Forage Sorghum and Millet

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SUMMARY OF BEST PRACTICE MANAGEMENT

1. Plan well ahead, choosing the best crop type and variety for the likely frost-free growing conditions and end-use, and prepare a fertile, weed-free paddock of suitable size for the purpose.
2. Sow at the correct time and at a favourable soil temperature, using top quality seed and appropriate fertilisers into a firm, moist, seedbed (or a suitably prepared no-till situation) to encourage fast, even and robust germination.
3. Monitor the crop, at early stages and later, for weed and insect pests, and use appropriate control measures.
4. Practise effective grazing management and forage conservation strategies and techniques:
   * Use subdivisional fencing to allow a relatively short grazing period when the crop is at the right stage and before it becomes too advanced, followed by a longer spell allowing recovery to optimum growth stage.
   * Avoid potential stock health problems involving hydrocyanic acid (HCN) or nitrates and carry out routine vaccinations, drenches etc.
   * Supply ample clean drinking water and shade.
   * Provide sulphur and salt blocks when grazing stock on sorghum.
5. Cut at the recommended growth stage for hay, silage or green chop to achieve the best compromise between fodder quality and yield.

1. INTRODUCTION

This Agfact will help in making good decisions on crop choice, growing the crop, efficient and safe grazing management, avoiding common pitfalls and making money from forage sorghum and millet.

Productive perennial or regenerating pastures which survive for years are a major factor in successful livestock enterprises. However, the continuing economic need for increasing efficiency and livestock market targeting points to the need for special purpose summer forage crops such as sorghum and millet.

Forage crops, per hectare, can be expensive in terms of growing costs and down time from start of paddock preparations to the last grazing. They need to be well planned and wisely managed for favourable outcomes. But when well managed they provide very cheap feed, and can deliver superior animal performance, providing excellent return for a relatively small outlay.

In situations where pastures are undeveloped or less productive and cannot provide the high quality or yield of forage required in summer, well managed forage sorghum and millet can fill this need.

Environmental, climatic and varietal factors play a vital role, but practical and financial success with these crops is dramatically influenced by decisions within the manager's control.

2. CHOICE OF CROP AND VARIETIES

Crop type and variety depends on variety characteristics, crop rotation factors and the specific purpose and end-use.

Variety characteristics

There is a wide range of physical characteristics between, and within crop types. The more obvious differences are in the degree of leafiness and stemminess, leaf and stem thickness, length of the vegetative stage before flowering and seasonal growth pattern.

There are also other important but less obvious differences. For example, soil temperature requirements for sowing, speed of growth, total yield, feed quality, sugar content, animal preference and palatability, and the potential to cause poisoning of livestock. These factors will be discussed in the following text.

Crop rotation factors

Effective forward planning is essential, especially regarding seedbed weed reduction, and development of flexible alternative sowing plans. Unless irrigated, a soil moisture-building period or fallow is required over several months to ensure sufficient moisture for a successful crop. Where summer rainfall is unreliable, at least 60 cm depth of moist soil is desirable at sowing.

The soil must be free of herbicide residues, which could damage seedlings, and this factor will require forward thinking when planning crop sequences. It is essential to understand the action of herbicides on weeds and crops, the safe plant-back interval, and implications of herbicide resistance on herbicide selection.

Purpose and end-use

Crop choice and variety is dependent on the role of the crop and the urgency of feed requirement. A clear idea of this helps in choosing the most appropriate variety. Some common uses of forage crops are listed.

- finishing young stock
- filling a seasonal feed-gap
- growing out adult stock
- high rate of feed production on limited area
- providing highly digestible feed to achieve weight gain targets
- stand-over holding feed
- green chop
- fodder conservation as silage and hay.

HOT TIP: There are significant differences in the volume, quality and continuity of forage produced by different varieties and crop types, but crop ESTABLISHMENT and GRAZING MANAGEMENT can have even greater impact on crop and animal performance than variety.

Where a continuity of high quality forage is required over a long time span several sowings should be staggered two to three weeks apart, and a range of varieties used.

Even the best variety available can not overcome basic problems caused by factors such as:

- infertile or shallow soil
- incorrect sowing time
- a crop which is uneven, too thin or too thick
- weed invasion and insect attack
- harsh grazing practises without spelling.

There are a few open-pollinated varieties still available but the most popular forage sorghums, Sudan grasses and millets are hybrids. Table 1 lists the varieties available at the time of writing and indicates their major use.

In selecting varieties, look for the appropriate suite of characteristics to meet the needs of the situation, then choose one or more from those available. For current varietal information, consult commercial sources such as the seed companies and merchants.

A regional guide to seasonal growth patterns and the effective period of forage availability of forage sorghum and millet is available in Appendix 4 of the PROGRAZE manual. This manual is supplied to participants of the PROGRAZE course, or can be bought separately from NSW Department of Primary Industries.

Ian Collett

Hybrid Sudan grass in the vegetative Phase II growth stage supplies quality forage for lactating ewes and prime lambs.

