

Tetraploids: More feed and better quality

Improved dry matter (DM) production was the main focus for plant breeders developing tetraploid ryegrasses. Better forage quality was an added and unexpected bonus of the development process. Higher energy and lower fibre levels in tetraploid ryegrasses offer production benefits of the grazing animal and improved profitability for the farmer.

Increased feed value

Cell contents include water soluble carbohydrates (WSC) and proteins that are quickly broken down in the rumen, fuelling the rumen microbes with energy, peptides and amino acids. More cell contents mean a potentially more efficient rumen and better animal productivity.

Cell wall includes the less degradable parts of the cell, including hemicellulose, cellulose and lignin. Neutral detergent fibre (NDF) is the term used to measure the cell wall content of feeds. Less cell wall means a higher feed intake and a more efficient conversion of pasture to meat, milk or wool.

Tetraploids have more cell contents and less cell wall

Tetraploid cells contain twice the number of chromosomes of diploid ryegrasses. The plant cell is bigger to fit in the extra chromosomes. A bigger cell means more cell contents and less fibrous cell wall.

If the two boxes below were plant cells, the surface area (cell wall) of the small box (diploid cell) is 24cm^2 , and its volume (cell contents) is 8cm^3 . The cell wall to cell contents ratio is 3:1. The surface area of the big box (tetraploid cell) is 54cm^2 and its volume (cell contents) is 27cm^3 . The cell wall to cell contents ratio is 2:1. The proportion of cell contents to cell wall is higher for the larger box (tetraploid cell) which means more WSC and proteins relative to cell wall.

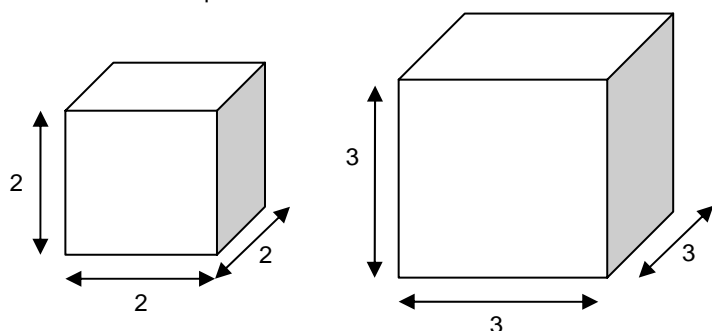


Figure 1. An example of the volumetric difference between a diploid (lhs) and tetraploid (rhs)

Better animal productivity from tetraploid ryegrass

Scientific studies and farmer anecdotes agree that tetraploid ryegrasses can produce more milk, liveweight gain and wool. Better performance may reflect:

1. More DM production / hectare, including improved winter productivity
2. Greater feed intake due to one or more of the following:
 - Better grazing preference - stock find tetraploids tastier than diploids
 - More upright tillers that allow the animal to eat more because each bite contains more nutrients
 - Better utilisation of tasty tetraploids means less 'thatch' in the sward, reducing risk of growth of unpalatable fungi such as *Fusarium* and *Pithomyces*
 - Tetraploid ryegrass allows 10% or more clover than diploid ryegrasses and clovers are generally tastier than many grasses due to the high water soluble carbohydrate concentration
 - Lower NDF and faster breakdown of NDF during chewing and rumination

Tetraploids and fibre (NDF) – the animal intake story

- Low NDF diets are better than high NDF diets
- Animals can eat more of a low NDF feed
- Tetraploid ryegrasses usually contain 1% to 2% less NDF than diploid ryegrasses.

With high NDF diets, the rumen fills up with fibrous feed that takes time to break down. The animal feels 'full' and won't eat more feed until the fibre clears from the rumen.

Animals eat between 1.2% to 1.5% of their bodyweight as NDF depending on the type of forage. 1.2% is more typical for poor quality forages, e.g. high NDF silages and pastures. 1.5% is typical for quickly degraded, low NDF pasture.

