



# GRAIN SORGHUM

## PRODUCTION GUIDE

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## CONTENTS

<b>A) INTRODUCTION</b> .....	1
<b>B) ADAPTABILITY</b> .....	1
1. Climatic Requirements .....	2
2. Soil Requirements .....	3
<b>C) CULTIVATION PRACTICES</b> .....	4
1. Soil Preparation .....	4
2. Planting Time .....	4
3. Plant Population .....	4
4. Cultivars .....	5
5. Seed Requirements .....	5
6. Planting Depths and Conditions at Planting .....	6
7. Fertilisation .....	6
8. Weed Control .....	10
9. Insect Control .....	11
10. Disease Control .....	13
<b>D) HARVESTING</b> .....	16
<b>E) GRADING AND MARKETING</b> .....	17
<b>F) YIELDS</b> .....	18

## A) INTRODUCTION

Grain sorghum is the fifth most important grain crop in South Africa after maize, wheat, sunflower and soybeans.

As the local malt market is somewhat limited, grain sorghum will have to compete directly with maize as a grain crop if future production of this crop is to increase significantly. As a result of its better grain quality in comparison to grain sorghum cultivars, there presently exists a greater demand for maize than grain sorghum on the export markets, but grain sorghum generally plays an important role as a stabilising factor in the summer grain production areas. On account of its superior drought tolerance, better economic returns may be expected from grain sorghum than from maize on marginal and heavy clay soils; under these conditions it is a good alternative cash crop to maize.

## B) ADAPTABILITY

The superior drought tolerance of grain sorghum in comparison to most other crops, especially maize, may be attributed to the following factors:

- a) Grain sorghum has the ability to “mark time” during a period of stress. In this way moisture uptake is reduced and physiological development is delayed. After good rains the crop recovers rapidly. If the main stem has been severely damaged by stress, the plant will compensate by producing ear-bearing suckers.
- b) The stems and leaves of sorghum are covered with a waxy layer and have a corky cuticle which helps resist drying out and wilting.
- c) Leaves have the ability to roll inwards which slows down the transpiration rate.
- d) The sorghum plant has a strong and effective root system which penetrates the soil more effectively and utilises stored soil moisture on heavy clay soils more efficiently than, for example, maize.
- e) The sorghum plant has a smaller leaf area than the maize plant and therefore better transpiration control during warm, windy conditions. Furthermore, the moisture requirements of sorghum just before, during and after flowering are less critical. Damage as a result of drought during this period is significantly less.
- f) Grain sorghum is not affected as drastically by stress during pollination as maize. The synchronisation between stigma and pollen development is much better and pollination takes place effectively even under fairly unfavourable conditions.
- g) Grain sorghum has the ability to compensate by producing ear-bearing suckers in the event of the plant population being too low or where the main ear has been damaged during the period of active growth.

## 1. CLIMATIC REQUIREMENTS

- a) Grain sorghum is well adapted in areas with a summer rainfall of 400 – 800 mm. However, high humidity may sometimes affect seed set.
- b) This crop is very sensitive to frost and most cultivars require approximately 30 – 140 frost free days during the growing season. The length of the growing season of cultivars will be critical in this respect.
- c) Germination is slow at soil temperatures below 18°C. It is more sensitive to low soil temperatures than maize, which still germinates well even at 12 – 15°C.
- d) The ideal growing temperature is 25 – 30°C with a minimum of 15°C. However, grain sorghum can withstand high temperatures better than most other crops, but extremely high temperatures during flowering may be detrimental.

### **LOW TEMPERATURE DURING THE FLAG LEAF PERIOD TO FLOWERING STAGE**

#### **a) The effect on pollination:**

During the flag leaf period, just before the developing ear becomes visible, the sorghum plant is sensitive to low temperatures. This period just precedes the full development of pollen grains. Studies in this regard have shown that at temperatures of approximately 10°C the normal development of pollen grains is affected to such an extent that sterile pollen is produced. Further evidence suggests that exposure to certain critically low temperatures for as little as two hours is sufficient to cause male sterility. The female portion of the developing flower at this stage is not affected by low temperatures.

