TECHNICAL NOTE TN694 DECEMBER 2017 • ELEC

Alternative Forages for Sheep: Fodder Beet

Farm Advisory Service

National Advice Hub
T: 0300 323 0161
E: advice@fas.scot
W: www.fas.scot

SUMMARY

- **Fodder beet is a highly palatable, digestible feed for livestock offering a sugar rich energy feed. It is a high yielding crop which is demanding of nutrients. Weed control is essential to prevent yield loss.**
- **The crop can be utilised in situ or harvested. Roots offer high energy, while the tops are high in protein. It is essential to allow for a transition period when introducing sheep on to the crop. Other forages and minerals must be offered to livestock grazing fodder beet.**

Fodder Beet root and tops

Why Grow Fodder Beet for Sheep?

Fodder beet is one of the highest yielding forage crops grown in Scotland with root and top yields of 65-90 tonnes/hectare (26-36 t/acre). Dry matter content varies from 15-22% therefore dry matter yield can be substantial. The crop is high quality forage with good palatability due to high sugar content

Fodder Beet is a member of the Beta vulgaris and not of the Brassica family; giving it good crop rotation value to minimise the risk of brassica related diseases such as club root. It offers a high yielding alternative to the traditional swede grown for sheep, although the cost of production is higher. It is a deep rooting crop – an ideal break crop before or after grass.

Growing a crop such as fodder beet for utilisation through the winter, reduces the requirement for conserved forages and purchased feed stuffs increasing efficiency on farm. A high stocking density on the crop can be achieved in the winter months, which can eliminate the requirement for away wintering and associated haulage, rent, hassle and time. Carrying a high stocking density over the winter on forage crops allows the grass leys a break from livestock, aiding early spring growth.

The crop is particularly high yielding if it is grown correctly, it is an expensive crop to establish but the yield achieved in a good crop allows for a good return and a cost-effective winter forage.

Ewes grazing fodder beet

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
Riaghaltas na h-Alba
gov.scot

331211TN665DMN29.06.17

Nutritional Value

	Fresh Yield (t/ ha)	Dry Matter (%)	Crude Protein (%)	D value	Metabolise Energy (MJ/kg DM)
Fodder Beet Roots	65-80	10-20%	6%	80	13.2
Fodder Beet Tops	10-20	10-13%	15-20%	65	10.4
Swedes	70-90	9-13%	10-12%	80-82	14
Kale	60-75	14-16%	18-20%	66-68	11
Forage Rape	20-30	12-14%	18-20%	66-68	11
Barley	6	86%	11.5	80	13.2

Table 1 – Nutritional Value of Various Forage Crops

Establishment and Growing Fodder Beet

Site Choice

The ground should ideally be a light to medium, free draining soil.

The crop will be utilised in the winter, therefore consider shelter and water. Provide a water trough with hard standing to reduce risk of poaching and nutrient run off into watercourses. A grass run back should be offered to the grazing animals, bear this in mind when selecting the site. If the aim is to lift the crop rather than graze it, good access for modern machinery will be required.

Seedbed and Sowing

A fine, firm seed bed is required with no soil compaction problems. Ground preparations should create good soil conditions for establishment, reaching water and nutrients and full root development.

Sowing	Late March – April
Seed Rate	100,000 seeds/ ha (40,500 seeds/acre)
Sowing Depth	2–3 cm (0.8-1.2 inches)
Drill Width	45-50 cm (18-19.5 inches) between rows
Seed Spacing	15-20 cm (6-8cm)

Sowing Fodder Beet

The soil temperature should be at ***least 5^{0}C*** for sowing the seeds. If the ground is cooler some of the plants will bolt in retaliation to the stress at establishment. If drilling the seeds is delayed, there will be a degree of yield loss.

Bolted fodder beet in field

Soil nutrition

Soil analysis should be carried out well in advance of planting to identify pH levels and the reserves of P_2O_5 (phosphate), K_2O (potash) and Mg (magnesium). The target pH for fodder beet is 6.0 – 6.5.

