Diverse Winter Forages as an alternative to monocrop Brassicas

Field Lab May 2022 – April 2023

Team:

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Introduction

The objective of this farmer-led research trial was to investigate a new approach to winter feed provision for livestock that considers the overall health of the farm system, including soil health, biodiversity, animal welfare, farmer welfare and economic sustainability. Current grazing of mono-culture winter brassicas is detrimental to soil health and farm biodiversity. They leave the soil bare after grazing, increasing the risk of run-off and leaching, diminishing the most important primary asset on the farm (soil) and impacting ecosystems outside the farm boundaries such as waterways. Additionally, the use of single species can make crops more susceptible to pests and diseases, requiring the use of chemicals and often require synthetic fertilizer for maximum yield. The high nitrogen content and low fibre in mono-culture crops can also compromise the rumination and general contentment of grazing animals.

To address these challenges, the group members of this project seek to investigate diverse forage mixtures as a new approach to winter grazing. The project will establish AB trials on four farms to compare a diverse forage mixture with a 'conventional' mono-crop forage brassica – in this case Bombardier kale.

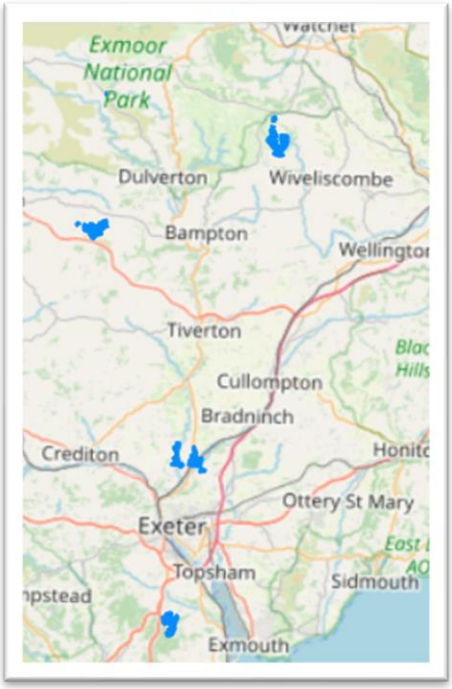
The outcomes of this project will include determining suitable plant species and varieties for winter grazing that can maintain green leaf area and ground cover and provide suitable nutrition to animals for rumination and to maintain or increase daily live weight gain compared to current options. The project also measured changes in soil health, such as earth worm counts, VESS, assessing surface run-off, and key biodiversity indicators. Additionally, the project considered farm economics and cost reduction compared to traditional wintering systems.

The results of this project could inform regulatory policy around options for winter grazing that benefit wild birds, ELMs, SFI, and Countryside Stewardship. This project could have a significant impact on changing farming practices by providing farmers with a new approach to winter feed provision that considers the overall health of the farm system.

Knowledge Gaps

- Detailed knowledge on perennial and annual plant species & varieties to include:
    - Growing traits
    - Forage quantity and quality
    - Compatibility (with other species)
    - Establishment
    - Winter hardiness
    - Nutrient requirements
    - Grazing management
- Farm system metrics to assess overall impact to annual feed supply, livestock enterprise performance and economic benefit.
- Biodiversity assessment – wider benefits to the environment from more diverse forage options, including bird surveys.
- Impacts to soil health, earthworm numbers and nutrient supply.

Methodology



4 x Trial Farms located in East Devon and Somerset.
2 organic and 2 conventional farms

- Establish 4Ha plot of forage brassica or fodder beet as per their "normal" system (A)
- Establish 4Ha plot of diverse forage crop based on mixture of annual and perennial plants (B)
- Soil samples taken prior to crop establishment to determine total nutrient availability.
- Both plots must be large enough to be grazed by a comparable group of animals (i.e., one mob split in half) and should be in the same field (or adjacent fields) to match soil type, topography etc.
- Soil Health assessments were carried out twice through the field lab using VESS scoring, Earthworm counts and Slake tests.
- Cattle were weighed and body condition scored prior and post grazing.
- Crops were grazed as required for best management under the farm systems approach. Forage analysis (Laboratory)
- Grazing systems included strip and cell grazing – moved once or twice daily depending on performance at the farmers discretion.
- Supplementary feed provided at farmers discretion.
- Bird counts late autumn and winter as a key ecosystem indicator species.
- Animals were introduced at a suitable time and stocking rate for each farm.
- Observations were recorded by the farmers on dung scoring and animal condition during the trial.

Participating Farms.

