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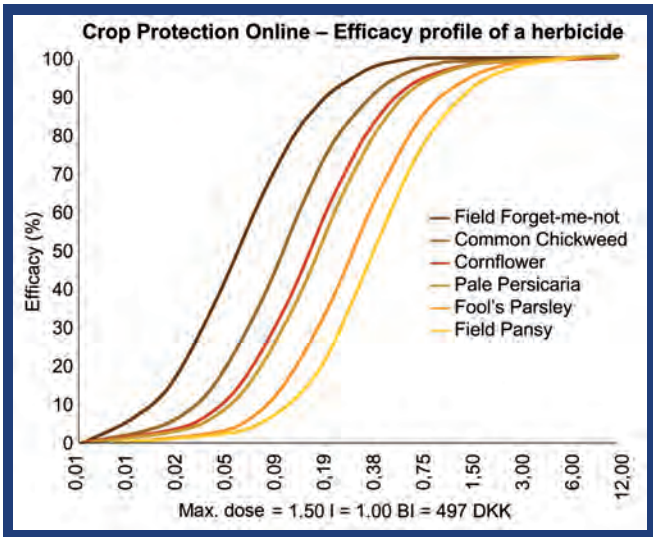
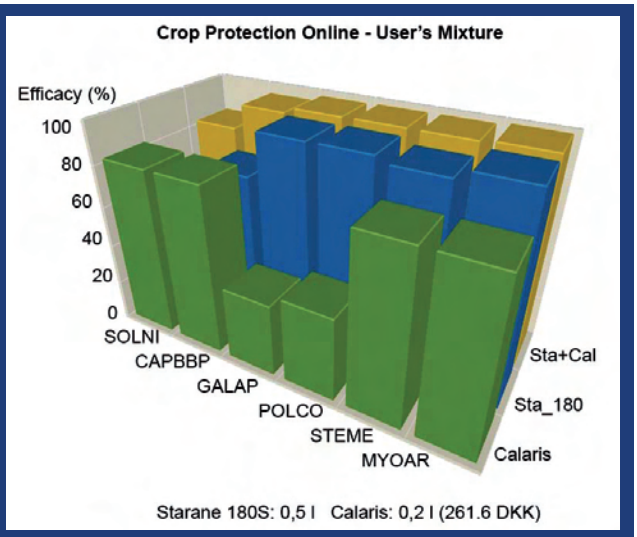
Fact sheet on the Decision Support System
Crop Protection Online

Crop Protection Online – the weeds module

Crop Protection Online (CPO) is a commercialized Danish Decision Support System on integrated management of weeds, pests and diseases in major crops. The process of developing CPO was initiated after the launch of the first Danish Pesticide Action Plan in 1986. This plan required significant reductions in the application of pesticides. The first PC version of CPO was released in 1991. Since 2001 CPO has been accessible on the Internet (pvo.planteinfo.dk).

A free demo version is available, which contains the same functionality as the commercialized version. However, in the demo version only a limited number of crops and herbicides are included. The demo version is available in English, Danish and German.





Web site tools of the English demo version of CPO.

The concept

Infestations of weeds differ strongly between fields, and different weed species differ strongly with respect to potential damage on crops and with respect to susceptibility to different herbicides. When herbicide applications are targeted to match conditions on a field level, a substantial reduction in the use of herbicides can be achieved, while still maintaining yield and quality of crop production.

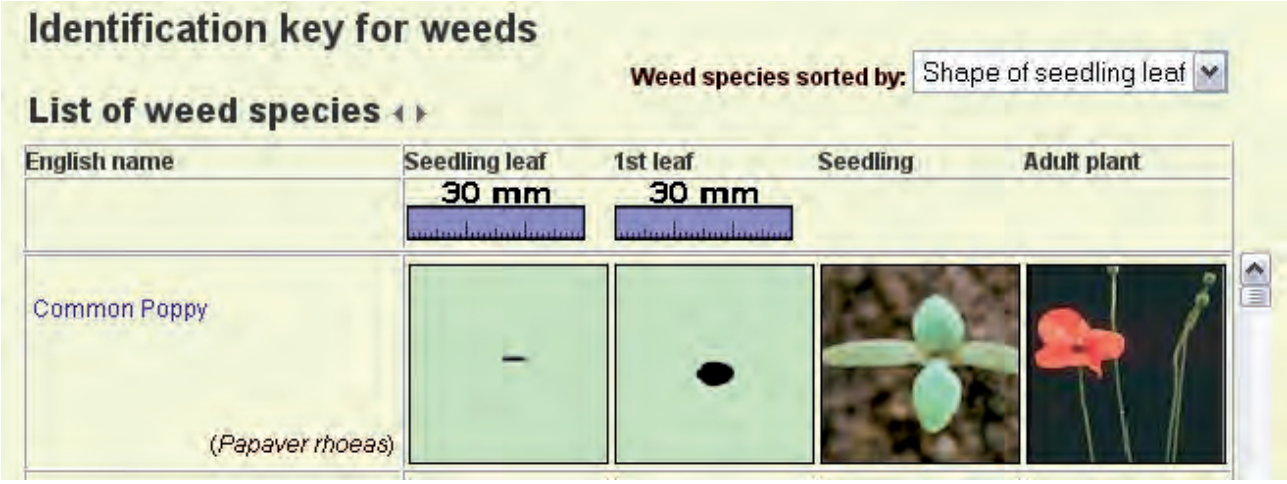
CPO evaluates the need for weed control and suggests treatment options by utilizing:

