FORAGE CROPS
PRODUCTION GUIDE

Pannar Seed (Pty) Ltd

HEAD OFFICE: PO Box 19, Greytown, 3250
Tel: 033 - 413 9500 Fax: 033 - 413 2618
www.pannar.com

PANNAR®

TABLE OF CONTENTS

INTRODUCTION

Since the inception of Pannar Seed (Pty) Ltd, the company has made good progress with the development of improved grain crop cultivars. These cultivars are widely sown and play an important role in many respects. Over the past decade considerable advances have been made in the development of various forage crops and Pannar's exclusive products are sown on many farms with overwhelming success.

Broad guidelines of the following aspects and forage crops are discussed in this manual:

- Factors that play a role in the choice of a forage crop.
- Important aspects regarding the establishment of fine seed forage crops.
- Intensive pasture crops.
- Semi-intensive strongly perennial grasses.
- Extensive strongly perennial grasses.
- Leguminous crops: Clover
Lucerne
- Supplementary annual forage crops.
- Carrying capacity is specified for a period of 12 months.

For any further or more specific advice, please contact your nearest Pannar Regional Office or representative.

CHAPTER 1

PLANNING AND ESTABLISHMENT

1.1 PLAN BEFORE YOU PLANT

When it comes to choosing the best forage crop to plant, it is important to consider the following factors:

- Is the forage crop suited to the soil and climatic conditions?
- What sort of animal production will the forage crop be used for? For example, will it be used for milk production, fattening of weaners or the maintenance of dry cows, and so on?
- What are the advantages and disadvantages of a particular forage crop, and how do these characteristics fit in with current stock farming practices?
- How versatile is a forage crop and can it be used for more than one purpose?
- Ensure that sufficient forage is planted to supply the required stock needs. It is preferable to work on a conservative forage yield and to make provision for a surplus.
- Where intensive forage crops are planted under irrigation, be sure to plant crops which provide good yields and have a high feed value. Irrigation is expensive and one must look at obtaining optimal forage yields and optimal usage.
- Before establishment, ensure that you know the fertilizer requirements for forage crops, the correct application times and how to correct any soil nutrient deficiencies.
- Where possible plant more than one forage crop, especially perennial grasses, in order to spread risk and to create a better fodder flow programme. Well-matched grass or legume mixtures can play an important role in this regard.
- Plant forage crops to complement sources of natural grazing and field crop remains and to gain the best advantage from all these sources of animal feed.
- Use of intensive pastures, particularly those under irrigation, can result in internal parasite and fungal disease problems in stock. An effective dosing programme should be followed and, in the case of sheep and dairy cows, preventative measures must be taken for foot rot.

1.2 ESTABLISHMENT REQUIRES GOOD PREPARATION

DRYLAND PERENNIAL PASTURES

Soil fertility

- Take a soil sample and have it analysed in order to correct the basic fertility.

Sowing time

- January and February are usually the most suitable months for pasture establishment. In warmer areas establish in late autumn to prevent seedlings from being scorched.

Why at this time?

- The seedbed can be ploughed in the preceding months and the rains that follow should help to produce a firm seedbed.
- The necessary soil moisture can accumulate.
- Weeds can be eradicated with a light cultivation to produce a weed-free seedbed.
- This should give the pasture enough time to develop a good root system before the winter.

Seedbed

- With the first preparation, which should take place at least a few weeks before planting, prepare a fine seedbed.
- The seedbed must get the chance to settle with the rains to produce a firm surface.
- For weed control before planting, use a shallow tine or disc cultivation.
- Roll the seedbed before sowing and follow up with a good rolling after sowing. Do not use a disc implement to cover the seed.
- Planting seed in rows is generally more successful than broadcasting it, although broadcasting can also yield good results with the right preparation.
- For successful establishment under dryland conditions it is important that the soil profile is wet at sowing time, while the topmost layer of soil is dry. Germination will then take place with the first shower of rain.

Fertilization

- Factors such as the phosphorus content of the soil and soil acidity (pH) must be rectified before sowing, if necessary.
- As far as fertilization is concerned, use the following as a guideline:
  One ton of grass hay taken off a pasture will remove approximately 10-20 kg of nitrogen (N), 1.2 kg of phosphorus (P) and 12 kg of potassium (K). The higher the rainfall, the higher the yield potential. For the best economic advantage, fertilization levels should be adjusted to suit the area's yield potential.
- Where hay is cut, it is necessary to apply more fertilizer, especially potassium, to a pasture than when grazed since no nutrients are returned to the pasture via the grazing animal.

General

- Newly established pastures should not be grazed too soon – they need time to develop a good root system. Annuals are generally only ready for grazing 6 to 8 weeks after sowing, and

perennials 8 weeks or more. Perennial pastures may in some cases only reach their full production in the second year. Heavy grazing after establishment must be avoided.

- If weed control is necessary in a newly established pasture, the first option should be to mow the pasture together with the weeds. A selective herbicide should only be used if the weeds continue to be a problem.

- The costs of establishing a pasture are high, so attention to detail, particularly when establishing a perennial pasture, will more than compensate for the effort involved.

1.3 METABOLIC DISTURBANCES IN ANIMALS ON CULTIVATED PASTURES

The use of intensive pastures for animal production may lead to metabolic imbalances in pastoral animals, which may in turn lead to a state of disease or a limitation on the animal's production. The high nutritional value of pasture plants sometimes indicates potential toxicity. Toxicity is a well-known risk of intensive pasture use.

Nitrate Toxicity

Nitrogen is a basic building block of proteins and is essential for good animal and plant production. Excessive amounts of nitrates (NO_3) in plants cause the animal to eat less, abort foetuses or even die. Excessive nitrate concentrations usually only occur when plants grow in nitrogen-rich conditions or during a period of overcast weather. Plants sprayed with 2,4-D may also accumulate a higher concentration of nitrates. Drought conditions, as well as high temperatures, insects, low light conditions and even frost can also lead to higher nitrate concentrations in pastures.

Most crops that are grazed or used to make hay or silage, such as maize, oats, wheat, ryegrass, lucerne, soybeans, sorghum en Japanese radish may build up toxic nitrate levels. Higher nitrate concentrations are particularly toxic for ruminants. When pastures that contain nitrate are consumed, the rumen microbes convert it to nitrite (NO_2). The nitrite is usually converted to ammonia by the rumen microbes and is used to synthesise protein. The microbial proteins become an important source of protein, which is absorbed in the small intestine. If the rumen microbes are overwhelmed by high nitrate concentrations, the intermediate and toxic product, nitrite, may accumulate. High nitrite concentrations may lead to the absorption of nitrate across the rumen wall into the blood steam. This leads to oxidation of oxyhemoglobin to methemoglobin and a reduction in the blood's oxygen-carrying capacity. The first symptom is bluish discolouration of mucous membranes. The blood also acquires a chocolate-brown colour due to the methemoglobin in the blood. A reliable symptom is the blue-grey discolouration of the cow's vulva as opposed to a normal pinkish colour.

Nitrate toxicity can easily be confused with prussic acid poisoning given that both share many of the same symptoms.

Prussic Acid Poisoning (Hydrocyanic Acid Poisoning)

Many forage crop species, including forage sorghum, contain the sugar compound cyanogenic glycoside. The compound itself is not harmful. When the plant is stressed by factors such as overgrazing, hail damage, drought or wilting, the cyanogenic glycoside is converted into a new compound called hydrocyanic acid or prussic acid. High levels of nitrogen fertilisation can also contribute towards this condition. When consumed, the hydrogen cyanide is absorbed into the blood stream and it prevents the oxygen from being released from the haemoglobin to tissue cells. The animal consequently dies of asphyxiation. The rumen microbes can also create a prussic acid poisoning scenario. It may also occur when plants are trampled and chewed releasing the hydrocyanic cyanogenic glycoside into the rumen where the abovementioned reaction occurs, prussic acid is created and the animal is poisoned.

The clinical signs can be similar to those of nitrate poisoning. The colour of the blood provides useful information in a differential diagnosis. Prussic acid poisoning is distinguished by a bright red blood sample that does not clot easily. Animals poisoned by prussic acid actually die from a shortage of oxygen. The poisoning can be treated by administering a sodium nitrate injection. The sodium nitrate releases the cyanide from the

haemoglobin in the blood, which is excreted in the urine. Animals usually recover after receiving the treatment.

Bloat (Foamy Bloat)

Bloat is a common digestive disorder caused by plant protein. It is usually associated with the ingestion of lucerne and clovers. Under certain conditions stable foam is formed in the rumen, which impedes normal gas releases, breathing and circulation. It can lead to the death of an animal. Secondary plant products such as saponiene, cyanogenic glycosides and amines can also affect the course of the bloating. Bloat sensitivity differs between animals. Oils and synthetic antifoaming agents can be used successfully for treating bloat.