Table 1. Forage sorghum and millet varieties available in NSW in 2004

Crop Type	Variety	Maturity	Main Use
Sorghum x Sudan grass hybrid	'Jumbo'	VL	Grazing (cattle); hay;silage
	'Sweet Jumbo'	VL	
	'Pacific BMR'	L	
	'SuperSudax'	Q	
	'Cow Pow'	VL	
	'Betta Graze'	Q	
	'Everlush'	VL	
	'Revolution BMR'	L	
Sorghum x Sorghum hybrid	'Chopper'	M	Pit silage; limited grazing (cattle)
	'Graze-N-Sile'	M	
Sweet sorghum x Sweet sorghum hybrid	'Sugargraze'	L	Grazing (cattle); stand over autumn and winter grazing; pit silage; hay
	'Mega Sweet'	M	
	'Hunnigreen'	VL	
Sweet sorghum x Sudan grass hybrid	'Nectar'	L	Grazing (cattle); pit and round bale silage; hay
Sudan grass x Sudan grass hybrid	'Superdan'	L	Grazing (sheep & cattle); hay; pit round bale silage
	'New Pac 8288'	M	
Pennisetum hybrid millet	'Nutrifeed'	VL	Grazing (sheep & cattle); pit and round bale silage
Open-pollinated millet	'Shirohie'	Q	Quick feed (sheep & cattle) earliest effective sowing time
Echinochloa spp.	'Jap Millet'	Q	

Maturity code :

Q	Quick - short vegetative growth phase (about 7 weeks of grazing)
M	Medium - medium vegetative growth phase (about 9 weeks of grazing)
L	Late - long vegetative growth phase, photoperiodic (about 11 weeks of grazing)
VL	Very Late - very long vegetative growth phase, photoperiodic (about 12 weeks of grazing)

Other open pollinated millet varieties such as Tamworth Pearl, Red and Siberian millets are sometimes available. These perform in much the same way as Shirohie millet but usually have a longer useful grazing period. Open pollinated Sudan grass varieties may be available but are uncommon.

Perennial sorghum cultivars such as Silk, Sirosilk and Sucro may be available. These are tough, subtropical forages with similar growth characteristics to the weed Johnson grass, but may have a place in north-western NSW. **All perennial sorghum can contain hydrocyanic acid (HCN), which is poisonous to livestock. Growers are urged to check with their relevant local weed authority before sowing perennial varieties. Silk is a Declared W2 category noxious weed in parts of NSW. For further informatioon on noxious weeds consult the NSW DPI website.**

J.Christie

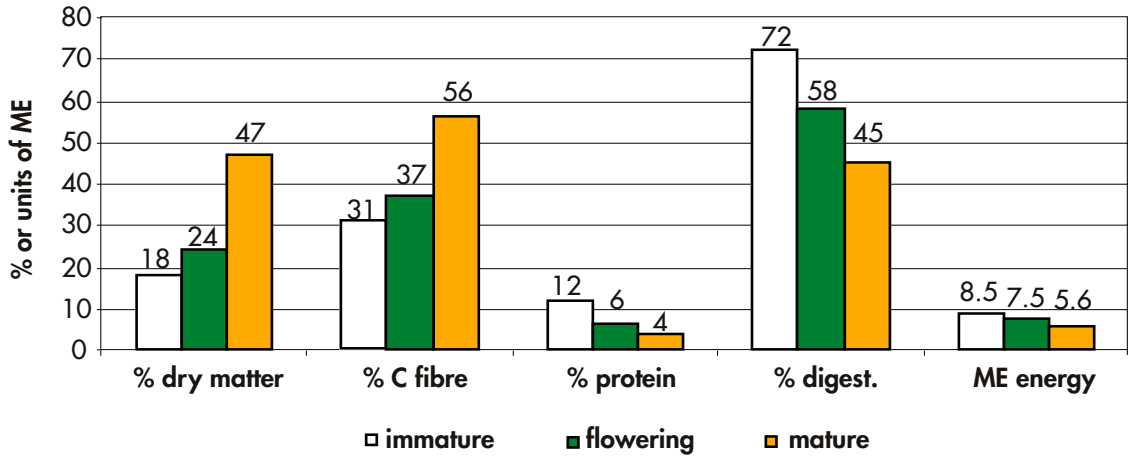
Cattle in irrigated, young, leafy hybrid Sudan grass at the right grazing height with high digestibility and high protein.

Unlike hybrids, open pollinated varieties have the dual-purpose option of seed production. Plant Breeders Rights must be taken into consideration if seed production is contemplated.

3. NUTRITIONAL VALUE

As with all forage, the young green leaf and shoots of sorghum and millet are the most digestible, and initially the highest in feed value; but both digestibility and food value decline rapidly as growth matures. **(See HCN comment next page and CAUTION NOTES on page 12.)** Grazing management, and timing in particular, are most important in maximising the vegetative growth Phase II when forage digestibility is high and animal performance is near its best. (Phase II is described in the PROGRAZE manual).

Graph 1. Influence of maturity on nutritive value of forage sorghum



Young growth is highly digestible, high in protein and energy and low in fibre. Graph 1 shows a typical example of the decline in quality of forage sorghum as the crop progresses from the leafy vegetative stage through flowering to maturity.

