Chicory management (1-72b)

Introduction

This Farmfact is based on NZ trials and experiences growing the chicory cultivar Choice under dairy cow grazing. Other chicory cultivars may require different management. This Farmfact focuses on management; for establishment guidelines see Farmfact 1-72a.

Key points

- In Northern regions expect no more than two productive summers from chicory.
- First year chicory should be grazed at 25-35 cm height, while second year chicory should be grazed at 25 cm height to minimise stem growth.
- To maximise yield and persistence avoid over-grazing (e.g. lower than 5 cm), treading damage on wet soil and grazing during winter.

Characteristics of chicory

Chicory grows throughout New Zealand however; it is best suited to dairy farm situations where the amount and quality of summer feed limits milk production. Chicory plants have a deep tap root which supports growth through dry conditions.

Chicory is a multi-graze crop and can be incorporated into a rotational grazing system through its active growing months, September to May. During this period it yields 8-16 tonne DM/ha (average = 10.6 t DM/ha). The yield depends on many factors, including summer rainfall.

Spring-sown chicory stays leafy in the first summer and does not go to seed. If taken into a second summer chicory does go to seed (after winter vernalisation) which reduces feed quality.

Chicory does not persist indefinitely due to fungal root diseases slowly increasing in the soil and, if in a mixed pasture, potentially repeated selective grazing. In Northern regions under dairy grazing, farmers should expect no more than two productive summers, with the greatest production in the first year.

Management

1. As a pasture mix

Where chicory is in a pasture mix the paddock should be managed as it would be as a normal grass/clover pasture, grazing to residuals of 1500-1600 kg DM/ha.

2. As a special purpose crop

Chicory should be first grazed no earlier than the seven leaf stage (i.e. plants have seven fully grown leaves). This is normally 8 weeks after spring-sowing. This ensures that plants have well-developed tap roots to improve survival through the growing season.

Target covers are: Pre-grazing 25-35 cm height (about 3-4 weeks regrowth; ignore stems)
Post-grazing 5 cm height

Dairy cows will readily graze lower than 5 cm and management strategies need to be in place to ensure this does not occur.

Updated December 2013
If the chicory is to be taken through a second summer it is important to avoid overgrazing and treading damage in the autumn to maintain plant populations and tap root size. Grazing should also be avoided when soils are wet as treading damage has a major impact on plant survival.

Chicory is semi-dormant in the winter (June-August) and should not be grazed through this period. Grazing during this dormant period reduces the size of the root and can damage plant crowns which creates entry sites for fungi, and reduces the survival of chicory plants.

**Estimating yield and feed allowance**

The dry matter (DM) percentage of chicory ranges from 7-15% so DM yield estimates can vary by up to 50% if DM is over- or under-estimated.

The DM yield can also differ greatly depending on plant density. For example, a dense (~140 plants/m²), first year pure chicory crop at DairyNZ had a pre-grazing mass of 2700 kg DM/ha, while a less dense crop (~55 plants/m²) had a pre-grazing mass of 2000 kg DM/ha; both at the same 25 cm height.

Three methods for yield estimation and feed allocation are suggested:

1. **Best practice**
   - Bend a 2 m length of wire into a square of 0.5m x 0.5m (=0.25m²) or join a 1.77 m length of alkathene pipe into a circle
   - Place the square or circle in four representative areas in the paddock
   - Cut the chicory inside the square or circle to 5 cm height
   - Bulk up the four samples and weigh
   - Multiply by 10,000 to get fresh weight (kg/ha)
   - Take 200 g sample of fresh chicory and dry in microwave
   - Re-weigh dry chicory
   - Calculate DM % (dry weight / fresh weight)
   - Calculate kg DM/ha (fresh weight x DM %)
   - Allocate area based on 20% of cows diet (~3 kg DM/cow/day)

2. **Rising platemeter (RPM)**

   Like for pasture, the RPM can be used to estimate the yield of first year chicory crops when there is no stem present. Take at least 40-50 readings in a 'W' shape across the paddock and calculate yield using the equation: 
   \[ \text{Yield (kg DM/ha)} = \text{RPM height (clicks)} \times 86 + 235. \]

   Allocate area based on 20% of cow's diet (~3 kg DM/cow/day). This equation is affected by many factors so it is important to check post-grazing residuals as below to ensure adequate herbage allocation.

3. **Height-based yield assessment**

   If the pre-grazing mass of chicory at 35 cm height is 3200 kg DM/ha the herbage available to cows is ~1900 kg DM/ha (above a post-grazing residual of 5 cm). For cows to eat 20% of their diet (~3 kg DM/day):
   - Allocate daily area based on 17 m²/cow (0.17 ha per 100 cows)
   - Monitor grazing as cows will readily overgraze chicory
   - Cows will likely reach 5 cm in 2-3 hours. If the cows reach this residual a lot quicker than this, then it is likely that they are not eating 3 kg DM/ha.
Second year crop

The decision to take chicory through a second year should be made in autumn. As a guide at least 30 plants/m² are required to achieve a yield of 10-12 t DM/ha in the second year.

In its second year chicory will go to seed. Careful management is required to minimise the number of plants that have mature reproductive stems. Mature reproductive stem is generally avoided by grazing cows, reducing the utilisation of DM grown.

