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FORAGE SORGHUM AGRONOMY

Early paddock selection and preparation is advisable to take advantage of and utilise sowing opportunities for forage sorghums. The final decision on which forage sorghum variety to plant can be made nearer to sowing time when anticipated needs can be better identified.

SOILS & SOWING

Soil selection

Forage sorghum performs best on heavier soils due to their greater moisture holding capacity and natural fertility. Although forage sorghum has good drought tolerance and can be sown on lighter soils, productivity may be reduced unless adequate fertilising is carried out and good seasonal conditions prevail.

It is advisable to avoid planting on poorly drained soils or shallow country. Sowing on these types of soils normally results in a disappointing performance.

Soil preparation and planting

Forage sorghum is comparatively easy to establish, although an investment in good seed beds and sowing techniques will result in superior plant establishment and higher productivity.

Early preparation followed by a fallow period will allow better weed control and produce a finer seed bed. Rough seed beds will usually result in poor establishment.

Prepare the seed bed in a similar manner to winter cereal, grain sorghum or corn. In preference to broadcasting and working in, plant with a combine, air seeder, or row crop planter. The use of press wheels or rollers to provide good seed/soil contact is also recommended.

It is difficult to exert too much press wheel pressure on forage sorghum. However, in many cases the greatest problem has been exerting too little pressure and not providing the required seed/soil contact - especially when the seed bed is drier than ideal.

The use of harrows, chain or mesh behind the roller or press wheels will help to avoid crusting on soils prone to crusting.

In the absence of a roller or press wheels, consider using inverted harrows. This will provide some seedbed compaction, yet leave the coarser material on top. This technique is recommended only for good seed beds.

Broadcasting and incorporating

This system can provide good results; however it should only be used when there is no alternative.

a) Prepare a seedbed as you would for conventional sowings.

b) Work the ground with the aim of covering the seed with 2-5cm of soil. With this system it is not possible to get all the seed to the desired 5cm depth.

c) Harrow and roll the ground to provide good seed/soil contact. This will also reduce the rate of drying of the surface soil, giving the shallow placed seed a better chance to establish.

Light rain or a quick irrigation after broadcasting is the best means of ensuring a good, uniform establishment, but only on non-crusting soils.

Sowing depth

Depending on the situation, sowing depth can vary from 2-10cm, but for most soils a 5-6cm sowing depth will provide the best establishment. The key to a successful strike is to plant as shallow as possible but deep enough to ensure adequate moisture for germination.

Irrigation

Despite the benefits that irrigation offers, there is still a need for close attention to seedbed preparation and sowing technique in order to achieve the best results.

Although the irrigation farmer can control his sowing time and moisture for crop establishment, these advantages are worth little without proper preparation.
Sowing time
One of the critical factors which determines how early to sow is soil temperature. This has a large effect on the speed of germination and rate of seedling growth. Towards the time when sowing is anticipated, check the soil temperature by placing a thermometer into the cultivated soil at planting depth at 9am. It is best to do this over a number of days to determine any apparent trends. Soil temperatures are publicised in many areas or are available from local Department of Agriculture offices.

For forage sorghum, soil temperature should be 18°C and rising to provide a good establishment and vigorous early growth. Sowing at 16°C can be successful provided soil temperature is rising.

Table 1 outlines the risks involved by planting at lower temperatures. It should be noted that low temperature has a far greater effect on seedling emergence than on actual seed germination, as shown.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Effect on germination</th>
<th>Effect on seedling emergence</th>
</tr>
</thead>
<tbody>
<tr>
<td>12°C</td>
<td>Slow germination providing time for soil borne pests and diseases to attack</td>
<td>Poor emergence coupled with increased incidence of soil diseases (Pythium, Fusarium etc).</td>
</tr>
<tr>
<td>15°C</td>
<td>Satisfactory germination</td>
<td>50% emergence to be expected. Similar disease expectations as at 12°C.</td>
</tr>
<tr>
<td>16°C</td>
<td>Good germination</td>
<td>Adequate for good emergence.</td>
</tr>
<tr>
<td>18°C</td>
<td>Good germination</td>
<td>Good, quick emergence.</td>
</tr>
<tr>
<td>20°C</td>
<td>Ideal</td>
<td>None.</td>
</tr>
</tbody>
</table>