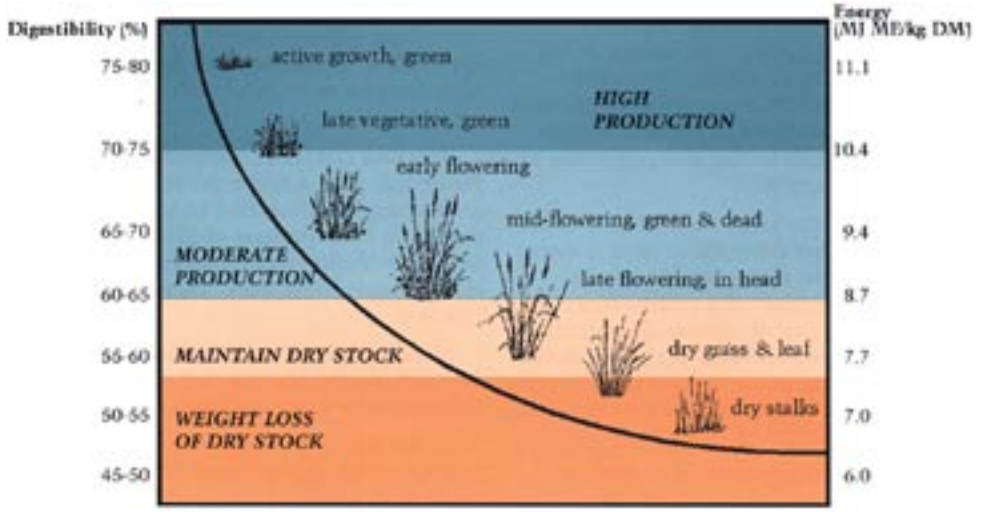
Graph 2, below, taken from the PROGRAZE manual, indicates rapid quality decline of temperate pastures as they mature. A similar trend occurs with tropical pastures as well as summer forage crops. Note that for moderate production at least 60–65% digestibility is required.

In Graph 3 overleaf, the digestibility of Sudax ST6 sorghum (now superseded) and Shirohie millet are compared in experiments at Trangie. Longer season varieties should hold their digestibility better past the 53 day post-sowing stage.

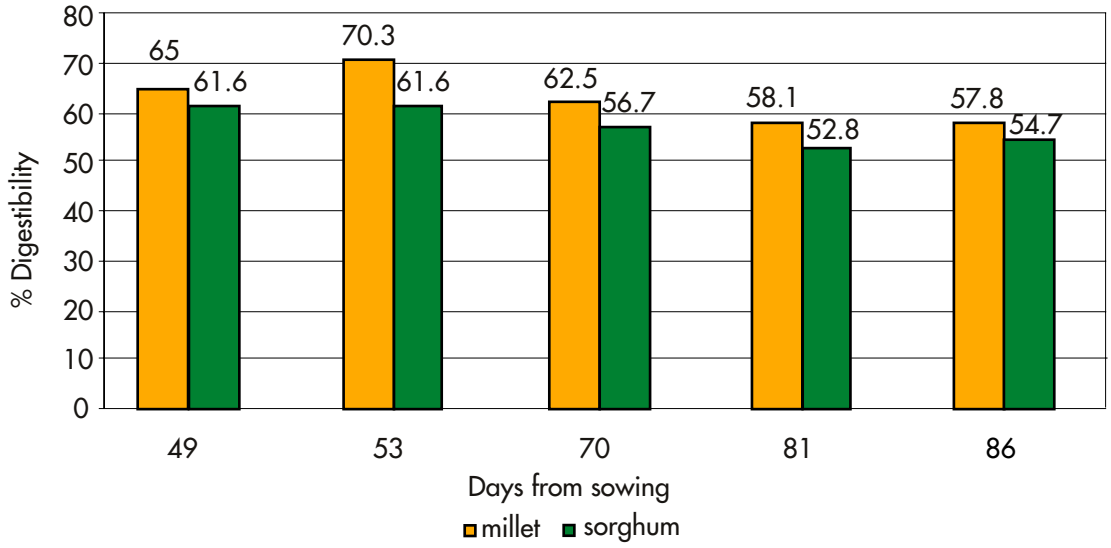
Many sorghum varieties are long season, or photoperiodic, producers, and don't flower until day-length shortens. They have an extended vegetative Phase II growth period with longer availability of maintenance or better quality feed.

It can, nevertheless, be a challenge to maintain high quality as the crop advances, particularly

Graph 2. A guide to digestibility decline as temperate pastures mature



Graph 3. Dry matter digestibility of millet and sorghum hay at Trangie



when seasonal conditions or other factors prevent timely grazing and allow the crop to develop beyond optimal grazing stage.

Sorghum is generally more productive than millet (see Graph 4) but more difficult to manage because of its lower leaf-to-stem ratio and stalky structure, and also due to the possibility of HCN poisoning of livestock under certain conditions.

Poisoning risk increases with sorghum when it is less than 0.5 metre high or if it has been stressed (eg by drought, waterlogging, nutrient deficiency, insects or diseases). The degree of risk varies with the crop and the variety. Millet is free of HCN, whilst Sudan grass and Sudan grass hybrids have less risk than sorghum hybrids. Stubble or forage from failed grain sorghum varieties can contain very high levels of HCN.

