



Establishing and managing Chicory and Ryegrass pasture mixes on the Far North Coast of NSW

Chicory (*Cichorium intybus*) is a deep-rooted leafy herb suited to regions with higher than 550mm annual rainfall. On the far north coast of NSW, it can produce high dry matter (DM) yields of excellent quality feed year-round. Most growth is achieved through the warmer months, making it a suitable competitor and valuable addition to any tropical grass pastures, especially to improve overall pasture quality. Chicory can also be planted in a mix with short term ryegrass for high-quality winter feed as practised by many dairy farmers and beef fattening enterprises.

Whilst chicory can be planted from spring to autumn, provided soil temperatures exceed 10°C, local trials have shown that autumn is the best time to establish chicory. Autumn usually provides adequate soil moisture for germination, increased follow-up rainfall, and less risk of summer grass and weed competition. Therefore, this Fact Sheet will focus on the autumn establishment.

These recommendations are based on farm trials, observations and more intense studies at the Department of Primary Industry's Wollongbar Research Station on the far north coast of NSW. Work on chicory is ongoing in a subtropical climate and adds to information from temperate regions in Victoria and New Zealand.

Establishment of Chicory in a mix with short term ryegrass over sown into summer grass pastures in autumn for winter feed only.

Planting time: Late March to Early April on the far north coast.

Sowing rate:

- 1-2 kg/ha chicory plus 35kg/ha short season Tetraploid ryegrass over sown into summer grass pasture.

Key points:

- This option of planting chicory at 1-2 kg/ha with ryegrass at 35 kg/ha will provide good quality winter feed, primarily from ryegrass. While some chicory will survive into summer, its contribution toward quality summer feed will be minimal compared to chicory as a base pasture (Chicory sown at a higher rate-see below). Due to the loss of chicory plant density and size from ryegrass competition (shading) through winter/spring. This is explained in more detail in the Establishment Option 2, below.
- Planting ryegrass and chicory together for winter feed requires careful timing. Planting too early in March is likely to favour chicory as it's generally too hot for ryegrass, whilst planting too late for Chicory in April will favour the ryegrass. Resulting in dominance by the plant that is most suited to the temperature conditions at the time.

Establishment of Chicory as a base pasture with or without short term ryegrass

OPTION 1 – A PURE CHICORY PASTURE

Planting time: Late March to Early April on the far north coast.

Sowing rate:

- First year planting 6kg/ha Chicory.
- Second year pastures over sown with 3kg/ha Chicory.

Key points:

- Chicory planted alone and managed as a pure stand through winter provides the best opportunity for its persistence. **Figure 1 below** shows the chicory plant density over 12 months when planted alone or with ryegrass in a cut plot study.

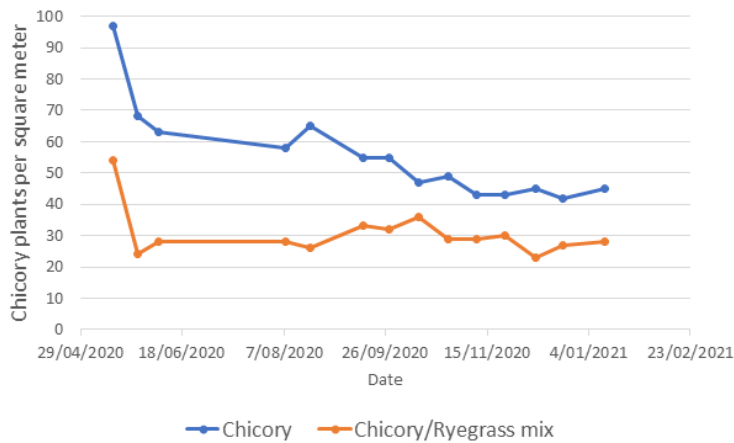


Figure 1: Plant density of chicory planted alone at 6kg/ha or in a mix with 20kg ryegrass/ha

- In this case, the pure chicory pasture produced 5,884 kg DM/ha compared to 9,165 kg/ha for the chicory and ryegrass mixture, through winter and spring, up until October 12th under the condition of adequate moisture. However, the annual yields were much closer, with pure chicory producing **13,160 kg DM/ha** and the chicory/ryegrass mixture, **14,280 kg DM/ha**. The reason for the much lower yield of the chicory from October 12th on for the ryegrass/chicory mix is that fewer chicory plants survived; they were much smaller and had fewer energy reserves due to the competition (shading primarily) from the ryegrass. In the chicory alone treatment, the larger chicory plants were better able to respond to the warmer spring days and provide a valuable feed of high quality.
- The weaker chicory plants in the chicory/ryegrass mix were also less able to suppress weeds after the ryegrass period.
- In addition to higher growth post ryegrass, the other advantages of pure chicory pastures are as follows:
 - It provides the opportunity to plant chicory earlier in the autumn when it's still too hot for ryegrass and, therefore, reduces the autumn feed gap.
 - Provides the opportunity to control grass weeds using a grass specific herbicide.
 - Provides year-round high-quality feed.



