

Progres report

Crop-Weed interactions determined by sensor techniques (COMSENS)

Name: Preben Klarskov Hansen (PKH)
University: The Royal Veterinary and Agricultural University (KVL)/Danish Institute of Agricultural Sciences (DIAS)
Department: Department of Agricultural Sciences, KVL/Department of Crop Protection (DIAS)
Supervisors: Associate Professor Dr. Christian Andreasen (KVL)/ Head of research unit Dr. Niels Holst (DIAS), Senior Scientist, Dr. Henning Tangen Søgaard (DIAS)
Timescale: 1 July 2003-31 July 2006
E-mail/phone: PrebenK.Hansen@agrsci.dk /+45 58 11 33 97
Master's degree: Cand Agro.

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.
- LOTZ, L.A.P., CHRISTENSEN, S., CLOUTIER, D., FERNANDEZ QUINTANILLA, C., LÉGÈRE, A., LEMIEUX, C., LUTMAN, P.J.W., PARDO IGLESIAS, A., SALONEN, J., SATTIN, M., STIGLIANI, L., & TEI, F. (1996). Prediction of the competitive effects of weeds on crop yields based on the relative leaf area of weeds. *Weed Res.* **36**:93-101.

Progress – 1.10.2005-31.9.2006

In the period Preben Klarskov Hansen and co-authors have submitted two manuscripts to Weed Research

- HANSEN, P.K., KRISTENSEN, K. & WILLAS, J.. A suppressive index for spring barley (*Hordeum vulgare* L.) varieties. Submitted 27 February 2006.
- HANSEN, P.K., RASMUSSEN, I.A., HOLST, N. & ANDREASEN, C.. Tolerance of four spring barley (*Hordeum vulgare* L.) varieties to weed harrowing. Submitted 28 August 2006.

In the period Preben Klarskov Hansen

- attended and passed the SOAR Summer school with the title "Globalisation: Threat or Opportunity for Organic Farming?" A pre course assignment was worked out and sent to the arrangement committee before for the summer school that took place 3-7 October 2005.
- gave a statusseminar about COMSENS 25 October 2005 at KVL.
- presented results from COMSENS and WP2 at the BAR-OF network meeting 14 December 2005 at RISØ National Laboratory.
- gave a presentation about competitiveness of cereal varieties at the Plantekongress 11 January 2006 in Herning.

Plans - 2007

In the coming period a manuscript about sensorbased determination of weed biomass and crop yield loss will be worked out. Further, a course assignment in multivariate statistics will be finished, and the PhD-thesis will be worked out. PKH has applied for an extension of the PhD-project until 31.12.06.

Publications

- Hansen, Preben Klarskov** (2005) [Beregning af konkurrenceindeks \(KI\)](#) [Calculation of competitive index (KI)], in Deneken, Gerhard and Pedersen, Jon Birger, Eds. *Sortsforsøg 2005. Korn bælgssæd og olieplanter*. Report, page 7, 21 & 31. Danmarks JordbrugsForskning og Dansk Landbrugsrådgivning, Landcentret, Planteavl.
- Hansen, Preben Klarskov** (2005) [Forskelle i bygsorters tolerance overfor ukrudtsharvning](#) [Differences in tolerance to weed harrowing by spring barley varieties]. *FØJOenyt* 2. Online at <<http://www.foejo.dk/enyt2/enyt/apr05/harvning.html>>
- Hansen, Preben Klarskov** (2005) [Suggested outline of the thesis "Crop-Weed interactions determined by sensor techniques"\(COMSENS\)](#). Paper presented at Midtterm Seminar, KVL, 25. October 2005, page pp. 1-2.
- Hansen, Preben Klarskov** (2005) [Tolerance to weed harrowing in spring barley genotypes](#). Poster presented at 13th European Weed Research Society (EWRS) Symposium, Bari, Italy, 20-23 June 2005; Published in *Proceedings from the 13th European Weed Research Society (EWRS) Symposium*.
- 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, Landcentret, 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.
- 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.
- Hansen, Preben Klarskov; Kristensen, Kristian and Willas, Jakob** (2006) [A suppressive index for spring barley varieties](#). [preprint]
- Hansen, Preben Klarskov; Kristensen, Kristian and Willas, Jakob** (2006) [Forskellige sorters konkurrenceevne overfor ukrudt](#) [Competitiveness in different varieties against weeds]. Paper

presented at 3. Danske Plantekongres, Hernning, 10.-11. Januar 2006; Published in *Sammendrag af indlæg 3. Danske Plantekongres. Hernning 10.-11. Januar 2006*, page pp. 342-343. Danmarks JordbrugsForskning & Landcentret.

Hansen, Preben Klarskov and Rasmussen, Ilse A (2005) [Sorters vekselvirkning med miljøet, betydning af mekanisk ukrudtsbekæmpelse](#) [Genotype*Environment interaction, importance of mechanical weed control]. [oral] Presentation at *BAR-OF netværksmode*, Forskningscenter Risø, 14. december 2005.

Hansen, Preben Klarskov; Rasmussen, Ilse A.; Holst, Niels and Andreasen, Christian (2006) [Tolerance to weed harrowing in four spring barley varieties](#). [preprint]

Lund-Nielsen, Tina; Mejer, Helena; Gunnarsson, Carina; **Hansen, Preben Klarskov** and Grigalaviciene, Ilona (2003) [How is ideologies related to actions?](#). Report, Unit for Learning and Interdisciplinary Methods, Royal Veterinary and Agricultural University.

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.

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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.