Grazing modern stubbles

A guide to the nutrition and management of sheep grazing stubbles in mixed farming areas

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Overview

Each year, about 25 million hectares of dryland crops are sown in Australia, typically producing more than 40 million tonnes of grain, with a roughly equivalent mass of crop residue (stubble) remaining in the paddock[1].

Most broadacre crops are grown in mixed farming areas, where cropping and livestock enterprises are combined. In these areas, stubbles make up an important part of the seasonal feedbase, except where the business is cropping only, or stock are kept off stubbles for soil management reasons.

It is estimated the crop stubbles grown in Australia could provide about three billion ewe grazing days, or enough forage to feed Australia's ~65 million sheep flock for six weeks.

Australian broadacre crops include[1]:

- Winter crops: wheat, barley, oats, triticale, lupins, field peas, canola, faba beans, chickpeas, cereal rye, vetch, safflower, millet and lentils.
- Summer crops: sorghum, sunflowers, maize, mungbeans, soybeans, peanuts and cotton.

Management of stubbles at harvest

The way harvesters are set up for harvest varies widely across farms, particularly in relation to chaff management. Chaff and screenings are important components of stubbles because this affects the grazing value of stubbles.

Stubble management practices

Table 1 highlights the range of stubble and chaff management practices used by 40 producers in WA during the 2018/2019 harvest.

Table 1: Stubble management practices at harvest and before seeding in WA (proportion of producers implementing) during the 2018/2019 harvest

At harvest	
Spread	30%
Chaff cart	18%
Either line/windrow or spread	15%
Either chaff cart or spread	13%
Chaff in line and straw spread	8%
Seed destruction	5%
Windrowed	5%
Baled	3%
Chopped and baled	3%
Chopped and spread	3%

Before seeding	
Graze only	32%
Graze and burn	29%
Graze and burn some years	12%
Graze and burn heaps	9%
Burn, no grazing	9%
Graze, rake and burn	3%
Baled, no grazing	3%
Combination of the above	3%

Wheat chaff heaps (above), collected using a chaff cart towed behind the harvester and dumped in rows (right). Credit: Dr Dean Thomas from springfieldgrenfell.com.au

Spreading chaff was the most common individual type of management, but over half of the producers surveyed aggregated chaff by using chaff carts, lines, windrows and baling. While this is principally done for the control of weeds, outcomes for grazing management were also considered important.

While the main stem makes up about half of total stubble material, chaff lines and heaps typically contain only 10–20% main stems (main stems are generally not eaten by sheep).

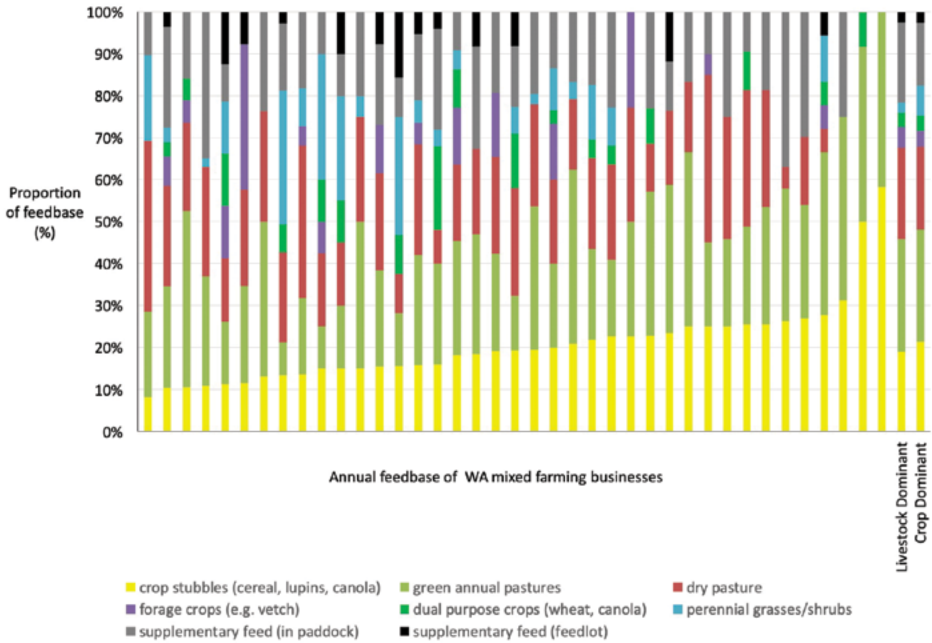
Stubbles in the feedbase

Seasonal feedbase

Extensive livestock producers have adapted to high rainfall variability, both within and between seasons, by diversifying their sources of feed. This combination of feed is referred to as the seasonal feedbase.

