Cover crops choice and management for spring cropping

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ADAS

Outline

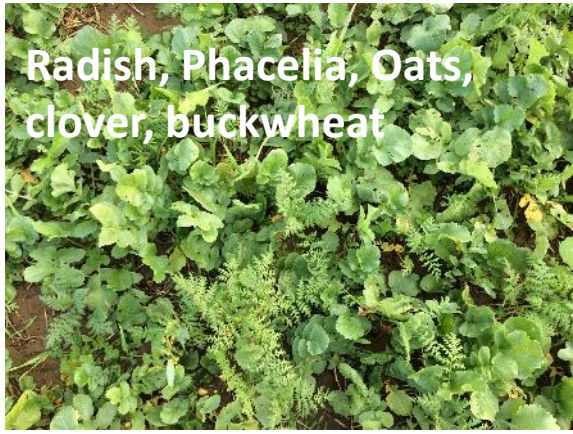
1. Why grow cover crops
2. Cover crop choice to achieve objectives
   - Rotational conflicts
3. Establishment timing
4. Establishment method – focus on oversowing
5. Methods & timing for destroying cover crops
6. Impacts of Cover cropping
   - Nitrate leaching
   - Nitrogen supply to following crop
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

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

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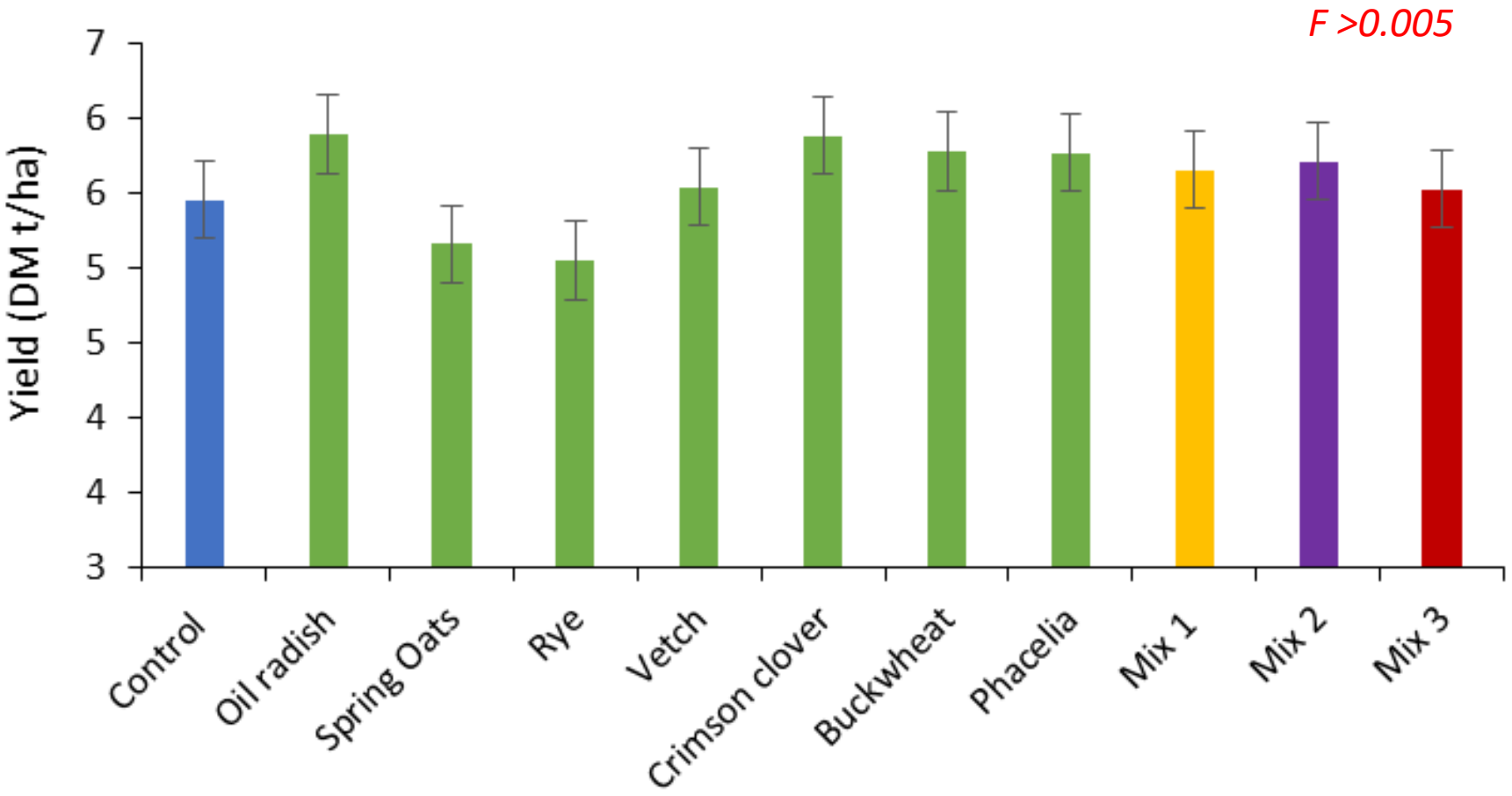
Rotational conflicts

