Maximising the Potential of Forage Crops in a Challenging Climate

A Monitor Farm Scotland Innovation Project

MONITOR FARM Scotland

Delivered by:

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Executive Summary

The Deeside Monitor Farm Management Group consists of several innovative and next generation producers, who have implemented various outwintering systems. These are enabling them to reduce the cost of wintering cattle and improve health and welfare of the stock, while returning key nutrients to the land from the grazing stock. Systems have been adapted to minimise the effect on the environment e.g. back fences to prevent constant travelling on land and siting of bales ahead of winter, halting the requirement for heavy machinery in the fields.

The project allowed for an independent consultant (Kirsten Williams, SAC Consulting) to support four members of the group throughout the growing period and winter of 2024/25. This allowed the members a deeper understanding of their systems including the cost of production of the crops, nutritional analysis, nutritional advice, a deeper insight into the animals' requirements and the supply given from the systems in place. A total of ten crops or systems were followed.

The producers were Deeside monitor farmer, Duncan Morrison and management group members Robert Marshall, Jonny Stewart and Alex Stephen. Duncan managed his in-calf cows on deferred grazing with bale grazing, and a separate group of cows on kale. This was the first year Duncan offered bale grazing to the cows on the deferred grazing, to reduce the impact of poaching around ring feeders. Duncan runs low-input systems over three units and a lower yielding, low risk crop suits his system, given he has scope and available grazing acres for his cattle over the winter outdoors.

Robert Marshall outwintered his in-calf cows and heifers on a mixed brassica crop. For the first time, he laid out wrapped silage bales in the field prior to winter, to reduce tracking from machinery throughout the winter season. Robert farms over a large area and has availability of areas for out-wintering cattle. His crop choice includes a medium yielding, highly nutritious crop for the cattle. The mixed brassica allows for a canopy to be generated quickly, reducing the possibility of a weed burden to the crop.

Jonny Stewart's crop choice included fodder beet and swedes for outwintering his cattle. Jonny doesn't have the same resource of land as Duncan and Robert, and chose a higher yielding crop, allowing for a higher stocking density on the wintering area. The risk is higher for these crops, as the input (fertiliser, herbicide, fungicide and insecticide) requirements are greater, and the risk of crop failure is higher. Good crop husbandry and management are required with the high yielding crops.

Alex Stephen's outwintering system included fodder beet for pregnant ewes and stubble turnips for growing dairy cross steers. The stubble turnips are a low-cost crop, acting as a catch crop, following a harvest of winter barley. These only receive slurry as an input and can be utilised 10-12 weeks post sowing. The fodder beet is a high input, high yielding energy crop for the pregnant ewe lambs. The main system on the holding is a dairy, meaning grass must be available for an early cut of silage in the spring. Growing the fodder beet allows a high stocking density on the crop throughout the winter, giving the grass a break to achieve the early spring growth for a suitable cut of silage.

The ten crops ranged in yield from 20.48t DM/ha for a fodder beet crop to 3.03t DM/ha for a brassica mix. The nutrition of the crops varied slightly from typical book values in some scenarios; most notable was high protein recorded in a kale crop.

The higher yielding crops typically had a higher establishment cost per kg freshweight. However, when this was converted into cost/kg DM they had a lower establishment cost. The lowest cost crop/kg DM to establish was deferred grazing £0.00/kg DM, followed by the stubble turnip catch crop at 2p/kg DM. The average across the 10 selected crops followed was 6p/kg DM.

The cost of supplementary forage supplied in the systems was calculated with livestock units (LUs) used to allow comparisons between the different stock classes (suckler cows, heifers, dairy X steers, ewes, lambs). The fodder beet held the highest stocking density at 16.88LU/ha, while the stubble turnips held 2.40 LU/ha.

Four farms with different systems made comparisons challenging due to different modes of establishment, classes of stock and farm resources available. Replicating this study with similar trials in other areas of Scotland is recommended to build the dataset further, covering different climates, conditions and stock classes, to gather a greater understanding of costs, capacity and usefulness.

Contents

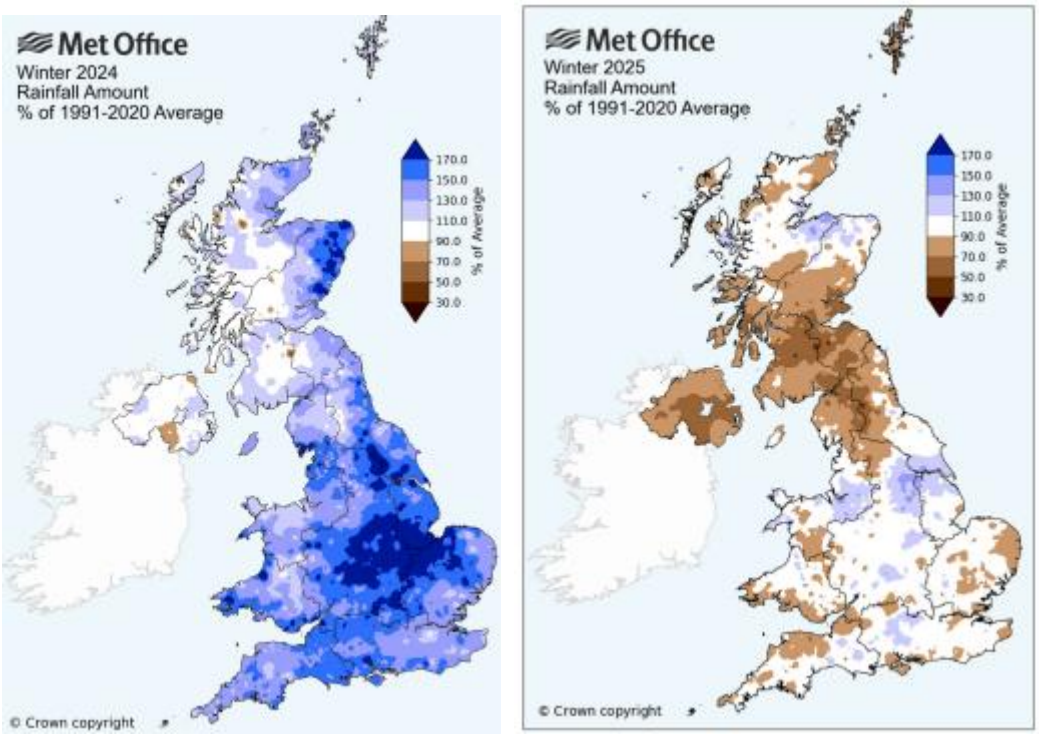
Introduction

There are numerous, alternative over-wintering strategies available for livestock farmers to practise, away from traditional housing of stock, throughout the winter period. Several management group members from the Deeside Monitor Farm are practising these, allowing them to reduce the cost associated with winter housing, while offering good nutrition for the stage of production of the animal and reducing health challenges associated with housing e.g. pneumonia. Further benefits of the outwintering systems include; growing a break crop, allowing for nutrient cycling from the animals and increasing the organic matter of the land.

The Deeside Monitor Farm Management Group is made up of young, innovative individuals, who have a drive to run low cost-efficient systems. The project provided these individuals the opportunity to have a closer eye on costs of outwintering systems and their nutritional analysis. They were supported by Kirsten Williams, SAC senior sheep and beef consultant. who provided an external eye to the four businesses, to assist with data collection and advice throughout growing and utilisation of the ten crops. This information will allow for informed decisions for future wintering decision making, for the four farmers, the Deeside Monitor Farm members and the wider industry.