Other animal health issues such as the potential for nitrate poisoning, especially if nitrogen fertilisers have been used, need to be considered. Growers are advised to get veterinary advice with all animal health concerns.

The quick-flowering forage sorghums will often flower around sixty days after sowing. As feed quality quickly declines after flowering, it is important to start grazing on time.

In practise, the most desirable grazing window is limited to the vegetative Phase II growth stage. This generally means between a height above 0.5 metre, due to the HCN factor, and a nominal height up to 1.0 metre, due to forage quality decline with maturity. Late flowering sorghum varieties have a larger window, but will lose digestibility more quickly than millet.

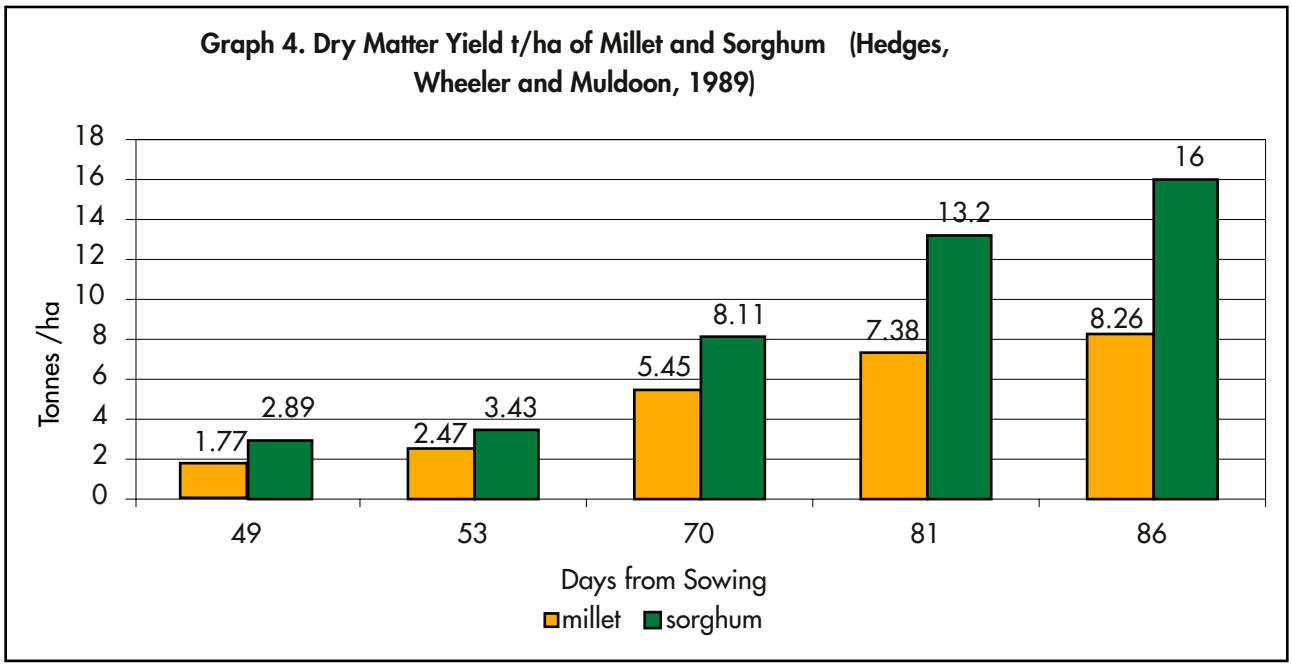
Palatability

As plants get older and taller, fibre content rises and animal intake declines. However, with sweet sorghums the sugar content reaches a peak in the older growth, so they can be efficiently used for fattening at a later stage.

Millet and Sudan grass have finer stems and leaves and better leaf-to-stem ratio than sorghum, and so are better suited to sheep

W. McDonald

In this variety trial, both forage millet on the left, and forage sorghum on the right have bolted past the optimum grazing or cutting stage. Yield will be high but feed quality will be low and only suitable for maintenance of dry stock.



grazing. Millet is generally superior to sorghum in feed quality and digestibility. Millets do not produce any HCN, so they can be grazed as soon as plant roots are developed enough to anchor the plants, if necessary. However, millets produce less total forage yield than sorghum hybrids (Graph 4). For example, the pennisetum hybrid millet, Nutrifeed, will produce about 80% of the yield of Jumbo.

Millet is capable of causing photosensitisation to the grazing animal under certain conditions, but can be safely grazed at a more immature stage for superior animal performance. Premature grazing will, however, reduce total production, especially if spelling time is inadequate.

Lamb feeding experiments at Trangie, NSW, comparing lamb growth on hay made from an early maturing sorghum (Sudax ST6) with that of millet (Shirohie) showed a significant **decline in digestibility** of both varieties as maturity advanced beyond 53 days after sowing. See Graph 3:

- millet digestibility fell from 70.3% at 53 days to 57.8% @ 86 days
- sorghum digestibility fell from 61.6% @ 53 days to 54.7% @ 86 days post-sowing
- hay cut for this experiment included the whole plant, whereas in a paddock situation animals would selectively graze more leaf and perform better.