To minimise the amount of mature reproductive stems the pre-grazing height of the leaves should not exceed 25 cm in the second year. Letting the leaves grow beyond 25 cm will not accumulate any more leaf, just increase stem growth.

In second year chicory it is difficult to achieve target residual heights due to stem. As residuals have less impact on yield and persistence than grazing interval, the main concern should be achieving target pre-grazing heights.

Fertiliser requirements

Annual maintenance phosphate, sulphur and potassium are the same for chicory as for ryegrass-based pastures.

Chicory is responsive to nitrogen fertiliser. Applications will depend on soil fertility and potential yield, but typically two to four applications of 35 kg N/ha are recommended over the spring/summer period. For chicory sown without clover, 140-180 kg N/ha is needed annually to make up for the lack of nitrogen fixation. Indications of nitrogen deficiency are a decline in herbage production without a corresponding drop in plant numbers and a paling or yellowing of the leaf.

Dairy systems with chicory

For ease of management, the preferred system is to establish paddocks of chicory close to the dairy shed. However, chicory crops can also be useful in a pasture renewal programme to resow under-performing paddocks, so this should also be considered in paddock choice.

To ensure a daily diet of ~3 kg DM/cow of chicory during the summer/early autumn (~20% of diet), the amount of chicory planted needs to be about 3.5 ha per 100 cows.

Once well-established, an area of chicory (about 0.17 ha per 100 cows) should be fenced off and cows moved onto this break for 2-3 hours. Electric wires are moved during the following day and the exercise is repeated. Back-fencing is preferred to avoid grazing regrowth.

This system provides for a 21 day grazing rotation, which is about how long it takes to grow to 25-35 cm. The rotation length may need to be adjusted if growth of chicory is unusually slow or fast.

If farmers wish to feed a different daily amount of chicory then the area of chicory planted will need to be adjusted as shown in the table below.

<table>
<thead>
<tr>
<th>Chicory to be fed per cow</th>
<th>Area to sow in chicory</th>
<th>Daily area of chicory*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 kg DM/day</td>
<td>2.3 ha / 100 cows</td>
<td>0.11 ha / 100 cows</td>
</tr>
<tr>
<td>3 kg DM/day</td>
<td>3.5 ha / 100 cows</td>
<td>0.17 ha / 100 cows</td>
</tr>
<tr>
<td>4 kg DM/day</td>
<td>4.7 ha / 100 cows</td>
<td>0.23 ha / 100 cows</td>
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</tbody>
</table>

*On a 21 day rotation.
The profitability of including chicory in a farm system has been investigated using modeling. At a baseline milk price of $5.50/kg MS, a System 1 farm had optimal profitability when chicory was planted on 7% of the farm area. This area decreased as the system intensity increased due to the ability of imported supplements to be more profitable and offer greater flexibility to fill feed deficits than chicory.

In some situations the costs of growing chicory can be partially attributed to a pasture renewal programme, where chicory is used as a break crop to pasture pests and weeds, and address issues of soil pH, fertility and compaction.

If the chicory is taken through a second year, changes to the farm system are required to overcome the lack of growth from chicory paddocks during the winter (accounted for in winter and early spring feed budgets) and the feed gap filled either from supplements or reduced stocking rate.

**Herbage quality**

Well-managed chicory (0-20% stem) has a lower DM content than ryegrass-based pasture and generally contains less fibre, and more protein and soluble sugars (Table 1). Chicory also has greater mineral content (P, K, S, Ca, Mg, Na, Zn, Cu and B) than ryegrass pasture.

Chicory has high digestibility and low fibre content and isn’t suitable as a sole diet for cows. High digestibility allows the chicory to be cleared from the rumen more quickly than perennial ryegrass, providing an opportunity to increase voluntary feed intake.

**Table 1. Herbage quality of chicory and pasture.**

<table>
<thead>
<tr>
<th></th>
<th>DM (%)</th>
<th>Protein (% DM)</th>
<th>Soluble sugars + starch (% DM)</th>
<th>Fibre (% DM)</th>
<th>Digestibility (% DM)</th>
<th>ME (MJ/kg DM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicory</td>
<td>7-15</td>
<td>16-27</td>
<td>10-22</td>
<td>20-30</td>
<td>72-83</td>
<td>11.5-13.0</td>
</tr>
<tr>
<td>Pasture (spring to autumn)</td>
<td>10-30</td>
<td>12-28</td>
<td>8-21</td>
<td>40-55</td>
<td>65-85</td>
<td>9.5-12.5</td>
</tr>
</tbody>
</table>

DM = dry matter; ME = metabolisable energy. Quality may be outside these ranges depending on pasture/crop management.

**Animal production**

Milk responses to chicory in summer varies with pasture availability and quality and have been measured at similar levels to turnips (40 g MS/kg DM). If pasture quality consistently drops away in summer, then including chicory can increase milksolids production per cow compared with a pasture diet.

**Animal health**

Chicory is facial eczema safe.

High nitrate levels can occur in chicory during periods of rapid growth or under certain environmental conditions (cold or overcast after a period of good growing conditions). Under these conditions, a sample of the leaves should be tested for nitrates. Cases of toxicity are rare, however, probably as chicory is fed as a small part of the diet.

When grown with red and/or white clover, chicory crops have the potential to cause bloat, however; this is relatively low risk because most of the daily diet is still pasture/chicory in the recommended system.