WP 2
Innovative IPM solutions for winter wheat-based rotations
Modification/change of sowing date

Members of WP2 PURE project
February, 2015
What are the issues?

- **Agronomical issues**
  - development of cultivars with resistance to plant pathogens and pests. Cultivars with good competition too weeds to decrease the need for pesticides

- **Health issues**
  - Less spraying means less exposure to pesticides by farmers
  - Less risk for pesticide residues in feed, food and drinking water.

- **Environmental issues**
  - Less risk for negative impacts from pesticides on the environment - water, soil and air (many references)

- **Economic issues**
  - Alternative methods should be applied if they can minimize problems with plant pathogens, weeds and pest without causing a significant yield decrease
What are the issues?

- Regulatory issues
  - Ecophyto 2018 plan
  - Water Framework Directive (applies for all EU Member States)
  - National Action Plan (Germany)
  - Early sowing is promoted to minimize risk of Nitrogen leaching, early sowing (before 7th Sept) can replace area with intercropping (in Denmark)

GOAL

We have to identify the possibilities for reducing the dependency on pesticides in sustainable cropping systems
PURE project (WP2)
Innovative IPM cropping systems designed for winter wheat-based rotations

Trials locations in Europe where IPM cropping systems were assessed, Pure project (WP2)
Different controls against plant pests used in the innovative IPM cropping systems designed for winter wheat-based rotations

Chemical control

Cultural methods:
- modification of sowing date

Biological control
- Trichogramma against Ostrinia nubilalis on maize

Physical control
- Mechanical weeding

Genetic control
- Different winter wheat varieties

pesticides sprayings
Strategies to reduce plant pests

• Action plan on initial stock
  - rotation modifications, tillage practices, ...

• Pathogens avoidance
  fostering time lag between pathogens contamination period and crop sensitivity: **to delay or to bring forward sowing date**

• Impact mitigation over crop growth
  • Increase crop competitiveness (as sowing intercropping, resistance varieties, ...)

• Remedial actions
  • When practices are unsuccessful: use mechanical weeding or herbicide
Modification of sowing date in the different innovative IPM cropping systems (cs) in some WP2 trials to reduce pest impacts

**Slagelse (D)**

<table>
<thead>
<tr>
<th>IPM cs1</th>
<th>IPM cs2</th>
</tr>
</thead>
<tbody>
<tr>
<td>WOSR</td>
<td>WOSR</td>
</tr>
<tr>
<td>WW</td>
<td>WW</td>
</tr>
<tr>
<td>SB</td>
<td>SO</td>
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</table>

**Dahnsdorf (G)**

<table>
<thead>
<tr>
<th>IPM cs1</th>
<th>IPM cs2</th>
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<tbody>
<tr>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>WW</td>
<td>WW</td>
</tr>
<tr>
<td>WB</td>
<td>WB</td>
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</tbody>
</table>

**Grignon (F)**

<table>
<thead>
<tr>
<th>IPM cs1</th>
<th>IPM cs2</th>
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<tbody>
<tr>
<td>WFB</td>
<td>SFB</td>
</tr>
<tr>
<td>WW</td>
<td>WW</td>
</tr>
<tr>
<td>WORS</td>
<td>HE</td>
</tr>
<tr>
<td>WW</td>
<td>TR</td>
</tr>
<tr>
<td>SB</td>
<td>M</td>
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</table>

**Poznan (P)**

<table>
<thead>
<tr>
<th>IPM cs1</th>
<th>IPM cs2</th>
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<tbody>
<tr>
<td>WOSR</td>
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<tr>
<td>WW</td>
<td>WW</td>
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<tr>
<td>SB</td>
<td>SB</td>
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</tbody>
</table>

E = earlier than current practice
L = later than current practice

Crop rotations of on-station experiments. WW=winter wheat, WOSR=winter oilseed rape, SB=spring barley, SO=spring oat, PEA=pea, M=maize, WB=winter barley, WDW=winter durum wheat, BW=buckwheat, SL=spring linseed, ALF=alfalfa, WFB=winter faba bean, SFB= spring faba bean, HE=hemp, TR=triticale
Winter wheat: different sowing date
Case in Poznan (Poland, 2014)

Current sowing date
more weed germination in autumn

Beginning of spring,
March 2014

Before harvest, July 2014

Delayed sowing date
lower weed infestation
Impacts of sowing date modification

On diseases
- reduce potential disease cycle number with late sowing,
- reduce sensitive period of crop with late sowing in winter or early sowing in spring,
- increase robustness of plant over contamination period with early sowing of winter oilseed rape.

On weeds
- Enhance crop growth competitiveness with early sowing for crops which have high growth before weed emergence,
- Avoiding weeds which have same emergence date than crop sowing with late sowing which allowed false seed-bed.

