Combined weed control, french experiences

**Institut Technique de la Betterave**

**Brief return on trials**

- After a joint meeting Mechanisation and Weed control group in Bergen op Zoom (2003), ITB decided to evaluate new machines to control weeds between and on the rows and preserve sugar beet.
- 2004-2006: we tested cultivator with stars and rotative hoe in different conditions to evaluate:
  - Efficacy on different weeds,
  - Risks for sugar beet,

**Different types of machines**

- **Cultivator with stars**
- **Rotative hoe**
- **Chain harrow**
- **Boom for band spraying**

**Mechanical work on the row**

- **Rotative hoe (Yetter)**
- **Cultivator with stars (Kress)**

- The machine works on all the width, High speed (18 km/h)
- Depth 2 to 3 cm
- 9 cm between 2 spoons
- Wheels installed on 2 independent arms
- It's possible de adapt the pressure of ressort

- Stars installed on a classical cultivator
- 2 plastic stars by row
- The rotation is assured by metallic stars by the movement of the machine
“Desherbineuse”

- This machine combine spray of herbicides on the row and mechanical weed control between the rows,
- Guidance by wheel
- Advantage: 1 machine to spray and hoe, spraying and hoeing in same time,
- Disadvantage: working speed is low and size limited to 12 rows,

Results efficacy

- As chemical weed control, the efficacy of stars or rotative hoe is better on young plants, before 4 true leaves of weeds,
- The graphics present results of 2 trials with 1 machine according with the stage of weeds

Results selectivity

- To avoid too important losses of plants of sugar beet, it's necessary to realise first mechanical passage after 4 true leaves of beets

Results selectivity

- To avoid too important losses of plants of sugar beet, it's necessary to realise first mechanical passage after 4 true leaves
Losses of plants in percentage of chemical reference 2009

- 2 chemical interventions before mechanical passage
- Losses of plants are too important with chain harrow

Synthesis after some years of tests

- 2 chemical applications necessary at first stage of crop
- Work on young weeds from 4 leaves to 10-12 leaves of the crop
- Classical cultivator + stars wheels
- No problem on interrow
- Poly crop Independent of rows, Working seed: 15 to 18 km/h

Reduction of herbicides use

- The objective is to reduce, if possible, by 50% the use of herbicides,
- The indicator is TFI, Treatment Frequency Index,
- TFI is ratio between applied rate/registration rate,
Guidance system

Objectives:

- Optimise position of blades and respect totally the rows without intervention of driver,
- Minimise the non cultivated zone, around 10 cm,
- Make easier the work of driver and increase speed and size of machines without loss of precision even in uneven field.

Guidance system

- Guidance with mark realised during sowing:
  A tine installed on sowing machine realise a trace, this trace is followed by a wheel installed with parallelogram on cultivator or band sprayer applicator,
  Advantages: sure, simple system, Disadvantages: traces can disappear on certain soils,

- Guidance by camera:
  A camera film 1 or 2 rows ,
  A monitor of control command necessary corrections.
  Advantages: no trace during sowing,
  Disadvantages: difficulties of detection of rows if numerous weeds,

- Guidance by GPS RTK :
  Installed on guidance system of tractor, GPS permit to guide the cultivator with high precision,
  Advantages: precision,
  Disadvantages: more expansive if surface is low.

Advantages / Disadvantages

<table>
<thead>
<tr>
<th></th>
<th>+</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultivator with wheeling stars</td>
<td>✓ Efficacy known in interrow</td>
<td>✓ Aggressively on sugar beet before 4 leaves stage</td>
</tr>
<tr>
<td></td>
<td>✓ Reduction of herbicides</td>
<td>✓ Efficient on grass</td>
</tr>
<tr>
<td></td>
<td>✓ Possibility of adjustment</td>
<td>✓ Lifespan of star wheels unknown</td>
</tr>
<tr>
<td>Rotative hoe</td>
<td>✓ Usable on others crops</td>
<td>✓ Aggressively on sugar beet before 4 leaves stage</td>
</tr>
<tr>
<td></td>
<td>✓ Work rate</td>
<td>✓ Efficient on grass</td>
</tr>
<tr>
<td></td>
<td>✓ Reduction of herbicides</td>
<td>✓ No adjustment</td>
</tr>
<tr>
<td>Band spraying</td>
<td>✓ Good control of weeds</td>
<td>✓ High number of elements</td>
</tr>
<tr>
<td></td>
<td>✓ Reduction of herbicides</td>
<td></td>
</tr>
<tr>
<td>“Désherbineuse”</td>
<td>✓ Good control of weeds on the row</td>
<td>✓ how find good compromise between optimal conditions for chemical and mechanical weed control</td>
</tr>
<tr>
<td></td>
<td>✓ Reduction of herbicides</td>
<td>✓ Work rate limited</td>
</tr>
<tr>
<td>Chain harrow</td>
<td></td>
<td>✓ Not adapted to weed control on sugar beet</td>
</tr>
</tbody>
</table>

Evaluation of time

- How much time is it necessary to achieve mechanical weed control in comparison with chemical, large sprayer (28-36m)?
- What is the cost of combined weed control: herbicide, engineering, working force?
Evaluation of working time

- For the time, we must compare for chemical: time of application, but also time of preparation and cleaning sprayer,

![Graph showing comparison of working time for different sprayers.]  
- **Sprayer**: 27 m, Localised sprayer 36 rows, Désherbineuse 12 rows, Hoe 12 rows + stars wheels, Rotative hoe 5 m 40.

Costs comparison

- Cost of herbicides represent a large part of the total cost, for reference, around 30 €/ha/passage for a B0,6T0,15G0,3V0,1h for example,
- Cost of working force and traction are lower.

![Graph showing costs comparison for different treatments.]  
- 4 chemical Treatments reference, 2 chemical Treatments + 3 passages of hoe + stars wheels, 2 chemical Treatments + 3 passages of rotative hoe, 4 localised chemical treatments + 2 passages of hoe, 4 Passages of désherbineuse.

Some strategies of weed control

- Evaluation of CO₂ and energy has been realised: the contribution of mechanical weed control is very low in comparison with fertilizer, especially nitrogen.

![Graph showing reduction of herbicides and final efficacy.]  

Environmental evaluation

- CO₂ emission and Energy.

![Graph showing CO₂ emission and Energy.]  
- kg CO₂/ha and MJ/ha.
Some axes of reflexion

- Complete mechanical weed control is not possible in our context,
- Some possibilities exist to reduce use of herbicides and maintain quality of weed control,
- New interest for localised application and hoeing,
- The economy of herbicides can be invested in equipment or manpower,
- Is it possible to engage manpower in situation with few persons in farm,
- An estimation of possible time is necessary to choice most adaptable strategy, crops, workforce, ...
- Each grower must estimate what is the strategy most suitable to his farm,
- Different situations were followed in 2010 and 2011, dry conditions. Hoeing allowed to control developed weeds, more 4 leaves stage, when chemical herbicides have low efficacy due to these conditions.

Many thanks for your attention!