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SESSION 3

Integrating nature-based and agri-tech solutions on the ASSIST commercial farm network

Photo: Lucy Hulmes

UK Centre for Ecology & Hydrology

ROTHAMSTED RESEARCH

BGS British Geological Survey

Chair: Jonathan Storkey

funded by

UKRI Natural Environment Research Council

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The ASSIST farm network - testing sustainable intensification within real arable systems

UK Centre for Ecology & Hydrology
ROTHAMSTED RESEARCH
BGS British Geological Survey

Sam Cook, Ben Woodcock, Martin Torrance, Jennifer Swain, Jamie Hall, Lucy Hulmes, Sarah Hulmes, Richard Ostler, Marek Nowakowski, Matt Heard, Richard Pywell & Jon Storkey

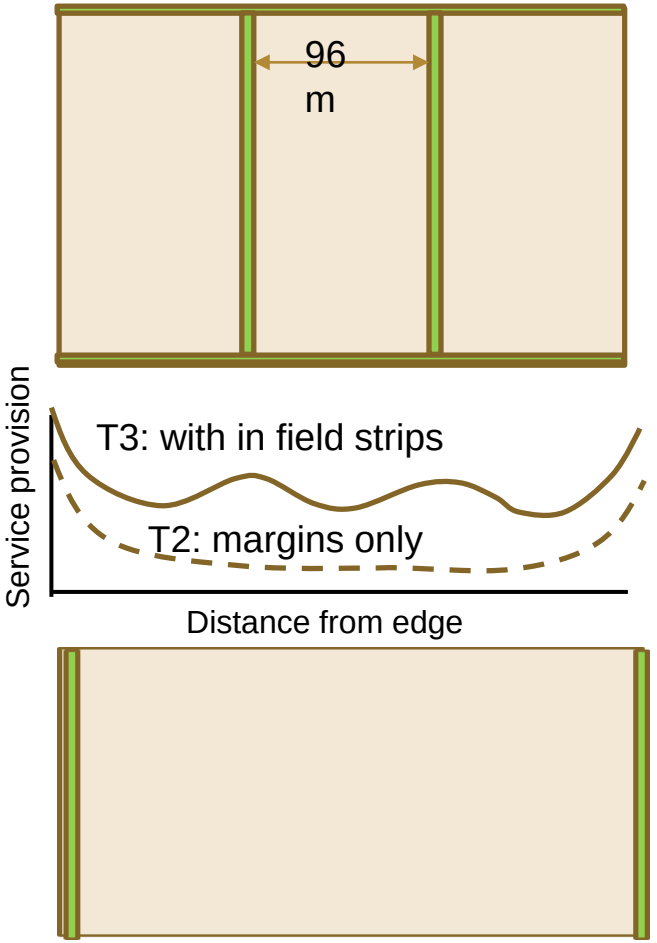
funded by

UKRI Natural Environment Research Council
UKRI Biotechnology and Biological Sciences Research Council

Aims

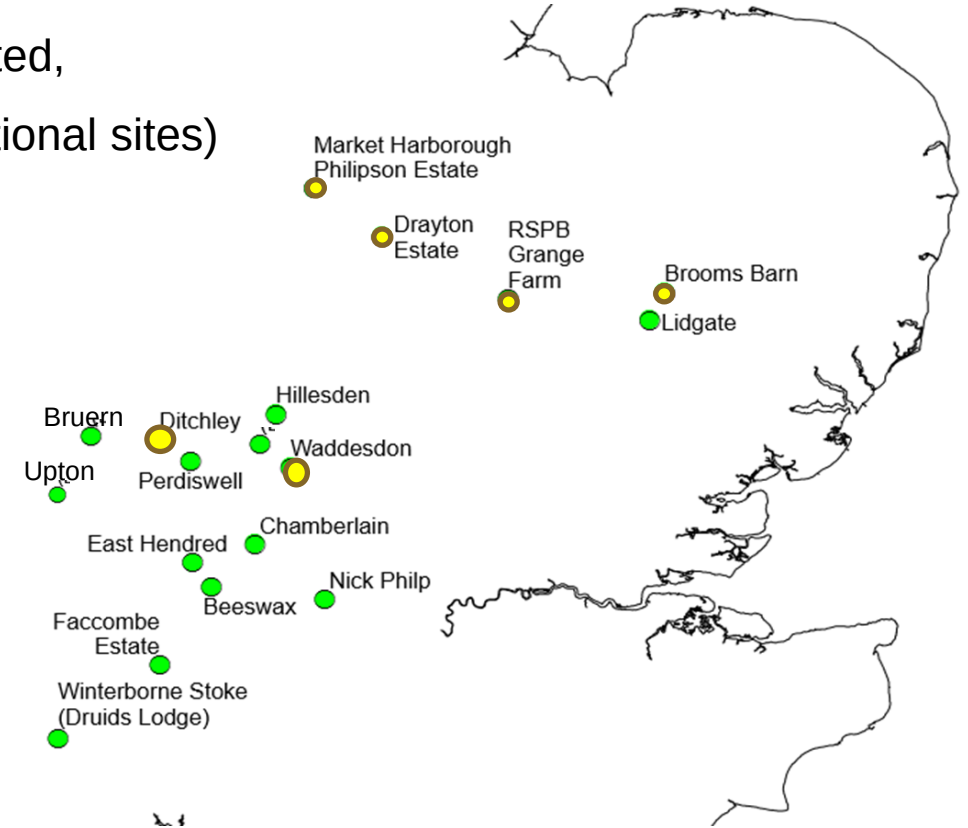
Aim to quantify the systems level benefits of sustainable management practices that enhance ecosystem processes (Pollination, Pest regulation, Soil health) vital for supporting crop production

- Practical interventions to be tested co-designed with ASSIST farmers
- Sown flower-rich field margins - to support pollinators and natural enemies of crop pests
  & growing cover crops and adding organic matter to enhance soil functions.
- Quantifying background levels of biodiversity, including key service providing taxa but focus on service *delivery*, not just proxies
- Quantifying spatial patterns of service delivery linked to impacts on yield.



