BRIGADIER
Fodder beet
grower guide
INTRODUCTION

The potential for fodder beet is becoming more widely recognised. Improved plant genetics, herbicides and agronomy techniques are providing the impetus for a shift toward this exciting crop. However, the unique Kiwi innovation of grazed fodder beet crops has been the main reason for the increasing number of hectares around the world.

This guide contains information relating to Joordens’ variety Brigadier fodder beet and the steps required to help grow a successful crop. Fodder beet is one of the highest yielding forage options available to farmers. Its full potential will only be achieved by good husbandry.

Key points for considering fodder beet in a rotation are:

- Very high yield potential, enabling smaller areas to be cropped, therefore reducing the strain on crop rotation and increasing the overall farm stocking rate
- Consistent, high energy feed
- Highly palatable and digestible for ruminants
- Ease of feeding
- Relatively low nitrogen requirement

Fodder beet seed is quite different to many of the seeds that are typically sown in pasture based systems. It is bred as two main types; technical monogerm (mechanical separation of seed clusters) or genetic monogerm (singulation by breeding). Technical monogerm seed is produced and harvested as a clustered seed. This then has to be processed mechanically by way of rubbing or cutting the cluster of seeds to produce single seeds. This results in a seed that often varies in shape and size. The seed is then pelleted to help ensure consistent seed size and uniformity to aid with sowing. As it is a mechanical process it cannot be guaranteed that
all the seeds will be singular and so post-emergence there may be double seedlings in the field. This is not a negative as both seedlings will survive and combine to yield as well as a single plant.

Genetic monogerm seed has the benefit of not going through this mechanical process and therefore the seed size can often be more uniform. The downside to this is that the genetic monogerm seeds are more expensive to produce and therefore more costly to grow. Regardless of seed type it should be noted that fodder beet seed carries a slightly lower germination percentage than that of more common species. This is addressed with sowing rates, as the seed is always germination tested to international standards and must reach predetermined requirements.

Fodder beet is a slower germinating species compared to brassicas for example. Depending on seed bed and climatic conditions, emergence is usually seen from three weeks post sowing and may be staggered. The growth and development of fodder beet will differ across areas so it is important to seek appropriate agronomic advice for your region.
Brigadier is a traditional polyploid, mangel type fodder beet with orange roots. Brigadier fodder beet sits higher out of the soil (>60%) compared to other forms of fodder beet. This is ideal for grazing in situ by all livestock classes. Its high sugar level and soft bite make it very palatable. The roots of Brigadier are typically high in energy but low in crude protein. The tops have a lower energy value but good crude protein levels. Together they form a balanced nutritional feed.

Fodder beet is a well-known crop, but with modern management practices it is gaining rapid interest for its ability to produce very high yields of high quality forage. It is typically sown in spring using specialist seeders and has a 4–6 month growing period. Brigadier offers new potential and is capable of producing up to 40t DM/ha for late autumn and winter grazing.

**Agronomic features:**
- The highest proportion of bulb above ground
- Higher than any other commercially available variety
- High energy feed option
- Very good palatability for all livestock classes
- Lowest bulb DM% available (up to 13%) = true mangel type
- Can yield up to 20-40t DM/ha
- Proven over ten-thousands of hectares

**RELATIVE FORAGE RATINGS**

<table>
<thead>
<tr>
<th></th>
<th>Sowing rate</th>
<th>Energy MJ/kg DM</th>
<th>Crude Protein (%)</th>
<th>Yield ton DM/Ha</th>
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<tr>
<td>Fodder Beet</td>
<td>90,000-100,000 seeds</td>
<td>12</td>
<td>11-13</td>
<td>20-40</td>
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<tr>
<td>Kale</td>
<td>4-5kg</td>
<td>10-11</td>
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<td>Stubble Turnip</td>
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<td>Forage Rape</td>
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<td>Forage Maize</td>
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<td>9-10</td>
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<td>Lucerne</td>
<td>30-35kg</td>
<td>10</td>
<td>17-22</td>
<td>10-12</td>
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</table>

*Source: Fodder beets today*
FIELD SELECTION

Field selection is very important for fodder beet. The crop prefers light sandy to medium clay loam, free draining soil and peats. It is more suited to alkaline soils and does not perform well in acid soils, so the pH will need to be corrected early if there is a known issue and ideally over the preceding 12 months prior to the crop being sown. Soil test the autumn prior to sowing with a 100mm probe to check that the pH is within 6.0 – 6.2. Anything below 5.7 will require liming. Any known issues with nematodes will also need to be addressed, for example by using cover crops (see field pest control). In addition, cover crops will also help improve the soil structure and aid drainage, thereby improving the growing conditions for the beet crop. Avoid planting a fodder beet crop on poor fields which have a low nutrient status and a high weed burden.

