

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 these 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).

References

Hansen, P.K. & Rasmussen, I.A. (2003) Design og sortsvalg i specialforsøg BAROF-WP2 – Ukrudtskonkurrence. Report, Dept. of Crop Protection, Danish Institute of Agricultural Sciences. 7 pp.

Kropff, M.J. & Spitters, C.J.T. (1991). A simple model of crop loss by weed competition from early observations on relative leaf area of weeds. *Weed Res.* **31**:97-105.

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Progress 1.10 2004 - 31.9 2005

The field experiment in 2005 at Research Centre Flakkebjerg, has been conducted, and all data, except the results from the harvest, have been gained. The field experiment is common field for both COMSENS and WP2 and it was conducted with the same design as in 2004.

PKH attended and passed a course on Computer Vision arranged by DANET, at Aalborg University Centre (5 ETCS points). In the spring 2005 PKH attended an internet-based theoretical course on multivariate data analysis. PKH has asked the responsible for the course for possibility to extend the course from 6 to 11 ETCS points, to ensure having 30 ETCS point at 31. July 2006.

PKH had one-month leave (from 13 September until 13 October 2004), which was used for writing a chapter in a new edition of the book entitled “Ukrudtsbekæmpelse i landbruget” published by Danish Institute of Agricultural Sciences, Department of Integrated Pest Management.

PKH was co-organiser and teacher at an internal course about the use of a GIS-application called "MarkGIS" in planning and management of field trials. The course was held at Research Centre Flakkebjerg 1-2 March 2005

PKH gave a presentation at Department of Variety Testing about COMSENS and BAR-OF 6 June 2005.

PKH attended the 13. European Weed Research Society Symposium 20-23 June in Bari, Italy, with the poster "Tolerance to weed harrowing in spring barley genotypes."

In December 2004 PKH gave a lecture in the Weed course on KVL entitled "Præcisionsjordbrug og alternativ bekæmpelse."

PKH gave a presentation about COMSENS 10.1.05 at KVL.

Plans 1.10 2005 - 31.7.2006

PKH will attend the SOAR Summer school with the title "Globalisation: Threat or Opportunity for Organic Farming?" A pre course assignment has been worked out and sent to the arrangement committee for the summer school.

Due to changes in the original plan for field experiments (as described in the progress report from 2003) it has been decided to use data from the field experiments from 2004 and 2005 mainly. The reason for this is that the experiments have been conducted in the same way in these two years. Data from 2003 will in a limited scale be used to support results from 2004 and 2005. Therefore the manuscript about *varietal differences in tolerance to mechanical weed control*, which was planned to be submitted to Weed Research before Christmas 2004 has been postponed to Christmas 2005.

Before Christmas 2005 a manuscript about the improvement and validation of the index of competitiveness will be submitted to Weed Research, too.

Finally a manuscript about the correlation between the relative coverage of crop and weeds estimated by image analysis, and yield loss will be submitted Weed Research in the spring.

Ultimo October PKH will give a statusseminar at KVL. And medio November PKH will give a presentation of results from COMSENS and WP2 at the BAR-OF network meeting at RISØ national Laboratory.

PKH has further been asked, and accepted to give a presentation about competitiveness of cereal varieties at the Plantekongress in Herning January 11, 2006.

Publications

Hansen, Preben Klarskov (2005) [Forskelle i bygsorters tolerance overfor ukrudtsharvning](http://www.focjo.dk/enyt2/enyt/apr05/harvning.html) [Differences in tolerance to weed harrowing by spring barley varieties]. *FØJOenyt* 2. Online at <<http://www.focjo.dk/enyt2/enyt/apr05/harvning.html>>

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- Hansen, Preben Klarskov** (2004) [Beregning af konkurrenceindeks i vinterhvede og vårbyg \(KI\)](#) [Calculation of competitive index for winter wheat and spring barley]. Danmarks JordbrugsForskning og Dansk Landbrugsrådgivning, Landscentret, Planteavl.
- Hansen, Preben Klarskov** (2004) [Important values in the PhD-project "Crop-Weed interaction determined by sensor techniques \(COMSENS\)" and the project "Characteristics of spring barley varieties for organic farming \(BAR-OF\)"](#). Report, Department for Crop Protection, Danish institute og Agricultural Sciences.
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- Hansen, Preben Klarskov**; Kristensen, Kristian and Rasmussen, Ilse A. (2005) [Forsøgsbeskrivelse af specialforsøg BAROF WP2 2005](#) [Description of the special field experiment BAROF WP2 2005]. Report, Department of Integrated Pest Management, Danish Institute of Agricultural Sciences.
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- Olesen, Jørgen E.; **Hansen, Preben Klarskov**; Berntsen, Jørgen and Christensen, Svend (2004) [Simulation of Above-Ground Suppression of Competing Species and Competition Tolerance in Winter Wheat Varieties](#). *Field Crop Research* 89:pp. 263-280.
- Rasmussen, Ilse A.; Østergård, Hanne; Willas, Jakob; Nielsen, Niels Erik; **Hansen, Preben Klarskov**; Hovmøller, Mogens and Backes, Gunter Rasmussen, Ilse A., Eds. (2004) [Hvad er en god vårbyg til økologisk jordbrug?](#). Report, Dept. of Crop Protection, Danish Institute of Agricultural Sciences.
- Rasmussen, Ilse A. and **Hansen, Preben Klarskov** (2005) [Index beregner hvor godt økologisk vårbyg konkurrerer med ukrudt](#) [An index calculates how well organic spring barley competes against weeds]. *FØJOenyt* 3. Online at <<http://www.foejo.dk/enyt2/enyt/jun05/ukrudt.html>>
- Rasmussen, Ilse A.; Melander, Bo; **Hansen, Preben Klarskov** and Holst, Niels (2004) [Langsigtet balance i ukrudtsbestanden](#) [Long-Term balance in the weed population]. Paper presented at Seminar om planteværn, Landbrugsafgrøder, Januar 2004; Published in *Seminar om Planteværn 2004, Landbrugsafgrøder*, page pp. 12-15. Dansk Landbrugsrådgivning, Landcentret, Planteavl.**
- Rasmussen, Ilse Ankjær; Holst, Niels; Graglia, Enrico; **Hansen, Preben Klarskov**; Melander, Bo; Mathiassen, Solvejg Kopp; Kudsk, Per; Jensen, Peter; Boelt, Birte and Madsen, Katrine Hauge

(2004) [Ukrudtsøkologi og -biologi](#), in *Ukrudtsbogen*, chapter 2, page pp. 19-42. Danmarks JordbrugsForskning.

Other products (Oral presentations, public meetings, field days, etc.) These products have not been uploaded to Organic E-prints.

Hansen, Preben Klarskov (2003). Crop-weed competition with presentation of BAROF experiments. Presentation at a meeting with Martin Wolfe, Elm Farm Research Centre, UK at Research Centre Flakkebjerg 18.March 2003.

Hansen, Preben Klarskov (2003). COMSENS. Oral presentation at the SOAR Autumn seminar at Research Centre Flakkebjerg 14 November 2003.

Hansen, Preben Klarskov (2003). Præcisionsjordbrug og alternativ ukrudtsbekæmpelse. Lecture at the Weed course at the Royal Veterinary and Agricultural University, 2 December 2003

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