The seasonal feedbase varies widely from farm to farm, reflecting the farm's soils and climate, the make-up of the business and the producer's own preferences (Figure 1).

Figure 1: Seasonal feedbase composition reported by mixed crop livestock producers (proportion of time ewes spent grazing each feed component)



Average feedbase composition for livestock dominant (≥50% land area) and crop dominant businesses are shown

Feedbase composition

Figure 1 shows the composition of the feedbase for 40 mixed farms where stubbles were grazed. For most, stubbles make up 15–25% of the feedbase (yellow bars); in terms of the time sheep spent grazing.

Little difference was found in the feedbase between livestock or cropping dominant farms. The reason may be that while more stubble is available in crop dominant areas, in livestock dominant areas (mostly higher rainfall) producers tend to use stubbles more heavily[2].

Sheep consistently grazed stubbles for 10–20% of the year, while the proportion of time sheep grazed perennials or forage crops was more variable across the farms surveyed.

Quality of stubbles

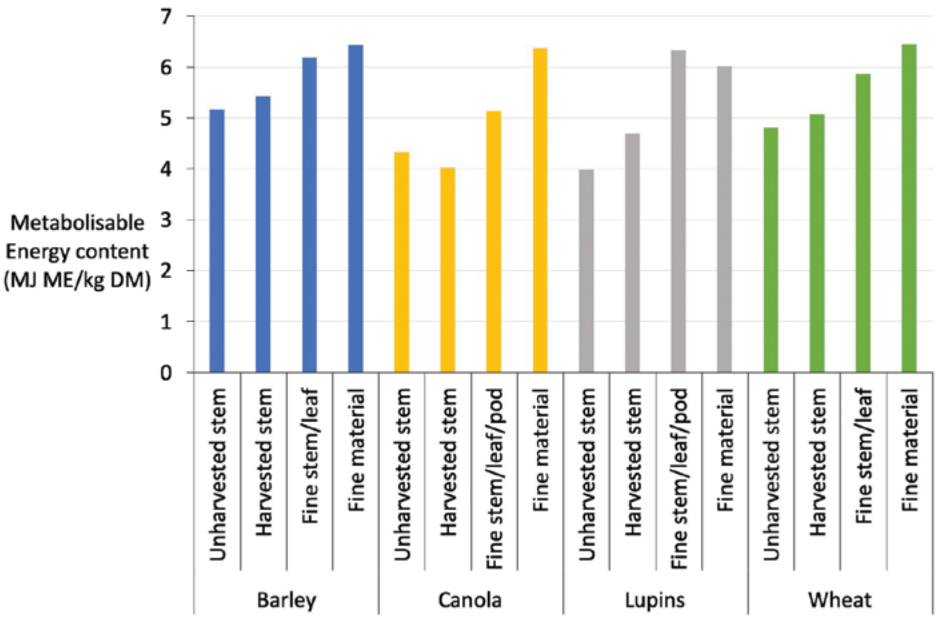
Stubble components (grains, leaf and stem) vary widely in quality due to their chemical composition. For example, ripe wheat stems have a high proportion of structural carbohydrates such as cellulose and lignin, which are poorly digestible. As a result, they are of low nutritive value.

Stubble components vary widely from crop to crop due to:

- crop species and variety
- interactions with climate
- soils and crop management (fertiliser and herbicides)
- paddock conditions.

Stubble component quality was consistently below maintenance quality (except grains) for commonly grazed crop stubbles (Figure 2).

Figure 2: Metabolisable energy content (MJ ME/kg dry matter) of components of barley, canola, lupins and wheat



Grain (top left), small, medium and large (L–R) wheat stubble components Credit: Andrew Toovey

