BARENBRUG

Summer forage

Production guide

EDITION 4.0

Grow with Confidence

Using summer forages

Spring and summer present an opportunity to plant a forage crop for summer, autumn or winter feed. Depending on the environment, planting time, stock needs, climate and water availability, there is a range of productive varieties available. Forage brassicas are mostly grown in cool temperate parts of southern Australia, however many rape varieties can also be effectively grown in warmer broadacre areas by using an earlier sowing date.

In hotter regions, sub-tropical cereals including millet and sorghum are ideal for grazing and fodder production. Chicory is another beneficial inclusion, either as a sole stand or in combination with brassicas or millet. Not only do fodder crops provide valuable feed, they are also an excellent way to provide a pasture break during a pasture renewal program.

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Summer forage crops can be grown in a wide range of soil types, however, it's often the poorer performing pasture paddocks that are targeted, as better pastures tend to be retained. To grow a successful crop, it's important to address the factors that have led to the paddock's poor performance to date. To do so, it is advisable to take a soil test ahead of sowing to determine soil acidity and fertility for nutrient correction, lime and to apply suitable starter fertiliser for the crop.

Some paddocks are sown to forage crops as part of a pasture establishment process to reduce weed problems and to correct problems for future pasture sowing.

Heavier soil types and locations that retain moisture will often assist yield. Terminating a pasture before moisture runs out in the spring will help maintain sub-soil moisture and offer the crop some resilience in dry times. It's generally not suitable to grow forage brassicas under flood irrigation.

Paddock preparation

Tillage or spray fallowing should be carried out at least 4–6 weeks prior to sowing to control weeds and conserve soil moisture. Initial tillage will encourage a strike of weeds.

Further cultivation or chemical control will help ensure weed problems are reduced. In situations with a high level of turf-grass 'mat' multiple passes may be needed, although it may be prudent to retain some proportion of turf-mat in soils prone to erosion by wind or on sloping sites. Brassica seeds are very small, so a fine but firm seedbed is ideal, however direct drilling is sometimes required, often with good success, particularly with one-pass machinery.

Sowing

To ensure maximum germination, sow brassicas no deeper than approximately 1.5cm into a firm, moist seedbed. Millet should be sown at 2–3cm, sorghum and maize may be sown at 4–6cm which is useful for chasing moisture on heavier soils. Pre-watering may be extremely beneficial, and essential if using cold water sourced from a deep dam. Light rolling and/or a light harrowing can be used to aid seed soil contact and encourage better germination provided the soil surface is not likely to crust. An even and quick germination is often the key to success, especially when managing weeds.

Crop protection

It's important to monitor for pests including mites, cut-worm and slugs then respond rapidly with any required treatment. If weed control is required, treat weeds as early as possible to remove competition and to observe stock grazing withholding periods.

Grazing management

Sound grazing management of forage crops is essential to maximise yield, feed quality and utilisation. Strip grazing or small block grazing will allow the crop to be utilised more effectively. To minimise trampling and gorging, it is advised to manage stock movements. Back-fencing of multiple-graze crops, together with fertiliser top-dressing and timely irrigation will maximise the potential of the paddock. For tall crops like sorghum and forage maize, wider row spacing will tend to reduce trampling losses.

Avoid introducing empty, hungry animals onto a lush crop as various illnesses may result. Stock should have access to good clean water. This is especially important over summer when evaporation rates are higher and will help prevent suppression of appetite and consequent production setbacks. It is advisable to introduce animals onto a forage crop slowly at first, so that the rumen can adjust to the change of a high quality diet.

Brassicas are highly digestible and have a low fibre content, so access to roughage such as hay or a run-off to dry pasture may provide a more balanced diet and improved performance. Leafy millet and sorghum offer a reasonably well balanced feed, but become fibrous and lower in energy and protein as they mature later in the season.

