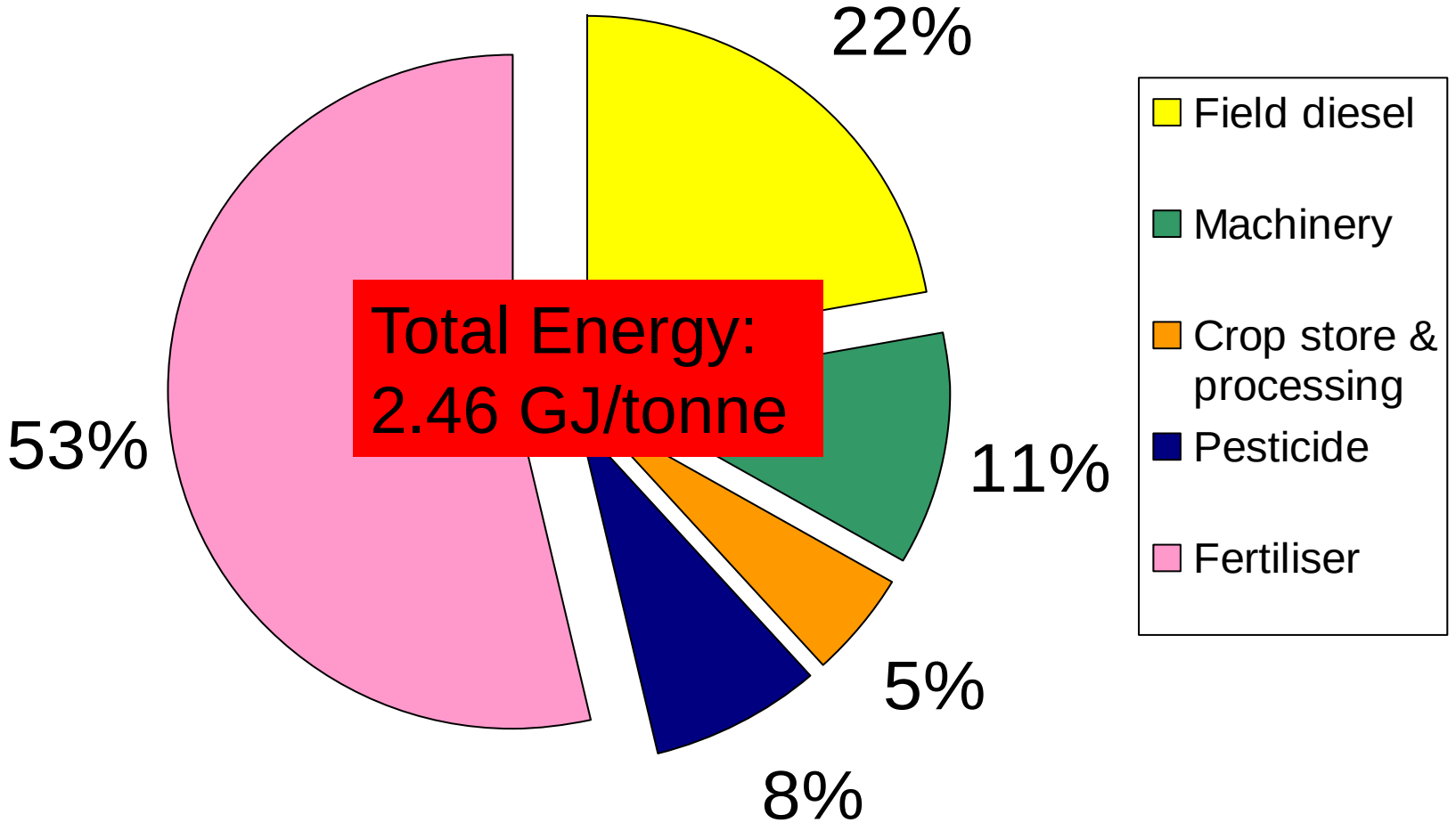
Rotations, Systems and Bio-diversity

Thursday 15th July 2010

Ron Stobart, NIAB TAG

Energy required to produce 1 tonne of feed wheat (conventional)

75% of energy = fertiliser + fuel



From a Defra Project report IS0205 by Williams and Audsley, Cranfield University

New Farming Systems

- New Farming Systems research programme
  - long term rotation project looking at reducing energy usage and pollution risks in conventional farming
  - delivered with the support of The Morley Agricultural Foundation and The JC Mann Trust.
- Main research themes
  1. **Cover crops**; The evaluation of the potential energy saving and fertility building benefits of cover crops and/or legume bi-crops within a range of rotational systems.
  2. **Cultivations**; To determine cultivation suitability within defined approaches; seeking to develop approaches where shallow tillage can be used with confidence.
  3. **Amendments**; Determining the value of soil amendments; addressing the benefits of soil amendments within the context of the potential impact of wetter winters and drier summers.

