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Milk production from kikuyu grass based pastures

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Introduction

Kikuyu (*Pennisetum clandestinum)* is a tropical grass introduced into Australia in the 1920's from stolons brought from the Belgian Congo. In 1969, "Whittet" a seeded kikuyu cultivar from Kenya was released. Kikuyu has since naturalised along most of the east coast of Australia and is now the dominant summer pasture on coastal dairy farms.

Kikuyu is capable of high summer growth but milk production can be limited by its relatively low quality.

Figure 1: Cow grazing kikuyu pastures

Thus, to maximise production per cow and per hectare, it is essential to maximise the quality of the pasture consumed by the cows.

To provide winter-spring forage kikuyu is commonly oversown each autumn with annual Ryegrass (*Lolium multiflorum*) or less commonly, Oats (*Avena sativa*), Brassica (*Brassica spp*) or White Clover (*Trifolium repens*). A smooth transition from the summer kikuyu phase to the winter forage at both the establishment and heading of the annual forage is essential.

Kikuyu for milk production

Cows can produce up to 14 L milk/day grazing kikuyu compared to 20-22 L milk/day from ryegrass, provided the kikuyu is well-managed and dairy cows grazing the kikuyu are supplemented with minerals to address deficiencies inherent in kikuyu.

This production is based on an intake of 13 kg DM/cow of kikuyu after which intake is limited by fibre as Neutral Detergent Fibre (NDF) cannot exceed 1.5% of body weight. Cereal-based concentrates are commonly fed to achieve higher milk production and the response to the first 3-4 kg/cow/day is excellent as shown in Table 1. The response to higher levels of cereal concentrates declines and can cause acidosis.

Table 1: Milk production and composition from cows in mid lactation grazing well managed kikuyu grass pastures (Reeves 1998)

Barley kg/day	Milk (L/day)	Milk Fat (%)	Milk Protein %
0	14.2	3.8	3.1
3	18.2	3.5	3.2

Diet is balanced for calcium, sodium and phosphorus with mineral supplements. All milk coming from feed, not body reserves, and is equivalent to yields coming from an all year round calving herd

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Kikuyu for dry cows

Kikuyu grass can be a suitable feed for dry cows if appropriately grazed. Kikuyu contains less available calcium than ryegrass, thus kikuyu is preferable for dry cows up to late pregnancy.

Young kikuyu leaves contain very high levels of potassium which blocks the uptake of magnesium by the cows. This can cause milk fever and other metabolic problems. Kikuyu should be rotationally grazed so cows are forced to graze the leaf and stem at the right leaf stage. If dry cows are set stocked on large areas of kikuyu, they can selectively graze the newer shoots, increasing the potassium content of their diet to dangerous levels.

Grazing management

In contrast to ryegrass, the aim of managing kikuyu is to maximise quality.

Metabolisable energy is the first limiting factor for dairy cows on a pasture-based system. Table 2 illustrates the difference in metabolisable energy of leaf, stem and dead kikuyu.

Table 2: Metabolisable energy (MJ/kg DM) and crude protein (%) content of kikuyu leaf, stem and dead material

Kikuyu component	Metabolisable energy	Crude protein
	(MJ/kg DM)	(%)
Leaf	9.2	21
Stem	7.4	17
Dead	6	9

This shows that to maximise metabolisable energy and protein, grazing management needs to maximise leaf available to the cow and reduce the development of stems. This is achieved by maintaining an optimum “grazing interval” that is based on the plant maturity; as indicated by the number of leaves on each tiller.

Grazing Interval

After grazing, each kikuyu tiller grows up to 4 new leaves before the oldest leaf begins to die. After 4 new leaves have grown the stem growth increases substantially. As a result the proportion of green leaf available to the animal decreases. This is associated with a dramatic decline in the digestibility and protein of kikuyu (Figure 2).

Therefore grazing at the 4.5 leaf stage provides the highest proportion of leaf and the highest quality grass for cow consumption. Grazing past this stage increases the stem growth and that stem fraction accumulates with each grazing.

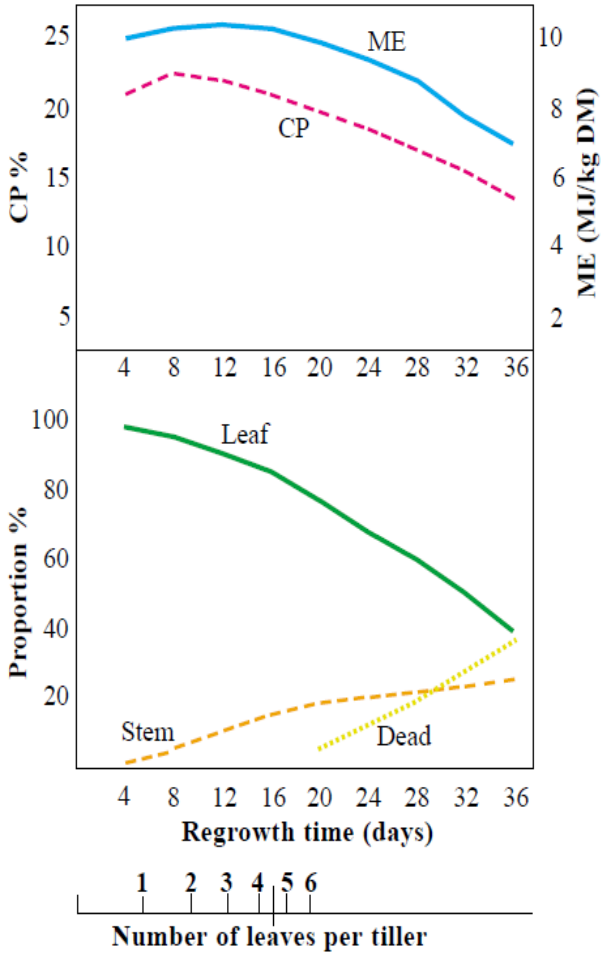


Figure 2: Changes in crude protein percentage (CP%) and metabolisable energy (MJ ME/kg DM) with age of regrowth (upper). The proportion kikuyu of leaf, stem and dead components of total DM above 5cm stubble (lower).

