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Legumes and legume mixtures for soil fertility and structure

Mark Measures IOTA (ORC)

Nitrogen fixation and release

Rooting

Organic matter

Legume characteristics

Mixtures

Subsequent crop yield

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Nitrogen fixation

	Kg N fixed/year	
White clover/grass	100 - 200	
Red clover/grass	200 – 300 +	
Lucerne	300 - 500	Innoc
Sweet clover	150	Innoc
Birdsfoot trefoil	100 - 150?	
Black Medic	Lower than W Clover	
Crimson clover	150	
Vetch	100 – 250 ?	
Sainfoin	150 - 200	

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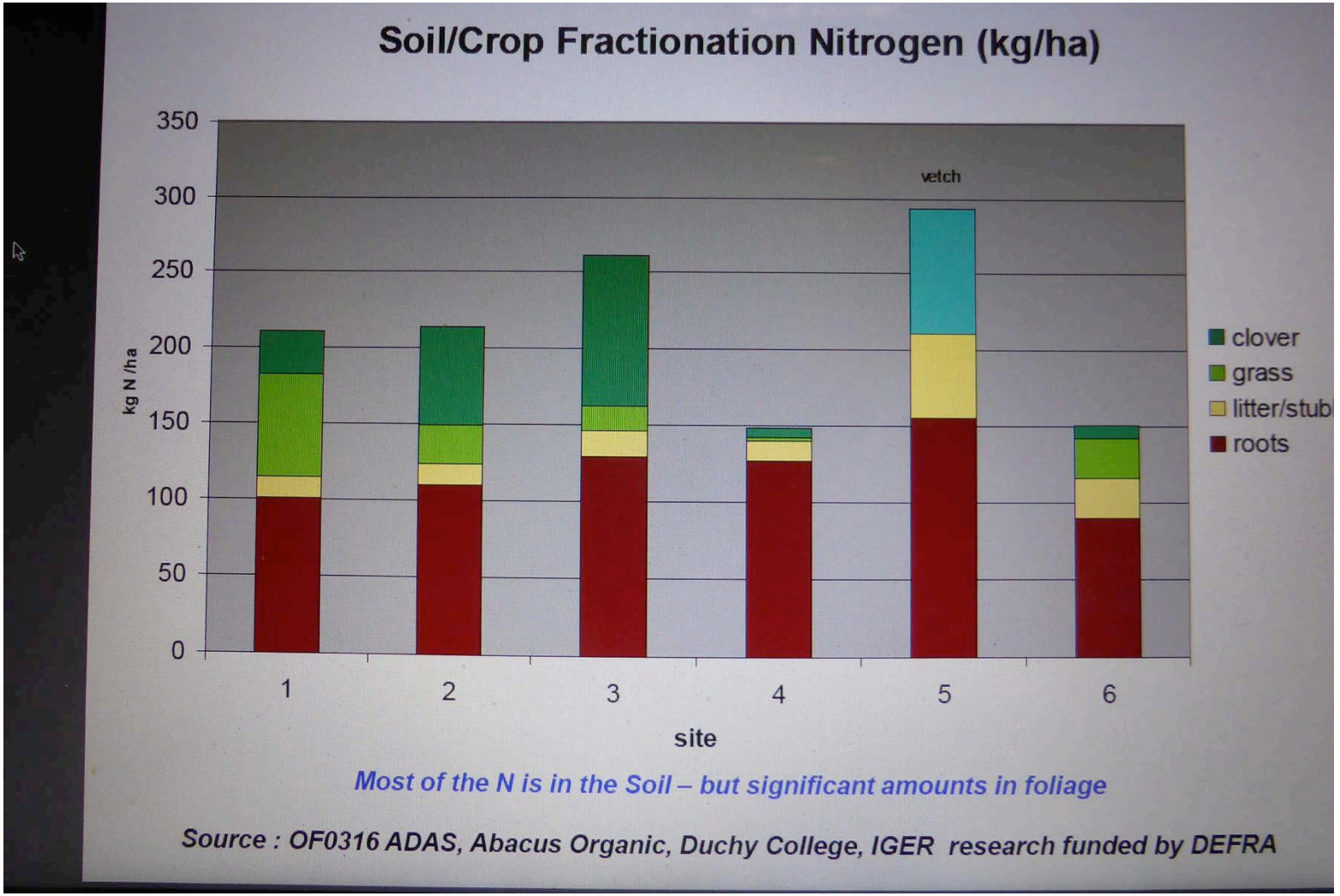