KEYPOINT: It is impossible to control rainfall and therefore growers must evaluate planting opportunities as they occur. In some seasons planting opportunities will arise when soil temperatures are considered too low. A decision to sow may be made however, after weighing up the risks and feed situation. Table 1 helps identify some of the risks. If you intend to plant in cooler conditions you should consider a higher planting rate to compensate for the lower seedling emergence.

Row spacing
Forage sorghum will produce similar results on a varied range of spacing, from 15cm to 1m. For grazing purposes, it is suitable to use any spacing that is convenient for the planting machinery. For hay production purposes narrower row spacings are more popular. In drier regions wider row spacing can be more beneficial, as the subsoil moisture between the rows acts as a reserve to be tapped as the roots develop into it.
Sowing rates
The most common sowing rates are shown in Table 2 and Table 3.

**TABLE 2**
Sowing rates - sorghum x sudan hybrids and sweet sorghum hybrids (e.g. Sweet Jumbo LPA and Sugargraze). Average seed count 30,000 seeds/kg.

<table>
<thead>
<tr>
<th>Situation</th>
<th>Sown alone (kg/ha)</th>
<th>Sown with legume companion crop (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal dryland</td>
<td>3 - 5</td>
<td>2 - 4</td>
</tr>
<tr>
<td>Favourable dryland</td>
<td>5 – 10</td>
<td>3 - 6</td>
</tr>
<tr>
<td>Irrigation/coastal</td>
<td>15 - 25</td>
<td>10 - 15</td>
</tr>
</tbody>
</table>

The lower rates are only for good seed beds, ideal sowing times and when using planters with effective rollers or press wheels.

**TABLE 3**
Sowing Rates - sudan grass (e.g. Superdan 2 and Nectar). Average seed count 80,000 seeds/kg. A good guide is 70% of the sorghum x sudan sowing rate.

<table>
<thead>
<tr>
<th>Situation</th>
<th>Sown alone (kg/ha)</th>
<th>Sown with legume companion crop (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal dryland</td>
<td>2 - 4</td>
<td>2</td>
</tr>
<tr>
<td>Favourable dryland</td>
<td>5 – 8</td>
<td>2 - 4</td>
</tr>
<tr>
<td>Irrigation/coastal</td>
<td>10 - 20</td>
<td>Uncommon</td>
</tr>
</tbody>
</table>

The lower rates are only for good seed beds, ideal sowing times and when using planters with effective rollers or press wheels.

**Wireworm**
There are several species of wireworms which can attack the seed and to a lesser extent the roots. The larvae feed on the seeds as soon as they are sown, thus destroying the seed. The symptoms of wireworm damage are bare areas of various sizes and a general thinning of the crop.

When wireworms are present or anticipated, some means of control should be considered. Various insecticides can be used either as a seed dressing or applied with water injection behind each planting tyne. Press wheels can also help reduce damage from wireworms.

**Cutworm**
Cutworms can also be a problem as they chew through the young seedlings stems at, or slightly below the soil surface. Control measures include applying a suitable registered insecticide. Once again, check label recommendations before purchase.

As chemical registrations vary from state to state, consult label recommendations before application.

**OVERCOMING SOME COMMON ESTABLISHMENT PROBLEMS**

Based on field experience, some common problems faced by growers and the suggested prevention measures have been listed below.

**Problem (a): Patchy poor strike**
**Symptoms:**
- Emergence is satisfactory in sections of the paddock, but poor in others.

**Reasons and advice:**
- Planting too shallow or too deep. Ensure seed is sown into moisture, this is generally about 5cm, it is not advisable to go much deeper than this.
- Check seed placement.
- Check for insect damage to the seed or seedlings. Note any common factors between the areas of good and bad establishment. It is essential that early inspection is done to make identification, before the insects move into their next life cycle. Monitoring prior to planting and taking preventative measures is recommended.