Autumn and Winter 2023 tested many outwintering systems. Four named storms, from late September to Mid-November Agnes, Babet, Ciarán and Debi, made it exceptionally wet at times, with localised flooding. This led many producers to delay putting stock on to forage crops, and contingency plans were put in place. The 6-7th October 2023 proved to be Scotland's wettest two days on record. The winter was extremely changeable with December starting especially cold with temperatures in Deeside in the region of -10°C, before turning mild with the winds from storms Elin and Fergus. This mild weather continued with persistent rain throughout the month, and further wind brought with storm Gerrit at the end of December. January then started wet, with another storm – Henk. Throughout the month, the rain stopped, however the temperature fluctuated greatly rising to almost 19°C and dropping to sub-freezing. Further storms then came with Isha and Jocelyn. With this extremely wet and changeable winter, those managing outwintering systems faced challenges with ground conditions, shelter for stock and crop losses.

Following the challenging conditions for out wintering in winter 2023, the Deeside Monitor Farm, planned an innovation project to monitor crops throughout the following (2024/25 winter). The maps show these were two very different winters in terms of rainfall.



Source: MetOffice, (downloaded May 2025)

Sowing was delayed by many following a slow, wet and cold spring in 2024. With the assistance of Kirsten Williams, SAC senior sheep and beef consultant, the four farmers from the Deeside Monitor Farm Management Group shared their experiences of how they plan for winter, build resilience into their systems and manage their crops in a challenging climate.

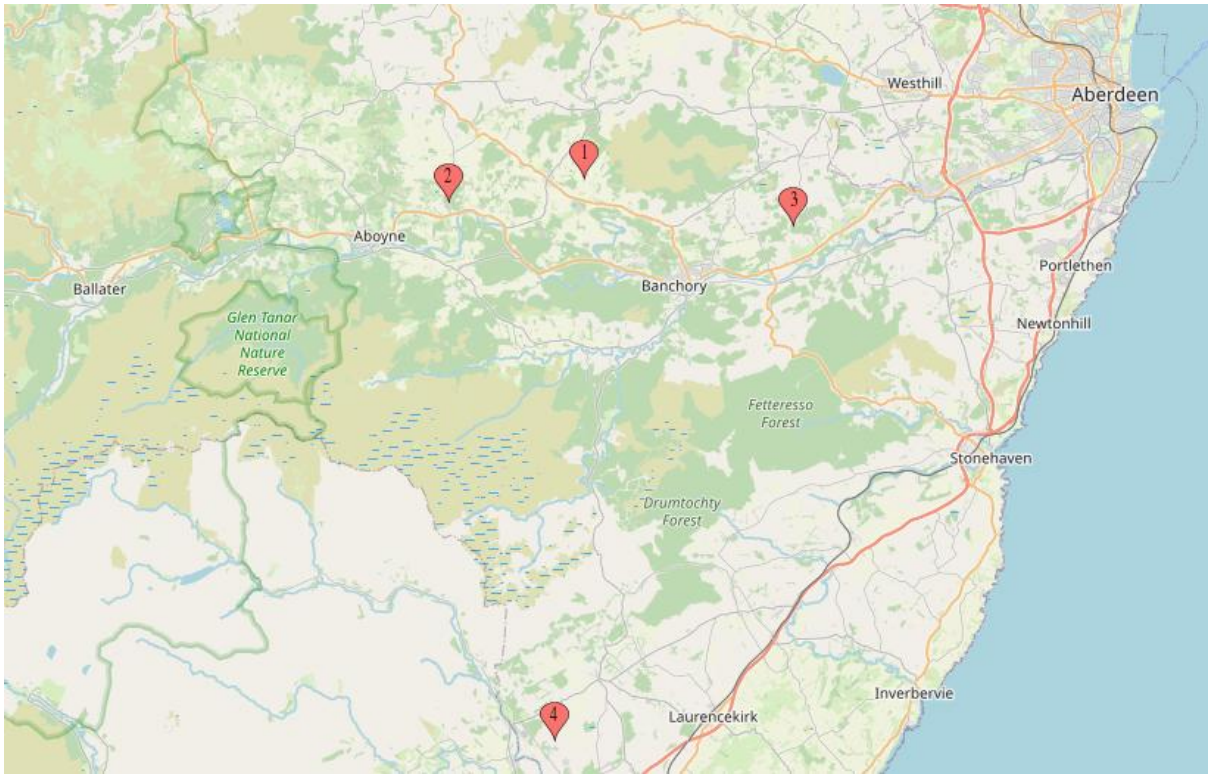
Method

Data was collected on the various crops that were grown, including varieties, crop inputs and establishment success. The crops were monitored throughout the growing season and a dialog kept between the farmers, sharing best practice, photos and recording of crop applications. Yields were calculated across the crops and the standing forage crops were analysed for their feed value with resulting nutritional and utilisation advice tailored for the farmers. Cost and nutritional comparisons were performed on the different systems managed by the farms.

The project included four livestock farms, who are members of the Deeside Monitor Farm Management Group. The farms have different stock classes, altitudes and forms of outwintering. The four farms are:

1) Duncan Morrison, Meikle Maldron, Torphins – Deeside Monitor Farmer
2) Robert Marshall, Kincraigie Farms, Lumphanan
3) Jonny Stewart, Mains of Balfour, Rashenlochy Farm, Drumoak, Banchory
4) Alex Stephen, Inch of Arnhall, Edzell

The location for these, are shown below,



Leaflet (http://leafletjs.com) | Map data © OpenStreetMap (https://www.openstreetmap.org/) contributors, ODbL (https://opendatacommons.org/licenses/odbl/1.0/)

The project covered ten different crops, over four different businesses, in the 2024 growing year, shown below. Links to introductory videos for each of the businesses are shown below. Kirsten Williams introduced the project at Deeside Monitor Farm: Introduction to the Winter Forage Crop Project

	Crop Grown	Animal Utilising
Duncan Morrison 	1. Kale 2. Bale Grazing & Deferred Grass Deeside Forage Crop Project: Kale and Bale Grazing	In calf cows and heifers
Robert Marshall 	1. Hybrid Rape 2. Hybrid Rape and Yellow Neep Deeside Forage Crop Project: Hybrid Rape and Yellow Neeps	In calf cows and heifers
Jonny Stewart 	1. Swedes 2. Fodder Beet Deeside Forage Crop Project: Fodder Beet and Swedes	In calf cows and heifers
Alex Stephen 	1. Fodder Beet 2. Stubble Turnips 3. Forage Brassica Deeside Forage Crop Project: Stubble Neeps and Forage Mix	In lamb ewes Growing Dairy x Steers Lambs

The different methods of establishment for the different crops and management for the wintering systems on the farms are explained below.

Duncan Morrison, Meikle Maldron

Duncan is experienced in overwintering his herd of 250 suckler cows, as his farm has limited facilities for housing cattle. Duncan is motivated by producing cattle on an extensive forage-based system. For the winter of 2024/25, he managed kale and bale grazing for winter utilisation.

Kale

	Kale
Drainage	Freely Drained Mineral Soils
Previous Crop	Deferred Grass
Forage Area	5.00 ha
Sown	May 2024

Establishment

Duncan sows kale on an annual basis. The kale crop follows either the previous year's deferred grass winter area or arable silage. Duncan chooses Caledonian due to its high yielding ability.

Establishment of the crop is low cost, with the seed bed power harrowed, before broadcast sowing at the end of May, with inorganic fertiliser (16.16.16) applied at sowing. The field is rolled, to maximise seed to soil contact and to retain the moisture into the soil to aid germination of the seed.

Management

Bales were sited throughout the crop, early in the season. There was no need for heavy machinery to access the field throughout the winter, aiding soil conditions.

The crop was yielded and analysed prior to stock being introduced (see yield and analysis section).