JC Mann Trust

Cultivations

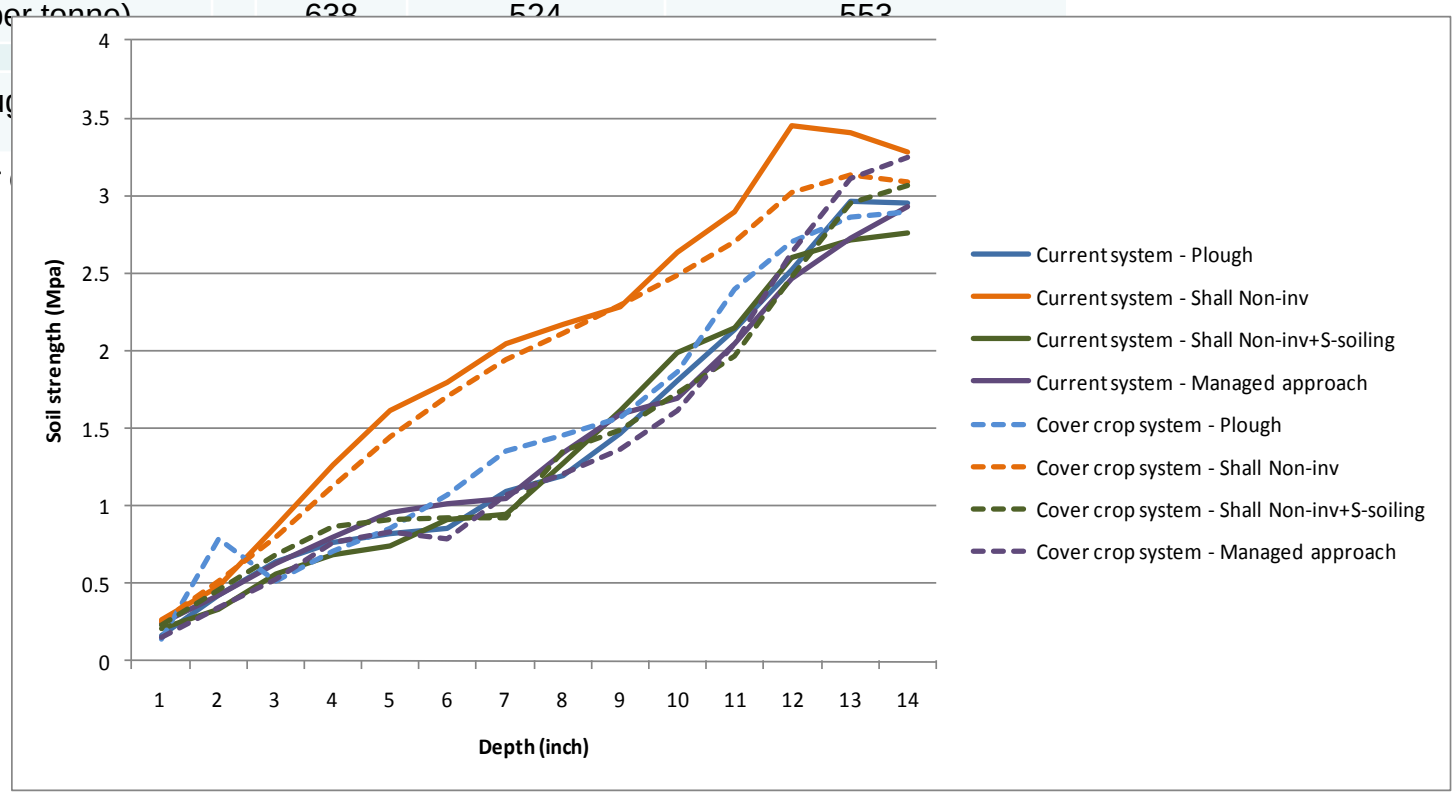
- **Aim** - To determine cultivation suitability within defined approaches; seeking to develop approaches where shallow tillage can be used with confidence.
- Rotation
  - spring cropping (winter wheat with spring break crops)
- Cover crops
  - treatments repeated with or without a brassica cover crop
- 4 x cultivation approaches
  - Plough
  - Shallow non inversion with sub-soiling
  - Shallow non inversion
  - Managed (directed by soil measurements)

