Developing winter wheat and winter pea for intercropping purposes
- Optimising the management itinerary

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Unit Soil fertility

SPW-DGO3
Context and Objectives
Why (re-)introducing pea in rotation?

- Source of (plant-based) proteins
- Natural N supply / fertilisation
- Increase the biodiversity
- Increase the landscape diversity
Objectives

➢ Objectives of intercrop:
  ▪ Decrease the inputs (N fertilisation, Pesticides, etc.)
  ▪ Secure the protein production and the grain yield
  ▪ Interesting contribution to farmers revenue?

➢ Prerequisites:
  ▪ Design and optimisation of the itinerary
History
Intercropping @ GxABT

- 2009-12: Exploratory trials
- 2012-14
- 2014-16: Project funded by DGO3 (Wallonia)
- 2016-18
- >2013 Collaboration with Wallagri to coaching farmers in this process.

Sustainable production of protein-rich seeds by optimization of the management itinerary of the winter pea - winter wheat association
Project design
Project design

- Axis 1: Vegetation structure and architecture
  - Sowing density
  - Choice of variety

- Axis 2: Plant nutrition
  - Nodosity development
  - Plant development
Project design

• Axis 1: Vegetation structure and architecture
  • Sowing density
  • Choice of variety

• Axis 2: Plant nutrition
  • Nodosity development
  • Plant development

• Axis 3: Mechanical weeding (2017-18)
  • Comparison of itinerary and machines

• Axis 4: Pesticide application (2017-18)
  • Fongicide
  • Herbicide
Sites description
Sites description

Soil:
- Cutanic Luvisol (WRB classification)
- Soil texture: silt 70-80% - clay 18-22% - sand 5-10%
- “Classic” loamy soil of the Hesbaye Area

Climate:
- Temperate climate (Cfb in Köppen-Geiger classification)
- Rain: 819 [mm] per year
- Average temperature: 9.8 [°C]
- Average solar radiation: 825 [J.cm².d⁻¹]
Sites description
## Sites description

### Itinerary:

<table>
<thead>
<tr>
<th>Year</th>
<th>Preceding crop</th>
<th>Sowing Date</th>
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<td>2012-13</td>
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**Sites description**

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» Sowing window has to be between 25 Oct. and 15 Nov.  
» Same sowing technique for both crop
Sites description ~ 1,000 plots per year
Example of results
Results: Global performances

- **Peas yield**
  - Lodging problem
  - Security of yield and profitability

- **Wheat yield**
  - Efficiency ↑↑↑

- **Intercrop yield**
  - Intercropping performances ≈ Wheat
Results: Global performances

Results: Axis 1 – Varietal choice

\[ LER = LER_{\text{Pea}} + LER_{\text{Wheat}} = \frac{\text{Mixed pea yield}}{\text{Pure pea yield}} + \frac{\text{Mixed wheat yield}}{\text{Pure wheat yield}} \]

| Varietal Choice          | 2013 | 2014 | 2015 | 2016 | 2017 |
|--------------------------|------|------|------|------|------|   |
| Sy Epson Ivernel         | 1,43 | 0,66 | 1,28 | 4,12 | 1,23 |   |
| Sy Epson Spencer         | 0,85 | 0,52 | 1,17 | 3,42 | 1,15 |   |
| Edgar Ivernel            | 1,15 | 0,75 | 1,17 | 3,64 | 1,15 | Edgar Gangster, Smart Furious |
| Edgar Spencer            | 1,04 | 0,71 | 1,18 | 3,42 | 1,15 |   |
| Moyenne                  | 1,12 | 0,66 | 1,20 | 3,65 | 1,19 |   |

Results: Axis 1 – Sowing densities
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#### Impact of sowing densities on lodging (15/07/2016)

<table>
<thead>
<tr>
<th>Densités (FH/Pois) /Association</th>
<th>Pur</th>
<th>Froment</th>
<th>300/50</th>
<th>300/25</th>
<th>150/50</th>
<th>150/25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sy Epson Gangster</td>
<td>100</td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Sy Epson Spencer</td>
<td>100</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>51</td>
<td>8</td>
</tr>
<tr>
<td>Edgar Gangster</td>
<td>100</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Edgar Spencer</td>
<td>100</td>
<td>0</td>
<td>17</td>
<td>1</td>
<td>41</td>
<td>10</td>
</tr>
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</table>
Results: Axis 1 – Varieties and densities

Biomass monocrop equivalent:
Biom. pea/ha + Biom. wheat/ha

<table>
<thead>
<tr>
<th></th>
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<tr>
<td>Sy Eps-lv</td>
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</tr>
<tr>
<td>Sy Eps-SP</td>
<td></td>
</tr>
<tr>
<td>Edg-lv</td>
<td></td>
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Biom. pea/ha + Biom. wheat/ha

2
Results: Axis 1 – Varieties and densities

Biomass monocrop equivalent:
Biom. pea/ha + Biom. wheat/ha

Observed intercrop biomass
Results: Axis 2 – Biomass production

N fertilisation amount and timing does never seem to impact the biomass of pea.
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N fertilisation amount and timing does never seem to impact the biomass of pea

N fertilisation @ ZS39:
- Does not impact pea or wheat biomass
- Impacts wheat protein
Results: Axis 2 – Biomass production

- N fertilisation amount and timing does never seem to impact the biomass of pea

N fertilisation @ ZS39:
- Does not impact pea or wheat biomass
- Impacts wheat protein

N fertilisation @ ZS29-30:
- Impacts wheat biomass and yield
Results : Axis 2 – Nodule production
Results : Axis 2 – Nodule production

- N fertilisation decreases the number of nodules

![Diagram showing average nodule production across different N fertilisation levels (0, 40, 80) on main and secondary roots.]

- On main root
- On secondary roots

- N fertilisation decreases the number of nodules
Without N application, yields are fairly good

N fertilisation increases intercrop production (especially wheat production)

Not necessary to fertilize with too high level

N fertilization allow to play on the ratio wheat-pea (Interspecific dominance)
Results: Axis 2 – Protein production

W. Wheat – W. Pea intercropping allows

⇒ to increase protein production within wheat grains
⇒ does not impact protein production of pea

Protéines du blé Edgar cultivé pur et associé

<table>
<thead>
<tr>
<th>Year</th>
<th>Pure Wheat (M/MS%)</th>
<th>Associated Wheat (M/MS%)</th>
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<tr>
<td>2013</td>
<td>12</td>
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Fumure (TR-DF)
Results: Axis 2 – Protein production

W. Wheat – W. Pea intercropping allows

→ to increase protein production within wheat grains

→ does not impact protein production of pea

On average: + 3.46 % MPT/MS – 0kgN/ha

+ 2.46 % MPT/MS – 40-60kgN/ha
Conclusion
Conclusions

➢ The management of w. wheat- w. pea intercropping is primarily an art
Conclusions

- The management of w. wheat- w. pea intercropping is primarily an *art*
Conclusions

➢ The management of w. wheat- w. pea intercropping is primarily a matter of *art*

➢ To success with the association, one has to do the good choices:
  - Varieties to be in the association
    ➔ Alone but above all in *association* (not always same behavior)
    ➔ *Synchronicity* of the species and the varieties
  - The density of sowing
    ➔ *Equilibrium* of *plant population*
    ➔ Minimize the adverse effects of monocrop
  - The fertilization and the nutrition of plant
    ➔ To optimize quantity and *quality*
    ➔ Regulate the *interspecific competition*
  - ...
Thanks for your attention

??? Questions ???

Ir. Pierreux Jérôme
Dr. Benjamin Dumont