In the last couple of years, great progress has been made in the development of cultivars with good cold tolerance. This is a quality that has a great advantage when choosing a cultivar for the cooler production areas.

#### **b) The effect on disease:**

The disease which is possibly of greatest economic concern to the farmer is Ergot. Cool, wet climatic conditions favour infection and the development of the disease. It is important to note that this disease is more prevalent in the higher rainfall and cooler production areas of the grain sorghum growing regions. A more detailed discussion of this disease appears later in the bulletin.

### **LOW TEMPERATURE DURING GRAIN FILL PERIOD**

For optimum grain production grain sorghum requires a maximum daily temperature of 25 – 30°C. Lower temperatures reduce yield; it is therefore important that planting dates are chosen in such a way so as to attain

maximum advantage of prevailing climatic conditions. The sorghum plant is very sensitive to the occurrence of frost, so plant maturity should be achieved before the first frost occurs.

## **LIGHT INTENSITY AND SORGHUM PRODUCTION**

The second important aspect which affects yield potential and is often overlooked is the number of sunlight hours which occur during the growing season.

In this regard, two growth stages are of importance:

**a) *Boot Stage to Complete Ear Ascertain Stage***

This occurs approximately two weeks before the 50% flowering stage. In this regard, a reduction in the number of sunlight hours can cause the development of fewer grain kernels, which in turn affects ultimate yields.

**b) *Milk Stage to Soft Dough Stage***

During this period sufficient sunlight is required to ensure good grain mass. Excessive cloudiness during this stage affects grain mass considerably. It is under these conditions that yields are often poorer than expected.

## **2. SOIL REQUIREMENTS**

- a)** The best results are obtained on deep, well-drained, fertile sandy-clay loam soils with a pH of approximately 5.0 (KCl). However, grain sorghum adapts to a wide range of soils provided the soil fertility is reasonable. Good yield may also be produced on soils with a pH of 4.5 – 7.5 and it can withstand a certain amount of salinity.
- b)** Grain sorghum can be grown with greater success than maize on less fertile soils, shallow soils, heavy turf soils and soils subject to water-logging.
- c)** Heavy soils produce the best yields in good seasons, but during times of stress sandier soils are better; however, during a normal drought grain sorghum will still produce satisfactory yields on soils with a clay content of more than 50%, whereas maize will yield very little grain.
- d)** Grain sorghum is more sensitive to aluminium toxicity than maize and should not be planted on very acid soils (acid saturation of more than 15%).
- e)** Soils heavily infested with witchweed must also be avoided, as sorghum is extremely sensitive to this parasite.

## **C) CULTIVATION PRACTICES**

### **1. SOIL PREPERATION**

Soil preparation for grain sorghum cultivation is similar to that for maize, but as the seeds are smaller, the following must be borne in mind:

- a) The seed bed, particularly on clay soils, must be finer to ensure good germination.
- b) The soil crust that may develop after planting must be broken in order to enable the young seedlings to emerge.

Good soil preparation may increase yield by 25 – 30%. On soils that are susceptible to wind erosion, furrows must be drawn or strip cultivation practised to prevent wind damage.

### **2. PLANTING TIME**

Planting may commence when the soil temperature is at least 18°C and the soil moisture is sufficient for germination. In most areas planting should take place during late October and November.

In the eastern Highveld, indications are that the earlier planting can take place, the better. However, grain sorghum may still be grown successfully as late as January, depending on the climatic conditions, length of growing season available and that required by the cultivar.

In the western areas, the best planting time is approximately mid-November.

#### **PLANNING OF THE PLANTING DATE**

It is impossible to determine the outcome of climatic conditions during a specific growing season at the outset of the season. However, one can choose a planting date taking long term climatic conditions into consideration. Potentially cool climatic conditions during planting and later during flowering should be avoided where practically possible. Any risks can furthermore be spread by adopting a reasonably long planting period, and also by planting hybrids with varying maturities.