Cultivation study

Plant Science into practice

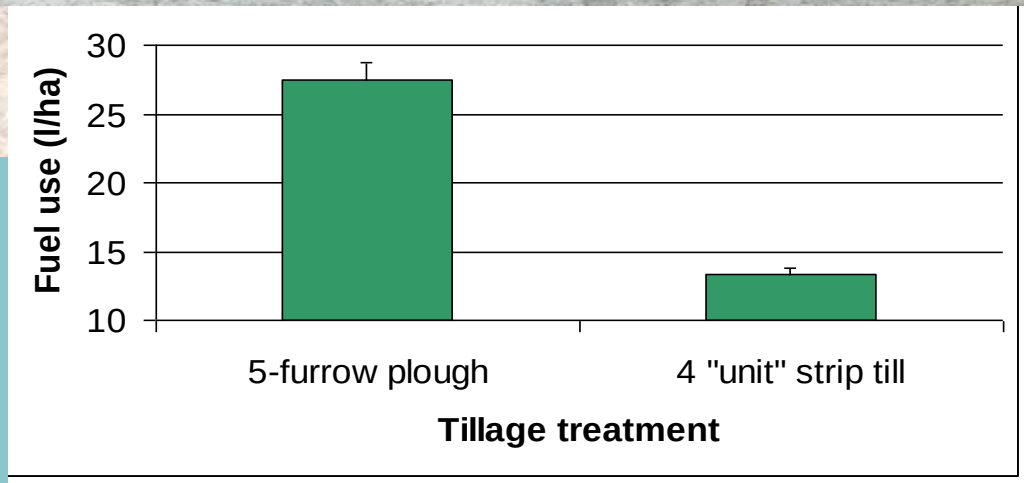
System		Plough based	Shallow non inversion	Shallow non inversion + sub-soiling
Cultivation energy (MJ)		2543	866	1341
% saving compared to plough per ha		-	65%	47%
Other energy inputs (MJ)		5596	5596	5596
Total energy (MJ per ha)		8139	6462	6937
Yield (t/ha)		12.75	12.33	12.55
Energy of production (MJ per tonne)		638	524	553
% saving compared to plou				

Thanks to Dr Doug Warner



Strip tillage

	Ha/hr	Mins/ ha
Plough	**0.80**	**75**
Strip Till	**1.02**	**60**



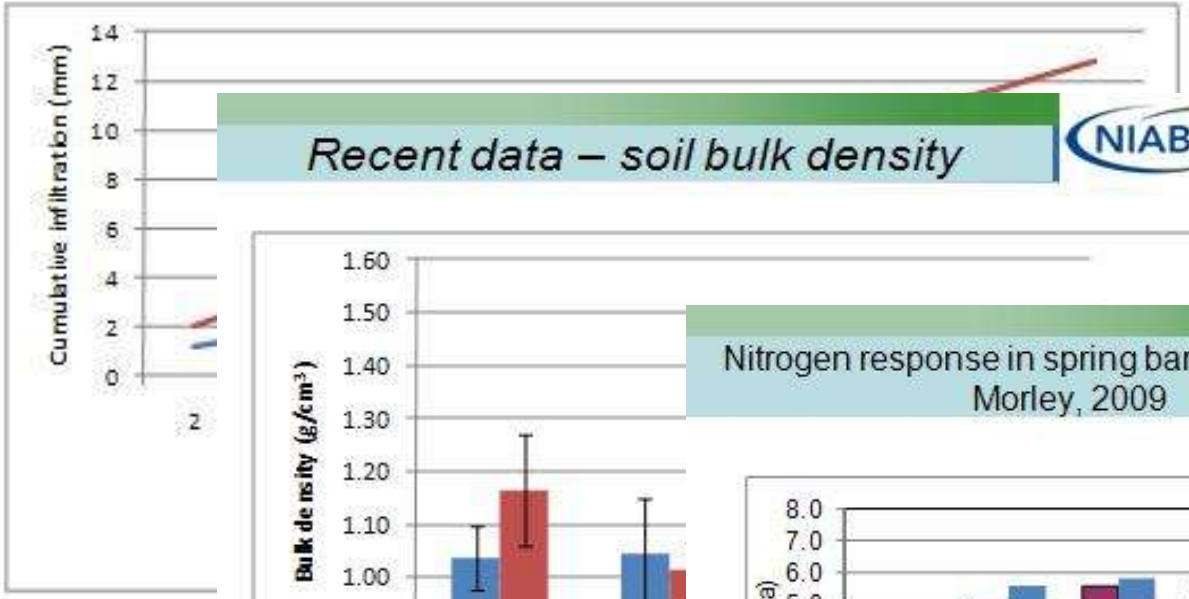
Cover Crops

- **Aim** – To evaluate the potential energy saving and fertility building benefits of cover crops or legume bi-crops within a range of rotational systems.