General Management Guidelines

Apply nitrogen fertiliser in instalments according to the growth potential of the pasture crop; for example less at a time during colder months of the year and more in the warmer spring months in the case of ryegrass

Apply nitrogen fertiliser to the specific portion of the pasture that has been grazed or cut short. Then avoid grazing the area for at least three weeks after fertilisation or until the pasture has grown out to ±25cm.

Hungry animals should preferably eat silage or hay for an hour before they are given access to pastures that carry a risk of the abovementioned problems. In the beginning, limit the animal's access to not longer than 30 minutes. Thereafter, increase the grazing time period if no problems occur.

Avoid grazing wilted or damaged pastures for at least two weeks after the limiting factor has been removed or until the plants have completely frosted off in the case of forage sorghum.

Provide additional sulphur for the animals that graze pastures with potential prussic acid problems. The cyanide in the rumen and liver is then metabolised into thiosulfate and excreted by the animal.

Cutting lucerne before it wilts and allowing it to wilt on the trailer will reduce the risk of bloat.

Provide fibre-rich hay for the animals that graze luscious, green, irrigated pastures and adapt the lick supplementary feeding for the specific pasture that is used.

Acknowledgement: Free use of various sources.

CHAPTER II

INTENSIVE PASTURES

These temperate pastures are almost solely grown for intensive farming. These species are also known as the cool season species because many of them are winter active and all are frost tolerant, remaining green throughout the winter. Compared to the subtropical species they are relatively high quality, highly digestible and very palatable. Producers who farm with dairy cattle, raise fat lambs or fatten weaners should include the temperate species in their fodder flow programme for best animal production.

2.1 ANNUAL PASTURES

2.1.1 ANNUAL RYEGRASS

Species: ***Lolium multiflorum***

Westerwold vs Italian

Westerwold varieties are sown during early autumn only (February/March). They depend on day length to become reproductive and flower in early summer. They are true annuals.

Italian varieties are sown during spring after the major frosts (August/September) or early autumn (February/March). They need to be vernalised to become reproductive – i.e. experience a certain minimum period of cold before they will flower. In some areas this ryegrass may last for a period of 18 months and have a longer grazing season than the Westerwold varieties. Westerwold types yield better in midwinter, while Italian types provide better late spring production. In the case of autumn plantings it is important to establish the pasture as early as possible to gain the best economic advantage. Young seedlings should be nurtured in early plantings by applying a light irrigation every 2-3 days. This must be kept up until the roots are well developed.

a) Recommended areas:

Ryegrass should be sown on irrigated land which is fertile and fairly well drained. These pastures are not recommended for dryland conditions unless the summer rainfall exceeds 1000 mm per annum and the climate is temperate. In the winter rainfall areas ryegrass can be cultivated dryland. Spring planting of Italian types should only be done in areas with temperate summers. General irrigation requirements for most soil types are 25 mm every 4 to 5 days if sown during January or February, and 25 mm per week for the remainder of the growing period.

Ryegrass can withstand acid soils. For optimum production, an acid saturation of less than 10% is preferable.

b) Characteristics:

Ryegrasses are grouped as diploids or tetraploids. Tetraploids have larger seeds – the TKW (Thousand Kernel Weight) equals 4 grams, while diploids have a TKW of 2 grams. Tetraploid ryegrasses are taller growing, darker green in colour, have broader leaves and are more palatable, but are not as dense or as hardy as the diploids.

c) Seed Quality:

Certified seed must have a minimum germination of 75% and purity of 96%.

d) Management:

The key to successful ryegrass pastures is high nitrogen fertilization and efficient irrigation. The first nitrogen application is very important in maximising autumn production. In winter the shortened day length and lower temperatures result in slower growth, so apply a top-dressing of 300 kg LAN / ha just before establishment or about one week after germination. The total N requirement of the pasture should be split into 4 or 5 top-dressings in order to ensure a good even production throughout the season. No pasture can utilize more than a certain amount of nitrogen per unit time so it makes good economic sense to spread the nitrogen top-dressings out over the full growing season. This should also limit pollution and acidification.

Maintaining control of grazing by means of an electric fence is vitally important to maximise production. Allow the pasture to grow out to approximately 20 cm before grazing it for the first time. This will be about 6 weeks after establishment. After this, the grazing height should be 30 cm. Never graze shorter than 8 cm. This is to ensure that regrowth will be quick. Withdraw irrigation 2-3 days before grazing for better DM intake and animal production.

Feeding of ryegrass on its own can provide 15-20 litres of milk per day or 0.5-1 kg average daily gain in mass per weaner. To improve the effectiveness of ryegrass, which is high in moisture and low in fibre, additional roughage in the form of silage or high quality hay is recommended. This practice will increase production, especially in the case of dairies.

e) Fertilization and production:

The ideal pH (KCl) is 4.5. Ryegrass can tolerate an acid saturation as high as 25% but it is advisable to reduce acid saturation to less than 10%.

Optimum	:	P level (Bray 1)	:	> 20 mg / kg
		K level	:	> 120 mg / kg

Nitrogen fertilization:
About 35% of the total production takes place before the winter, and the rest from August to November.

Apply 300 kg LAN / ha at planting or before the seedlings reach the 4-leaf stage. Then apply 250 kg LAN / ha after every second grazing, thus ± 4 top-dressings. Alternatively 35-45 kg N/ha can be applied after each grazing. Keep in mind that the peak growth periods are in the autumn and spring, with growth slowing down in the winter. Fertilize according to the peak growing periods.

Production:

Cold winters and mild summers	:	12 – 15 tons DM / ha
Fair winters with light frost	:	10 – 12 tons DM / ha
Warm, lowveld areas	:	8 – 10 tons DM / ha

DM = Dry Matter

f) **Sowing time:**

Westerwold varieties:

Cooler areas	:	January – February
Warmer areas	:	Mid-March – May

Italian varieties:
January to May or August (spring planting)

Seeding rate:

Rows (180 mm)	:	20 kg / ha diploids 25-30 kg / ha tetraploids
Broadcast	:	25 kg / ha diploids 35-40 kg / ha tetraploids

g) **Utilisation:**

Grazing	:	Excellent grazing for up to 240 days.
Hay	:	Difficult to make hay.
Silage	:	Silage can be made. This may be risky as a high moisture content can lead to rotting. To be successful at making this silage, the cut grass must be allowed to wilt in order to increase the DM content. Bacterial additive can be beneficial as it induces rapid fermentation.
Foggage	:	Not generally used for foggage.

These ryegrasses can be grown with red or white perennial clover or Berseem clover. Preference is given to Berseem clover with annual ryegrass. This gives the additional benefit of extending the grazing period after the ryegrass has matured.

2.2 PERENNIAL PASTURES

2.2.1 PERENNIAL RYEGRASS

Species: ***Lolium perenne***

a) **Recommended areas:**

Irrigation:
The same as for the annual ryegrasses, but if possible always select a cool aspect or bottom land on which to sow this type of pasture.

Dryland:
Perennial ryegrass can be sown under dryland conditions in cool temperate areas with a high rainfall of 1000 mm or more, and where the rainfall is evenly distributed throughout the year.

b) Characteristics:

These grasses are short-lived perennials providing ample high quality feed for up to 3 years. They are slow to establish compared to annual ryegrasses and should therefore preferably not be sown in spring but rather in autumn. Spring plantings are adversely affected by competition from weeds and hot summer temperatures. Apart from the year of establishment, winter production is not as vigorous as with annual ryegrass.

c) Seed: Use quality seed

Certified seed must have a minimum germination percentage of 75% and purity of 97%.

d) Management:

To get the best results from perennial ryegrass, it should be grazed relatively intensively and kept short throughout the growing season. It is true that, if the pasture is allowed to produce seed, the longevity of the pasture will be negatively affected, but, on the other hand, there is no grass species on earth that will give optimum production if it is continually overgrazed.

The ideal practice is to allow the pasture to grow to a height of not more than 20 cm, and then intensively graze it to a stubble height of 5 cm within 5 days. Under optimum conditions the grazing cycle should be 21 to 28 days. The grass should then grow out to a height of 20 cm before it is grazed again.

Some varieties have a high endophyte (*Acremonium lolii)* content, which on the one hand has desirable insect repellent properties but on the other can cause ryegrass staggers if grazed too low i.e. < 5 cm. Non-ruminants are particularly susceptible to this condition.

It must be emphasised that perennial ryegrass will perform better when frequent lighter irrigations are applied as opposed to less frequent heavy applications. During the warm summer months 25-30 mm of water should be applied every 3-4 days.

e) Fertilization and production:

The two most important aspects of fertilization are to rectify the pH or acid saturation and to build the soil phosphorus up to the desired levels. Rectifying these aspects not only boosts production, but also increases the vigour and longevity of the pasture.