- actual registrations of infestations of weeds
- economic thresholds of herbicide applications
- differences in the susceptibility to herbicides of the occurring weed species in various growth stages and differing weather conditions
- for example, some weed species are controlled at a satisfactory level with just 10% of a registered herbicide dose, while other weed species may require >100% of a registered dose.

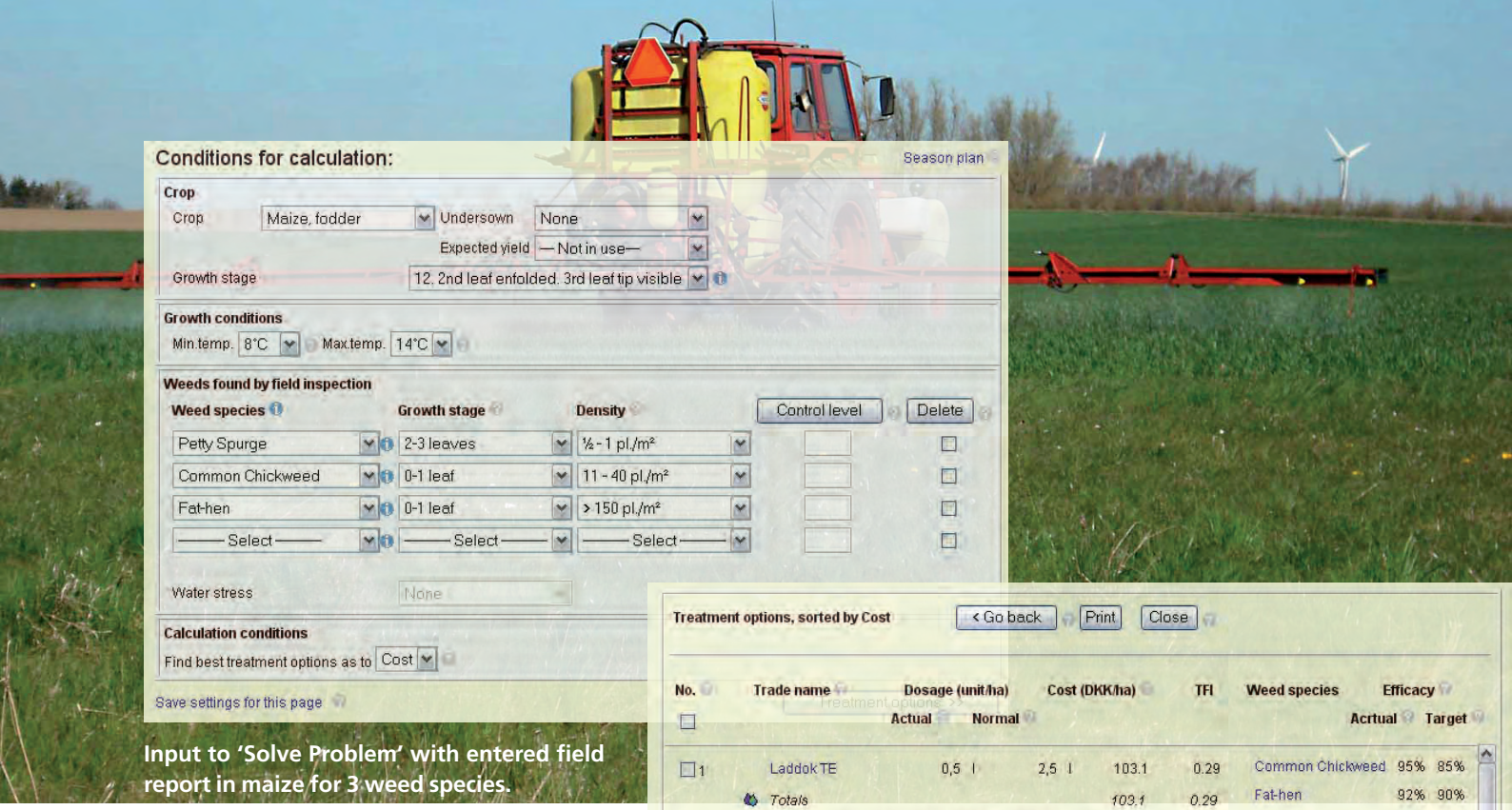
The website tools

Three different calculation tools are available on the website:

- *'Solve problem'*. This tool will evaluate a field report and find treatment options that can match requirements for efficacy with a minimum input of herbicides.
- *'Efficacy profile'*. This tool calculates the expected efficacy on various weed species of 4 different dose rates. It also calculates the dose rates that are required to produce specific levels of efficacy. The tool has been designed to produce overviews of strengthens and shortcomings of different herbicides.