### **3. PLANT POPULATION**

Grain sorghum is less sensitive to plant population than most other dryland crops. At low plant populations the crop effectively compensates by producing ear-bearing suckers with the result that, in practice, large differences in the ultimate ear counts between lower and higher populations seldom occur. A too low population, i.e. less than 90 000 plants/ha, must be avoided, however, as poor canopy may lead to a weed problem.

Plant populations of 100 000 – 160 000 plants/ha are normally recommended. The higher population applies especially where weed competition may be severe.

#### 4. CULTIVARS

Various factors must be taken into consideration in the process of selecting a suitable grain sorghum cultivar for a particular area.

- a) The yield potential of the cultivar.
- b) The adaptability of the cultivar with regard to soil and climatic conditions in the area.
- c) The length of growing season in the area.
- d) Important agronomic characteristics of the cultivars such as:
  - Standability
  - Length of growing season
  - Plant height and uniformity
  - Threshability
  - Compactness of ears
  - Bird resistance
  - Malting characteristics
  - Resistance to diseases and pests
  - Fodder characteristics
  - Ear exertion under stress
  - Cold tolerance
- e) The grading class in which the cultivar will be marketed, the demand thereof and the price.

As existing cultivars are replaced by new, improved cultivars from time to time, it is recommended that the latest PANNAR brochure or the local PANNAR representative or agronomist be consulted for information regarding the latest developments and recommendation per production area.

#### 5. SEED REQUIREMENTS

SPACING BETWEEN ROWS	SPACING IN ROW	SEED REQUIREMENTS PER ha
0.9 m (3')	5 – 7 cm (2 – 3")	5 – 9 kg
0.9 m X 2.3 m (3' x 7'6") or 1.5 m (5')	5 – 7 cm (2 – 3")	4 – 6 kg
2.3 m (7'6")	5 – 7 cm (2 – 3")	3 – 4 kg

The spacing between the rows will depend on the yield potential of the area in question. Under high potential conditions, particularly in the eastern area,

0.9 m rows are recommended, while under marginal conditions wide rows or tramlines are preferred.

## **6. PLANTING DEPTHS AND CONDITIONS AT PLANTING**

Grain sorghum must be planted shallow, especially on heavy soils. Take care to place the seed in moist soil, otherwise germination is compromised. The planting depth should vary from 3 – 5 cm. Crust formation must be prevented at all times.

## **7. FETILISATION**

The nutrient requirements of grain sorghum are equivalent to those of maize, and more or less the same quantities of nitrogen (N), phosphorus (P) and potassium (K) are removed from the soil by these two crops. Grain sorghum can utilise soil nutrients more efficiently than maize, however. The recommendations for maize, therefore, may also be applied to grain sorghum – expect slight adjustments under certain conditions.

As in the case of maize, the fertilisation programme must be based on the projected yield and a reliable soil analysis.

### **GUIDELINES FOR THE ADMINISTRATION OF MACRO-NUTRIENTS**

#### **a) Lime**

Lime is recommended where the pH (KCl) of the soil is less than 4.6 [pH 5.6 (H<sub>2</sub>O)] or where the acid saturation of the soil is higher than 15%. Fertiliser efficiency increases as the soil acidity is reduced. The choice between dolomitic and calcitic lime will depend on the magnesium content of the soil.

Liming soils with an aluminium solution is essential for successful grain sorghum production.

Lime must be spread evenly and worked well into the soil, preferably at least two months before planting.

#### **b) Nitrogen**

Recommendations for nitrogen application are based on calculations for yield target.

Table 1 has been created, according to results from a number of widespread trials, as a guideline for nitrogen application for the western and eastern regions. The lowest value in each production class is the lower 50% confidence limit, the middle value is the regression value and the highest value is the upper 50% confidence limit. The confidence limit includes the spread – the width of the calculated N-optimum in 50% of the cases. This variation in N-optimum is influenced by various factors.