Liming is essential if the soil pH (KCl) is lower than 4.5 or if acid saturation is higher than 10%.

Optimum	:	P-levels (Bray 1)	:	> 25 mg / kg
		K-levels	:	> 120 mg / kg

Nitrogen fertilization*:*
Apply approximately 60 – 70 kg N / ha when the pasture is well established. Thereafter apply 60 kg N / ha after every second grazing cycle. Do not apply any nitrogen in the summer months.

Yields of 10 – 12 tons DM / ha can be obtained during the first year.

f) <u>Sowing time</u>:

February to May.

Sowing rate:

Rows (180 mm) : 20 kg / ha

Broadcast : 25 kg / ha

g) <u>Utilisation</u>:

Grazing : Excellent grazing for up to 3 years. Do not over-utilise the pasture during the hot summer months. Allow a canopy to develop to protect the surface roots from the sun. Keep the pasture short the rest of the year.

Hay : Difficult to make.

Silage : Silage can be made but there is unlikely to be sufficient material after the first year to make it worthwhile. The same management tips apply as for annual ryegrass.

Foggage : If foggaged, the pasture becomes tufted.

Perennial ryegrass combines very well with red and white perennial clover. Sow red clover at a rate of 4 kg/ha and white at 2 kg/ha.

2.2.2 TALL FESCUE

<u>Species</u>: ***Festuca arundinacea***

a) <u>Recommended areas</u>:

Tall fescue will grow well in most soil types and in most climates, but is particularly well adapted to moist and bottom land soils. It can withstand a certain amount of water logging, and does not perform particularly well on warm sandy soils. Tall fescue tolerates a certain amount of soil acidity (up to 25% acid saturation), but as it is often grown together with clover, acidity should be reduced to meet the requirements of the clover.

b) <u>Characteristics</u>:

Tall fescue is a hardy deep-rooted perennial, which can persist for more than 15 years in the right environment. The pasture provides good spring and autumn grazing. Fescue has a reputation for being unpalatable in the summer – this can be rectified by reducing nitrogenous fertilizer applications. It is advisable to avoid applying nitrogen from November to January. Certain varieties of tall fescue contain toxic amounts of the endophytic fungus *Acremonium caenophilum*. The Pannar

variety is free of endophytes.

c) Seed:

Certified seed must have a minimum germination percentage of 75% and purity of 95%.

d) Management:

Allow fescue to become well established before it is utilised for the first time. It is important to prevent the grass from becoming tall and rank as this will cause animal production to decline sharply. A grazing height of 15 cm is recommended with a grazing interval of about 30 days. This grass is usually sown dryland in high rainfall areas but will benefit from supplementary irrigation, especially during the dry winter months in the summer rainfall areas.

Fescue is normally closed off in the autumn to provide excellent foggage for the winter months. This rest period is very important in increasing the vigour of the pasture.

For persistence it is recommended that fescue be rested every second year so that it can produce seed. After the rest period the pasture can be mowed and baled.

e) Fertilization and production:

The ideal pH (KCl) is 4.5, but this grass can tolerate an acid saturation of up to 25%. If clover is sown with fescue, the acid saturation should be reduced to less than 10%.

Optimum	:	P-levels (Bray 1)	:	> 20 mg / kg
		K-levels	:	> 120 mg / kg
Nitrogen fertilization	:	Apply 200 kg LAN / ha after establishment. Top-dress up to a total of 600 kg LAN / ha in 3 applications through the season. Do not apply any N from beginning of December to mid-January.		
Production	:	Under irrigation a yield of 10 – 12 tons DM / ha can be obtained.		

f) Sowing time:

March to July. Irrigation is required if sown after March.

Sowing rate:

Rows (180 mm)	:	20 kg / ha
Broadcast	:	25 kg / ha

g) Utilisation:

Grazing	:	Very good spring and autumn grazing. Poor growth in winter and relatively poor quality during summer.

Hay : Easier to make hay than with ryegrass.

Silage : Silage can be made, but best made with a bacterial additive for optimum fermentation.

Foggage : Excellent foggage for the winter months, particularly when grown with clover.

Tall fescue combines very well with red and white perennial clover.

The sowing rates are:	Red clover	4 kg/ha
	White clover	2 kg/ha
	Tall fescue	20 kg/ha

2.2.3 COCKSFOOT

Species: ***Dactylis glomerata***

Varieties: Wana

a) Recommended areas:

Cocksfoot is adapted to areas with a cool climate and an annual rainfall of 900 mm or more. The highest production potential is on cool south-facing slopes in the high rainfall areas. It will grow well on most soil types, but prefers light fertile soils. Cocksfoot tolerates a certain amount of acidity (up to 25% acid saturation) but as it is often grown together with clover, acidity should be reduced to less than 10%. Although this pasture responds well to irrigation, there are other temperate pastures that are more productive under irrigation.

b) Characteristics:

Cocksfoot is a hardy persistent perennial in the right environment. It has a relatively high dry matter content of 30 – 32%, and since it is very palatable its use increases animal dry matter intake.

c) Management:

Under good growing conditions a grazing cycle of 1 week on and 35 days off is recommended. Cocksfoot production will be reduced by continuous close grazing. Allowing the pasture to grow out makes good sense as it improves productivity. The associated decline in palatability and feed value is not as great as with other grasses when allowed to grow out. It therefore provides excellent quality foggage.

d) Fertilization and production:

Cocksfoot responds well to nitrogen fertilization. It is therefore economical to top-dress the pasture under high rainfall and irrigation conditions. A total application of between 180 and 270 kg N / ha will ensure high production. Apply the higher rate if cultivated under irrigation. The N-application should be divided into 3 or 4 smaller top-dressings to be applied between August and April.

Optimum	:	P-levels (Bray 1)	:	> 20 mg / kg
		K –levels	:	> 120 mg / kg

Production : Under irrigation a yield of 10 - 14 tons DM / ha is obtainable.

e) <u>Sowing time</u>:

March to July. Irrigation required if sown after March.

Sowing rate:

Rows (180 mm)	:	15 - 20 kg / ha
Broadcast	:	20 - 25 kg / ha

f) <u>Utilisation</u>:

Grazing	:	Very good all year round grazing but slow to recover in winter.
Hay	:	Some varieties developed specifically for hay production.
Silage	:	Good silage, but best made with an additive.
Foggage	:	Excellent foggage when grown with clover.

Cocksfoot combines well with perennial clover.

CHAPTER III

SUBTROPICAL SUMMER PASTURES

This group of pasture species is summer growing and dormant during winter. They tend to translocate nutrients to their root systems during autumn for an accelerated spring flush.

With one or two exceptions, most subtropical species occur naturally on the southern African subcontinent.

This type of pasture is established in the summer rainfall areas of South Africa during any month from October to February. Early sowing is recommended where weed competition is not a factor, and also where the mean annual rainfall is less than 500 mm. However, January appears to be the best month in which to sow the seed. For successful establishment planting should take place into a wet soil profile after the top layer has dried off. The grass seed will germinate after the first shower of rain and the roots will grow down into the moist soil. This improves the seedlings' chance of survival.

These pastures are grown under semi-extensive to semi-intensive farming conditions.

3.1 ANNUAL PASTURES

3.1.1 TEFF

Species: ***Eragrostis tef***

a) Recommended areas:

Teff is adapted to most soil types, and can be sown under dryland conditions in areas with an annual rainfall of 400 mm or more. The best production is achieved in areas with an annual rainfall of more than 600 mm.

b) Characteristics:

Teff is an annual summer-growing grass. The grass is leafy which makes it a very good hay crop. Teff is quick to establish and can be ready for hay-making within 65 – 75 days. Cut when ± 10% in flower. Cut before it starts to lodge – this will also benefit the regrowth of the next hay crop.

c) Management:

Teff is not suitable for grazing as it is relatively unpalatable. However, it makes excellent hay. On average the grass is cut twice, yielding about 4 tons DM from the first cut and 2 tons from the second cut.

d) Fertilization and production:

Teff is tolerant to soil acidity and can tolerate an acid saturation as high as 50%. Above a pH (KCl) of 4.5 there should be no limits to production as a result of acidity.

Where two or more hay cuttings are planned, two top-dressings of 50 kg nitrogen

(180 kg LAN) each can be applied. The first top-dressing should be applied at or just after seedling emergence and the next one after the first cut.

Soil fertility levels:

Optimum	:	P-levels (Bray 1)	:	>15 mg / kg
		K-levels	:	> 100 mg / kg
Production	:	4 - 7.5 ton DM with a crude protein of 8 - 11%, crude fibre of 30 - 35% and a digestibility of 55 - 60%.		

e) Sowing time:

The best time to sow is from October to December.