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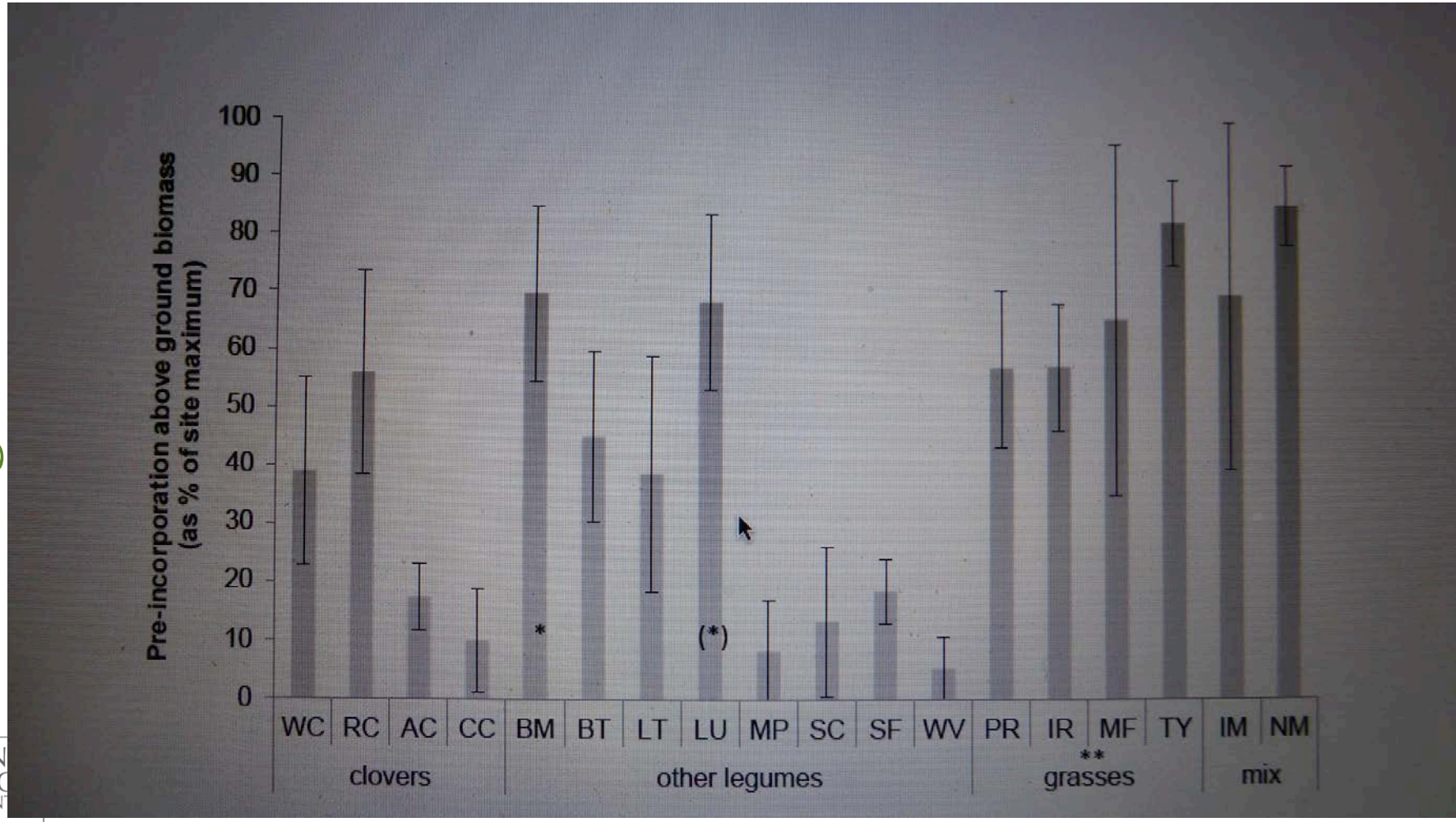
N release and mobilisation

- **C:N ratio**
- **Lignin**
- **Possibly polyphenols**

Subsequent crop yield

- **Above ground yield of the ley is linked positively to subsequent crop yield**

