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Grain sorghum: NSW planting guide 2006–07

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Key management issues 2006–07

- Use no-till for dryland crops as stored soil moisture increases more quickly and deeply than conventional fallows, thereby leading to increased yields and water use efficiency.
- Use response cropping in favourable dryland areas to reduce the risk of deep moisture drainage.
- Be aware of the possible risks associated with growing sorghum after canola or mustard as VAM levels are at their lowest following these crops.
- Adjust plant population and row spacing to target yield. Uniformity is the key.
- Use nitrogen fertiliser rates based on target yields, soil tests and/or previous crop yields and protein levels.
- Use effective weed control, especially for grasses.
- Consider previous herbicide applications for potential residues in the soil and herbicide resistance in weeds.
- Select at least two hybrids that have the desired characteristics for your sowing conditions to spread production risk.
- Reduce the risk of ergot in northern NSW by planting crops so that they flower by mid-March.
- Wide sowing windows occur for most areas. Avoid sowing too early (cold) or too late (ergot and frosts). Aim to avoid flowering during extreme heat.
- Monitor and if necessary control insects, especially wireworms, midge and heliothis.
- Desiccate crops using knockdown herbicides at physiological maturity to hasten dry down, improve harvesting and start recharging the fallow in dryland crops, unless dry seasonal conditions dictate otherwise.
- Be prepared to dry grain with late sown crops.
- Plan your grain marketing.

Soil moisture and fallow management

Don’t plant grain sorghum unless the soil is wet to a minimum depth of 1 m. Planting sorghum with less than one metre of wet soil significantly reduces yields, increases the risk of crop failure and places a greater reliance upon in-crop rainfall to produce an economic yield.

Crops sown on heavy clay soils with 1.5 m of wet soil and receiving 100 mm of effective rain should yield about 3.5 t/ha but crops starting with 1 m of wet soil plus 50 mm of effective rain will yield only about 1.3 t/ha. After the initial 100–110 mm of soil water is used, sorghum can produce grain at the rate of about 15 kg/ha/mm of stored soil water.

Using this water use efficiency estimate, producers with good management practices should be achieving long-term average yields in the Quirindi area of 5 t/ha; Gunnedah, Inverell and Tamworth districts of 3.5 to 4.0 t/ha, and in the Moree and Narrabri districts 2.5 to 3.0 t/ha.

Increasingly, producers are using no-till and minimum till fallows following winter crops. No-till crops following winter cereals consistently yield approximately 0.5 t/ha more than conventional crops because no-till fallows store about an extra 30 mm of available water. Using no-till and minimum till fallows enables crops to be sown up to 6 to 7 weeks after rain. This widens the planting window, increasing the likelihood of achieving an optimum sowing time. It can also mean the difference between planting a crop on no-till and minimum till fallows and not planting a crop on conventional fallows. No-till fallows are often started with one or two sprays of glyphosate in the late summer and autumn, followed by an atrazine spray in late autumn – early winter and a glyphosate or glyphosate-atrazine application during September. The minimum till fallows have 2–3 cultivations before a late winter application of atrazine.

Successful sorghum crops have been grown immediately after winter pulse crops provided the soil is wet to 1 m depth. Growing sorghum crops immediately following canola or mustard is not advised as these brassica crops can have a strong allelopathic effect and can reduce VAM levels.

Hybrid selection

Selecting the right hybrid will depend on the location and seasonal prospects. Growing two or three hybrids with different characteristics can help spread production risk. Hybrids available for planting in the 2006–07 season are listed in Table 1. Hybrid characteristics are listed in Table 10 with varietal performance in trials included in Table 11. This may assist you in selecting varieties suitable for your area.

Maturity

Select hybrids with a maturity length suitable for the local climatic conditions. With good to average dryland conditions on the North-West Slopes and Liverpool Plains, the medium-slow to medium maturity hybrids are recommended. On the North-West Plains, the medium to medium-quick hybrids are recommended, depending on subsoil moisture storage. Under irrigation, hybrids with longer maturity and therefore higher yield potential are best. Changing row configurations may vary these recommendations.

In northern NSW, quick maturity hybrids take about 66 days from planting to the start of flowering, medium maturity hybrids take about 73 days and slow maturity hybrids take about 80 days. The time a hybrid takes to reach flowering will vary, depending on temperature. At Moree for example, medium maturity hybrids planted in early October take about 80 days to flower but only take about 60 days when planted in mid-November. At Spring Ridge, medium maturity hybrids planted in early November flower in about 80 days compared to 65 days if sown during late November.