Utilisation

The crop was grown on 5 hectares, this was utilised by 85 cows, for 43 days, grazed in situ behind an electric wire. Once the kale was finished, cows were moved on to an area of deferred grazing.

Bale Grazing and Deferred Grass

Duncan introduced bale grazing on deferred grass for the first time in 2024 for his in-calf cows in the winter. Duncan has managed deferred grazing in the past, without bale grazing. This involved silage bales offered to the cattle by ring feeders. Duncan has seen other producers bale grazing, with benefits of

- Reduced poaching
- Uniformity of grass when it grows back (e.g. not having notable rings at feeding sites)
- Seeding grass the following year from the hay offered
- Animals being content with less competition due to the bales being rolled out

	Bale Grazing and Deferred Grass
Drainage	Freely Drained Mineral Soils
Previous Crop	Grass
Forage Area	12.14 ha
Crop Shut Off	Post hay being made June 2024

Establishment

Planning for the bale grazing began in the spring when the field was shut off to allow forage conservation, with hay cut from a 30-acre field in late June. The field was chosen for the outwintering system as it was underperforming. This field was one of Duncan's first reseeds when beginning his tenancy at Meikle Maldron, making it, at 7 years old, some of the older grass on the holding.

While making the hay, weather conditions deteriorated and a small number of the approximately 270 bales were wrapped, giving a total yield of 9 bales/acre. The bales were placed in three lines along the field, allowing the field to be shut off to build a wedge of deferred grass for the winter, with the bales sitting in situ.

After hay was positioned, no heavy machinery entered the field for the remainder of the year. Ahead of winter, Duncan purchased a bale unwinder, operated by a quad which unwinds the hay bales along the ground for the cattle to graze, along with the deferred grass.

Management

Duncan estimated the field would winter 110 cattle for 79 days. The cattle would then finish this wintering area close to the steading, allowing an easy move onto calving pasture to begin calving outdoors in April. His calculation extremely close: 114 cattle overwintered on the system for 80 days.

A back fence was used to prevent cattle from trampling the whole field, allowing the grass to come back and grow. The bale unroller worked well in the system.

Ground conditions held up extremely well and grass growth has been impressive following the cattle grazing. It is planned to use this field for deferred grazing again in winter 2025/2026 before being sown to kale.

The hay did not analyse as well as Duncan had hoped, the deferred grass, shut off since June, was also tested:

	Dry Matter	Protein	Energy
Maldron Hay 2024	77.60%	6.30%	9.30 MJ/kg DM
Maldron deferred Grazing (Jan 25)	21.90%	12.40%	10.20 MJ/kg DM

Table 1: Analysis of hay and deferred grazing 2025

Utilisation

Karen Stewart, SAC Ruminant Nutritionist assessed the diet for the cows pre calving.

Bales = 200kg each, with 4 bales per day = 7kg/hd/day less 10% wastage = **6.3kg/day hay (4.9kg DM)**

Fence 456m long x 3m wide = 1,368m^2 / 114 cows = 12m^2/hd/day

Deferred grass cover = 3,150 kg DM/ha, allowing a 500kg DM/ha residual = 2,650kg DM/ha available/eaten

= 0.265kg DM/m^2 x 12m^2 = 3.2kg DM/hd/day (**14.6kg FW) of deferred grass**

Karen estimated the ration allowed for a daily dry matter intake (DMI) of 8.1kg, with 78MJ of energy and 8.7% crude protein. This is borderline for DMI, protein and energy. Karen advised Duncan to offer the cattle a better forage e.g. Duncan had red clover silage available, or increase the quantity of deferred grass, as calving approached.

As the winter progressed, the winter was extremely kind, and the cattle remained in good body condition, which Duncan wanted to hold. The weather very much favoured this out wintering system with dry soils and sunny days, which reduced the energy requirement for the cows. On another year the hay may not have been sufficient, and the red clover silage would have been required. Karen recommended that Duncan carry out blood sampling pre calving to understand the energy and protein status of the cow.

Best practice for this includes:

- Cows should be settled on their ration for at least 2 weeks prior to sampling
- Ensure that cattle have been eating prior to sampling and not blood sampled on an empty rumen
- Sample 3-4 weeks pre calving

Blood sampling was done on five cows. Levels of protein and energy were at adequate levels, except for cows which were close to calving (10-12 days) whose energy levels were lower than ideal, as would be expected. Duncan offered the cows feed blocks as an insurance policy, to supplement the cow's energy and protein on the run up to calving.

Duncan's bale grazing system was featured on FAS TV, the footage is available at https://youtu.be/o_joLUoM7fk?si=n5DJC7c8OlZaWBZY

FAS TV Series 5 Ep 3 - Outwintering & Virtual...

Scotland's Farm Advisory Service
1.5K views • 2 months ago

The cows held their condition well throughout the winter and calved down well in the spring. The farm suits overwintering systems with sheltered fields and free draining soil. The deferred grazing is clean for the animals in wet conditions, and the kale holds up better in the snow. The kale and the deferred grazing allow for an element of contingency planning in the outwintering system, with grazing being available in wet conditions, and kale in snowy conditions. Duncan does have a stock of silage that can be offered to the cows if weather conditions turn for the worse. These can be fed in ring feeders or through the tractor mounted unwinder.

Robert Marshall, Kincraigie

Robert has overwintered suckler cows for many years, seeking to reduce the costs associated with winter housing, while benefitting from the ability to grow the suckler herd without investment in buildings. For the winter of 2024/25, he managed three different crops of hybrid brassica. Previously, Robert offered supplementary forage through silage trailer feeders and ring feeders, where the forage is brought into the field using tractors. This winter (2024/25) he put bales in situ for one of these sites, where he was grazing in-calf heifers.

	Hybrid Rape – Aboyne	**Hybrid Rape and Yellow Neep – Hill**	**Hybrid Rape and Yellow Neep – Pheasant**
Drainage	Imperfectly drained Mineral Soils	Freely Drained Mineral Soils	Freely Drained Mineral Soils
Previous Crop	Spring Barley	Permanent Grass	Grazed Grass
Forage Area	2.42 ha	4.04 ha	6.80 ha
Sown	May 2024		

Hybrid Brassica

Establishment

The hybrid brassica mixes included hybrid rape and yellow turnip. The establishment of the crops in the spring allowed for minimal cultivations to the soil.

	Winter Mix / Crop	Previous Crop	Sowing Method
1	Hybrid Rape	2023 barley stubble Poor nutrient status	Direct Drill to stubble
2	Hybrid Rape & Yellow Turnip	Grass – grazed by cattle through winter	Disced and Sprayed Off – Direct Drilled 10-14 days after
3	Hybrid Rape & Yellow Turnip	Permanent Grass	Disced and Sprayed Off – Direct Drilled 10-14 days after

Table 2: Details of previous crop and sowing method

Establishment of the hybrid rape involved direct drilling into the stubble from the previous spring barley crop. The hybrid rape and yellow turnip fields were established using Roundup to kill grass weeds, then disced before being sown with the Moore drill. The fields were rolled, to maximise moisture in the seed bed.

Inputs to the crops included inorganic fertiliser (16.16.16) at sowing, followed by a light application of nitrogen a month post-sowing. A weed spray was required for broad leaved weeds in one of the fields (site two) and the crops all received a foliar feed of minerals when leaves showing signs of deficiencies.

Management

The crop analysis and yield were taken prior to stock being introduced (see yield and analysis section).

Utilisation

With different field histories, the fields performed very differently.

	Winter Mix / Crop	Area	Number of stock	Period
1	Hybrid Rape	2.42ha	25 in calf heifers	30 days
2	Hybrid Rape & Yellow Turnip	4.04ha	63 in calf cows	90 days
3	Hybrid Rape & Yellow Turnip	6.80ha	66 in calf heifers	140 days

Table 3: Field performance

Field 3 had sited silage bales. Robert rolled a feed ring over these bales to offer them to the cattle as he moved the fence.