To achieve the high yields that fodder beet offers, the plant must be supplied with adequate nutrients. Organic and inorganic fertilisers should be applied at rates that will result in the maximum yield of crops of acceptable quality, whilst ensuring protection of the surrounding environment and complying with Nitrate Vulnerable Zone (NVZ) regulations if applicable.

Nitrogen, phosphate and potash recommendations are based from *Technical Note TN649: fertiliser recommendations for vegetables, minority arable crops and bulbs.* These are aimed at giving the best financial return for the producer whilst complying with NVZ rules and minimising losses to the environment. Reference the note for further information.

Nitrogen (N)

Nitrogen can be applied by means of organic manures or inorganic fertilisers. Table 2 below shows the total nitrogen recommendation for growing fodder beet, table 3 demonstrates the nitrogen residue group from the previous crop. These tables should be used together.

Nitrogen is applied twice to the crop. Initially this is to the seed bed to aid establishment of the crop, often 20-40kg/ha at this stage. The remaining nitrogen recommendation should be applied after the seedlings have established.

	Previous Crop/Grass Nitrogen Residue Group					
	1	2	3	4	5	6
Nitrogen (N)						
(kg/ha N)	100	90	80	60	30	0*
*Up to 20kg/ha of nitrogen may be needed where soil nitrogen supply is expected to be low initially, for example cold, wet conditions						

Table 2 – Nitrogen Recommendations (kg/ha)

Group	Previous Crop
1	Spring cereals winter cereals, triticale, carrots, shopping swedes, turnips (human consumption), linseed, courgette, onions, asparagus, beetroot (red baby, other), radish, narcissus, tulip, swedes/turnips (stock feed), parsnips, ryegrass (seeds)
2	Harvested fodder (whole crop), forage maize, kale cut, winter oilseed rape, spring oilseed rape, hemp, vining peas, potatoes (<60 days, seed and punnets), potatoes (60-90 days, seed and punnets), potatoes (60-90 days, ware), potatoes (90-120 days), potatoes (>120 days), blackberries, loganberries, blackcurrants, redcurrants, blueberries, tayberries, 1-2 year low N leys not grazed within 2 months of ploughing or Sept/Oct
3	Harvested fodder (root only), beans, combining peas, whole crop lupins, leek, rhubarb, strawberries, raspberries, uncropped land 1-2 year low N leys grazed within 2 months of ploughing or Sept/Oct, 1-2 year high N leys not grazed within 2 months of ploughing or Sept/Oct, Thin permanent grass, low N, low clover
4	Grain lupins, lettuce. 1-2 year high N leys grazed within 2 months of ploughing or during Sept/Oct, 3-5 year old low N leys not grazed within 2 months of ploughing or during Sept/Oct, Thick permanent grass, low N
5	Leafy brassica and non-brassica vegetables, grazed fodder, turnips grazed, Brussel sprouts, cabbage, calabrese, cauliflower, kale grazed, forage rape, chicory. 3-5 year old high N leys not grazed within 2 months of ploughing or during Sept/Oct, 3-5 year old low N leys grazed within 2 months of ploughing or during Sept/Oct, Permanent grass, high N not grazed within 2 months of ploughing or during Sept/Oct
6	3-5 year old high N leys grazed within 2 months of ploughing, Permanent grass, high N grazed within 2 months of ploughing

Table 3 – Previous Crop Groups

For example, if previous crop was permanent grass with low nitrogen content and no clover, the recommended rate of nitrogen would be 80kg/ha (32kg/acre).

In addition adjustments for N can be made for soil type.The following tables from TN649 are shown:

	Soil Type		
	Sands and Shallow Soils	Sandy Loams & Other Mineral Soils	Humose and Peaty Soils
Vegetable* and minority crops other than linseed, forage maize, forage rape, kale, shopping swedes, turnips (human consumption), swedes/turnips (stockfeed) and potatoes.	+ 10%	No Change	- 10%
*Vegetables are grown on sands but very rarely grown on shallow soils (less than 40 cm over rock)			

Table 4 – Adjustment to standard N recommendation for different soil types

The drier the Winter and the greater the soil capacity to hold water, the smaller the proportion of N from crop residues that will be washed out of the soil before crop growth starts in the Spring. If Winter rainfall between 1 October and 1 March is more than 450 mm, then the standard N recommendations should be adjusted according to the table below.