Sowing rate:
Broadcast : 15 - 20 kg seed / ha

f) Utilisation:

Grazing	:	Not recommended, but is suitable if grazing is urgently needed.
Hay	:	Makes excellent hay and is sought after by horse owners.
Silage	:	Not recommended.
Foggage	:	Not recommended.

3.2 PERENNIAL PASTURES

3.2.1 SMUTS FINGER GRASS

Species: ***Digitaria eriantha***

a) Recommended areas:

Smuts finger grass grows on a wide variety of soil types including shallow stony soils. Not recommended on waterlogged soils. This grass is adapted to the summer rainfall areas and is best grown in regions with an annual rainfall of 500 mm or more. Smuts finger grass is drought and cold tolerant.

b) Characteristics:

This is a very palatable tufted perennial grass.

c) Management:

Smuts finger grass is often mixed with Rhodes grass. Rhodes will initially grow faster than Smuts finger and will compete better with weeds in the early stages, and also provide better production for the first 2 years after establishment. In cold areas the

Rhodes grass will disappear after 3 – 4 years and the Smuts finger will take over.

Smuts finger grass is a species that can be utilised at strategic times during the growing season. It is normally utilised for grazing from mid-November to the end of April. Rotational grazing with a high stocking rate is recommended for the best results. This is an excellent grass for use as foggage as it remains palatable and nutritious after it has frosted. Good quality foggage should be at least 600 mm high. This can be obtained by closing off the pasture from mid-January and letting it grow out. It can then be utilised after the first frost.

d) <u>Fertilization and production</u>:

This grass can tolerate an acid saturation of up to 25%. Above a pH (KCl) of 4.5 there should be no limits to production as a result of acidity.

Phosphorus and Potassium levels				
Rainfall	mm	< 500	600	800
Optimum P (Bray 1)	mg / kg	> 10	15	15
Optimum K	mg / kg	80	100	100
Approximate carrying capacity per ha				
Production	tons DM / ha	2	4	9
Lactating cows	per ha	0.33	0.65	1.47
Weaners	per ha	0.69	1.37	3.08
Lambs	per ha	4.12	8.24	18.54

Nitrogen fertilization:
If the pasture is used intensively, nitrogen fertilization is recommended for higher yields and quality. Nitrogen application can take place after good early season rains. Apply 50 - 60 kg N / ha in early summer. Up to a total of 150 kg N / ha can be applied in high rainfall areas. For foggage purposes an additional top-dressing can be applied in January or February.

e) <u>Sowing time</u>:

Sow during October or November if competition from weeds is not a problem. The best results are usually obtained with a January or February planting.

Sowing rate:

In rows (250 mm) : 3 - 4 kg / ha

Broadcast : 5 - 7 kg / ha

f) <u>Utilisation</u>:

Grazing : Excellent.

Hay : Makes very good hay.

Silage : Good with additive.

Foggage : Excellent.

3.2.2 RHODES GRASS

Species: ***Chloris gayana***

a) Recommended areas:

Rhodes grass is indigenous to the thornveld of the Eastern Province and KwaZulu-Natal, and is also found growing in relatively low rainfall areas. This grass is adapted to a wide range of climates, from subtropical to temperate regions. Rhodes grass can grow in areas with a rainfall of 400 - 1000 mm / annum. It is also a very good ley crop.

b) Characteristics:

This is a summer-growing perennial grass with fairly strong stolons which readily root at the nodes and rapidly cover the ground. The leaves are smooth and fine tapering to a point.

c) Management:

This grass is excellent for erosion control because it is quick to establish. Rhodes grass can serve as excellent grazing during the summer. Because of its eelworm resistance, it is also useful in a rotation with susceptible crops like pineapples or tobacco. One of the advantages of Rhodes grass is that it yields well during the year of establishment. However, it cannot tolerate heavy grazing. For these reasons a mixture of Smuts finger grass and Rhodes grass is often recommended.

d) Fertilization and production:

Phosphorus and Potassium levels			
Rainfall	Mm	450	550
Optimum P (Bray 1)	mg / kg	15	20
Optimum K	mg / kg	120	140
Approximate carrying capacity per ha			
Production	ton DM / ha	3.0	8.0
Lactating cows	per ha	0.49	1.31
Weaners	per ha	1.03	2.74

Nitrogen fertilization:
If the pasture is used intensively, nitrogen fertilization is recommended for higher yields and quality. Nitrogen can be applied after the first good spring rains. Apply 50 - 60 kg N / ha in early summer. Up to 150 kg N / ha can be applied in high rainfall areas. For foggage purposes an additional top-dressing can be applied in January or February.

e) Sowing time:

Sow during October / November or January / February. The later planting time is recommended for high rainfall areas where there is heavy competition from weeds.

Sowing rate:

Rows (250 mm)	:	5 - 7 kg / ha
Broadcast	:	8 - 10 kg / ha
Mixture	:	2 - 4 kg Rhodes en 4 kg Smuts Finger

f) Utilisation:

Grazing	:	Good (but should not be over-utilised)
Hay	:	Good.
Silage	:	Not recommended.
Foggage	:	Good.

3.2.3 WEEPING LOVE GRASS (ERAGROSTIS)

Species: ***Eragrostis curvula***

Varieties: Ermelo

a) Recommended areas:

This grass grows best in the eastern parts of the country where the average annual rainfall is 650 mm or more. It prefers sandy soils and is best grown on soils with a light texture. *E. curvula* pasture does not grow well in heavy turf soils where it tends to be invaded by better adapted species such as *Paspalum*.

b) Characteristics:

Eragrostis is a perennial tufted grass. It grows in a wide range of climatic and soil conditions. It is recommended in areas with an annual rainfall of 650 mm or more (generally east of Johannesburg), although it can be grown in areas where the average rainfall is around 600 mm.

c) Management:

Eragrostis is one of the first grasses ready for grazing in spring. If it is well fertilized,

it will provide good spring grazing for high potential animals. This grass loses palatability if it is allowed to grow out. For optimal usage, rotational grazing is recommended. A common practice is to graze the grass early in spring, and then leave it for hay production.

Eragrostis is ideal for hay production because of its fine leaves and thin stems. This grass should be cut at the 10% flowering stage to obtain the best quality hay. The quality will deteriorate as the grass reaches maturity. Top-dressing with nitrogen is important to maintain quality, especially after mid-December.

d) <u>Fertilization and production</u>:

Eragrostis is tolerant of acid saturation levels as high as 50%.

Nitrogen fertilization:
Nitrogen fertilization is essential for quality and palatability. Apply the total recommended nitrogen during September and October to best utilise the quick early season growth habit of *E. curvula*.

Phosphorus and Potassium levels			
Rainfall	mm	600	800
Optimum P (Bray 1)	mg / kg	15	15
Optimum K	mg / kg	100	100
Recommended N	kg N / ha	50 - 75	120 - 150
Approximate carrying capacity per ha			
Production	ton DM / ha	4	9
Lactating cows*	per ha	0.65	1.47
Weaners	per ha	1.37	3.08
Lambs	per ha	8.24	18.54

* Spring grazings only
DM = Dry Matter

e) <u>Sowing time</u>:

E. curvula can be sown with teff, or it can be sown on its own. When Eragrostis is sown on its own, the best results will be obtained if it is sown during October / November or January. In the lower rainfall areas row planting is recommended, while in the higher rainfall areas seed can be broadcast. The soil should be rolled before and after sowing. The pasture should not be grazed in the year of establishment as the young plants are easily uprooted. When hay is cut for the first time, the mower should be set fairly high.

Sowing rate:

Low rainfall : 250 mm rows : 3 - 5 kg / ha

High rainfall	:	Broadcast	:	6 - 8 kg / ha

f) <u>Utilisation</u>:

Grazing	:	*E. curvula* is normally ready for grazing earlier in the season than other subtropical grasses. If well fertilized, it will provide good quality grazing for high potential animals when grazed before the flowering stage.
Hay	:	Because of the thin stems and fine leaves, this is an excellent grass for hay production.
Silage	:	Not recommended.
Foggage	:	Not recommended.