Yield Target (ton ha <sup>-1</sup> )	N-application (kg ha <sup>-1</sup> )	
	*West	East
2	0 – 15 – 30	0 – 20 – 40
3	5 – 25 – 40	20 – 40 – 60
4	10 – 35 – 60	40 – 60 – 80
5	40 – 65 – 90	60 – 80 – 100
6	75 – 95 – 120	80 – 100 – 120
7		100 – 120 – 140
8		120 – 140 – 160

\* For sandy soils (<10% clay) and loam sand soils (10 – 15% clay), 20 and 10 kg N ha<sup>-1</sup> are added to these values respectively.

**c) Application methods**

The choice of application method depends on local environmental factors. The following is important:

- The following application levels within the band at planting should not be exceeded:
  - 0.9 m wide rows: not more than 40 kg N ha<sup>-1</sup>
  - 1.5 m wide rows: not more than 30 kg N ha<sup>-1</sup>
  - 2.1 m wide rows: not more than 20 kg N ha<sup>-1</sup>

**d) Phosphorus**

Soil analyses are used as the basis for gauging the P status of a soil. Phosphorus fertilising guidelines are given where soil P status is gauged by the standardised Bray-1 extraction method.

Other methods are also used. Although there is no simple set relationship between methods that holds true for all soils, the comparative analyses in Table 2 can be used for most soils.

Exceptions which should be noted are: heavy clay soils, alkaline soils (pH (KCl) > 6) and especially soil that contains free lime. Table 2 does not hold true where rock phosphate is applied.

Table 2: Comparative P values from different P extraction methods

Bray I	Bray II	Ambic I	Olsen
7	9	5	4
10	13	8	6
13	18	11	9
16	22	13	11
19	26	15	13
23	31	18	15
27	36	21	17
30	40	24	19
33	45	27	22

### Application procedures

- The general practice is to apply phosphorus in the band; the exception would be an instance where the required quantity exceeds the amount applied in the fertiliser mixture.

The optimal P concentration under conditions where between 5 and 11 kg P ha<sup>-1</sup> is applied in the band at planting was determined as approximately 17 mg P kg<sup>-1</sup> over all regions.

The quantity of phosphorus that must be applied per hectare to raise the soil P concentration by 1 mg P kg<sup>-1</sup> (Bay 1), also known as the “P requirement”, is 5, 7 and 9 kg P ha<sup>-1</sup> for texture classes from <10%, 10 – 20% and 21 – 35% clay respectively.

Research data shows that more P than that required for grain removal ( $\pm 3$  kg P ton<sup>-1</sup>) is needed to maintain P levels. P concentrations should thus be managed to maintain optimum P concentration by making allowance for P needed per ton of grain produced. Concentrations which are lower than the optimum can, with due allowance for the financial implications for the producer, be build up over a number of years.

The following examples for the application of P guidelines are offered:

**Example 1**

Target yield: 3 ton ha<sup>-1</sup>

Soil texture: Sand (8% clay)

Soil P optimum: 17 mg kg<sup>-1</sup>

Soil P requirement factor: 5 kg ha<sup>-1</sup>

Soil P analysis: 7 mg kg<sup>-1</sup>

P needed:  $(17 - 7) \times 5 = 50 \text{ kg ha}^{-1}$

P maintenance per year:  $3 \times 4 = 12 \text{ kg ha}^{-1}$

The producer considers the risks and decides to build up the soil P concentration to the optimum level within four years (i.e.  $50 \text{ kg ha}^{-1} \div 4 = 12.5 \text{ kg ha}^{-1}$ ).

The P fertilisation programme (kg P ha<sup>-1</sup>) is thus as follows:

	Year 1	Year 2	Year 3	Year 4	Year 5
Basic application	12.5	12.5	12.5	12.5	-
Maintenance	12	*8	*16	*8	*20
Total	24.5	20.5	28.5	20.5	2

\* During years 1, 2, 3 and 4, 2; 4; 2 and 5 ton ha<sup>-1</sup> are realised respectively, and therefore the quantities in the following year are adjusted accordingly.