Also check the field history with regard to herbicide use as seedling beet can be susceptible to residual chemicals such as: Aminopyralid (Forefront), Picloram (Tordon) and oxyfluren (Titan, Rival). If following a cereal avoid fields that have a history of Chlorsulfuron (Glean). Similarly if following a maize or millet crop avoid fields that have a history of Atrazine. It is best if the prior crop has had no post emergent herbicides other than Clopyralid (Lontrel).

If these chemicals have been used and the fodder beet is planted the plants will often emerge more slowly and be discoloured – red or brown instead of bright green, and disfigured – curling or crinkling of the leaves - and consequently the crop yield will be significantly reduced.

It is generally best to plant fodder beet after pasture or cereals, especially for the grower’s first year of beet production, as the ground will generally prepare well and there are usually fewer weeds to contend with.

Never double crop fodder beet as this will result in significant problems in regards to specific beet diseases and pests. Always use another species as a break crop between beet crops, for at least 2-3 years.
FIELD PREPARATION

Care is required when establishing the seed bed, but after establishment the crop will tolerate moderate drought conditions better than many forage plants currently used. Each soil type and climate will have specific guidelines in regards to field preparation. However, the following key points should be followed regardless of soil type.

Always focus on optimizing moisture retention in the seed bed especially to the depth where the seed is placed. In most areas a period of moisture build up will be required to conserve moisture (fallow period). This can be achieved using a chemical fallow, for example spraying out with glyphosate early and again before cultivation. Do not combine Tribenuron methyl or Thifensulfuron methyl with your knock down glyphosate as this will affect seedling emergence and can damage seedling plants. If you have multiple weeds in your field other than grass weeds add clopyralid to your glyphosate.

These knock down sprays are crucial for removing as many weeds as possible prior to the crop being planted. Add an insecticide if there is a population of pests present and always add an organo-silicone penetrant to aid in knock down and always use an appropriate wetting agent or penetrant to add to the knock down based on weeds present.

A well prepared seed bed is essential to establish the crop as evenly and as quickly as possible. Sub-soils should be free draining and free from plough pans or compaction. A thorough plough is recommended, which also has the benefit of burying many weed seeds, followed by surface workings to ensure a fine seed bed to optimise seed: soil contact once drilled.

A fine firm tilth is essential for successful establishment. Aim for the equivalent of a vegetable seed bed or a well prepared Lucerne seed bed as a guide. Apply crop fertilizer prior to your last surface working of the field. Finally, roll the field prior to drilling.

Weed control is vital for establishing beets and a poorly prepared seed bed will affect seedling emergence and subsequent herbicide timing.

It is crucial to monitor your field as growing conditions can change leading up to the sowing season. Conditions are rarely uniform across an entire field which is why thorough seed bed preparation is essential for even germination.
SOWING

Precision sowing of fodder beet is recommended and there are precision drills available to sow the crop. Fodder beet crops sown with conventional drills will have a lot more inter plant competition and non-uniform beets. Sowing time will depend on climate and location but it is generally from early to late spring (after the last frosts). Fodder beet requires at least five days of 10°C or higher before planting. Take into account evening soil temperatures as well as low night temperatures can greatly reduce your germination and subsequent seedling emergence.

To promote rapid establishment seed should be sown to a depth of 1.5–2.0cm. Drill to lower depths in drier, warmer seed beds. If the seed bed is too loose the seed can often be drilled too deep, even if the depth control is set correctly on the drill – this can affect the evenness and timing of emergence. With precision drills, sowing speed needs to be slow, 4–5km/hour, to ensure correct seed placement. For good seed to soil contact ensure adequate tension adjustment on the drill’s press wheels. It is sometimes necessary to follow drilling with another roll to help even up the seed bed and to conserve moisture.

Sow one full box per hectare (100,000 seeds per box) when using a precision drill, at a row spacing of 400–500mm to achieve the desired plant density. If seed is sown using a conventional drill then a higher seeding rate is typically needed to reduce gaps within the crop (120,000 seeds). If using conventional equipment then the drill should be a sponge feeding type, to minimize the risk of seed being crushed.
GENERAL REQUIREMENTS

Nitrogen (N) will depend on the levels of available soil N reserves. Beet may require between 100–150kg N/ha as split applications.

