The influence of nitrogen fertilisation on CO_{2e}-emissions in sugar beet production

Kerrin Trimpler, Heinrich Reineke & Nicol Stockfisch

Institute of Sugar Beet Research, Holtenser Landstr. 77, D-37079 Göttingen, Germany

Institut für Zuckerrübenforschung

Introduction

N-fertilisation is an important part of sustainable soil use and influences the yield.

The production of N-fertiliser consumes energy and causes greenhouse gas emissions. After application, about 1 % of the N-fertiliser emits directly as N_2O (N_2O has a 296-fold higher greenhouse effect than CO_2; IPCC[a], 2006). The actual amount is up to different parameters like applied quantity, the type of fertiliser, the time and technique of application and soil characteristics. Furthermore, the N-fertilisation plays an important role during the cultivation process regarding the amounts of greenhouse gas emissions and energy consumption. The question is how sugar beet cultivation could be optimized concerning high productivity, efficient energy use and low emissions.

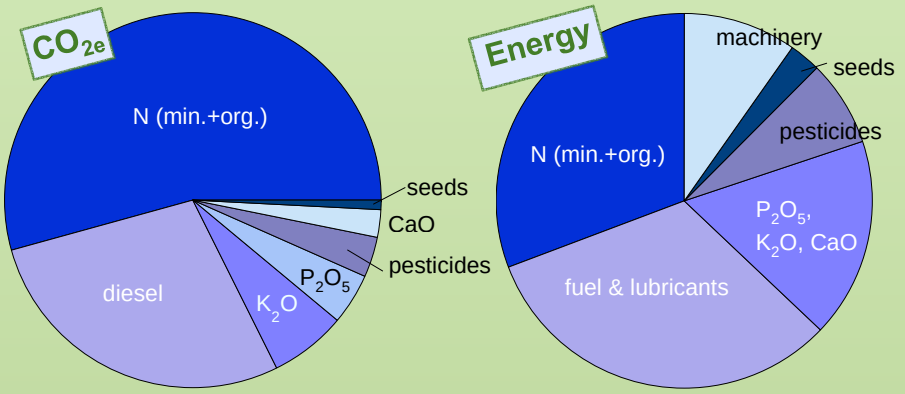

Fig.1: *Percentage of agricultural inputs of the CO_{2e}-emissions[b] (left; N-fertilisation ex. N_2O-emissions after application) and of the energy consumption (right) in sugar beet cultivation (mean of farm survey 2004, n=285)*

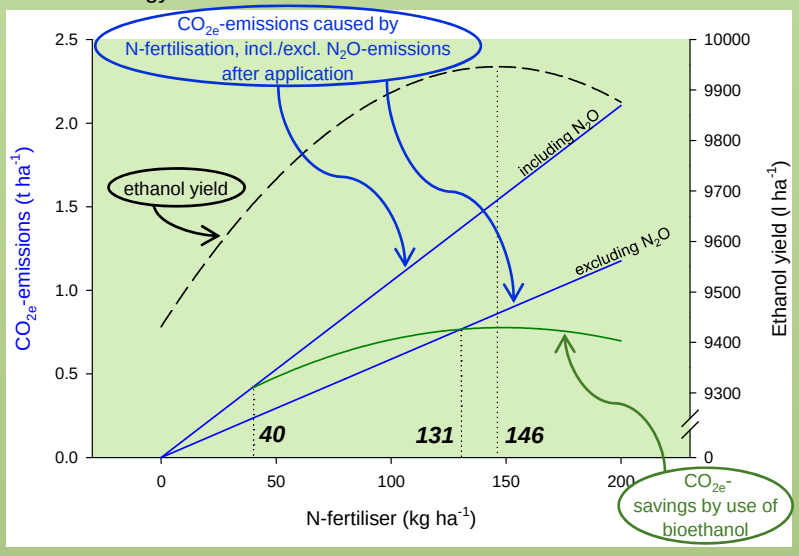

Fig.2: *Influence of N-fertiliser on ethanol yield, CO_{2e}-savings associated with the resulting surplus yield and CO_{2e}-emissions caused by N-fertiliser; mean of field trials of ARGE Franken, 2000-2009, location: Giebelstadt*

Database and Methods

Emissions of greenhouse gases (in CO_2-equivalents [CO_{2e}])[b] were calculated for the entire process of cultivation from data of a survey among sugar beet farmers regarding the cultivation in the year 2004.

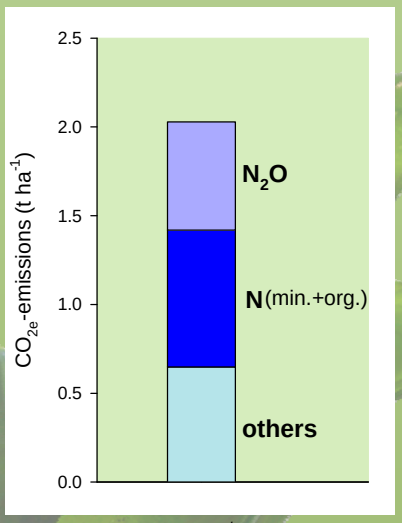

Fig.3: *CO_{2e}-emissions[b] for the entire process of sugar beet cultivation; mean of survey of farms 2004, n=285 [others: crop protection, fertilisation (except N), seeds, diesel]*

Results

N-fertilisation caused the biggest part of the emissions of greenhouse gases as well as an important part of the energy input for sugar beet cultivation (Fig.1). Field trials showed a maximum rate of 146 kg N ha^{-1} for the highest yield of ethanol and a rate of 131 or 40 kg N ha^{-1} for additional savings of CO_{2e}-emissions (Fig.2). Taking account of the N_2O-emissions correlated to N-fertilisation, an increase of the CO_{2e}-emissions of about 80% could be noticed. The other parameters´ part of the CO_{2e}-emissions in sugar beet cultivation should be declared as relatively low compared to the N-fertilisation and to the N_2O-emissions (Fig.3).

Conclusions

The N-fertilisation of sugar beet should – for bioenergetic purposes – be adapted regarding the ecological and economical indicators. Concerning the balance of CO_{2e}/energy the optimum N-fertiliser amount laid below the amount for the highest yield.

[a] www.ipcc.ch, [b] www.biograce.net