Also in this experiment, lamb **liveweight gain/head** was determined on both millet and sorghum from 49 days post-sowing stage, and continued through to 86 days. There were increasingly heavy weight losses on sorghum from the 53 day stage as it matured and became lower in digestibility. Mean daily liveweight change on millet was plus 54 g/head. On sorghum it was minus 7 g/head (see Graph 5 below).

Note that Sudax ST6 was a quick-flowering sorghum (now unlikely to be available) which declined rapidly in quality with maturity. Most late flowering types now available should hold quality beyond the 53 day period. Shirohie millet is still available but it is one of the least productive varieties and both Pearl millet and current hybrids should out-perform it.

Ian Collett

The author inspecting hybrid sorghum which is short and uneven, severely moisture stressed and is therefore more likely to poison livestock with HCN.

Ian Collett

Irrigated hybrid sorghum, still leafy, rich green in colour but already past the most desirable stage of digestibility and needs immediate grazing or cutting.

4. SOILS AND FERTILISERS

A major cause of unsatisfactory forage crop performance is poor plant nutrition. Nitrogen deficiency is a common problem on many soils. Forage sorghum and millet are very heavy users of nitrogen especially, and when grown in favourable locations or with irrigation for high yields. Topdressing with nitrogenous fertilisers between grazing or cuts is often required to sustain high yields. There must also be an adequate supply of phosphorus, sulphur, potassium and other essential nutrients at sowing to carry the crop right through.

The rate of nutrient removal from the soil can be huge if dry matter yields are high. For example, one tonne of dry matter of sweet sorghum will remove approximately the following amounts of nutrients:

- Nitrogen 28 kg
- Phosphorus 3.5 kg
- Potassium 20 kg
- Sulphur 2.5 kg
- Calcium 3 kg
- Magnesium 3 kg

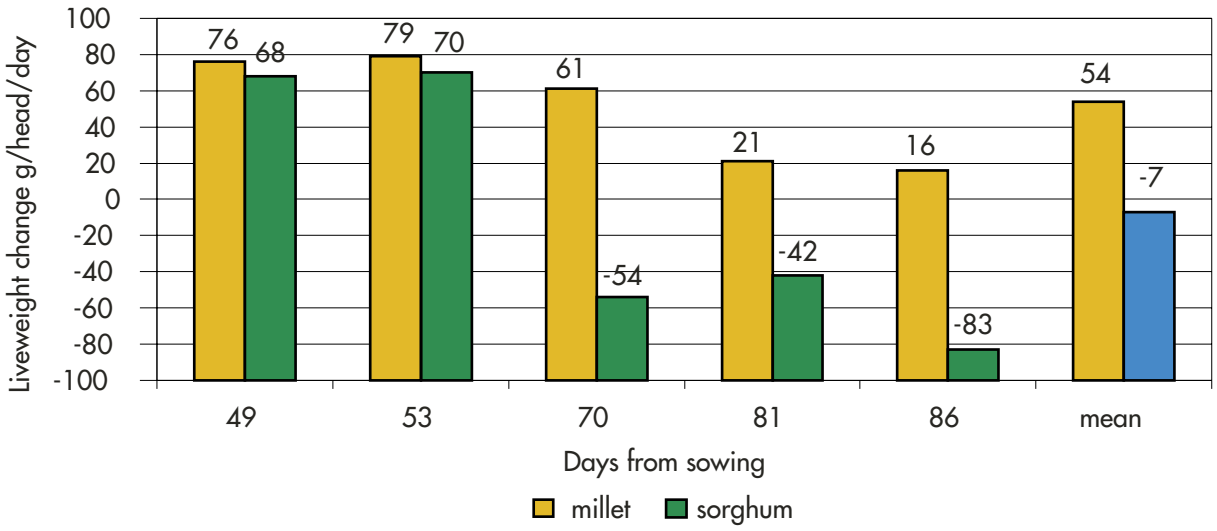
Calculations using the above figures indicate that a highly productive irrigated hay crop yielding 20 t/hectare dry matter removes approximately the following:

- 1160kg/hectare Urea
- 700kg/hectare single super
- 800kg/hectare muriate of potash
- 300kg/hectare dolomite

High yielding crops obviously require high fertility soils, but the soil must also have generous moisture-holding capacity and favourable structure and texture to at least 1 metre depth. These characteristics are even more essential for maximum yields in rain-grown crops.

Paddock history, previous crop performance, nutrient budgeting and reliable soil testing can help to determine likely fertiliser needs for sustainable forage cropping.

Graph 5. Lamb Liveweight Change (grams/head/day) on hay cut at 49 to 86 days from sowing (Hedges, Wheeler and Muldoon, 1989)



As a guide to soil nutrient status, a soil test should show the following thresholds:

- nitrate nitrogen level averaging at least 15 mg/kg down to 1 metre depth of soil (a deep core sample to 1 metre is required)
- phosphorus level of at least 50 ppm (Colwell test), or at least 30 ppm (Bray no. 1 test)
- sulphur level of at least 10 ppm (KCl test)
- potassium level of at least 0.4 (meq%/100 gm).
- pH between 5.5 and 7.5 (CaCl, extract)

Note that 15 cm sample depth is used for phosphorus, potassium and sulphur.