Figure 3: Leafy kikuyu at the 4.5 leaf stage –ready to graze

Table 3 shows the cumulative effect of cutting kikuyu at an interval equivalent to 2, 4 or 6 leaves/tiller in summer. This is the same as grazing at 6, 12 and 18 days. Cutting at a 2 leaves/tiller interval produces the most leaf in summer, but over the whole year the yield is less.

If cut at 6 leaves/tiller, the summer leaf yield is lowest but stem growth is substantially higher than when cut earlier at either 2 or 4 leaves/tiller.

Table 3: The yield of kikuyu leaf and stem in summer and yield of leaf, % leaf and average metabolisable energy (ME) annually when kikuyu is cut at 2, 4 or 6 leaves/tiller (Fulkerson et al. 1999)*

Defoliation Interval (leaves/ tiller)	Summer		All Year		
	Leaf	Stem	Leaf	Leaf	ME
	(kg DM/ha)		(kg DM/ha)	%	(MJ/kg DM)
2 (6 days)	4240	340	8,707	91	9.1
4 (12 days)	3530	470	10,399	87	8.8
6 (18 days)	2500	1440	9,336	79	8.6

To maintain the quality of pasture consumed by cows, it is important not force them to graze into the stems or more than about sixty percent of the pasture. This will leave a residual of 5 - 8 cm. Even though kikuyu is grazed at the 4.5 leaf stage, stem material will build up after a few grazings. The stems will need to be removed mechanically by mulching to a height of 5 cm. Alternatively, animals with lower herbage quality requirements that can graze harder into the stems e.g. dry cows can be used.

If the kikuyu stems are not removed they increase in height over the growing season and fewer leaves develop. Also where the stems are left to grow too tall, regrowth after mulching will be slow as many of the growing points will have been removed.

Figure 4: Kikuyu stems left by cows after grazing kikuyu too late. These should be removed by mulching or hard grazing using dry cows.

Kikuyu can be grazed **before** the 4th leaf stage without too much detriment to plant growth, but there are several concerns:

- If pasture growth rates are high, shorter grazing intervals may be possible. However, the lower pasture on offer means cows need to cover more area and expend more energy for a given intake.
- The content of magnesium and calcium is low in kikuyu leaf and is lowest in new regrowth as shown in Figure 5, but rises with maturity. Therefore, grazing younger kikuyu will increase the deficiencies of calcium and magnesium. Thus, apart from phosphorus, the mineral status of kikuyu improves substantially up to the 4 ½ leaf stage.

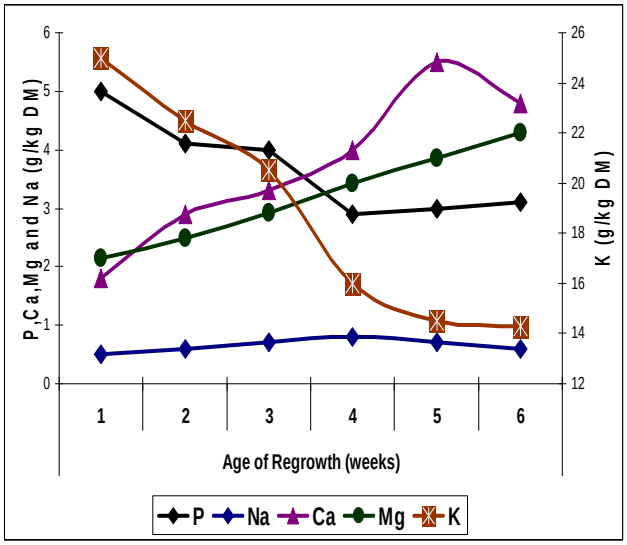


Figure 5: Content (g/kg DM) of Potassium (K), Phosphorous (P), Calcium (Ca) and Sodium (Na) in the leaves of kikuyu (adapted from Reeves et al. 1998). In this example the 4 leaves/tiller stage is at about 4½ weeks

- Potassium is too high for grazing ruminants before the 4th leaf stage.
- Nitrate content is also high in early regrowth. Nitrate is converted to nitrite in the rumen, which is toxic to some micro-organisms, thus reducing digestibility of roughage, including kikuyu. At very high levels, (>1500 ppm) nitrate can cause nitrate toxicity and be fatal.

