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
  - Directive eau cadre framework in France (2015)
  - 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

pesticides sprayings

Cultural methods:
modification of sowing date

Plant PESTS

Genetic control

Different winter wheat varieties

Physical control

Mechanical weeding

Biological control

Trichogramma against *Ostrinia nubilalis* on maize

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)

IPM cs1	IPM cs2
WOSR	WOSR
WW ⇐ L	WW ⇐ L
SB	SO

Dahnsdorf (G)

IPM cs1	IPM cs2
M	M
WW	WW ⇐ L
WB	WB ⇐ L

Grignon (F)

IPM cs1	IPM cs2
WFB	SFB
WW	WW
WORS ⇐ E	HE
WW	TR
SB	M
	WW ⇐ L

Poznan (P)

IPM cs1	IPM cs2
WOSR	WOSR
WW ⇐ L	WW ⇐ L
SB	SB

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)

Before harvest , July 2014

Beginning of spring, March 2014

Current sowing date
more weed germination in autumn

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

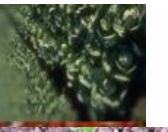
Main Weeds in the PURE WP2 trials in France

Cirsium arvense

Lolium perenne

Galium aparine

Fallopia convolvulus



Polygonum aviculare

Chenopodium album

Rumex crispus

Avena fatua - sterilis

Bromus sterilis

Positive and negative effects from none chemical methods, including sowing date, in winter wheat

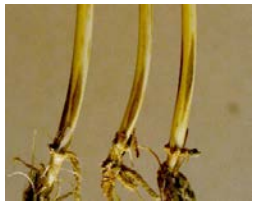
Factor	Septoria tritici blotch	Powdery mildew	Yellow/ brown rust	Tan spot	Take-all	Fusarium	Eyespot
Resistant cultivars	⇩⇩	⇩⇩	⇩⇩⇩	⇩⇩	⇩	⇩	⇩⇩
Early sowing	⇧⇧	⇩	⇩		⇧⇧		⇧⇧
Minimum tillage after wheat				⇧⇧		⇧⇧	⇧
Increased seed rate	⇩	⇧⇧	⇧⇧				
High nitrogen	⇧	⇧⇧	⇧⇧	⇧	⇩		⇧