Summer forage selection guide

Summer conditions	Purpose	Use pattern	Enterprise intensity	Suitable species and variety	Page
Milder summers (usually most days <32^{0}C)	Summer / autumn feed	Re-grazing possible, high quality	Extensive sheep / beef	**Leafmore rape**	11
			Intensive dairy / finishing	**Interval rape**	10
		Fast feed, re-grazing	Most systems	**Falcon leafy turnip**	12
		Single graze, quality and yield	Intensive dairy / finishing	**Falcon leafy turnip**	18
	Winter keeping	Single graze only	General purpose dairy / beef	**Caledonian kale**	19
Most conditions	Summer / autumn feed	Re-grazing, high quality	Most systems	**Commander chicory**	29
		Re-grazing, silage, hay	Most systems	**Shirohie millet**	33
		Re-grazing, silage, hay	Sudan x Sudan	**Nudan forage sorghum**	31
		Re-grazing, silage, hay	Sudan x Sorghum	**Lush / Revolution BMR forage sorghum**	32
		High yield, single graze	Most systems	**Summer Green forage maize**	34
Warm-hot summers	Summer / autumn feed	Stand-over, silage, hay	Sweet x Sweet	**Hunnigreen forage sorghum**	32
		Fast feed	Most systems	**Ebony cowpea**	35
		Longer season	Most systems	**Lablab (various)**	37

Forage brassicas

Brassicas are specialty forage crops established in the warmer months to provide high yield, high quality to meet the autumn or winter feed gap.

Sowing rates vary widely, and depend on many factors including:

- condition of the seed-bed at sowing time, method and accuracy of sowing equipment
- seed size; and
- length of time to maturity.

Brassicas need a fine, weed-free seed bed, with a pH of 5.5 or above. Crops may respond to boron, molybdenum and phosphorus. Nitrogen application is usually needed, but care should be taken to avoid nitrate poisoning, particularly with drought (or other) stressed crops. Brassica crops will often respond well to appropriate applications of potassium, as this will tend to aid keeping ability and leaf retention. High rates of sulphur (S) are not advised unless the site is particularly low in S. Newly introduced stock should be carefully monitored, and may take a little time to become accustomed to the crop. Flowering crops should not be fed to livestock.

Within the brassica options there are good forage solutions as well as great versatility. As maturity times are relatively predictable, brassicas offer a terrific tool for feed budgeting to meet forage demand and output targets. Seek specific advice for your situation.

Brassica sowing and grazing plans

			Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Forage rapes	Spring sown	Plant	▶	●	●	●	◀									
		Graze				▶	●	●	●	●	●	●	◀			
	Autumn sown	Plant							▶	●	●	◀				
		Graze										▶	●	●	●	◀
Leafy turnips	Spring sown	Plant	▶	●	●	●	◀									
		Graze				▶	●	●	●	●	●	●	●	●	◀	
	Autumn sown	Plant						▶	●	●	●	●	◀			
		Graze								▶	●	●	●	●	●	◀
Dynamo turnip		Plant			▶	●	●	●	◀							
		Graze						▶	●	●	●	◀				
Caledonian kale		Plant			▶	●	●	●	◀							
		Graze										▶	●	●	◀	

▶ Earlier than ideal, but acceptable ● Optimum sowing time ◀ Later than ideal, but acceptable

Forage brassicas may be planned to meet specific feed gaps or production targets. There is also a very good opportunity to plan for a series of crops and grazings.

For example, if a number of paddocks were sown in November with different brassica crop types, then there would be potential for on-going feed:

	Sep	**Oct**	**Nov**	**Dec**	Jan	Feb	Mar	Apr	May	June
	Plan	Prepare	Sow	Grow	Continuous feed available and on-going pasture renewal					
			0–4 wks	5–8 wks	9–12 wks	13–16 wks	17–20 wks	21–24 wks	25–28 wks	29–32 wks
Early crop 8–10 weeks	Identify suitable paddocks, soil test, spray off	Prepare sites - fertiliser, lime, cultivate etc	Leafmore rape	Manage weeds, pests, irrigation etc	1st grazing	Regrowth	2nd grazing	Re-sow to new pasture	Look after new pasture	Look after new pasture
Main season crop 10–14 weeks			Dynamo turnip		Maintain crop care	Grazing	Re-sow to new pasture	Look after new pasture	Look after new pasture	Grazing
Late crop 20–24 weeks			Caledonian kale		Maintain crop care	Maintain crop care	Maintain crop care	Grazing	Grazing	Plan spring crop or pasture

Brassica crop nutrition

Brassicas are a very nutrient demanding crop, and good results will only be achieved if the fertiliser supply is adequate. Soil testing prior to starting the crop is highly advisable. The results of the test may help to achieve desired yield outcomes, target specific nutrient imbalances or deficiencies, and present the paddock in good condition for subsequent crops or pastures.

As the crop is being grazed in situ, a very high proportion of the nutrients will remain in the same paddock after grazing from passing through the animal, plant trash and the plant roots. Allowing for animal production outputs and some losses through the environment or transferring to laneways, around 75–80% of the nutrients are likely to remain in the paddock.