Phosphorus (P) Brigadier is not a high P demanding crop. If the Olsen P is greater than 25mg/kg then no capital requirements are needed; typically 50–70kg P/ha pre planting would be sufficient.

Potassium (K) Brigadier has a high K requirement and the amount to be applied will depend on soil reserves; typically 75–200 kg K/ha is adequate in grazing systems.

Sulphur (S) If the S levels are less than 7mg/kg then apply 25kg S/ha.

Calcium (Ca) Fodder beet does not use a large amount of Ca. However this is important for correcting pH, so ensure lime or dolomite is applied pre crop where required.

Magnesium (Mg) Brigadier has a moderate Mg requirement. If the Mg levels are less than 1.3mg/kg then apply 50–200kg Mg/ha of Magnesium oxide broadcast prior to cultivation.

Sodium (Na) Beet will not grow rapidly without an adequate supply of Na. Na & K can substitute each other in the plant. If both Na and K are low, then both nutrients should be applied. This unusual feature means Brigadier will handle moderate to high saline soils. Consider broadcasting 50–100kg NaCl/ha pre canopy closure.

Boron (B) is required for all root crops and beet is no exception. Typically broadcast 2-3kg B/ha pre cultivation and where the soil test amount is less than 2mg/kg.

Fodder beet is an intensive crop so it is important to provide the necessary inputs to optimise yield and return per hectare. Target yields for feed budgets will need to be based on soil fertility, water availability and crop experience. Inputs will need to be appropriate for the target yield which may be 10, 20 or even up to 40t DM/ha. A typical 20t DM/ha crop will remove:

- 200kg/ha Nitrogen
- 60kg/ha Phosphorus
- 400kg/ha Potassium
- 30kg/ha Sulphur
- 40kg/ha Calcium
- 35kg/ha Magnesium

Actual removal levels will be about 70–75% of this if crop is grazed in situ rather than harvested. Select fields that have a reasonably good base fertility and/or fields that you want to take through to renewal. Apply fertiliser pre planting or post emergence, but do not sow with the seed. Each farm’s fertiliser and trace element requirements will be different so a recent soil test is recommended to determine the base nutrient level prior to sowing.
WEED CONTROL
This is a crucial area for successful establishment of the fodder beet crop.
There is a range of registered chemistry available, from pre-emergent to post emergence options. The available proprietary chemicals are:
- Tramat, a registered trademark of Bayer CropScience
- Betanal Forte, a registered trademark of Bayer CropScience
- Lontrel, a registered trademark of Dow Agrosciences
- Pyramin, a registered trademark of Nufarm.

Timing of sprays is critical for achieving the best results as delays may result in the weeds becoming too large for adequate economic control. Make sure the contractor is aware of the field and the frequency of potential spray programs.

The first spray is pre-emergence/post planting application. This is generally with Tramat although in areas where wild turnip or volunteer brassicas are an issue Betanal Forte is included in the spray mix. This is applied after drilling but before plant emergence and you should aim to apply as soon as possible post drilling. The chemical needs moisture to activate it so if conditions are dry the chemical must be incorporated, i.e. chain harrows into the surface. An insecticide is often applied at this stage to control pests which might attack emerging seedlings.

There are generally two post emergence herbicide spray applications. These are a combination of some of the actives above depending on the weed spectrum. The first will be applied when the crop is at two true leaf stage – do not mistake with the cotyledons.

It is advisable not to mix too many actives in the one pass to avoid burning the beet foliage. The second spray is generally applied 7–10 days later with another application of multiple actives, often similar to the first post emergent spray. As the crop is generally larger at this stage the chemical rate or the number of actives can be increased to help ensure adequate control of invasive weeds or pests.

Generally all sprays must be completed before bulb formation, when the root at the base of the plant starts swelling and forming a similar size to your thumb. Applications after this will generally result in bulb distortion or reduction in yield. It is advisable to use higher water rates than those stated on label recommendations.
**TOPDRESSING**

Once the crop is established and is close to canopy closure (when the leaves are almost touching between the rows), it is time to apply the last of the plant’s nutrient requirements. This is generally a small application of Nitrogen, approximately 50–70kg N/ha, depending on available soil N and rates prior to sowing.

Consider an additional application of Potassium if the plant requires it. This is also an ideal time to apply any trace elements, like Boron, if these were not applied at sowing or if the crop is seen to be deficient. A foliar tissue test may be required to confirm trace element deficiency.