Table 1. Sorghum varieties available for 2006–07

Maturity	Hybrids
Dryland North-West NSW	
Medium Slow	Enforcer (Hylan) 85G83 (Pioneer Hi-Bred – even though the maturity is medium-slow, the company recommends this variety for tough dryland conditions)
Medium	Armour (Hylan)
	Banjo (Lefroy Seeds)
	Bonus MR (Pioneer Hi-Bred)
	Dominator (Hylan)
	Liberty (Hylan)[a]
	MR Bounty (Pacific Seeds)
	MR Buster (Pacific Seeds)
	MR Maxi (Pacific Seeds)
	MR 43 (Pacific Seeds)
	Overflow (Lefroy Seeds)
Medium Quick	MR Goldrush (Pacific Seeds)
	MR Pacer (Pacific Seeds)
	MR32 (Pacific Seeds)
	PAC2417 (Pacific Seeds)
	86G87 (Pioneer Hi-Bred)
	Patterson (LeFroy Seeds)
	Venture (Hylan)
Irrigation in Northern NSW (based on company recommendations)	
Medium Slow	Enforcer (Hylan)
Medium	Bonus MR (Pioneer Hi-Bred)
	Dominator (Hylan)
	Liberty (Hylan)[a]
	MR Buster (Pacific Seeds)
	MR Maxi (Pacific Seeds)
	MR Pacer (Pacific Seeds)
	MR43 (Pacific Seeds)
Medium Quick	86G87 (Pioneer Hi-Bred)

[a]White sorghum

Yielding ability

Choose hybrids that have a high yielding ability under a range of seasonal conditions. Use hybrid trials as a guide (see Table 11). Trial the hybrids on your farm and grow those that perform best on average.

Lodging and disease resistance

Lodging can be a problem in all dryland growing areas. Select hybrids with good lodging resistance where severe moisture stress is likely during the latter stages of grain fill. Moisture stress is the most common cause of lodging. Fusarium and charcoal stem rots are often associated with lodging, leading to plant death and considerable yield loss. Crops that remain green with some available soil moisture during grain-fill are generally less prone to lodging.

Agronomic practices such as no-till, stubble retention and controlled traffic farming, which all aim to store more in-fallow and in-crop rainfall, will help reduce lodging. The use of low plant populations and wide rows, especially in the North-West Plains, will also help. These practices will also allow medium maturity hybrids with higher yield potential to be grown.

Lodging is rarely a problem on fully irrigated crops but can occur in partially irrigated crops that are stressed during the later stages of grain fill.

Select hybrids that are resistant to diseases prevalent in your area. Information on the disease reaction of hybrids is available from seed companies.

Sorghum midge resistance

Most hybrids have good levels of resistance to sorghum midge. Newly released hybrids are tested by the Industry Testing Group, comprising Queensland Department of Primary Industries and seed companies, for their midge resistance. Refer to Table 10 for midge resistance ratings and to Tables 8 and 9 for economic thresholds for spraying. Midge resistant hybrids have significantly reduced the need to spray. The top midge rating is 8+.

Organophosphate reaction

Some hybrids have a phytotoxic reaction to organophosphate (OP) insecticides. This causes spotting to intense purpling of leaves and stems. When crops are likely to be sprayed with OP insecticides, it is suggested to grow tolerant hybrids with a rating of 4 or 5 to reduce possible yield losses. See Table 10 or consult seed companies for hybrid ratings.

Planting time

The preferred planting time for Moree and Narrabri districts is early October to mid-November and for Gunnedah, Inverell and Tamworth districts, mid-October to late November. Planting at the beginning of these windows is often more successful in minimising moisture stress during flowering. However, the earlier planted crops are more likely to suffer from cold conditions as seedlings. Planting by early January so that crops finish flowering by mid-March may reduce the risk of sorghum ergot infection. January planted midge resistant hybrids with good soil moisture and nutrition still have good yield potential despite being slower to dry down and being more prone to midge damage.

Sorghum should be planted when the soil temperature at 9 am EST at the intended seed depth (about 5 cm) is at least 16°C (preferably 18°C) for three to four consecutive days and the risk of frosts is past. Soil temperatures usually reach 16°C in early October at Moree and mid-October at Gunnedah.

Planting into cold soils slows emergence, reduces germination and establishment and increases susceptibility to seedling blight. Low soil and air temperatures slow plant growth and reduce nutrient uptake (especially phosphorus) inducing purpling in some hybrids. Note that some hybrids tolerate cold better than others.

Crop establishment

Apart from moisture stress, poor crop establishment, low seedling vigour and weed competition are usually the major factors that significantly reduce yields. The following guides should help to improve crop establishment and crop yields.

