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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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

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

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

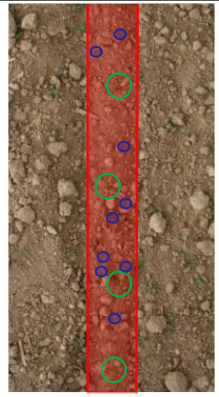



Field trials for mechanical weed control

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



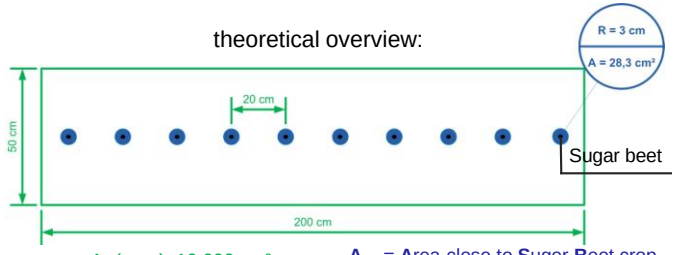
Plant spaces within the row

- 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:



A_t (area): 10.000 cm²

A_{SB} (area)= 10 *28,3 cm² = 283 cm²

A_{SB} = **A**rea close to **S**uger **B**eet crop (mechanical weed control isn´t possible)

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

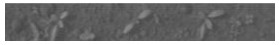
Camera-based control system of a hoe

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

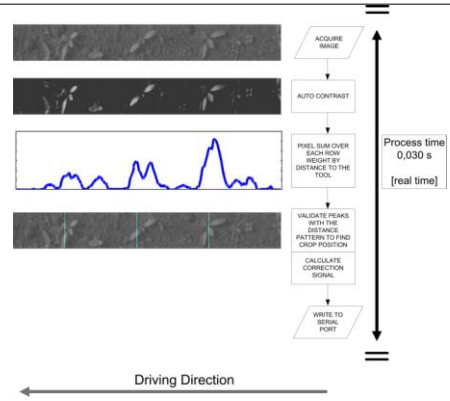
- generated grey-level image provides a high contrast between plants and soil

Image size: 576*80 pixels

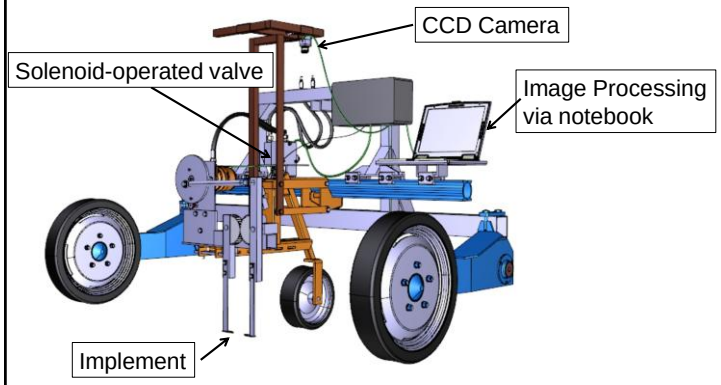
- CCD camera is triggered by an inductive proximity switch at each full rotation of the implement



Camera-based control system of a hoe



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



Some Pictures of first field trials in 2009/2010

Preliminary results

Image processing

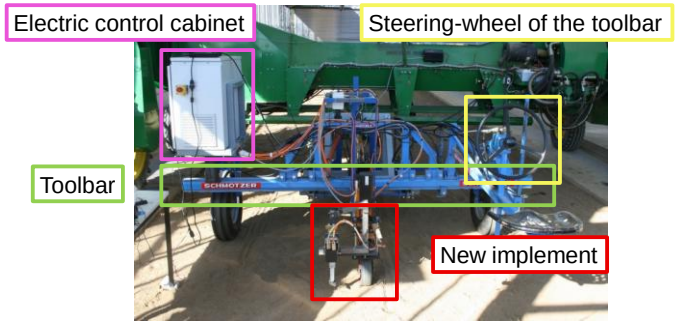
- High detection rate of following plants > 90 %
- No defined lighting conditions necessary
- Imprecise seed placement and missing plants may cause problems in position detection

Preliminary results

- The whole system fulfils 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

Corollary of the problems with the hydraulic drive:
Latest prototype



Outlook

- Key benefits of the new electrical drive:
  - Higher velocity possible (responding behaviour 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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