estimated based on observations.

All simulations were run on three soil types (loamy sand (JB4) with free drainage, sandy loam (JB6) and loam (JB7) with pipe drains) and 500 years of synthetic weather representing conditions in the eastern part of Denmark. The crop rotation consisted of spring barley - winter wheat - winter rape - winter wheat - winter wheat. Calibration of winter wheat and spring barley were done together, using the entire rotation. After the calibration of old and new varieties, scenarios were produced to evaluate

effects of differences in fertilization level, background mineralization, weather etc. between the beginning of the 1990'es and 2014-15.

Two findings were particularly interesting for modelling. We had expected to be able to interpret the Daisy relevant nitrogen concentrations C_{nonf}, C_{crit} and C_{pot} in grain from plots of the experimental data as shown in Fig. 1. However, it became clear that the maximum N-concentrations in grain in the dataset did not represent the C_{pot} used in Daisy to calculate the N-demand of the grain and the minimum concentrations did not represent C_{nonf}. The final concentration in the grain can increase in the last phase of growth due to respiration, causing a loss of dry matter. C_{pot} was therefore reduced, which also resulted in a lower N-uptake at high N-availability. With respect to C_{nonf}, the crop will not reach this level, because the growth will be limited by N-stress. To obtain the growth and N-concentrations actually observed, C_{nonf} had to be given a very low value.

Secondly, the observed changes in dry matter production and N-content in grain due to plant breeding required an increased harvest index in the grain crops, and therefore adjustments in the assimilate allocation. *The changed Harvest Index influenced organic matter turn over and leaching*. The study therefore underlines the importance of considering changes due to plant breeding when updating plant descriptions, also in studies of environmental effects.

It was concluded that it is possible to explain the observed changes in N-concentrations in grain based on changes in varieties, fertilization, deposition and management practices, weather, and background mineralization. For winter wheat more than half the observed drop of approx. 2.5 % protein appear to be caused by changed fertilizer norms while for spring barley, half the change appear to be caused by plant breeding.

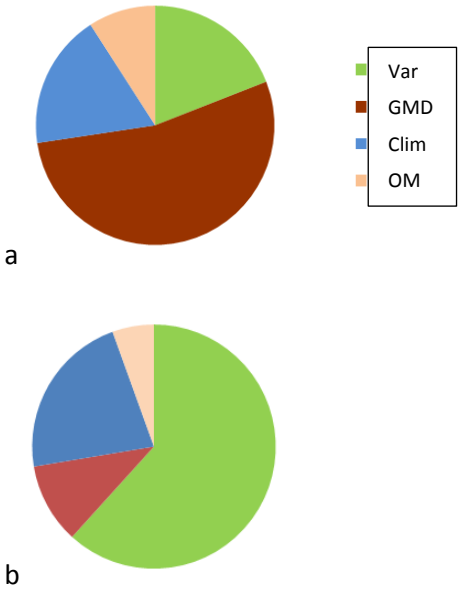

Fig. 2. Contribution to total change in N % in grain in a) winter wheat (both mineral and organic fertilizer, weighted according to area) and b) spring barley in a rotation receiving mineral fertilizers on a JB7 (sandy loam/loam). The diagrams show how the total change is divided on effects of new varieties (Var), change in fertilization (incl. Management and 6 kg N/ha less deposition (GMD), a slightly higher temperature combined with 10 % mere precipitation (Clim) and little less mineralization due to falling humus content.

The report is presently only available in Danish on

http://plen.ku.dk/english/research/env_chem_phys/agrohydrology/Rapport_Proteinindhold.pdf/.

An English summary can be found on http://daisy.ku.dk/publications/, and in Chapter 5 of the report, the exact changes in crop parameterisation have been described in "Daisy language".