3.2.4 BAHIA GRASS

<u>Species</u>: ***Paspalum notatum***

a) <u>Recommended areas</u>:

Bahia grass is recommended in regions with an annual rainfall of 650 mm or more. It can tolerate wet conditions and may stand in water for up to 36 days without any ill-effects. This grass can be cultivated under irrigation in almost any part of South Africa but is usually planted dryland in the higher rainfall areas of the country. Although *Paspalum* turns brown quickly after frost or cold, it can withstand temperatures as low as -10ºC.

b) <u>Characteristics:</u>

Paspalum is a perennial, summer growing grass with short rhizomes. It forms a dense sward that can withstand heavy grazing. Certain varieties are also suitable as amenity grasses. *Paspalum notatum* can be used as an alternative to kikuyu.

c) <u>Management:</u>

Paspalum should be lightly grazed during the first year but once well established it can take heavy grazing pressure. This grass provides excellent sheep grazing because of its relatively low growth habit. The grazing height is very important – it is beneficial to allow this grass to be grazed down to a height of 50mm from the ground. Bahia grass can also be used as foggage during the winter.

d) Fertilization and production:

Phosphorus and Potassium levels		
Rainfall	Mm	800
Optimum P (Bray 1)	mg / kg	30
Optimum K	mg / kg	100
Approximate carrying capacity per ha		
Production	ton DM / ha	9.0
Lactating cows	Per ha	1.47
Weaners	per ha	3.08

Nitrogen fertilization:
If the pasture is used intensively nitrogen fertilization is recommended for higher yields and quality. Nitrogen can be applied after good early season rains. Apply 50 - 60 kg N / ha in early summer. Up to 150 kg N / ha can be applied in high rainfall areas. For foggage purposes an additional top-dressing can be applied in January or February.

e) Sowing time:

Sow during December or January in a well prepared seedbed. After sowing the field should be well compacted by rolling it. Plant at a depth of approximately 5 mm.

Sowing rate:

Rows (180 mm) : 10 - 15 kg / ha

Broadcast : 20 - 25 kg / ha

f) Utilisation:

Grazing : Bahia grass should be lightly utilised during the year of establishment. Excellent grazing for sheep.

Hay : Good.

Silage : Good silage with an additive.

Foggage : Very good foggage.

3.2.5 KIKUYU

Species: ***Pennisetum clandestinum***

a) Recommended areas:

Kikuyu is recommended for regions with an annual rainfall of 750 mm or more. It does particularly well on soils with a high organic matter content. It can be cultivated in humid areas under irrigation, but is usually planted dryland in the higher rainfall areas of the South Africa. Kikuyu is a subtropical grass that turns yellow-brown very quickly when frosted but it can survive low night-time temperatures of -10ºC. Kikuyu does not perform well when over-shaded.

b) Characteristics:

Kikuyu is a perennial, summer growing grass that spreads by its shoots. It forms a dense sward that can withstand heavy grazing. Kikuyu is also well suited to use on sports fields.

c) Management:

Kikuyu must be left until it is well established and has started to shoot before it can be grazed in its first season. From the second season kikuyu should be able to handle heavy grazing. The pasture should periodically be grazed very short to prevent the formation of a mat which will affect the palatability of the grass. A system of intense short periods of grazing with a minimum rest period of 20-30 days is recommended. In the midsummer an imbalance between calcium and phosphorus may occur – this should be rectified using a supplement. In the cooler summer rainfall areas the grass can be left to grow out before it is frosted. This grass is palatable as foggage during the winter.

d) Fertilization and production:

Phosphorus and Potassium levels		
Rainfall	mm	>750
Optimum P (Bray 1)	mg / kg	20-30*
Optimum K	mg / kg	80-120*
Approximate carrying capacity per ha		
Production	ton DM / ha	6-14
Lactating cows	per ha	0.98-2.29
Weaners	per ha	2.05-4.79

* Dryland and irrigation respectively.

Nitrogen fertilization:
If the pasture is used intensively nitrogen fertilization is recommended for higher yields and quality. Nitrogen can be applied after the first good spring rains. Apply 50

- 70 kg N / ha in early spring and again after every grazing. Up to 280 kg N / ha can be applied over the growing season in the subtropical high rainfall areas. If the pasture is to be used for foggage purposes, an additional nitrogen top-dressing can be applied in February.

Maintain phosphorus and potassium as close to the optimum levels as possible.

e) <u>Sowing time</u>:

Sow in warm soil any month from the end of October to the beginning of February in a well prepared and firm seedbed. Sow the seed on the soil surface and roll afterwards. If a planter is used take precautions not to plant deeper than 5mm. After planting keep the soil moist by irrigating frequently.

Sowing rate: 2 kg / ha

f) <u>Utilisation</u>:

Grazing : Excellent summer grazing for beef and dairy cows.

Hay : Kikuyu is not used as a hay crop because it dries too slowly.

Silage : Not normally done.

Foggage : Very good foggage in areas with cold winters.

3.2.6 WHITE BUFFALO GRASS

<u>Species</u>: ***Panicum maximum***

a) <u>Recommended areas</u>:

It commonly occurs in the bushveld and lowveld areas, where it is also known as bushveld buffalo grass. It grows well under trees and in amongst bushes. White buffalo grass is adapted to a wide range of soil types, but does not grow well on very sandy soils. More than 500 mm rain per annum is required for good production. This grass is suited to both subtropical and tropical areas. It cannot tolerate very low temperatures.

b) <u>Characteristics</u>:

White buffalo grass is a perennial, tufted grass that can grow up to 1.5 metres tall. It is very leafy with thin stems and is very palatable. A very high root density is found in the topsoil which enables it to regrow quickly after rain.

c) <u>Management</u>:

All surplus carbohydrates accumulate in the leaves of this grass and are not translocated to the roots. This gives the grass greater palatability but has important management implications. A very short grazing period is recommended as heavy utilisation can lead to slow regrowth. The correct method is therefore to ensure that there is a reasonable amount of leaf material remaining on the plant, without allowing it to grow out too much. The recommended practice is a relatively short period of

grazing (± 7 days) followed by a long rest period (± 42 days).

d) <u>Fertilization and production</u>:

White buffalo grass reacts well to increased soil fertility.

Phosphorus and Potassium levels			
Rainfall	mm	650	800
Optimum P (Bray 1)	mg / kg	15	20
Optimum K	mg / kg	80	100
Approximate yield and carrying capacity			
Production	ton DM / ha	6.0	9.0
Lactating cows	per ha	0.98	1.47
Weaners	per ha	1.2	3.08

DM = Dry Matter

Nitrogen fertilization:
If the pasture is used intensively nitrogen fertilization is recommended for higher yields and quality. Nitrogen can be applied after good early season rains. Apply 50 – 60 kg N/ ha in early summer. Up to 150 kg N / ha can be applied in high rainfall areas. If the pasture is to be used for foggage purposes, an additional nitrogen top-dressing should be applied in January or February.

e) <u>Sowing time</u>:

Sow during late summer or early autumn, but not later than mid-March. Like the other summer grasses, white buffalo grass is sensitive to weed competition after germination.

Sowing rate:

Rows (300 mm) : 3 - 5 kg / ha

Broadcast : 6 - 8 kg / ha

f) <u>Utilisation</u>:

Grazing : Excellent.

Hay : Fair because it is relatively difficult to cure.

Silage : Good with additive.

Foggage : Good.

CHAPTER IV

LEGUMES

4.1 CLOVERS

4.1.1 RED AND WHITE PERENNIAL CLOVER AND ANNUAL BERSEEM CLOVER

Species: **Red Clover** - ***Trifolium pratense***

White Clover - ***Trifolium repens***

Berseem Clover - ***Trifolium alexandrinum***

a) Recommended areas:

Wherever ryegrass is successfully grown, clovers will also perform well. Refer to section 2.1.1 for recommended areas. In general clover will grow on any soil type where moisture is not a limiting factor, but the phosphorus (Bray 1) status must be at least 30 mg / kg, the potassium status at least 140 mg / kg and the acid saturation less than 10%.

b) Characteristics:

The red clovers are shorter lived than the white clover, but will maintain good production for 3 to 4 years. White clovers have been known to persist indefinitely under ideal conditions.

Red clovers have better summer production than the white and are often grown in a mixture with white clover to ensure a better fodder flow over the season. Red clover and some of the white clovers have an upright growth habit, making them suitable for hay or silage production.

Berseem clover is an annual clover with excellent regrowth and yield potential similar to ryegrass. It is ideal in a mixture with ryegrass, with no recorded cases of bloat. Berseem clover exhibits auto-toxicity and should only be planted on the same land every third year.

Clovers produce high quality protein and make an ideal pasture when grown in a mixture with the temperate grasses, such as ryegrass, tall fescue or cocksfoot. The danger of bloat is also reduced when clovers are grown in mixtures with grasses.

With legumes, bloat is always a danger which must be guarded against. There are many ways of doing this and farmers who intend growing clover are well advised to learn about effective prevention.

When clovers are correctly inoculated with *Rhizobium* bacteria, the well-nodulated clover that results can make a meaningful contribution towards the nitrogen requirements of a pasture. Before use, ensure that the inoculant is well within the expiry date printed on the package.

c) Management:

Maintaining the correct balance between grass and clover is the most important aspect of grass-clover management.