Karen Stewart, SAC Ruminant Nutritionist ensured that the cattle met their requirements on the crop. The mature cows' ration was based on 30/70 dry matter ratio of straw/forage crop. Daily fence shifts of 130m x 3m, supplied 390m^2 of new crop/day or 6m^2 for each cow. The yield of crop meant protein and energy were slightly low, so additional forage was offered as silage through a barrier trailer.

Initially, 45 in-calf heifers calving at 2 years grazed in crop 3, the hybrid rape and yellow turnip, with a fence length of 180 metres with shifts of 8-10 metres/day. This was not quite working for the way the silage was set up, as too many bales were on offer daily. To get around this Robert shaped the fence around the bales. More animals were required to make the set up more efficient. 25 heifers were shifted from area 1 when it ran out.70 heifers were then on area 3 from 1st November – 18th February. Previously, 45 heifers grazed the crop from 1st October – 31st October. This worked well for Robert., The crop was eaten down, and the placed silage bales balancing the ration.

Ground conditions held up extremely well throughout the winter, and Robert reported that the heifers grew satisfactorily over the winter. He felt the batch of heifers were the strongest he has had to date, calving at two. Calving was a great success with few assisted calvings, thriving calves and the heifers had plenty of milk.

Robert was featured on FAS TV, with the drone footage showing the ground conditions while the cattle were grazing (https://youtu.be/qgTb_uAdPHY?si=NVR-m5W6KqEgR-RK).

Jonny Stewart, Rashenlochy Farm

Jonny has over wintered his suckler cows for many years, as a solution to limited farm buildings on his farm. He managed several forage crops in the winter of 2024/25, including a mixed brassica catch crop, swedes and fodder beet. The swedes and fodder beet are main crop, sown in the spring. The mixed brassica crop is a catch crop sown after winter barley is harvested, this is hand sown using a seed dispenser. This crop allows for an early bite of forage when grass growth slows down, prior to the cows being offered the main crop swedes or fodder beet.

Swedes

	Swedes
Drainage	Freely Drained Mineral Soils
Previous Crop	Fodder Beet and Spring Barley and Grass
Forage Area	6.80 ha
Sown	May 2024

Establishment

A total of 6.80 hectares of swedes were grown on the holding. These are sown using a swede drill. This was a later sowing date compared to previous years, due to the slow cold spring. Previous crops include fodder beet, grass and barley. Areas that were previously used for outwintering had a higher weed burden than other areas, due to soil compaction, seed dispersal to bare parts of the field, and nutrients from dung and urine around feeding sites. There were two fields of swedes, one grown on heavier soil following permanent grass.

Management

Inputs to the swedes included inorganic manure (16.16.16) at sowing, and top dressing, weed sprays for broadleaved weeds and grasses and insecticide for flea beetle. The swedes were very mixed, struggling with smothering in areas where there was a weed burden. The crop was yielded and analysed prior to stock being introduced (see yield and analysis section).

Utilisation

The crop was utilised by 60 cows, for 50 days, grazed in situ behind an electric wire. The cows were transitioned slowly onto this crop, with supplementary forage being offered via silage trailers in the field.

The cows performed well on the swedes, retaining their body condition over the 50 days that they grazed the crop. When the crop was finished, they were offered silage and hay in feed wagons on arable stubble, before being housed for calving. Jonny reported that the cows calved well, with a low assistance rate, colostrum quality was high. Jonny has a refractometer for testing colostrum of his cows, to ensure they are above the benchmark of 22% (50g/lire of IgG).

Fodder Beet

	Swedes
Drainage	Freely Drained Mineral Soils
Previous Crop	Spring Barley
Forage Area	4.00 ha
Sown	May 2024

Establishment

Fodder beet was grown on 4 hectares of land, with the variety of choice being Bangor, a yellow root. The crop followed spring barley and was sown in 2024, later than normal, at the end of May, due to the wet and cold spring weather. The seeds were sown into a well-prepared seed bed at 100,000 seeds per hectare with a Horsch drill, before being rolled. The calculated establishment rate averaged 73% at five sites across the field.

Management

Fodder beet has the potential to be the highest yielding forage crop, and for this reason, requires a higher level of inputs than others. Inputs included cattle muck, inorganic fertilisers (16.16.16 at sowing followed by two applications of nitrogen), weed sprays for broadleaved weeds and grasses, and an aphid spray. The crop faced challenges through the growing season from aphids, which caused beet yellow virus, which was controlled through input from Jonnys agronomist. The crop was yielded and analysed prior to stock being introduced (see yield and analysis section).

Utilisation The crop was utilised by 90 cows, for 55 days, grazed in situ behind an electric wire. The cows were transitioned onto this crop by first being offered the mixed brassica catch crop, and then slowly introduced to the sugar rich fodder beet, with supplementary forage being offered via silage trailers in the field. This catch crop area then allowed for a dry run back area for the cows.

The mixed brassica was established in the part of the field that was in crop. This was applied using a handheld spinner after harvest. This allowed the cows to go onto forage,

when grass growth had slowed down in the back end. Following grazing the brassica, the cows were transitioned onto the beet.

The cows performed well on the fodder beet. Jonny noted how well they kept their body condition throughout their time on the crop, with some increasing condition slightly. The cows were housed for calving. Jonny noted how well they calved, with little assistance as they were fit from being outdoors rather than housed earlier in the winter. Similar to the cattle grazed on swedes, Jonny checked the colostrum quality with his brix refractometer; the quality was high.

Jonny was featured on FAS TV, in the spring of 2025, following his fodder beet being sown – https://youtu.be/xDTw9x1Qsww?si=ASdqFG2-OlcouHSJ

FAS TV Series 5 Ep 6 - Lamb Castration & Cattle Outwintering

461 views • 1 month ago

Alex Stephen, Inch of Arnhall

Alex and his family have a dairy farm, producing milk, dairy beef and breeding sheep. The enterprises on the farm are all integrated. The dairy is the main driver and grass growth for milk production is key. It is essential to get an early cut of silage on the farm, to achieve three cuts over the summer. Maximising stocking numbers on a small amount of ground during winter is essential. This is achieved through growing fodder beet for the sheep and a catch crop for growing cattle.

The outwintering strategies reduce concentrate usage for ewes pre lambing and reduce the cost of winter for the cattle. Alex believes there are benefits with improved health on an outdoor system for his dairy beef steers, reducing housing associated infections including pneumonia and foul of the foot/foot rot.

Fodder Beet

	Fodder Beet
Drainage	Freely Drained Mineral Soils
Previous Crop	Grass
Forage Area	6.00 ha

Sown	May 2024

Establishment

The fodder beet was sown in early May over 6 hectares and included three different varieties, Robbos (yellow root), Geronimo (orange root) and Fosyma (red root). Soil preparations following five-year-old grass included plough, power harrow, and sowing. The crop was not rolled. The seed rate was 125,000 seeds per hectare, with a beet drill. An average establishment rate of 96% was calculated from five sites across the field.

The fodder beet was sown in a large field that had grass sown either side of the fodder beet. This allowed stock access to the grass while grazing the beet, and allowed two different groups access to the crop, from each side.

Management

Inputs to the crop included slurry, inorganic fertilisers (only nitrogen, as the soil is high in P & K from dairy slurry) and weed sprays for broadleaved weeds. Inputs are high for this crop, however the yield achieved makes it a low-cost crop in terms of dry matter and energy yield.