**e) Potassium**

- Soil analyses are used as the basis to calculate the K status of a soil.
- Findings indicate that there is little difference between the quantities of K in the soil that are calculated by the Ambic or ammonium acetate method.

Table 3 thus refers to soil potassium concentrations without further reference to the method of analysis.

## Guidelines

Guidelines for K fertilisation are given in Table 3.

Table 3: Potassium application for different topsoil K concentrations

Concentration (mg K kg <sup>-1</sup> )	Recommendation (kg K ha <sup>-1</sup> )
<41	12 – 50
41 – 50	10 – 40
51 – 60	8 – 30
61 – 70	6 – 20
71 – 80	3 – 10
>80	0

Potassium requirements for sandy soils (<10% clay) should mainly be calculated according to crop requirements (4 kg K ton<sup>-1</sup>). K requirements for medium textured soils (10 – 35% clay) should mainly be based on the achievement of an optimum concentration of at least 80 mg K kg<sup>-1</sup>. Soils with less than 10% clay and less than 41 mg K kg<sup>-1</sup> in the topsoil should always be analysed for K below the topsoil layer. Furthermore, the financial risks associated with erratic climate should also be considered.

## Application

Potassium is normally placed in the band by means of fertiliser mixtures. The following application levels should not be exceeded:

0.9 m wide rows: not more than 40 kg ha<sup>-1</sup>

1.5 m wide rows: not more than 30 kg ha<sup>-1</sup>

2.1 m wide rows: not more than 20 kg ha<sup>-1</sup>

There should also be a safeguard against high, mixed applications of K and nitrogen in the band. These should not exceed 70, 50 and 30 kg ha<sup>-1</sup> for row widths of 0.9, 1.5 and 2.1 respectively.

In the case of potassium requirements being too high to place in the band, a portion should be spread before planting.

## 8. WEED CONTROL

As the sorghum plant grows very slowly in the early stages, it can easily be suffocated by weeds. The young sorghum seedling is not capable of

competing with weeds. Therefore, it is important that weeds are effectively controlled, particularly in the early stages.

- a) A well prepared seed bed largely prevents weeds from becoming a problem after planting.
- b) Mechanical weed control from just before emergence until just before the piping stage – using a rotary cultivator and a tined cultivator with tines or sweeps – is usually effective, however, sometimes the use of a rotary cultivator before the plants have reached the 5 – 8 cm stage may result in a reduction of the plant population, as the seed is planted shallowly and is therefore easily damaged. The tined cultivator may damage the roots if used too close to the row, especially in the later stages.
- c) Various chemical herbicides offer effective weed control in grain sorghum cultivation.

It is extremely important that the manufacturer's instructions regarding the use of herbicides are carefully followed, as grain sorghum is very sensitive to herbicides such as 2,4-D and Atrazine under certain conditions.

## 9. INSECT CONTROL

### a) Cutworms

Similarly controlled as for maize. Cutworms are however not as serious a problem in grain sorghum cultivation.

### b) Maize Stalk Borer and Grain Sorghum Stalk Borer

Both these pests may attack grain sorghum and cause serious damage. The maize stalk borer (*Busseola Fusca*) is normally observed throughout the entire country. Although the grain sorghum stalk borer (*Chilo partellus*) mainly occurs in the low-lying areas of Limpopo Province and the Springbok Flats, it is observed in most of the production areas. The larvae differ from those of the maize stalk borer in that they are slightly smaller, pale white in colour, with pigmented spots.

For the most part, the same practices are effective to prevent outbreaks of both pests, although the grain sorghum stalk borer is more difficult to control. They have similar life cycles, but the grain sorghum stalk borer can complete more life cycles per annum than the maize stalk borer.

In both cases, early October and late December/January plantings are most susceptible to infestation. Late plantings, in particular, may be severely affected and yields may be completely destroyed. Chemical control measures are absolutely essential for the timely control of both pests.

c) **Aphids**

Grain sorghum is affected by three types of aphids, the most important of which is the honeydew aphid. The other two are known as the “wheat aphid” and the “maize aphid”.