	Soil Type		
	Sands, sandy loams and shallow soils, previous crop group 2	Sands, sandy loams and shallow soils, previous crop groups 3 - 6	All other soils, previous groups 2 - 6
All vegetable and minority crops	+ 10 kg/ha	+ 20 kg/ha	+ 10 kg/ha

Table 5 – Adjustments for rainfall

Phosphate (P_2O_5) and Potash (K_2O)

The table below illustrates the phosphate and potash requirements for fodder beet. The crop has a high potash requirement; this can be delivered through a mixture of organic and inorganic manure sources. The potash is required for numerous processes including nitrogen uptake, which affects the protein of the crop, and it is also required for the formation of sugars in the plant.

	Soil P_2O_5 and K_2O Status		
	Low	Medium	High
Phosphate (P_2O_5) (kg/ha)	80	60	50
Potash (K_2O) (kg/ha)	200	150	75

Table 6 – Phosphate and Potash Recommendations (kg/ha)

For further details see the ***Technical Note TN649: fertiliser recommendations for vegetables, minority arable crops and bulbs.***

Sodium

Fodder beet has been developed over time from cultivars such as wild beet and sea beet. These originated in the Mediterranean and grew in land with a high sodium (salt) content. Some soils in Scotland contain high levels of sodium, such as fen peats and silt, but most agricultural soils do not. For this reason 200kg/ha of Na_2O as agricultural salt is recommended to ensure the desired growth and leaf expansion is achieved. Deeply cultivate the application into the soil prior to drilling.

Sulphur

In situations where sulphur levels might be low, for example on light soils, following wet winters, where there has been no previous history of manure use or sulphur-containing fertilisers, use of sulphur-containing fertilisers should be considered as a base dressing to supply both N and S ***(see Technical Note TN685: sulphur recommendations for crops).***

Magnesium

Magnesium is an element that aids plant growth; fodder beet is a rapid growing plant that has a high requirement for the nutrient. If soil magnesium levels are low (L) or very low (VL) apply magnesium (MgO) at 150 kg/ha where the index is VL and 100 kg/ha where the index is L. If lime is required to raise the pH, magnesium lime is a cost-effective option to achieve both purposes.

Boron

Boron deficiency can cause huge losses in root crops, where symptoms initially show death at the growing point, moving to heart rot. This shows as a black rot spreading from the heart to all of the root tissue to the crown and shoulders of the beet. Most soils contain a sufficient supply of boron, but losses from deficiency can destroy a crop (see ***Technical Note TN671: management of boron in soils for crops***). Boron can be added to a compounded fertiliser for application to the seedbed, or a boron spray could be applied with herbicide when the cotyledons show in the crop. Where soil analysis indicates a deficiency, or for susceptible crops such as fodder beet, apply boron to the seedbed (2 kg/ha boron) or as a foliar spray according to manufacturers recommendations as soon as leaf cover allows. It is usually sufficient to apply boron once during a rotation, though if root crops are being grown, it is advisable to apply boron prior to each of these crops, regardless of whether boron has already been applied in the rotation. It is not advisable to over-apply boron, since toxicity can cause problems in some crops in the rotation (e.g. spring barley).

Manganese

Manganese deficiency often occurs in high pH situations, dry sandy soils, and soft seedbeds and/or immediately after liming. Deficiency is shown through yellow spots appearing on the beet leaves. A foliar manganese sulphate spray can deliver a supply to the crop.

Weed control

Fodder beet is a sensitive crop and does not like competition. Weeds should be eliminated from the previous crop prior to establishment and weed seedlings in the growing crop must be cleared. Various management options can prevent competition from weeds, including using a stale seed bed, ploughing to bury weeds, mechanical weeding and pre- and post-emergence herbicides. Always consult a BASIS accredited agronomist on herbicide use.