Sites – 18 commercial farms in SE England

- 7 sites monitored by Rothamsted,
- 8 monitored by CEH (+ 3 additional sites)



Experimental design – on full field scale

- 3 fields on each farm each randomly assigned to one of 3 treatments:

T1: Control
= Business as usual

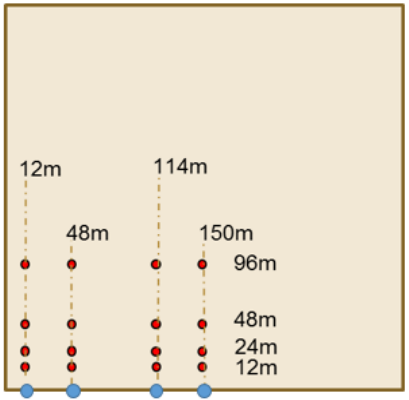
T2: Supporting ES processes
+ Cover crops
+ Wildlife margins

T3: Maximising ES delivery
+ Cover crops
+ Green waste/FYM.
+ margins & in-field strip

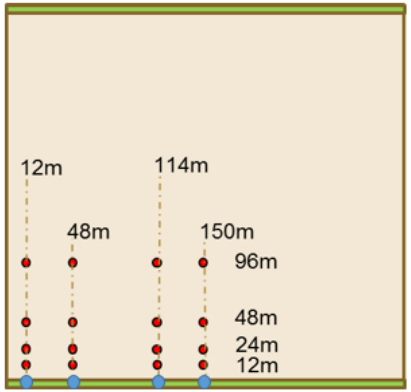
96m

Experimental design – on full field scale

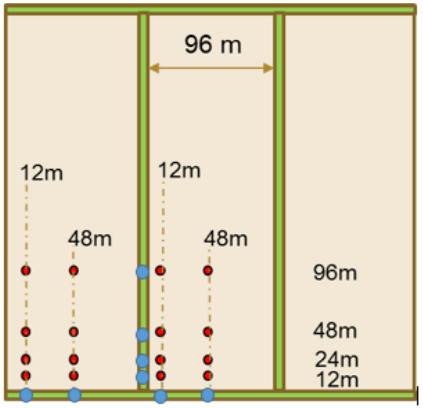
- Sampled ‘field corners’ to standardise (as all field sizes different)
- Sampled in a grid, along transects - sample points 12m, 24m, 48m & 96m from crop edge



Treatment 1



Treatment 2



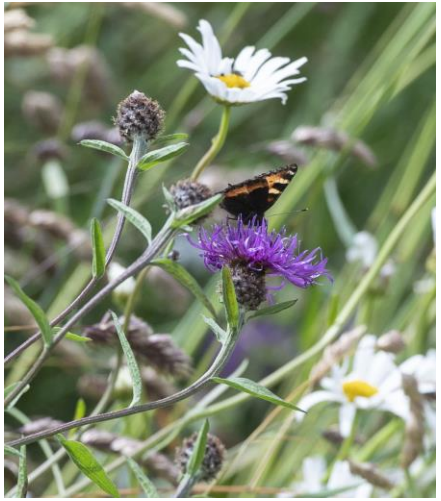
Treatment 3

- 16 in-crop sampling points
- 4 field boundary
- 4 in-field margin sample points

Margins - plants

- Plant cover,
- % sown species

Margin biodiversity assessments (transect walk)



Pest gastropods (slugs & snails)

Weeds - blackgrass

Biodiversity (including pests, natural enemies & pollinators) – Vortis suction sampling

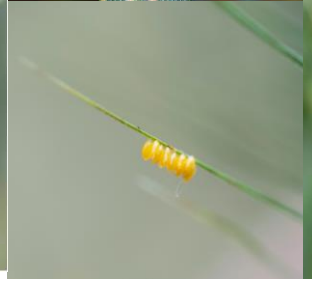
Biodiversity: Pitfall trapping – ground predators

Crop searches – pests, and pest regulators

- Plants assessed by eye recording, pests & pest regulators







Sentinel prey: Artificial slugs - predation

- Plasticine pieces (large & small) placed on the ground, left for 3-days
- Bite marks recorded

Sentinel Aphids - pest regulation

- Aphid glued to cards set on the ground and on plant foliage to assess predation

Soil samples – soil health/ properties

- Soil cores taken for analysis

Earthworms – soil health/ properties

- Worms surveys adapted from 30 minute worm survey (Jackie Stroud, RRes)

- Juveniles (missing saddle)

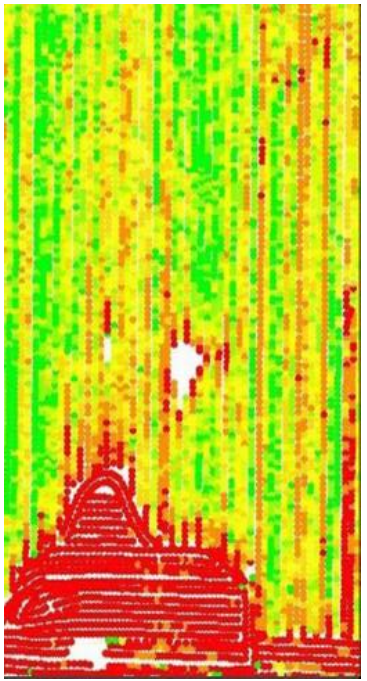
- Epigeic (litter-dwelling)

- Endogeic (topsoil- dwelling)

- Anecic (deep burrowing)