Below are several examples where animal production differences based on varied NDF intakes can be demonstrated through modelling with 'CPM Dairy' program.

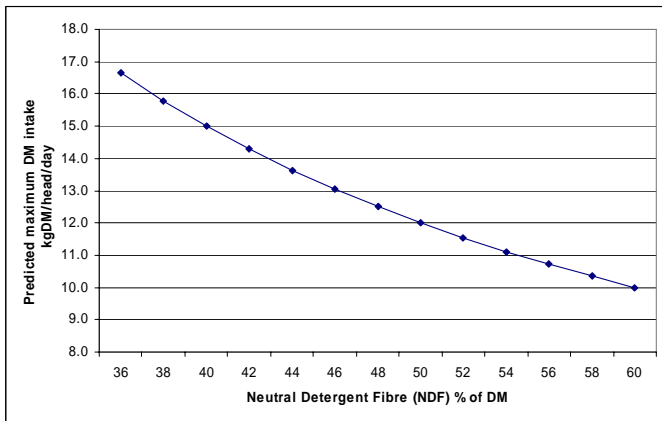


Figure 2. Relationship between dietary NDF and maximum DM intake for a 500 kg steer based on the 1.2% rule of thumb

For example, a 500kg steer can eat $500\text{kg} \times 1.2\% = 6.0$ kg of NDF / day (= A).

(a) If a diploid ryegrass contains 53% NDF (0.530 kg NDF/kg DM (= B))

the steer eats a maximum of 11.3 kg DM / day (=A/B).

(b) Similarly, if a tetraploid ryegrass contains 51% NDF the steer eats a maximum of 11.8 kg DM / day. **An extra 0.5 kg** of dry matter can be eaten because of the lower NDF level in the grass.

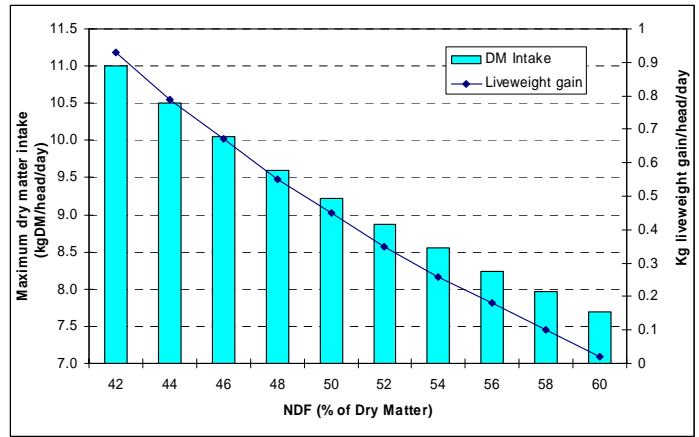
If the pasture contains 10 MJ of metabolisable energy / kg DM, the steer eats an extra 5 MJME per day. This could be worth another 110g of liveweight gain per head per day for steers grazing tetraploid grasses.

Note The NDF 1.2% rule of thumb may underestimate the benefits of tetraploid ryegrasses. The NDF calculation doesn't take into account many other factors that influence grazing and rumen efficiencies including ease of harvest, palatability, levels of protein and WSC and rate of NDF degradation.



NDF and Young Stock

NDF will predict how much a heifer will eat and grow when grazing at different levels of NDF. For a 16 month old 375 kg liveweight heifer, productivity is very different for different NDF pastures*:



* Modeled using 'CPM Dairy'

Figure 3. Relationship between dietary NDF and maximum DM intake for a 375 kg heifer based on the 1.2% rule of thumb

If a tetraploid ryegrass contains 2% lower NDF than an equivalent diploid ryegrass, a heifer fully fed on a tetraploid ryegrass will grow another 0.1kg liveweight per day.