Farm Name	Address	Postcode
Higher Thornton Farm	Kenn	EX6 7XH
Lower Brown Farm	Somerset	TA4 2EL
Fortescue Farm	Thorverton, Devon	EX5 5JN
Weston Farm	East Knowstone, Devon	EX36 4ED

Species Selected and Purpose

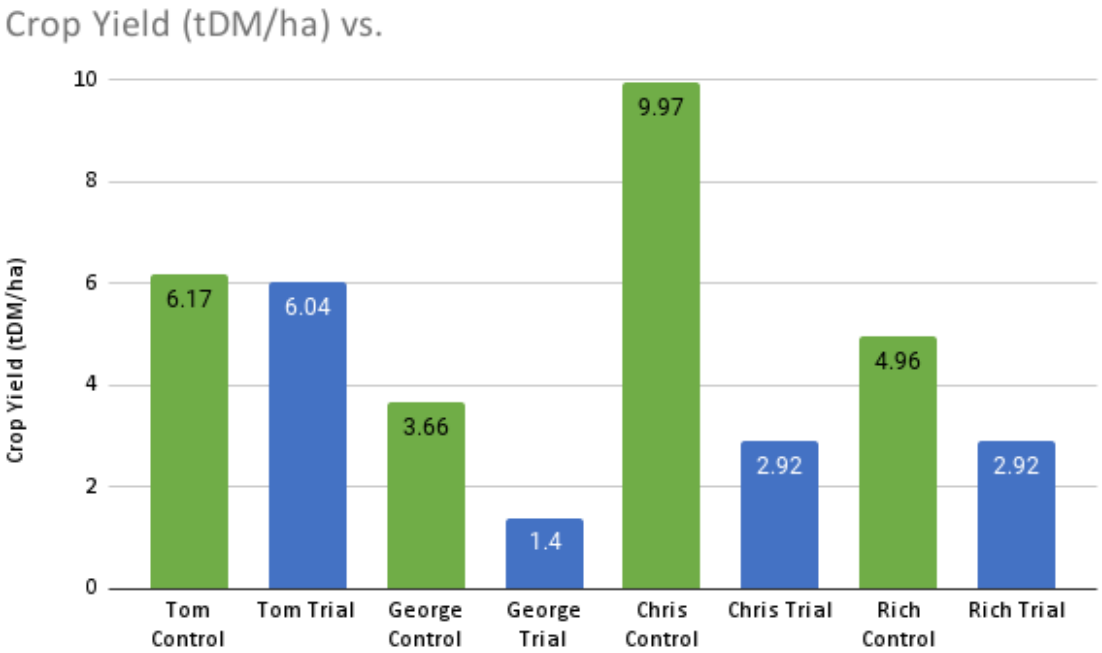
Species	%	Functional Group	Description
White Clover	2.9	Legume	Low growing, high protein content, minerals, digestibility, persistence, waterlogging tolerance, good relative yield
Berseem Clover	1.1	Legume	Annual, fast growing, large biomass, least hardy, soil fertility
Crimson Closer	1	Legume	Annual, soil fertility
Alsike Clover	1	Legume	Perennial, slower growing than red clover, Good for heavy and acid soils, frost tolerant
Hairy Vetch	16	Legume	Out competes weeds, fixes N, improves soil structure
Linseed	5.31	Forb	Annual, bird feed, improves soil structure
Forage Rape	2.1	Brassica	Palatable, high yield, protein rich
Kale Seed R/C	1.9	Brassica	Highest yielding brassica, winter hardy, high protein
Kale x Rape Hybrid R/C	0.45	Brassica	Quick establishment, winter hardy, high protein
Attila Diploid Italian Ryegrass	25.7	Grass	Short lived, high yielding,
Spadona Perennial Chicory	0.4	Herb	Protein, Minerals, digestibility, good yield, anthelmintic, drought and frost tolerance
Ribwort Plantain	0.8	Herb	Protein, Minerals, good relative yield, anthelmintic, waterlogging tolerance, marginal soil, drought
C2 Canyon Spring Oats	28.6	Grass	Soil improving, can be allelopathic, grows on less fertile soils
Daikon Tillage Radish	5.7	Brassica	Deep rooted, improves soil structure, competes with weeds
Iregi Sunflower Seed	6.2	Forb	Strong roots break up compacted soils, seeds for farmland birds
White Millet Seed	0.84	Grass	Bird seed
Functional Groups	**% Composition**		
Brassica	10.15		
Grass	55.14		
Herb	1.20		
Legume	22.00		
Forb	11.51		
Grand Total	**100.00**		