Yield

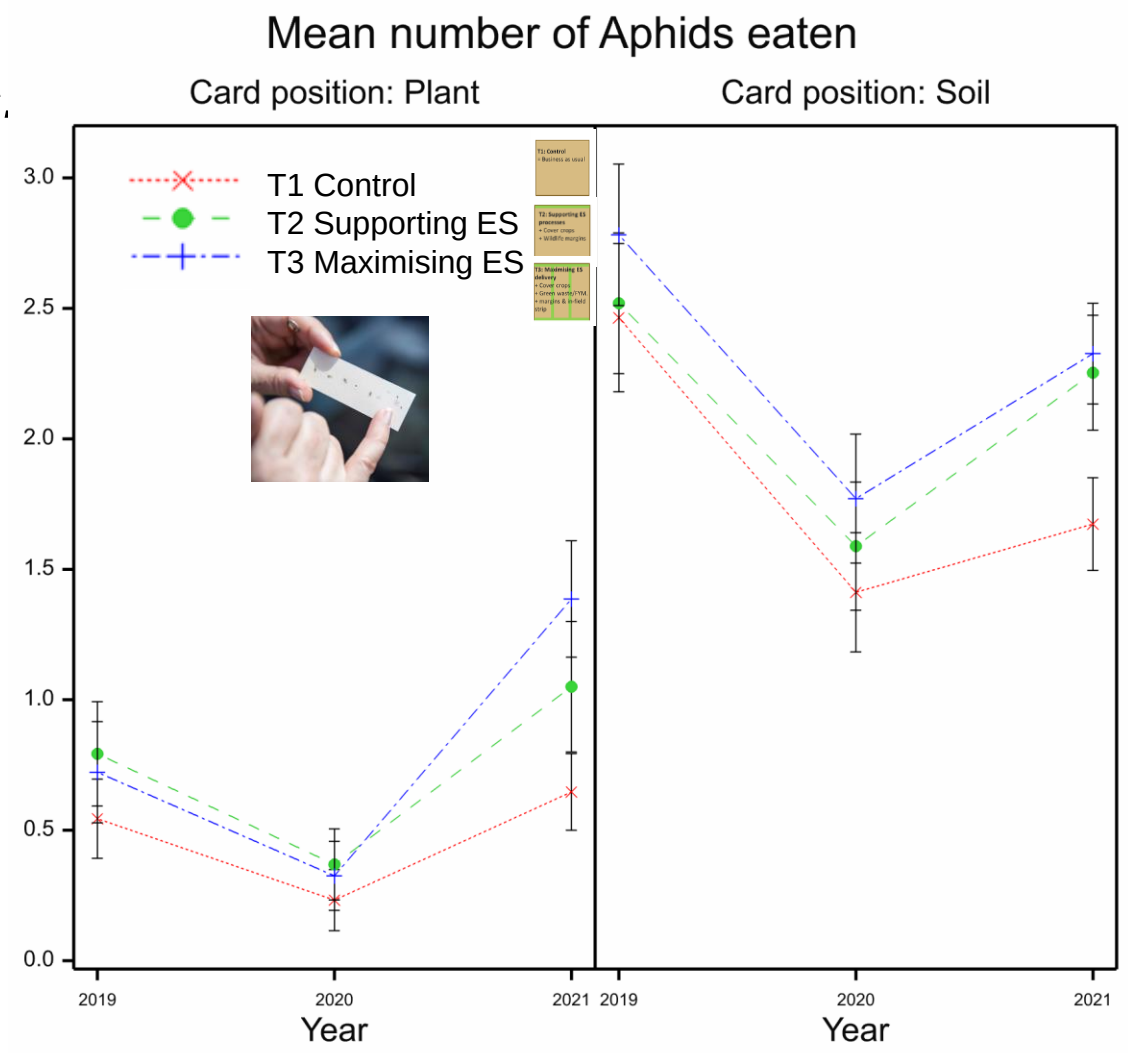
- Hand harvested 1 m area
- Yield maps from GPS-enabled combine yield monitors where available



Preliminary Results: Predation

- Significantly more aphids predated when on soil surface than on plants
- Significant treatment effects: generally T3 > T2> T1
- No effect on distance from margin

GLMM with binomial distribution with year, site & sample as random factors. Card position, treatment and distance as fixed effects.

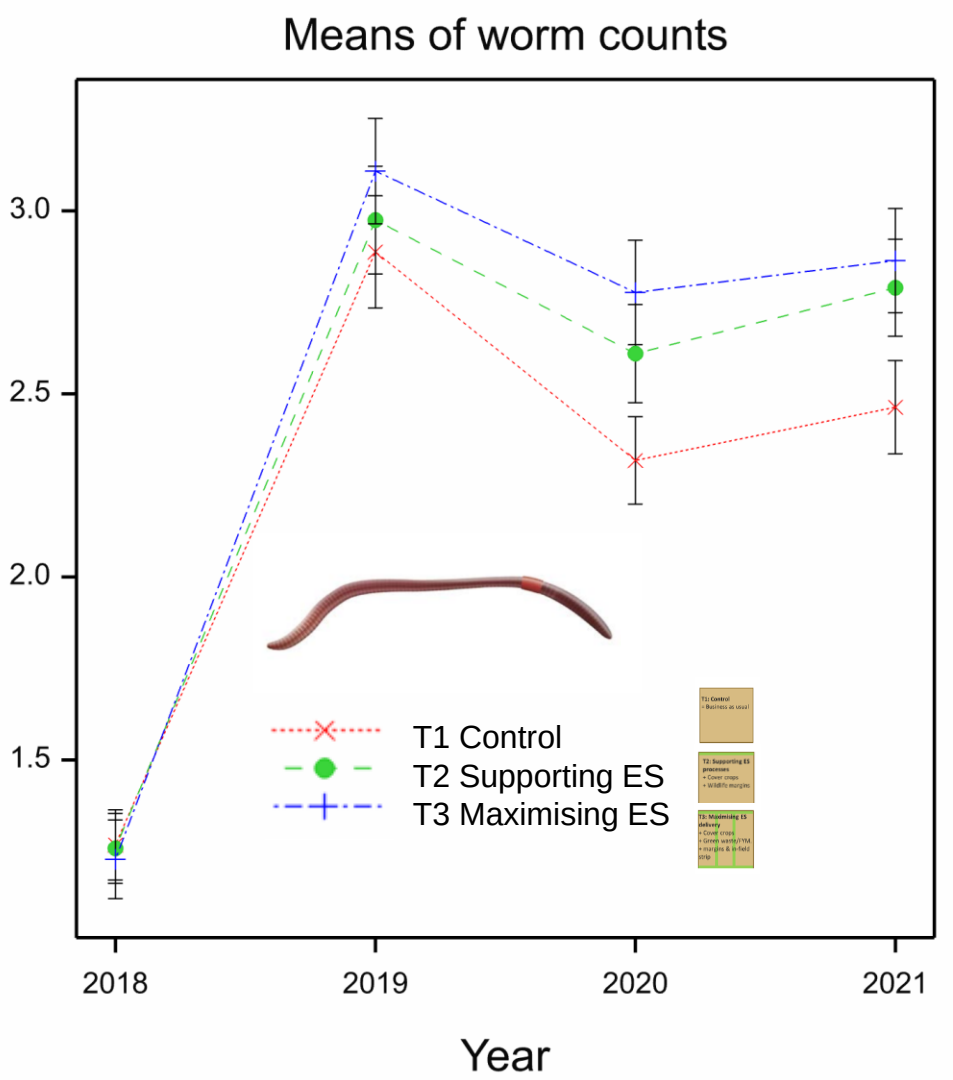


Preliminary Results: worms

- Significant treatment effects: generally more worms T3 > T2> T1
- Differences between worm type changes with distance

- Results so far are encouraging
- Lots more work to do: processing, data analysis…
- Watch this space!