- Rotation
  - winter cropping (winter wheat with winter break crops)
  - spring cropping (winter wheat with spring break crops)
  - mixed (winter wheat with both winter and spring break crops)
- Cover crops
  - no cover crop
  - brassica cover crop (ahead of spring crops)
  - legume cover crop (ahead of spring crops)
  - clover bi-crop (permanent)
- Nitrogen regime
  - 0% of standard dose
  - 50% of standard dose
  - 100% of standard dose

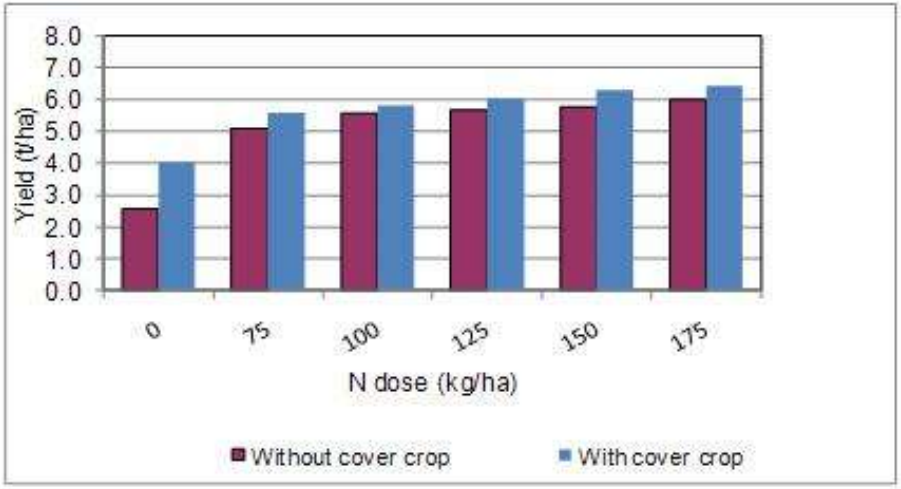
Cover crops

Recent data – infiltration (April 10)



Recent data – soil bulk density

Nitrogen response in spring barley. Yield (t/ha) Morley, 2009



LSD = 0.620 t/ha CV 6.75%

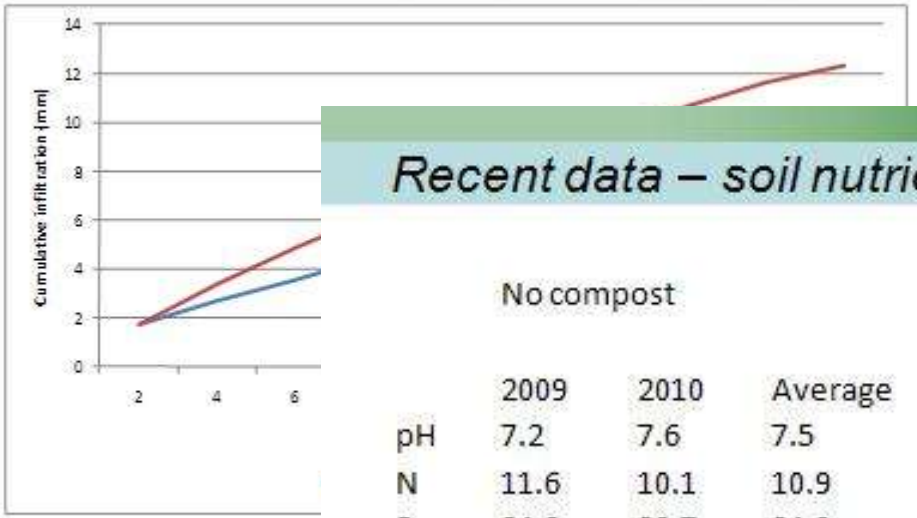
Soil amendments

- **Aim** – To determining the value of soil amendments; addressing the benefits of soil amendments within the context of the potential impact of wetter winters and drier summers.

- Rotation
  - spring cropping (winter wheat with spring break crops)
- Cover crops
  - treatments repeated with or without a brassica cover crop
- 2 x soil amendment approaches
  - 35 t/ha green waste compost applied per annum
  - standard practice (i.e. nothing applied)

Amendments study

Recent data – infiltration 2010



Recent data – soil nutrient status

	No compost			Compost		
	2009	2010	Average	2009	2010	Average
pH	7.2	7.6	7.5	7.5	7.8	7.7
N	11.6	10.1	10.9	15.4	12.0	13.7
P	24.8	23.7	24.3	33.5	31.9	32.7
K	137	106	122.0	205	192	198.5
Mg	27	30	28.5	50	48	49.0
S	20.5	10.9	15.7	20.6	11.8	16.2
OM %	1.7	2.0	1.9	2.1	2.5	2.3