Existing cropping	Avoid the following as a cover crop
Cereals in rotation	Rye or Ryegrass
Oilseed rape in rotation	Mustards or Radish
Pulses and legumes	Legumes e.g Vetch or clovers

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

Effect of establishment timing

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

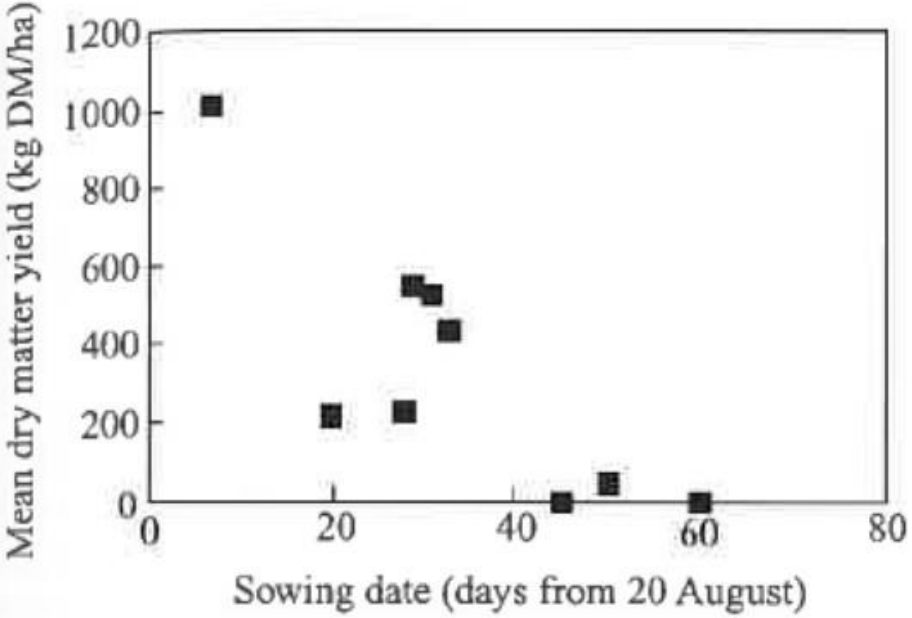


Fig. 1. Relationship between mean dry matter (DM) yield of sown cover crops at time of incorporation (DMY) and date of sowing (DT, in days from 20 August): DMY = 906 (S.E. 167) − 16·9 DT (S.E. 4·5).

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)

Species	1991 (dry autumn)	1993 (wet autumn)
	N-uptake (kg N/ha)	
Volunteer wheat	15	45
Forage Rape	-	48
Winter Barley	20	51
Winter Rye	22	55
Phacelia	25	39
Oilseed Rape	15	-
White Mustard	30	57
Stubble Turnips	-	63

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 (NO_3-N) leaching losses compared to conventional practice

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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