- Precision planters achieve more uniform establishment. Accurate depth placement of seed is essential.
- Parallelogram planters capable of following paddock undulations, with large diameter depth wheels located within the frame and tines or discs mounted on the planter units, will give the best results.
- In moist seedbeds, the seed should be placed about 5 cm deep. In dry seedbeds using moisture seekers for deep furrow planting, the seed is placed under 5 cm of moist soil. This may be 10–12 cm below the original soil surface.
- Press wheels are essential not only to improve establishment but also to help control soil insect pests of germinating and emerging sorghum, including true and false wireworms. Use press wheel pressures of 6 to 10 kg/cm wheel width for no-till and minimum till seedbeds. Use pressures at the higher end of the range when seedbed moisture is marginal, seed is deeply planted, tilth is poor or soil insects are present. Use pressures at the lower end of the range when soils are hard

setting or surface crusting. Crop establishment is improved when the shape of the press wheel matches the shape of the seed trench. Planting speeds above 10 km/h generally reduce establishment, or above 8 km/h if disc openers are used.

Plant populations

Even though target plant population will vary with conditions, the uniformity of that plant population is always extremely important. The plant populations targeted depend on the depth of soil moisture at planting and the likely growing conditions (see Table 2).

Table 2. Plant population guide

Growing conditions	Target population 000/ha
Dryland	
Good conditions	40–60
Av. Conditions	30–45
Marginal areas	20–35
Irrigation	
Supplementary	100–150
Full	200–250

Consider re-planting when populations are less than about 12 000–15 000 plants/ha, especially with quick maturity or low tillering hybrids.

In skip row situations, aim for plant populations similar to average dryland moisture conditions.

When calculating planting rates allow for 20 to 25% for establishment losses when planting into a very good seedbed on heavy black soil using press wheels and 40 to 50% when seedbed conditions are fair or when press wheels are not used. Obtain the number of seeds/kg and the germination percentage from the bag label.

$$\text{Planting rate (kg/ha)} = \frac{\text{Required number of plants/ha} \times 10\,000}{\text{Seeds/kg} \times \text{germ\%} \times (100 - \text{establishment loss \%})}$$

Example

$$\text{Planting rate} = \frac{40\,000 \times 10\,000}{30\,000 \times 90 \times (100-25)}$$

$$= \frac{40\,000 \times 10\,000}{30\,000 \times 90 \times 75}$$

$$= 1.98 \text{ kg/ha}$$

Row spacing

Narrow rows (≤75 cm) outyield wide rows under good growing conditions, therefore narrow rows are more appropriate with high-yielding irrigated crops and/or high rainfall environments, while wide rows (≥1 m) are more advantageous in low moisture, lower yielding dryland situations. Table 3 is a useful guide to determine which row spacing is more appropriate for a particular target yield in a dryland situation.

A method of conserving water during the vegetative stage of a crop, for use at flowering and grain fill, is broadly termed 'skip row'. This term indicates that the row configuration is changed by 'skipping' or not planting rows. This 'skip row' management strategy has been used with peanuts, cotton and maize, as well as sorghum.

An alternative is a 'wide row' configuration, for example sowing all rows on 1.5 m spacings.

When discussing row spacing for sorghum, it is useful to refer to the table below:

Table 3. Optimum row spacing for expected yield

Expect yield	Optimum row spacing
Above 4 t/ha	≤ 0.75 m
3–4 t/ha	≤ 1.0 m
Below 3 t/ha	≥ 1.0 m

Table 4. Wide/ Skip row configurations used to plant sorghum

Row configuration	Rows planted
1.0 m solid plant	All rows planted on 1.0 m row spacing
1.5 m solid plant	All rows planted on 1.5 m row spacing
2.0 m solid plant	All rows planted on 2.0 m row spacing
Single skip	Two rows planted, one row unplanted
Double skip	Two rows planted, two rows unplanted

The use of wide or skip row configurations should conserve some soil water for later in the growing season. These configurations are most effective when starting soil water levels are good with the wide areas between rows acting as a buffer for poor or variable in-crop rainfall. In more marginal dryland areas, growers could regard wide rows as mandatory and consider single skip / double skip. These wider rows improve risk management by increasing yield stability and reduce the risk of crop failure. However, in high yielding environments, resulting in 1.0 m solid plant yields of 5 t/ha or higher, yield loss of 10%–30% (compared to solid plant) should be expected if wide or skip row configurations are used.