Above ground Biomass



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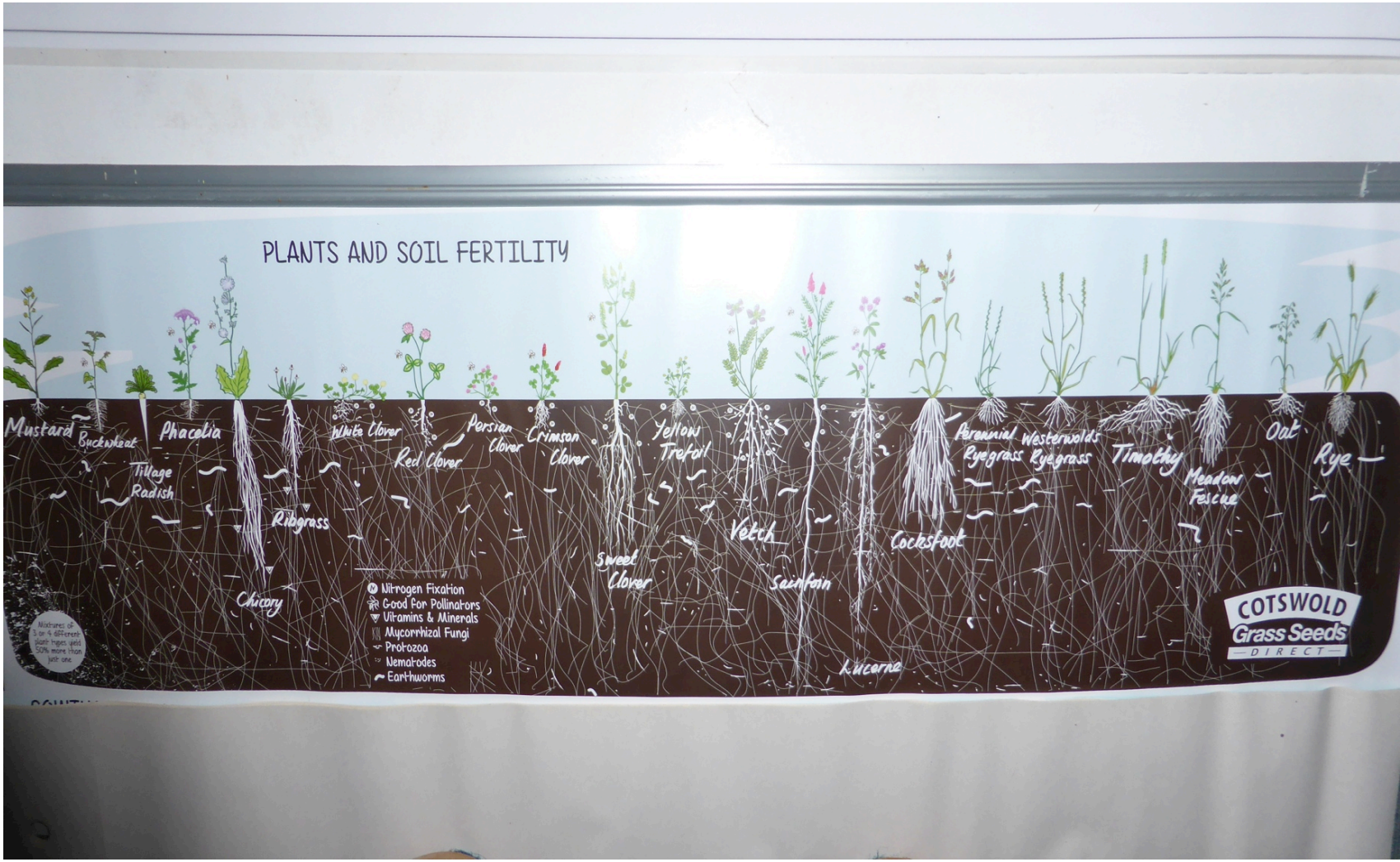
Root depth



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Subsequent wheat yield and quality

Reading University Jones, H. et al

Split plot design, fully randomised replication, 2 years. ASM v Control (red clvr., wht clvr., chicory, cocksfoot)