NDF and lactating dairy cows

NDF can predict how much a cow will eat, how much milk is produced and rate of liveweight gain or loss). For a 605 kg dairy cow 120 days in milk, producing milk with a 4.00 % fat test and 3.2% protein test, the response to pasture with different NDF (with no extra supplements) is shown below*:

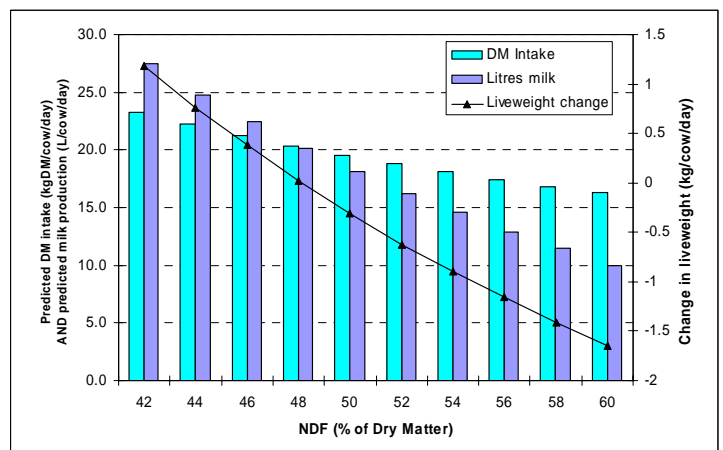


Figure 4. Relationship between dietary NDF and milk production for a 605 kg dairy cow at 120 days into lactation. *Modelled with 'CPM Dairy program'.

If a tetraploid ryegrass contains 2% lower NDF than an equivalent diploid ryegrass, a dairy cow fully fed on the tetraploid ryegrass may produce another litre of milk per day and gain an extra 300g of liveweight per day, depending on the stage of lactation.

Tetraploids and forage quality: Other factors to consider

Digestibility of tetraploid grasses is usually better than diploids. This means a higher proportion of the dry matter in tetraploids ends up used for energy by animals and less energy is lost in the dung.

Crude protein and water soluble carbohydrate contents don't appear to be very different between tetraploid and diploid ryegrasses.

Wetter tetraploids. Tetraploids may contain between 1 to 5 % more water than diploid ryegrasses. Or the other way to describe this is tetraploids contain 1% to 5% less dry matter per kilogram of wet pasture than diploids. The practical implications of this are minor:

- **Dry matter on offer:** The slightly lower DM% of tetraploids means that sometimes there will be less DM on offer to stock than what is assessed using a rising plate meter or by visual appraisal.
- **The animal 'fill factor':** Some people suspect that the higher water content of tetraploids fills animals up with water and prevents them eating to appetite. There's no good evidence to support this theory for pasture-fed stock. Extra water is absorbed by the gut and is unlikely to limit intake.

Fertilisers for tetraploid ryegrasses

Tetraploid ryegrass won't use any more fertiliser than a diploid at the same DM production level. Tetraploids *are* bred to produce more DM – when tetraploids yield more DM they must be fed more nutrients. Base your fertiliser planning for tetraploids on expected DM production, aiming to replace nutrients removed through cutting or grazing. Failure to replace nutrients will deplete soil nutrient reserves and potential DM production may not be realised.

Approximate nutrient removal by a ryegrass pasture at different production levels are shown in Table 1 below.

Table 1. Relative nutrient removal per tonne DM.

Annual Pasture production Tonnes DM / ha	Approximate annual nutrient removed (kg/ha)			
	Nitrogen	Phosphorus	Potassium	Sulphur
6	210	24	150	18
8	280	32	200	24
10	350	40	250	30
12	420	48	300	36
14	490	56	350	42
16	560	64	400	48
18	630	72	450	54

Nitrogen requirements for tetraploid ryegrass

The characteristic dark green colour of tetraploid ryegrasses is caused by more chlorophyll in the leaves of tetraploids than in diploids. Nitrogen (N) deficiency is harder to detect with the darker colour although you'll still see some lightening of colour and urine patches in tetraploid swards if N is very deficient. Tetraploids require the same amount of N and respond to N fertiliser in a similar way as diploids for the same DM production level. Set up a proactive nutrient budget that predicts N losses from a tetraploid system to prevent a N deficiency from occurring.