Fodder Beet growing with good weed control

Pest Control

Prevalent pests include slugs, wireworm, flea beetles, leatherjackets, aphids and beet cyst eelworm. Consult a BASIS accredited agronomist for thresholds of the various pests and methods of control including treated seed.

Varieties

There are numerous different varieties of fodder beet on the market. You must know how you plan to utilise the crop e.g. harvesting or feeding in situ when choosing the variety to sow.

Basically there are white rooted and coloured varieties. The white rooted varieties often have a higher dry matter and have up to 80% of the root in the ground, often these are well suited for harvesting. The coloured varieties are lower in dry matter, meaning they are softer for livestock to eat. These coloured roots sit further out of the ground giving a good utilisation rate when fed in situ by livestock.

Utilising Fodder Beet for Sheep

Fodder beet was historically widely grown across Scotland but lost popularity due to complexities with harvesting and feeding.

Planting areas have steadily increased over the last few years due to easier access of harvesting machinery and the use of electric fencing for feeding in the field. As well as a combination of benefits such as high yield potential, digestibility, greater weed control options than brassicas and an ability to grow fodder beet in rotation with brassica crops in a livestock situation such as swedes.

Harvesting

The crop can be harvested using machinery such as a sugar beet harvester. Machinery hire can usually be arranged through services such as local machinery rings. Costs do vary for hiring the machinery; these should be investigated when initially planning growing the crop.

A sugar beet harvester which lifts six rows at a time charge around £100/acre (£40/ha) (November 2017). In favourable conditions, these machines can lift in the region of 30 acres (12.14 hectares) per day. The sugar beet harvester holds 17 tonnes of beet, at which stage it is emptied in to a trailer and hauled off the field to storage.

Timing for harvest must be assessed carefully, to minimise soil contamination to the lifted roots. The crop grows through the autumn months but this potential yield benefit later in the year must be balanced with soil conditions for carrying harvest machinery.

Grazing In Situ

Fodder beet is a nutritious feed for sheep offering a protein and energy rich diet, with a high intake potential.

	Fresh Yield (t/ha)	Dry Matter (%)	Crude Protein (%)	D value	Metabolise Energy (MJ/kg DM)
Fodder Beet Roots	65-80	10-20%	6%	80	13.2
Fodder Beet Tops	10-20	10-13%	15-20%	65	10.4

Table 7 – Nutritional value of fodder beet roots and tops

Sheep must be gradually introduced to the crop, to minimise digestive upsets. The transition time should initially allow for animals with a full stomach, only 1-2 hours on the crop per day. The time on the crop should steadily be increased until the animals have constant access.

The sheep should have an ad lib supply of fibrous forage such as hay, silage or straw as well as having a clean run-back area. The run-back area is essential to enhance animal welfare while offering the animals an area to forage on grass as well as a clean, dry surface for loafing. Forage such as hay, silage or straw should ideally be placed in the field while ground conditions are favourable to prevent soil damage from machinery such as tractor wheels. In addition to fibrous forage ad lib minerals and trace elements should be offered to the sheep grazing the fodder beet.

To maximise the utilisation of the forage, the crop should be strip grazed using an electric fence. Ideally the strips should be long and shallow to prevent wastage and trampling of the crop and benefit the shy feeding sheep. Daily moves of the electric fence

Sheep grazing fodder beet *in situ* behind an electric fence

are recommended as the sheep will select the leafy tops initially and leave the roots.

Feed Allocation

A simple yield assessment and calculation can be carried out to work out the dry matter yield and required daily allocation to the sheep; this forms the basis of how far to move the fence on a daily basis.

To calculate the dry matter yield all that is required is

- 1m square quadrat or 2.66m of alkathene pipe in a loop
- a bag
- a pair of shears
- a set of scales.

Step 1: Place the quadrat on a representative area of the field (avoiding end riggs, poor yielding patches, etc.) If using the alkathene pipe method place over two areas to allow for a square metre reading.

Step 2: All roots within the area should be pulled and placed inside the bag.

Step 3: Weigh using the scale.