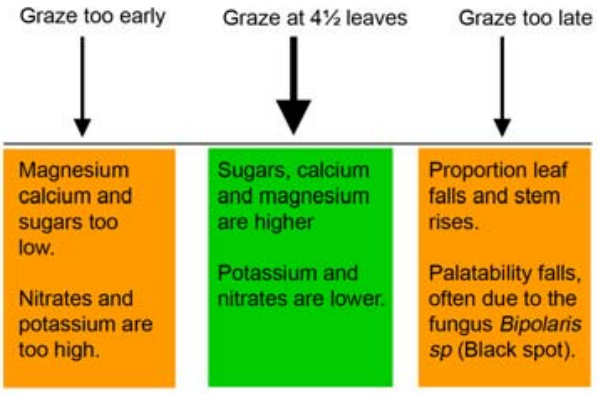


Figure 6: The reasons why we need to graze at 4 to 4.5 leaves/tiller.

Note: Periods of severe moisture stress will increase the leaf appearance interval.

Identifying leaf stage of regrowth

The number of leaves per tiller is like the hands on a biological clock in the paddock. It indicates when the pasture is ready to graze. In order to use leaf stage effectively, the following points need to be considered:

1. The '**remnant**' leaf is the new shoot first appearing after grazing, it was only partly extended before grazing and continues to extend after grazing. It can be identified by the tipped end that was removed when grazed (Figure 7).

   If the remnant leaf grows to half normal length or more, it is counted as the first leaf. The subsequent leaves will emerge from the sheath before each previous one has fully extended. Therefore at the 4th leaf stage, the fifth leaf will just be emerging out of the sheath (Figure 9).

2. There are more lateral (tillers that come off a horizontal stolon) than apical tillers (tillers that are at the end of a stolon). The apical tillers usually have a higher rate of leaf appearance so that there will be more leaves at a given time. Thus, look at 8 -10 tillers at random to get an accurate measurement of leaf stage.
3. The rate of emergence of leaves depends primarily on temperature. From December to March, the 'leaf appearance interval' for kikuyu might be as low as 3 days giving a 12 day (4 leaves x 3 days/leaf) grazing interval. Thus a 12-14 day grazing interval at this time of the year is recommended. In April and November the grazing interval extends to around 20 days.

Figure 7: A kikuyu tiller immediately after grazing showing the 'remnant' leaf extending

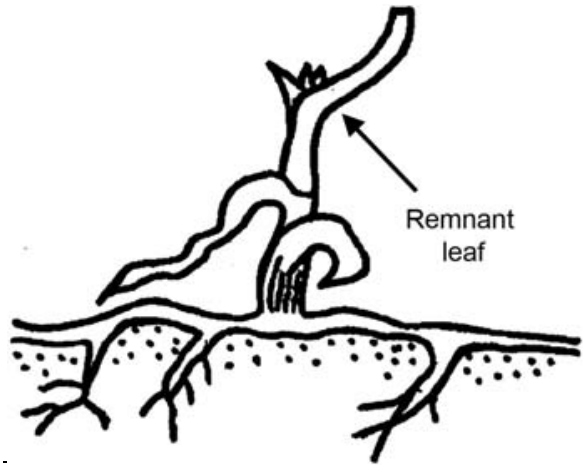


Figure 8: A stolon of kikuyu grass with three lateral tillers and one apical tiller.

Supplements for kikuyu grass

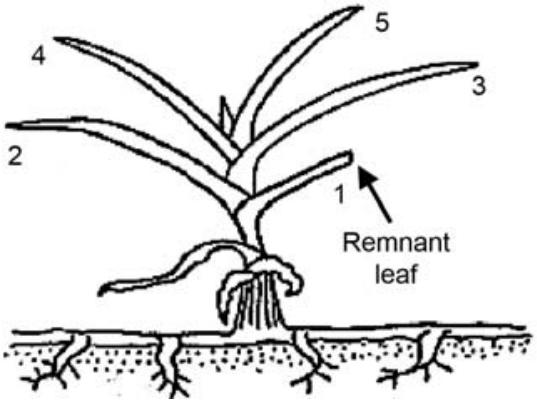
Since kikuyu is low in sodium, calcium and phosphorous cows grazing kikuyu pastures are usually supplemented with dicalcium phosphate and salt or sodium bicarbonate. This is added to the ration to buffer the change in pH in the rumen brought about by feeding grain-based supplements

When kikuyu is optimally managed, metabolisable energy values of up to 9.5 to 10.0 MJ/kg DM can be achieved particularly on the south coast of NSW where the climate is cooler compared to the warmer areas to the north.

The intake of kikuyu is limited by the relatively high fibre content (>50% Neutral detergent fibre, see Table 4). The response to high energy, low fibre supplements, such as cereal grain, can be 1.5 – 1.6 L milk/kg grain fed under good management.

Protein is normally adequate when kikuyu is fertilised with nitrogen. However, once 'protein' content gets above about 23% (≈ 3.4% nitrogen) nitrates start to accumulate and this could cause rejection by stock and a reduction in rumen efficiency (Figure 10).

Figure 9: A kikuyu tiller with 4.5 leaves, the 5th is extended, the sixth leaf just emerging and the remnant oldest leaf (Leaf 1) senescing is counted as half a leaf.



