Chicory Guide for Dairy Farms

Description

Chicory is a perennial herb with a deep tap root, high forage quality, and high warm-season pasture growth. It has been thoroughly proven on farms, and in research, to substantially improve production both per animal and per hectare in dairy cows. It can be considered as a re-growth summer crop.

Features of chicory

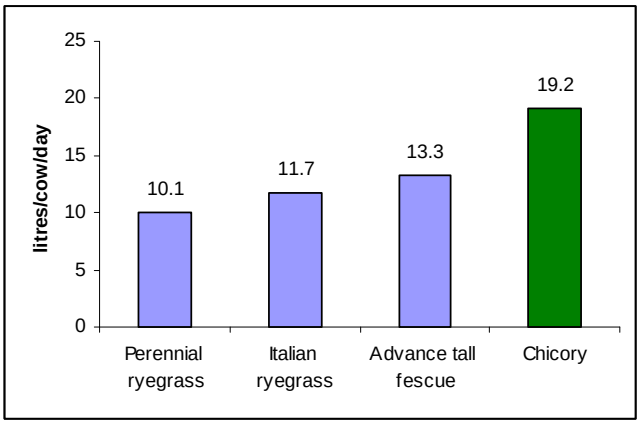
- High forage quality (protein and digestibility)
- Improves milk production
- High summer growth
- Slow winter growth in cold climates
- Perennial with moderate persistence (3-4 years)
- Good drought tolerance, deep tap root (1.5 m)
- Elevated mineral content (Zn, Cu, Mg, Ca, K)
- Reduced facial eczema spore levels
- Good grazing tolerance

Choice chicory in DairyNZ trial

Performance of Chicory

A trial has shown that in a dry environment cows can produce up to 90% more milk when fed on chicory relative to perennial ryegrass (Figure 1). In general it is noted that dairy cow milk production responses from chicory are similar to those from turnips, improving milksolids production when supplementing pasture over the summer and/or autumn periods (Waugh *et. al* 1998).

Figure 1. Summer milk production from cows grazing four pasture types. Tharamaj *et al.* 2005.



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There seem to be several reasons for the improved milk production. Chicory has good protein levels (up to 26% CP, and contains condensed tannins which may improve protein supply to dairy cows), and high digestibility. This quality does not deteriorate as much over summer, as ryegrass does, so that in late-summer and autumn, quality differences between the two species can be large. Chicory is also processed significantly faster in the rumen than ryegrass, allowing for higher daily intakes. Chicory is highly preferred by cows, and this feature can be used to stimulate appetite in summer when cows are hot in the afternoon. The high protein and digestibility of chicory in summer and autumn is ideal to balance with high fibre and low protein forages (e.g. maize silage, ryegrass pastures).

Chicory can produce over 20,000 kg DM/ha in a year with reasonable summer moisture, and daily growth rates around 80-100 kg DM/ha/day in summer/autumn.

Limitations of Chicory

Chicory does not persist indefinitely, due to fungal root diseases slowly increasing in the soil, and repeated selective grazing when mixed with less desired species. Choice chicory normally lasts for about three years, but semi-annual cultivars thin drastically in their first winter. Persistence of chicory is poor on heavy and poorly-drained soils, when suffering pugging damage, when planted with dense grasses, and when grazed while soils are wet. Many weeds, including buttercup (giant and annual), stinking mayweed, and chickweed can be controlled with a registered herbicide (Preside™). Chicory is however susceptible to thistle herbicides, so these need to be controlled before establishment, and after establishment by way of mowing, grubbing, spot spraying, or wiping.

Uses of Chicory

There are three main ways that chicory is used,

1. **Mixed with a grass/clover pasture** – this is the most common use of chicory because it requires very little change to pasture establishment and management practices. It is an easy way to increase animal production from a pasture. Seed is mixed at the rate of 1 to 4 kg/ha, depending on the content required. Establishment can be poor when mixed with high rates of perennial ryegrass, when sown in cold soils, or when planted too deep (>12 mm). Best results come from sowing with highly palatable grasses such as tetraploid ryegrass, timothy, or tall fescue.
2. **As a special-purpose crop** – this is often the best way to realise the benefits of chicory on a dairy farm, because it provides a greater amount of high quality feed over summer. It also allows for selection of suitable soil types, and grazing management that is specific for chicory. Seed is sown at 4 to 6 kg/ha with white and red clover.
3. **Oversown into pasture** – good establishment can be achieved by spreading seed just prior to grazing in spring. This suits grass pastures planted in autumn without chicory which require thistle spraying in the first winter.

Chicory oversown into tall fescue pasture

Establishment of Chicory

Chicory is more sensitive than ryegrass to sowing depth and soil temperature. It establishes best when sown into warm soils (12°C +) at 10 mm in depth, and where there are low amounts of competition from other plants in the first three months. Spring sowing is highly preferred, and late-autumn planting should be avoided as the ideal time for first grazing from a mid-March planting is mid-June.