Utilisation

After the yield was taken for the crop, Alex realised he could graze a higher number of ewes on the beet than he had initially planned. His pregnant ewe lambs were grazed on the beet, as well as his mature ewes. The lambs took slightly longer to transition onto the crop than the ewes did, preferring to eat the leaves and the hay in ring feeders initially. The lambs were initially offered a smaller amount of beet more often to offer a fresh bite daily, which aided the transition vastly.

The grass area of the field was electric fenced. Daily fodder beet was offered to the ewes, as well as a fresh bite of grass to aid the balance of protein and energy in their diet.

Fodder beet was offered to a group of ewes, and a group of ewe hoggs. 580 sheep were grazed on the fodder beet from February through to lambing in the middle of April. The beet was grazed behind an electric wire, with the ewes having access to hay in a ring feeder and a run back of grass, where a break was offered daily.

The grass was analysed in February 2025:

	Inch of Arnhall Grass Analysis
Dry Matter	18.2%
Protein	30.7%

Metabolise Energy	12.5 MJ/kg

Table 4: Grass Analysis (February 2025)

The grass offered an excellent supplementation to be fed alongside the fodder beet. The analysis showed high protein and energy. Alex reported that both the mature and young ewes, held their condition well throughout late pregnancy. They kept fit by moving between the grass and beet area throughout the day, and there were very little problems at lambing time, with lambs of a good birth weight and quick to stand and suck.

For interest Alex took random colostrum samples using a refractometer at lambing time, to check on the quality of colostrum from the ewes, gimmers and ewe lambs. The quality of the colostrum across the groups was high quality, offering an insurance that the ewes' nutrition was meeting their requirements.

Stubble Turnips

	Stubble Turnips
Drainage	Freely Drained Mineral Soils
Previous Crop	Winter Barley
Forage Area	23.82 ha
Sown	September 2024

Establishment

Stubble turnips were sown immediately into stubble after harvesting winter barley. This crop was established at a very low cost. Inputs were seed, slurry, and drilling costs. There was no inorganic fertiliser applied to the ground.

Management

Following sowing, bales of silage were placed out for the winter. This meant heavy machinery did not access the field over winter feeding. Dairy cross stirks were turned out in November, at approximately 500kg, with a target growth rate of 0.7-0.8kg per day.

Utilisation

Initially 62 500kg dairyX steers were transitioned onto the stubble turnips, with forage available in silage bales. The animals were fed 0.8kg of concentrate feeding (beef rolls) daily to balance the ration. The initial break of silage bales was very wet; both the bales and stubble turnips contained a lot of water. Straw was offered in ring feeders to counteract this. Drier bales were available for most of the grazing period. After one month Alex increased numbers to 132 steers. Animals were housed when they reached 550kg, when others were added to the system.

This 24ha area grazed animals from the start of November to the middle of January.

Karen Stewart, SAC ruminant nutritionist evaluated the planned ration.

Alex moved 270 metres of fence 10 metres into the crop every 2 days. This is 5m/day which gives 1,350m^2/day.
Alex estimated the dry matter yield was 3t/Ha which is 300g (0.3kg)/m^2

0.3kg x 1,350m2 equals 405kg of dry matter per day between 62 cattle.

It's reasonable to expect 20% wastage in a crop. This gives an available 5.2kgDM/day per animal (or 52kg fresh weight) of stubble turnips.

The silage bales weighed 700kg, giving 11kg fresh silage/head/day (2 bales every 2nd day). Plus 1kg concentrate feeding (beef rolls)

Indoors, this ration predicts a daily weight gain of 0.9kg. Outside, allowing for weather, Karen estimated this gain would be lower, potentially 0.7-0.8kg/day.
Trace elements in the diet looked low, so a mineral lick was advised.

The cattle did well on this system, helped by the excellent conditions throughout winter. Animals performed on par with what was expected through the ration.

Forage Brassica

Alex grew an area of forage brassica for grazing lambs. This crop did not yield as expected due to a nutrient deficiency. The crop was not analysed for this project.

Alex discussed the Inch of Arnhall forage system on a recent Monitor Farm Scotland podcast Series 2 Episode 5: Exploring Forage Crop Management

Welcome to Field Talk, the Monitor

Yield and Analysis

The crops were visited numerous times throughout their growth and use. Yields were calculated before being grazed, to allow calculations to be made on the daily allocation of crops. The crops' dry matter contents were analysed to provide accuracy in daily allocation calculations.

Forages that were fed alongside the crops were also analysed. Values showed great variation between farms, as shown in table 5.

Supplementary Forage Analysis Range

	Dry Matter (%)	Crude Protein (%)	ME (MJ/kg DM)
Hay	77.6 – 81.7	6.3 – 10.2	7.1 – 9.3
Silage	18.8 – 51	7.6 – 11.6	9.3 14
Deferred Grass	21.9	12.4	10.2
Fresh Grass	18.2	30.7	12.5

Table 5: Range of forage analysis for supplementary forages

Forage Crop Analysis

	Dry Matter (%)	Crude Protein (%)	ME (MJ/kg DM)	Yield t DM/ha
Forage Brassica 1 (RM)	14.10	11.42	-	3.03
Forage Brassica 2 (RM)	12.10	17.16	-	5.14
Forage Brassica 3 (RM)	10.10	21.76	-	4.18
Forage Brassica (AS)	14.10	10.01	-	2.11
Fodder Beet Leaf (JS)	10.30	16.07	-	3.90
Fodder Beet Leaf (AS)	15.00	25.80	11.40	4.40
Fodder Beet Bulb (JS)	19.00	6.00	12.30	16.6
Fodder Beet Bulb (AS)	21.90	6.60	12.50	13.50
Kale (DM)	18.90	30.67	12.70	8.97
Stubble Turnip (AS)	10.40	15.74	-	0.36
Swede Bulb (JS)	8.10	9.32	12.50	5.40

Table 6: Forage crop analysis from the various crops
Key: RM – Robert Marshall; AS – Alex Stephen; JS – Jonny Stewart; DM – Duncan Morrison

*Note not every analysis contains ME, due to lab reporting.

Some of the real crop analyses were far from typical book values e.g. kale protein levels are typically 16-17%, while Duncan's kale was 30% protein. This shows the importance of understanding the nutritional components of a forage when calculating daily allocation of crops.

	Dry Matter (%)	Crude Protein (%)	ME (MJ/kg DM)	Yield t DM/ha
Forage Brassica	12-13	19-20	10-11	3.5
Fodder Beet Leaf	10-13	15-20	10.4	17
Fodder Beet Bulb	10-20	6	13.2	
Swedes	10-13	10-11	13	9
Stubble Turnip	8-9	17-18	11	4
Kale	14-16	16-17	10-11	9

Table 7: Typical book values for forage crops

The Ultimate Forage Crop

Yields and analysis of the ten crops and, the costs to establish them were gathered from the four farms.

The farms have different livestock classes, production systems, establishment measures, etc. The calculations, displayed in the tables below, attempt to standardise the crops for comparison.