Soil Fertility

pH ($CaCl_2$)	> 5.5, 5.8–7.0 is preferred. Lime if required, and incorporate with cultivation.
Phosphorus (P)	Olsen P > 20 is preferred. Crops typically benefit from applications of 20–30kg P/ha.
Nitrogen (N)	Crops generally respond well to N. Requirements will vary depending on soil type and paddock history. If too much N is made available and /or in combination with other crop stresses, then nitrate poisoning may result. Do not apply too soon before grazing in particular. Often useful to apply 80–100 kg N/ha split between sowing and top-dressing at around 4–6 weeks after emergence. The balance of the nitrogen need is usually supplied from nutrients available in the paddock. Leaf testing during early growth will offer further guidance on N needs.
Potassium (K)	May be applied in areas where levels are typically low. There is good evidence that adequate K nutrition will aid the prevention of plant diseases and help crops 'keep' for longer. High application of K may be at best wasteful or contribute to an imbalance of magnesium.
Sulphur (S)	S is rarely needed for forage brassicas. High levels may induce red-water in grazing stock through the crop's accumulation of S-methylcysteine sulphoxide (SMCOs). Avoid high rates of S unless soil test levels are particularly low.
Molybdenum (Mo)	Mo is an essential nutrient for the development of brassicas. May be required where levels are historically low, Mo has not been applied for some years or pH is low. Usually apply in conjunction with Cu for animal health. Liming may increase the availability of Mo.
Boron (B)	May be beneficial on sites with low levels, or on sites with soil types that are subject to quickly drying out. Apply specified rates with care as high levels may create stock toxicity.

The balance of crop requirements may be provided by the background fertility in the paddock. Often direct drilled paddocks may need higher levels of fertiliser, especially nitrogen (N), as compared to cultivated paddocks. Cultivation increases the rate of oxidation and hence break-down and release of some nutrients. Avoid sowing more than 25kg/ha of N or P in contact with the seed as fertiliser burn may result in a lower rate of establishment. Adopt pre-spreading instead or split the fertiliser need between spreading and drilling. Consider keeping K levels up for longer maturity/keeping resilience and general good crop health. For multiple-graze crops, a top-dressing of N or mixed NPK fertiliser may be prudent in many circumstances. As the crops are grazed 'in-situ' a high proportion of the fertiliser is retained on the paddock, which may be considered a capital application, and will contribute positively to following crops or pastures. It is strongly recommended to take a soil test through an accredited laboratory and obtain good advice to set up a fertiliser program.

Crop requirements for 10t DM/ha			
10t/ha DM	N	P	K
	250kg	30kg	150kg

This is an indication of the nutrients held up in the crop to produce at 10t DM/ha brassica plant canopy. Not all of the nutrients need be applied as fertiliser, as the paddock will often supply much of the nutrition. A soil test and sound agronomic interpretation should be used to develop a specific program.

Example fertiliser program			
Fertiliser*	N	P	K
Pre-sow 350kg/ha 19:8:17:1	67kg	28kg	60kg
@4 wks 125 kg/ha Urea	57kg	-	-
Soil/ mineralisation contribution#	126kg	2kg	90kg

* Plus trace elements #From background paddock nutrients

Forage rape
Brassica napus

Rape is a fast-maturing leafy, single or multi-graze crop that can be sown for summer, autumn or winter feed. Rape has a broader adaptation than most other brassicas and can be used with great success in drier areas with warmer summer temperatures, particularly if sown in late winter/early spring and established prior to the onset of summer. It typically has higher protein and dry matter than turnips. There is a wide spectrum of varieties available from shorter stature, hardier types suitable for extensive systems to higher yielding taller types intended for intensive dairy and beef operations.

Fit and use pattern

Rape can be sown from early spring to late summer depending on its use. Usually rape is sown as a lone stand, but may be used in combination with other summer forages such as millet and chicory, or often sown in early autumn for winter feed in combination with annual or Italian ryegrasses with good results. Rape's feed value is high, but usually the crop must be mature before grazing, approximately 10–12 weeks after sowing. In some circumstances, and certainly with older cultivars, it is necessary to wait approximately 14 weeks for the crop to turn bronze prior to offering to animals.