Mixing tetraploid and diploid ryegrasses

Diploids and tetraploids should be sown alone with companion legume species. Sowing a tetraploid with a diploid in the same pasture mix is not generally recommended. Animals will selectively graze the tetraploid in preference to the diploid resulting in the tetraploid being overgrazed. Persistence of the tetraploid may be compromised and lack of grazing pressure may cause the diploid to lose feed quality.

Set stocking or rotational grazing for tetraploid ryegrasses

Tetraploids may be set stocked for short periods over winter and spring although the combination of erect growth habit, large leaves and palatability mean they can be prone to overgrazing if set stocked for long periods of time. A fine leaved densely tillered diploid cultivar is more suited to a continual set stocking situation.

Tetraploid ryegrasses and clover: A natural pair

The clover-friendly nature of tetraploid ryegrasses is well known. Tetraploid ryegrasses have a more upright and open growth habit and have larger tillers than diploid ryegrasses. These characteristics allow more light into the pasture base for the clover to grow. On average you can expect to see 10% more clover in a tetraploid pasture than in a pasture containing diploid ryegrass.

Extra clover offers benefits for the system. A well managed white clover based pasture will fix up to 200kg/ N per year from the atmosphere. This is the equivalent of almost 400kg urea FOR FREE!! Clover will help maintain pasture feed quality especially over the summer when the ryegrass quality can deteriorate.

Managing tetraploid ryegrasses for better longevity

Stock will overgraze tetraploid ryegrasses when given the chance. We don't understand why, but this is probably because tetraploids are tastier than diploid ryegrasses.

Avoid overgrazing of tetraploid ryegrasses because:

- Less DM matter is grown and harvested. An overgrazed plant is slow to recover and grow DM because too much 'solar panel' has been removed. Sunlight falls onto bare ground and dead leaves instead of leaves, and photosynthesis does not occur.
- Overgrazing reduces longevity which then may reduce persistence. Continual overgrazing depletes root reserves and stresses the plant and it's less likely to persist.

The negative effects of overgrazing can be explained by the pasture growth curve below. Pasture growth happens in 3 distinct phases. Initial regrowth is slow after very hard grazing because most of the leaf has been eaten and the rate of photosynthesis is low. During phase 2, sunlight is falling on green leaves and rate of photosynthesis is high. Over grazing delays the start of phase 2. More lax grazing encourages an immediate start to phase 2 following grazing. Phase 3 is the period when accumulation of grass slows as the pasture length increases and more leaves become shaded.

Pasture regrowth after grazing showing three phases of growth in Fig. 5 below.

Larger seed sizes for tetraploid ryegrasses

Tetraploid seed is heavier and larger than diploid seed. This has two key practical implications:

1. Larger seed size improves seedling vigor, results in more rapid seedling development and may offer first season winter establishment and DM production benefits.
2. Sowing rates need to be about 40% higher than comparable diploid cultivars – see table below. Multiply your usual rate x 1.4. Actual sowing rates will depend on weather at the time of sowing, if the pasture is a perennial or short term mix, availability of irrigation and rainfall, and other pasture species in the mix. Your Wrightson Seeds Sales Agronomist will be able to help formulate specific sowing rates for your farm.

Comparable sowing rates Diploid v Tetraploid ryegrasses

Usual diploid sowing rate (kg / ha)	Comparable tetraploid sowing rate (kg / ha)
10	14
15	21
20	28
25	35
30	42

For more information contact **Cattle Production Consultants** on 02 4655 8532 or FREECALL **Wrightson Seeds** on 1800 619 910

Acknowledgements

Charlotte Westwood from Strategic Bovine Services for assistance in writing this article.

