

Linking remote sensing to sugar beet leaf area

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Introduction

Remote sensing and vegetation indices can be used to describe and characterize the canopy of crops with a non-destructive method on a large scale.

Leaf area formation of sugar beet in early summer is a good parameter to describe the developmental stage of the plants. For yield formation the early closure of the canopy is very important, which is affected by many factors.

This study aimed at testing, whether differences in leaf area development of sugar beet can be estimated with remote sensing. Furthermore, the relationship between NDVI and root yield was studied.

Material and Methods

Field trials with sugar beet were carried out in 2001 and 2002 with different treatments (N application, sowing date, weeds, plant population, damage due to herbicide application, soil tillage) in 4 replicates. For each plot, leaf area index and NDVI were measured during the season and final root yield was determined in October.

Leaf area index (LAI) was determined by an optical, non-destructive method (Licor2000).

Plant pigments (chlorophyll a+b, carotinoides) reflect radiation in a very characteristic way, so that canopy can be distinguished from soil. The NDVI (Normalized Difference Vegetation Index) was calculated as the ratio between the reflection in NIR and red wave length:

$$\text{NDVI} = (\text{NIR} - \text{red}) / (\text{NIR} + \text{red})$$

Results

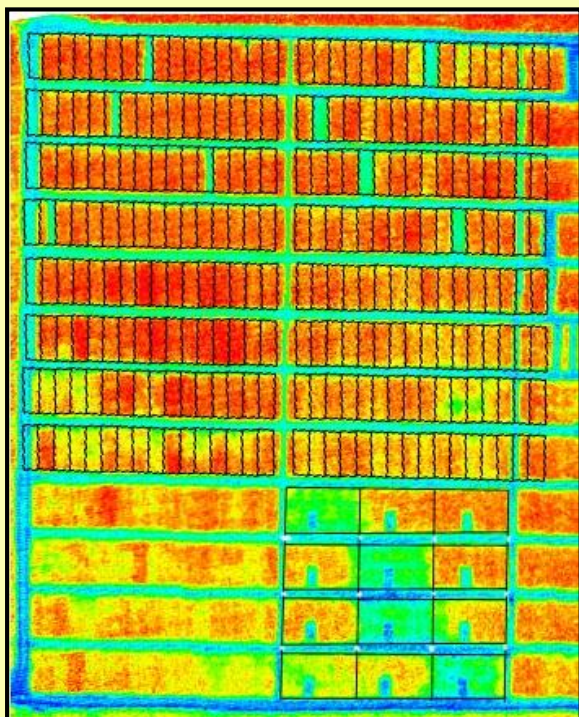


Fig. 1: Trial field with sugar beet in Harste, June 2001, NDVI given in colours from blue (low) to red (high)

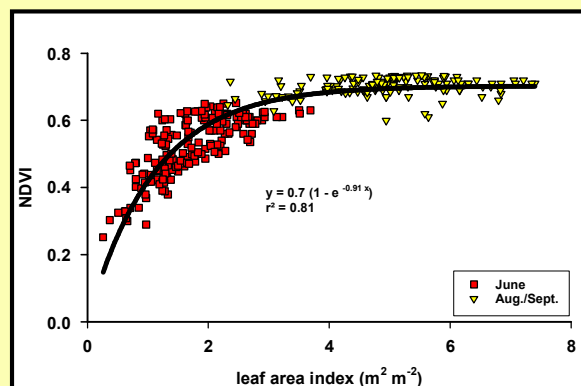


Fig. 2: Leaf area index and NDVI of sugar beet; 2 trials in Harste 2001 and Pansen 2002

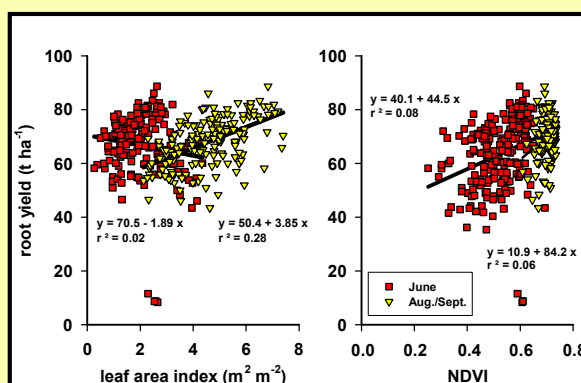


Fig. 3: Root yield of sugar beet in October as affected by leaf area index or NDVI during the season; 2 trials in Harste 2001 and Pansen 2002

Conclusions

The NDVI gave a good impression of differences in leaf development of sugar beet in the field (Fig. 1). The leaf area index of sugar beet varied from 0.5 to 8.0 m² m⁻² as affected by treatments and season, whereas the NDVI varied from 0.2 to 0.7 (Fig. 2). The NDVI increased with increasing LAI up to a LAI of 3.5 m² m⁻², but above that it did not change markedly, so that the relationship between leaf area index and NDVI was not linear. Therefore, the NDVI did not respond as distinctly to treatments as the leaf area index.

Root yield in October did not show any relationship to leaf area index or NDVI during the season (Fig. 3), independent on whether it was measured in June or August/September.

Further investigations are needed to describe yield formation by means of NDVI measurements.