Agronomic management is very important if sorghum is planted on wide or skip row configurations. Plant population should be the same as solid plant on an area basis (same plants/ ha). Uniform plant establishment within rows will maximise the water use between the wide rows. Stubble retention (ground cover) will reduce water and soil loss between planted rows. Effective weed control before and during the season is critical, otherwise the advantages of the wider rows will be lost.

Sorghum sown using wide or skip row spacing should have a lower risk of pest problems (midge), lower herbicide costs (if band spraying) and more even flowering and dry-down time improving harvestability.

The yields from skip row spacings in wet seasons may be less than solid plant, however, research indicates that in some instances where chickpeas are double cropped into skip row sorghum, the gross margin was higher than where the chickpeas were double cropped into solid plant sorghum. These results will obviously depend on both the summer and winter seasons and commodity prices.

Weed control

Significant yield losses occur if weeds are not killed until four to five weeks after planting. For effective control of most weeds, apply atrazine either before planting, at planting or immediately after planting. Apply Primextra® Gold, Dual® Gold or other metolachlor products as a pre-emergent spray for grass control, especially liverseed grass. Treat seed with Concep®II seed safener when using Primextra® Gold, Dual® Gold or other metolachlor products.

No-till and minimum till fallowed crops where atrazine and glyphosate have been applied, will usually have excellent weed control at planting and during crop growth. Also, these fallows conserve more soil moisture and improve the chances of planting crops at the optimum time.

Atrazine residues prevent the planting of crops other than sorghum or maize for 18 months after application of 2.5–6.5 L/ha of atrazine 500 g/L, 1.4–3.3 kg/ha of atrazine 900 g/kg or more than 3.2 L/ha of Primextra® Gold. Check the herbicide label. Where residues occur on soils with a pH ($CaCl_2$) greater than 7, a small field test, pot test or an analytical test should be done before planting susceptible crops. Pennisetum forages, white French millet, faba beans, chickpeas and cowpeas (in order of decreasing tolerance) may tolerate limited residues. Most other crops are highly sensitive.

Nutrition

Nitrogen (N) Sorghum responds to the application of nitrogen fertilisers. On the Liverpool Plains, the average yield increase in 15 trials during 1990–93 from 80 kg N/ha was 1.8 t/ha (from 3.7 to 5.5 t/ha). With a short fallow, sorghum following sorghum, the yield increase was 2.9 t/ha. Trials in other areas where soil nitrogen levels have been higher have given smaller and less consistent yield responses.

Rates of 80 to 120 kg/ha of nitrogen are used on high yielding crops grown after winter cereals on the Liverpool Plains. Tables 5 and 6 provide guides of economic rates of N fertiliser that incorporate the N impact of the previous crop for dryland and irrigated crops respectively.

The contribution of a pulse crop or pasture to soil N largely depends on the quantity of dry matter produced and levels of nodulation. However, as a guide, compared with a previous sorghum crop, cowpea and mungbean crops may leave up to an additional 40 kg/ha of soil N, while soybeans and pigeon peas may leave 25–50 kg N/ha. Previous lucerne pastures can produce higher sorghum yields than cowpeas or long fallow.

Table 5. Guide to nitrogen rates (kg N/ha) for dryland sorghum grown on the Liverpool Plains

Previous crop	Yield target	
	4 t/ha	6 t/ha
Sorghum, sunflower, cotton,	100	140
Cowpea, mungbean	60	120
Long fallow winter cereal	80	120
Long fallow faba bean	30	90
Long fallow chickpea	45	100
Lucerne (good stand)	0	0

Table 6. Guide to nitrogen rates for irrigated sorghum

Previous crop	Nitrogen rate (kg/ha)
Sorghum, maize, cotton	180
Soybeans	100
Long fallow wheat	150
Long fallow faba beans	120

Nitrogen budgeting can also be used to determine the nitrogen requirements of a crop and can be calculated using the formula below. The quantity of N required to grow the crop is about double the quantity removed in the grain.

N removed in grain (kg/ha)

= target yield (t/ha) x grain protein % x 1.6

N required for crop (kg/ha) = N in grain x 2

Example

N required for crop (kg/ha) = (5 t/ha x 10% x 1.6) x 2

= 160 kg N/ha

N uptake by a crop comes from the available soil nitrate N and from fertiliser N. Soil nitrate N is estimated by soil testing preferably to 90 cm depth and from the cropping history, especially the grain yield and protein content of the previous crop. Using the above example, if only 80 kg/ha of nitrate N was available in the soil, then a further 80 kg N/ha would be needed. The protein content of grain is a good indicator of the N deficiency of a crop (see Table 7).