If a reliable soil test (for example from a National Analytical Testing Authority [NATA] accredited test laboratory) indicates lower figures than above, then appropriate fertilisers will be needed for best crop performance.

Sorghums tend to be low in sulphur up-take, so it is particularly important to supply enough sulphur.

5. ESTABLISHMENT

5.1 Area Required

The appropriate area of forage to sow will vary widely from farm to farm, and depends on many practical, physical, environmental, marketing, locality, and personal factors. Some factors which must be considered are:

- livestock numbers and target market
- equipment available for crop establishment
- management skill and knowledge
- soil depth and fertility
- environmental conditions

Sudan grass at the right stage for suitable digestibility and high feed volume to fatten young steers.

J.Gasparotto

- several small paddocks sown with staggered timing, say from early October to the end of November are easier to manage and more effective than one large one (unless it is divided up with temporary fencing).

Hot Tip: A limited area of well-grown fully-fertilised and well managed forage will generally give better economic results than a larger area with thinly spread resources.

As a general guide one hectare of well grown irrigated sorghum in north-western NSW should produce at least 15 tonnes of hay, or 40 tonnes of silage, or support between 7 and 10 adult cattle through the growing season, provided it is managed well and strip-grazed.

A well managed rain-grown crop in north-western NSW in an average season should perform at about 1/4 to 1/3 the yield of an irrigated crop.

5.2 Forage Budgeting

Forage budgeting is an objective way to help estimate the area to sow for any purpose. For a basic forage budget, a reasonable estimate of animal feed intake is 3% of animal liveweight per day. More accurate estimates of feed requirements for animals of different liveweights and stages of development are available from the PROGRAZE manual. The following is a simplified example of a forage budget which shows the steps involved.

The example animals are steers, each weighing 300 kg; the calculations are as follows:

- Daily feed requirement is 9 kg /head, on a dry matter (DM) basis, plus an allowance for wastage or trampling of 50%. Therefore 9 kg + 4.5 kg totals 13.5 kg DM/head/day.
- Our estimated total seasonal feed supply from forage is 10,000 kg DM/hectare.
- Potential stocking capacity therefore is 10,000 divided by 13.5 which equals 740 head/hectare for one day
- A realistic stocking capacity for, say, 60 days is calculated by dividing 740 by 60 which equals 12.3 head/hectare for 60 days.
- So if mob size was 100 head, the area of crop required is calculated by dividing 100 by 12.3, which is 8.1 hectare, rounded to 8 hectare.

CAUTION NOTE: On 15 cm rows no more than 20 kg/hectare nitrogen (eg. 40 kg/hectare urea) fertiliser should be sown in direct contact with seed to avoid potential seedling burn. On 30 cm rows the maximum rate would need to be 10 kg/ hectare nitrogen (ie. 20 kg/hectare urea) to achieve the same fertiliser concentration within the row. Concentrated compound fertilisers such as MAP and most 'starters' also have the potential for seedling burn and must not be sown in contact with seed above recommended rates. There is a greater risk of seedling burn on light-textured soils and where moisture is marginal than on heavy soils.

One lactating cow or calf unit is roughly equivalent to 15 dse (dry sheep equivalent), where one dse equals the feed requirement of one adult dry sheep. A 12 month old steer is equivalent to 9 dse (source: PROGRAZE manual 2000).

Millet and lower-yielding varieties typically produce about half the feed quantity of the better sorghum hybrids, so double the area sown to them when using the above calculation.

5.3 Preparation

Start preparing the paddock at least 12 months ahead to reduce the weed seed burden using techniques such as a cleaning crop, strategic grazing, cultivation and herbicides. Close to sowing time, aim to provide an even, firm seedbed, ideally with both surface soil moisture and good moisture well down the soil profile.

5.4 Timing

There may be pressure to sow as early in spring as possible to obtain feed quickly, to maximise forage crop usefulness and increase total production. However, forage sorghum and millet require stable minimum soil temperatures for at least three days for even germination and to encourage quick growth. If sown too early at lower soil temperatures the result will be a patchy, weedy crop, which is counter-productive and uneconomic.

Observing these temperature guidelines will help to ensure that germination and early growth are robust and rapid. Such crops will usually surpass struggling crops sown too early.

Recommended soil temperatures are typically reached from early October in the northern parts of NSW, but there is considerable variation. Soil temperature is influenced by factors such as moisture, climate, elevation, slope, aspect, soil colour and texture. Growers are advised to monitor individual seedbed temperatures to avoid establishment problems.

Sweet sorghums intended for late stand-over feed are best sown in mid January to February so that forage quality carries well into winter.

HOT TIP: Don't sow open pollinated millets such as Shirhoie until soil temperature stabilises at 14 ˚C or above (at seed depth at 8 am). This will produce the quickest possible spring feed. Sorghum and hybrid millets can be sown when soil temperature stabilises at 18 ˚C or above.

5.5 Seed Rate and Sowing Method

The following approximate guide to seed rates (Ttable 2, opposite) is reliant on using high quality, high germination percentage (eg. 95%) seed which is sown into a fertile, fine, firm and moist seedbed. With less ideal conditions, rates should be adjusted upwards to compensate. For example, if broadcast sowing into a rough seedbed, increase seed rate by 50%. High rates will increase crop density, resulting in finer stem growth, but this can increase risk of moisture stress, especially in rain-grown crops.

