

# Effective control of weeds in organic cropping



WEEDS 2007-2010



*A prototype robotic weeder*

## Effective control of weeds in organic cropping - novel technology and new management strategies

Perennial weeds are widespread in organic cropping and cause severe problems in many crops. Traditionally, perennial weeds are controlled by repeated and prolonged soil cultivations in the autumn. However, this strategy conflicts with nutrient management, and the project seeks to develop new control strategies against major perennial weed species that meet the requirement for optimal nutrient handling.

Intra-row weeds in row crops still constitute an appreciable financial burden for organic growers. The requirement for hand-weeding can be high and it is an obstacle to growing more profitable row crops. The project investigates the possibilities of building a weeding robot and to make use of punch planting and the stale seedbed technique to reduce intra-row weed emergence and improve weed control.

# Weed problems in Danish organic crop production



Rhizomes of *Elymus repens*

Currently two major weed problems put severe constraints on organic crop production in Denmark:

- 1 perennial weeds, most notably *Elymus repens*, *Cirsium arvense*, *Rumex crispus* and *Tussilago farfara*, cause problems in various crops, and
- 2 annual intra-row weeds entailing laborious hand-weeding, especially in vegetable row crops.

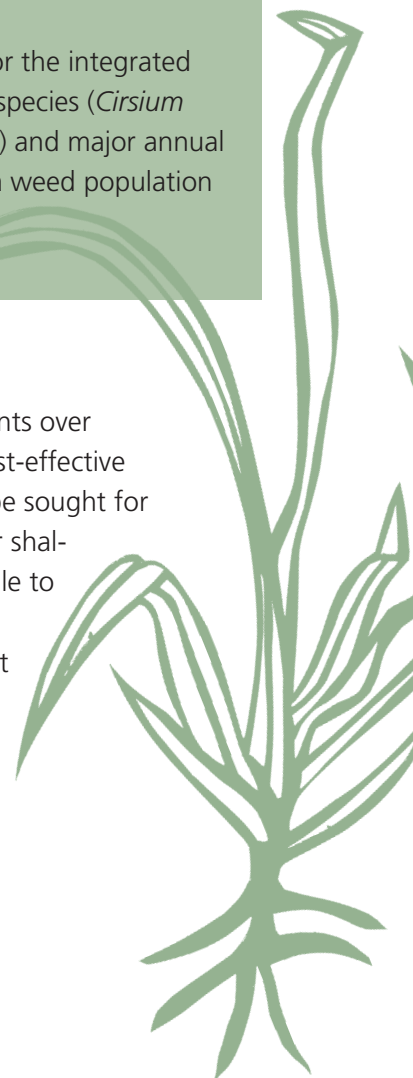
## Perennial weeds

Perennial weeds are traditionally controlled by repeated and prolonged stubble cultivation in autumn, which conflicts with the objective of retaining nutrients in the upper soil layer by keeping the soil plant-covered during autumn and winter. In a previous DARCOF-project, effective control of *Cirsium arvense* was achieved without disturbing the plant cover, but treatment intensity was high and not immediately acceptable for organic growers. It was concluded that further research should focus on strategies involving fewer and timelier treatments based on a better understanding of the carbohydrate source/sink dynamics in regenerative roots in response to growth disturbances. *Elymus repens*

## Project objectives

1. To develop effective management strategies for *Cirsium arvense* and *Tussilago farfara*, involving both preventive and direct control measures
2. To develop novel technology for exposure and destruction of *Elymus repens* rhizomes and *Rumex crispus* rootstocks, and for *Elymus repens* to validate the technology in an organic cropping system context
3. To develop a weeding robot that operates in vegetable crops and physically destroys weeds in the rows
4. To develop and validate punch planting techniques and their strategic use with stale seedbed and physical intra-row weeding in collaboration with objective 3
5. To formulate strategies for the integrated control of two perennial species (*Cirsium arvense*, *Tussilago farfara*) and major annual weed species, based on a weed population dynamics model

also requires repeated treatments over long periods and quick and cost-effective control measures should also be sought for this weed. Owing to the rather shallow rhizomes, it may be possible to effectively uproot, expose and destroy rhizomes within a short time. *Rumex crispus* also has a shallow rootstock and a technology developed for *Elymus repens* may also have potential for *Rumex crispus* control.



## Annual intra-row weeds

---

Methods for controlling intra-row weeds have been studied in previous DARCOF-projects. However, finding a solution for effective and selective intra-row weed management, that reduces the need for hand-weeding remains a challenge in organic farming. Several research institutes have studied different advanced technologies for intra-row weeding, some of which have potential for integration into an intelligent system for arable intra-row weed control. However, there is a need to direct research towards an integration of knowledge on the biological environment, cultivation tactics, implements, robotic technology and seeding technology into a system capable of selective weeding under field conditions. Punch planting in conjunction with stale seedbed techniques appears to be a crop establishment technique that could supplement robotic weeding. Both punch planting and transplanting create a propitious environment for e.g. cameras to distinguish crop plants from weed plants due to reduced and delayed weed emergence.