- The life cycle of the aphids is such that their numbers build up gradually during the early summer months until a population explosion takes place in December and January. This coincides with the piping and flowering stage of the grain sorghum, a very sensitive stage, and a severe reduction in yield will result if the aphids are not effectively controlled.

Typical of the honeydew aphid, a mature aphid has a life expectancy of approximately 30 days; during this time one aphid may produce up to 100 young, which in turn reach maturity within 6 days. All aphids are capable of asexual reproduction, known as “parthenogenesis”.

The aphid feeds mainly on the underside of the leaves, and lives off the sap of the plant. They absorb mainly the protein and nitrogen particles of the sap and excrete excess sugars known as “honeydew”, a sticky, gummy secretion which appears on the leaves. A fungus grows on this honeydew, giving infected plants a typical black colour.

Chemical control measures must be applied as soon as the plant starts exhibiting honeydew in patches.

d) **Black Maize Beetle**

The Black Maize Beetle occurs mainly in the eastern Highveld and eastern Free State. It looks similar to the dung beetle. It is black in colour and is approximately 1 cm long. The larva looks very similar to the white grub and the two are often confused. Beetles occur throughout the year with increased numbers in March and October.

The beetles feed on young plants near the soil surface, resulting in the death of the plant or damage to its growth point. Damaged plants that recover produce ears mainly on suckers.

e) **American Bollworm**

Eggs of the American Bollworm are laid singly on the plant and the larvae feed on the ears. Usually infestation occurs shortly before the flowering stage. The colour of the larvae varies from nearly brownish-black to green and even pink, but may be easily identified by the dirty white line on both sides of its body on which the respiration openings are clearly visible. They usually hide in the ear and damage to the grain may continue until it has hardened.

Chemical control is recommended as soon as the pest is observed. In cultivars with very compact ears, spraying may often be less effective as the chemical only penetrates the ear with difficulty.

f) **Sorghum Midge**

This pest feeds on the developing florets and results in poor seed development.

No chemical control measures are recommended and where the sorghum midge is a problem, the crop must be planted early.

g) **Spotted Maize Beetle**

This yellow and black beetle sometimes attacks sorghum and feeds on the ears while the grain is still in the milk stage.

Spraying with a registered chemical is recommended as soon as the number of beetles reaches serious proportions.

## 10. DISEASE CONTROL

a) **Pre- and Post-Emergence Seedling Wilt**

The disease complex is caused by a large number of harmful fungi. Germinating seedlings die before emergence, while those that do emerge wilt and usually also die.

The affected seedlings have a purplish colour and are stunted, as the causal organisms affect the mesocotyl and primary root system. The roots rot and the development of the secondary root system are delayed. As soon as the latter develop, the plants recover fairly rapidly.

The disease is particularly prevalent in early plantings and where heavy rains have fallen immediately after planting. Although most plants may die, this seldom happens as the disease is usually localised, particularly where water has been standing in the planter furrows.

Certain herbicides can aggravate the disease, while seed treatment with a fungicide has a limited preventative effect.

b) **Grain Sorghum Leaf Spot (*Various organisms*)**

This disease is particularly prevalent in wet years. It is caused by a variety of organisms, which manifest themselves together on the leaves. They may be transmitted on the seed and can cause considerable damage under conditions favourable for its development and spread. Symptoms vary from light green spots to large reddish-purple discolorations and from small, slightly elongated light brown spots to large necrotic areas where the spots merge. Leaf spots

usually first appear on the lower leaves and then spread to the top leaves. On the leaf itself, the spots first appear on the tips of the leaves and then spread back onto the leaf margins. The disease may also affect the young kernels and result in small, shrunken seeds. The infection of the grain is of particular importance in seed production.