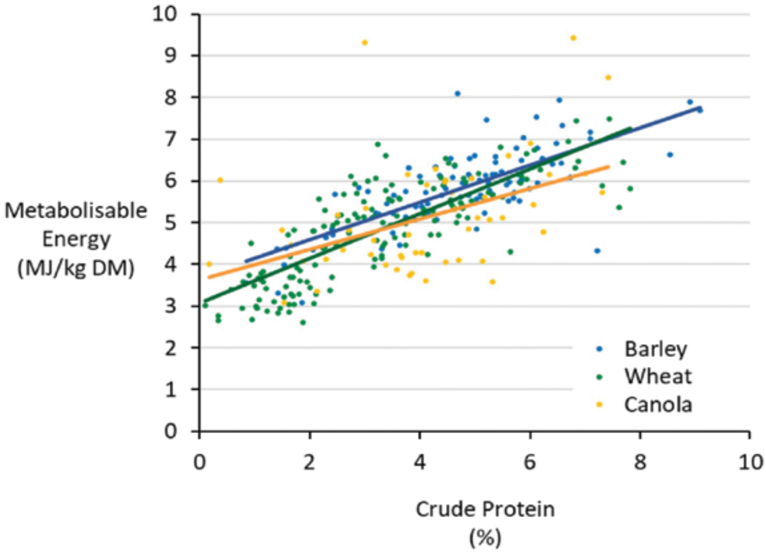
Grains and green plants have a higher proportion of digestible carbohydrates and protein, so they typically have a higher nutritive value.

Metabolisable energy

The metabolisable energy (ME) content of feed refers to energy that can be gained from the diet during digestion. For dry, adult sheep to maintain weight, feed needs to contain 7–8 MJ/kg dry matter of metabolisable energy (see Table 2).

Therefore, the non-grain components of stubbles and chaff are well below maintenance requirements. The components progressively get lower in ME as they go from small to large (Figure 2). The energy content of stubble components is closely related to their protein content, especially cereals (Figure 3).

Figure 3: Relationship between crude protein (%) and metabolisable energy content (MJ ME/kg dry matter) in chaff



Andrew Toovey (CSIRO) sampling a canola stubble. Credit: Gonzalo Mata

Unharvested grain

The amount of unharvested grain remaining in stubble paddocks has been measured in field studies. One report of nine grazed wheat stubbles found an average of ~100 kg/ha was left in paddocks[4].

A paddock survey, grain in barley chaff generally made up 2–3% of the material but was measured as high as 8%. While grain content was consistently lower at 0.5–1% in other crop chaffs.

The wide variation in the amount of unharvested grain has significant implications given that about half of the feeding value of stubble comes from grain.

Understanding the amount of grain left in the paddock is also important for measuring financial losses in the cropping enterprise.

A range of factors influence the amount of grain in the stubble, which may include:

- crop species and cultivar
- harvest conditions (moisture/threshing)
- harvester settings and chaff management
- harvester front and harvest method (swathing, stripping).

Grazing stubbles

The type (or class) of livestock influences how producers prioritise stubbles for grazing:

- Ewe lambs are often given access to the highest quality stubbles, followed by pregnant ewes (or in preparation for joining).
- Older or dry ewes are grazed on lower quality stubbles, such as those that have already been grazed or wheat and canola stubbles.

Nutrition

When provided with enough choice and sufficient availability, sheep can effectively select feeds that meet their energy and protein requirements.

There is also evidence of selection for required vitamins and minerals, particularly when livestock are deficient. Thus, sheep grazing stubbles will eat mineral mixes, which can improve their nutrition.

Sheep grazing stubbles are highly selective and prioritise eating spilled grains and any green pick when these components are available. For this reason, supplementation with high energy and protein grains, such as lupins, can improve the utilisation of stubbles.

Grazing duration

The duration producers graze stubbles for each year varies widely.

These differences are attributed to:

- crop type
- summer rain
- growing season conditions (crop yields, frosts)
- stocking rate
- harvesting conditions (header grain losses)
- weed burden
- paddock conditions.

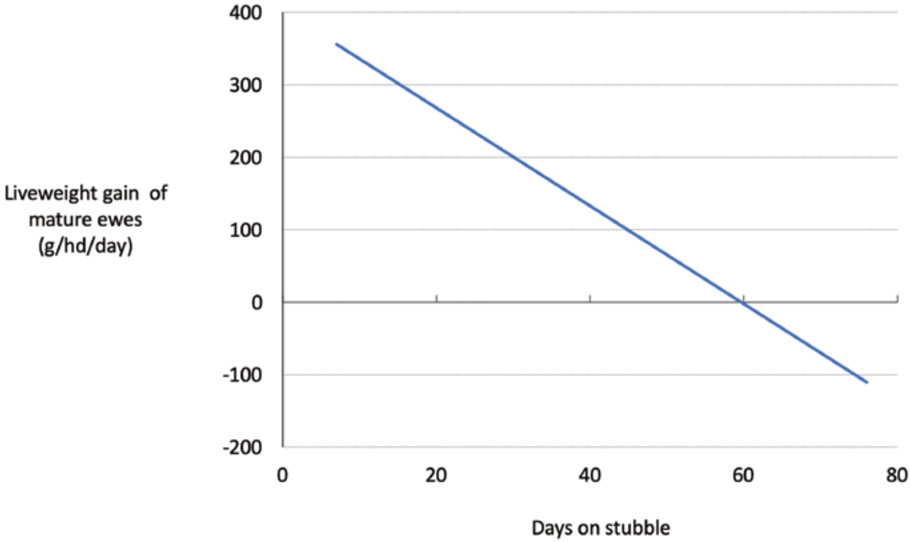
Dry or early pregnancy ewes grazing wheat stubbles were found to consume (on average) 70 kg/ha of grain and 150 kg/ha of dry leaf and stem. So, energy intake from these components (grain and other plant material) is similar, due to grain having a higher energy content.