Weed identification key, weeds sorted by shape of seedling leaf.



Input to 'Solve Problem' with entered field report in maize for 3 weed species.

Output from 'Solve Problem' precenting the cheapest treatment option for 3 weeds in maize using TFI=0,23 (23% of a full dose) of the herbicide Calaris (330 g/l terbuthylazin + 70 g/l mesotrion).

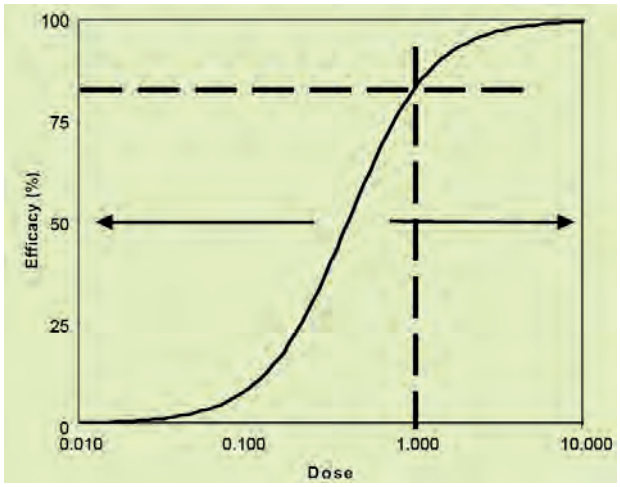


Illustration of CPO model step 2. Dose-response function of 1 herbicide, 1 crop, 1 weed species, 1 weed growth stage, 1 scenario of climatic conditions. A different scenario for one herbicide can be achieved by horizontal displacements of the dose-response graph.

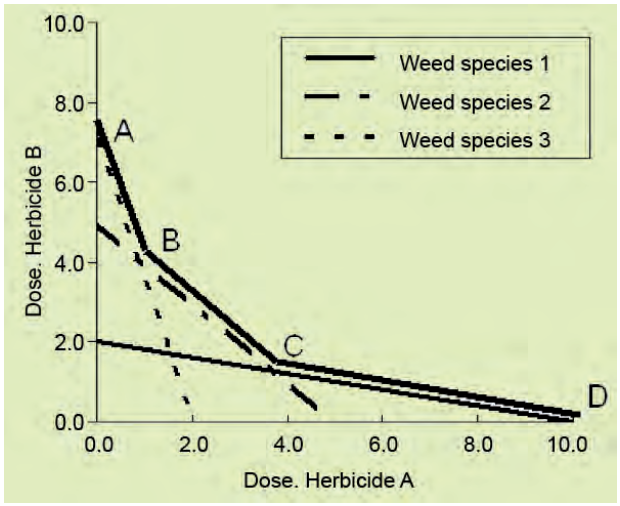


Illustration of CPO model step 3. According to the ADM, any 2-component mixture defined by the 'border isobole' A-D will provide at least the target levels of efficacy on weed species nos. 1-3.

- *'Users' mixture'*. This tool calculates the expected efficacy on various weed species from a user chosen herbicide mixture with 2-4 mixing components. The tool can be used to produce a 'second opinion' on herbicide mixes suggested by companies and advisors.
- *'Herbicides Across'*. This tool provides overviews of treatment options: a) in specific crops, b) for specific herbicides and c) for a specific weed species.

The techniques

Basically, the CPO weed module applies 3 techniques:

1. the need for weed control is quantified on a single weed species level and is based on a field report on crop and weeds. This evaluation results in efficacy targets, which have been defined by experts for various combinations of crop, expected crop yield, weed species and weed density. The efficacy levels integrate risks of yield loss and risks of weed seed production.

2. continuous dose-response functions are used to select herbicides and calculate dose-rates that match various levels of efficacy, e.g. the requirements determined in (1). These functions differ between weed species, weed growth stages, temperatures, relative humidity and water stress on the day of herbicide application.
3. the so-called Additive Dose Model (ADM) is used to automatically optimise tank-mixes of herbicides consisting of 2-4 mixing components, in case such mixes are advantageous in terms of costs or, the Treatment Frequency Index (TFI), the latter for which political reduction plans have been made in Denmark.