GLMM with Poisson distribution where year, site, sample as random factors. Worm type, treatment and distance as fixed effects.



Acknowledgements

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EMORSGATE SEEDS
"Specialist growers of British wild flower and wild grass seeds"

Many thanks to the ASSIST WP3 farmers, agronomists & land owners who made this possible!
William Bates, William Batt, Georgina Bray (RSPB), Dan Bussey, Charlie Chamberlain, Tim Chamberlain, Matt Childs, Garth Clark, Roger Davis, Rob Ding, Mike Doggrell, Martin Down, Gordon Edwards, John Elliot, Rob Field, Graham Flux, Charlie Fowler, Rob Fox, Mark Gardner (RRes), Dougal Hosford, George Hosford, Julian Gold, Ed Hall, Robert Hobill, Al James, David Kinnersley, John Lane, Ben Lambert, John Martin, Isobel O'Kelly, Jamie Orpwood, Tom Paybody, Nick Philp, James Price, Leon Shepherd, David Thornton & Mike Wheeler.

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UK Centre for Ecology & Hydrology

ROTHAMSTED RESEARCH

The ASSIST farm network

Can sustainable intensification support increased productivity?

Ben Woodcock, Sam Cook, Lucy Hulmes, Sarah Hulmes, Martin Torrance, Jennifer Swain, Jamie Hall, Richard Ostler, John Redhead, Marek Nowakowski, Matt Heard, Jon Storkey and Richard Pywell

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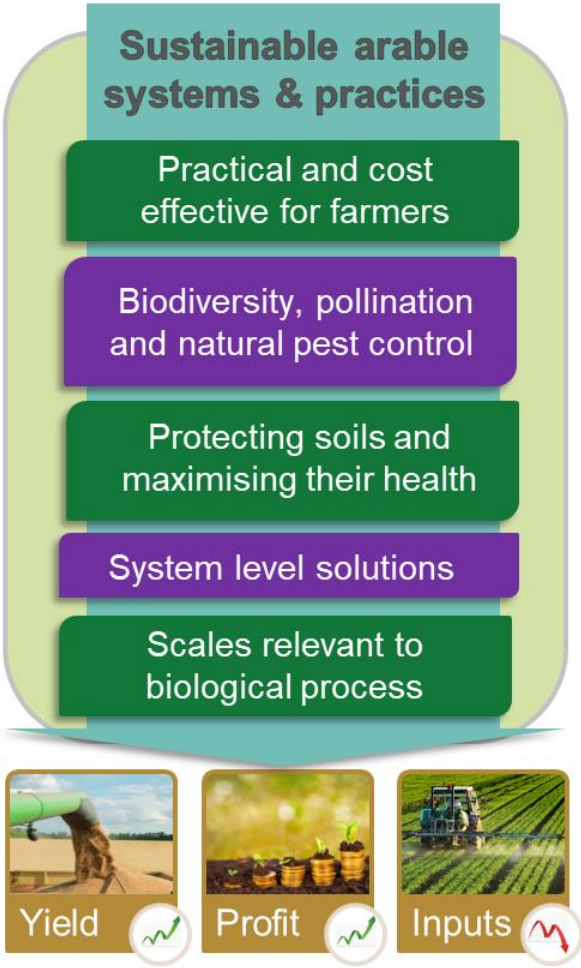
Natural Environment Research Council

Biotechnology and Biological Sciences Research Council

Delivering yield gains though sustainable solutions

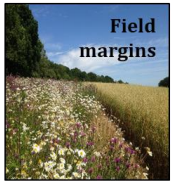
- The ASSIST farm experimental network allows us to test management interventions at scales relevant to real farming systems.
- Does this result in measurable benefits to arable crop yields?
- This will underpin farmer engagement.
- Need to explore the link between measures of yield and the underlying ecosystem processes.



Where is sustainable intensification effective

- The big question is whether sustainable intensification has effects on yield?
- Are these consistent across different farming systems?
- If they aren't, where do they work?
- Are these practices cost effective - is this something farmers would do as part of their future management strategy?

Sustainable intensification management



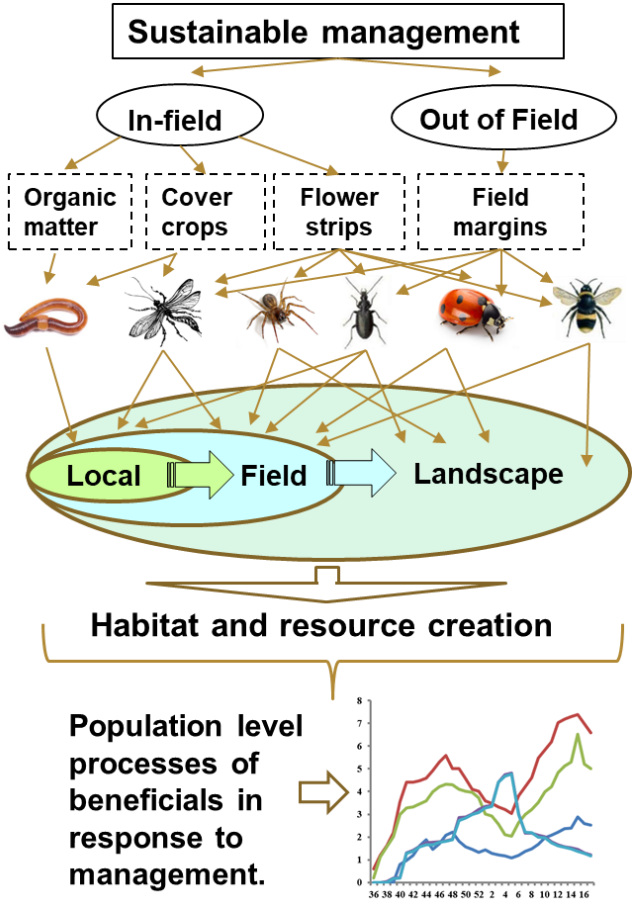
Systems level treatment combinations

Control	Treatment 2	Treatment 3
Business as Usual	SUPPORTING Soil & beneficials + Cover crops + Flower margins	MAXIMIZING Soil & beneficials + Cover crops + Compost/FYM + Flower margins + In-field strips