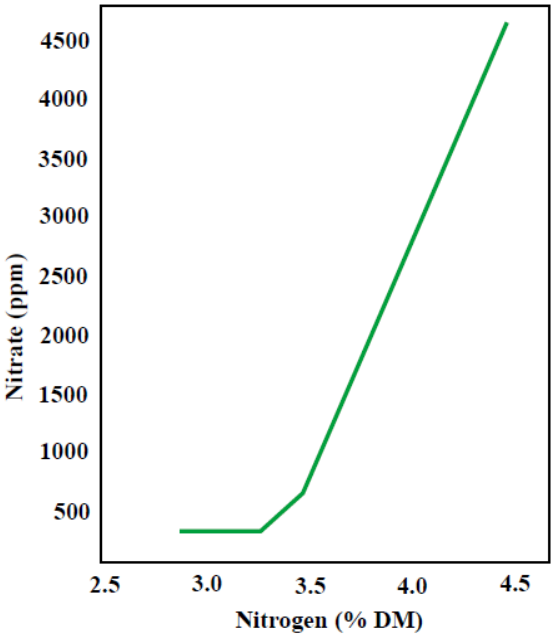


Figure 10: The relationship between percentage of nitrogen (% DM) and nitrate content (ppm) of Kikuyu pasture above the 5cm stubble height with fitted regression line.

Variation in Sugar content through the day

Sugar or water soluble carbohydrate content in the leaves accumulates during the day as the supply of sugar from photosynthesis exceeds the plants needs. The sugar levels then decline during the night when there is no photosynthesis, and the sugars are used by the plant for respiration.

There can be a milk response by feeding the kikuyu, once a day, during the afternoon. This utilises the peak in sugars and may be useful when there is:

- insufficient kikuyu to feed twice a day, or
- other components of the daily ration can be fed in the morning.

Pasture Intake and Stocking rate

Milking cows tend to eat around 1,200 kg DM/ha from a kikuyu pasture, irrespective of the amount on offer. This represents the new growth of the last 4 to 5 young green leaves. The remaining material is made up of the stem and senescent material.

Where conditions allow kikuyu to produce 1,200 kg DM/ha every 14 days, or around 80 kg DM/ha/day, it is possible to carry 7 to 8 cows per hectare. This assumes each cow consumes 10 kg DM/day. Although this is possible under irrigation, under dryland conditions it is achieved for only a few months, so lower stocking rates of 2-4 cows/ha are more common.

Table 4: The nutrient content (%) of kikuyu in comparison to perennial ryegrass (vegetative state) and the requirements for a 600kg Holstein-Friesian cow giving 20 litres of milk/day

Nutrient	Perennial Ryegrass May -Oct	Kikuyu Nov-May	Cow Needs
ME (MJ/kg DM)	11.4	9.9	10.3
Nitrogen	3.9	4.1	2.4
Non-protein N	0.9	1.1	
Nitrate N	1.1	0.52	0.14_a
Crude Protein	24.3	25.3	16
ADF *	23	26	18
NDF *	49	50	<45
WSC *	7.8	3.6	7^a
Calcium	0.53	0.42	0.51
Phosphorus	0.22	0.28	0.33
Potassium	2.2	2.9	0.9
Magnesium	0.28	0.29	0.2
Sodium	0.1	0.14	0.18
Sulphur	0.43	1.31	0.2
ERDP:FME *	17	20	10
BP *	42	40	

All figures are in % DM unless otherwise stated. * ADF=Acid Detergent Fibre, NDF= Neutral Detergent Fibre, WSC= Water Soluble Carbohydrate, BP=Bypass Protein as % of total protein, ERDP:FME = Ratio of effective rumen degradable protein (ERDP) to fermentable Metabolisable energy (FME) (g/MJ).

[a] Maximum content

In good seasons the more conservative stocking rates cannot consume the excessive growth. This can lead to low forage quality if the grazing interval is extended. To preserve quality, consume or delay extra kikuyu growth by:

1. Heavy mulching after grazing to less than 5 cm for the first 7 to 10 days after heavy rain.
2. Setting aside areas for silage.
3. Adding dry cows or replacement stock to the milking area.
4. Reduce nitrogen rates or skip applications.

These strategies also assist to prepare seedbed conditions for sowing ryegrass in autumn by reducing the height of stubble residues.

Water use efficiency of kikuyu

The water use efficiency of kikuyu is near that of maize. It is twice as high as annual and perennial ryegrass in summer, even when the latter is adequately watered (Table 5). This is due to a decline in both the growth rate and forage quality of the ryegrasses as daytime temperatures increase above 30 °C. The metabolisable energy of ryegrass declines from 11.0 MJ ME/kg DM in July to 10 MJ ME/kg DM in February and NDF increases from 27% to 47% in the same period. Thus the quality of ryegrass over late spring early summer is only marginally better than kikuyu, and growth rates are 30 to 40% of kikuyu.

Table 5: Water Use Efficiency (MJME/mm Water) for Kikuyu in Summer in Comparison to Perennial Ryegrass in summer and winter

	Perennial Ryegrass	Kikuyu
Winter	360	
Summer	160	410

* Includes irrigation, rain and soil moisture

Fertiliser management

Kikuyu is able to achieve high summer growth rates of 80 to 150 kg DM/ha or 6 to 11 t DM/ha of kikuyu consumed. When over-sown with ryegrass in the winter, a further 6 t DM /ha can be consumed giving a total pasture utilised of 12 to 18 t DM/ha. To support this level of growth, high soil fertility and nutrient inputs are required.

Phosphorous

Soil phosphorous (P) should be maintained at greater than 20 ppm Bray. For the Colwell test, the soil Phosphorus Buffering Index (PBI) is used to refine the optimum levels. Levels as high as 100 ppm Colwell will optimise pasture growth in soils with a high PBI (>400). Lower levels of 50 to 80 ppm Colwell can be adequate for soils with low PBI (<400).