Field Lab Establishment Data

Establishment						
Farms	**Farm Type**	**Previous Crop**	**Tillage**	**Drill Date**	**Seed Rate**	**Inputs**
Lower Brown Control - Cows	Organic	Three-year Red Clover ley	Plough, roll, Power harrow drill combination, roll.	07.05.2022	5kg/ha	None
Lower Brown Control - Calves	Organic	Three-year Red Clover ley	Plough, roll, Power harrow drill combination, roll.	07.05.2022		None
Lower Brown Trial - Cows	Organic	Fodder Beet	Plough, roll, Power harrow drill combination, roll.	10.05.2022	33kg/ha	None
Lower Brown Trial - Calves	Organic	Fodder Beet	Plough, roll, Power harrow drill combination, roll.	10.05.2022		None
Fortescue Control	Organic	Red Clover, Rye Grass & Chicory	2 passes with discs then drill and double roll	20.06.2022	4.5kg/ha	Cattle FYM
Fortescue Trial	Organic	Winter wheat followed by forage rape	3 passes with discs, then drill and roll	15.05.2022	30kg/ha	Cattle FYM
Higher Thornton Control	Conventional	Ryegrass and clover	LDS, part chisel plough, disced x3.5 rolled x 2, broadcast harrow	27.05.2022	5kg/ha	5t/ha lambing bedding, Humber Palmers 10.5.16.31.5 S+ Boron 550kg/ha
Higher Thornton Trial	Conventional	Ryegrass and clover	LDS, part chisel plough, disced x3.5 rolled x 2, broadcast harrow	27.05.2022	30kg/ha	5t/ha lambing bedding, Humber Palmers No11 + Boron 250kg/ha
Weston Control	Conventional	Ryegrass and clover	1x Sub Soil. 1x cultivate 1x power harrow drill 1x roll	04.06.2022	5kg/ha	Roundup, lime, FYM 2.5T/ha, AN 80kg
Weston Trial	Conventional	Ryegrass and clover	1x Sub Soil. 1x cultivate 1x power harrow drill 1x roll	04.06.2022	33kg/ha	Roundup, lime, FYM 2.5T/ha, AN 80kg

	Stock Information			Grazing							
Farms	**No of Animals**	**Stock type**	**Breed**	**Grazing Start**	**Grazing End Date**	**Days Grazing**	**Ha per day**	**Remaining after trial**	**Supplementary feed**	**SF Bales Amount**	**Vet/ Meds / disease**
Lower Brown Control	24	Cows	Stabiliser	14.11.2022	01.01.2023	48	0.04		Silage	48	
Lower Brown Control	25	April born Calves	Stabiliser	14.11.2023	01.01.2024	48			Silage		Bloat mortality x 1
Lower Brown Trial	24	Cows	Stabiliser	14.11.2024	01.01.2025	48	0.05		Silage	33	
Lower Brown Trial	24	April born calves	Stabiliser	14.11.2025	01.01.2026	48			Silage		
Fortescue Control	18	In calf heifers	Aberdeen Angus x Pure Red Poll	30.12.2022	24.01.2023	24		0.81 ha	-		
Fortescue Trial	20	In calf heifers	Aberdeen Angus x Pure Red Poll	30.12.2022	24.01.2023	24			-		
Higher Thornton Control	31	April-June calves	Angus	28.11.2022	21.02.2023	85	0.030	1.0 ha	Lucerne Haylege, salt and minerals	19	Tetramycin x 3
Higher Thornton Trial	22	April-June calves	Angus	28.11.2022	21.02.2023	85	0.035		Lucerne Haylege, salt and minerals	26	
Weston Control	18	21 - 22 months	Devon Red	19.11.2022	21.01.2023	63	0.04	0.8 ha	Hay	11	
Weston Trial	18	22 - 22 months	Devon Red	19.11.2023	21.01.2024	63	0.06-0.08		-		