On insects
- To avoid peak period of attacks with late sowing for winter cereals (against aphids) with early sowing for winter oilseed rape (against psylliodes chrysocephala)
Most important diseases in winter wheat in the PURE WP2 trials (2011-2013)

- Septoria
  - Mycosphaerella graminicola

- Yellow rust
  - Puccinia striiformis

- Brown rust
  - Puccinia recondite

Disease impacts which could be decreased by modifying sowing date
Main Weeds in the PURE WP2 trials in France

- *Cirsium arvense*
- *Lolium perenne*
- *Polygonum aviculare*
- *Chenopodium album*
- *Galium aparine*
- *Fallopia convolvulus*
- *Rumex crispus*
- *Avena fatua - sterilis*
- *Bromus sterilis*
Positive and negative effects from none chemical methods, including sowing date, in winter wheat.
Crops are not just attacked by single pest. Changes in sowing dates can increase or decrease a problem

- Early sowing increase problems like:
  - Take all, eyespot
  - Septoria
  - BYDV (aphid transmitted)
  - Snowmould

- Late sowing increase:
  - Mildew
  - Yellow rust
  - Risk of slugs attack
Link between sowing dates and attack of septoria (3513 UK fields)

Gladder et al., 2001
Winter wheat take all. Effect of sowing date

Figure 6. Inoculum level and drilling date: later drilling = lower inoculum

Data from Rothamsted
Sowing times effect on septoria and yield

<table>
<thead>
<tr>
<th>Sowing date</th>
<th>% attack in June</th>
<th>% attack in July</th>
<th>Yield (dt/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 September</td>
<td>2.4</td>
<td>4.1a</td>
<td>80.7</td>
</tr>
<tr>
<td>20 September</td>
<td>1.8</td>
<td>2.9b</td>
<td>80.5</td>
</tr>
<tr>
<td>10 October</td>
<td>1.2</td>
<td>2.7b</td>
<td>55.5</td>
</tr>
</tbody>
</table>

4 trials AU 1993-94
Results from innovative IPM cropping systems assessed in the WP2 trials

- No result specifically linked to a modification of sowing date because to be efficient this cultural practice has to be combined with other ones as follows...
To be efficient, strategies and practices have to be combined (1/3)

Classification of combined practices against diseases

<table>
<thead>
<tr>
<th>Main practices</th>
<th>Second practices</th>
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</thead>
<tbody>
<tr>
<td>Rotation</td>
<td>Seed quality</td>
</tr>
<tr>
<td>Variety choice</td>
<td>Tillage management</td>
</tr>
<tr>
<td>Variety or species mixtures</td>
<td>Residue management</td>
</tr>
<tr>
<td></td>
<td>Volunteers management</td>
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<tr>
<td></td>
<td><strong>Date</strong> and density of sowing</td>
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<tr>
<td></td>
<td>Nitrogen availability management</td>
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<tr>
<td>Additional practices</td>
<td>Biologic control</td>
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<tr>
<td></td>
<td>Chemical control</td>
</tr>
</tbody>
</table>

To ensure effective disease control, it is crucial to combine various strategies and practices.
To be efficient, strategies and practices have to be combined (2/3)

Classification of combined practices **against weeds**

<table>
<thead>
<tr>
<th>Mains practices</th>
<th>Rotation</th>
<th>Tillage management</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Date of sowing</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Second practices</th>
<th>Seed quality</th>
<th>False seed-bed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>density of sowing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nitrogen availability management</td>
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<th>Chemical control</th>
</tr>
</thead>
</table>
To be efficient, strategies and practices have to be combined (3/3)

Classification of combined practices against pests

- **Mains practices**
  - Rotation

- **Second practices**
  - Tillage management
  - Residue management
  - Volunteers management
  - Date of sowing
  - Nitrogen availability management
  - Variety or species mixtures

- **Additional practices**
  - Biologic control
  - Chemical control
Examples of cultural practices against plant pathogens, weeds and pests

For winter wheat against diseases
Resistant variety or mixture of varieties + **late sowing date** + decrease of sowing density + decrease of nitrogen fertilization to reduce disease impacts

For winter oilseed rape against diseases and insects
Resistant variety + **early sowing date** + decrease of sowing density + decrease of nitrogen fertilization to reduce disease (*phoma lingam*) or insect impacts

For maize or sunflower against weeds
False seed-bed + **late sowing date** + Competitive variety choice + mechanical weeding
Conclusion

• Modification/change of sowing date could be a efficient alternative practice to reduce impact from different pests,

• To be efficient, this practice need to be combined with different others practices,

• To reduce pest impacts, it is necessary to act as early as possible to decrease theirs pools