Applications in the order of 30 to 40 kg P/ha/year are required to replace nutrients removed. This is often applied as 20 kg P/ha as nitrogen blend when sowing annual ryegrass, followed by topdressing 10 to 20 kg P/ha as single superphosphate or a potassium blend in early spring.

Nitrogen

To achieve maximum yield under irrigation, a total nitrogen (N) requirement of 150 to 200 kg N/ha should be applied during the kikuyu growth phase (November to March). Lower rates are required in dryland conditions.

For kikuyu a rule of thumb is to schedule nitrogen applications under irrigation as follows:

- If grazing interval is less than 14 days, apply 50 kg N/ha as urea every third grazing or 35 kg N/ha every second grazing
- If grazing interval is greater than 14 days, apply 50 kg N/ha as urea every second grazing.

Nitrogen fertiliser will last for about 6 weeks after application but growth declines significantly after 4 weeks. Cease applying nitrogen to kikuyu pasture 4-5 weeks or one to two grazings prior to sowing ryegrass.

In the ryegrass phase a further 150 to 200 kg N/ha is required. This is applied as urea at 30 to 50 kg N/ha after each grazing.

Potassium

Soil potassium levels should be maintained above 0.6 meq/100g. In many cases, nutrient imports from grain and silage will maintain soil potassium status. Where soil test levels are below ideal, fertilise with a split application of 30 kg K/ha in autumn and again in early spring.

Oversowing kikuyu in autumn for winter feed

Annual, Italian or Short Rotation Ryegrass

The establishment of annual ryegrass into a kikuyu pasture requires an understanding of the growth characteristics of both kikuyu and ryegrass.

Time of sowing

The optimal time to start sowing ryegrass into kikuyu is when the minimum air temperature has fallen below 15°C. At this time the soil is still warm enough to get good establishment and growth of ryegrass but close enough to the onset of colder weather to restrict competition from kikuyu. This will be in late March for northern NSW, mid March in the central coast below Taree, and early March on the south coast of NSW, below Nowra.

Sowing time may need to be delayed further in frost free situations, within a few kilometres of the coast, where kikuyu continues to grow further into the winter.

Sowing prior to these optimum times can be desirable to produce early winter grazing, but it requires more aggressive management strategies to suppress the growth of kikuyu.

Management before sowing ryegrass

There are various options that can be implemented before sowing ryegrass that will reduce kikuyu competition for light, water and nutrients after the ryegrass is sown. These will also reduce the stem height of kikuyu, allowing a better flow of kikuyu

residue around the sowing tynes when using direct seeding machinery.

These options are:

1. The most common method is to graze, sow and then “hard” mulching. Hard mulching means a residue height of **less than 2 cm** with some soil exposed. Problems can arise if there is too much residue left after grazing which may restrict light and so smother the emerging ryegrass seedlings.
2. Hard mulching after the second last grazing before sowing and then again at sowing is also common. With this method it is mainly the leaf that is removed at the last mulching, having a minor effect on setting back kikuyu growth.
3. A better method is to graze and mulch at the third last grazing, that is 2 grazings before the ryegrass is sown. This allows time (usually 28 days) for the mulched mat to break down and more stem to grow. More stem and so growing points are removed at the mulching prior to sowing. This will suppress the kikuyu growth for a longer time.
4. Application of desiccants, such as gramoxone at 1.6 to 2.4 L/ha of (250 g /l) usually sets back kikuyu growth for 2-3 weeks. Glyphosate at 300 to 500 ml/ha (of 450 g/l) can also be used to set back kikuyu growth. (However, if glyphosate is used repeatedly, the kikuyu may not recover over summer allowing less productive grasses such as couch grass to take over. Therefore avoid unnecessary use of high rates and repeated use of glyphosate on the same fields).
5. Make kikuyu silage. Hard mulch, then lock up the kikuyu for 4-5 weeks before taking silage cut. This sets back kikuyu growth for 2-3 weeks because the stem grows well during lockup and the silage harvest then removes the growing points on the stem. Sow ryegrass as soon as possible after the silage is removed.
6. Stop applying nitrogen fertiliser at least two grazings or 5- 6 weeks before sowing ryegrass, as it only promotes kikuyu growth after sowing ryegrass.

Schedule of events presowing for establishing annual ryegrass in kikuyu the North Coast of NSW:

8 Feb	22 Feb	6 Mar	20 Mar
Last N	Graze Mulch Hard	Graze	Graze Mulch & Sow

Management at sowing

Ryegrass should be sown at a rate of 20 to 40 kg/ha. Tetraploid ryegrasses can establish better in the early sowings as the seedlings are more vigorous and so competes better with kikuyu.

Drilling or sod seeding is the preferred method of establishment for early sowings. The seed is sown at 1-2 cm into the soil and there is less opportunity for the seedling to dry out in warm conditions. Also the discs or tynes cut the stolons retarding kikuyu growth more than broadcasting. Broadcasting is more reliable with later sowings and in wet conditions. The alternatives are:

1. Drilling after grazing then mulching.
2. Broadcast the seed before grazing, allowing the cow’s hooves to tread the seed into the ground, then mulch. This method is often the best when it is wet as it minimizes aerial rooting (roots growing in the mulched mat) of ryegrass and death in a dry spell.
3. A light disc harrowing before sowing and rolling after sowing may improve seed to soil contact.

