Interaction of pre-crop effects and nitrogen fertilization in sugar beet production

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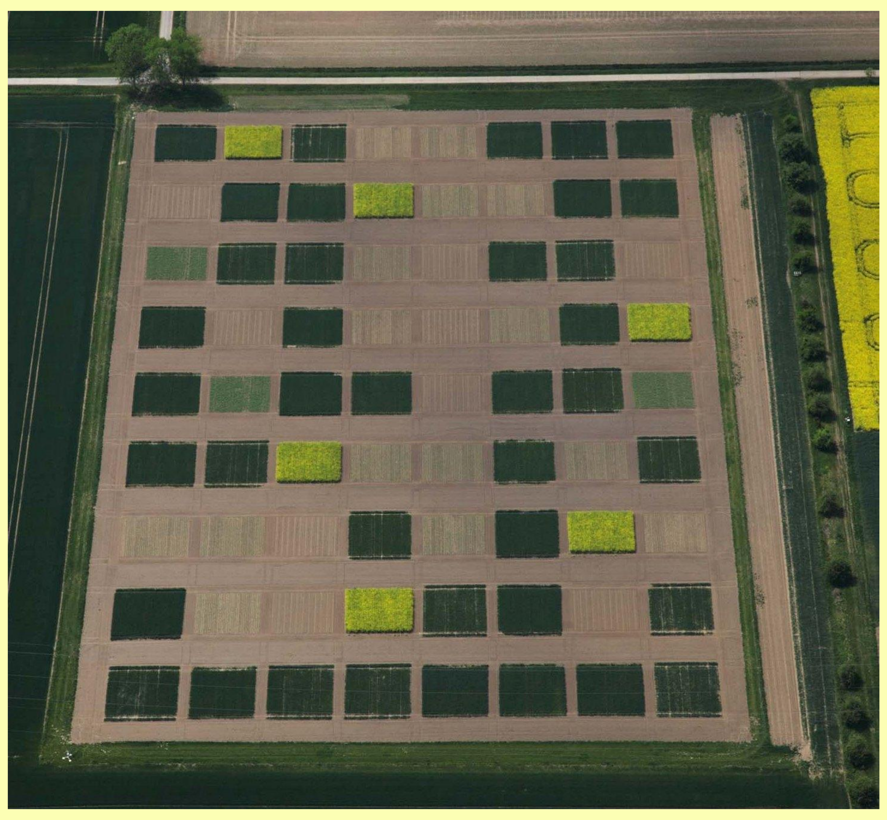

Introduction

Sustainable development of agricultural production implies a concept of “as little as possible - as much as necessary” for nitrogen (N) fertilization. Pre-crop effects may contribute to optimize the nutrient supply. For the production of sugar beet, we aimed to investigate (a) if an adjustment of the N-target value due to the pre-crop was an appropriate mean to optimize the N-fertilization and (b) if the N-fertilization might be reduced generally.

Materials and Methods

- Site: near Göttingen, Germany
  Stagnic Luvisol; 86% silt, 12% clay
  8,9°C, 620 mm (annual mean)
- Management: Table 1
- Pre-crops: three field replicates per year
  2008 - 2010: winter wheat, grain maize, grain pea
  2011: winter wheat, silage maize, grain pea
- N-fertilization trials:
  2008: 0, 60, 120, 180 kg N ha^{-1};
  2011: 0, 40, 80, 120 kg N ha^{-1}

Table 1: Production management of sugar beet after different pre-crops

Pre-crop		Winter wheat	Grain maize (GM) Silage maize (SM)	Grain pea
Catch crop		mustard (50 kg N ha^{-1})	---	mustard (50 kg N ha^{-1})
Tillage		cultivator (18 cm), frost tillage (10 cm)		
N-target value (kg N ha^{-1})		160-20	GM: 160+30 SM: 160	160-30
N-fertilization (kg N ha^{-1})	2008	60	GM: 120	60
	2009	85	GM: 150	60
	2010	75	GM: 135	40
	2011	80	SM: 120	0

Results

- Yield decreased after grain maize as pre-crop (2008 - 2010; Fig. 1).
- Increased N-fertilization did not fully compensate the yield gap after grain maize as pre-crop (2008; Fig. 2a).
- Reduction of N-fertilization by 60 and 40 kg ha^{-1} did not reduce white sugar yield (Fig. 2a, 2b, respectively).