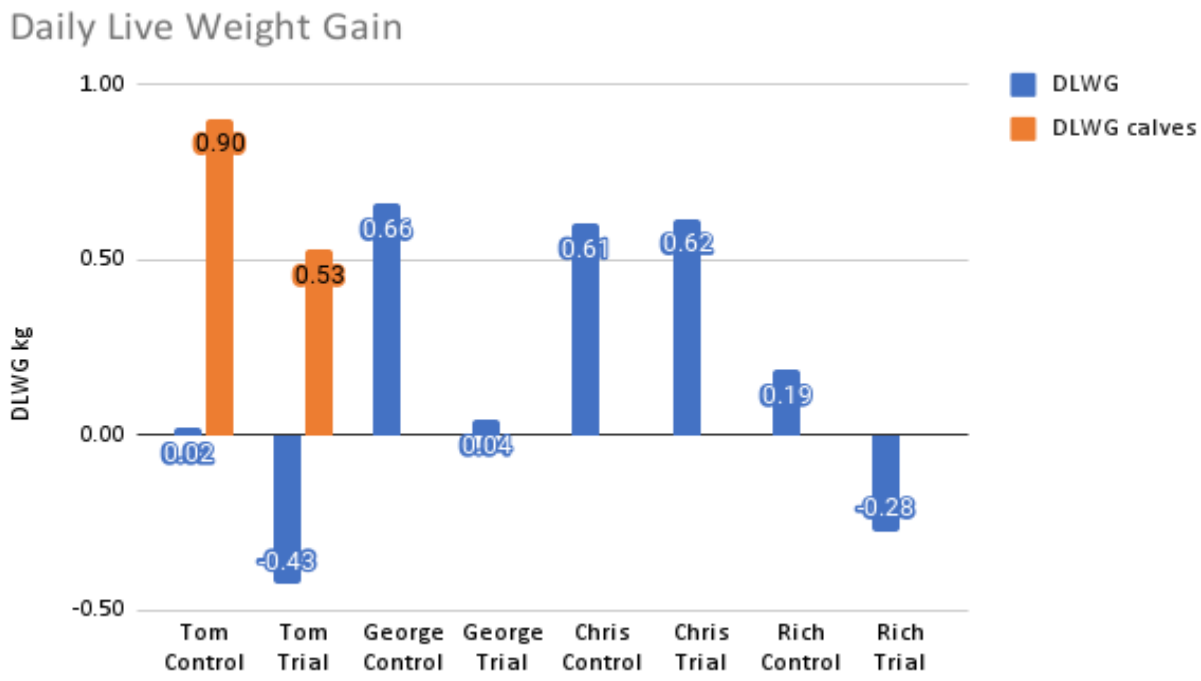
Results Crop Yield

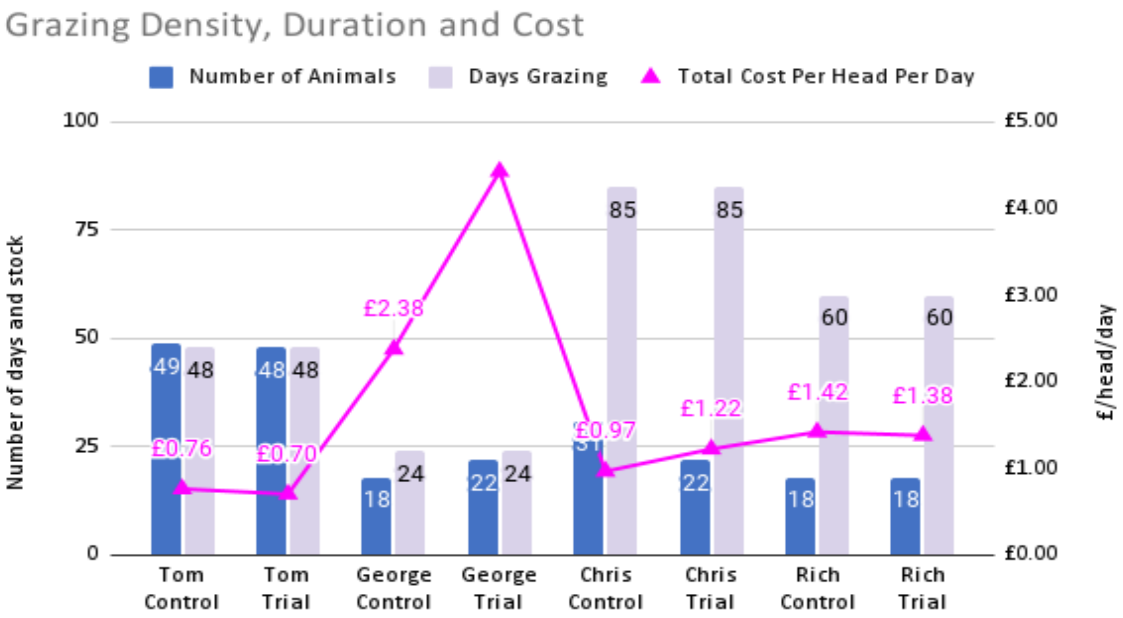


Key Values Assumed:				
Crop	MJME/kgDM			
Kale	11			
Diverse Species Mix	10			
Supplement	MJME/kgDM	kgFW	DM%	Utilisation
Hay	9	300	85	85
Lucerne Silage Bales	11	650	40	85
Grass Silage Bales	10	650	40	85

Note: The crop yields have been estimated by Precision Grazing using animal energy requirements for the grazing period. FARMAX was used to analyse the change in animal liveweight over the grazing period, metabolic state and sex to determine animal energy requirements for the period. Animal energy requirements have been adjusted up for climatic conditions experienced during the trial (eg. exposure and heat loss).

Grazing Results





Animal Performance Data

	Stock Information			Grazing							Animal Performance			
Farms	No	Stock type	Breed	Grazing Start	Grazing End Date	Days Grazing	Ha per day	Supplementary feed	SF Amount	Vet/ Meds / disease	Av Start Weight	Grazing End Wt.	Change	DLWG
Lower Brown Control	24	Cows	Stabiliser	14.11.2022	01.01.2023	48	0.04	Silage	48		649.88	650.88	1.00	**0.02**
Lower Brown Control	25	April born Calves	Stabiliser	14.11.2023	01.01.2024	48		Silage		Bloat mortality x 1	271.27	314.69	43.42	**0.90**
Lower Brown Trial	24	Cows	Stabiliser	14.11.2024	01.01.2025	48	0.05	Silage	33		608.4	588	-20.40	**-0.43**
Lower Brown Trial	24	April born calves	Stabiliser	14.11.2025	01.01.2026	48		Silage			269.64	295	25.36	**0.528**
Fortescue Control	18	In calf heifers	Aberdeen Angus x Pure Red Poll	30.12.2022	24.01.2023	24		-			460.67	476.5	15.83	**0.660**
Fortescue Trial	20	In calf heifers	Aberdeen Angus x Pure Red Poll	30.12.2022	24.01.2023	24		-			518.05	519.10	1.050	**0.044**
Higher Thornton Control	31	April- June calves	Angus	28.11.2022	21.02.2023	85	0.030	Lucerne Haylege, salt and minerals	19	Tetramycin x 3	252.26	303.74	51.484	**0.61**
Higher Thornton Trial	22	April- June calves	Angus	28.11.2022	21.02.2023	85	0.035	Lucerne Haylege, salt and minerals	26		252.05	304.68	52.636	**0.62**
Weston Control	18	21 - 22 months	Devon Red	19.11.2022	21.01.2023	63	0.04	Hay	11		381.78	393.50	11.72	**0.186**
Weston Trial	18	22 - 22 months	Devon Red	19.11.2023	21.01.2024	63	0.06-0.08	-			398.11	380.78	-17.33	**-0.275**