Figure 11: Drill sowing ryegrass into mulched kikuyu

Management after sowing

The emerging seedling has limited energy reserves that can be rapidly depleted during the process of emergence. It is essential that light reaches the young seedlings within 6 -7 days of sowing to allow photosynthesis in the first leaf to start to replenish sugar reserves. Where this is delayed, it can lead to seedling death. For example when:

- the seed is sown too deep, and, or
- the first leaf is shaded by a thick matt of kikuyu leaves and residue.

Minimize competition from kikuyu by mulching before sowing and graze the kikuyu leaves for 2-3 hours every 7-10 days after sowing if the seedlings are being shaded. Shading will kill most of the seedlings, trampling may kill 10-20% of seedlings.

In warm dry conditions the established kikuyu can compete strongly for soil moisture in the upper few 5 cm of soil. Irrigation may be needed to ensure ryegrass seedling survival.

Spring Management

Strong growth of ryegrass in November to December from later maturing varieties will shade the kikuyu, slowing early summer growth. This can cause the kikuyu to thin out, reducing production over the entire summer and allowing weed invasion.

Avoid shading from tall growth of ryegrass by

- shortening rotations in late spring,
- limit nitrogen inputs.
- take silage harvests in early, rather than late spring.

It is also wise to avoid using the same field for making silage every year.

Figure 12: Drill sown ryegrass emergence with white clover in mulched kikuyu

Over sowing kikuyu with white clover

The kikuyu/white clover system has been shown to be extremely productive with up to 12 t DM/ha of white clover and 8 t DM/ha of kikuyu grown under a commercial dairy farm situation.

However, the dense pure swards of white clover require strict management of bloat. White clover also allows root knot nematodes, *Meloidogyne trifoliophila,* and *Heterodera trifolii*, to multiply rapidly resulting in a severe decline in clover population and vigour in the third year.

A survey in northern NSW and south east Queensland, found that root knot nematodes were present on white clover roots at all 12 sites, and at 9 sites the effect on seedling growth was severe (seedling growth at less than 25% normal). As there are no root knot nematode-resistant varieties of white clover, over-sowing kikuyu with white clover may be seen as a short term (1 to 2 years) rotation crop that must be followed by pure kikuyu-ryegrass for at least 2 or 3 years.

Irrigation

Over sowing kikuyu with white clover should not be attempted unless irrigation is available as white clover is very sensitive to moisture stress. White clover's seasonal growth pattern is predominantly in spring and this is the driest period of the year on the north coast of NSW. The shallow root system of white clover limits use of moisture stored deep in the soil profile. Therefore frequent irrigation will be required to attain the best growth from white clover.

Establishment

Time of sowing and preparation before and at sowing is similar to over-sowing short rotation ryegrass. White clover only needs to be sown in the first year and then relies on naturally set seed in the second year.

The preferred variety to sow is the short season variety Haifa sown at 4 kg/ha. Haifa seeds prolifically in November and its growth slows just as kikuyu begins to grow. Thus, Haifa white clover complements the growth of kikuyu well.

Regeneration in the autumn is dependent on abundant seed production. Timely spring irrigation and lenient grazing during seedset can assist overall production.

Fertiliser

White clover growth will be optimal where the soil pH $_{(CaCl2)}$ >5.5. Where the soil pH $_{(CaCl2)}$ is less than 5.0, lime will need to be applied several months before sowing. If lime cannot be applied at this time it is also important to apply molybdenum superphosphate for effective nodulation. Alternatively sodium molybdate can be sprayed onto pastures. Molybdenum needs to be applied only once in every 3-5 years.

White clover is more sensitive to low potassium and sulphur than ryegrass. Soil tests will assist to determine plant requirements. Good white clover growth will greatly reduce or eliminate the need for nitrogen application to kikuyu in summer.

Grazing management

As kikuyu growth increases from December, the white clover 'disappears' to remain dormant during the summer. White clover is then reinitiated in autumn, from dormant existing plants and seedlings from seed set in the previous spring. This coincides with a decline in kikuyu competition due to lower temperatures.

In early autumn (mid-March onwards), suppress kikuyu growth by ceasing to apply nitrogen fertiliser, and grazing to keep the kikuyu sward below 10 cm height.

In dry conditions the kikuyu sward can compete for soil moisture leaving the surface too dry for the germination and growth of white clover seedling.

Irrigation can be needed to ensure germination before mid April.

Over sowing with Brassicas (Forage Rape)

Brassica seedlings are less sensitive to heat and moisture stress than ryegrass enabling them to be over-sown earlier than ryegrass (early March). When sown at this time brassicas have higher growth rates than ryegrass until early May, providing a good option for early autumn feed.

The brassica cannot be grazed until at least 6 weeks after sowing. Therefore the kikuyu needs to be set back by a desiccant such as gramoxone or glyphosate before sowing. The brassica seed is very vigorous and under ideal conditions will emerge after 4 days. Brassica seedlings will compete well with kikuyu once it is established.

Management before and at sowing is similar to over-sowing white clover. Brassica should be sown at a seed rate of about 4kg/ha of insecticide-treated seed. Brassicas can be sown with ryegrass into a kikuyu pasture. However, if sown early, it will not allow the pasture to be grazed for 6 weeks, and the kikuyu may swamp the ryegrass.

Figure 13: Kikuyu silage is a useful preparation of for ryegrass sowing. It removes the kikuyu growing points setting back the kikuyu growth and allowing the ryegrass time to establish.