Implemented across 18 real world and diverse farming systems

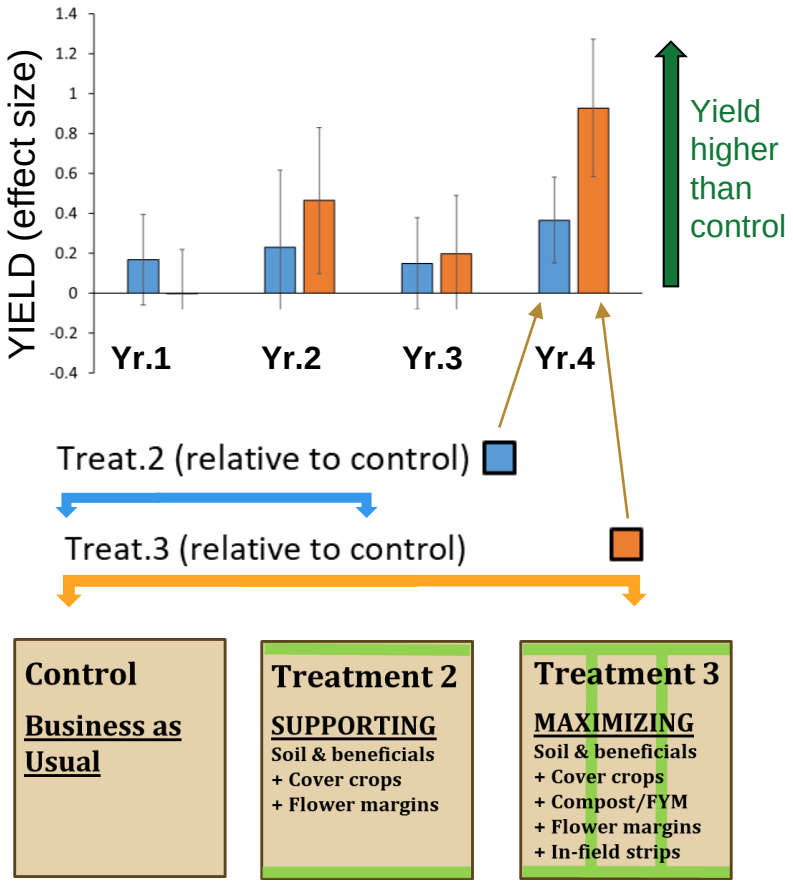
Systems level effects

- Agriculture is a complex system.
- A wide range of management practices and farmer philosophies to production.
- Management impacts different aspect of biodiversity that underpin ecosystem service provision.
- Complexity and scale can interact in unpredictable ways
- Biological system have response times.



Impacts on yield

- Overall results across 18 sites for 4 years.
- Cereals and oilseed rape crops.
- Sustainable management systems treatments 2 & 3 have positive effects on yield.
- The more complex system (Treat.3) is on average better.
- It takes time for biological systems to respond.



Preliminary results using Information Theoretic multi-model averaging based on plot level yield measures

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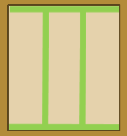
Treatment 2

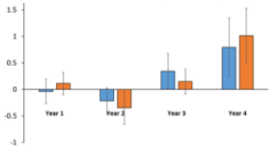
Organic matter
Flower margins

Treatment 3

Organic matter
Cover crops
Flower margins
In-field strips

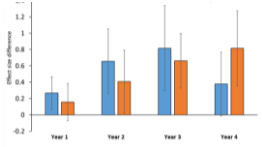


High slug predation rates



Time for populations of beneficials to increase (4 years)

Healthy soil fauna



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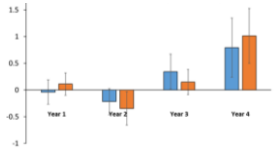
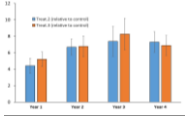


16.3 % increase in Yield

17.9 % increase in Yield

Field margin floral diversity



Preliminary results using Information Theoretic multi-model averaging based on plot level yield measures

Summary

- More to sustainability than yield.
- Sustainable intensification shows promise to support yields under real world conditions.
- Flexible and simple options work.
- Infrastructure cost & run in time to before results.
- Socio-economic barriers to uptake and engagement.
- Future proofing the farming systems.

Acknowledgements

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Managing multi-functional grassland systems