Long-term straw incorporation study

- Defra-funded research involving
  - ADAS, TAG, Rothamsted Research, Harper Adams University College and the University of Abertay
- Morley experiment established in 1984
  - 6 differential rates of inorganic fertiliser N (0-250 kg/ha)
  - has resulted in the incorporation of 3-7 t/ha crop residue dry matter (*ca.* 2-5 t OM/ha) into the soils every year
  - grain yields ranged from about 2 t/ha 'no N' to 10 t/ha at 'highest N'
- Key results
  - increase in SOM at highest N rates of about 10% (1.57% to 1.74%)
  - microbial biomass (N) pool increased by *ca.*35% at the highest N application rate
  - potentially mineralisable N (the ability of the soil to supply N from the decomposition of OM) increased by *ca*.60%.
  - Soil physical properties changed e.g. a 10% decrease in topsoil penetration resistance

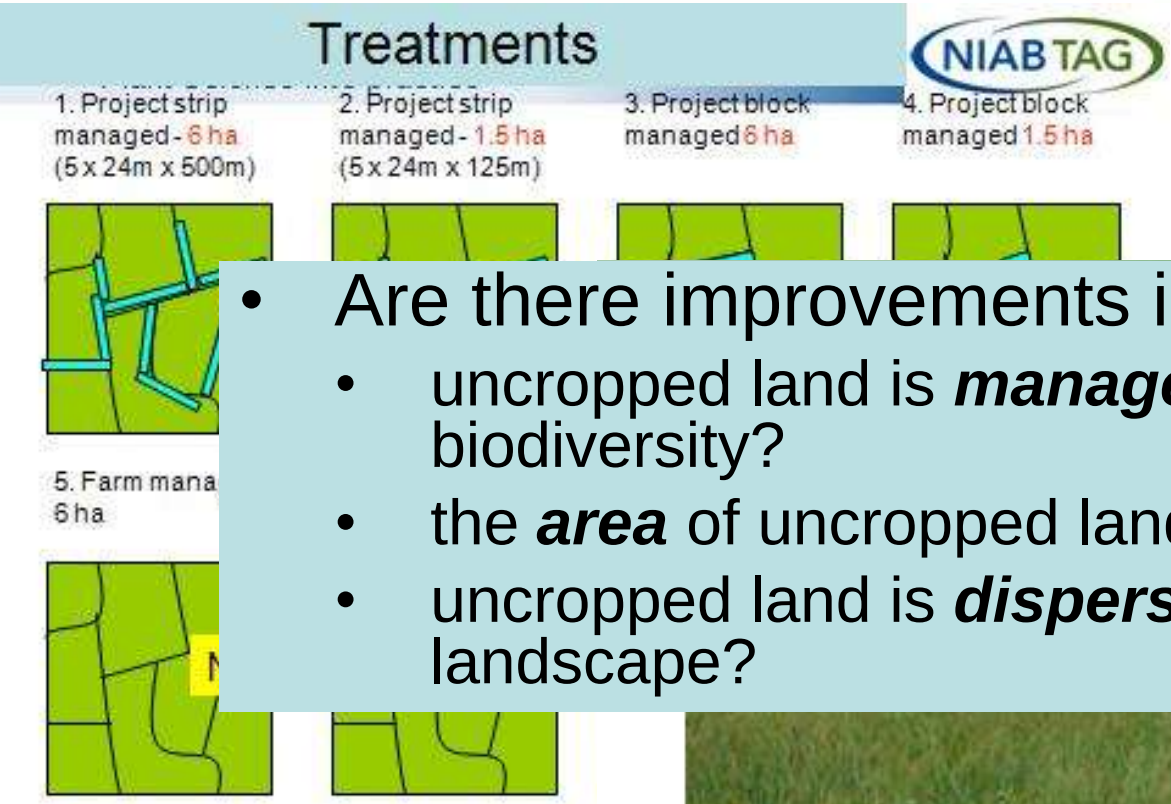
Managing uncropped land in order to enhance biodiversity (Farm4bio)

www.hgca.com/farm4bio

Objective: To determine whether acceptable levels of biodiversity can be achieved on conventional arable farms through the management of uncropped land* and to identify the best arrangement of such land.

* = land that otherwise would be cropped

Is it what you've got or what you do with it?



- Are there improvements in biodiversity if:
  - uncropped land is ***managed*** for biodiversity?
  - the ***area*** of uncropped land is increased?
  - uncropped land is ***dispersed*** across the landscape?

