Cover crops choice and management for spring cropping

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Outline

1. Why grow cover crops
2. Cover crop choice to achieve objectives
   • Rotational conflicts
3. Establishment timing
4. Establishment method – focus on oversowing
5. Methods & timing for destroying cover crops
6. Impacts of Cover cropping
   • Nitrate leaching
   • Nitrogen supply to following crop
   • Earthworms
7. Research gaps
8. Conclusions
Why grow cover crops?

1. As a ‘catch crop’ - reduce erosion, run-off and nitrate leaching
   - Retain N (and P) – improve soil fertility
   - Increase N retention – maybe available to next crop

2. As ‘green manure’ to return fresh organic matter – benefits for soil condition

3. Disrupt pest and disease cycles or for weed management

4. Grazing/forage production offers financial return
Considerations

- Cover crop species – straight or mix?
  - What do I want to achieve
  - What fits with my rotation
  - Seed costs
  - Do they need to be EFA compliant

- Establishment?
- Management?
- Destruction?
# Cover crop species

- **Legumes**
  - Vetch, clovers, peas, beans, trefoil
- **Non-legumes**
  - brassicas: mustards, radish
  - grasses: rye/oats
  - others: phacelia, buckwheat, chicory

<table>
<thead>
<tr>
<th></th>
<th>Brassicas</th>
<th>Legumes</th>
<th>Grasses and cereals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Examples</strong></td>
<td>Mustards, radishes,</td>
<td>Vetch, clovers, peas</td>
<td>Oat, rye, ryegrass</td>
</tr>
<tr>
<td><strong>Benefits</strong></td>
<td>Rapid growth Deep rooting</td>
<td>Fix nitrogen (modest over-winter) Potential for deep rooting</td>
<td>Good early ground cover Wide range of sow dates</td>
</tr>
<tr>
<td><strong>Sowing</strong></td>
<td>Late summer/early autumn-sown</td>
<td>Slower growing and often need to be sown earlier (late Jul-Aug)</td>
<td>Sowing times vary with species; Jul - Sept.</td>
</tr>
<tr>
<td><strong>Considerations</strong></td>
<td>Good autumn establishment is critical Potential rotational conflicts, e.g. clubroot,</td>
<td>Careful establishment of small-seeded legumes. Potential rotational conflicts</td>
<td>Can act as a green bridge for cereal pests and diseases.</td>
</tr>
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Rotational conflicts

<table>
<thead>
<tr>
<th>Existing cropping</th>
<th>Avoid the following as a cover crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals in rotation</td>
<td>Rye or Ryegrass</td>
</tr>
<tr>
<td>Oilseed rape in rotation</td>
<td>Mustards or Radish</td>
</tr>
<tr>
<td>Pulses and legumes</td>
<td>Legumes e.g Vetch or clovers</td>
</tr>
</tbody>
</table>

Table adapted from Agrovista “cover crops for the future on your farm”
To include information on legumes from AHDB sheet 41
AHDB Maxi Cover Crop – spring barley yields cross site analysis

3 site years

Trend for lower spring barley yields following cereal cover crops

\[ F > 0.005 \]
Effect of establishment timing

• Drilling after mid-September can significantly reduce cover crop biomass & N-uptake (Van Erp and Oenma, 1993)

Data taken from Richards et al., 1996
Catch crops – nitrogen uptake

- **Mainly** influenced by: cover crop species, drilling date, weather conditions. **Lesser extent**: N-status of soil

- N-uptake can range from 10 to 150 kg N/ha (Silgram and Harrison, 1998)

<table>
<thead>
<tr>
<th>Species</th>
<th>1991 (dry autumn)</th>
<th>1993 (wet autumn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volunteer wheat</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>Forage Rape</td>
<td>-</td>
<td>48</td>
</tr>
<tr>
<td>Winter Barley</td>
<td>20</td>
<td>51</td>
</tr>
<tr>
<td>Winter Rye</td>
<td>22</td>
<td>55</td>
</tr>
<tr>
<td>Phacelia</td>
<td>25</td>
<td>39</td>
</tr>
<tr>
<td>Oilseed Rape</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>White Mustard</td>
<td>30</td>
<td>57</td>
</tr>
<tr>
<td>Stubble Turnips</td>
<td>-</td>
<td>63</td>
</tr>
</tbody>
</table>

Data taken from: Froment and Cook, 1995
Oversowing maize demonstration 2018-2019

• To demonstrate the impact of oversowing perennial ryegrass or tall fescue on maize yields and quality compared to conventional practice

• To demonstrate the impact of perennial ryegrass or tall fescue ground cover on over-winter nitrate-N (NO₃-N) leaching losses compared to conventional practice
Methods to establish ground cover in maize

• Drilling maize and grass/clover at same time, can significantly reduce maize yields (e.g. reductions of c.40-50% Defra, 2001)

• Alternative approach is oversowing

Impact on maize yield:

• Limited UK evidence, oversowing maize with ryegrass reduced maize yields by c.5% compared to conventional practice (Defra, 2001)