Parameterization in Denmark

The commercialized version in Denmark includes full assortments of herbicides in 30 crops, and about 30.000 combinations of crops, 'seasons', herbicides and weed species. It also takes into account 4 levels of weed growth stage, 9 regimes of weather conditions and 3 regimes of water stress. By combining these factors, CPO can simulate about 2.7 mio. different dose-response scenarios on single herbicides. These scenarios are used as starting point for optimizing tank-mixes with 2-4 mixing components, which increases the total number of treatment options significantly. In consequence, CPO can find treatment options for conditions and weed compositions in most fields in Denmark.

The potential

Various parametized versions of CPO *'Solve problem'* were constructed and thoroughly tested in field trials before the system was released. From 1987 to 2006, more than 2,000 field trials were carried out, mainly in cereal crops, but also in field pea, sugar beet and maize. The trials show that the recommendations from CPO have a potential to significantly reduce the input of herbicides without jeopardizing weed control. In terms of costs, herbicide input was reduced by about 45% in cereals and about 20% in sugar beet and maize.

Supplementary tools

- a separate tool is available to manage a seasonal strategy on a crop level. This tool specifies adequate timing for field inspections for various weed types that may occur during a full growing season.
- a weed key is available to assist identification of weed species. This key presents a list with colour pictures of 105 weeds at 4 different growth stages, which can be sorted for various criteria.
- a specific tool is available to administer the adding of herbicide adjuvants for application of single herbicides and for so-called tank-mixes of 2-4 herbicides.
- original herbicides and adjuvants are given preference in the user interface, but available generic products are recommended as possible substitutes.
- label information on the herbicides included can be studied as full integration has been made with a comprehensive database on pesticides.
- a specific tool to suggest spraying techniques, which are suitable for various spraying tasks, is being developed.

Implementation in other countries

In 2003 the CPO concept was adapted and implemented for 1-2 crops and limited assortments of weed species and herbicides in Estonia, Latvia, Lithuania and Poland. In 2005 CPO was implemented in Norway for 4 crops, 35 weed species and the full assortment of herbicides.

Advantages and disadvantages

The concept of CPO requires quite detailed field and semi field studies in order to establish dose-response functions for specific combinations of herbicides, weed species, weed growth stages and weather conditions. In return, traditional field studies on the efficacy of various tank-mixes of herbicides and various strategies of splitting applications can be totally ignored, as the Additive Dose Model automatically will compose tank-mixes with minimum input of herbicides, and the overall strategy of timing and splitting will be to spray new flushes of weeds as many times as required, until the crop reaches a specific growth stage. This strategy has been generally implemented in CPO, as this has been found to be most efficient in order to reduce the total use of herbicides.

Contact and more information

Feel free to contact academic employee Per Rydahl at the Faculty of Agricultural Sciences at the University of Aarhus for more information about the weed module of CPO or study the website pvo.planteinfo.dk for details. ■

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Selected literature

Henriksen. K.E., Jørgensen, L.N. & Nielsen, G.C. 2000. PC-Plant Protection - a tool to reduce fungicide input in winter wheat, sinter barley and spring barley in Denmark. Brighton Crop Protection Conference. Pest and diseases. 835-840.

Høstgaard, M.B., Hagelskjær, L., Hansen, J.G., Hansen, L.M., Jørgensen, L.N., Lassen, P., Rydahl Nielsen, P., Thysen, I. & Wolffhechel, H., 2003. Validation and adaptation of a Danish Decision Support System for crop protection in Lithuania, Estonia, Latvia and Poland. In: Wolffhechel, H. (ed.). Proc. Crop Protection Conf. for the Baltic Sea Region, 28-29 April 2003. Poznan. DIAS report Plant Production 96, 93-102.

Jørgensen LN, Noe E, Nielsen GC, Jensen JE, Ørum JE, Pinnschmidt HO (2008). Problems with disseminating information on disease control in wheat and barley to farmers. Eur J Plant Pathol, 121, 303-312.

Rydahl, P., 2004. A Danish decision support system for integrated management of weeds. Aspects of Applied Biology 72, Advances in applied biology: providing new opportunities for consumers and producers in the 21st century, 43-53.

Rydahl, P., Hagelskjær, L., Pedersen, L. & Bøjer, O.Q., 2003. User interfaces and system architecture of a web-based decision support system for integrated pest management in cereals. Paper presented at the EPPO Conference on Computer aids for plant protection, York (GB), 15-17 October 2002, 473-481.

Tørresen, K.S., Netland, J. & Rydahl, P., 2004. Norsk utgave av det danske beslutningsstøttesysstemet Plantevern Online for ugrassprøyting i korn. Grønn kunnskap 8(2),