Photo 1: A pure chicory pasture, planted in autumn and rotationally grazed for 12 months.

OPTION 2 – CHICORY AND RYEGRASS PLANTED AS A MIXTURE

Planting time: Late March to Early April on the far north coast.

Sowing rate:

- First year planting 6kg/ha chicory plus 20kg/ha short season Tetraploid ryegrass.
- Second year planting 3kg/ha chicory plus 20kg/ha short season Tetraploid ryegrass.

Key points:

- Planting ryegrass and chicory together requires careful timing-planting too early in March is likely to favour chicory as it's generally too hot for ryegrass whilst planting too late in April will favour the ryegrass.
- After emergence, a few light grazings at 10-14 days, will be required to prevent ryegrass from shading the chicory. The cow's hooves' damage to the young chicory is far less severe than the effects of shading by ryegrass.
- Thus, reducing the ryegrass planting rate to 20kg/ha and short grazing interval (12-16 days) in the spring months of August and September will minimise ryegrass's shading effect and allow chicory to make a greater yield contribution during this period and regrow better post ryegrass.
- As an example, Table 1 shows the results from a grazing trial, when setaria pasture was over sown with 1 or 4 kg of chicory plus 35 kg tetraploid ryegrass per hectare, or 8 kg Chicory and 20kg ryegrass per hectare on April 10th (late for chicory). The ryegrass completely dominated the chicory, which made an insignificant yield contribution. Even at 8 kg chicory per hectare plus only 20 kg ryegrass per hectare, the chicory contribution was small. Post ryegrass, chicory growth remained very low for the 1 and 4kg per hectare sowing rates due to the low chicory plant density and smaller plants (not recorded), but the yield of chicory planted at 8 kg per hectare, post ryegrass was good.

	Ryegrass yield (kg DM/ha)	Chicory yield (kg DM/ha)	Total yield (kg DM/ha)	Chicory 14th June (plants/sq m)	Chicory 29th Oct (plants/sq m)
1 (8kg Chicory + 20kg ryegrass/ha)	5,814	916	6,730	19	10
2 (4kg Chicory + 35kg ryegrass/ha)	6,925	495	7,420	10	5
3 (1kg Chicory + 35kg ryegrass/ha)	7,194	158	7,352	2	4

Table 1: Impact of chicory and short season tetraploid ryegrass on chicory plant survival and yield when over sown into a setaria pasture on 10th April.

- **Figure 2 below** shows that when chicory was grown in a mixture with ryegrass, the chicory plants were smaller and slower to commence growth in the spring period after the ryegrass had finished. In this period, between October 10th and December 26th, chicory plants grown with ryegrass produced 0.53g DM/plant, whereas the chicory that had been grown as a pure stand produced 1.6g DM/plant. The reason for the slower growth and smaller plants was that the ryegrass shaded the companion chicory and left it with depleted energy reserves, so much so that it took 2 ½ months for these chicory plants to catch up in size to the plants in the pure chicory pasture. This ultimately resulted in the pure chicory pasture producing 4,955kg DM chicory/ha and chicory that had been grown with ryegrass only producing 2,228kg DM/ha, after the ryegrass period.

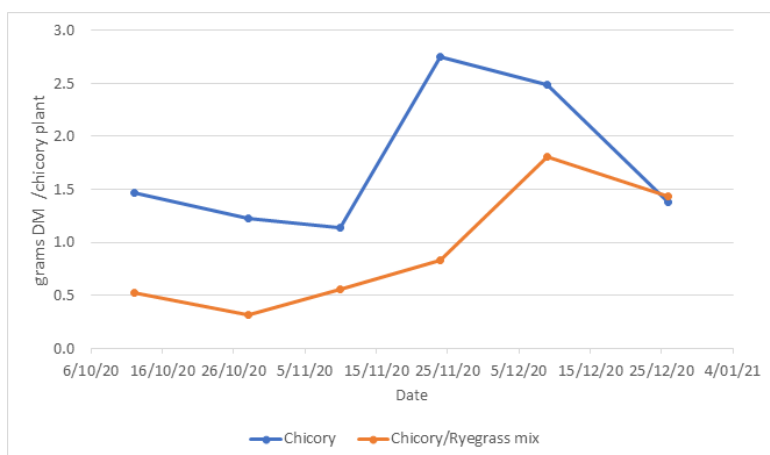


Figure 2: The chicory plant size (g DM of leaf/plant) for a pure chicory and a chicory/ryegrass mix pasture in the post ryegrass period from October 12th to December 28th



Photo 1: A pure chicory pasture, planted in autumn and rotationally grazed for 12 months.