The maximum rate of nitrogen fertiliser that can be safely sown with sorghum seed is 5 kg/ha in 90 cm rows and up to 12.5 kg/ha in 36 cm rows. Higher rates should be sown 5 cm to the side of the planting tine.

Table 7. Using grain protein levels to indicate N deficiency (at various moisture content %)

Grain protein			Indicated N supply
Wheat (12% mc)	**Barley** (10% mc)	**Sorghum** (13.5% mc)	
Less than 11.5%	Less than 11%	Less than 9%	Acute N deficiency More yield highly likely with more N
11.5 to 12.5%	11 to 12%	9 to 10%	Marginal N deficiency. Yield may increase with more N
Greater than 12.5%	Greater than 12%	Greater than 10%	N not limiting More N will increase grain protein

Phosphorus (P) Sorghum is more tolerant of low soil phosphorus levels than wheat or barley. Soils with less than 10 ppm bicarbonate, obtained from a soil test, are likely to respond to phosphorus. Responses to starter fertilisers are likely in the areas east of Moree and are starting to occur in parts of the Liverpool Plains.

Zinc (Zn) Sorghum frequently responds to zinc on the heavy alkaline clay soils. Good yield responses have been obtained from starter fertilisers containing about 2.5 % zinc that are applied at 40–100 kg/ha in sowing rows 75–100 cm wide.

Salinity, sodicity and acidity Subsoil salinity is reasonably common in the brown, grey and black clay soils in northern NSW. Salinity is the salt concentration in the soil solution. Recent research in northern NSW indicates that grain sorghum is sensitive to salinity. In this research, plant growth and yield declined rapidly as soil salinity increased, that is, when Electrical Conductivity (saturated extract - EC) increased from 2 to 5 dS/m. These experimental results are supported by anecdotal evidence from growers and agronomists that where subsoil salinity exists, root exploration by grain sorghum into these saline layers is greatly reduced.

In addition to subsoil salinity, subsoil sodicity is also reasonably common in northern NSW. A sodic soil has an excess of exchangeable sodium ions attached to clay particles. This excess of ions affects the physical characteristics of a soil, causing dispersion. When a clay soil disperses with water, the clay particles swell as they are no longer bound together and reduce drainage through the soil pores (spaces). Subsoil sodicity restricts rooting depth. It therefore restricts crop access to water and nutrients. Surface sodicity results in surface crusting, sealing, reductions in water infiltration and may cause waterlogging on the surface.

Diseases

Sorghum ergot has been found in late flowering commercial grain crops in northern NSW. It has also occurred in seed production crops in the Macquarie Valley and at Boggabri and in late flowering forage sorghum crops in the Moree and Gunnedah districts. It is difficult to estimate the impact of sorghum ergot on yields of commercial grain crops in NSW.

The fungus (*Claviceps africana*) infects sorghum heads at flowering and is favoured by mild temperatures (15 to 30^{o}C), high humidity and overcast conditions. Ergot spores compete with pollen in the unfertilised florets, decreasing grain set and potential yield.

To reduce the risk of ergot in northern NSW, plant crops by early January so that they flower by mid-March (when the weather is hotter and drier than it is later in autumn). Crops with poor pollination risk the same infections as forage sorghum crops, tillers of late flowering plants, late sown grain crops and those affected by cold temperatures during flowering. Forage sorghum crops should be grazed or cut late in the season to prevent flowering.

Sorghum ergot can cause harvest delays with the sticky honeydew clogging machinery. Ergots are creamy coloured sclerotes usually smaller than sorghum seed that replace the developing seed. At levels higher than 0.3% by weight, they are toxic to livestock. If precautions are in place to ensure the ergot levels are less than 0.3% by weight, the grain is within safe usage levels for many end users.

Johnson grass mosaic virus is spread by aphids and causes mosaic, red leaf or red stripe symptoms on the leaves. The disease has not significantly damaged crops in NSW in recent years.

Head smut is soil-borne or introduced on seed and usually occurs in early planted crops with the seedlings becoming infected during cool weather. During the booting stage, the head is replaced by a mass of black spores within a white fungal membrane. When the head emerges, the membrane ruptures, releasing the spores. Around Inverell and Warialda, head smut incidence has been up to 10–15%. Most hybrids have good resistance.

Leaf rust is a serious disease in susceptible hybrids in humid coastal areas. Although rust often appears in autumn at the end of grain fill in northern NSW, it does not usually reduce yields.

Insects

Soil insects, such as **wireworms, false wireworms and wingless cockroaches**, can severely reduce crop establishment, and can therefore have a major impact on yield. Wireworms and false wireworms eat the emerging seedling. Wingless cockroaches feed on the stems of seedlings.

