Protein crop options for Scotland with potential for more than one end-use: Intercropping as a tool

[1]ROBIN WALKER, [1]CHRISTINE WATSON, [1]JOHN BADDELEY, [2]OLUYINKA OLUKOSI and [3]JOS HOUDIJK

[1]SRUC, Craibstone, Aberdeen, Aberdeenshire, UK AB21 9YA

[2]SRUC, Auchincruvie, Ayr, KA6 5HW

[3]SRUC, Roslin Institute Building, Easter Bush, Midlothian, EH25 9RG

Leading the way in Agriculture and Rural Research, Education and Consulting

Background

- Increasing concerns from policy makers regarding food and feed security (particularly protein)
  - in Scotland, the UK and EU
- There is also a commitment towards more sustainable forms of food and energy production
- Production of protein crops for animal feed and especially human food in the UK (e.g. the grain legumes peas, beans and lupins) is often problematic
  - acceptable yield and quality difficult to achieve consistently
  - particularly tricky in the North of the UK

SRUC research on alternative crop options for Scotland

- **Diverse / multi-functional end use** of forage cropping systems
  - Food / feed / bedding
  - **Protein**
    - Replacement for SBM
  - Energy
    - Primarily around AD process
  - Environmental
    - CAP
    - N-fixing, soil improver, biodiversity
- Trial work on **protein crops**
  - With or without **intercropping**

Winter rye

Energy crops

Protein crops

Greening crops

Protein crops for Livestock

Rational

- Livestock production systems depend on our ability to provide sufficient quantities and quality of (metabolizable) energy and nutrients

Currently a great reliance on soya bean meal (SBM)

Can we shift from imported SBM to home grown options (in this case in Scotland)

- **Forages**
  - Increased protein levels in whole crop forage (silage)
- **Concentrates**
  - SBM replacement with home grown alternatives
  - Home-grown soya (?)

Investigation of options for plant protein production in Scotland

Demonstration of potential – for livestock (and human use)

- Try to encourage farmers to think about growing more protein on farm
- Typical protein crops (although still relatively minor)
  - Beans, peas and lupins
- More unusual protein crops (?)
  - Soya & lentils (& Fat hen)
- Demonstration of alternative practices
  - Intercropping (with cereal)

Approach @ “Hub site”

SRUC

Based on known / suggested agronomy

- **Basic approach following from previous years**
  - **Discussion with farmer group (EU ReMIX)**
    - **Sowing rate treatment – in mixtures**
- **Yield / quality** sampling regime
  - **Multi-use options** aimed for
    - Biomass, Silage, Combinable grain
  - Feeding value
    - Analysis of micro-silage
    - Pulse use in animal feeding studies

ReMIX
Species mixtures for redesigning European cropping systems

UK MAP
www.remix-intercrops.eu

UK MAP

- **ReMIX presented**: by SRUC at several of their own and third party events
  - E.g. demo at Cereals in Practice, Innovative Farmers Field Labs, SOPA meetings
- Potential contacts via **SRUC advisory service** and other networks
- Follow up **emails** and **phone exchanges** with farmers & other interested parties (e.g. processor)
  - Conventional and organic - all have experience of intercropping – 2 farmers have intercrops on both organic and conventional land
- **closed Facebook Group** - easier flow of information

UK MAP (5 farmers; 1 processor; 2 organic certification bodies; several researchers)

Many intercrops (all spring sown)

Central hub Peas, beans, lupins, lentils - sole cropped (except lentil) and with spring cereal – different ratios (60/40 & 40/60) tested

Satellite farms **(1)** Beans & oats (O and C); Peas, OSR & oats (C); Barley & OSR (O); Barley, strawberry clover, white clover, yellow trefoil (C). **(2)** Peas & barley (O & C) – with sole pea & barley crops. **(3)** Peas & wheat (O). **(4)** Beans & OSR (C); Oats & clover (C); Lentils & flax (C). **(5)** Pea & barley (O); Pea & wheat (O), Barley & wheat (O); Barley, wheat & peas (O); Barley, wheat, peas & vetch (O) – with sole barley, wheat & pea crops.