Costings

Establishment Costs	LB Control	LB Trial	Fortescue Control	Fortescue Trial	HT Control	HT Trial	Weston Control	Weston Trial
Total Ha (grazed in trial period)	2	2.4	2.19	4	2.5	3	2.4	3.24
Tillage	£121.00	£121.00	£105.00	£145.00	£79.71	£79.71	£49.40	£49.40
Organic Nutrient			£108.00	£180.00	£40.00	£40.00	£100.00	£100.00
Drilling			£50.00	£50.00	£25.00	£25.00	£61.75	£61.75
Seed Cost	£62.50	£88.50	£50.40	£88.50	£66.50	£88.50	£80.00	£88.50
Herbicide					£34.59	£34.59	£35.00	£35.00
Pesticide					£22.40	£22.40	£0.00	£0.00
Fertilizer					£385.00	£175.00	£62.50	£62.50
Per Ha	£183.50	£209.50	£313.40	£463.50	£653.20	£465.20	£388.65	£397.15
Total Cost	£367.00	£502.80	£686.35	£1,854.00	£1,633.01	£1,395.61	£932.76	£1,286.77
Grown Forage Cost per head per day								
Number of Animals	49	48	18	22	31	22	18	18
Days Grazing	48	48	24	24	85	85	60	60
Forage Cost	£0.16	£0.22	£1.59	£3.51	£0.62	£0.75	£0.86	£1.19
Supplementary feed	£0.41	£0.29	£0.00	£0.00	£0.14	£0.28	£0.28	£0.00
Minerals								
Labour	£0.20	£0.20	£0.55	£0.68	£0.20	£0.20	£0.28	£0.19
Electric			£0.08	£0.09				
Fencing Equipment			£0.06	£0.05				
Water			£0.10	£0.10				
Vet/Meds					£0.00			
Total	£0.61	£0.49	£0.79	£0.92	£0.35	£0.48	£0.56	£0.19
Total Cost Per Head Per Day	£0.76	£0.70	£2.38	£4.43	£0.97	£1.22	£1.42	£1.38

Anecdotal observations during grazing:

- Dung scores were consistently better on the diverse mix. This is most likely due to higher fibre content and lower protein values than the kale (despite kale mobs having supplementary bales on all farms).
- The diverse mix held the animals out of the mud better than on the kale. The kale plots lacked root biomass and became poached and pugged much sooner than the diverse plots, with surface sitting water. Once at field capacity and with heavy rain and snow early in the winter animals needed to be moved on faster on both.
- Animals were content on both forages but tended to take a bit longer to adjust to the kale initially.
- Mobs moved through the diverse mix faster in all trials. This requires greater land area, but potentially less supplementary feed. This could be improved with more winter hardy species within the mix.
- Soil condition was almost always better in the diverse mix post grazing than in the kale plots.
- Post grazing regrowth on trial plots indicates potential for additional graze in spring/early summer, which would have an implication for the costings done above.
- Early frost and snow reduced the forage value of the diverse mix considerably. This is evident in the results, with the DM utilised within the grazing period consistently lower on the diverse mix than in the kale plots across all farms. A solution could be to increase the % of winter hardy species within the diverse mix, and the incorporation of a high feed value root.
- There were more health issues on the kale crop, with the loss of one calf at Lower Brown Farm (possibly to bloat), and three animals requiring tetramycin at Higher Thornton Farm. This could be due to transition stress onto the kale crop but may also be down to animal genetics or other factors.

Grazing Systems and Discussion

Lower Brown Farm used strip grazing and had a heavy stocking density with no back fence. This method proved to leave the ground in a poorer state than the cell grazing plots. However there has been regrowth on this farm on the diverse plot, whereas the kale plot has had bare and exposed soil throughout the rest of the winter.

Fortescue Farm had the lowest stocking density, and shortest duration of grazing. Higher Thornton similarly had a lighter stock class with lower density and both these farms had less poaching and pugging. They are both in drier areas and have sandier free draining soils. Fortescue Farm did have some diversity within the kale plot as rye and clover from the previous ley grew back.