At this stage, no effective seed treatment against grain sorghum leaf spot has been registered. Therefore, the use of resistant cultivars offers the best preventative measure at present.

c) **Bacterial Stripe (*Xanthomona holycicola*)**

This disease is known as “red death”. Wet or high humidity conditions favour the incidence and development thereof. In wet years yield losses can be considerable.

Symptoms may be observed as early as the 2-leaf stage. Light reddish-purple stripes increase in size as the disease develops and eventually form dead, necrotic areas bounded by a thick dark margin. Severely affected plants stay dwarfed and usually do not produce any grain.

Little is known about the transmission and control of Bacterial Stripe. Transmission through the seed is not considered to be a serious source of infection though, and indications are that the disease can be easily controlled by the use of resistant cultivars.

d) **Helminthosporium Blight (*Helminthosporium turcicum*)**

As with maize – where it is also known as “northern corn leaf blight” – this disease usually only occurs in the more humid eastern production areas. Severe infections before flowering can cause considerable damage, but yield losses are negligible if infection is slight or occurs late.

The disease starts with the formation of small red or white spots on the leaves which develop rapidly and later become oval-shaped spots with sharp points and reddish-purple margins. As the size of the spots increases, they merge and can consequently damage a large portion of the leaves. The disease begins on the lower leaves and later spreads to the top leaves.

The only effective control measure is the use of resistant cultivars.

e) **Anthracoze (*Collectrichum graminicola*)**

Anthracoze is a fungus disease affecting the leaves as well as the stems of grain sorghum. If only the leaves are infected, the plants may be weakened to some extent, but the resultant effect on the yield is seldom serious. However, when the stems are infected as well, particularly just under the ear, the consequences may be serious.

Apart from the yield loss the plants lodge, which complicates mechanical harvesting.

The casual fungi penetrate the leaves during the young stages and reddish-brown, red or purple spots appear on the leaf surface. The diameter of the spots is usually approximately 3 mm, but may be up to 25 mm. Infected stems also turn red or purple and when they are cut open, the tissue inside the stems of infected plants will also be discoloured.

The only effective control measure is the use of resistant cultivars. Crop rotation may keep the disease in check as the spores over-winter in the plant.

f) **Rust (*Puccinia purpurea*)**

Rust usually only develops when the plants are maturing and seldom has a serious effect on the yield. Brown and brownish-red spots appear on the leaves. Later these spots burst open and release the typical brownish-red spores which easily rub off the leaves.

Control measures are seldom necessary.

g) **Ergot (*Sphacelia sorghi*)**

Ergot is a fungal disease also known as “sugary disease”. Cool, wet climatic conditions favour infection and the development of the disease. Individual flowers on the sorghum ear are susceptible to infection before fertilisation of the ovary.

The fungus then develops within the unfertilised ovary forming a mass of hyphae (fungal body). This is followed by maturation of the fungus during which period millions of spores are produced. This later period is associated with a sticky pinkish-white secretion which later darkens and becomes reddish-brown or even black. It drips readily from the ears and forms a white deposit on the soil surface. This in turn often creates an ideal medium for the development of secondary organisms.

If conditions remain favourable, infection of the disease occurs during the secretion period. Millions of spores present within this section are then spread to adjacent flowers by wind, rain and insects. This accounts for the rapid spread of the disease. As the fungus matures under these favourable conditions, the hard, so-called “egots” are formed in the ears. These are the over-wintering bodies of the fungus which provide for infection the following year, should conditions be favourable. Ergot is the most important sorghum disease and is mostly associated with cool wet conditions and later plantings.

**h) Head Smut (*Sphacilotheca reiliana*)**

The fungus responsible for cob- and tassel-smut in maize may also infect grain sorghum. The disease is known as “head smut” and the whole ear is destroyed. At first, the spores are covered with a thin

white membrane. The membrane eventually bursts open and millions of black spores are released. The use of resistant cultivars is the only effective control measure.

**i) Physiological Leaf Discolouration**

Often a red to purplish discolouration of the leaves is observed in sorghums, which is similar to the symptoms of certain diseases such as Anthracnose, among others. This discolouration is caused by the chemical Anthocyanin, which is usually found in the leaves of sorghums.

