Integrated crop protection – approaches to increase the percentage of mechanical weed control in sugar beets

IIRB Seminar ‘Advances in combined weed control’

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Introduction

Integrated crop control

- The rational application of a combination of biological, chemical, physical or plant-breeding measures

Physical measures:

- Direct action
- Indirect action

The aim of the research project is to improve the mechanical weed control in sugar beet cultivation

Outline

- Introduction
- Conclusions of field trials for mechanical weed control
- Challenges for mechanical intra-row weed control
- Camera-based control system of a hoe
- Prototype for intra-row weed control
- Preliminary results
- Outlook

Field trials for mechanical weed control

Employed technology:

Inter row:
- Inter-row cultivators
  - ‘L’ Blades
  - ‘A’ Blades

Intra row:
- Yetter rotary hoe
- Finger weeder
- Annaburger Turbo rotary hoe
Field trials for mechanical weed control

Results of two years field trials:
- Successful inter-row weed control
- Problems to reduce weeds within the row

Challenges for mechanical intra-row weed control

- Disturbance of beet during early growth stages
- Competition for inputs/growth factors
- Retention force of the beet and the weed is nearly the same
- Yield losses

Sensor based mechanical intra-row weed control

How large is the potential area to be cultivated?

Theoretical overview:

- Theoretically sensor based mechanical weed control on >95% of the area possible

Camera-based control system of a hoe

- Most important requirements:
  - a real time detection of the following plant position
  - driving and working velocity ≥ 1 m/s
  - theoretical seed plant position is adjustable between 14 and 20 cm
  - sufficient hoeing of interspaces
  - low losses of cultivated plants
Camera-based control system of a hoe

CCD camera with daylight cut filter (wavelengths < 780 nm are filtered)

- generated grey-level image provides a high contrast between plants and soil
- Image size: 576*80 pixels
- CCD camera is triggered by an inductive proximity switch at each full rotation of the implement

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Single-row hoe prototype to control weed within the row in 2009

- Solenoid-operated valve
- CCD Camera
- Implement
- Image Processing via notebook

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Some Pictures of first field trials in 2009/2010
Preliminary results

Image processing
- High detection rate of following plants > 90%
- No defined lighting conditions necessary
- Imprecise seed placement and missing plants may cause problems in position detection

Outlook

Corollary of the problems with the hydraulic drive:
- Latest prototype: Electric control cabinet, Steering-wheel of the toolbar, Toolbar, New implement

Preliminary results

- The whole system fulfills the first requirements
  - a real-time detection of the following plant position
  - operating speed ≥ 1 m/s
- Weed removal is made possible at a crucial growth stage of the sugar beet plants
- Limits of hydraulic drive has achieved at increasing operating speed!

Outlook

- Key benefits of the new electrical drive:
  - Higher velocity possible (responding behavior of the new drive)
  - Electronic components more precise than hydraulic components
  - Data collecting without additional measurement instrumentation possible
  - Any implement-movement programmable
### Outlook 2011/2012

- During cultivation season 2011: two field trials to evaluate the electric drive
- Comparison of newly developed system with standard methods of weed control
- Further Development of the image processing and mechanical components

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