Crop Costings

	Fodder Beet 1 (JS)	Fodder Beet 2 (AS)	Swedes (JS)	Kale (DM)	Stubble Turnip (AS)
Seed	*243.39*	*200.00*	*81.54*	*62.50*	*24.00*
Fertiliser	*241.94*	*137.74*	*212.50*	*158.52*	-
Sprays	*191.00*	*98.33*	*52.20*	-	-
Other	-	-	-	-	-
Variable Costs	£676.33	£436.07	£346.24	£221.02	£24.00
Machinery Costs	£210.00	£90.00	£187.00	£127.00	£50.00
Growing Cost/ha	**£886.33**	**£526.07**	**£533.24**	**£348.02**	**£74.00**
Yield (t DM/ha)	20.48	17.90	8.94	8.97	4.91
Cost/kg DM	4p	3p	6p	4p	2p
ME (MJ/kg DM	12.3	12.5	12.5	12.7	11
£/MJ ME	3.5p	2.4p	5p	3.1p	1.4p
Protein (g/kg DM)	79.8	113	93.2	306.7	157.4
£/kg protein	0.5p	0.3p	0.6p	0.1p	0.1p

Table 8a: Growing, energy and protein values for project crops

	Brassica Mix (RM)	Brassica Mix + Yellow Neep 1 (RM)	Brassica Mix + Yellow Neep 2 (RM)	Forage Mix (Failed) (AS)	Deferred Grass (DM)
Seed	*67.00*	*67.00*	*67.00*	*60.40*	-
Fertiliser	*147.50*	*147.50*	*147.50*	*97.75*	-
Sprays	*43.00*	*43.00*	*43.00*	-	-
Other	*0*	*0*	*0*	-	-
Variable Costs	£257.50	£257.50	£257.50	£158.15	-
Machinery Costs	£142.65	£142.65	£142.65	£74.00	-
Growing Cost/ha	**£400.15**	**£400.15**	**£400.15**	**£232.15**	**-**
Yield (t DM/ha)	3.03	5.14	4.80	2.11	3.10
Cost/kg DM	13p	8p	8p	11p	0p
ME (MJ/kg DM	15	19	19	18	10.2
£/MJ ME	8.8p	4.1p	4.4p	6.1p	0p
Protein (g/kg DM)	114.2	171.6	217.6	100.1	124
£/kg protein	1.2p	0.5p	0.4p	0.1p	0p

Table 8b: Growing, energy and protein values for project crops

Fodder beet and swede crops show the highest growing costs. However, when the yield is considered, the cost per kg of dry matter is more in line with the crops which are cheaper to establish. Fodder beet 1, has the highest establishment cost at £886.33, and the highest yield at 20.48t DM/ha. Establishing a high cost crop does hold risk and requires cash flow for inputs. However, it can allow a high stocking density in the winter with a high level of dry matter production.

- Highest cost crop to establish – Fodder Beet
- Lowest cost crop to establish – Deferred Grazing
- Highest yielding (DM/ha) crop – Fodder Beet
- Lowest yielding (DM/ha) crop – Forage Brassica Mix
- Highest cost/kg DM – Forage Brassica Mix
- Lowest cost/kg DM – Deferred Grazing

For comparison, the break down costs for barley, a typical 18% protein concentrate and soya using standard book values, are shown below.

	Spring Barley	18% Ewe Concentrate	Soya
Fresh Yield	6t/ha	-	-
Dry Matter	86%	86%	89%
Growing or Purchase Cost/ha FW	**£550.00/ha**	**£300/t**	**£350/t**
Yield (t DM/ha)	5.16	-	-
Cost/kg DM	10.7p	26p	31p
ME (MJ/kg DM)	13.20	12.50	13.30
£/MJ ME	8.1p	2.1p	2.3p
Protein (g/kg DM)	115	180	530
£/kg protein	0.9p	0.1p	0.05p

Table 9: Crop comparison, values for a spring barley crop and a 18% concentrate

The deferred grazing stands up, with no establishment costs. This was a grass sward ready for rejuvenation. The supplementary winter forage costs have been calculated for the various scenarios, as follows,

	Forage Type	Forage Cost	Cob Cost	Total Supplementary Feed Costs
Fodder Beet 1 (JS)	Silage	£1,755.60	-	£1,755.60
Swedes (JS)	Silage	£1,064.00	-	£1,064.00
Forage Mix 1 (RM)	Silage	£0.00	-	£0.00
Forage Mix 2 (RM)	Silage	£1,925.00	-	£1,925.00
Forage Mix 3 (RM)	Silage	£2,016.00	-	£2,016.00
Stubble Turnips (AS)	Silage	£2,230.25	£1,837.00	£4,067.25
Forage Mix (F) (AS)	N/A	-	-	£0.00
Fodder Beet 2 (AS)	Hay	£700.00	-	£700.00
Deferred Grass (DM)	Hay	£3,631.50	-	£3,631.50
Kale (DM)	Silage	£2,240.00	-	£2,240.00

Table 10: Supplementary feed costs (those feeds in addition to the outwintering crop)

Deferred grazing was the lowest cost crop/kg DM to establish at £0.00/kg DM, followed by the stubble turnip, catch crop (2p/kg DM) and then fodder beet (3p/kg DM). The average across the 10 crops followed was 6p/kg DM.

	Crop	Cost/kg DM
1	Deferred Grazing	-
2	Stubble Turnip	2p
3	Fodder Beet 2	3p
4	Kale	4p
	Fodder Beet 1	4p
5	Swedes	6p
6	Brassica Mix and Yellow Neep 1+2	8p
		8p
7	Forage Mix (Failed)	11p
8	Brassica Mix	13p

Table 11: League table of cost/kg DM for the project crops

Energy costs for the deferred grazing again stand out as there are no establishment costs. The stubble turnips catch crop costs 1.4p/MJ ME, followed by fodder beet 2 at 2.4p/MJ ME and the kale at 3.1p/MJ ME. The average over the 10 crops was 3.8p/MJ ME. Returning to table 9, this is low against barley at 8.1p/MJ ME and shows how cost effective forage crops are in energy terms.

Protein analysis of the crops showed that some far exceed traditional book values. Averages over the ten crops were 0.5p/kg protein, with the best being deferred grazing, followed by the stubble neep catch crop and kale, due to their low establishment costs. The lower yielding brassica crops, which did not meet their expected yields reduced this average. Forage crops are not grown or known for their high protein content, which makes it difficult to compare against other protein crops. Soya equates to 0.05p/kg protein (see table 9). If comparing to barley which has a book value of 11.5% protein, similar to a swede its current protein cost is 0.9p/kg DM.

Crop Comparisons

Crops were grazed by different classes of stock (dairy X steers, in calf cows and heifers, sheep). We have used various measures, including livestock (LU) units to compare the crops' performance. The livestock units are as follows:

	Livestock Units
Beef Cows	0.75
In Calf Heifers	0.80
Cattle 0-12 months	0.34
Cattle 12-24m	0.65
Cattle Over 24 months	0.80
Lowland Ewe	0.11
Store Lambs	0.04
Breeding Ewe Lambs	0.06

Source: The Farm Management Handbook 2024/2025

Table 12: Livestock units used in the calculations

The crops are separated into two tables below, to allow ease of reading.

	Fodder Beet 1 (JS)	Fodder Beet 2 (AS)	Swedes (JS)	Kale (DM)	Stubble Turnip (AS)
Growing Cost/ha	£886.33	£526.07	£533.24	£348.02	£74.00
Area Grown	4.00	6.00	6.80	5.00	23.82
Forage Cost	£1,755.60	£700.00	£1,064.00	£2,240.00	£2,230.25
Conc. Cost	-	-	-	-	£1,837.00
Animal Class	In Calf Cows	Preg Ewes	In Calf Cows	In Calf Cows	Dairy X Steers
LW of animals	675kg	70kg	675kg	675kg	500kg
No of animals	90	601	60	85	88
Yield (t DM/ha)	20.48	17.90	8.94	8.97	4.91
Total LU/ha	16.88	11.02	6.62	12.75	2.40
LU/ha/day	0.31	0.16	0.13	0.30	0.03
LU/ha over 90 days	27.61	14.17	11.91	26.69	3.00
Cost/ha	£1,325.23	£642.74	£712.71	£796.02	£244.75
Cost/ha/LU	£78.53	£58.33	£107.70	£62.43	£101.92
kg of LW/ha	1,5187.50	7,011.66	5,955.88	11,475.00	1,847.18

Table 13a: Crop comparisons using livestock units

The data and calculations displayed above for five crops have been divided by colour for ease of interpretation.