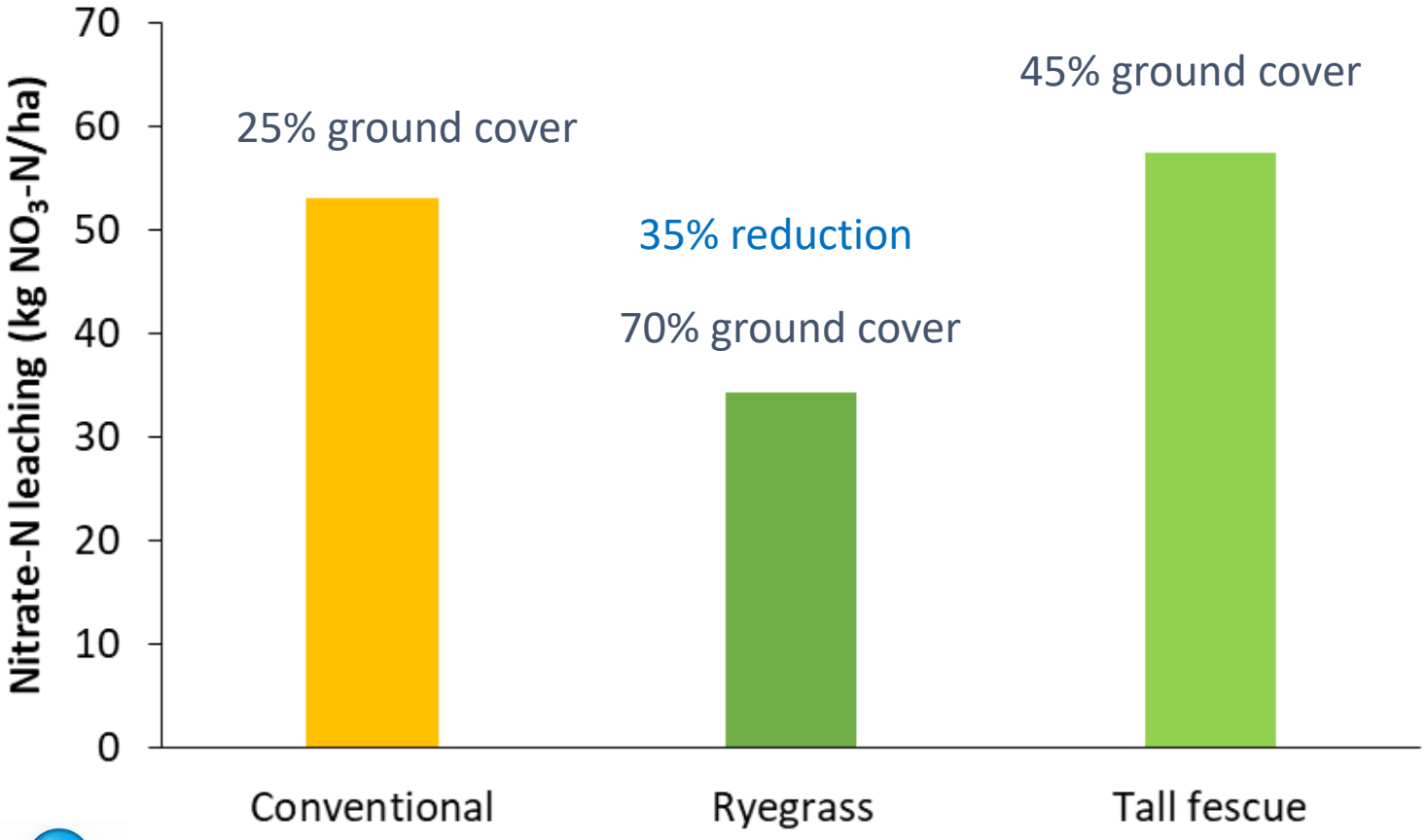
Large plots, 22 m x 100m – to accommodate farm machinery

Treatments:

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

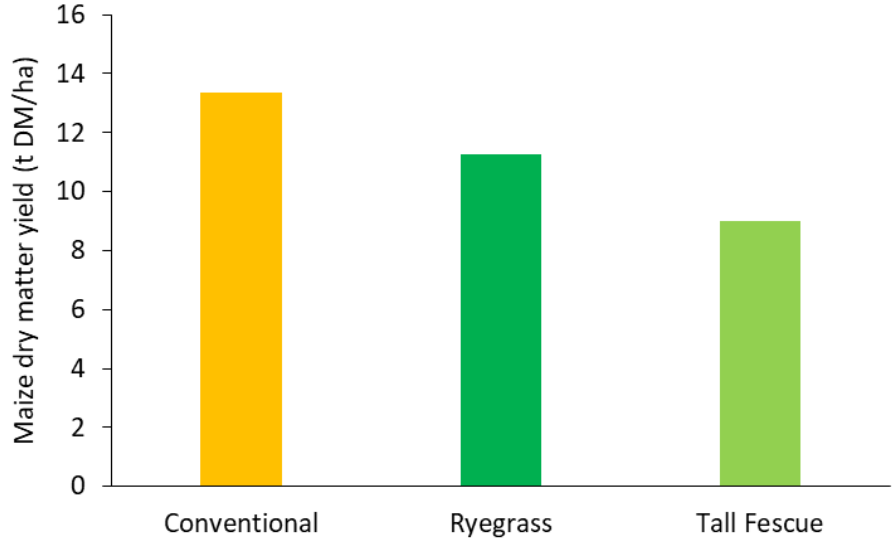
- Maize yields and N-offtake
- Soil mineral nitrogen and cover crop N-uptake (pre and post over-winter drainage)
- Nitrate leaching losses, over-winter (2018-2019)
- Visual evaluation of soil structure