Dilemmas with early or late sowing in wheat in Denmark

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

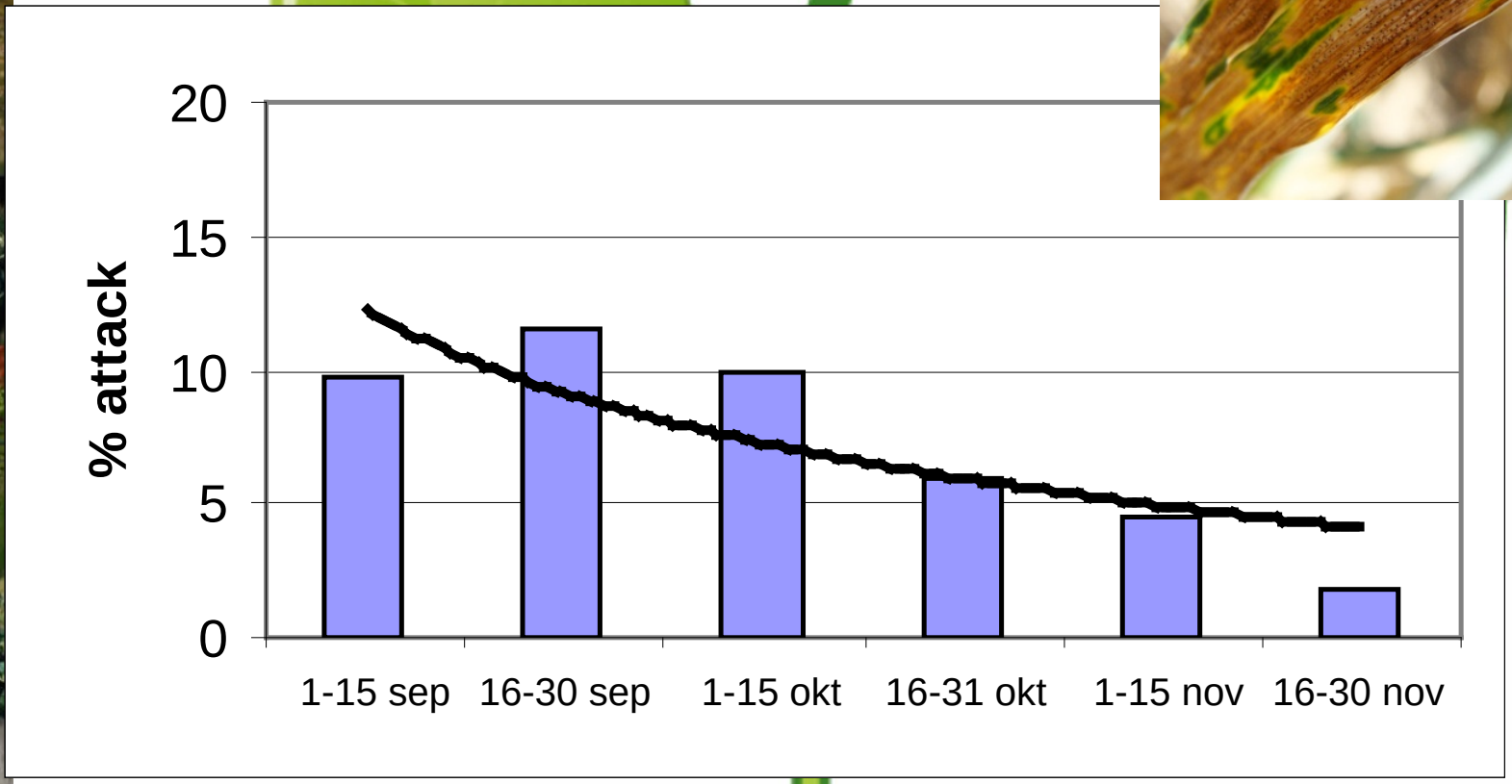





- Late sowing increase:
  - Mildew
  - Yellow rust
  - Risk of slugsattack



Link between sowing dates and attack of septoria (3513 UK fields)



Gladder *et al.*, 2001

Winter wheat take all. Effect of sowing date

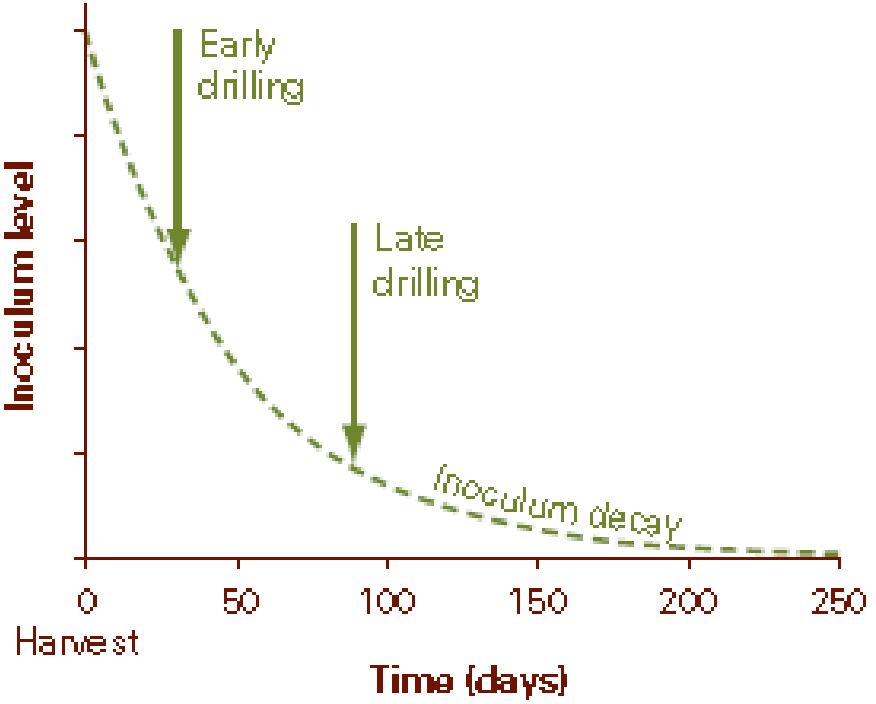


Figure 6. Inoculum level and driling date: later drilling = lower inoculum

Data from Rothamsted

Sowing times effect on septoria and yield

Sowing date	% attack in June	% attack in Jully	Yield (dt/ha)
1 September	2.4	4.1a	80.7
20 September	1.8	2.9b	80.5
10 October	1.2	2.7b	55.5

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**

Main practices	
	Rotation Variety choice Variety or species mixtures
Second practices	
	Seed quality Tillage management Residue management Volunteers management **Date** and density **of sowing** Nitrogen availability management
Additional practices	
	Biologic control Chemical control

➔To be efficient, strategies and practices have to be combined (2/3)

Classification of combined practices **against weeds**

Mains practices

Rotation
Tillage management
Date of sowing

Second practices

Seed quality
False seed-bed
density of sowing
Nitrogen availability management
Variety choice

Additional practices

Biologic control
Chemical control

➔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