When applying the fertiliser try and follow earlier spray tracks to avoid damage to bulbs. Once this is applied the crop should require no further inputs, including late insecticides as pests will generally leave larger fodder beet plants alone. From this time the beet plants will really start to achieve their yield potential. With a healthy canopy beet plants assimilate carbohydrates into bulb formation and it becomes evident why the inter row spacing is required.

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**PEST CONTROL**

Fodder beet seedlings are susceptible at emergence to a range of pests. The main threats to an establishing crop will be from slugs, springtails and *Mysius*. Cutworms can be a threat in some areas where this pest is present in other crops. Include an insecticide in the pre crop knockdown spray to target any adult pests that may carry over or include with pre emergence spray as stated above.

Monitor the emerging crop carefully for signs of pest damage and control them with foliar insecticides (Perethrin and Primiphosmethyl). The application of an insecticide is often required prior to the applications of herbicides. Be careful mixing insecticides and herbicides as the resulting mix may damage the beet seedlings. Also be aware that many foliar insecticides can dissolve residue in the spray tank of previously used chemicals, so make sure that a thorough wash down technique is followed prior to tank refill.
NEMATODE CONTROL, ATTRACTION AND REDUCTION OF BCN WITH FODDER RADISH

Presence of the BCN (Beet cyst nematode) in fodder beets emerges just after early development of the plant. Germinated plants fall out at high nematode densities. The most common visual damage is the hanging of the leaves (the so-called sleeping beets), which occur later in the season under hot and sunny conditions when the availability of water in the soil is limited. During summer 3 to 4 generations of beet cyst nematode can develop. The white beet cyst nematode starts to be active when the soil temperature rises over 8°C. Research shows that even at low levels of beet cyst nematode infestations, yield losses of 10-12% do occur. With high infestations (over 1,500 eggs and larvae per 100 cc soil) over 33% yield loss can be expected.

Fodder radish (*Raphanus sativus*) is an often used cover crop in agriculture, and has many positive effects on reduction of different nematodes and on soil structure. The most positive effect of nematode reduction will be obtained when the fodder radish is grown before the fodder beet crop. When drilled early it is necessary to cut the fodder radish 1 to 2 times. After cutting the fodder radish needs to have a good re-growth.

Fodder radish attracts the BCN (Beet cyst nematode) by a bait which comes from the roots of the plant. In the 4th larvae stage, there will be more male than female nematodes formed. Due to this, fewer females are available for fertilisation. The nematode population drops. The number of nematodes formed depends on the resistance level of the fodder radish.

**Nematode threats in Fodder beets**

<table>
<thead>
<tr>
<th>Nematode threat</th>
<th>Cover crop solution</th>
<th>Variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beet cyst nematode (BCN)</td>
<td>Oil seed radish</td>
<td>DOUBLET, TERRANOVA</td>
</tr>
<tr>
<td>Root knot nematode (RKN)</td>
<td>Oil seed radish</td>
<td>DOUBLET, TERRANOVA</td>
</tr>
<tr>
<td>Stubby root nematode</td>
<td>Oil seed radish</td>
<td>DOUBLET, TERRANOVA</td>
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</tbody>
</table>

**WEED IDENTIFICATION**

Images kindly supplied by BayerCropScience
BACKGROUND
Historically, fodder beet has only been fed to ruminants after harvesting and leaf removal, and as a minor component of the total ration. In New Zealand in the past decade, a new system of fodder beet feeding has been developed, where cattle and sheep graze the crop *in-situ* as a primary diet, with minimal additional roughage used. This method has proven very productive in dairy, beef and sheep systems, and on the back of this, fodder beet has become the fastest growing hectarage in New Zealand history, with approximately 500 000 stock grazing beet in 2016.

There are several longstanding myths about grazing fodder beet, and these have been the subject of significant research in New Zealand for some years now. The leaf is not toxic, and can be safely grazed from early autumn forward, contrary to earlier European ideas. The leaf is important to grazing stock as it carries much of the protein of the plant, and matching this with the energy of the bulb is a central management tool in beet grazing. Stock do consume some soil with grazing beets, and this is not a cause of animal health issues. Finally, the low dry matter of beets (e.g. <15%), especially the mangel varieties such as Brigadier, do not restrict animal intakes, but actually increase voluntary intake and thereby production.

Beet systems for use in dairy cows are split between dry cow and lactation feeding. Dry cow systems use high intake grazing, while lactation feeding uses beet at a lower input rate to replace expensive cereal and silage supplements. Both are significantly less expensive than alternative feeds, and reduce the cost of production.