The use of press wheels at pressures of 4 to 6 kg/cm width of wheel reduces the mobility of soil insects near the seed and can improve establishment.

Control with terbufos 150 g/kg GR or chlorpyrifos 300 or 500 g/L EC is warranted when 2 wireworm larvae or 3 false wireworm larvae/m^2 occur. Terbufos 150 g/kg GR products are applied at 1.7 to 2.0 kg/ha (based on 17 to 20 g/100 m of row) as an in-furrow band 18 cm wide 2–3 cm below the soil surface and about 3 cm above the seed. Chlorpyrifos is used as a 500 g/L or 300 g/L product at 0.8–2.5l/ha or 0.5–1.5 L/ha and applied as an in-furrow spray.

Gaucho® 600 is a seed treatment that seed companies can apply for control of false wireworm, true wireworm, wingless cockroaches and black field earwigs. Cruiser® 350 is a similar treatment that only controls false wireworms, but offers protection against true wireworm and black field earwig. These two products are only currently available for treating large seed lots by commercial seed treatment equipment.

Sorghum midge can severely reduce yields, especially in late sown crops. During head emergence and flowering, crops should be checked daily about 3–4 hours after sunrise. Midge are very mobile and so re-infestation of crops is common. A range of synthetic pyrethroids are available to control midge. Crops should be sprayed at 3–4 day intervals when the economic thresholds in Table 8 are reached (based on $17/ha spray cost, grain at $120/t and a benefit cost ratio of 2:1). Because insecticides are only 60–80 % effective, a cost benefit ratio of 2:1 is appropriate in most situations.

Table 8. Sorghum midge populations to warrant spraying of hybrids with different levels of midge resistance

Midge resistance (Tested rating)	No. of midge per head Flowering heads/ha		
	20 000	40 000	60 000
Susceptible (1)	2.5	1.2	0.8
Low (2)	5.0	2.5	1.7
Moderate(4)	10.0	5.0	3.3
High (6)	15.0	7.5	5.0

Midge thresholds for a particular crop can also be calculated by using the following formula. For more detailed information, seek advice from your agronomist.

Spray for midge when

$$\frac{NM}{R} \text{ is greater than } \frac{C \times W \times CB}{1.4 \times V \times RD}$$

where

NM = number of midge/m row

R = midge rating of hybrid used

C = cost of control ($/ha)

W = row spacing width (cm)

CB = cost benefit ratio

1.4 = constant

V = value of crop ($/t)

RD = residual life of chemical used (days)

Example

$$\frac{NM}{R} = \frac{4}{3} = 1.33$$

$$\frac{C \times W \times CB}{1.4 \times V \times RD} = \frac{17 \times 100 \times 2}{1.4 \times 155 \times 4}$$

$$= \frac{3400}{868}$$

$$= 3.92$$

As 1.33 < 3.92, do not spray at this stage

Avoid sorghum midge by planting during the preferred sowing window and within 2–3 weeks of planting in your locality. Plant the slowest hybrid first and ensure an even establishment. Damage to crops, especially late planted crops, can be significantly reduced by planting a hybrid with a resistance rating of at least 4.

Use of synthetic pyrethroids for midge control can lead to increased aphid populations which can create harvest problems. Synthetic pyrethroids reduce populations of beneficial insects as well.

All **heliothis** caterpillars on sorghum are Helicoverpa armigera. These heliothis are often resistant to pyrethroids and carbamates. The effectiveness of these products depends on the percentage of resistant heliothis. GemStar® or Vivus® (nuclear polyhedrosis virus - NPV) are regarded as highly successful alternative control options, when used under the right conditions. The use of NPV will reduce selection for resistance and is therefore the preferred control option. Note that NPV often kills larvae more slowly than conventional chemistry.

Checking for heliothis should be done early in the morning or late in the evening at least at weekly intervals. Heliothis can attack sorghum both in the vegetative and reproductive phases. It is only when they attack developing grain that control may be needed. Aim to control larvae before they reach 5 mm in length as larger larvae cause more damage and are harder to control.

Heliothis thresholds to warrant spraying are given in Table 9 (based on $20/ha spray cost, $120/t for grain and a benefit cost ratio of 2:1).

Table 9. Heliothis populations to warrant spraying

No. of heads/ha	No. of Heliothis/head
30 000	1.2
60 000	0.6
100 000	0.4
150 000	0.2

Heliothis thresholds for a particular crop can also be calculated by using the following formula. It is based on one heliothis causing 2.4 g loss of yield.

$$\text{If } C < \frac{N \times 2.4 \times Y \times V}{100}$$

then it is worth spraying.

where C = cost of control ($/ha)

N = number of heliothis (per m^2)

Y = expected yield (t/ha)

V = value of crop ($/t)

Example.