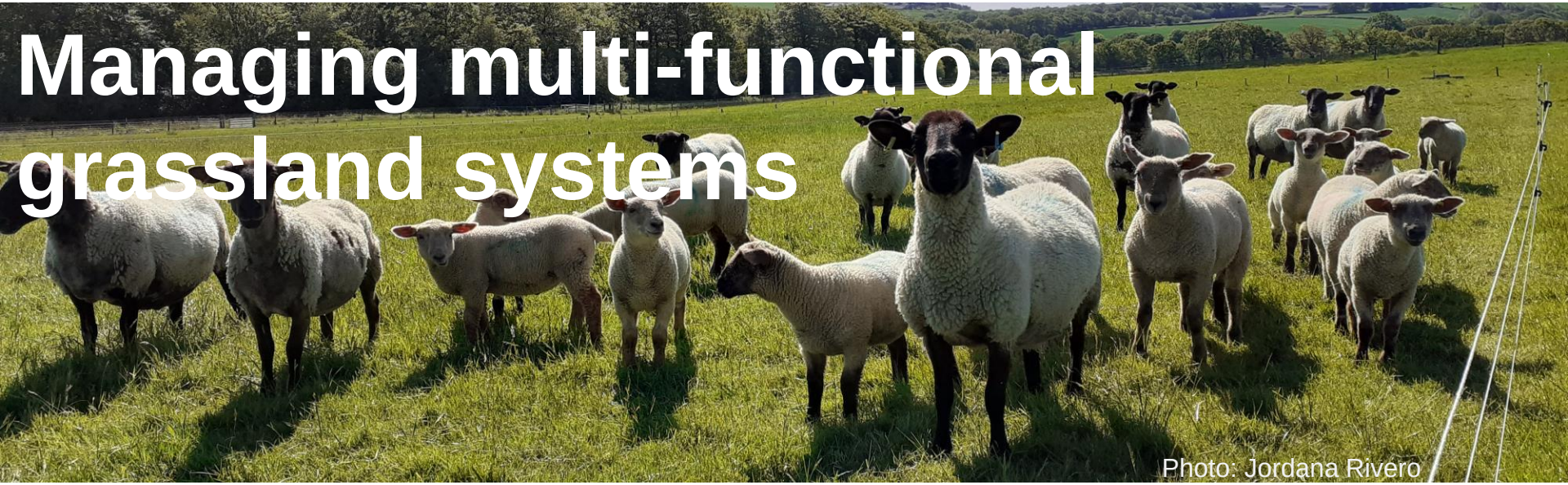

Photo: Jordana Rivero

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BGS British Geological Survey

M. Jordana Rivero, Deborah Beaumont, Suzanne Demirkaya, Martin Blackwell, Sam Cook, Jon Storkey

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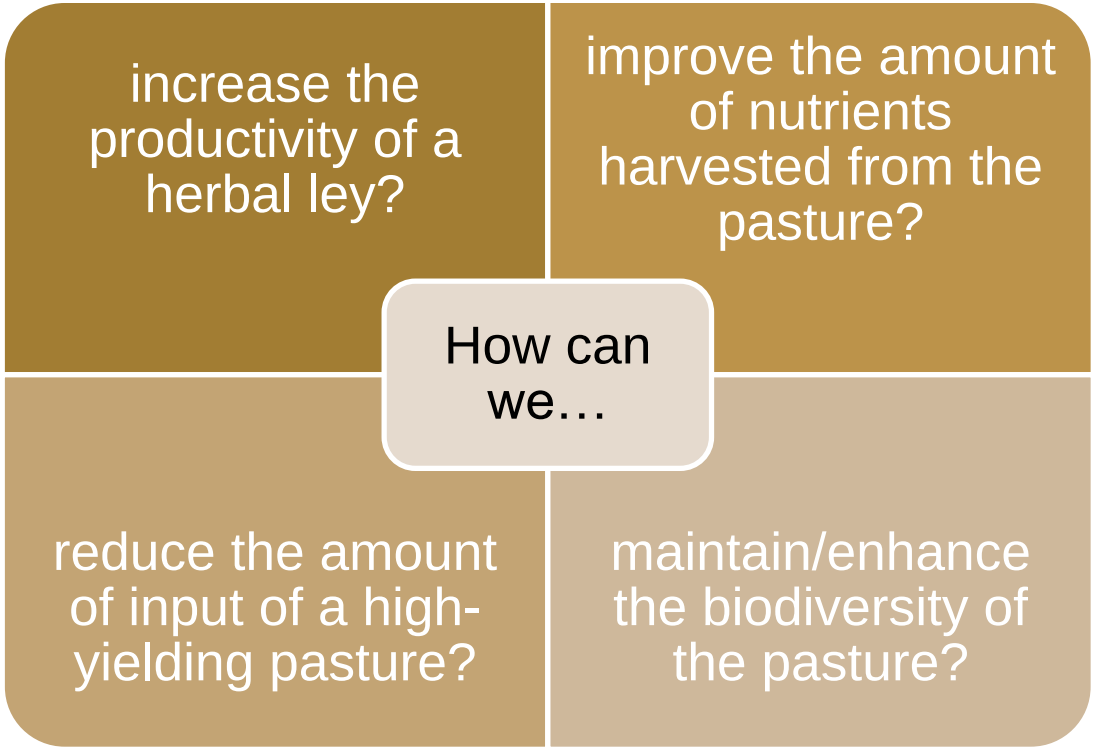
Objective and research questions

Objective:

Developing innovative grazing livestock systems which minimise inputs while maximising yield, and build resilience to future environmental change