Farmer survey on cover management

- FEG the most attractive option:
  - reliable (but slow) establishment & perennial
  - ideal for awkward corners
- Non-cereal covers can be difficult to establish reliably
  - fodder radish easier to establish than kale and provides seed late into the winter
- Natural regeneration
  - dominated by annual grass weeds of little biodiversity value on heavy soils
  - annual spring cultivation is best on light/chalky soils where there is a history of spring cropping

Landscape and farm structure

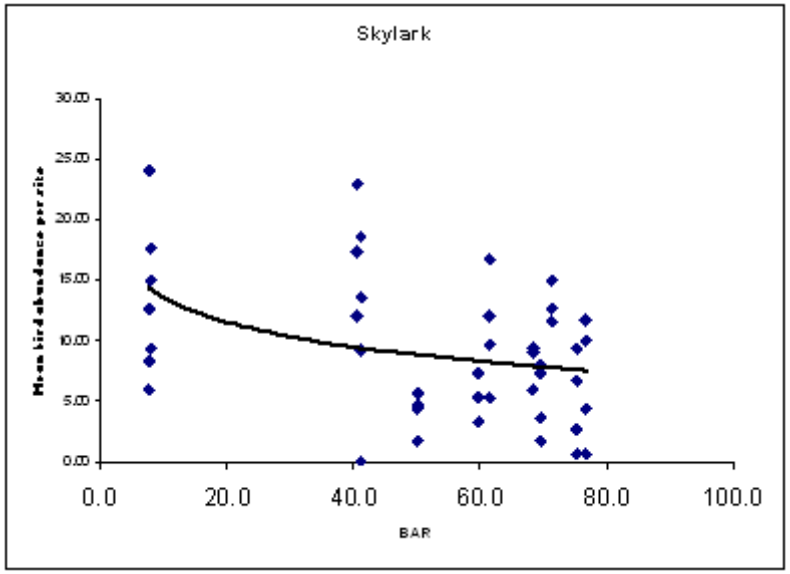
More plant and butterfly species can be expected on a farm if there is:

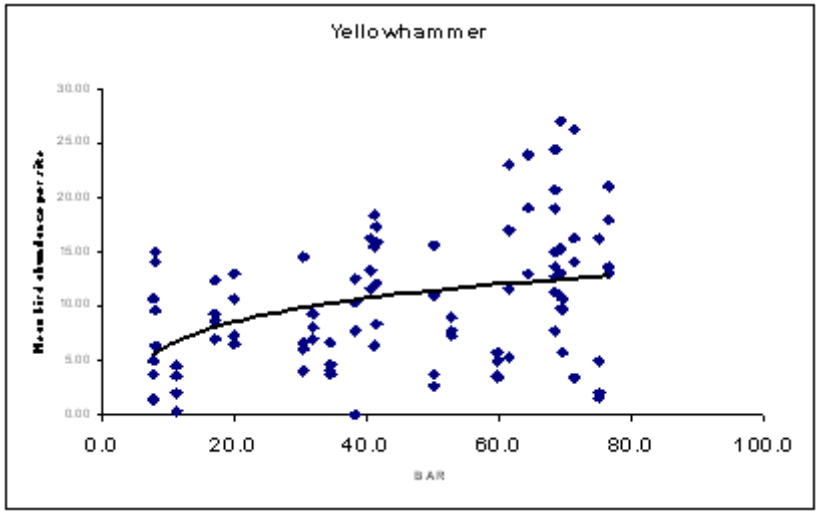
- Less arable land in the surrounding landscape
- More uncropped land on the farm
- Several different types of uncropped land on the farm

Birds respond to boundary density (i.e. boundary length to field area ratio):

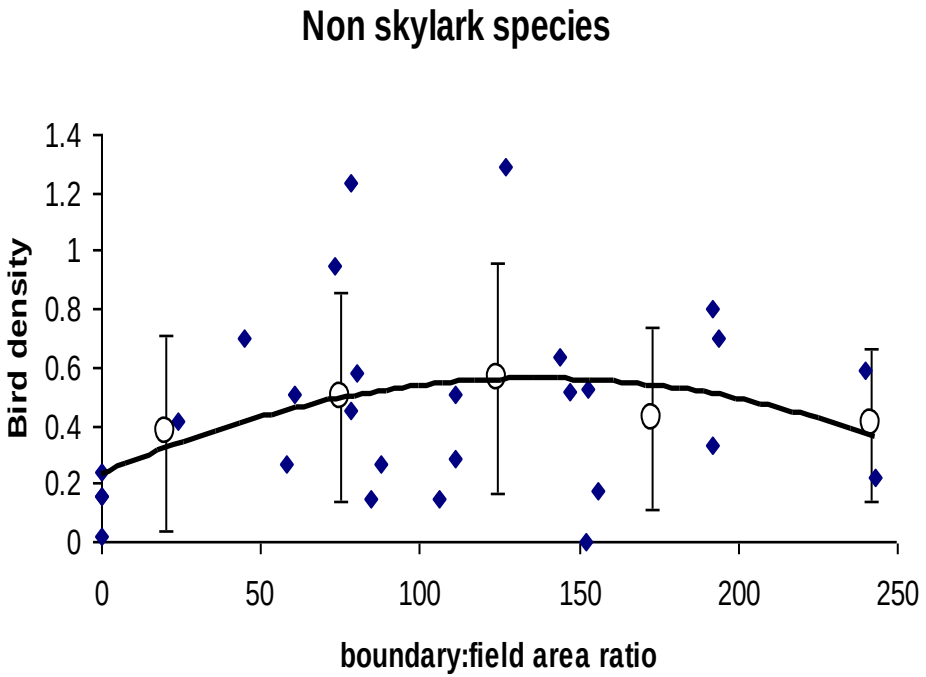
- Skylarks decreases
- Boundary-based species, such as Yellowhammer, increase

