Joint Project
Environmental Effects of
Sugar Beet Cultivation

Nitrogen balances in sugar beet rotations

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Within the joint project “Environmental effects of sugar beet cultivation” 12 sugar beet growing farms, out of a total of 109 farms, are completely analysed on the farm level. We have included an analysis of various indicators, however, the main focus is on nitrogen balances, since this indicator integrates a number of different aspects of the sustainability of agricultural production. For this project comprehensive data from sowing to harvest operations for the years 2004 till 2006 were considered in the analyses.

Database and Method

As a tool for the assessment we used the model REPRO, which is a computer model developed at the Martin Luther University of Halle-Wittenberg. With REPRO we are able to analyse energy and material flows on field or farm level and it is possible to assess and to analyze a great number of environmental indicators, however, for this investigation we focus on the parameter nitrogen balance. In the REPRO model the nitrogen-uptake, as a significant part of the N-balance, reflects parameters like farms size, husbandry, crop yields and nitrogen contents of the products. Those parameters are balanced against the N-supply from the different sources.

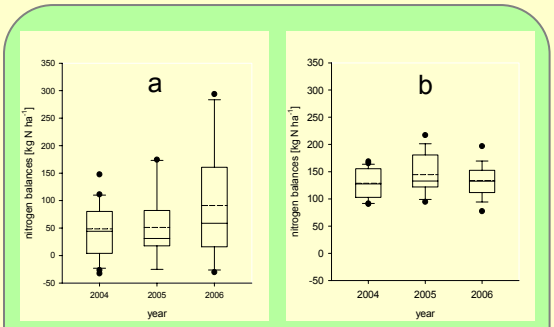

Fig. 1: Nitrogen losses for sugar beet fields, without (a) and with (b) changes in soil-nitrogen stocks

Description of Δ Nitrogen

In the first part of the project we have focussed on seven different farms with sugar beet cultivation in the experimental years 2004 to 2006 with a total of 15 to 20 different fields per year of sugar beet. Shown in the first graph (a) of figure 1 is the N-balance calculated with REPRO.

In this calculation, the nitrogen uptake by the crop, which is based on mineral and organic fertilization, and the nitrogen immisions. In comparison in the second graph (b) the are changes in soil-nitrogen stocks are also taken into account, which represents the dynamic approach in REPRO, the coupling between the humus- and the nitrogen balance.

With this approach it is possible to estimate the positive or negative effects of organic fertilization within the crop rotation on soil organic matter.

Analysis of crop rotation

A further analysis includes the entire rotations including sugar beet. There were three rotations evaluated. The crop rotation one includes two crop of sugar beet (SB) and winter wheat (WW). In the second crop rotation continued to winter wheat and winter oilseedrape (WOSR) grown in the third winter wheat and silo corn (SC).

As a result, all three rotations had almost similar balances, but some distinct differences occurred with respect to changes in the soil organic matter level. This effect was due to the organic fertilizing, in the first crop rotation, leading to a fixation of nitrogen in the soil, with positive effects on the N-balance.

In the second crop rotation without the organic fertilizer application we calculated a release of nitrogen from the organic nitrogen pool, with negative implications for the nitrogen balance.

With winter wheat and silo corn in the third crop rotation we calculated an even greater reduction of soil organic matter with an associated release of nitrogen from SOM.

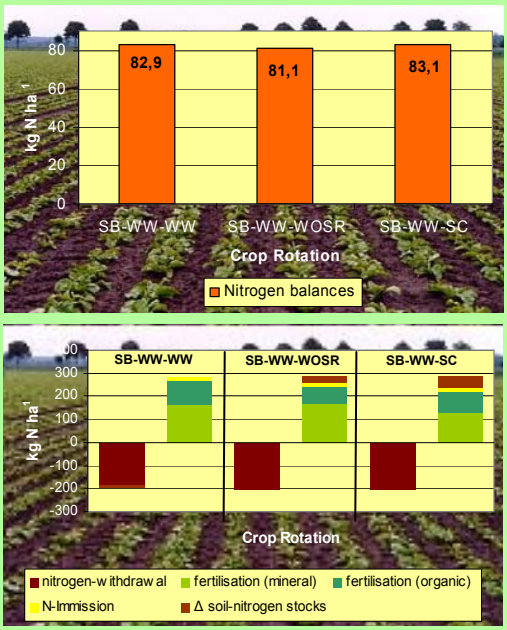

Fig. 2: Nitrogen Balances in different crop rotations

Conclusions

From an environmental point of view, it must be imperative for the farmers to produce sugar beet with an acceptable nitrogen balance. In order to achieve a balalanced soil organic matter in crop rotations with sugar beet it is important to inlcude crops which positively affect SOM and /or use organic fertilisers in the rotation.

Subproject „REPRO“ in the joint project „Environmental Effects of Sugar Beet Cultivation“. A co-operation between the Institute of Sugar Beet Research and the Universities of Göttingen and Halle.