Beef systems use beet as a finishing diet to accelerate the cattle to earlier slaughter ages. The system is not only far more cost effective than other feeding strategies, such as grain feeding, but also has a number of key advantages in both the carcass produced, and the environmental footprint of production. Annual carcass production of above 2500 kg / hectare has been demonstrated in these systems, with growth rates in yearling cattle above 1 kg daily published. It is proving a pivotal contribution to the ability of pasture fed beef production systems to supply high quality carcasses all year around.

Sheep systems use beet grazing for wintering pregnant ewes and replacement stock, and also for autumn and spring shoulder feeding to effectively increase stocking rates and conserve pasture for use after lambing. Prime lamb systems use autumn to winter grazing as a means of holding high volumes of stock on small areas, enabling early season purchasing of lambs at significantly reduced prices.

OPERATIONAL FEEDING
However, feeding the crop in this method requires a number of simple safeguards for effective use, and seeking specialist advice is a necessity. The beet bulb is high in rapidly fermentable sugars, and there is a strict requirement to transition the stock slowly to the crop to avoid rumen acidosis, which is a serious animal health issue. There is also a requirement for supplemental roughage in the ration to maintain good intakes, as beet is a low fibre feed. By grazing the beet in-situ, the leaf is eaten with the bulb, and for most stock classes, the total plant protein content is therefore adequate. However, in some systems there is an additional requirement for targeted mineral supplementation, either trace elements, macro-minerals, or both.

The crop is typically strip-grazed behind an electric wire, moved daily. However, there are also systems using beet harvested both in the manner common to sugar beet, and using specialized equipment to scrape the beets out of the ground with the leaf intact. These can be fed out to stock on pastures, or in lot feeding systems.
KEY FEATURES OF BEET BULBS

- Very high water soluble carbohydrates (WSC)
- Very high digestibility and palatable
- Brigadier is easy to graze in situ as bulb is up on the ground

KEY FEATURES OF BEET LEAVES

- Much higher crude protein (CP) than the bulbs
- Low in WSC
- No toxicity issues
- Higher in DM

GRAZING FODDER BEET

- Used widely in New Zealand as a grazed crop for dairy, beef and sheep systems
- High performance diet, high metabolisable energy
- Can be safely grazed from early autumn forward
- High grazing intake with low supplement inputs required means lower cost and higher production
- Transition onto the crop is required, and this process requires strict attention to avoid animal health issues.
**Fodder beet grower checklist**

- Select free draining fields that are able to be prepared to a good standard.
- Avoid fields where previous crops have had residual chemicals applied.
- Soil test early using a 100mm soil probe. Test pH of fields being considered for fodder beet well before sowing. A pH (water) above 6 is required, ideally 6.2.
- Spray out and prepare seed bed as early as possible using a double spray program if necessary.
- A fallow period should be used to help conserve soil moisture.
- Fertiliser use should be based on a recent soil test, fertiliser should not be applied with the seed.
- A fine, firm seed bed is essential.
- Apply insecticides prior to or at drilling if required, monitor for insect pests post establishment.
- Sow into adequate soil moisture from when soil temperature is at least 10°C (pay attention to evening time soil temperatures as well as day time and check last frost date).
- Best results are achieved using a precision drill. Sow seeds at 1.5–2.0cm depth. Make sure coulters are set to an even depth.
- Sow one full box per hectare (80-100,000 seeds/ha), when using a precision drill.
- Drill speed should be low to avoid poor seed placement, 4-5km/hour maximum.
- Apply post plant/pre emergence herbicide after sowing. If conditions are dry this may have to be applied and incorporated prior to sowing.
- Plan your herbicide program based on expected weeds and to avoid delay in correct timing of application.
- Apply when the crop has at least two true leaves and before weeds reach the four true leaf stage.
- Apply second nitrogen and potassium application after weed control for maximum yield.

*An example crop program and feed cost calculator is included on page 15 and can be used to set up your program and monitor feed costs.*
CROP TIMELINES AND FEED COST CALCULATOR

<table>
<thead>
<tr>
<th>Day</th>
<th>Operation</th>
<th>Products &amp; rates</th>
<th>Cost $/ha *</th>
<th>Price *</th>
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<tbody>
<tr>
<td>-60</td>
<td>Soil test</td>
<td>understand nutrient status</td>
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<tr>
<td>-30</td>
<td>First knockdown</td>
<td>Glyphosate plus any spikes required</td>
<td>2.0l/ha glyphosate $8</td>
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<td></td>
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<td>40mls/ha Hammer $7</td>
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<td>-14</td>
<td>Pre-sowing fertiliser</td>
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Feed cost calculator

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* Example based upon US dollar
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