The skylark likes open fields (a small boundary to field area ratio - BAR) but other farmland birds prefer a large BAR



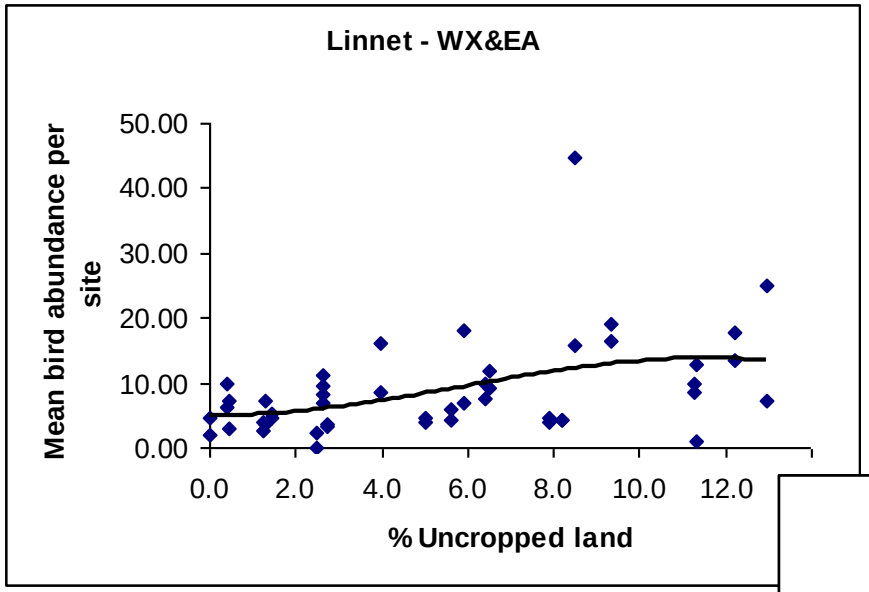


Colworth

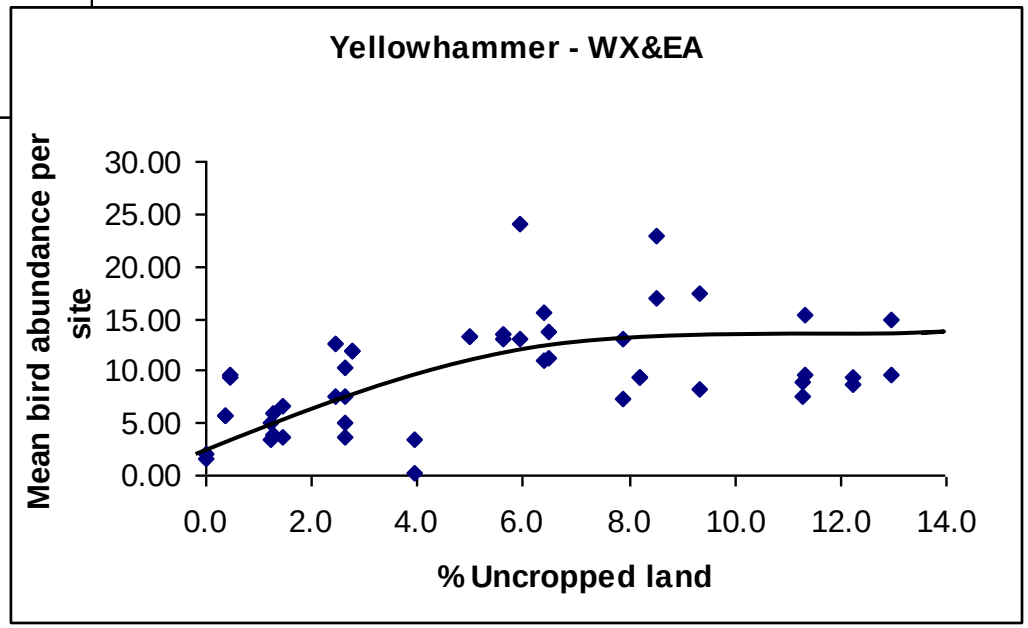


Birds – some species require ~4% uncropped land

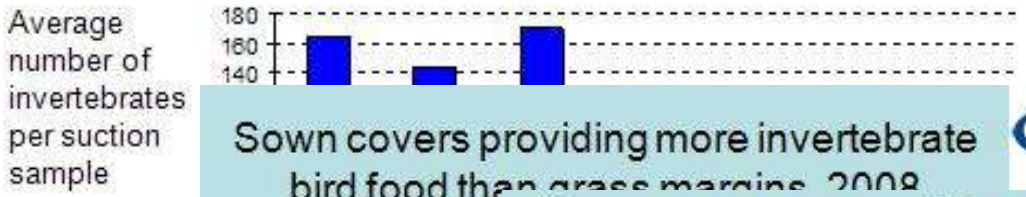
Bird species - specific responses to area (%) of uncropped land – 2008&2009



