Designing innovative winter crops based cropping systems

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Why redesign cropping systems?

• There is strong economic and strategic need to control pests
• But also strong socio-political and environmental pressure to limit pesticide usage

What constitutes a cropping system?

o Crops and their sequence
o Season of cropping
o Crop management
  — including crop protection measures

All these can influence pesticide use
Winter crops in Denmark, England & France

- Winter wheat, winter oilseed rape & winter barley

  o Denmark, 2008 figures
    - 35% of the total arable area
    - Winter wheat composed 42% of the small grain cereals

  o England, 2007 figures
    - 69% of the total arable area
    - Winter wheat covered 64% of the small grain cereals

  o France, 2007 figures
    - 65% of arable crops
    - Winter wheat composed 56% of the winter crops
Redesigning cropping systems

- **Alternative systems (AS)**
  - Currently available technologies
    - Integrated pest management systems
    - Organic cropping
  - Tested, knowledge of effects in cropping system
  - Ready-to-use

- **Innovative systems, level 1 (IS1)**
  - Existing technologies
  - Not yet tested in cropping systems

- **Innovative systems, level 2 (IS2)**
  - Look into the future, 10-20 years ahead
  - Developing technologies
  - Predict performance in various future scenarios (as defined by ENDURE foresight study)
The Danish approach

- **Current system**
  - Intensive crop and pig producers
  - Strong reliance on pesticides
  - Strenuous crop sequences
  - Major pest problems
    - Annual grass weeds and cleavers
    - Weevil, pollen beetle, aphids
    - Rust, mildew, septoria, net-blotch

- **Non-negotiable requirements:**
  - Secure the supply of forage grain
  - Comply with crop preferences
  - Economically feasible

**Danish pesticide consumption is already low**
Current crop sequence:
  w barley – w rape – w wheat – w wheat

AS and IS1 crop sequence
  w barley – w rape – w wheat - w wheat + catch crop – s barley + catch crop – s barley

AS tools
- Inversion tillage
- Stubble cultivation
- Choice of variety
- Sowing time
- Row cropping of oilseed rape

IS1 tools
- Farm logistics
- Precision technologies (GPS)
- Breeding programmes
- Trap cropping
- Application, forecasting, decision support

TFI-current: 2.5  ➔  TFI-AS: 1.68  ➔  TFI-IS1: 1.57
The UK approach

- **Current system**
  - Intensive arable
  - Major pest problems
    - black grass (resistance), bromes
    - aphids/virus, flea beetle, pollen beetle (resistance), slugs
    - *Septoria* (resistance), yellow rust, *Phoma*, light leaf spot, *Sclerotinia*

- **Non-negotiable requirements:**
  - Maintain yields and farm incomes

- **Crop protection strategy:**
  - Pesticides and cultural control (e.g. cultivations, sowing date, crop rotation)
Current crop sequence:
w wheat - w wheat/w barley - w oilseed rape

**AS crop sequence**
w wheat – s beans –
w wheat – s barley – w rape

**AS tools**
- lengthening rotation
- pesticide targeting and resistance management
- diversifying crops
- minimising tillage where possible
- conservation biological control
- resistant cultivars

**IS1 crop sequence**
w wheat – s beans – s barley – w rape

**IS tools**
- lengthening breaks between wheat crops
- greater proportion of spring crops
- precision farming
- trap cropping
- rape on wide rows
- landscape management

TFI-current: 6.2 ➔ TFI-AS: 3.8 ➔ TFI-IS1: 2.7
Innovative cropping systems: The French approach

The French approach

- **Current systems**
  - Intensive cropping systems, low proportion of non-productive areas in the regions considered
  - Strong reliance on pesticides (TFI 5.8-7.1)
  - Major pest problems:
    - Autumn weeds in cereals
    - Stem weevil & pollen beetle in WOSR, aphids in cereals
    - *Septoria* in cereals, *Sclerotinia* in WOSR

- **Characteristics of the farms considered**
  - Equipped for mechanical weeding
  - Opportunity to sell forage crops for cattle livestock
**Innovative cropping systems: The French approach**

**Current crop sequence:**
- w rape – w wheat – w barley

**AS crop sequence**
- w.rape-w.wheat-w.barley-(legumes)-sunflower-w.wheat

**AS tools**
- Diversify crop rotation
- Use of resistant cultivars against diseases, cultivar mixtures
- Diversify sowing periods (spring crops and sowing dates)
- Mechanical weeding and stale seedbed

**IS1 crop sequence**
- W.rape-w.wheat-s.barley-(mustard)-sunflower-triticale

**IS1 tools**
- Enhanced use of AS tools
- Landscape management
- Biological control (e.g. Contans®)

**TFI-current: 5.8 – 7.1** → **TFI-AS: 2.2** → **TFI-IS1: 0.4**
Conclusions

Farm level
- Considerable scope for pesticide reduction
- Improved environmental sustainability in the UK and French proposals
- Different local contexts, constraints and priorities led to different approaches to pesticide reduction:
  - UK and DK: Modifying existing systems
  - France: Developing systems from a zero pesticide scenario

National or European level considerations
- Full socioeconomic and environmental analysis needed
- Implications for markets, prices, food security
- Policy instruments for implementation

http://www.endure-network.eu/endure_publications/deliverables (DR 2.16)
Developing higher level innovative cropping systems (IS2)

- **Objectives**
  - Look further ahead, 10-20 years, to the development of higher level innovative systems
  - Identify immature technologies that could contribute to pesticide reductions
  - Help to define long-term research priorities

- **Methodology**
  Workshop with relevant experts:
  - Address the 5 future scenarios described by the ENDURE Foresight study
  - Identify innovative technologies relevant to each scenario
  - Highlight technologies with the most robust potential across all scenarios

http://www.endure-network.eu/endure_publications/deliverables (DR 2.24)