Fertilization:
One of the biggest problems with a grass-clover pasture is managing nitrogen fertilization. If nitrogen is withheld, the clovers produce sufficient nitrogen for themselves but the grass remains unproductive. **The result is that the clover will dominate and the pasture is then a potential bloat hazard**. Nitrogen application is therefore important to ensure that the grass component holds its own. Try not to apply more than 60 kg N/ha per application, with a maximum of 120 kg N/ha over the season.

Relatively high phosphate levels are important for the clover component in the pasture. If too little P is applied, the clover will not be able to compete with the grass component. Since clovers are sensitive to acidity, the soil acidity must be adjusted before establishment. Liming on most soils is therefore recommended before planting.

Grazing height:
Most grasses respond well to high levels of nitrogen. If the grass component is allowed to become overgrown (higher than 20cm), the grass will shade out the clover component. When a grass-clover mixture becomes overgrown, the result is a sharp decrease in feed value.

On the other hand, the continual close grazing of the pasture favours the legume and reduces the vigour and production of the grass. This leads to domination by the clovers with all the associated problems. This situation can be rectified by increasing nitrogen fertilization and allowing the pasture to grow out, which will suppress the clover.

Grazing period:
A very important aspect in the use of grass-clover mixtures is to allow quick, highly intensive grazing so that selective grazing does not occur. Red clover is especially sensitive to overgrazing because the growing point is above the ground and is easily damaged. The use of an electric fence to limit the grazing period to 2-3 days is essential.

d) Fertilization and production:

To ensure good nodulation, nitrogen fixation and good growth from clovers, it is important to lime the soil if it is acidic. Calcium levels must be higher than 600 mg / kg. Use dolomitic lime if the magnesium content of the soil is lower than 60 mg / kg. A molybdenum seed treatment or aerial spray will also enhance nodulation and subsequent growth.

Optimum P-levels (Bray 1)	:	> 30 mg / kg
Optimum K-levels	:	> 140 mg / kg
Production from pure clover:		A lot of factors will influence the production, but a dry matter yield of 6 - 8 t / ha is possible.

e) Sowing time:

February to May.

Sowing rate:

White clover alone	:	2 kg / ha
Red clover alone	:	6 kg / ha
Berseem clover alone	:	15 kg / ha
Red and white pure clover mix	:	2 kg white / ha 4 kg red / ha
Berseem clover mixed with a grass	:	10 kg / ha
Red and white clover mixed with a grass	:	2 kg white / ha 4 kg red / ha

f) Utilisation:

Grazing	:	Excellent quality, all year round grazing. A pure stand when rationed to 1 - 2 hours grazing per day could replace the need for HPC (High Protein Concentrate) in a dairy cow's ration.
Hay	:	Difficult to make.
Silage	:	Very good silage when mixed with a temperate grass and if a legume silage inoculant is added.
Foggage	:	Excellent foggage as it retains its quality when mature. A pure stand is often utilised as green chop.

4.2 LUCERNE

Species: ***Medicago sativa***

a) Recommended areas:

Lucerne can be successfully cultivated both as an intensive high production crop under irrigation or as a dryland crop in areas where the annual rainfall is less than 500 mm.

Lucerne is well adapted to a wide range of climatic conditions, but it is very specific in its soil requirements, especially with respect to acidity and drainage. Soil acidity must be reduced to a minimum. Lucerne will not tolerate any aluminium in the soil. The acid saturation, which is a measure of exchangeable aluminium must be reduced to zero by the addition of lime.

b) Characteristics:

Lucerne is often called the "king of forage crops" because of its high quality (18 -

20% crude protein) and high digestibility. It is very palatable and produces large amounts of dry matter, particularly under irrigation. It is a true perennial and will yield consistently for six years and longer. Longevity depends on management and on the dormancy class of the cultivar planted.

Winter dormancy, based on the US system, is numbered from 1-10, where 1 means that the plant is strongly dormant during winter, and 10 means that the plant is winter active or non-dormant. In South Africa the NLEP trials have shown that the most suitable range for all our climatic conditions is from 5 to 9, as follows:

5	–	semi-dormant
6 & 7	–	intermediate dormancy
8	–	non-dormant
9	–	very non-dormant.

The more winter dormant a variety, the longer its lifespan and the better adapted it is to grazing. Conversely, the less winter dormant a variety is, the shorter its lifespan and the more suited it is for hay production. A general rule is that a lucerne produces approximately 120 tons of dry matter in its life cycle. The annual DM yield of the non-dormant varieties is usually higher than the more perennial dormant varieties and therefore better suited to hay production. Dormant varieties handle stress (environment or utilisation) better than non-dormant varieties.

Care must be taken to prevent bloat when grazing lucerne.

c) <u>Management</u>:

In some cases lucerne is grazed for extended periods, which leads to a decrease in the vigour of the crop. Another malpractice is to utilise lucerne during the winter. Winter grazing without an autumn or spring rest drastically reduces the productivity and life-span of the crop. Poor management of lucerne can lead to severe leaf drop during seasonal droughts. It is therefore important to utilise lucerne at the correct time.

In dry marginal areas the effective life-span of lucerne is greatly improved by allowing the plants to have an extended rest, and by not utilising it until it has set seed. This gives the plant a chance to translocate reserves to its roots for use during the following season's rains.

In the higher rainfall and irrigation areas, lucerne should be managed by close inspection of crown buds and not by stage of flowering. Lucerne should be cut when the crown buds are fully developed (±1 cm long), but not long enough to be cut off by the mower. If the buds are cut, growth will be impaired and the time taken to the next cutting will lengthen because new buds must first be formed. Cutting before full bud development also drains root energy reserves. This influences the productivity and longevity of the crop.

Lucerne has a high root oxygen requirement and soil compaction must therefore be overcome by periodic ripping. Planting lucerne in rows makes it easier to till the soil.

d) <u>Fertilization and production</u>:

It is important to build up the phosphorus levels before establishment, as recommended in the following table. If necessary, also correct the pH through lime

application before establishing the crop.

Liming:
The percentage acid saturation in the soil must be zero. pH is also important and the ideal pH (KCl) is above 5.6.

Calcium levels should be >350 mg/kg for sandy soils and >750 mg/kg for clay soils.

Magnesium deficiencies may occur where the soil analysis shows magnesium levels lower than 60 mg/kg.

Phosphorus and Potassium levels				
Rainfall	mm	600	800	Irrigation
Production	ton DM / ha	6	10	15 - 25
Optimum P (Bray 1)	mg / kg	20	20	30
Optimum K	mg / kg	150	150	150

DM = Dry matter

Expected yield potential (under irrigation) for the following areas:

Area	**Average maximum January temp.°C**	**Yield potential DM / ha**
Bloemfontein	30	20
Wepener	29	17
Germiston	26	12
Kimberley	33	25

Correct basic fertility before planting.

Fertilization for maintenance:

Phosphorus : Every second year in the spring, apply 3 kg P per ton DM removed. Use the super phosphate form of P so that the lucerne's sulphur requirement is also met.

Potassium : Rate of removal is 15 - 25 kg / ton DM removed. Fertilize with an application of around 200kg (KCl) in the spring and, if necessary again in the middle of summer. This applies especially for hay production.

Molybdenum : Spray 200 grams of sodium molybdate / ha on established lucerne (apply after cutting). This application should be enough for a number of years. If the pH is correct, molybdenum should not be a problem. Molybdenum trioxide can be mixed with the

inoculant at a rate of 1g/kg seed.

Boron : Deficiencies are associated with well drained, sandy soils which are low in organic matter. Apply 1, 2 and 3 kg B / ha respectively to light, medium and clay soils (> 35% clay). Apply before establishment or after lucerne has been cut.

e) <u>Sowing time</u>:

From February to June, depending on the climatic region. The later months are applicable to the winter rainfall regions. Seed must be inoculated with the correct *Rhizobium* bacterium before planting.

Sowing rate:

Dryland : 5 kg / ha in 900 mm rows, where mean annual rainfall is < 500 mm.

10 - 15 kg / ha in 250 mm rows or broadcast in areas where mean annual rainfall > 500 mm is.

Irrigation : 25 kg / ha broadcast.

f) <u>Utilisation</u>:

Grazing : Excellent quality grazing, but could cause bloat. Add 5% flower of sulphur in a lick to help prevent bloat. Alternatively, it can be cut and left in the trailer to wilt before being fed to animals. This will also reduce the risk of bloat.

Hay : Lucerne is mainly grown in the winter rainfall areas and drier regions where it is easier to make hay. If lucerne is grown for hay production in the moister regions, it should be conditioned or treated with additives before being baled to avoid a loss of quality. Do not mow shorter than 7.5 cm as regrowth might be inhibited.

Well made lucerne hay is a high quality feed and is of great value on any farm.

Silage : Lucerne makes good quality silage if ensiled with another crop like maize. If maize is not available, the correct legume silage inoculant must be added.