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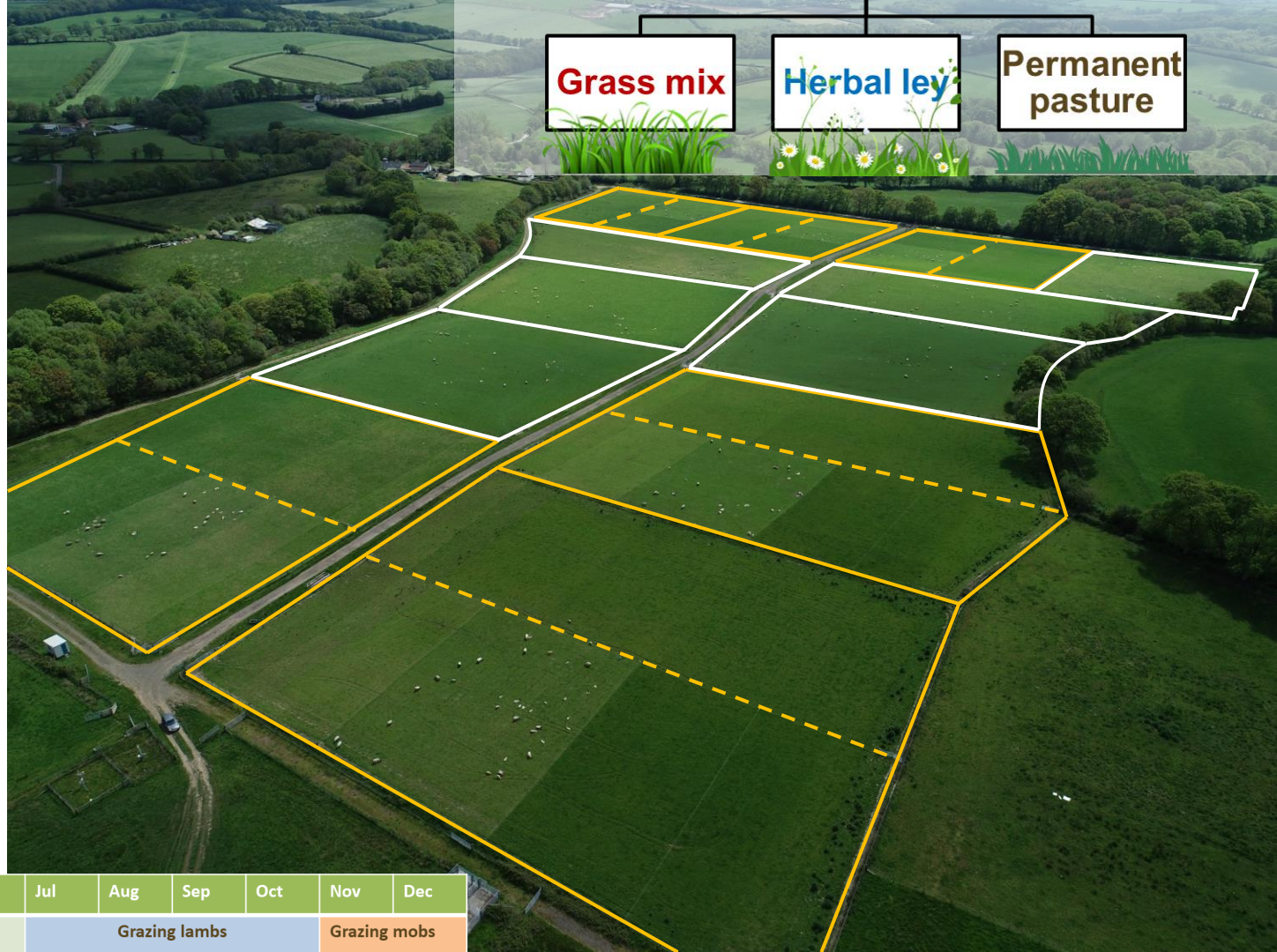
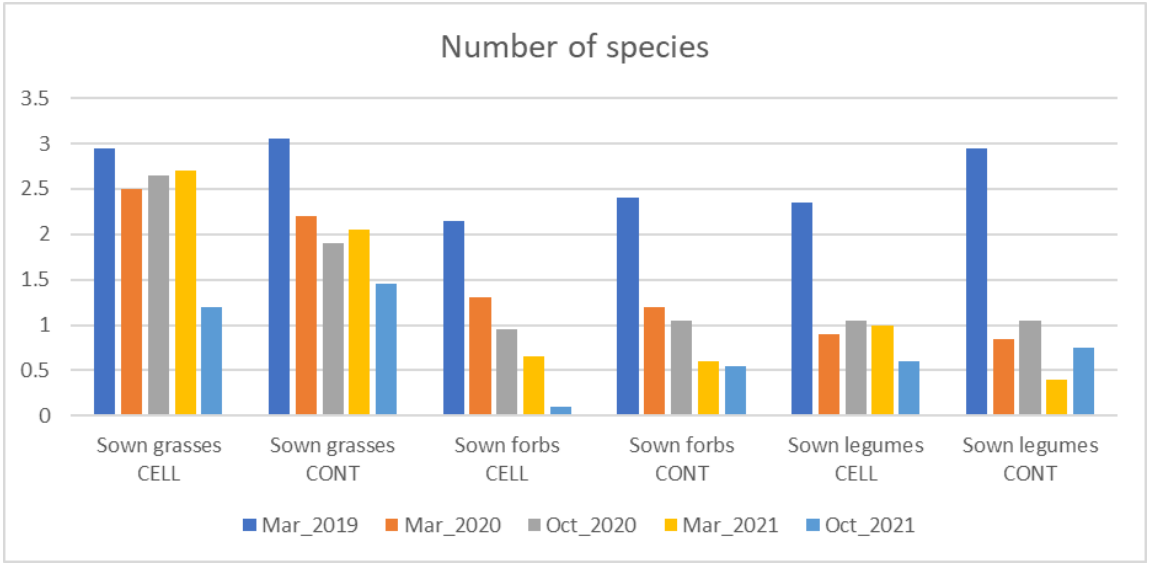
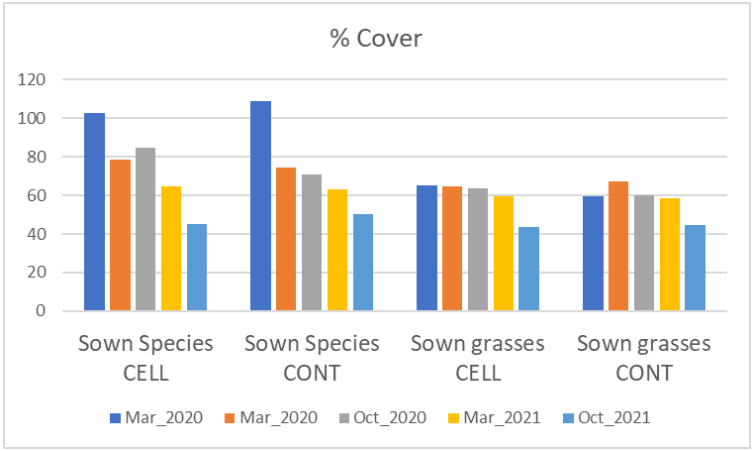