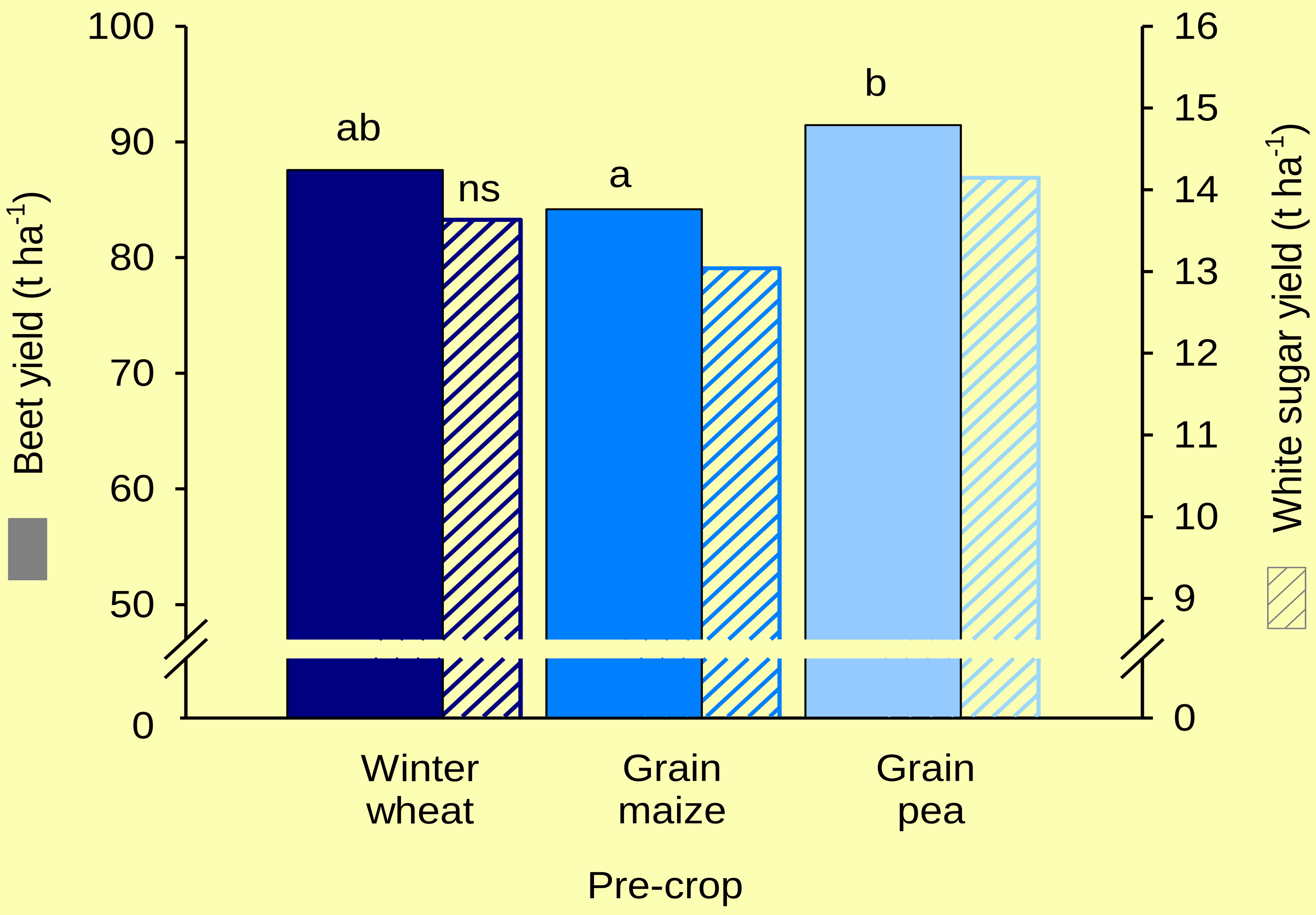

Fig. 1: Beet yield and white sugar yield after different pre-crops as the mean of 2008 - 2010 (n = 9).
Letters indicate significant differences ($p \leq 0.05$) between treatments, ns = non-significant.