Step 4: Multiply the weight by 10,000 gives the fresh weight per hectare.

Step 5: Multiply the result by the estimated dry matter of the crop (e.g. roots and tops 15%) and divide by 100 to calculate the dry matter per hectare.

E.g. Total bag weight of 20kg x 10,000 = 200,000 kg fresh weight per hectare x 15% (estimated dry matter) = 30,000kg / 1,000 = 30 tonnes dry matter per hectare.

Using the dry matter (DM) yield a daily allocation can be calculated depending on the stock class grazing the fodder beet. An example is shown on the following page for a 70kg ewe.

		Example: 70kg ewe
A	Total Estimated Intake (using 2% of liveweight)	1.40kg DM/day
B	Fodder Beet Inclusion of The Diet (allowing 30% fibrous forage)	70%
C	Daily Requirement of Fodder Beet (AxB)	0.98kg DM
D	Number of Animals Grazed	500
E	Daily Requirement of Fodder Beet (CxD)	490kg DM
F	Estimated Crop Yield (DM/m2) (crop yield as above – 15 tonnes @ 80% utilisation – (3kg/m2 x 0.8)	1.20 kg/DM/m2
G	Total Grazing Area Required/Day (E/F)	408.33m2
H	Length of Electric Fence (Feed Face)	150m
I	Width of Fence Moved Per Day (G/H)	2.72m/day

Table 8 – Calculating Daily Allocation

Using the simple dry matter and daily allocation calculations, instructs how far to move the electric fence on an daily basis to ensure high utilisation.

Calculate the area required for the winter with a feed budget, as shown below for 70kg ewes.

	Follow steps A-C as above	Example: 70kg ewe
C	Daily Requirement of Fodder Beet (AxB)	0.98kg DM
D	Feeding Period	150 days
E	Total DM Requirement per Animal (CxD)	147kg DM
F	Total Required for flock (e.g.500 ewes x E)	73.50 tonnes DM
G	Fodder Beet Utilised Yield (t DM/ ha) 15 tonnes @ 80% utilised	12.00 tonnes DM
H	Fodder Beet Area Required for Winter (F/G)	6.12 hectares

- Ensure an area of run-back is also budgetted for.

Table 9 – Calculating Feed Budget

Sheep Management While Grazing Fodder Beet

Fodder beet can be grazed by all stock classes of sheep e.g. breeding ewes and gimmers, hoggs, store or feeding lambs, cast ewes, tups, etc. All breeding sheep should be condition scored going on to the fodder beet and condition must be monitored throughout the grazing period. Any ewes which are above or below the desired condition score should not be grazed on the fodder and instead be managed separately and brought to the appropriate condition score for the time in their breeding cycle (see technical note on condition scoring).

Condition scoring

The different varieties of fodder beet include high dry matter varieties. Ensure that the sheep can eat these especially hoggs and older ewes/tups which may not have scaled up teeth (hoggs) or have lost/worn teeth (older ewes/tups). If it seems that sheep are loosing condition, inspect the teeth to ensure they can eat the beet. Some sheep may get lazy on fodder beet and not walk very far, staying at feed rings or one spot of the fence, these sheep will get fat quick, again condition scoring will keep these in check.

Ensure sheep's feet are sound before grazing fodder beet. When grazing a long narrow strip, ground can be contaminated quickly. Remove lame sheep and treat. Minimise continuous travelling on ground e.g. through a gate way to adjoining run-back to reduce associated feet problems and poaching of the ground.

Belly clip stock prior to grazing on fodder beet to prevent contamination. This may be for feeding lambs, to ensure lambs are clean for slaughter or for breeding ewes, to ensure the ewes belly and udder is clean when lambs are searching for the teat at lambing time.

As with transitioning sheep "on" to fodder beet gradually, it is equally important to transition sheep "off" fodder beet gradually.

Cost to Grow Fodder Beet

Fodder beet is a high cost crop to grow, but the yield that can be achieved allows for a low cost per tonne of dry matter.