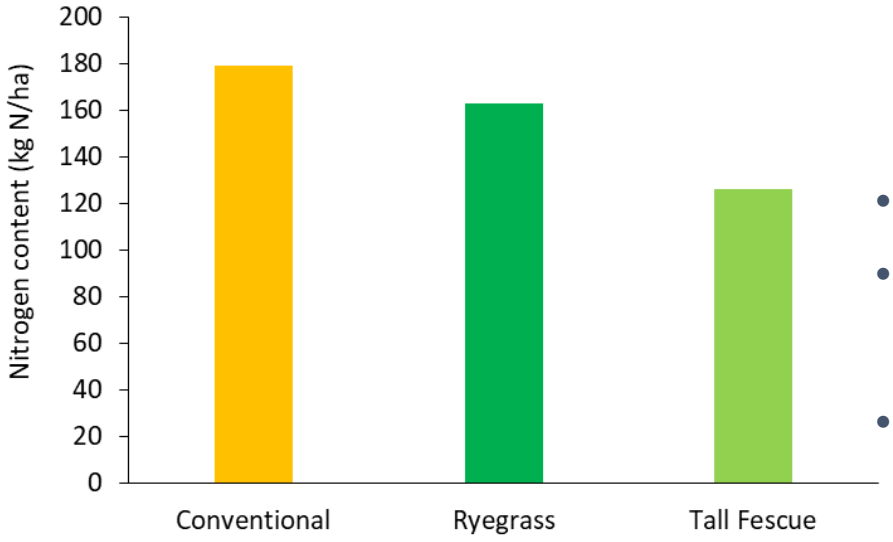
Total nitrate-N leaching losses



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

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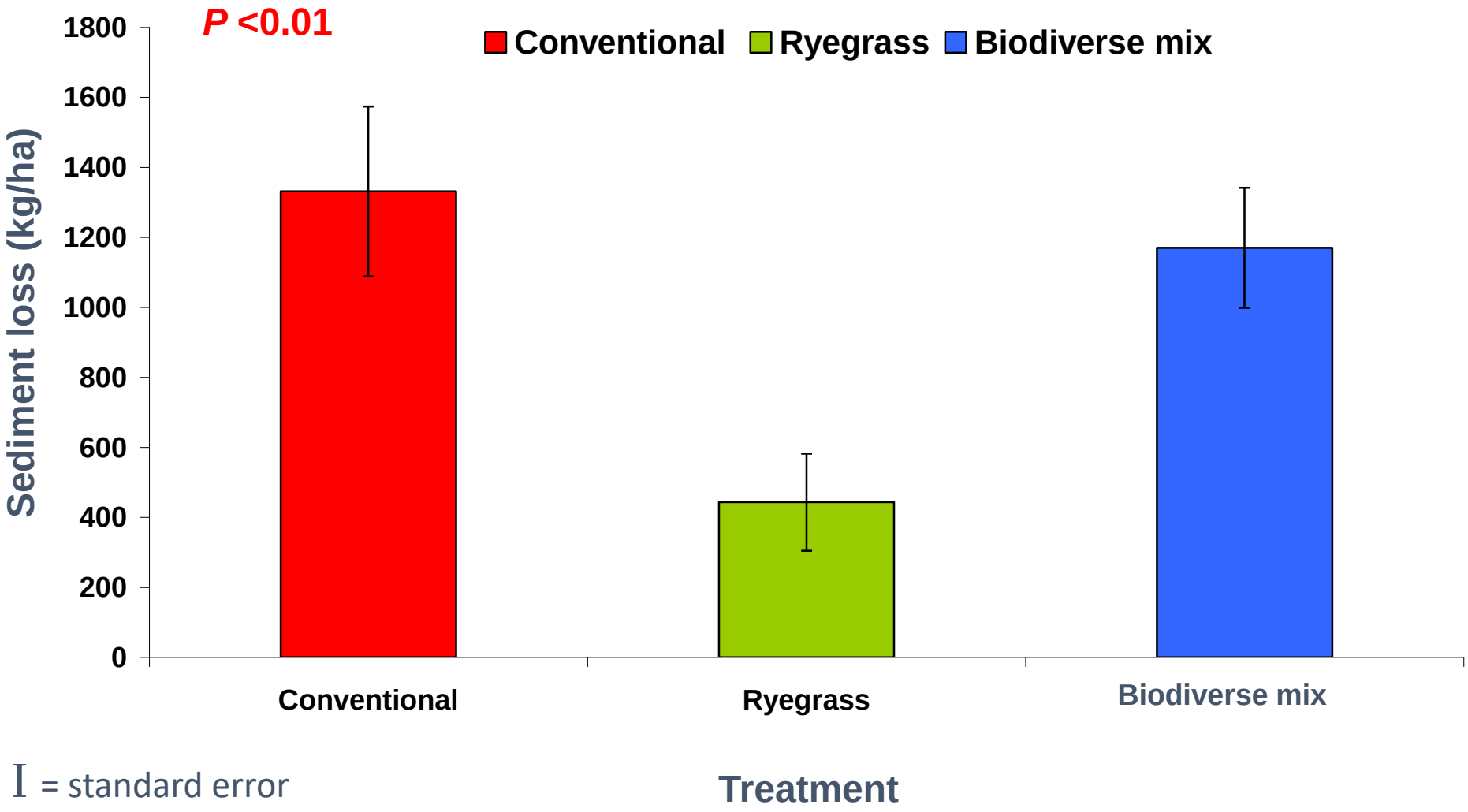
Defra ‘Competitive Maize’ study Fakenham: sediment loss (over-winter 2012/13)