Next steps

- Maintain dialogue between all MAP partners
  - email / phone / Facebook
- Adapt and clarify the management with each farmer individually
- Determine their needs for research support
- Determine ability to collect basic data for comparison
- Arrange link up meeting(s) - ideally in summer
- RNAS and CiP events (and others)

Peas - spring barley

Pea sole cropped

Pea-barley intercrop

Lupins - spring barley

Lupin sole crop

Lupin-pea intercrop

Beans - spring barley

Faba bean sole crop

Faba bean-barley intercrop

Lentils with spring oat scaffold

Anicia

Gotland

Protein content of grain (2016 & 2017)

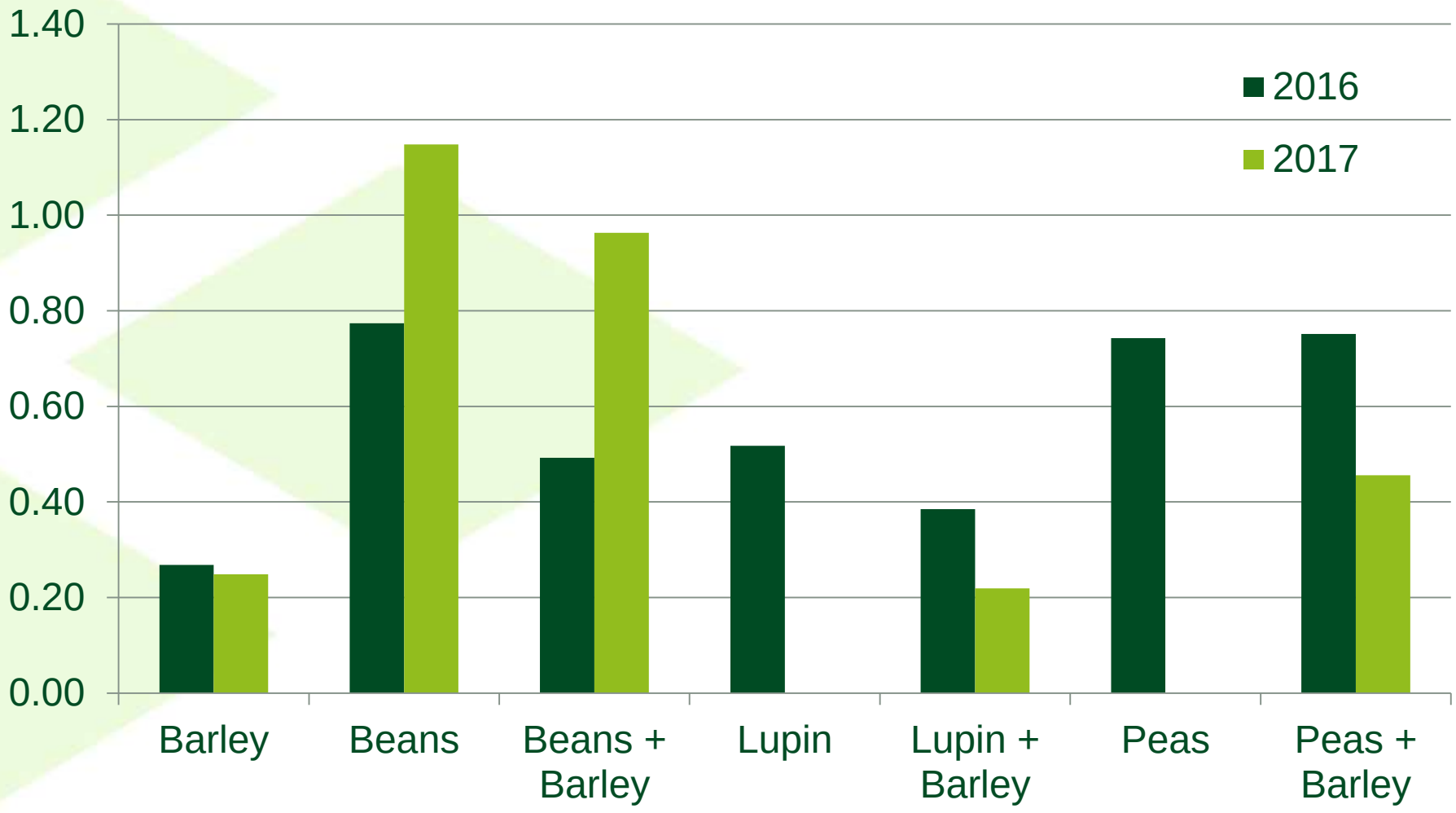
2016			
Grain Legume	% Protein	StDev	SEM
Beans	27.0	1.26	0.63
Beans + Barley	27.0	1.23	0.61
Lupin	30.2	2.93	1.46
Lupin + Barley	32.3	0.13	0.09
Peas	23.8	0.50	0.25
Peas + Barley	23.0	0.56	0.28