Estimated growing costs using 2017 input and contracting rates include:

	Per Hectare	Per Acre
Ground Work		
Ploughing	£54.36	£22.00
Levelling	£22.24	£9.00
Sowing	£64.26	£26.00
Rolling	£11.12	£4.50
Spraying	£10.00	£4.05
Fertiliser Spreading	£11.12	£4.50
TOTAL	**£173.10**	**£70.05**

Inputs		
Seed	£153.10	£62.00
Fertiliser	£218.80	£88.54
Salt	£24.13	£9.77
Spray	£160.42	£64.97
TOTAL	**£556.45**	**£225.28**
TOTAL COST	**£729.55**	**£295.33**

Assumptions

- Seed was treated for pest control
- Fertiliser application should be tailored to previous crop and soil analysis, this is an example only
- Salt applied at 400kg/ha
- Two herbicide sprays, pre emergence and post emergence

If this crop yielded 30 tonnes of dry matter (DM) per hectare, fed to 70kg ewes for a 150 day period the cost per day would be £0.02 and over a 150 feeding period £3.57 (calculation shown below).

A	Cost of Production	£729.55/ha
B	Estimated DM Yield	30 tonnes/ha (roots and tops)
C	Cost per Tonne of DM (A/B)	£24.31/tonne DM/ha
D	Cost per kg of DM (C/1,000)	£0.024/kg DM/ha
E	Daily DM Requirement of Fodder Beet (see table x)	0.98kg DM
F	Cost per day per head (DxE)	£0.02
G	Feeding Period	150 days
H	Total Cost per Feeding Period per head (FxG)	£3.57

Table 10 – Calculating Wintering Costs of Feeding Fodder Beet

Key Points

- High yielding crop offering a palatable, digestible feed for sheep throughout the winter.
- From the beta vulgaris family and not brassica family.
- Requires key nutrients (N, P & K) as well as a requirement for sodium.
- Weed control is essential.
- Harvest or strip graze the crop.
- Timing for harvest should be balanced between when the crop stops growing and ground conditions.
- Transition sheep on and off gradually, offering only 70% of dry matter intake as fodder beet.
- Fibrous forage should make up 30% of the dry matter intake.
- Allow adequate run-back for the sheep ensuring there is shelter and water provided.
- Monitor condition of sheep on fodder beet.
- Fodder beet is a nutritious economically viable crop for overwintering sheep on.

Pros and cons of fodder beet

Pros	Cons
High Dry matter (DM) yield possible (20t DM/ha or 8 t DM/acre)	Expensive to grow well (approx. £730/hectare or £295/acre)
High Energy (13 MJ ME/kg DM)	Intolerant of weeds
Good for crop rotations including brassica families and grass reseeds	Needs careful management at feeding

Top ten tips for growing success

1. Soil test and correct pH, phosphate, potassium and magnesium levels
2. Select sheltered, relatively flat field with light to medium, free draining soil
3. Remedy compaction issues and establish fine firm seed bed
4. Remove all weeds and do not allow weeds to manifest in growing crop
5. Assess nitrogen requirements, apply 20-40kg N/ha to seed bed and the remaining requirement after seedling establishment
6. Apply 400kg/ha of agricultural salt (exception fen, peats and silty soils), magnesium and boron (Sulphur in light land see TN685)
7. Use white rooted varieties for harvesting and coloured varieties for grazing
8. Sow in March-April, when soil temperature exceeds 5°C
9. Check for signs of manganese deficiency – yellow spots on appearing leaves – apply foliar manganese sulphate if required
10. Monitor slugs, wireworm, flea beetles, leatherjackets, aphids, beet cyst eelworm against published thresholds for treatment

Feeding in the field effectively

1. Measure the dry matter available per hectare
2. Estimate the flock requirement
3. Use this to determine electric fence shifts and calculate area required for the winter

Author:

Kirsten Williams
Beef & Sheep Consultant
SAC Consulting
Select Services
Clifton Road, TURRIFF
Aberdeenshire, AB53 4DY
E: Kirsten.williams@sac.co.uk
T: 01888 563333

Production of this SRUC Technical Note was funded by the Scottish Government as part of its Farm Advisory Service.