

Balancing diets based on sorghum forages – what to consider

Dave Barber

Dairy Team Leader
Department of Agriculture and Fisheries, Queensland



With fall army worm (FAW) already an issue in maize crops this summer, both forage and grain sorghums are the likely replacements for maize silage in subtropical dairy diets. Sorghums are also susceptible to FAW attack; however, they seem to be less susceptible and have been seen to recover better than maize crops. When feeding sorghum silage there are a few things that need to be considered based on the physical characteristics of sorghum (Table 1).

Forage quality

On paper, maize silage is generally superior across several quality parameters (Table 2) including metabolizable energy (ME), neutral detergent fibre (NDF) concentration and digestibility, lignin and starch. Forage quality can vary considerably within and between forage types due to management, climatic conditions, and variety, so it is extremely important to conduct feed analysis on your forages regularly to understand the amount of variation in forage quality. This will make balancing diets easier and result in better milk responses to nutritional changes.

Metabolisable energy is a function of NDF, starch and sugar concentration and digestibility. Therefore, the important physical characteristics of the plants that drive forage quality are primarily the leaf to stem ratio and the proportion of seed head within the plant. Grain sorghums harvested at the milky dough stage tend to have a higher leaf (leaf:stem ratio) and seed head proportion to stem when compared to forage sorghums and maize silages (Figure 1a). Leaves and the seed head also have a lower indigestible NDF (iNDF) concentration (Figure 1b) or higher NDF digestibility (Table 2), which means that the fibre contained within those plant parts is more digestible resulting in more nutrients available for milk production when digested in the rumen. Forage sorghum has a higher proportion of stem which means that there is a two-fold effect on forage sorghum quality due to the higher NDF concentration and proportion of stem. Therefore forage sorghum is typically grown for bulk dry matter (DM) production as it will handle low water availability when growing.

Forage Sorghum	Grain Sorghum
Taller and higher yielding	Shorter and moderate/high yields over two cuts
Lower leaf to stem ratio	Higher leaf to stem ratio
Higher proportion of structural fibre	Bigger seed size
Small seed size	Seed head makes up 45-70% of dry matter yield
Lower dry matter and starch digestibility	Moderate dry matter and starch digestibility

Table 1 Physical characteristics of forage and grain sorghums.

Nutrient	Maize	Liberty White Sorghum	Megasweet Forage Sorghum
Crude protein (% ^a DM)	8.8	10.8	10.1
Metabolisable energy (MJ ME/kg DM)	10.97	10.04	8.55
Neutral detergent fibre (NDF) (% DM)	35.1	37.4	45.3
NDF digestibility (% NDF @ 24hrs)	38.0	29.0	32.0
Lignin (% DM)	2.3	2.9	4.1
Starch (% DM)	32.3	27.8	6.3
Fat (% DM)	2.9	3.1	2.5

^aDry matter

Table 2 Forage quality of maize, white sorghum and forage sorghum silage used in a feeding experiment at Gatton Research Dairy in 2019.

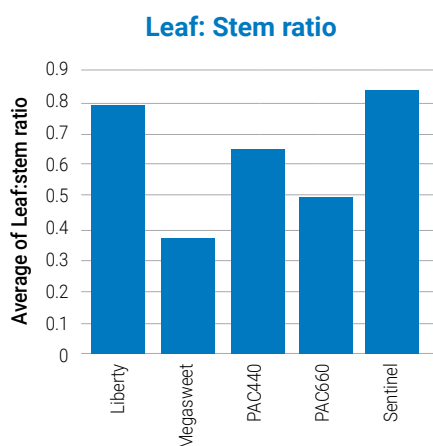


Figure 1 A The leaf:stem ratio of Liberty white sorghum, Megasweet forage sorghum, PAC440 maize, PAC606 maize and Sentinel red sorghum.

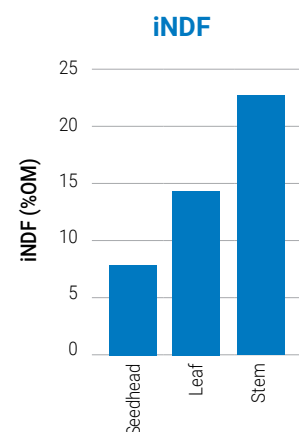


Figure 1 B The concentration of indigestible NDF (iNDF) of the seedhead, leaves and stem of forage sorghum grown under full irrigation.

Starch availability

Starch availability is driven by seed size and extent of processing at harvest, seed head proportion (affects starch concentration), starch type and length of ensiling. Forage sorghum has a small seed and therefore is less likely to be well processed at harvest, hence a reduced starch availability compared to maize and grain sorghum forage crops. They also have a lower seed head proportion due to the high proportion of stem that is produced, resulting in lower starch concentrations. Grain sorghums have a bigger seed size and the seed head contributes to a higher proportion of the DM produced, with similar proportions to maize (Figure 2).

Sorghums have a strong starch:protein matrix which reduces their starch availability, so processing and length of ensiling will be important. Maize silage has been shown in the United States to increase in starch availability the longer it is stored within the pit, with at least six months being the critical length of time required. More recent data from on farm maize silage samples analysed within the C4Milk project shows an increase in starch availability of approximately 10%/month. Due to the strong starch:protein matrix of sorghum grain this improvement is likely to be lower, however, there is an improvement in starch availability when grain sorghum forages are ensiled for longer periods of time. Red and white sorghum varieties also have different starch concentrations and starch digestibilities, with white sorghum typically having a lower starch concentration and higher digestibility compared to red sorghum silages. The example provided in Table 3 (top right) highlights that starch availability after seven hours in the rumen is a function of starch concentration and digestibility, with the white sorghum having a lower concentration but a higher digestibility resulting in more starch being digested after seven hours of fermentation for the white sorghum silage.