Fresh wheat stubbles can support about 150 sheep grazing days per hectare (in mature ~60 kg ewes), without supplementation, before their live weight returns to their initial weight when they started grazing the stubble (Figure 4).

This means that a wheat stubble stocked at three dry ewes/ha would be expected to maintain the ewes for seven weeks without supplementation:

Three ewes/ha x seven weeks x seven days/week = 147 sheep grazing days.

Figure 4: Weight gain (g/head/day) trend of Merino ewes grazing wheat stubbles in seven trials, average stocking rate was 2.5 DSE/ha (range from 2.0-3.2 DSE/ha)



Collecting chaff at harvest

Collecting chaff at harvest (chaff heaps or lines) may help sheep select higher quality stubble components by concentrating the foraging area. This may also reduce the rate of degradation of the higher quality fine material.

However, by combining high and low quality components (particularly in piles) sheep may eat less selectively. Chopping chaff through the harvester will likely improve feed quality of larger material, as the rate of intake in sheep is higher for finer material.

A total of 57% of producers thought that stubbles with chaff lines and piles have a higher feeding value compared with 7% who thought stubbles where chaff had been spread would be of higher value (36% were undecided).

Supplementary feeding

Supplementary feeding can extend grazing of stubbles by:

- helping sheep reduce weight loss as stubbles become depleted
- increasing the utilisation of low-quality stubble forage.

Provision of high protein supplements such as lupins and peas will help ensure sheep meet their protein requirements when grazing cereal stubbles, which have a low protein content. This is particularly important for young, growing sheep, which have higher protein requirements.

Table 2 shows the nutritive value of a range of grain, hay and chaff compared with the requirements of sheep for maintenance. These values provide an indication of the level of supplementary feeding of grains required to maintain sheep grazing chaff.

Table 2: Metabolisable energy, crude protein and fibre content of a range of feeds, and the requirement of sheep for maintenance

Feed		Metabolisable energy (MJ/kg)	Crude protein (%)	Fibre (% ADF)
Grain[3]	Wheat	13	11	3
	Barley	12	11	8
	Oats	11	9	18
	Lupins	14	38	20
	Canola	16	22	24
Hay[3]	Cereal	9	9	29
	Pasture – early cut	10	14	28
	Pasture – late cut	9	10	32
Chaff (excl. main stems and grain)	Wheat	6.0	4.5	45
	Barley	6.3	5.5	42
	Lupins	7.0	6.5	42
	Canola	6.0	5.0	47
Sheep requirements (for maintenance)	Dry adult ewes	7.1–8.0*	8	~15
	Mid pregnancy (100 days) – single	9.9**	10	~15
	Mid pregnancy (100 days) – twin	11.1**	11	~15
	Weaners (20kg) growing at 50g***	6.5–7.5	11–13	~15

* Lower value condition score two, higher value condition score three.
** Condition score three ewes.
*** Minimum acceptable rate of growth for 20kg animals.

Other things to keep in mind when grazing stubbles

Water supply

Stubble is a dry feed with typically less than 10% moisture content. A sheep will require 3–5 litres/day when grazing stubbles, depending on their size and the ambient temperature.

If sheep are provided a salt supplement, or the paddock contains saltbush, water requirements are also increased by 0.5 litres/day per 10g of additional salt consumed[5]. Sheep can consume 10–15 litres of fresh water per day when on a grazing diet with a very high salt content.

Protein

The protein content of a diet of grains and leaf/stem from cereal stubbles is typically less than 10% and will decrease further as stubbles are depleted of grain. This means that the feed may not meet the protein requirements, particularly for growing stock that require about 14% protein in their diet.