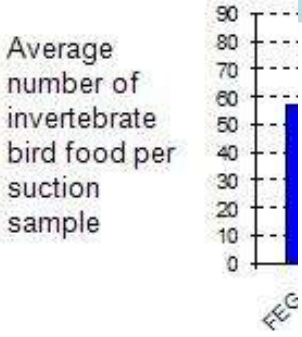
Plus healthy boundaries



Sown covers providing a better habitat for invertebrates than grass margins, 2008

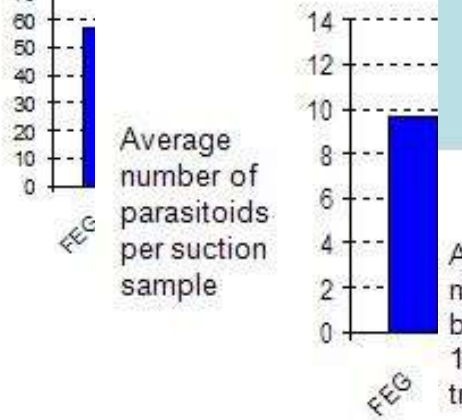


Sown covers providing more invertebrate bird food than grass margins, 2008

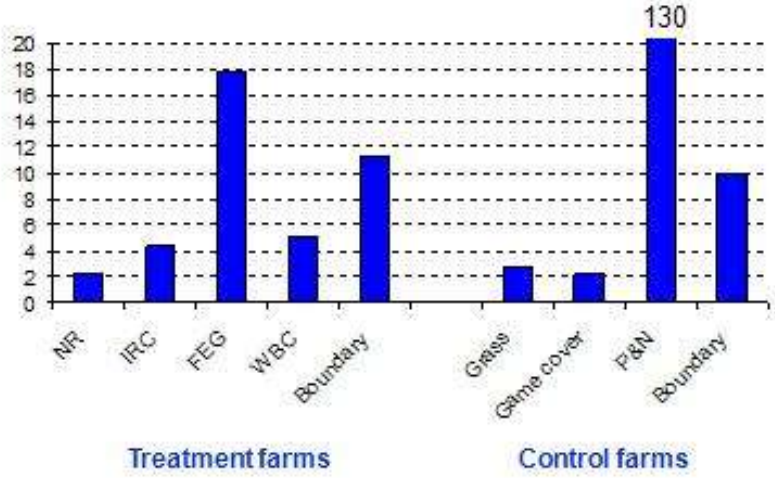


Sown covers providing a better habitat for aphid parasitoids than grass margins

SE farms in 2008



FEG and pollen & nectar providing more bees than grass margins, 2008 & 2009



A few key findings

- Winter bird cover
  - quantity of food appears to be more important than area. Canopy needs to be open enough for birds to get to seed heads and to the ground
- Butterflies, bees and invertebrates
  - prefer strips (more edge length/area) close to field edges; no threshold area – the more the better!
- System management
  - Grass weeds; can be an issue in natural regeneration on heavy soils. A graminicide may be needed to avoid grasses dominating broad-leaved plants in Floristically Enhanced Grassland or flower rich mixtures
  - Other pernicious weeds; treat site before establishment for thistles and possibly ragwort in perennial flower covers
  - Slugs; pellets may be beneficial for establishment of cereals/brassicas and spring N will help seed production
  - Insect pests; autumn sow brassicas can help to minimise impact of pollen beetles

Farm4bio

www.hgca.com/farm4bio

- Every farm can produce a difference
  - findings support the approaches suggested in the Campaign for the Farmed Environment
- A simple approach can make a real impact but grass margins are not as productive as sown mixtures
- Results to date indicate different responses to area and layout of uncropped land:
  - densities of Skylark, Linnet and Yellowhammer tend to be very low below around 4% uncropped land
  - some farmland birds appear to prefer blocks of uncropped land (must be 'open' enough for nesting and access to food)
  - bees, butterflies and invertebrates prefer strips alongside field edges
- Make sure that covers is compliant with any scheme requirements and other objectives (water protection) are met e.g. floristically enhanced grassland as buffers alongside water bodies or to reduce run-off