If lucerne is cut after the flowering stage and is allowed to wilt, a molasses additive should not be necessary.

Foggage : Lucerne is not usually grown for foggage.

g) Nutrient removal:

Removal per ton DM (kg/ton)		
Nutrient	**USA data**	**ARC data**
P	3	2.7
K	24	21.0
Ca	15	13.0
Mg	3	2.7
S	3	2.7
B	0.04	
Mn	0.06	
Fe	0.165	
Zn	0.025	
Cu	0.005	
Mo	0.001	

DM = Dry matter

CHAPTER V

SUPPLEMENTARY ANNUAL FORAGE CROPS

Supplementary annual forage crops should be viewed as an essential part of the fodder flow on any farm. Some farmers see these crops as strategically useful sources of forage. If feed is needed early after a drought period, or if winter feed is needed because the veld is not producing enough to meet the animals' needs, this type of forage crop can fill the gap on a farm. Additional information is available in Pannar's Forage Sorghum production guide. Also see the website www.pannar.com.

5.1 ANNUAL FORAGE CROPS FOR SUMMER

5.1.1 FORAGE SORGHUM

Cultivars: Grain sorghum x Sudan grass hybrids
Grain sorghum x Sorgho hybrids

a) Recommended areas:

It is adapted to most soil types. Forage sorghum can be sown in all areas with a rainfall of more than 400 mm / annum.

b) Characteristics:

Forage sorghum is a crop with a relatively large seed size that is fairly easily established. It is an annual and can grow to a height of ± 3 metres. A wide range of varieties is available on the market. The stems are relatively thick and the plants are very leafy. The grain sorghum x Sudan grass hybrids are predominantly used as a forage crop for intensive feed production where it is grazed or cut 4 or more times during the summer season. These are dual purpose types and may also be used as a silage crop where it is utilized once and then left to grow and mature so that it can be cut as silage. Some varieties are sweeter than others, namely sorgho x sorghum hybrids, and these are more suitable for foggage or silage making. This crop can be utilized once when approximately 0.8 m high, after which it is left to grow out for silage or foggage purposes. The sorgo x sorghum hybrids remain palatable after they have grown out and frosted. The once-off utilization (cut or grazing) to a height of 15 cm stimulates tillering, which results in more shoots that can then grow out.

c) Management:

The best time for grazing is when the plants reach a height of 600 - 1000 mm. A rotational grazing system is best. The grazing period should not exceed ± 6 days and the sorghum should not be grazed lower than ± 150 mm. Fertilize with 20 to 40 kg N / ha after each grazing if weather conditions allow it. Then allow the crop to grow out to the desired height and graze again. If the crop is allowed to grow out too much before being grazed, reproductive growth may begin and the plants will not grow vegetatively again after grazing.

To prevent prussic acid poisoning do not allow stock to graze young wilted or frosted plants. Furthermore, 5-10% flowers of sulphur in a salt-phosphate lick is a good precautionary measure.

d) Fertilization and production:

For optimum production the acid saturation should be < 15%. Above a pH (KCl) of 4.5 there should be no limits on production due to acidity.

Optimum P levels (Bray 1) : > 10 mg / kg

K levels : > 80 mg / kg

Production				
		Rainfall mm		
		< 500	600	> 600
Production	ton DM / ha	5	7	8 - 12

Plant with same fertilizer mixture as for maize or grain sorghum. Top-dress with 20 to 40 kg N / ha after each grazing or cutting if weather conditions allow it.

e) Sowing time:

Sowing times vary from area to area. In the eastern areas earlier plantings are possible – from October to November. Late plantings tend to get Ergot. In cold areas it is advisable not to sow sorghum before the beginning of December. The best sowing time in the west is November to the beginning of December. Optimum minimum soil temperatures are 17 - 18°C.

Sowing rate:

Dryland : Low rainfall : 900 - 1500 mm rows at 4 - 6 kg / ha

High rainfall : 400 - 800 mm rows at 7 - 15 kg / ha

Irrigation : 150 - 180 mm rows at 15 - 25 kg / ha

The sorgho x sorghum hybrids should be planted at no more than 7-8 kg/ha for good standability.

f) Utilisation:

Grazing : Good for grazing. The sorghum x Sudan grass hybrids are best suited for this purpose. Prussic acid poisoning can be a problem when plants are wilted, hail damaged or after frost.

Hay : Can be used for hay.

Silage : Good silage yields. Add inoculant to ensure good fermentation. Sorgho x sorghum crosses do not require an additive.

Foggage : Can be utilised as foggage in the drier regions. Sorgho x sorghum hybrids are well suited for use as foggage.

5.1.2 HYBRID BABALA

Species: ***Pennisetum glaucum***

a) Recommended areas:

Hybrid babala is usually sown dryland in areas with a rainfall of 400 mm per annum or more. This crop can be sown in any soil type, except waterlogged soils.

b) Characteristics:

This crop has a very well developed root system that utilises moisture effectively. It is hardy and can withstand droughts reasonably well. Will regrow well after a drought period.

Witchweed (Rooiblom) geminates on the roots of hybrid babala but it does not develop further so can help to reduce a witchweed problem. Can be utilised by all kinds of animals, including horses. No danger of prussic acid poisoning.

c) Management:

Use this crop when it is 400 - 600 mm high. Do not graze it too heavily because regrowth will be slow and valuable grazing will be lost. Leave at least 150 mm stubble for a quick regrowth.

d) Fertilization and production:

For optimum production the acid saturation should be below 15%. Above a pH (KCl) of 4.5 there should be no limits on production due to acidity.

Optimum : P levels (Bray 1) : > 10 mg / kg

K levels : > 80 mg / kg

Production				
		Rainfall in mm		
		<500 mm	600 mm	>600 mm
Production	ton DM / ha	5	7	8 - 12

Plant with same fertilizer mixture as for maize or grain sorghum. Top-dress with 20 to 40 kg N / ha after each grazing or cutting if weather conditions allow it.

e) Sowing time:

Can be sown from October to December for best results. Soil temperatures must be > 17ºC. It is recommended that this crop is planted in rows rather than broadcast.

Sowing rate:

Broadcast	:	10 - 15 kg / ha
In rows (900 mm apart)	:	5 - 10 kg / ha

f) <u>Utilisation</u>:

Grazing	:	Very good.
Hay	:	Not recommended.
Silage	:	Can be ensiled, with 2% molasses as additive.
Foggage	:	Not recommended.

5.2 ANNUAL FORAGE CROPS FOR WINTER

Pannar supplies high yield potential oats, triticale and stooling rye cultivars and offers a forage cereal package which provides good quality feed in the critical late autumn, winter and spring months. The right cultivar choice ensures that sufficient grazing is produced at the right time.

As with wheat cultivars, forage cereal cultivars are grouped by their growth habit onto spring, intermediate and winter cultivars. Each of these types has their own application in a fodder flow programme. It is therefore important to consider the characteristics of each type to gain the best advantage from these crops.

Spring type forage cereal cultivars do not require a period of cold (vernalisation) in order to set seed, but are daylight sensitive. They will progress to the flowering stage when day length is sufficient for this purpose. If planted too early in the season, they will start to flower before winter. These cultivars are planted in early spring in the summer rainfall areas to avoid frost damage during the flowering stage, hence the name “spring type”. Cultivars in this growth class do not normally stool and tend to grow in an upright manner. Spring types are mostly used for grain or silage production but can be used for a once-off grazing if grazing is urgently needed.

Winter type forage cereal cultivars have high cold requirement. They have to be exposed to winter cold for a long period before seed production is initiated. For seed production, this group of cultivars should be planted in late autumn or early winter to meet the cold requirements of the crop. The name “winter type” is therefore again derived from the planting time for grain production. Cultivars in this growth class initially exhibit a distinctive flat growth habit while stooling takes place. These cultivars all develop at a much slower rate than the spring and intermediate types but sustain their role by providing grazing in the harsh late winter and early spring months. Winter type green forage crops should preferably be planted in soil with good moisture retention capacities. This will ensure that there will be enough soil moisture available in August in the summer rainfall areas to enable regrowth after grazing.

Intermediate forage cereals fall into a growth class between the spring and winter types. This group’s cold requirements vary from a low to a fairly high cold requirement. Intermediate cultivars will not proceed to the flowering stage as readily as the spring type cultivars. The stooling ability of these cultivars is fair to good. The intermediate types

develop more quickly initially than winter type cultivars.

The intermediate and winter types are the growth classes most suitable for use as green forage crops. Fair to excellent regrowth can be expected from these cultivars after grazing. Spring type forage cereal crops, on the other hand, are normally planted as grain crops.