Low protein intake is less likely in lupin and canola stubbles, where the protein content of grains is high. Supplementary feeding of high protein grains, such as lupins and peas, is a practical option to improve protein intake when grazing stubbles.

Similarly, sheep with lower protein requirements (dry or early pregnant mature ewes) are a better option for grazing on cereal stubbles. However, ensuring adequate nutrition for joining and pregnancy is essential.

Vitamin E

Dry feed diets such as grains and stubbles, have low vitamin E content and pose a risk of vitamin E deficiency (white muscle disease) to sheep. Sheep, and particularly lambs, that do not have access to green feed should be supplemented (drenched or injected) with vitamin E.

Alternatively, adjacent areas of perennial grasses and shrubs can provide a useful source of vitamin E for sheep grazing dry stubbles.

Acidosis

When sheep begin eating larger quantities of grain (particularly wheat) they may experience a build-up of lactic acid in their rumen, due to an insufficient population of microbes that break down the acid. If severe, this can kill sheep.

Sheep adapt to higher grain content diets over time provided the grain is introduced slowly (progressively increasing grain supplementation from 50–300 g/head/day over two weeks).

Alternatively, sheep could start by grazing barley or lupin stubbles (these grains contain more fibre and less starch, see Table 2), prior to being moved to wheat stubbles. Younger, less experienced sheep may be at a greater risk.

Lupinosis

Sheep grazing lupin stubbles may be exposed to a toxin produced by the fungus *Diaporthe toxica* growing on the lupin stems. Early and light grazing of lupin stubbles, prior to summer rain will help reduce the risk of toxicity.

For further information, see agric.wa.gov.au/livestock-biosecurity/lupinosis-sheep

Annual ryegrass toxicity (ARGT)

ARGT results from the accumulation of a toxin in sheep grazing annual ryegrass that is infected by the bacterium *Rathayibacter toxicus.*

ARGT is a cumulative toxin, meaning levels will build up in livestock over time. Its incidence in stubbles is highly variable depending on:

- level of ryegrass in the crop
- presence of the biological agents (nematode and bacteria)
- seasonal growing conditions.

Incidence of poisoning tends to be episodic (depending on location and seasonal conditions). Testing chaff for ARGT is suggested where stubble chaff contains a significant amount of ryegrass seeds, particularly in areas known to have ARGT problems in the past. Testing for toxicity risk is available at government laboratories.

Quadrat cut (0.1 m^2) of stubble being collected with electric garden shears. Credit: Gonzalo Mata

Techniques to estimate feed value in stubble

Visual estimates

Producers often rely on observations of stubbles and the livestock grazing them for management. While this can be an efficient and practical means of managing sheep flocks, outcomes depend on the skill of the individual and the amount of time they can allocate to monitoring.

However, the use of observations in decision making reduces the level of precision in management. When available, hard data is valuable for producers making decisions such as:

- nutrition at joining
- reaching growth targets
- level of supplementary feeding
- managing ground cover.

Field residue cuts and grain counts

The measurement of stubble components (stem, leaf, grain and green), provides a guide to the potential feed that is available for livestock.

However, these field measurements do not translate easily to feed available to livestock because sheep typically selectively consume a small proportion of this biomass.

Stubbles may be depleted of most of the edible material with as little as 10% of the total biomass eaten.

One exception is the measurement of unharvested grains, as these make up a high percent of the diet of sheep and the depletion of grain under grazing can be predicted[4].

Further information on the measurement of unharvested grazing to manage sheep grazing stubbles can be found at the website of the Department of Primary Industries and Regional Development, Western Australia.

Lab measurements

Laboratory testing can provide useful data to guide understanding of stubble feed value. Stubbles vary in quality for a range of reasons:

- season
- crop species
- crop management
- weeds.

Testing chaff for nutritive value, can therefore be indicative of the likely feeding value (nutritive value x intake) of the material, although the capacity of sheep to select higher quality stubble components is not well understood.

Laboratory tests for metabolisable energy, protein, nitrogen and fibre provide important information regarding the overall value of the material for feeding and additional supplementation that will be needed.

Weigh and condition score

Direct measurement of live weight and body condition of a subset of the sheep flock provides a precise assessment of the feed value of stubbles during the preceding period However, traditional weighing methods are labour and infrastructure intensive, and regular weighing may disrupt the animal's behavioural routines and potentially affect productivity.

On-animal sensors

Much attention has been given to the potential for livestock behaviour to be used as an indicator of their nutritional status[5].

The use of on-animal sensors in livestock enterprises is rapidly becoming feasible with recent improvements in hardware, software and analytics[6].

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