**Problem (b): Uniformly poor strike**
**Symptoms:**
- Overall poor seedling establishment.

**WEED & PEST CONTROL**

**Weed control**
In order to achieve maximum productivity, good weed control in forage crops is now being accepted to be just as important as weed control in grain crops. Weed infestation will severely affect crop growth.

A number of herbicides are registered for use on forage sorghum and will cover most situations. The most common herbicide used is ‘Atrazine’® which can control some grasses and a wide range of broadleaf weeds.

Current recommendations are available from your government advisor or local chemical distributor.

**Insect pest management**
Overall there are few insect pests of great concern in established forage crops. However, wireworm and cutworm can be very destructive in the early stages of germination and establishment.
Reasons and advice:
- Poor seed/soil contact caused by planting into a rough or wet seed bed or not using press wheels or roller to provide adequate seed/soil contact.
- Planting too deep, particularly in softer soils where the planter sinks into the soil when planting. Check planting depth at regular intervals.
- Planting too early into cold soil. Know the risk by monitoring soil temperatures prior to planting.
- Heavy rain or irrigation following planting can cause crusting and compaction of the soil above the seed. A light harrowing before emergence may overcome crusting.
- Seed quality. Always retain a representative sample of seed to check germination if in doubt. This is very rarely the cause of poor establishment unless the seed is old or stored in conditions detrimental to seed quality.

Problem (c): Seedling death/slow development
Symptoms:
- Seedlings show very slow growth and/or death.

Reasons and advice:
- Insects or diseases attacking the seedling. Early investigation to isolate the cause is essential.
- Planting too early will slow plant growth until conditions improve and temperatures warm up.
- A hard pan or dry layer beneath the seed will impede proper root development and stunt seedling growth. Check the moisture in the whole profile before planting.

Problem (d): Poor growth
Symptoms:
- Seedlings are slow growing and/or an abnormal colour.

Reasons and advice:
- Poor nutrition, particularly phosphorus and/or nitrogen. Correcting any soil deficiencies by fertilising and using a starter nitrogen and phosphorus fertiliser to give the seedling a ‘kick-start’, is highly recommended.
- Soil type unsuitable for the crop planted. If the country has been recently flooded, the soil can be in an anaerobic condition and there is poor nutrient availability to the plant.

FERTILISER REQUIREMENTS
As with all crops, it is necessary to have a soil with well balanced fertility in order to achieve optimum growth and feed value. High levels of nitrogen, in particular, will ensure high protein, fast growth and quick recovery after grazing or cutting. Consequently a good nitrogen program is necessary, provided moisture and other nutrients are adequate.

TABLE 4 Amounts of fertiliser that can be applied at planting with forage sorghum seed

<table>
<thead>
<tr>
<th>Row spacing (cm)</th>
<th>Nitrogen kg/ha</th>
<th>Phosphorus kg/ha</th>
<th>Maximum product (kg per ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Urea</td>
</tr>
<tr>
<td>18</td>
<td>24</td>
<td>50</td>
<td>54</td>
</tr>
<tr>
<td>35</td>
<td>12</td>
<td>25</td>
<td>27</td>
</tr>
<tr>
<td>45</td>
<td>10</td>
<td>20</td>
<td>23</td>
</tr>
<tr>
<td>70</td>
<td>7</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>90</td>
<td>5</td>
<td>10</td>
<td>11</td>
</tr>
</tbody>
</table>

Notes:
1) The rates given in Table 4 should be reduced by 50% for very sandy soils. The rates may be increased by 30% for heavy textured soils or where soil moisture conditions at planting are excellent.
2) The rates are for conventional seeding equipment. Minimum or zero till equipment with slit openers tend to increase the fertiliser concentration and the fertiliser rates in Table 4 should be reduced by 50%.
in these situations is wasted feed and lower feed value, resulting in significantly reduced livestock performance.