Preside™ can be applied to young chicory seedlings

Weeds should be thoroughly eliminated before sowing because post-establishment herbicides for chicory are limited. Some un-registered pre-emergence herbicides are used when establishing chicory without grass or plantain. Many weeds can be controlled in the early stages of establishment with Preside™ herbicide at recommended rates. Where it is expected that pastures will require a hormone spray after establishment, grass can be planted on its own and chicory (at least 3 kg/ha) and clover seed spread just before grazing in spring.

Soil fertility should be the same as required for ryegrass/clover pastures. Nitrogen fertiliser improves establishment of chicory, especially when temperatures allow for active growth.

Example of a good establishment programme (grass to pure chicory)

1. Plan to plant pasture when soils are 12°C and rising, most likely to be late-September.
2. Spray out existing pasture with glyphosate + Granstar.
3. Wait for 10-12 days, mouldboard plough, roll furrows, power harrow to shallow depth.
4. Farmers have successfully used Triflurilan as a pre-sowing herbicide (Triflurilan is not registered in NZ for use on chicory, use at your own discretion), at standard rates (2 l/ha, or 800ga.i./ha for loam and clay soils), incorporate into the soil **immediately** (i.e. 1 hour) after spraying (e.g. shallow power harrows to 5-10 cm). Triflurilan cannot be used when grass is planted with chicory. Level and roll seedbed.
5. Apply establishment fertiliser – nitrogen (N) for rapid establishment, and phosphate and potassium for long-term production.
6. Sow with a **roller-drill**, light chain harrows, then final Cambridge roller. Seed must not be planted deeper than 20 mm (ideal is 10 mm).
7. Spray-irrigate to germinate if no rain after sowing.
8. Monitor weeds, and if found (e.g. nightshade and shepherd's purse will escape Trifluralin), spray only with Preside™ (65 g/ha + Uptake oil). Apply when weeds are small (< $2 coin) as it will not kill some large weeds, and it has a residual effect to control late-germinating weeds.
9. Apply N 3-4 weeks after planting, then after each grazing (see below).
10. First graze whole paddock when plants have seven true leaves (crop will be about 25-30 cm high), leaving a 7-10 cm residual.

Do not plant chicory within the withholding periods for residual hormone herbicides (e.g. clopyraid, Tordon® dicamba) that may have been applied on previous crops. It is not advisable to plant chicory stands after Brassica crops, as they harbour and spread root diseases which can affect chicory.

Varieties of Chicory

Of the chicory varieties currently available, Grasslands Choice is very persistent and productive (Figures 2 and 3). It was bred from Grasslands Puna specifically for dairy cow grazing, having reduced lactucin levels, as well as improved cool-season growth and establishment vigour. Some other chicory cultivars are biannual-types from the Italian vegetable industry, and plant populations decline rapidly within 18 months. They also produce a lot more stem after their first winter.

Figure 2. Chicory production in a tall fescue sward over 30 months - Kimihia Research Centre, Canterbury

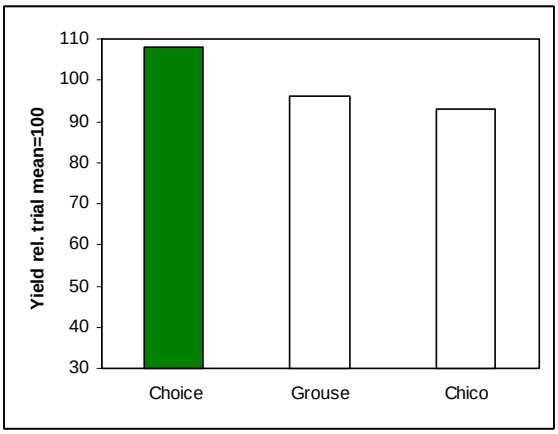
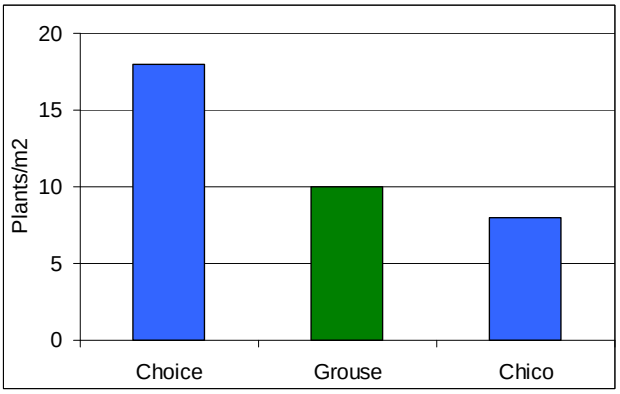


Figure 3. Chicory plant populations three years after planting - Kimihia Research Centre, Canterbury



Biannual chicories (right) produce more stem than Choice (left) after their first winter

Suggested Mixes

1. Specialist Chicory Stand

Cultivar	Sowing Rate (kg/ha)
Choice chicory	5
Tribute white clover	4
Sensation red clover	5
TOTAL	14

2. Year-Round Mixed Pasture

Cultivar	Sowing Rate (kg/ha)
Choice chicory	4
Ohau AR1 tetraploid long-rotation ryegrass	12
Tribute white clover	4
Sensation red clover	5
TOTAL	25

Specialist chicory stand

Chicory/fescue pasture

Management of Chicory

Chicory is most productive and persistent when it is rotationally grazed, and spelled until 2-4 leaves/plant have fully re-grown (crop will have a mass of about 3000 kg DM/ha, or 15-20 cm height). Between spring and autumn, this will mean a 21 to 35 day rotation.