It is worth spraying if,

$$C < \frac{N \times 1.5 \times Y \times V}{100}$$

$$\text{If } 20 < \frac{12 \times 2.4 \times 3 \times 140}{100}$$

If 20 < 40.32

Yes, it is worth spraying

Aphids may infest sorghum heads towards the end of grain fill. Even when conditions are dry, there is usually minimal economic damage. Nevertheless, aphid honeydew can cause blockages and breakdowns and delay or extend harvest. A pre-harvest spray with a knockdown herbicide (see below) will avoid the harvest problems caused by aphids.

Rutherglen bugs are another insect pest of grain sorghum, especially in hot, dry weather. They can when in very high numbers reduce yield and/or quality by sucking sap from leaves, stems and heads. Rutherglen populations within a head can increase rapidly. Control of adults is generally recommended because of this rapid build up as well as the difficulty in controlling nymphs hidden within the sorghum head. A threshold of 30 adults/ head is generally recommended. While 30 adults/head cause little economic damage, the subsequent generations of hundreds of nymphs may cause severe pinching of the grain.

Crop desiccation / harvest aid

A pre-harvest spray of either of the knockdown herbicides glyphosate or Reglone® applied immediately after the crop has reached physiological maturity (~25% moisture), will hasten dry down of the grain and should kill or desiccate crops. This allows crops to be harvested much earlier and more efficiently than if crops were not sprayed.

The timing of the pre-harvest spray is critical. Crops should be sprayed preferably when the temperatures are still warm and the crops are still green. The aim is to maximise yield and balance moisture use with storing water for the next crop. When between 95 and 100% of the grains have formed a 'black layer' (i.e. are physiologically mature), the crop is ready to be sprayed.

Sprayed crops stop using moisture and the soil profile therefore starts storing moisture for the next crop more quickly. Many growers in northern NSW have found that in wet summers, spraying out an early sorghum crop for harvest has given them a higher return over 14 months, as it allowed them to grow a successful chickpea crop immediately following the sorghum.

Sprayed crops should be harvested as soon as they have dried down as they are more prone to lodging.

Salvage weed sprays can be applied during the dry down stage to allow crops to be harvested.

Further information

Consult your local district agronomist for further information on grain sorghum. Other departmental publications on grain sorghum are:

Grain Sorghum Agfact P3.3.5

Insect and Mite Control in Field Crops 2005

Weed Control in Summer Crops 2006–07

Farm Budgets on the web
Summer Crops 2006–07

Sowing sorghum early helps minimise ergot Information Sheet. Queensland Department of Primary Industries, NSW Agriculture and Grains Research and Development Corporation 1997

Diseases of Sorghum and Broom Millet Agfact P1.AB.2

Sorghum Midge Agfact P3.AE.1

Table 10. Grain sorghum hybrid characteristics 2006–07

Company	Hybrid	Maturity	Height	Resistance to Lodging	Resistance to Sorghum midge	Organo-phosphate reaction*	Head type
HYLAN	Dominator	M	M	3	5	Min	O
	Liberty (White)	M	M	4	4	Min	SO
	Armour	M	M	CC	8+	CC	O
	Enforcer	MS	M	CC	6	Min	O
	Venture	MQ	M	5(P)	5	CC	SO
PACIFIC	PAC2417	MQ	M	4	6	CC	SO
	MR Goldrush	MQ	M	4	2	Mod	SO
	MR32	MQ	M	4	5	Mod	SO
	MR Pacer	MQ	M	4	3	Mod	O
	MR43	M	MT	4	5	Min	O
	MR Buster	M	M	5	4	Sev	SO
	MR Maxi	M	MT	5	3	Min	SO
	MR Bounty	M	M	4	5	Min	O
PIONEER	86G87	MQ	M	5	5	Min	SO
	85G83	MS	M	5	6	Min	SO
	Bonus.MR	M	MT	4	3	Sev	SC
LE FROY SEEDS	Banjo	M	M	5	6	Min	SO
	Patterson	MQ	MT	5	5	Min	O
	Overflow	M	MT	4	4	Min	O