Physiological leaf discolouration may be caused by the following:

**i) Cold**

Sorghums are susceptible to cold, especially in the seedling stage. The growth rate of the plants slows down under these conditions and the leaves turn red to purple. As conditions become warmer, plants recover and develop normally again.

**ii) Chemical Spraying**

Certain cultivars are more susceptible to so-called “chemical-burn” than others. Weather conditions before and during spraying may also have an effect. A general purplish discolouration of the leaves takes place and is usually limited to the top surface of the upper leaves. Sometimes the discolouration may also manifest as small reddish-purple spots. The sorghum plant is most susceptible to chemical burn at flowering.

**iii) Physical Damage**

Physical damage by chemicals or insects may also result in a discolouration of the leaves.

In general, physiological leaf discolouration seldom causes any yield loss. Experts are of the opinion that the sorghum plant may lose up to 50% of its leaf surface without any detrimental effect on the yield.

## **D) HARVESTING**

Mechanical combining is the primary method of harvesting.

## E) GRADING AND MARKETING

Grain sorghum is graded according to its malting and fodder qualities as well as its tannic acid content; the price set accordingly.

The table below gives the current class differentiations:

GRADING	
NEW CLASS	DESCRIPTION
GM	Feed and Malt Class (Good malting)
GL 1	Feed Class (Poor malting)
GL 2	Feed Class (With grain defects)
GH 1	High Tannic Acid (Good malting qualities)
GH 2	High Tannic Acid (Poor malting qualities)

### **Factors of importance with regard to the different grain sorghum classes:**

- a) Cultivars with a dark brown seed coat (pericarp) have a bitter taste that makes them more bird resistant. The bitter taste is attributable to tannic acid (polyphenol), which also has a detrimental effect on malting quality, as well as feed value for monogastric animals. Some of these cultivars may have a good malting quality once the tannic acid has been neutralised with formaldehyde. Tannic acid affects poultry, hence the lower feed value.
- b) Cultivars with a good malting quality are characterised as follows:  
  
The sorghum grain has a red colour and soft endosperm. During the malting process enzymes are readily produced which break the starch down into sugars. These cultivars have a fairly high diastatic value.
- c) Another aspect of grain quality which may receive more attention in future during cultivar development is a well-developed yellow endosperm. Yellow endosperms do not only have more Vitamin A available for animals, but also produce a yellow fat and deeper yellow-coloured egg yolk, characteristics which are both highly desirable in the poultry industry.

Grain sorghum generally has a similar feeding value for all types of farm animals when compared with maize. The only exceptions are the sorghum types with a brown, bitter pericarp (bird resistant types). These are not suitable for animal feed.

The advantages of maize over grain sorghum include superior palatability and a higher Vitamin A content (yellow maize). On the other hand, grain sorghum is approximately 10% cheaper than maize in normal production seasons.

## **F) YIELDS**

Grain sorghum compares very favourably with maize in all production areas:

- a)** Sorghum, unlike maize, may still generate economic returns in marginal areas and on heavy turf soils. Yields may vary from 2.5 – 4 t/ha, depending on climatic and soil conditions.
- b)** In acid soils with a low pH (4.4 KCl), maize will generally perform better. Sorghum is more sensitive to aluminium toxicity.
- c)** In higher potential areas, grain sorghum can produce yields similar to maize, namely 4 – 8 t/ha, depending on climatic and soil conditions. At present the emphasis in these areas is on maize as it is easier to manage and fetches better prices.
- d)** Under irrigation, as with maize, yields of 8 – 12.5 t/ha can be achieved; 75 cm rows are recommended in this case. At the higher projected yield targets approximately 10% more N per projected tonne must be applied than in the case of maize.

Please note that this document serves only as a guideline and is given in good faith. As conditions may vary from farm to farm and even from land to land within each area, adjustment may be necessary based on local conditions or on any priorities that may exist.