The sowing method should reliably place seed evenly, at the desired depth of 2-5 cm (sorghum) and 2-4 cm (millet), and in close contact with firm, moist soil. An excellent method is to sow with a seed drill or combine which has a band seeder attachment. A light trailing harrow or roller is an advantage where the surface is marginally dry and not prone to compaction. Broadcasting, harrowing then rolling into a well-prepared seedbed is also an effective method.

Row spacing ranges from 15–50 cm and depends on equipment available and purpose of the crop. Close spacing produces finer stems, which are better for fodder conservation purposes, and are appropriate under very favourable conditions where high yields are expected. Wider rows are applicable to less favourable situations. They allow easy animal access with less waste from trampling and are also desirable if sowing with forage legumes such as cowpeas.

No-till methods can be successful, provided that the soil is not compacted by years of grazing and that weed control is effective. There should also be good soil moisture down to at least 60 cm depth, and any previous crop residues should not obstruct sowing machinery. As a general rule, for a short term forage crop, it is less risky to sow into a seedbed after a cultivated or herbicide fallow period which ensures an adequate profile of soil moisture.

6. PEST CONTROL

6.1 Insects

Wireworm and cutworm can cause significant loss of seedlings especially if sowing into paddocks newly out of pasture. Seedbeds can be checked for wireworm before sowing and newly sown crops closely monitored at early emergence stage. Severe attack needs prompt insecticide control, but in practise control measures are usually too late; re-sowing may be the best option if time allows. For insecticide details refer to the booklet *Insect and Mite Control in Field Crops 2003* published by NSW Agriculture (now NSW Department of Primary Industries).

6.2 Weeds

In most situations potential weed problems will have been eliminated or at least reduced to manageable levels during previous preparations and weed seed reduction operations.

When required, early control of highly unpalatable broad-leaf weeds such as thornapple, Bathurst burr and Noogoora burr will be essential. Effective pre-emergent and post-emergent herbicides are available for these weeds in forage sorghum, but there are very few herbicides registered for millet. If unpalatable broad-leaf weed infestations are very heavy it may be advisable to plough in and start again.

Palatable grassy weeds, such as barnyard grass, summer grass and liverseed grass usually cause less problems. If infestations are extremely heavy they will compete strongly in the early stages and can smother the crop.

For herbicide control recommendations, refer to the booklet *Weed Control in Summer Crops 2000-2001* Agdex 100/640 published by NSW Agriculture (now NSW Department of Primary Industries).

6.3 Diseases

Diseases are usually insignificant particularly where crops are well managed and vigorous, and where desirable crop sequences are practised. Depending on climatic conditions and other factors, the diseases stalk rot, seedling blight, leaf blight and/or rust can sometimes be severe enough to reduce production in sorghum. Millet is susceptible to seedling blight and other minor diseases. There are no practical fungicidal controls for infected crops.

The relatively new disease sorghum ergot is also a possibility and is more likely to infect forage sorghum than grain sorghum. Crop rotation is the only practical defence against diseases in these forage crops. For more details see the leaflet *Ergot in Sorghum – A New Disease in Australia* published by Queensland DPI.

7. GRAZING MANAGEMENT

The following suggestions assume that the aim of the summer forage crop is to provide high quality, leafy, green, highly digestible and high protein forage in sufficient quantity to efficiently satisfy livestock growth rate and production requirements.

7.1 Introduce stock onto new forage slowly over a few days and never when they are very hungry. **Avoid digestive problems** by filling up hungry stock with safe feed such as cereal, or pasture hay with a low percentage of legumes, before introducing new forage.

7.2 Typical **height at start of grazing:**

Jap millet	20 – 30 cm
Pennisetum hybrid millet	40 – 60 cm
Hybrid sorghum	60 – 80 cm
Sweet sorghum	150 cm

Table 2. Guide to Seed Rates (note that rates recommended by seed companies may vary with the specific variety)

	Kg/hectare	
Situation	Sorghum/Sudan Grass	Millet
Marginal rain-grown	3	7
Average rain-grown	8	12
Favourable rain-grown	10	14
Irrigation	20	20
Irrigation (for green chop or hay)	30	25

Ian Collett

Hybrid sorghum still in the early vegetative growth stage. Quality is very high but yield is low, and there is a risk of HCN poisoning.

7.3 **Do not graze down too low** as this will slow the rate of recovery and reduce total production. **Use PROGRAZE minimum grazing forage mass benchmarks** as a guide to indicate when to remove stock. Annual crops such as sorghum and millet have a very limited time scale in which to establish, produce feed and recover. Any stress or check to growth will reduce forage production, which is never fully recovered.

7.4 Use enough subdivisional or temporary strip fencing and water supply to permit an adequate **rotational grazing strategy** (a 4 paddock system is the minimum) which will allow control of both the grazing and the recovery periods.

7.5 Allow for a relatively **short grazing period** (say one to two weeks) and longer **recovery period** (4 to 6 weeks) depending on rainfall, temperature etc.

7.6 If possible, **slash stubble** to a height of about 15 cm after grazing to encourage uniform regrowth, improve the speed of recovery and improve forage quality.