### The WEEDS project is organized in following work packages (1-5):

---

#### 1. Effective management strategies for *Cirsium arvense* and *Tussilago farfara*

The work will provide essential information, currently missing, to plan proper management strategies: (i) vulnerability in response to intensity and timing of root/rhizome fragmentation, desiccation and subsequent burial; (ii) the effect of treatments at various phenological stages on cutting and the fragmentation and distribution of roots/rhizomes in the soil.

The research will be made in growth chambers and glasshouses and subsequently validated and modified under semi-field and field conditions to identify the most promising control strategies (WP1).

#### 2. Exposure and destruction of *Elymus repens* rhizomes and *Rumex crispus* rootstocks

Research will concentrate on the development of a novel technology for effective uprooting, exposure and destruction of rhizomes and rootstocks within

a short time span. The work includes an iterative development of appropriate tools followed by field validation of functionality and biological effects. Finally, a prototype implement will be used for validation of the new technology in organic cropping (WP 2).

#### 3. Field machinery for automatic intra-row weeding in row crops

Essentially, we aim at constructing a robotic weeder capable of automatic intra-row weeding. Technical progress will be evaluated iteratively during the project, in terms of weeding effectiveness and reliability under field conditions (W 3).

#### 4. decreasing and delaying weed emergence row crops

Existing prototypes of punch planters will be improved in collaboration with international partners to develop seeding and stale seedbed strategies that reduce and delay the emergence of annual weeds. The robotic machinery developed in WP3 will be studied in combination with stale seedbed and punch planting strategies (WP4).

#### 5. Weed population dynamics model

The results obtained in the project will be included in an ongoing modelling effort to describe the long-term weed population dynamics in organic and conventional crop rotations. The model will serve to organize the work packages into a coherent whole, ensuring a common standard that will make results applicable across the project and also be for the benefit of the end-users by providing an analytical tool to formulate integrated weed management strategies (WP 5).



*Rumex crispus*

# Effective control of perennial weeds and intra-row weeds in organic cropping

- novel technology and new management strategies

(WEEDS 2007-2010)

## Project leader

---

Bo Melander, *University of Aarhus, Faculty of Agricultural Sciences, Department of Integrated Pest Management, Research Centre Flakkebjerg, DK-4200 Slagelse, Denmark*  
E-mail: bo.melander@agrsci.dk

## Project participants

---

Erik Fløjgård Kristensen, Michael Nørreremark, Esmaeil Nadimi, Claus G. Sørensen, Ivar Lund, Hans Jørgen Olsen, Kristian Kristensen, *University of Aarhus, Faculty of Agricultural Sciences*

Jens Carl Streibig, Libère Nkurunziza, Jesper Rasmussen, Hans Werner Griepentrog, *University of Copenhagen, Faculty of Life Sciences*

Inger Bertelsen, *Danish Agricultural Advisory Centre*

## Selected publications

---

Graglia E., Melander B. & Jensen R.K. (2006). Mechanical and cultural strategies to control *Cirsium arvense* in organic arable cropping systems. *Weed Research*, 46, 304-312

Melander B., Rasmussen I.A. & Barberi P. (2005). Integrating Physical and Cultural Methods of Weed Control – Examples from European Research. *Weed Science* 53(3), 369-381

Rasmussen J (2003) Punch planting, flame weeding and stale seedbed for weed control in row crops. *Weed Research* 43, 393-403

## Links

---

The projects homepage: [www.weeds.elr.dk/uk/](http://www.weeds.elr.dk/uk/)  
Other links: [www.ewrs.org/pwc](http://www.ewrs.org/pwc), [www.ifoam.org](http://www.ifoam.org), [www.oacc.info/](http://www.oacc.info/)

## About ICROFS

---

The International Centre for Research in Organic Food Systems (ICROFS) is a "centre without walls" where the research is performed in interdisciplinary collaboration between research groups in different institutions. The centre is an expansion of the former research centre DARCOF, which the Danish Government in 2008 decided to give an international mandate and an international board.

The main purpose of ICROFS is to coordinate and monitor international research in organic food and farming systems in order to achieve optimum benefit from the allocated resources. Further, the aim of ICROFS is to initiate research and create impact of the research results through support and dissemination of high quality research of international standard.

More information at [www.icrofs.org](http://www.icrofs.org)