I = standard error

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

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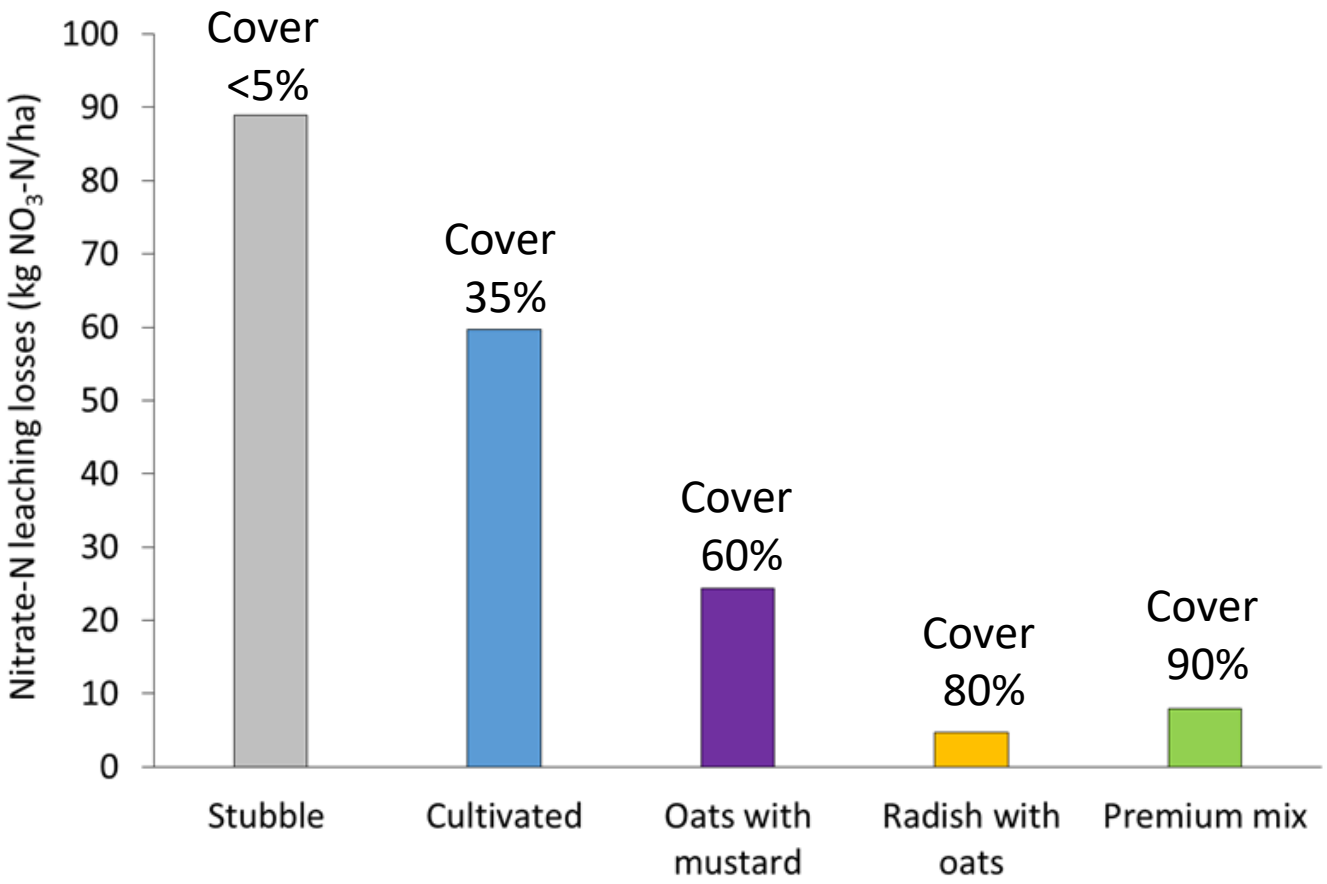
Total nitrate-N leaching losses



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

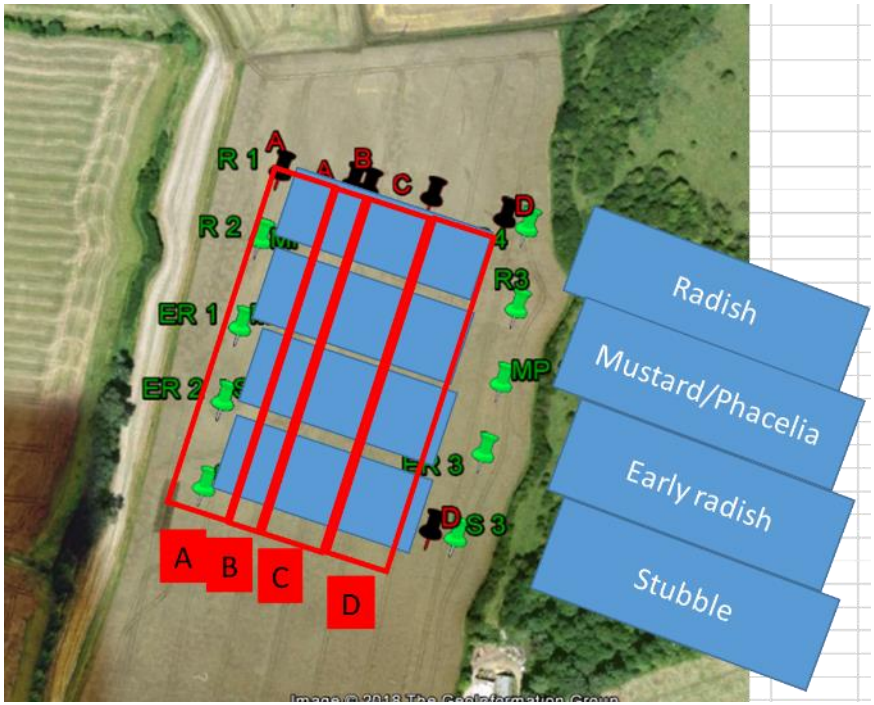
- Glyphosate, flail, crimp, roll, disc, graze?
- Field lab 2017-18: 5 farmers, split field/tramline trials:
  - Radish/oats or Phacelia/mustard/clover/buckwheat mixes
  - Disease and weed pressure
  - Crop establishment
  - Yield