OPTION 3– CHICORY PLANTED ALONE AND OVER SOWN LATER WITH RYEGRASS

Planting time: Early March for Chicory and then plant ryegrass mid to late April on the far north coast

Sowing rate:

- First year planting 6kg/ha Chicory. Over sow short season Tetraploid ryegrass at 20kg/ha.
- Second year planting 3kg/ha Chicory over sow short season Tetraploid ryegrass at 20kg/ha.

Key points:

- The timing of the over sowing date for the ryegrass is important. A well-established chicory stand will be competitive against seedling ryegrass whilst temperatures remain high.
- The ryegrass seed can be broadcast before the first grazing of chicory about six weeks after sowing, providing the cattle with the opportunity to tread the ryegrass seed into the soil. This is a suitable method for dairy farms where good stock control and high stocking rates for short periods can be managed. An alternative is to graze the pure chicory pasture hard and then disk drill the ryegrass immediately after grazing. The disc drill does not cause any major damage to the chicory plants, and the negligible soil disturbance minimises weed seed emergence.
- Avoid excessively high ryegrass seeding rates when over sowing the chicory. As discussed in Option 2, graze the pasture frequently in the August/ September period to minimise the chicory's time shaded by ryegrass.
- The use of a short season tetraploid ryegrass variety is important. The use of long season ryegrass varieties is likely to provide a longer period of competition for chicory in spring, further reducing chicory yield potential post ryegrass.

The need to increase chicory plant density in the second year:

At 6kg/ha, the planting rates for chicory will result in greater than 25 plants per square meter established. In our subtropical environment, this appears to decline to 10 plants per square meter at the beginning of the second year.

New Zealand recommendations are to re-sow chicory if the density falls below 25 plants/square meter. However, local trials suggest that a chicory plant density greater than 15 plants is adequate, presumably due to higher growth rates than New Zealand.

To maintain a chicory plant population at above 15 plants per square meter, over sowing with 3kg chicory/ha using a disc seeder in late March appears to be the best option. The disc seeder's advantage is good seed to soil contact with minimal soil disturbance and therefore less opportunity for weed seed to germinate. Damage to existing chicory plants from the disc seeder is minimal. Tyne drills will cause more disturbance, and this may cause some loss of the established chicory plants and a higher level of weed invasion.

Broadcasting chicory seed has not been a successful approach to increase plant density in the second year, presumably due to poor seed to soil contact.

Land preparation:

Chicory germinates best with good seed to soil contact; therefore, a weed-free prepared seed bed provides the most desirable establishment conditions. Direct drilling of chicory is also successful, provided weeds are controlled before planting through herbicides.

The ideal preparation is to spray out the existing pasture in autumn, sow ryegrass or oats alone for year 1, then spray out again in October/November and sow a summer crop such as millet or sorghum before spraying out again before direct drilling the chicory seed in early autumn. This allows three opportunities to deplete the weed seed bank, and the use of a direct drill will reduce soil disturbance and associated weed seed germination.

Variety to sow:

Chicory is summer-active, meaning good growth can be obtained during summer and autumn to improve pasture quality of tropical grass pastures regardless of variety. But if the intention is to over sow the chicory with ryegrass or another winter forage, plant a winter-active chicory variety because they can compete with the winter forage.

Planting depth:

Chicory is best drilled into about 1-1 ½ cm of soil, with press wheels or a heavy rolling to ensure good seed to soil contact, unless it is wet clay soil.

Drilling small amounts of chicory seed can result in uneven plant density with some seed drills. To address this, mix the chicory seed with prilled lime (14 kg prilled lime plus 6 kg Chicory seed) to improve sowing evenness. Set the seeder to deliver 20kg/ha of the prilled lime/chicory mixture.

Weed control:

Herbicide control is somewhat limited, but there are options for some broad leaf weeds with a herbicide containing Flumetsulam as the only active constituent (e.g. Broadstrike), and grass weeds with herbicides containing Clethodim as the only active constituent (e.g. Platinum). These products have an extended plant back period for ryegrass, so they cannot be applied after the middle of January in most cases, so check the label and seek advice. The only other way to control broadleaf weeds in chicory is to slash (topping) after grazing.

Grazing management

The initial grazing should be at the 6-leaf stage.