2016			
Cereal	% Protein	StDev	SEM
Beans + **Barley**	13.5	1.26	0.73
Barley	8.9	0.66	0.33
Lupin + **Barley**	10.9	0.29	0.21
Peas + **Barley**	11.3	0.16	0.08

2017			
Grain Legume	% Protein	StDev	SEM
Beans	25.5	0.33	0.17
Beans + Barley	26.7	0.10	0.05
Lentil + Oat High	25.1	0.97	0.48
Lentil + Oat Low	28.1	0.65	0.33
Lupin + Barley	32.5	0.29	0.14
Peas + Barley	23.0	0.09	0.04

2017			
Cereal	% Protein	StDev	SEM
Beans + **Barley**	9.3	0.62	0.31
Barley	8.9	0.66	0.33
Lentil + **Oat** High	10.9	0.26	0.13
Lentil + **Oat** Low	10.7	0.75	0.38
Lupin + **Barley**	9.8	0.33	0.17
Peas + **Barley**	11.3	0.78	0.39

Protein Yield (t/ha)



Current “Hub” Trial

Drilled end April 2018

Spring Barley (sole)

Lentils & Oats (low & high seed rate)

Lupins & Barley

100% Lupin

60% Lupin
40% Barley

40% Lupin
60% Barley

Lupins & Barley

100% Lupin

60% Lupin
40% Barley

40% Lupin
60% Barley

Peas & Barley

100% Pea

60% Pea
40% Barley

40% Pea
60% Barley

Beans & Barley

100% Bean

60% Bean
40% Barley

40% Bean
60% Barley

How do these crops fare in terms of feed value?

Pulses and older pigs

Provided that commercial availability constraints can be overcome:

peas and faba beans are viable home grown alternatives to SBM in nutritionally balanced diets for grower and finisher pigs

Crop quality

- Feeding value of micro-silage being assessed
  - NIR (whole crop scan):
    - DM, D-value, ME, CP, NDF, WSC, Oil Ash, TFA, pH, Lactic Acid, Ammonia
  - Underpinned with wet chemistry

- Making use of beans and lupins from the field trials
  - Feeding trial (broilers)
  - Antimicrobial assessments (*in vitro* and *in vivo*)

Conclusions

- Great potential to utilize more home grown protein sources, based on historic evidence and current work going forward
- Optimal level of bioactive alternative feed ingredients for more sensitive stock (broilers, weaner pigs)
- Intercropping cereals with grain legumes can lead to more reliable production of high protein food/feed in northern UK (e.g. Scotland) than sole crops
  - With additional benefits for soil and carry-over

Thanks for your attention

- Thanks to many colleagues CSS and MSRC
- and thanks to Scottish Government (RESAS) and EU ReMIX for financially supporting this work