Therefore, there is a need to understand prussic acid poisoning to:

a) Maximise livestock production from forage sorghum, and
b) Avoid potential stock losses.

**WHAT IS PRUSSIC ACID?**

Cyanogenic glucosides are a natural component of the plant which, when eaten by stock, are converted to hydrogen cyanide (HCN). In sufficient quantities this can lead to hydrogen cyanide poisoning or, as it is commonly referred to, prussic acid poisoning.

When animals consume forage sorghum containing cyanogenic glucosides, prussic acid is released and may be absorbed into the blood and carried to body tissue where it interferes with oxygen utilisation by the cells. Prussic acid poisoning is not a major problem provided sensible grazing management is adhered to.

Once stock have settled into a sorghum paddock, a portion of the forage they consume is high in prussic acid causing compounds (e.g. young growth, old stressed plants) but this has no effect because the toxic plants are only part of the diet and the animal is in a steady, rather than rapid intake, grazing pattern. However, environmental conditions can change which can result in a change in the level of these compounds in the plant, and this can in turn affect animal production.

**Symptoms of prussic acid poisoning**

Symptoms include muscle trembling, staggers, deep and rapid breathing, frothing at the mouth and gasping respiration. Collapse, coma and death may occur in extreme cases.

**Factors which influence the level of prussic acid**

1) **Stress (the most important influence)**

A plant which is under stress - particularly moisture stress - will have a higher level of prussic acid causing compounds than a plant not under stress, especially if the plant is in the young stage and less than 0.5 to 1m tall.

2) **Stage of growth**

The level of prussic acid decreases as the plant gets older and it is generally considered that once a healthy plant reaches 80cm to a metre tall the level of prussic acid is below a dangerous stage.
3) Sorghum type (genotype)
The sudan grasses, e.g. Superdan, are considered to be generally low in prussic acid whereas the sweet sorghum and grain sorghums are considered to be high.

There is a third group which comprises the majority of the forage sorghums and these are sorghum x sudan grass crosses which have a moderate level of prussic acid.

However, within each genotype or group there can be significant variations which have been identified by breeders and used in breeding programs. So, depending on individual parents, there is a difference in prussic acid levels between varieties.

Irrespective of varietal differences, caution should always be exercised, as even the varieties traditionally low in prussic acid can reach dangerous levels under severe stress.

4) Nutrient balance
High nitrogen levels in a plant can increase the prussic acid content, as can low soil phosphorus levels.

Recommended grazing management
1) Height
The plant should be healthy and preferably 80cm to 1m tall.

2) Stock condition
Starving stock should not be introduced to forage sorghum, particularly if the forage sorghum is young or showing any signs of stress.

3) Sulphur
Sulphur blocks are always highly recommended when grazing forage sorghums. When stock only have forage sorghum in their diet, they will become sulphur deficient, as forage sorghum is always low in sulphur. Therefore the significant effects of prussic acid in forage sorghum are not the infrequent fatal poisoning of animals, but the less obvious consequences. These include a depression in voluntary feed intake, sulphur deficiency and a decrease in growth rates.

The sulphur deficiency is increased when the forage has a high prussic acid level. This is because sulphur is used in a detoxification reaction within the animal which converts prussic acid to the nontoxic thiocyanate. Animals have this ability to break down the prussic acid as long as they have enough sulphur.

Sulphur deficiency causes a reduction in appetite which in turn leads to a decline in average daily weight gains or milk production.

As well as intake declining, there may be certain amino acids which become limiting factors to production. When this occurs, tissue synthesis and the ability to increase live weight in the animal decreases.

4) Salt
All forage sorghum varieties are low in salt and animals fed salt licks will show better performance.

Conserving forage sorghum high in prussic acid
1) Hay
Making hay from this material will decrease the prussic acid content to some extent, however as the moisture is reduced stock can consume the remaining dry matter (therefore prussic acid) more quickly, which increases the poisoning potential.

Standing forage that has a high prussic acid potential will also have a high prussic acid potential as hay.