Oversowing method:

• Oversowing maize by broadcasting seed successful in 3 out of 5 site years, dependent on rainfall (Defra, 2015)

• Research in Denmark – most effective method was to drill 3 rows, and leave 20cm gap between maize row and cover crop – small yield reductions on low to medium fertility soils (Hans Spelling Oestergaard, 2015)
Oversowing drill

- Maize oversown at 6-8 leaf stage (20 June 2018)
- Drill 3 rows of grass
- Maize row width 75cm
- Seed rate 6 kg/ha
Treatments & Measurements

Farm in North Lincolnshire – Loamy sand soil
Large plots, 22 m x 100m – to accommodate farm machinery

**Treatments:**
1. Conventional maize
2. Maize over-sown with ryegrass
3. Maize over-sown with tall fescue

- Maize yields and N-offtake
- Soil mineral nitrogen and cover crop N-uptake (pre and post over-winter drainage)
- Nitrate leaching losses, over-winter (2018-2019)
- Visual evaluation of soil structure
Total nitrate-N leaching losses

October to January (inclusive)
Total rainfall = 168 mm
Total drainage volume = 60 mm
Maize yield and nitrogen offtake Results

Harvest:
24 September 2018

• One site-year of harvest results
• Drought conditions in 2018 likely to have negatively impacted yields
• Trial repeated harvest year 2019 – results pending
Defra ‘Competitive Maize’ study Fakenham: sediment loss (over-winter 2012/13)

$P < 0.01$

- Conventional
- Ryegrass
- Biodiverse mix

$I =$ standard error

Treatment
Cover crop demonstration in Lincolnshire, 2017-18

A demonstration (i.e. un-replicated plots) was carried out in 2017-18, to compare nitrate leaching losses from bare cultivated soil, stubble, and 3 different cover crop treatments:

- Stubble
- Cultivated
- Oats with mustard
- Radish with Oats
- Premium mix
Total nitrate-N leaching losses

- Stubble: Cover <5%
- Cultivated: Cover 35%
- Oats with mustard: Cover 60%
- Radish with oats: Cover 80%
- Premium mix: Cover 90%

Cover crops drilled
29 August 2018

September to January (inclusive)
Total rainfall = 300 mm
Cover crop destruction

• Timing of destruction - affects soil temperature, soil moisture, nutrient cycling and workability of soil
• Timing will be dependent on, following crop, weather conditions, soil type i.e. site dependent
• Studies have shown late destruction can negatively impact on spring crop establishment – due to wet soils
• Ecological Focus Areas: catch crops (14 October) and cover crops (15 January)
• However, some species not frost tolerate (e.g. buckwheat)
Cover crop destruction

- Glyphosate, flail, crimp, roll, disc, graze?
- Field lab 2017-18: 5 farmers, split field/tramline trials:
  - Radish/oats or Phacelia/mustard/clover/buckwheat mixes
  - Disease and weed pressure
  - Crop establishment
  - Yield

  A- Rolled once
  B- Rolled twice
  C- Flailed (25 Nov)
  D- Crimped (9 Dec)
Soil benefits

Reduced Erosion
• Decrease erosion and run off if sufficient canopy cover (>30%)

Soil Organic Matter
• Effects are variable & difficult to detect
• Overtime increases in SOM
• No study reported a decline

Soil structure & Physical properties
• Some evidence for increased aggregate stability & reduced bulk density

Soil Biology
• Some evidence for increased earthworm populations
Maxi Cover-Crop: carry-over effect on winter crops? soil properties in WOSR,

Measurements taken one year after cover cropping Kent site, 2018
Yield and N-uptake of the following crop

- UK studies have shown – 15 to 50 kg N/ha can be recovered by the following crop (Silgam et al., 2015)

The amount of N released is affected by, for example:
- CC Biomass
- Timing & method of destruction
- Residue quality (greater mineralisation from legumes & brassicas (i.e. lower C:N ratios), compared to cereals)

The AHDB cover crop review found that:
- Yield response is variable
- NIAB TAG studies found on average c.0.36 t/ha yield response from covers ahead of spring barley (5 years of data)
Research gaps – focus on management practices

• Robust UK cover crop guide - disease pest susceptibility, suitability for different soils and climates - bring evidence together

• Nitrogen release: Destruction method & timing, soil type, cover crop species, N-fertiliser replacement values & longer term impacts on nitrate leaching losses

• Grazing cover crops – impact on over-winter nitrate leaching and nutrient release to the following crop

• Impacts on weeds, pests and diseases in the main crop

• Long-term cost benefit analysis – take account both gross margins and environmental benefits
Summary

• Cover crop selection,
  • Consider rotational conflicts
  • Be clear on objectives – catch crop, fertility building
• Early establishment important
• When well established cover crops can reduce nitrate leaching by up to 90% and sediment losses by up to 90%
• Volunteer weeds can reduce nitrate leaching losses by c.35%
• Cover cropping on heavy soils: wet springs = wet topsoils; destroy early to allow drying
• Variable impacts on yield
Thank you

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