7.7 Avoid **animal health concerns**, such as potential HCN poisoning with sorghum, and potential nitrate poisoning with all forages, by grazing at safe growth stages (ie unstressed and taller than 0.5 metre for sorghum).

7.8 **Supply sulphur and salt blocks** (10 – 12% Sulphur) to animals grazing sorghum to compensate for low sulphur and sodium content in forage sorghum. This will improve feed use and help reduce potential HCN poisoning.

7.9 Provide ample **clean drinking water** and a **safe run-off paddock** nearby, or ample hay for emergencies.

7.10 Carry out all essential **animal health** tasks such as drenching, vaccination, etc, before grazing.

7.11 **CAUTION NOTES** Forage crops can be toxic to livestock at times, therefore grazing managers are advised to fully acquaint themselves of potential risks and seek expert assistance or veterinary advice before sowing and grazing these crops.

All sorghums have the potential to produce toxic hydrocyanic acid (HCN) in plant parts, especially when young or stressed and when shorter than 0.5 metres. All forage crops, under certain conditions, have the potential to build up toxic levels of nitrate, especially when heavily fertilised with nitrogen and growing only slowly. Pulpy kidney is a potential risk for all livestock grazing lush forage crops. Photosensitisation can occur in livestock grazing millet. These livestock health issues are usually made worse if stock are very hungry and no other feed is available.

8. HAY, SILAGE, GREEN CHOP

Maize is usually the preferred crop for silage due to its high quality and high yield. Sorghum and millet are also suitable provided they are cut at the correct growth stage. Forage sorghum silage and hay are best cut at around 0.8 to 1.3 metres high to give a reasonable compromise between acceptable feed quality and yield. If high level animal performance is required then sacrifice some dry matter yield for higher digestibility and cut at around 0.75 metres.

Sweet sorghum is typically chopped for pit silage or green chop at the dough stage which is about 1.5 to 2.5 metres high, depending on conditions and variety.

Sweet sorghum can be a high-volume silage crop. It will be low in protein but high in energy. By using one of the specialist silage sorghum hybrids, silage of even higher energy content can be produced. Bunker silage is best made with finely cut material 5 cm long or less, resulting in easier compaction, better air exclusion and superior quality.

Millet is best cut at or before the early head emergence stage for hay and silage, with the same quality versus quantity compromise as for sorghum.

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This is the ideal height, 60 to 80cm, in hybrid sudan grass and hybrid sorghum for best animal performance.

Coarse, stalky growth is low in digestibility and particularly unsuitable for plastic wrapped silage, as it is almost impossible to adequately compress and maintain airtight conditions.

Green chop for both sorghum and millet is generally cut at the same growth stages described earlier for grazing.

Refer to other publications specialising in fodder conservation techniques for detailed recommendations, including the NSW Agriculture (now NSW Department of Primary Industries) publication, *Dairylink – Conserving Feed;* Department of Primary Industries Queensland DPI notes: *Summer Forage Crops on the Darling Downs* Agdex 127/21; Silage Agdex 130/32; and NSW Department of Primary Industries publication *Silage for beef production* available from NSW Department of Primary Industries Tocal.

REFERENCES AND FURTHER READING

NSW Department of Primary Industries publication *Dairylink – Conserving Feed*.

Tropical Grasslands Vol. 23, No.4, Dec 1989 publication, *Effect of Age of Millet and Sorghum Hays on Their Composition, Digestibility and Intake by Sheep*, by Hedges,Wheeler and Muldoon.

Pacific Seeds Pty Ltd publications, *The Forage Book* edited by P.N.Stuart, 1990; and *Forage Sorghum Product Guide 2001*.

Department of Primary Industries Queensland DPI notes *Summer Forage Crops on the Darling Downs* 1998; *Silage forage crop and pasture – Darling Downs* 1999; *Profitability of Forage Crops* 1997; *Feedyear Planning – a technique for identifying feed gaps* 1997; *Forage Millets Darling Downs* 1999.

CRT publication, *The complete Summer Forage Guide, 1999*.

Pioneer Hi-Bred Australia Pty Ltd publication, *New Forage Releases, 1999*.

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Note: this publication does not cover legume forage crops such as cowpeas and Lab lab. They provide very high quality feed which is highly desirable for rapid weight gain. Their ability to fix nitrogen is a particular advantage on low nitrogen soils. These forages can be successfully sown alone or in mixtures with sorghum or millet especially where broadleaved weeds are not expected. Where mixtures are sown, the individual variety seeding rates need to be reduced. For information on summer legume forages refer to Agfact P4.2.16 *Summer Legume Forage Crops: Cowpeas, Lab lab, Soybeans*.

The winter forage crops including oats, triticale, winter wheat, and the brassica forages such as turnips, swedes, kale, hybrid forage brassica and forage rape, can also be most beneficial, and further details on these crops are available from NSW Department of Primary Industries *Winter Crop Variety Sowing Guide,* from NSW NSW Department of Primary Industries Agfact P2.1.13 *Forage Brassicas 2002*, and from commercial suppliers.

Also consult the NSW Department of Primary Industries home page: www.dpi.nsw.gov.au