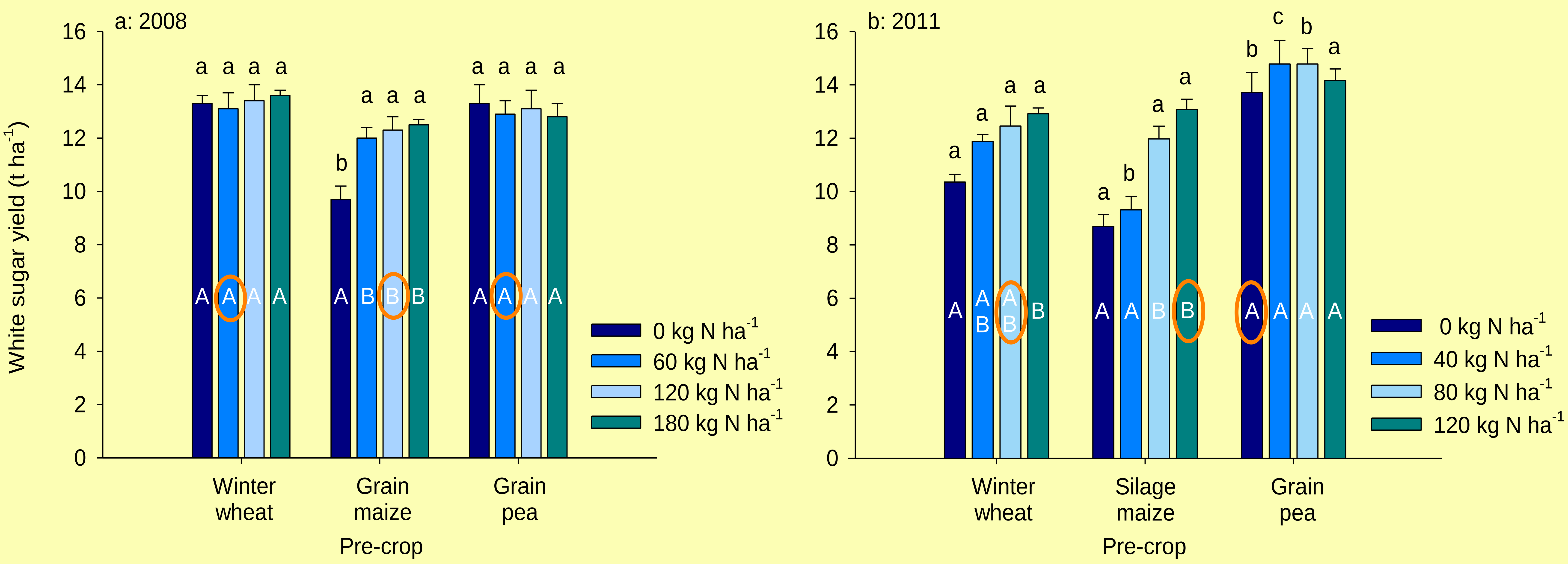

Fig. 2: White sugar yield after different pre-crops for different amounts of N-fertilizer in 2008 (a) and 2011 (b). Columns with orange circles represent the fertilization according to N-target value. Means (n = 3) and standard deviations.
Lowercase letters indicate significant differences ($p \leq 0.05$) between pre-crop treatments within one N-treatment and uppercase letters between N-treatments within one pre-crop treatment.

Conclusions

The choice of the pre-crop offers the opportunity to increase yields and N-efficiency in sugar beet production. The adjustment of the fertilization concept due to pre-crop effects can be a mean to further optimize the N-efficiency. Generally, the N-fertilization in sugar beet production can be reduced.

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