The livestock unit data/ha calculations show that the difference in stocking density between the crops is vast. Fodder beet sits at 16.88LU/ha and stubble turnips at 2.40 LU/ha. This highlights the importance of choosing a forage crop to suit the system. Farms with area and resources to establish large areas of a catch crop (such as stubble turnips) can hold a small number of animals over more acres. However, those who are limited with space, and looking to a higher density should lean towards the higher yielding crops that allow a higher stocking density over a smaller piece of land.

The cost/ha includes growing the crop and the forage/concentrates offered. The most expensive crop to grow is not the most expensive to feed/LU. When looking at the actual liveweight of the animals that are carried the data shows that Duncan's kale carried the highest kg of LW/ha.

	Brassica Mix (RM)	Brassica Mix + Yellow Neep 1 (RM)	Brassica Mix + Yellow Neep 2 (RM)	Forage Mix (Failed) (AS)	Deferred Grass (DM)
Growing Cost/ha	£400.15	£400.15	£400.15	£232.15	£0.00
Area Grown	2.42	4.04	6.80	7.82	12.00
Forage Cost	£0.00	£1,925.00	£2,016.00	£0.00	£3,6531.50
Conc. Cost	-	-	-	-	-
Animal Class	In Calf Heifers	In Calf Cows	In Calf Heifers	Lambs	In Calf Cows
LW of animals	550kg	675kg	550kg	32kg	675kg
No of animals	25	63	66	250	114
Yield (t DM/ha)	3.03	5.14	4.80	2.11	3.10
Total LU/ha	8.26	10.14	6.31	1.28	7.13
LU/ha/day	0.28	0.11	0.05	0.03	0.09
LU/ha over 90 days	24.79	10.14	4.06	2.30	8.02
Cost/ha	£400.15	£876.64	£696.62	£232.15	£302.63
Cost/ha/LU	£48.42	£86.49	£100.42	£181.54	£42.47
kg of LW/ha	5,681.82	10,526.00	5,338.23	1,023.02	6,412.50

Table 13b: Crop comparisons using livestock units

The above data shows similar trends to the previous five crops. Brassica Mix yielded poorly and forage mix (failed) had a nutrient deficiency; these crops show poorer performance on the data. The brassica mixes show a lower yield to the previous bulkier crops, however they still perform well. This again suggests that, if there is scope on a holding to have more land available for forage crops, a lower yielding crop can be as cost efficient as a higher yielding crop. However, if having a large scope of land out of productive grazing from the spring through to utilisation in the winter is not possible, then a higher yielding crop would be more suited to the system.

Looking at all of the data, livestock units grazed/ha stood out at 16.88LU for suckler cows on beet, with a low of 2.40LU on the stubble turnips, with an average of 8.27 LU for the 10 crops.

Comparison Against Traditional Systems

The Deeside Management Group members asked how the costs on the outwintering systems compared with more traditional systems of silage for cattle and forage and concentrate for ewes pre-lambing.

Ewes

Alex was the only person feeding ewes in the study, these were rationed on fodder beet and forage pre lambing. Looking at a 70kg ewe in late pregnancy, she will typically eat 1.6kg dry matter/day. A traditional system may be 0.50kg concentrate (0.44kg DM), with forage making up the rest of the diet.

To allow comparisons we use silage at £45/tonne @ 30% DM This equates to£150/t DM or 15p/kg DM with grass at 6p/kg/DM. Minerals/vitamins have not been added into this calculation.

	Traditional Feeding System	**Alex Feeding System – Fodder Beet**
Concentrate 0.44kg DMI @ 30p/kg DM (£300/t)	£0.13	-
Silage 1.16kg @ 15p/kg DM	£0.17	-
Fodder Beet 70% intake (1.12kg) @ 3p/kg	-	£0.03
Forage 0.48kg grass @ 6p/kg DM 0.48kg silage @15p/kg DM	-	 £0.03 £0.07
TOTAL	**£0.30/hd/day**	**£0.13/hd/day**

Table 14: Comparison of Alex pre lambing system V a traditional system

Cows

Duncan fed his cows on kale early in the winter, before offering deferred grazing and silage. We assume his 675kg dry cows eat 10kg dry matter per day, with kale making up 70% of their ration with 30% silage. We can compare this to a traditional silage based ration for dry cows. Minerals/vitamins have not been added into this calculation.

	Traditional Feeding System	**Duncan Feeding System - Kale**
Silage 10kg @ 15p/kg DM	£1.50	-
Silage 3kg @ 15p/kg DM	-	£0.45
Kale 7kg @ 4p/kg DM	-	£0.28
TOTAL	**£1.50/hd/day**	**£0.73/hd/day**

Table 15: Comparison of Duncan dry cow system on kale V a traditional system

Heifers

Robert fed his in-calf heifers on a mixed brassica crop throughout the winter. We assume brassica makes up 70% of their diet, with 30% as forage, and compare costs against a traditional silage based diet. The heifers were 550kg, so we can assume a dry matter intake of 8.5kg. Minerals/vitamins have not been added into this calculation.

	Traditional Feeding System	**Robert Feeding System – Mixed Brassica**
Silage 8.5kg @ 15p/kg DM	£1.27	-
Silage 2.55kg @ 15p/kg DM	-	£0.38
Mixed Brassica 5.95kg @ 8p/kg DM	-	£0.48
TOTAL	**£1.27/hd/day**	**£0.86/hd/day**

Table 16: Comparison of Robert in calf heifers on mixed brassica versus a traditional system

Energy Cost

Duncan Morrison, analysing the data for the forage crop performance, questioned whether there was surplus energy from the crops for certain classes of stock. E.g. was kale meeting the cow's energy requirements, was fodder beet providing too much energy, etc.

Mary Young, SAC ruminant nutritionist, created examples for kale, stubble turnips and fodder beet for all classes of stock. The forage intake has been calculated to meet 100% of energy requirement of each class of animal. The calculations assumed 70% DMI (dry matter intake) came from the fodder crops.

In summary:

- The kale fully met the energy requirements of growing lambs. There is no surplus energy for other classes of stock.

- This stubble turnips crop fully met the energy requirements of in calf heifers, and almost met the requirements for growing lambs. There was no surplus energy in any of the classes of stock for stubble turnips.

- The fodder beet example showed surplus energy for suckler cows (mid pregnancy), growing stock (12-24months), and almost fully met the energy requirements of the other classes of cattle. For ewes the energy was on the lower side of requirements in this example (for this we used Fodder beet 2 analysis).

- Fodder beet is not advised for growing lambs, due to the low level of protein in the bulbs and so no calculation was used.

We formulated the ration of fodder beet and grass intake to assess the energy requirements for the ewes. The mix would support the ewes up to 3 weeks pre lambing.

At 2 weeks pre lambing they are slightly low in energy. We noted that these ewes were in good condition and had access to high energy licks to supplement them. This formulation was calculated on 60% bulb and 40% leaf: with an open winter the leaf did remain throughout the grazing period.

The beet was offered to both ewe lambs and mature ewes. Throughout lambing, colostrum samples were collected from a random sample of sheep to ensure IGg levels were above the recommended 26. Samples were shown to be far in excess of this; lambs were born of a good birth weight and were thrifty and quick to get up and suck, with the Romney showing her excellent mothering ability.

Farmer Opinion and Feedback

The crop analysis, yield and allocation calculations were a key point for the four farmers. This gave them a greater insight into the nutrition of the crop. Along with the yield data and dry matter analysis, the farmers could estimate the potential stock numbers they could hold in the winter period. This changed their initial plans of some.