Plant characteristics and ratings

Maturity	Height	Lodging resistance	Midge resistance	Organo-phospahte reaction	Head type
Quick	**S**hort	**1** Poor	**1** Susceptible	**Sev** - Severe	**O**pen
Medium **Q**uick	**M**edium **S**hort	**2** Fair	**2** Low	**Mod -** Moderate	**S**emi-**O**pen
Medium	**M**edium	**3** Good	**4** Moderate	**Min -** Minimal	**S**emi-**C**ompact
Medium **S**low	**M**edium **T**all	**4** Very good	**6** High	**CC** - Consult company	**C**ompact
	Tall	**5** Excellent	**7** Very high	***These ratings are joint seed company approved ratings based on visible leaf damage only – and as such may not reflect possible yield losses due to the chemical**	
			8+ Excellent		
			(P) Preliminary		

Midge rating

Midge rating is the factor by which a hybrid's midge resistance exceeds that of a fully susceptible hybrid (rating 1). For example, if, it is cost effective to spray a rating 1 hybrid that has 2 midges per head, then it will be cost effective to spray a rating 7 hybrid only if there are 14 midges per head.

Table 11. NSW grain sorghum hybrid trials 2005–06 (Conducted by NSW Department of Primary Industries)

	2005–06 Coonamble	2005–06 Gurley	2005–06 Winton	2005–06 Garah	2005–06 Premer	Across Sites Analysis
Sow Date:	28/10/05	1/10/05	8/11/05	15/11/05	16/11/05	**2005–06 Trials**
Harvest Date:	9/3/06	14/2/06	27/3/06	22/3/06	27/4/06	(analysis of 6 trials)
	t/ha	t/ha	t/ha	t/ha	t/ha	**t/ha**
Hylan Seed Co						
Armour	–	–	–	–	–	**–**
Dominator	1.72	1.35	6.37	2.43	5.50	**3.40**
Enforcer	2.02	1.40	6.46	2.85	4.58	**3.25**
Liberty	1.74	1.21	6.57	2.35	4.32	**2.99**
SX55055	1.86	1.39	6.71	2.45	5.35	**3.45**
SX55056	1.94	1.15	6.76	2.98	5.38	**3.67**
SX71058	1.66	1.53	5.88	2.19	5.28	**2.97**
SX55304	1.90	1.64	6.69	2.74	5.37	**3.69**
LeFroy Seeds						
Banjo (LV22)	2.15	1.35	6.52	2.73	5.60	**3.66**
Overflow(LV23)	1.54	1.26	6.34	2.87	4.84	**3.45**
Paterson	1.92	1.33	5.60	2.27	4.75	**2.93**
Pacific Seeds						
MR Bounty	1.82	1.77	6.52	3.09	4.53	**3.64**
MR32	1.50	1.82	5.98	1.90	4.19	**2.86**
MR43	1.57	1.42	6.86	2.90	4.64	**3.55**
MR Buster	1.48	1.70	6.98	2.88	4.84	**3.54**
PAC2422	1.27	1.44	6.43	2.90	4.18	**3.11**
MR Goldrush	2.03	1.84	6.28	2.58	4.95	**3.49**
MR Maxi	1.77	1.54	7.16	3.00	4.86	**3.76**
MR Pacer	1.80	1.87	6.67	2.82	4.32	**3.54**
PAC 2418	1.83	1.85	6.66	2.76	4.81	**3.61**
Pioneer Hi-Bred						
85G83	1.76	1.33	6.75	2.74	5.00	**3.55**
86G87	1.72	1.47	6.43	2.75	5.39	**3.48**
Bonus.MR	1.85	1.49	6.38	2.87	5.43	**3.60**
PIO051	1.67	1.50	6.81	2.64	5.48	**3.65**
PIO052	1.87	1.46	6.66	2.78	3.50	**3.24**
PIO053	1.76	1.59	6.48	2.59	4.96	**3.43**
PIO054	1.71	1.47	6.55	2.80	5.37	**3.52**
PIO055	1.52	1.52	6.17	2.51	5.34	**3.23**
CV %	13.6	11.1	6.2	6.7	9.8	
LSD t/ha	0.33	0.248	0.56	0.270	0.71	**0.30**
Mean t/ha	1.76	1.51	6.52	2.69	4.92	**3.42**

The **mean** is given as the average yield (t/ha) of all varieties in the trial.

The **least significant difference (LSD)** indicates whether the difference in yield between two varieties is statistically similar or different. This is normally calculated at 5%, which means that there is only a one in twenty chance that the varieties or are not different.

Coefficient of variation (CV) is a measure of the accuracy and reliability of the experiment. Values below 10% indicate the trial is good. Those above 15% indicate the trial is poor and is not a true indication of a variety's performance.

Use the data above to assist in selecting hybrids suitable for your area.

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