Across all farms there has been regrowth on the diverse trial plots reducing the amount of time bare soil is exposed before drilling can begin in the spring. This could potentially offer an early spring bite and has been re-grazed on two farms. This will impact the costings and forage value of the land, which from our above results shows the diverse mix.

under performs in comparison to kale when looking at DM alone.

The grazing management and potential for regrowth are important considerations for anyone considering increasing their diversity for winter grazing systems. The multitude of benefits from the diverse mix cannot fully be costed or quantified, in particular soil health benefits for following crops and impacts on nutrient availability and the soil microbiome.

The consensus amongst the farmers involved has been that they will not return to monocropping winter crops again, but that the mixture of species and management need to be tweaked to improve performance of the animals. All farms additionally use bale grazing on deferred grass which is an important winter grazing option, but this diverse species mix could potentially fill a feed gap where required to preserve grass.

Lower Brown Farm strip grazing (above)

Weston Farm cell grazing (below)

Soil

Soil laboratory analysis was conducted by Eurofins using their Fertilizer Manager test that includes chemical, physical and biological analysis.

	Unit	Target value	LB Control	LB Trial	Fortescue Control	Fortescue Trial	HT Control	HT Trial	Weston Control	Weston Trial
Acidity (pH)		6,3 - 6,6	5,9	5,5	5,8	6,0	5,9	5,8	5,1	5,2
Soil crumbling	score	6,0 - 8,0	8,1	7,7	7,9	8,1	9,0	8,7	5,6	5,8
Soil slaking	score	6,0 - 8,0	6,9	7,1	4,3	4,2	4,8	4,2	5,9	5,9
Risk on wind erosion	score	6,0 - 8,0	9,1	9,1	8,2	8,1	7,9	8,0	8,7	8,9
Moisture retention cap.	mm		53	50	55	55	57	56	48	48
Microbial biomass	mg C/kg	170 - 510	818	1035	734	331	304	267	916	943
Microbial activity	mg N/kg	60 - 80	129	135	47	52	< 1	26	139	149
Fungal/bacterial ratio		0,6 - 0,9	0,9	0,8	1,0	0,7	2,3	0,6	1,7	1,3
C-organic	%		3,9	4,7	1,7	1,6	1,6	1,7	3,8	3,7
Organic matter	%		9,6	10,8	3,2	3,3	3,4	3,4	6,6	7,1
SOC/SOM ratio		0,45 - 0,55	0,41	0,44	0,53	0,48	0,47	0,50	0,58	0,52

Soil Health

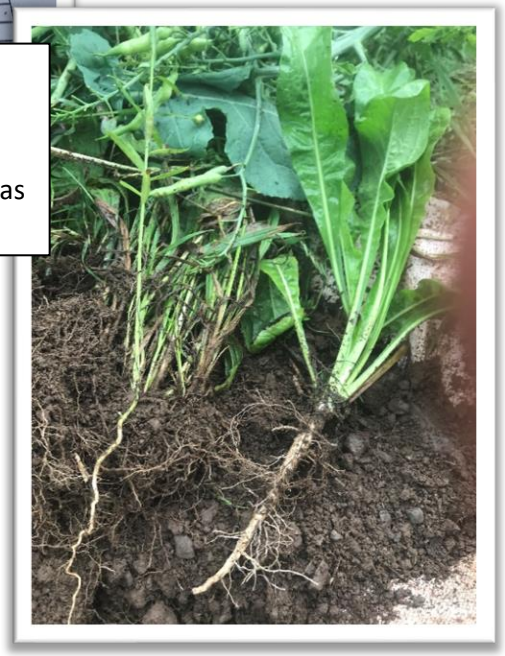
The very dry summer had a noticeable impact on the earthworm activity and during an August visit soil pits revealed very few worms across the farms. However generally the root biomass is vastly increased by incorporating diverse functional groups together. There were signs of increased fungal activity and improved soil structure, particularly at Weston Farm where the diverse mix performed very well, and a large amount of biomass was growing. The volume of root exudates would have been greatest on this farm and having the greatest benefits to the soil biome.

Lower Thornton and Fortescue farms both have sandier soils. Lower Thornton was particularly affected with poor establishment of the crop and lacked the biomass found on other trials sites, with bare and exposed soil.

General consensus amongst the farmers is that the diverse mix has improved their water infiltration. This was evident through the wet winter when the diverse plots had less surface sitting water and tended to hold the animals out the mud for longer. Extreme wet weather did leave the higher stocked grazed plots on both trial and control in a poached and pugged state, and this needs to be a key consideration of grazing management. Whilst this trial aimed to compare conventional winter brassica grazing with a diverse sward, it is not only the diversity of the plants that should be considered but also the grazing management. With lower stocking or shorter duration grazing there is a greater potential for preserving soil health and increasing the opportunities for a spring bite and additional forage value.

Soil Sampling Photographs

Roots: Rhizosheath formation three weeks after drilling at Lower Brown Farm, rooting depth, root density and signs of compaction such as J-rooting as seen in the kale at Fortescue Farm.



