

Crop-Weed interactions determined by sensor techniques (COMSENS)

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Background

It is wellknown that growth dynamics in the early growth stages are important characteristics for the outcome of the competition for light, water and nutrients, resulting in a certain yield loss of the crop due to presence of weeds.

If possible, an early and precise prediction of the growth dynamics of both crop and weeds could give a more precise assessment of the need for weed control. This could lead to a better confidence to point out sites in the field, where weed control can be reduced or even eliminated, if the competitive relationship between crop and weeds is in favour to the crop, and the costs to weed control would be less than the potential yield loss.

Since weed control is done mechanically under organic growing conditions, often by weed harrowing, there are risks for crop damages by soil coverage or other mechanical damages of the crop leaves. These damages are increasing with increasing weed control intensity, and are resulting in reduced crop growth, and possibly the yield too, immediately after weed harrowing. Taking this aspect into consideration, a further motivation to optimize the intensity of the weed control is given.

Several studies of the competition between crop and weeds have shown that the quota of weed leaf area to the total leaf area (crop+weed) gives a more accurate prediction of the yield reduction caused by weeds, than the weed density (plants m⁻²) (Kropff and Spitters 1991; Lotz et al. 1996). In other words; several but small weed plants have approximately the same yield reducing effect as a few but large plants. In relation to the use of automatic measurements of the competition between crop and weed, i.e. if a site-specific optimization of weed control intensity is wanted, it is obvious to use this relative leaf area model. However, it is not possible to measure leaf area automatically and precisely, yet. But it is possible to measure soil coverage of crop and weeds automatically, using digital image analysis. The coverage estimation is most accurate in the early growth stages, due to less overlapping leaves and no elongation growth, because the coverage is estimated as the vertical projected area of the plants. Before using the existing competition models, which are based on the relative leaf area, it will be necessary to determine the correlation between coverage and leaf area.

If there is a robust correlation between coverage and leaf area, (and competitive ability), then it could be possible to optimize weed control site-specifically, to assess damages by weed harrowing or selecting varieties with strong competitive ability, automatically.

Objective

The central aim of the PhD-project, COMSENS, is to provide new knowledge about competition between crop and weeds, aiming at predicting the outcome of the competition (the reduction of the crop yield) with a certainty, which equals the prediction from the relative leaf area model (Kropff & Spitters, 1991; Lotz et al., 1996).

COMSENS is planned to cover following issues:

- to examine if the competition between spring barley and weeds can be described with the relative leaf area model
- to estimate the relation between Leaf Area Index (LAI) and soil coverage
- to model growth in soil coverage of 3-6 spring barley varieties and 8-12 weed species under semi field conditions
- to examine interactions between varietal differences in competitiveness and tolerance to mechanical weed control
- to examine and test if sensor based methods (reflectance measurement and digital image analysis) can improve the estimation of competition between spring barley and weeds, if the methods are used in the growth stages, where weed control usually takes place.

COMSENS is closely linked to the Work Package “Crop-Weed interactions” (WP2) in the DARCOF-project “Characteristics of spring barley varieties for organic farming, BAR-OF”. For instance is the field experiment common for both COMSENS and WP2, and data is shared between the two projects. Further description of the field experiment and the planned measurements can be found in Hansen & Rasmussen, (2003).

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Progress – 2006 1.10.2006-31.9.2007

In the period PKH and co-authors have got the manuscript “HANSEN, P.K., RASMUSSEN, I.A., HOLST, N. & ANDREASEN, C. Tolerance of four spring barley (*Hordeum vulgare* L.) varieties to weed harrowing,” accepted and published in *Weed Research* 47, page. 241-251.

The manuscript "HANSEN, P.K., KRISTENSEN, K. & WILLAS, J. A suppressive index for spring barley (*Hordeum vulgare* L.) varieties" has been submitted to and accepted by Weed Research through the period. This manuskript is now in press.

Through the period PKH passed two statistical courses 1) Chemometrics and Multivariate Statistical Data Analysis 6 ETCS) and 2) Applied Statistics (6 ETCS) which resulted in a total amount of 31 ETCS for PKH.

Since spring 2007 PKH have mainly been involved in other activities than the PhD-project in the department (two applications for funding and work in other projects) which have delayed the finishing of the PhD-project. PKH have further been external supervisor for the PhD-student Federica Bigongiali, Land Lab Scuola Superiore Sant'Anna Piazza Martiri della Libertà 33, 56127 Pisa, Italy. Federica has been working at Research Centre Flakkebjerg since May 2007, where she has conducted a field experiment and analysed data from this experiment with weed suppressiveness of spring wheat under supervision from PKH.

Plans – 2007

In the coming period the thesis will be finished and submitted between other activities at the department.

Publications

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Time schedule details (whole PhD period)

The Phd project started 1. June 2003 and PKH had one month leave from 13 September until 13 October 2004. As described in the progress report from 2003, the field trial from 2003 was dropped due to unforeseen mistakes and the data which is the major base of the PhD-project came from field experiments in 2004 and 2005, therefore PKH applied for an extension of project until the end of 2006. Unfortunately, the analysis of the data has been delayed and since early spring 2007, PKH have been involved in other projects (approximately 6 months) in the Department of Integrated Pest Management. However PKH have planned to submit the thesis before 1st December 2007. Therefore the date for defence has not been planned yet.