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

Impact of cover crop on soil condition

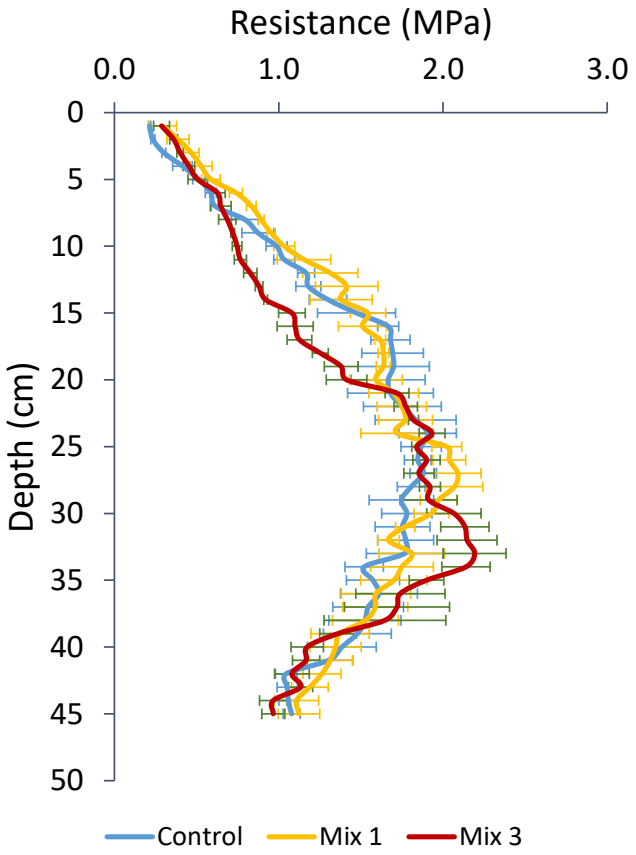
Rugeley, Staffs (03/02/12)

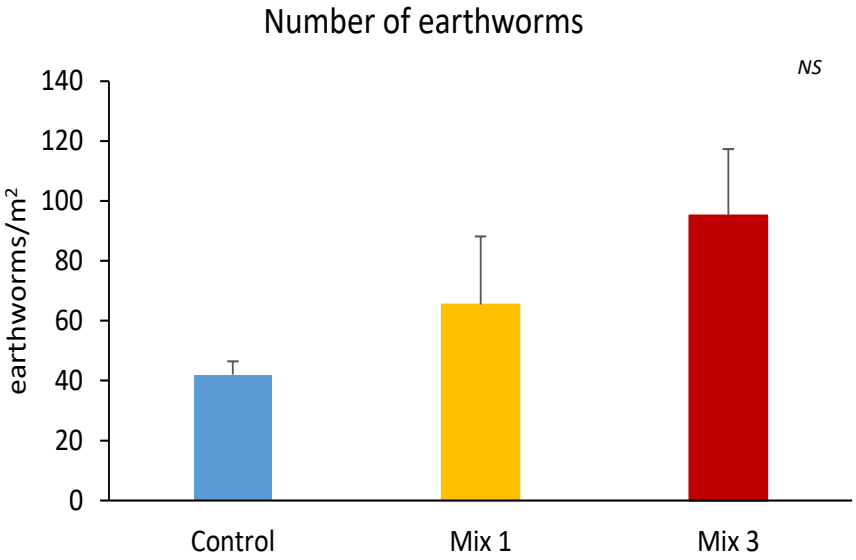
Bare stubble

Oil radish

NIAB

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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Lightly disced


Ryegrass


'Biodiverse' mix


Phacelia

Acknowledgements

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