Research locally has found that, after the initial grazing, there is no 'optimal' regrowth stage to graze chicory, as the herbage quality remains high regardless of leaf number or days post grazing, for up to 30 days. The average Metabolisable Energy (ME) was 12.3 MJ/kg DM, Crude Protein (CP) 26 %, Neutral Detergent Fiber (NDF) 36 % and Acid Detergent Fiber (ADF) 23 %. The fact that grazing can be delayed by up to 30 days (slightly longer in winter/spring than in summer) improves flexibility in grazing intervals. However, cattle tend to graze the youngest inner leaves of the chicory plant preferentially and trample/waste the outer leaves (see photo 3), which increases as the grazing interval lengthens. This wastage at grazing can be minimised by hard strip grazing. The only real increase in 'quality' for chicory as it matures is in the Water-Soluble Carbohydrate content, which is desirable if chicory is to be conserved for silage.



Photo 3: Wastage of eldest outer leaves as result of cattle showing preference for youngest inner leaves as chicory matures

The Need to adapt cows to grazing pure chicory pastures

Chicory has a low fibre content; if it is to form a significant part of the cow's diet, some hay, silage or summer grass pasture should always be fed (at least 1kg of hay or 3 kg silage per cow per day), particularly in the adaption phase of 6-7 days, to ensure the cow's rumen adjusts to a low fibre feed.

Another option to help cows adapt to chicory (or maintain adaption) is to first graze them for at least a week on a paddock that has a mixture of chicory and ryegrass or chicory and summer grass. Either one of these chicory pasture mixes will provide the fibre from the grass component. Cows grazing a chicory and grass pasture mix are not likely to require an adaption phase due to the companion grasses' fibre content. An exception would be introducing cattle to chicory and ryegrass from poor quality mature tropical grass, in which case either restrict access or provide hay or silage for 6 to 7 days.

Chicory quality

The forage quality of chicory is similar to ryegrass through winter up to early spring with very high levels of Metabolisable energy (ME) and Crude Protein (CP). However, the Neutral Detergent Fiber (NDF) content of chicory is consistently about 6% units lower than ryegrass but still reasonably high compared to Brassica at 18% and Cereal grain at about 15%, the Acid Detergent Fiber (ADF) is more than adequate. However, chicory's mineral content is generally higher than ryegrass (see Table 2).

In late spring, the fibre content of both chicory and ryegrass rises as ryegrass goes into its reproductive phase, and there is a commensurate small fall in ME. Chicory, however, continues to grow actively through summer and is much higher in quality than kikuyu, setaria or rhodes grass in terms ME and CP and lower in NDF, while most mineral levels in chicory exceed those in tropical grasses in particular, available calcium which is over 10 times higher in chicory than kikuyu or setaria (see Table 2).

SEASON	Winter/ spring	Winter/ spring	Summer
Nutrient/mineral	Chicory	Ryegrass	Chicory
Neutral detergent fibre (%)	38	46	41
Water soluble carbohydrate (%)	7	9	7.1
Crude protein (%)	28	28	23
Dry organic matter digestibility (%)	75	77	71
Metabolisable energy(MJ/kg DM)	12.4	13	11.1
Boron (mg/kg)	29	6.6	28
Calcium (%)	1.4	1.0	1.4
Cobalt (mg/kg)	0.23	0.1	1.3
Copper (mg/kg)	15	12	15
Potassium (%)	3.0	3.6	3.6
Magnesium (%)	0.43	0.79	0.43
Manganese (mg/kg)	115	78	109
Molybdenum (mg/kg)	0.2	0.6	0.2
Sodium (%)	1.2	0.8	0.7
Phosphorus (%)	0.37	0.37	0.37
Sulfur (%)	0.5	0.4	0.4
Selenium (mg/kg)	0.1	0.1	0.2
Zinc (mg/kg)	54	40	43
Chloride (%)	2.2	1.1	

Table 2: Average nutritional values for chicory and ryegrass in winter and spring and chicory in summer on the far north coast of NSW from samples collected from the same pasture, having the same soil, climatic and management conditions

Other observed advantages of chicory

- Good drought tolerance, mainly due to its deep taproot which develops by early spring in autumn-planted chicory. This can mean some good quality green feed in our typically dry spring.
- Provides an option as a break crop to remove problem grass weeds through grass-selective herbicides.
- Does not appear to be as susceptible to common armyworm attack as ryegrass, oats or summer grasses.
- Suitable for making silage

Potential observed disadvantages of chicory

- Does not tolerate prolonged water logging, especially the young seedlings. This is a considerable issue on flood plain areas, where a total loss of chicory can result due to prolonged water logging.
- Control of broadleaf weeds is somewhat limited at present.
- The cost of seed is high, currently from \$15 to \$25/kg which many farmers find expensive for a pasture species which only persists 2 -3 years.
- To maintain a viable stand of chicory, over sowing chicory to increase plant density to above 15 plants per square meter is likely to be required in year 2 and almost certainly in year 3.
- Not suitable for hay making.

For more information about
Establishing and Managing Chicory
and Ryegrass pasture mixes on the
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