Wheat yield

- **AS Mix resulted in higher yield than grass/cover Control**

	ASM	Control	Mean	
2012	2.71	2.72	2.71	
2013	4.23	3.56	3.89	
Mean	3.22	3.0		

- **Greater plough depth resulted in higher yield**

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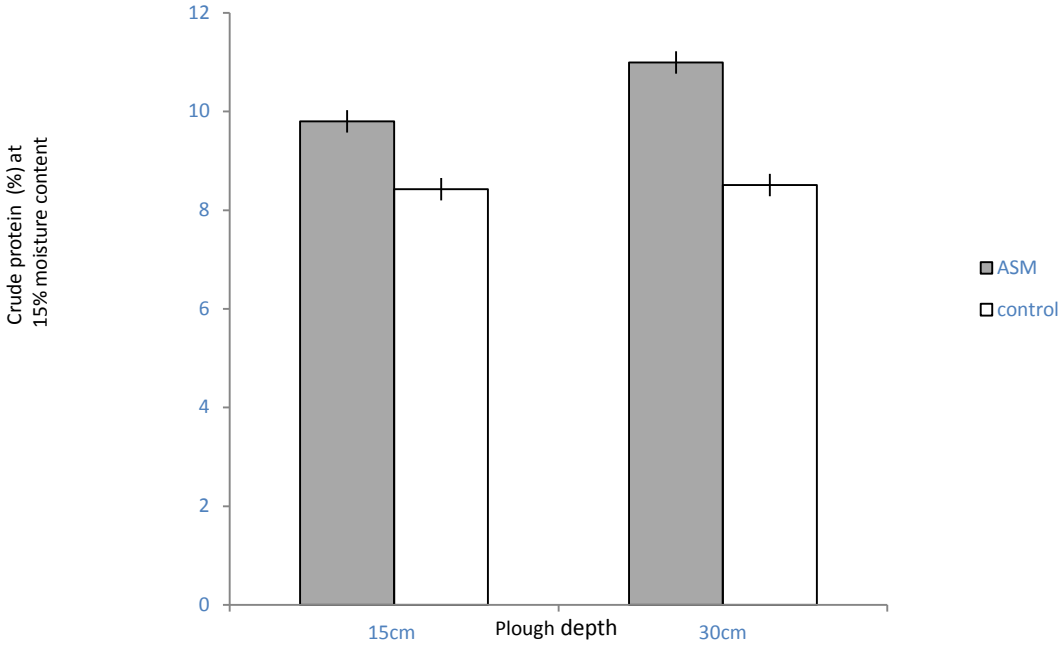
Subsequent wheat yield and quality

Reading University Jones, H. et al cont.

- **Grain protein**
  - **Protein was higher for all species Mix than grass/clover control**
  - **Greater plough depth (30 v 15 cms) increased protein for the ASM only**



  - **Cutting (mulch or conserved) tended to higher protein than uncut**

White clover

High yield, high yield of subsequent crop

Red clover

High yield and high yield of subsequent crop, leaches N

Black Medic (Medicago lupilina)

moderately high yield in second year, resistance to decomposition (lignin content and C:N ratio), high yield of subsequent crop

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Birdsfoot Trefoil (Lotus corniculatus)

good yield and protein, high tannins - high yield of subsequent crop and reduced methane and intestinal worms

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Crimson clover

an annual with high yield, high value for pollinators

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Farm experience

- **Species survival and suitability is site specific:**

  Lowest on heavy soils,

  Chicory and other herbs better than expected

- **Cocksfoot/Red clover is the most competitive mix and competes with couch**
- **Advantages and limitations of chicory**

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Upland farm experience

Yield and analysis 2015

Mix	Yield Dry T/ha 1 st cut	Yield Dry T/Ha 2nd cut	Total Yield T/ha	Crude protein g/kg	D Value %	ME MJ/Kg
	1 st July	7 th Oct				
Standard	5.4	2.5	8	12.7	66	10.4
Diverse	6	3.6	9.6	9.7	63	9.9

Species present at sampling

Standard mix: white clover, PRG, Timothy, chicory in all 3 samples. Low presence of plantain and yarrow in field but not in samples.

Diverse Legume mix: PRG, Cocksfoot, Timothy, white clover, red clover, lucerne, plantain, chicory, salad burnet in all 3 samples. Yarrow in 2. Low level of Black medic in field but not in samples.

(Second cut after 7 weeks regrowth, site at 1,200 feet upland farm in Welsh borders)

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Advantages of diverse mixtures – for fertility building and forage production

1. **In the Leg Link project the "All species mixture" was more productive than the farmer's own mixtures – forage yield is related to subsequent crop yield.**
2. **They provide greater stability**
3. **They can incorporate characteristics affecting nitrogen release, mobilization, leaching and utilisation:**

C:N ratio, lignin and possibly polyphenols

Summary

1. A 3rd or 4th Legume is generally advantageous for forage yield
2. Best multifunctional mixtures contained Black Medic, Lucerne and Red clover, with benefits for yield, N fixation and decomposition.
3. Black Medic, Red clover, Sainfoin, Lucerne and Crimson Clover significantly benefit bee and butterfly species
4. There are benefits from the inclusion of grass or non legume species – C:N ratio and N fixation.
5. The annual N accumulation of ley mixtures decreases after two years, although there may be other advantages from longer leys, such as weed control.
6. Aim to combine early and late weed suppression characteristics
7. Aim to incorporate deeper rooting and high biomass species for soil structure and organic matter
8. Selection of species must be site specific

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References

- **Soil analysis and Management IOTA Technical Leaflet**
- **IOTA Research Review**
  http://www.organicresearchcentre.com/?go=IOTA&page=reviews
- **Leg Link project** Döring *et al.* (2013) *Using legume-based mixtures to enhance the nitrogen use efficiency and economic viability of cropping systems*. HGCA Project Report No. 513.
- Reading University trials
- Duchy Originals Future Farming Field Labs

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