Making kikuyu silage

Making kikuyu silage in early autumn is a useful management tool to remove excess growth and reduce subsequent competition by kikuyu on the newly sown ryegrass seedlings. A metabolisable energy value above 9.5 to 10.0 MJ /kg DM ME and protein of 16% is achievable.

Maintaining feed quality during the silage making process can be achieved by taking the following steps.

1. Graze hard to ensure that all the new growth to be harvested is new leaf. In doing this aim to remove as much stubble as possible. This will avoid old stubble being picked up in the silage.
2. Slash or mulch the kikuyu hard and follow with 50 kg N/ha.
3. Harvest for silage when there is an average of 5 ½ leaves/tiller. In early autumn this should take about 20-22 days.
4. For pit or bunker storage allow the cut material to wilt to greater than 30 % DM. At this moisture content, no moisture is left on the hand when a sheaf of kikuyu silage is squeezed. A moisture content of 40 to 50% is ideal for baled silage.
5. If wilting takes more than 48 hours the kikuyu feed quality will drop dramatically.
6. Wilting, placement in the stack and the start of cold fermentation must occur as quickly as possible to retain sugars and maximise energy value.
7. Silage inoculant can assist the fermentation process. Molasses can be added to aid fermentation if a quick wilt is not possible
8. Cover the pit with plastic and seal well. Ensure good drainage around the pit.

Disorders of kikuyu

Kikuyu Poisoning

Kikuyu pastures have been implicated in deaths of dairy cows since the 1950's. In the past thirty years significant incidents have been recorded in NSW coastal areas in 1983, 1987, 2003, 2006, and 2010. The condition is relatively rare and tends to be sporadic, but it can result in fatalities for a large percentage (10 to 30%) of the herd within 24 to 48 hours.

Poisoning typically occurs in nitrogen fertilised pastures when there has been rapid regrowth of the pasture after an extended dry period. This often occurs in autumn, after a drought while conditions are still warm (>14 °C). Although this coincides with an increase in nitrate levels, symptoms are not consistent with nitrate poisoning. Poisoning has also been reported to be associated with recent army worm infestation, however this is not consistent in all cases.

The cause is unknown, although mycotoxins derived from a fungal association on the leaves have been suggested. The disease causes salivation, dehydration, depression, abdominal pain and death. Cows may exhibit sham drinking where they are standing at the drinking trough but not consuming water.

Controls

1. After the break of the drought ensure supplementary feeding of roughage continues

until the dry matter content of the pasture increases.

2. Ensure kikuyu is not the only forage source when introducing cows to suspect pastures.

Black Spot

Black spot (*Bipolaris* sp) is a fungal disease which infests kikuyu. Effects are more pronounced if the kikuyu is nitrogen deficient or moisture stressed. Typically the ends of the more mature leaves turn yellow and black spots can be seen on the leaf. Infection will reduce growth and leaves become unpalatable. There is no long term adverse effect of this disease on the kikuyu plant.

Controls

There are several options that can be used to reduce the impact of Black Spot.

1. Reduce grazing interval so that the leaves are younger when grazed.
2. If possible remove the stress factors such as the lack of nitrogen and moisture.
3. Allow cows to select the non infected grass and then mulch or slash the residue after grazing.

Figure 14: Black spot lesions on kikuyu

Kikuyu Yellows

Kikuyu Yellows (*Verrucalvus flavofaciens*) is a fungus that is unique to kikuyu, infecting the roots of the plant. Plants can be easily pulled from the soil due to stunted root systems. Visual symptoms are yellowing and stunting of the leaves and gradual death of the plant. As the plant dies out the Yellows fungus moves out from the initial contamination spot generally in a circular fashion. The bare area is then replaced by other grasses such as couch and paspalum and weeds such as thistles.

The disease is spread by water borne spores and as a consequence the areas of contamination tend to move down slopes but can be spread on the hooves of cattle. The fungus becomes inactive in early autumn when minimum daily temperatures fall below 15 °C.

It remains dormant in winter, reappearing in late October on the NSW north coast. As with Black spot, kikuyu plants are most susceptible to Kikuyu Yellows when N deficient or under moisture stress.

Figure 15: Actively spreading kikuyu yellows in January

Prevention

Providing adequate nitrogen and moisture will minimise the impact and spread of Kikuyu Yellows. For example, fertile kikuyu pastures grown under irrigation will show little effect on growth even though kikuyu yellows is present.

Control

Where there are only isolated patches of Kikuyu Yellows, spraying out the area with glyphosate to prevent it spreading. Include 0.5 to 1 m of the healthy kikuyu around the contamination patch to starve the fungi.

Where the infestation is widespread, spray out the kikuyu, then grow other species such as setaria, ryegrass, maize or brassicas before resowing in 2-3 years time.

Figure 16: *Dead areas formed by Kikuyu yellows, now dormant in May, broadleaf weeds filling the bare ground*.

Insect pests of kikuyu grass

In general, insect pests do not cause economic damage to kikuyu grass as production losses are low and infrequent. However kikuyu can harbour insect pests that affect subsequent crops and pastures.

Armyworm

The Common Armyworm (*Mythimna convecta*) and Lawn armyworm (*Spodoptera mauritia*) are common pests of kikuyu pasture on the north coast of NSW. The moths migrate throughout northern NSW during summer and autumn, laying eggs that hatch from January to March. The larvae feed on kikuyu leaves and stems reducing pasture growth. However this often coincides with good rain and a time of pasture surplus so losses are minor.