2) Silage
It is widely reported that the silage process results in a decrease in the prussic acid content. Also, no cases of prussic acid poisoning from sorghum silage have been recorded.

What to do with a stressed crop
When a crop is less than 1m tall and stressed, particularly drought stressed, there are two options:

a) The preferred option is to wait for rain to freshen up the crop to reduce the prussic acid, as it really is considered too risky to graze.

b) If the farmer is in a position where feed is extremely short and he wants to utilise the available sorghum, the following precautions should be taken:

i. Give the stock a good feed of hay or straw etc so when they are introduced onto the sorghum paddock they are full and will commence grazing in a slow manner. When an animal consumes a large quantity of toxic forage rapidly, its body cannot neutralise the prussic acid at the rate of intake and poisoning occurs.
productivity the aim should still be to commence grazing when the crop is approximately 1m tall. The main benefit of growing late flowering forage is that if grazing is delayed until several weeks after the optimum time, the crop will not have flowered and there will be better utilisation of feed. Therefore, under less intensive management systems where large areas are sown, or where greater flexibility is required Sweet Jumbo LPA, Superdan 2 or Nectar should be the preferred choices.

GRAZING MANAGEMENT FOR SUGARGRAZE

This variety belongs to the sweet sorghum hybrid group. The characteristics and application of Sugargraze vary significantly from the sudan and sorghum x sudan hybrids. If early grazing is required, Sugargraze can be grazed once it reaches 1.5m in height. It can also be left to grow and grazed later if feed is not needed until further in the season. For best regrowth do not allow stock to graze the crop lower than 15cm. It should also be remembered that sweet sorghums do not regrow as quickly after grazing as the sorghum x sudan hybrids. The real benefit of Sugargraze is its versatility, as it can provide useful feed at many stages of growth, from young growth right through to the post flowering stage and even after frost. As such, it can provide a ‘standing haystack’ for late autumn - early winter feed with the sweet stems ensuring minimal wastage. Although not as sweet as Sugargraze, Nectar can also provide this standover feed into autumn - early winter.

GRAZING MANAGEMENT FOR SUPERDAN 2, NECTAR, PACIFIC BMR AND SWEET JUMBO LPA

These hybrids belong to the sorghum x sudan and sudan grass groups. The ideal grazing height for this group is 1m which provides safe, high quality feed (in terms of protein and energy) as well as allowing for proper plant development. As forage gets taller, quality declines, although available bulk increases.

To achieve the best quality feed, rotational or strip grazing methods should be used. With intensive forage crops electric fencing is useful, provided wires are visible to stock. By grazing the forage at an early stage and then allowing regrowth, the best quality feed is obtained. For best regrowth, remove stock before the crop is grazed below 15cm.

Traditional quick flowering hybrids need to be intensively managed to prevent the crop going to head. Once the crop does go to head, feed quality will decline and a lot of feed will be trampled and wasted. If this does occur, slashing the uneaten stalks (to 20cm height) will promote better regrowth. This problem does not occur to the same extent with Sweet Jumbo LPA or Superdan 2 which have been developed to be later flowering.

However, even with the late flowering hybrids, it is not recommended that grazing be unnecessarily delayed. In other words, late flowering does not mean late grazing. For maximum stock

2. Introduce sulphur blocks to cattle well before they go into the sorghum paddock so they have sulphur in their system and have become familiar with their use.
3. Closely monitor the stock and if there is any indication of any toxic reaction occurring within the cattle, remove them immediately.
4. Be ready to drench affected stock. Affected stock can be treated by drenching with a ‘hypo’ (photographic sodium thiosulphate) solution at the following dose:

<table>
<thead>
<tr>
<th>Animal</th>
<th>Metric</th>
<th>Imperial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>56 grams of hypo in 500mls of water</td>
<td>2ozs of hypo in 1 pint of water</td>
</tr>
<tr>
<td>Sheep</td>
<td>14 grams of hypo in 500mls of water</td>
<td>0.5oz of hypo in 1 pint of water</td>
</tr>
</tbody>
</table>

Swiss Brown cows at a trough of forage silage.

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