5.2.1 TRITICALE

Species: ***Triticum x Secale***

a) Recommended areas:

Large areas of South Africa have a problem with good quality winter feed. Triticale is a winter grain crop and therefore can be planted for animal feed under dryland conditions in the winter rainfall areas, as well as the summer rainfall areas where the mean annual rainfall is more than 450 - 500 mm, especially where soil moisture conservation is practised. It is also an excellent crop under supplementary irrigation.

b) Management:

Triticale can be sown in order to provide forage during the winter for top producing animals such as ewes with lambs. Small camps are important in order to use triticale effectively in a rotational grazing system. Sow in February, March or April in order to have grazing available from around May to August.

Triticale varieties can be classified as spring, intermediate or winter types, as with other small grains.

c) Fertilization and production:

Fertilize at planting as with dryland wheat in the summer rainfall areas. Under dryland conditions in the summer rainfall areas, the recommended nitrogen application is no more than 30 kg nitrogen /ha. If the plants begin to turn yellow, a top-dressing of 40 - 50 kg nitrogen /ha may be considered after the spring rains.

Production (Summer rainfall)		
Rainfall (mm)	**tons DM / ha**	**SSU / ha for 90 days**
375 – 450	0.8	4
450 – 525	1.2	6
525 – 600	1.5	8

DM = Dry matter
SSU = Small stock units

d) Sowing time:

Sowing time is normally February / March in order to have grazing available during from April to June.

Sowing rate:

Rows (30 cm) apart	:	25 - 45 kg / ha
Broadcast	:	60 - 80 kg / ha

e) Utilisation:

Grazing	:	Very good winter grazing.
Hay	:	Not recommended.
Silage	:	Not recommended.
Foggage	:	Not recommended.

5.2.2 STOOLING RYE

Species: ***Secale cereale***

a) Recommended areas:

Similar to triticale, but more popular in the eastern regions of South Africa where it is often mixed with brassicas.

b) Characteristics:

There are spring, intermediate and winter types.

c) Management:

Stooling rye can be sown in order to provide forage during the winter for top producing animals such as ewes with lambs. Small camps are important in order to use stooling rye effectively in a rotation system. Sow in February, March or April in order to have grazing available from around May to August.

d) Fertilization and production:

Fertilize at planting as for dryland wheat in the summer rainfall areas. Under dryland conditions in the summer rainfall areas, nitrogen fertilization should not exceed 30 kg / ha. If plants show signs of nitrogen deficiency, a top-dressing of 40 - 50 kg N / ha may be necessary after the spring rains.

Production (Summer rainfall)		
Rainfall (mm)	**tons DM / ha**	**SSU / ha for 90 days**
375 – 450	0.8	4
450 – 525	1.2	6
525 – 600	1.5	8

DM = Dry matter
SSU = Small stock units

d) <u>Sowing time</u>

January to June.

Sowing rate:

In rows 30 cm apart : 25 - 40 kg / ha

Broadcast : 50 - 60 kg / ha

f) <u>Utilisation</u>:

Grazing : Very good winter grazing.

Hay : Not recommended.

Silage : Moderately successful.

Foggage : Not recommended.

5.2.3 OATS

<u>Species</u>: ***Avena sativa***

a) <u>Recommended areas</u>:

Oats is very popular in the central regions of South Africa.

b) <u>Characteristics</u>:

They are generally better quality and more palatable than triticale. Varieties can be divided into spring, intermediate and winter types.

c) <u>Management</u>:

Plant oats in a forage cereal package with triticale and stooling rye for a well balanced fodder flow programme.

d) **Fertilization and production**:

Fertilize at planting as for dryland wheat in the summer rainfall areas. Under dryland conditions in the summer rainfall areas, nitrogen fertilization should not exceed 30 kg / ha. If plants show signs of nitrogen deficiency, a top-dressing of 40 - 50 kg N / ha may be necessary after the spring rains.

Production (Summer rainfall)		
Rainfall (mm)	**tons DM / ha**	**SSU / ha for 90 days**
375 – 450	0.8	4
450 – 525	1.2	6
525 – 600	1.5	8

DM = Dry matter
SSU = Small stock units

e) **Sowing time:**

February to March.

Sowing rate:

Rows (30 cm) : 40 - 50 kg / ha

Broadcast : 50 - 70 kg / ha

f) **Utilisation:**

Grazing : Very good winter grazing.

Hay : Not recommended.

Silage : High protein silage.

Foggage : Not recommended.

5.2.4 PLANTING DATE AND EXPECTED GRAZING PERIOD

Please consult your PANNAR representative or the product catalogue for this information on the various cultivars.

5.3 JAPANESE RADISH

Species: ***Raphanus sativus***

a) **Recommended areas:**

Well suited to the cooler eastern areas with reliable rainfall from January to April, to

be utilised in the autumn and winter. It is resistant to cold and not affected by frost. Soils with a good water retention capacity are ideal for Japanese radish production.

b) Characteristics:

It is usually used as an annual crop and provides good forage for sheep and cattle. The dry matter is very digestible.

c) Management:

Japanese radish grows best on light sandy or sandy-loam soils. Avoid soils that are likely to become waterlogged. The fine seed of Japense radish requires a well-prepared firm seedbed for successful establishment. Apply moisture conservation practices in the months before planting. It is worthwhile rolling the land after planting.

For cattle Japanese radish is best pulled or ploughed out and fed whole, rather than chopping it into pieces which may cause cattle to choke. It is a good roughage supplement for dairy cows. Where ryegrass is grown, it can be a good complementary crop in the fodder flow during the winter months.

d) Fertilization and production:

It is more acid tolerant than maize. Fertilize at planting by applying an N, P, K mixture below and to the one side of the seeds in the row, at levels similar to those used for forage cereal production. If the nutrient status of the soil is good, apply about 30 kg N / ha at planting. A top-dressing of 50 - 70 kg nitrogen / ha may be applied five to six weeks after planting if soil moisture levels are favourable.

Production (Summer rainfall)		
Rainfall (mm)	**tons DM / ha**	**SSU / ha vir 120 days**
550-600	4	35
600-800	6	50
>800	10	85

DM = Dry matter
SSU = Small stock units

e) Sowing time:

On the Eastern Highveld sow from early to mid-December, but January to the end of February is the usual planting time. Plant in rows of 45 or 90 cm and not deeper than 25 mm. Ideally plants should be spaced about 40 cm apart in the row.

Sowing rate:

Dryland : 2 kg/ha

Irrigation : 3.5 kg/ha

f) Utilisation:

Grazing: Excellent autumn and winter forage for sheep and cattle.

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, adjustments may be necessary, based on local conditions or for any priorities that may exist.

SEEDING RATES FOR FORAGE CROPS

CROP	ESTABLISHMENT	SEEDING RATE (kg / ha)		
		RAINFALL (mm) / IRRIGATION	BROADCAST	ROWS
Ryegrass	Feb – Apr	Irrigation	25 - 30	20 - 25
Cocksfoot	Feb – Apr	> 900 mm / Irrig.	20 - 25	15 - 20
Tall Fescue	Feb – Apr	> 800 mm / Irrig.	25 - 30	20 - 25
White Clover	Feb – Apr	> 800 mm / Irrig.	2 - 3	2
Red Clover	Feb – Apr	> 800 mm / Irrig.	4 - 6	4
Berseem Clover	Feb – Mar	> 800 mm / Irrig.	15	10
Lucerne	Feb – Apr (Cool areas) Mar – Jun (Warm areas)	< 700 mm 700 – 900 mm Irrig.	- - 20 - 25	5 5 - 12 12 - 15
Oats	Feb – Mar	Dryland / Suppl. Irrig.	50 - 70	40 - 50
Triticale	Feb – Apr	Dryland / Suppl. Irrig.	50 - 70	35 - 45
Stooling Rye	Mar – Apr	Dryland / Suppl. Irrig.	40 - 60	30 – 40
Japanese Radish	Dec – Jan / Feb	Dryland / Suppl. Irrig.	-	2 – 3
Forage Sorghum	End Oct – Jan	< 600 mm > 600 mm	15 20	4 - 6 7 – 15
Hybrid Babala	End Oct – Jan	< 600 mm > 600 mm	10 15	3 - 5 5 – 10
Weeping Love Grass	Oct – Dec	> 650 mm	6 - 8	3 – 5
Teff	Oct – Dec	> 600 mm	15 - 20	10 – 15
Smuts Finger Grass	Nov – Feb	> 500 mm	5 - 7	3 – 4
Rhodes Grass	Oct – Nov & Feb – Mar	> 600 mm	8 - 10	5 - 7
White Buffalo Grass	Jan – mid Feb	> 500 mm	6 - 8	3 - 5
Bahia Grass	Dec – Jan	> 700 mm	25	15
Kikuyu	Oct – Jan	> 700 mm / Irrig.	2 - 3	2