Figure 17: Lawn armyworm larvae and below, the adult moth (Photo L. Turton)

Figure 18: Adult armyworm moth (Photo L. Turton)

Emerging ryegrass seedlings in over-sown kikuyu can be severely damaged by an existing armyworm infestation in the kikuyu sward. This may require resowing, delaying first autumn grazing by as much as 4 to 5 weeks. There is a range of insecticides available that can be applied prior to sowing ryegrass, to reduce the armyworm population and so protect the emerging seedlings.

Figure 19: Common armyworm larvae (Photo L. Turton)

Figure 20: Common Armyworm adult moth (Photo L. Turton)

African Black Beetle

African Black beetles (*Heteronychus arator* Fabricius) have both adults and larvae that live under the soil feeding on roots and organic matter. The adults that survive the winter begin mating and egg laying in August and continue to December. Larvae populations peak at this time coinciding with maize planting. Damage to seedling maize sown into kikuyu swards can be severe if seed is not treated. The larval populations decline over summer depending on moisture conditions, but may still be a significant threat for early March sown ryegrass. Current controls are seed treatment of maize and ryegrass with imidacloprid.

Damage to kikuyu is infrequent but can occur when populations build up in ideal conditions. This is associated with drier and warmer spring – summer.

Figure 21: African black beetle larvae (Photo L Turton)

Figure 22: Adult African black beetle (Photo L Turton)

Field Crickets

The Black Field Crickets (*Teleogryllus commodus*) can over summer in kikuyu pasture allowing large numbers of immature crickets to feed on over-sown ryegrass.

Field crickets attack both broadcast and drill sown seed. Surface application of insecticides before ryegrass sowing can reduce the threat.

Establishment of kikuyu grass

Kikuyu can be planted by seed, stolons or pasture sods in the warmer months provided wet summer conditions prevail or irrigation is available. Using stolons and sods is more laborious but can be more reliable than sowing by seed. As the original cultivar of kikuyu, Common, only sets a small amount of seed it was propagated from stolons.

Sowing by Seed

The variety Whittet which seeds prolifically is the only commercially available seed. Sowing rates are 2 to 5kg/ha

Sowing Time:

Autumn:

Kikuyu can be sown in March, when the soil is warm enough to germinate the seed. It is usually sown before a cover crop of oats or ryegrass sown at half the normal rate.

About 4 weeks before the cover crop is to be sown kikuyu seed is drilled into a cultivated seedbed or a seedbed sprayed with a knockdown herbicide. This allows the kikuyu seedlings to establish without competition for light and moisture before broadcasting the cover crop that will supply winter feed.

From October onwards, when it is warm enough for kikuyu to grow, graze or slash the oats and ryegrass every 10 – 14 days, to prevent young kikuyu seedlings being shaded. Apply nitrogen fertiliser at 50 kg N/ha as urea every second grazing to promote kikuyu growth.

Spring

Kikuyu can also be established in mid October to November, when the soil temperature has risen above 15°C. Either direct drilling or sowing into a prepared seed bed is possible but success depends on timely rain or irrigation.

Spring sowing can fail due to high populations of annual summer grasses as there are no selective grass herbicides available. A pre irrigation followed by a knockdown herbicide and/or cultivation prior to sowing can help reduce the infestation of annual summer grasses.

Where summer grasses do germinate with the kikuyu, graze hard before the sward reaches 15 cm in height, then mulch post grazing to allow the young kikuyu seedlings enough light to be competitive. Ensure that adequate nitrogen fertiliser is applied.

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Further reading

Bourke C. A., (2007). "A review of kikuyu grass (Pennisetum clandestinum) poisoning in cattle." *Australian Veterinary Journal*, 85 (7): 261-267.

Reeves M., (1998). Milk production from Kikuyu (*Pennisetum clandestinum*) grass pastures. PhD Thesis, University of Sydney, Camden.

Fulkerson, W.J., Slack, K., *et al*. (1998). Nutrients in ryegrass (*Lolium* spp) white clover (*Trifolium repens*) and Kikuyu (*Pennisetum clandestinum)* pastures in relation to season and stage of growth in subtropical environment. *Australian Journal of Experimental Agriculture*. 38: 227-240.

Fulkerson, W.J., Slack, K., and Havilah E. (1999). The effect of defoliation interval and height on growth and herbage quality of kikuyu (*Pennisetum clandestinum*). *Tropical Grasslands* 33:138-145.

Fulkerson W. J., Neal, J. S., *et al*. (2007). "Nutritive value of forage species grown in the warm temperate climate of Australia for dairy cows: Grasses and legumes." *Livestock Science* 107(2-3): 253-264.

Neal J.S. (2009). Yield rather than water use, is the primary determinant of water use efficiency of irrigated forages. PhD Thesis, University of Sydney, Camden.

Matthiessen J. N. (1999). "Late immature mortality is the major influence on reproductive success of African black beetle, Heteronchyus arator (Fabricius) (Coleoptera: Scarabaeidae), in a Mediterranean-climate region of Australia." *Australian Journal of Entomology* 38: 348-353.

Zahid M.I., Gurr G.M., *et al* (2001). Survey of fungi and nematodes associated with root and stolon diseases in white clover in the subtropical dairy region of Australia. *Australian Journal of Experimental Agriculture*. 41: 1133-1142.

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