In mid-spring (October) of the second season, chicory plants will develop a reproductive stem. This should be grazed off, close to the ground, while it is small (< 10 cm) and soft (see photo). A second grazing just two weeks later will reduce stem re-growth for the rest of the season. Stem growth doesn't need much control when chicory is planted in a grass mix because animals selectively graze the chicory plants.

Stem should be grazed before it goes past this soft-stem stage

Chicory is an extremely productive plant that is very responsive to large amounts of fertiliser. Its main requirement is nitrogen, and the clover in the sward will not be able to provide enough fixation for maximum chicory growth. Farms with specialist chicory pastures under irrigation are applying nitrogen (e.g. 60 kg/ha of urea) after every grazing, but for lower-input systems 2-4 applications of 80 kg/ha of urea over spring and early-summer will be adequate for moderate carrying capacities. Phosphate, sulphur and potassium should be applied at maintenance rates that reflect the higher stocking rates (e.g. 200% of farm average).

Specialist stands of chicory without grass will tend to get winter annual grasses (e.g. *poa annua*) after 1-2 seasons. These can be controlled with grass-selective herbicides to improve spring production and persistence.

Systems for Dairy Farms

The best system is to establish several paddocks of pure chicory/clover pasture close to the dairy shed. To ensure a daily 3-hour diet of chicory, the amount of chicory pasture planted should be about 5-6 ha per 100 cows.

Grazing of whole paddocks may be required for the first 1-2 grazings while establishing the crop. Once well-established, an area of chicory (about 0.3 ha per 100 cows) should be fenced off, and cows moved onto this break for 2-3 hours. Some farmers prefer to do this just before afternoon milking, as cows move quickly from their day/grass paddock to the chicory (reducing walking time to the dairy shed), and it stimulates cow appetite when they would normally have a low appetite on grass due to higher temperatures. The electric wires are moved during the following day and the exercise is repeated. Back-fencing is preferred to ensure good re-growth, but this can be impractical. If there are 6 paddocks of chicory on a farm, back-fencing is not essential as strip-grazing of each paddock is completed within two days, resulting in very little grazing of re-growth plants.

Choice chicory is palatable to cows, who will even eat leaf knocked to ground, utilising about 90% of the crop at each grazing

This system provides for a 25 day grazing rotation, but may need to be adjusted if growth of chicory is unusually slow or fast. It provides a daily diet of chicory, which is important because it reduces any rumen adjustment needed if they switch from ryegrass to chicory part way through a rotation. In the first season, chicory crops can have very high digestibility and low fibre, and are therefore not suitable as a sole diet for cows.

Farmer experience has found per cow production can increase by two litres/cow or 10% per day from just a couple of hours of grazing chicory each day. They have also found that 3 hours of grazing chicory sustains cows as well as 12 hours on grass/clover. Given the small land areas required, the per-hectare profitability of this is very high (as much as $1800/ha increase in summer milk production per season).

Red clover is an important part of a chicory/clover crop, because white clover often struggles to compete against the growth of chicory. Without red clover, up to five applications of 100 kg urea/ha would be needed to make up for the lack of nitrogen fixation. While the red clover has potential to cause bloat, this does not occur very often because red clover is less prone to causing bloat than white clover, and most of the daily diet is still chicory in this recommended system.

Chicory used in this method is effectively a regrowth substitute for summer turnips, and boosts animal nutrition when it is lacking from pasture in summer. The advantages are that Choice chicory will last for 2-3 years from one planting (reduces costs) and it provides repeated grazings over more months of the year (September to May).

Choice chicory will grow through winter, especially in the North Island, so will provide some grazing in early-spring, although not as much as ryegrass. To counter the slight reduction in early-spring carrying capacity, a crop rotation with Italian ryegrass can be used. For example, if a farm has six paddocks of chicory for grazing, two would be planted each year, and in their third autumn planted in Italian ryegrass. This would mean that in each spring, the slower growth from four chicory paddocks will be balanced by the extra growth from two Italian ryegrass paddocks. An additional method to overcome this issue is to plant annual ryegrass in the autumn into paddocks identified for planting into their first crop of chicory in the following spring.

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Choice chicory in Dairy NZ trial, Ruakura