Jonny, who had planned to graze the same number of cattle on the beet and swede area as before, adjusted grazing with 90 cows on the beet and 60 on the swedes. A ready reckoner was created, to allow farmers to calculate their actual field yield and daily allocation of crops. An example of this is shown below.

In some instances, the analysis of the crop was surprising, varying significantly from traditional book values. The businesses within the project have requested continued analysis for their forage crops in the 2025/26 winter to understand if these figures are normal or unusual for the year.

Karen Stewart, SAC ruminant nutritionist and Kirsten Williams, SAC sheep and beef consultant were available throughout the project for support and guidance. The farmers found this beneficial, especially those who were trying something new. This ensured nutritional requirements were met for each stage of production for the animal, taking the crop analysis, as well as supplementary forage into consideration. This support included farm visits to see growing crops and animals on the crop, phone calls, emails, WhatsApp, etc. The farmers found the visits reassuring, knowing that they were on track with growing and inputs, creating a plan for the winter, gathering analysis and yields of the crop, and then looking at potential stock numbers. Nutritional support throughout transition on and off the crop was supplied, which they found beneficial.

The four farmers are excellent communicators; each has recorded their wintering story twice, with all farms being filmed at the start of the winter. Three farms were filmed at the end and Alex did a podcast with Monitor Farm Scotland.

Next Steps and Recommendations

The project was carried out with four farmers who all have experience of growing, managing and utilising forage crops. These farms were all from one area and covered 10 growing crops. There was a little replication across the project e.g. there was only one crop of swedes, kale, stubble turnips and deferred grass. This project has developed a greater understanding of the costs associated with establishing the different forage crops, as well as managing them in the North East of Scotland.

The analysis of the forage crops has questioned industry book values, and further analysis of a wider range of crops over a broader area of Scotland would be extremely beneficial to understand if values need updated.

This could perhaps be led through the Monitor Farm Network. This would allow for further investigation of outwintering systems and crops, in a different area, different geographical conditions, different stock classes, etc. Repeating this in other areas would allow crops to be monitored during another winter, allowing comparison with the very open winter of 2024/25. This could potentially be carried out as an innovation project, building upon the current data set.

A greater understanding of how forage crops perform in the Scottish climate would be extremely beneficial to the industry. An industry led variety guide for forage crops in Scotland would be especially useful. Plant breeders currently have these based on trail sites South of the border, however the Scottish climate is very different. This would require replicated trials over different sites in Scotland, monitored and measured on an annual basis. This could be discussed with organisations such as SAC crop trials, Scottish Agronomy or plant breeders to take this further.

With a changing climate, producers are being exposed to different pest challenges e.g. aphids. An early warning system or a risk system, similar to potato crops may be useful to allow growers to assess when to apply pesticides or adopt other pest control measures.

Conclusion

Costs to produce the crop, yields and nutritional analysis have been gathered and analysed. The lowest cost crop/kg DM to establish was deferred grazing at 0p/kg DM (no cost), followed by the stubble turnip catch crop (2p/kg DM). The average across the 10 crops followed was 6p/kg DM.

With energy, the deferred grazing had no establishment costs. The stubble turnips catch crop at 1.4p/MJ ME, was next. Average over the 10 crops was 3.8p/MJ ME.

Finally, protein analysis raised some interesting results with, with some levels far exceeding traditional book values. The average over the ten crops was 0.5p/kg protein, with the best being the stubble neep catch crop and kale, due to their low establishment costs.

Ten crops over four farms, meant the comparisons were challenging, due to different modes of establishment, e.g. plough v direct drill, different classes of livestock and different farm resources available e.g. muck/slurry.

Livestock units grazed/ha stood out at 16.88LU for suckler cows on beet, with a low of 2.40 LU on the stubble turnips, an average of 8.28 LU was seen over the 10 crops.

The total cost of the forage crop, as well as supplementary feeding was taken into consideration, calculating the ha cost/kg liveweight carried, with the lowest being the deferred grazing and the highest being the stubble turnips.

The drive for the forage crops across the farms was different, where farms had scope they could produce a lower yielding crop over more acres, while those limited for space, required a high stocking density, and therefore a high yielding crop on a smaller area. The conclusion is there is no one crop outstanding overall, there are clear winners for highest DM, highest nutrition offered, lowest cost, etc. But the main driver for which crop was grown, was largely driven with the area and resources available on the farms.

Appendix

KALE	Dry Matter Intake (kg DM/day)	Energy Requirement (MJ)	ME supply from Crop (MJ)	% Supplied from Crop	Additional Cost to Meet Energy Demand
Suckler cow (650kg mid pregnancy)	9.1	92	81	88	14p
Suckler cow (650kg late pregnancy)	9.1	104	81	78	30p
In calf heifers (560kg growing 0.7kg/day)	9.8	114	88	77	34p
Growing stock (12-24m gaining 0.8kg/day)	7.4	77	65	84	16p
Pregnant ewes (70kg twins mid pregnancy)	1.0	14.8	8.9	60	8p
Pregnant ewe lamb (45kg growing 130g/day, 8 weeks pre lambing	1.2	16.2	10.7	66	8p
Growing lambs (6-12months, 35kg gaining 250g/day)	1.4	11.7	12.4	106	Nil

*Energy Requirement +15% for out wintering, assumed kale is 70% of DMI, additional cost of energy assumed silage cost £45/t or £28/bale.

Table 17a: Energy supply supplied from kale for various classes of stock

STUBBLE TURNIPS	Dry Matter Intake (kg DM/day)	Energy Requirement (MJ)	ME supply from Crop (MJ)	% Supplied from Crop	Additional Cost to Meet Energy Demand
Suckler cow (650kg mid pregnancy)	9.1	92	70	76	9p
Suckler cow (650kg late pregnancy)	9.1	104	70	67	28p
In calf heifers (560kg growing 0.7kg/day)	9.8	114	114	100	Nil
Growing stock (12-24m gaining 0.8kg/day)	7.4	77	71	72	9p
Pregnant ewes (70kg twins mid pregnancy)	1.0	14.8	11.4	77	6p
Pregnant ewe lamb (45kg growing 130g/day, 8 weeks pre lambing	1.2	16.2	9.7	60	9p
Growing lambs (6-12months, 35kg gaining 250g/day)	1.4	11.7	11.4	97	2p

*Energy Requirement +15% for out wintering, assumed crop is 70% of DMI, additional cost of energy assumed silage cost £45/t or £28/bale.

Table 17b: Energy supply supplied from stubble turnips for various classes of stock

Fodder Beet	Dry Matter Intake (kg DM/day)	Energy Requirement (MJ)	ME supply from Crop (MJ)	% Supplied from Crop	Additional Cost to Meet Energy Demand
Suckler cow (650kg mid pregnancy)	9.1	92	102	111	Nil
Suckler cow (650kg late pregnancy)	9.1	104	102	98	12p
In calf heifers (560kg growing 0.7kg/day)	9.8	114	110	96	5p
Growing stock (12-24m gaining 0.8kg/day)	7.4	77	83	108	Nil
Pregnant ewes (70kg twins mid pregnancy)	1.0	14.8	11.4	77	7p
Pregnant ewe lamb (45kg growing 130g/day, 8 weeks pre lambing	1.2	16.2	10.9	67	8p
Growing lambs (6-12months, 35kg gaining 250g/day)	1.4	11.7	N/A	N/A	N/A

*Energy Requirement +15% for out wintering, assumed 70% DMI allowing for bulb 60% and leaf 40%, additional cost of energy assumed silage cost £45/t or £28/bale.

Table 17c: Energy supply supplied from fodder beet for various classes of stock