Visual Evaluation of Soil Structure

VESS scoring.

Aggregation

Looking for crumbly beautiful aggregation as found at Lower Brown and Weston Farms.

Higher Fortescue suffered in the dry weather and was particularly compacted; you can see the horizontal layering and plough pan was evident when digging soil pits.

The above photographs were taken at Weston Farm, East Knowestone. This field lab was done on a single field which was split into two. The field had exactly the same previous cropping and management, and tillage and establishment were identical for both the diverse mix and the kale.

These soil pits were dug on the 24th of August 2022. The image on the left shows the soil condition of the diverse mix, whilst the image on the right is amongst the kale crop. It was noticeably improved within the diverse mix, with a high density of fibrous and deep roots, good aggregation and structure. There were many worms found on both sides, however you can clearly see the compaction layer and the lighter colour of the kale plot. The soil pits on this farm (three on each plot) were the clearest indicator of the benefits that the diverse species were having on the soil health and soil microbiome and are consistent with our current understanding of the impact of diversity on speed of recovery of soils.

Bird Surveys

Summary (complete report available).

• A total of 36 species of bird were recorded over the 4 farms and of these 8 were Red listed species of Conservation Concern and 13 were Amber listed birds (see definition below).

• A total of 20 species were recorded using the experimental forage crops and a total of 20 species were observed using the kale crop.

• Whilst the number of species recorded on each of the crops is the same the number of birds using the diverse forage crops was overall higher than in the kale crops. See Tables 1 and 3.

• The number of species and overall numbers of birds varied between farms, and this may be an indication of numbers and species of birds that are present/using the wider farm landscape and habitat rather than the quality of the forage.

• The diverse forage crop, as might be expected, was particularly attractive to seed eating birds such as Linnets, Chaffinch, Goldfinch and Greenfinch which were often present in large flocks. See Table 5.

• Fortescue Farm had the highest numbers of birds and diversity of species recorded for both crop types overall with considerable general bird activity over the farm.

• There was still a lot of insect activity on the fields for the autumn visits due to the mild weather and crop plants still in flower. This will have attracted birds to the crop for example Stonechats were observed catching insects perched from the top of sunflowers.

• There is value in both crops providing insect habitat and cover for foraging but there were a greater number of species that tend to go for insects etc like Wren, Blackbirds, Song Thrushes in the kale crop, possibly because it creates a sheltered overstorey for slugs/snails and other invertebrates, while providing enough structure to allow the birds to get in and find them. See Table 5.

• The presence of other casual/volunteer seed bearing species of plant in the crops such Fat Hen and Chicory were a key element in attracting seed eaters like Linnets, Goldfinches and Greenfinches. The only sown crop that had gone to seed in the autumn survey were the radishes on most of the farms. These casual species were largely gone by the time of the winter survey.

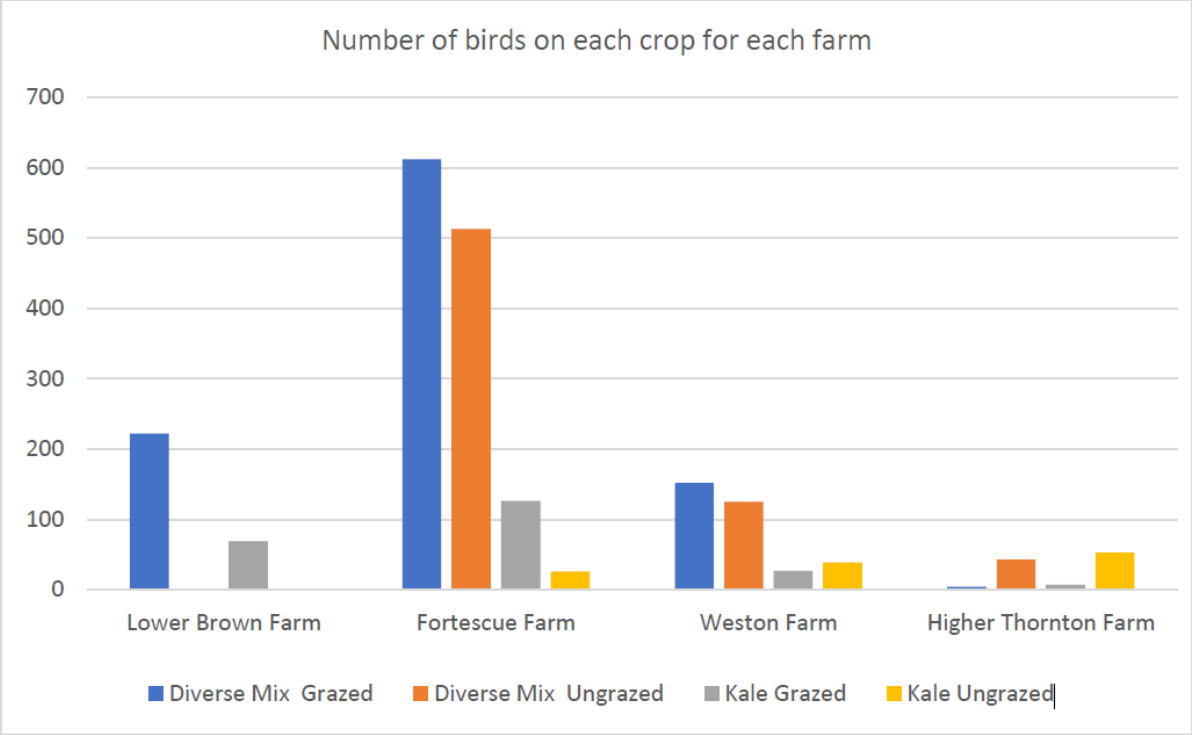
• The winter visits had little insect activity with the cold weather although there was noticeable bird activity amongst the grazing livestock who were no doubt disturbing any insects in the vegetation, soil organisms such as worms as well as spilt seed as well as dung.