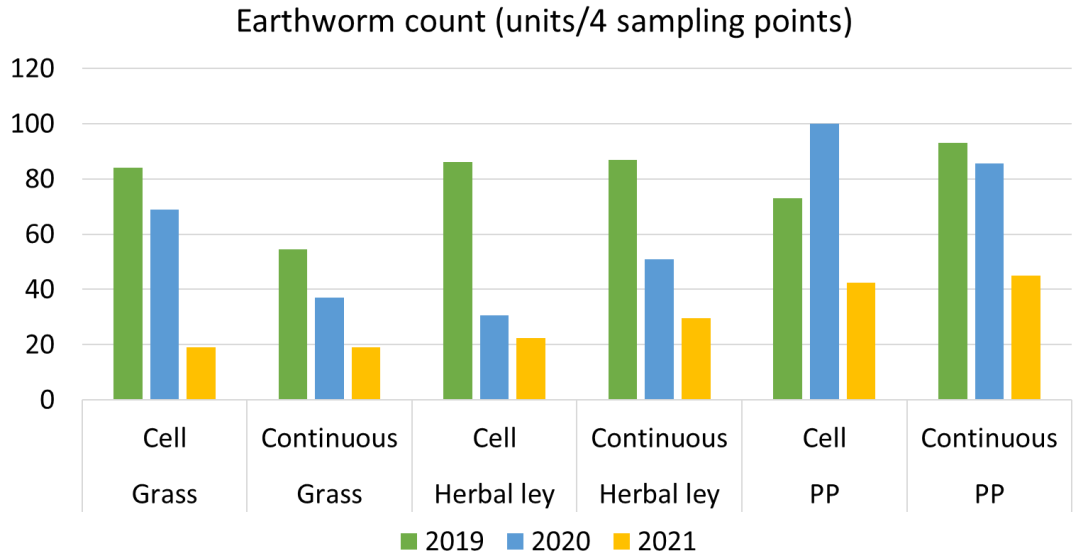
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			Grazing ewes & lambs			Grazing lambs				Grazing mobs	

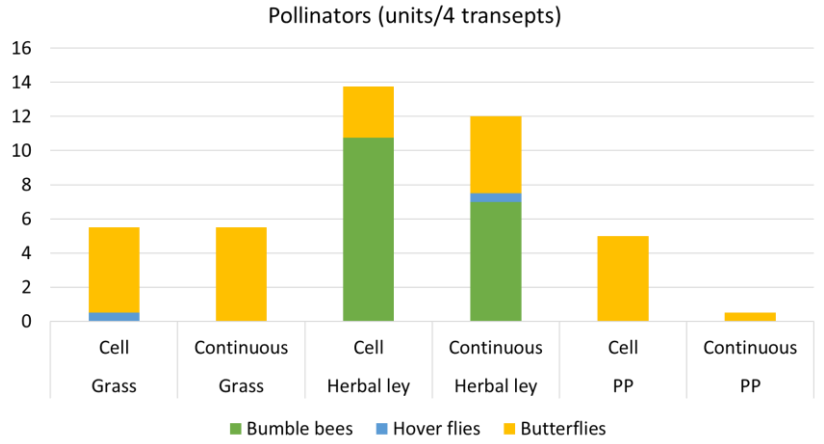
Pasture biodiversity



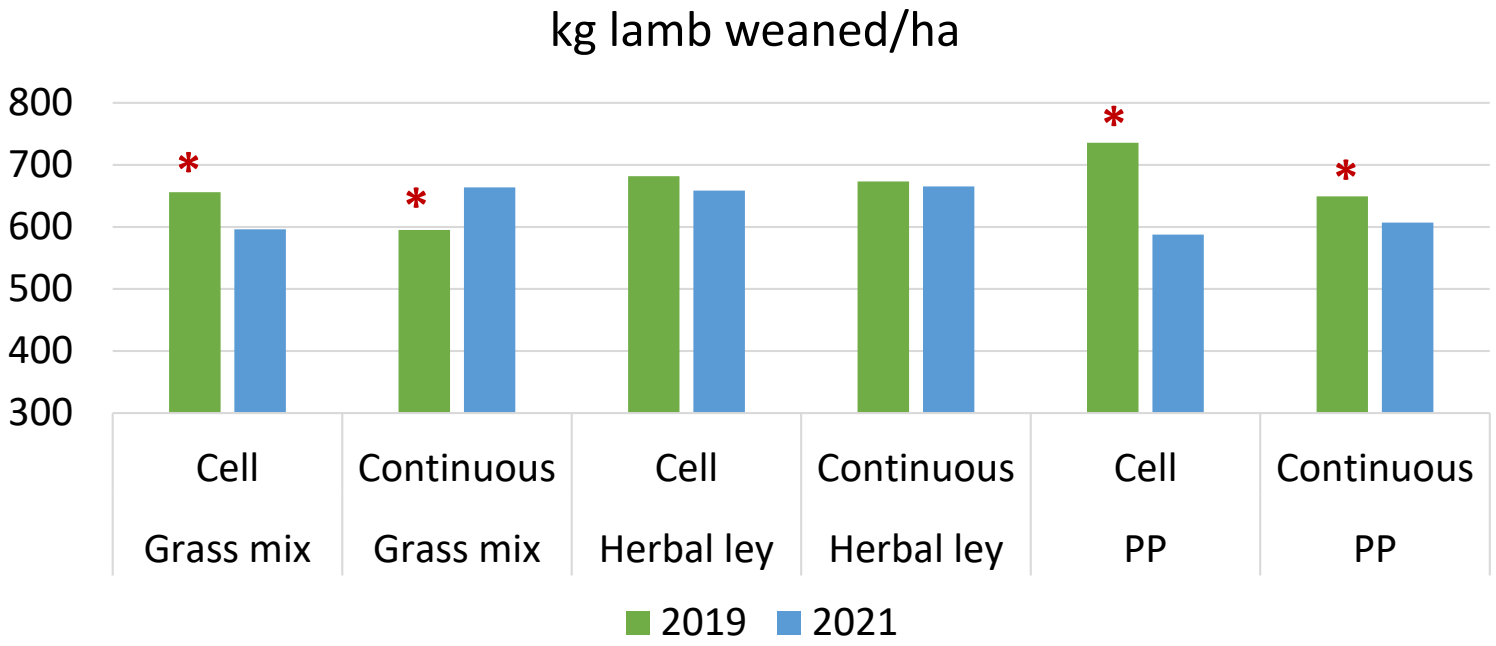


Pasture biodiversity





Pasture productivity



ADG lambing to weaning

2019: 300 g/d

2021: 296 g/d

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