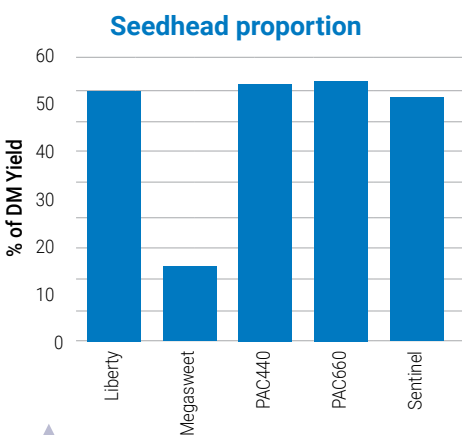


Figure 2 The seed head proportion of total dry matter (DM) yield for Liberty white sorghum, Megasweet forage sorghum, PAC440 and PAC660 maize, and Sentinel red sorghum.

Grain Type	Average silage starch concentration (DM)	7 hr in vitro starch digestibility	Starch digested at 7 hours
White	25.4 %	55.0 %	140 g/kg DM
Red	30.8 %	33.8 %	104 g/kg DM

Table 3 Average starch concentration and digestibility of white and red grain sorghum silage varieties.

Balancing the diet

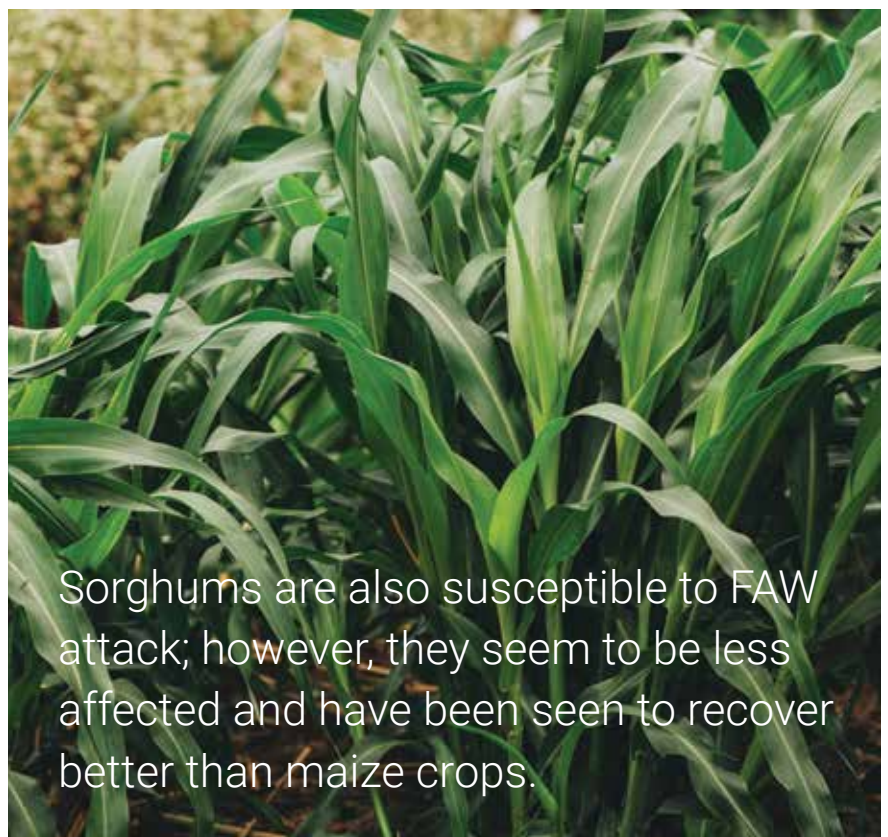
The key to balancing diet containing sorghum forages is to balance for NDF % of the total diet rather than substituting one for one with maize silage. The higher NDF concentration in the sorghum will result in lower DM intakes and lower production responses.

It is also important to discount the starch concentration of forage sorghums to 5% as it is likely most of the starch within the grain will pass through the cow and not be available for digestion. For grain sorghums and maize silages it is recommended to get a feed test done that gives you starch concentration and starch digestibility. This needs to be done regularly, particularly if silage from different paddocks or growers is being used.

Increase the crude protein (CP) of the total diet to try and utilise the higher fibre within the sorghum forage. Feeding higher levels (target 17-18% CP in the total diet) of a good quality protein meal such canola or soybean meal will improve rumen digestion and increase DM intake.

Cows tend to have higher DM intakes on sorghum-based diets which is possibly due to the chop length of the silage and passage rate through the rumen. Given this, it is advisable to offer 5-10% above requirements to ensure DM intake is not being limited in total mixed ration system.

If FAW-affected maize silage is being fed, it is worth feeding a mycotoxin binder at the recommended rate to minimise any digestive issues. The FAW larvae can bore into the cob during development and cause smut and other moulds to develop, resulting in the presence of mycotoxins in the silage. Starch levels in these silages is also likely to be lower than expected. Therefore, it is worth doing feed analysis on your forages and seeking nutritional advice from a nutritionist to get the best outcome from your forages and diet. ■ ■



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