• Highest bird numbers were on the grazed diverse forage crop areas, but this was largely concentrated on the interface between the grazed and ungrazed areas where livestock were feeding, and this appeared important for birds with good numbers present. This was not observed at Lower Brown Farm as both crops had been completely grazed off and no livestock were present.

• The grazed areas were quite poached on nearly all the farms with little residue vegetation/stubble left on the ground -the wet weather over previous weeks to the survey being a key factor in this. On other trials there was considerably more “stubble” and detritus left on the ground largely due to more frequent movements of livestock.

The only exception was the diverse forage crop on Fortescue Farm where back fencing had been done and some stubble remained which seemed to allow seed eating birds to use the entire grazed area.

Results from the mid-winter bird survey are show below:



Biodiversity

The diverse species had a notable impact on biodiversity activity and benefits. This was most clearly demonstrated through the summer with the numbers of pollinators, butterflies and insects making use of the floriferous species. Bird surveys reflected a similar result with greater numbers of birds making use of the diverse plots. There was consensus amongst all farmers that this was a highlight of the trial and something that they valued and considered of benefit to their own wellbeing, as much as the environmental benefits.

Bumblebees (top right)

Cabbage white butterflies

Lady Bird and Larvae (bottom left)

Farmer Welfare

Working with livestock in intensive grazing systems that require regular moves in winter weather can be challenging. All the farmers in this trial have had experience of outwintering cattle previously.

Cattle were moved once or twice daily, and although there are reduced tasks in comparison to indoor housing (bedding up, feeding etc) there were still fences that needed to be put up and water pipes unfrozen during the coldest periods.

Regular communications over a WhatsApp group proved to be really valuable for sharing experiences and ideas and boosting morale. Regular video and photographic reports informed all the farmers of exactly what was happening on each farm, and enabled farmers to quickly and easily share information without too much record keeping. Observational records were kept in spreadsheets which proved valuable for reflection but added an additional task in the office.

The group met online regularly and had a farm walk at Higher Thornton Farm in early February to discuss the trial and next steps.

There were many challenges the farmers faced including TB testing and very early winter snow and frosts, and then an extensive period of wet weather. They were also juggling their regular farming activities with management of this trial. However, all farmers have expressed that they have found the trial valuable as a learning exercise and have appreciated the group contact and support.

They all participate in the Precision Grazing discussion groups which provide a larger support base and technical support which is of great value to them.

Conclusion

The farmers agree that the following objectives were achieved through increasing diversity.

1. Improvements in soil structure and aggregation
2. Increases in soil organisms, and improvement in soil cycling of OM (evidence of fungal activity).
3. Increases in biodiversity, including pollinators, insects and birds.
4. Reduction in poaching and better water infiltration
5. Faster transition for the mobs onto the diverse mix.
6. Better dung scores consistently across the diverse mix.

The following improvements and further research are required:

1. The tweaking of species to ensure more winter hardy species are included. Reduce/eliminate daikon tillage radish and vetch. Species to add include sainfoin, forage rye, alfalfa, birdsfoot trefoil, yarrow (particularly on drier farms), and a winter hardy root (e.g.: swede)
2. Timing of grazing and stocking density need to be improved to encourage recovery and regrowth and reduce (aim to eliminate) poaching in all conditions. This was shown on Fortescue Farm where there were no poaching issues.
3. It is important to time the grazing to maximise forage value. This may negatively impact the biodiversity, but there was a significant loss of feed from the extreme weather which impacts profitability (and therefore sustainability) of the system.
4. Animal DLWG and body condition scores were directly impacted by this loss of forage value. A lower DM per Ha can be supplemented with baled feed (haylage and silage), but it is this comes at a cost and requires additional work.
5. Different stock classes performed better on the diverse mix, and this needs further investigation. Cows in gestation have different feed requirements to young stock.
6. There is additional research required to assess compensatory growth when stock are moved off both kale and the diverse mix. It is hypothesised that the rumen will be in a better condition from a diverse forage diet, and the animals may perform better than the kale mobs once moved to spring pastures.