Interval
Forage rape

450mm+ | pH 5.5–8.0 | Most soil types

- Tall, fast establishing rape
- Useful for both summer and winter feed
- Offers valuable feed opportunities for farmers wanting to finish stock
- Suitable for autumn and spring sowing
- Can be used as a summer crop where 1 to 2 grazings are required or as a late-spring/early-summer sown crop
- Strong frost tolerance and resistance to powdery mildew.

Leafmore

Forage rape

450mm+ | pH 5.5–8.0 | Heavy loam and clay

Sowing Rates	
Irrigation / high input	3–4kg/ha
Good dryland	3kg/ha
Marginal dryland	2—3kg/ha
In a forage mix	0.5–2kg/ha

- Cross between Winfred and Emerald
- Superior cold growth habit and frost tolerance
- Vigorous establishment and high yielding
- Early maturity to first grazing (8–10 weeks)
- Suitable for autumn and spring sowing
- Excellent regrowth for up to 4 grazings when spring planted
- Multi-stemmed with semi-erect growth habit
- High forage quality with good leaf to stem ratio and high dry matter.

Sowing and Grazing Window

		Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Spring sown	Plant	▶	●	●	●	◀									
	Graze				▶	●	●	●	●	●	◀	◀			
Autumn sown	Plant							▶	●	●	◀				
	Graze										▶	●	●	●	◀

▶ Earlier than ideal, but acceptable ● Optimum sowing time ◀ Later than ideal, but acceptable

Leafy turnips
Brassica campestris spp.rapa

Leafy turnips are a quick maturity rape/turnip hybrid cross. These are also known as hybrid leafy turnips or hybrid forage brassicas. They will grow a small bulb with high leaf yields and can provide quick feed, often in 6–8 weeks. With good grazing management leafy turnips can offer multiple grazings.

Fit and use pattern

Leafy turnips can be sown from September to April. They are often used as a sole stand although it is often rewarding to sow with companion species.

Similar herbicide techniques as per conventional rape may be used; pre-emergence options may be useful in some circumstances. Fertiliser requirements are similar to that for other brassica forages.

Leafy turnips should be grazed once they achieve around 30–40cm in height, or about 8–10 leaves. Repeat grazings are possible each time the crop returns to the desired height. To achieve rapid regrowth, grazing down to a range of 5–10cm is recommended. If grazed lower, regrowth may be slower. If left longer, regrowth may occur from the stem rather than bulb and be restricted. It is common to achieve at least 3–4 grazings under reasonably well managed situations.

Companion Species	
Spring sown	Millet, chicory, white and red clover, plantain
Autumn sown	Annual or Italian ryegrass, forage oats, forage barley, chicory

Sowing Rates	
High rainfall / irrigated	5–8 kg/ha
Good dryland	4–5 kg/ha
Marginal dryland	2–3 kg/ha
In a forage mix	1–2 kg/ha

Sowing Time	
Early spring areas	Aug – Oct (Ideal time for setting up early summer feed)
Late spring areas	Oct – Dec (Quick option to start up a summer feed program)
For fast autumn feed	Feb – April (Fast autumn feed and multiple winter grazings)

Falcon
Leafy turnip

500mm+ **pH 5.5–8.0** **Most soil types**

Falcon leafy turnip has many applications:

- Quick feed in 6–8 weeks: Suits sowing from early spring to mid-autumn
- Excellent companion plant for spring or autumn sown annual forages
- A break crop as part of a pasture renovation program
- May be used in a mix with other species for specific outcomes, although has excellent feed quality attributes when sown as a sole variety
- Very suitable for dairy, finishing and extensive sheep and cattle enterprises.
- Falcon leafy turnip offers benefits over alternatives:
- 10–15% yield advantage over older varieties
- Improved early vigour
- High stock acceptance and improved palatability
- Excellent recovery from grazing.

Sowing and Grazing Window

		Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Spring sown	Plant	▶	●	●	●	◀									
	Graze				▶	●	●	●	●	●	●	●	◀	◀	
Autumn sown	Plant						▶	●	●	●	◀				
	Graze								▶	●	●	●	●	●	◀

▶ Earlier than ideal, but acceptable ● Optimum sowing time ◀ Later than ideal, but acceptable

Forage rape trials

Forage rapes have a broad application for spring-summer and summer-autumn crops in southern summer-milk areas, and as an autumn crop in summer-dry areas that seek quick, economical quality feed in the cooler months.

Barenbrug trials at Howlong, NSW in 2014 were performed at a sowing rate of 4kg/ha in the autumn and measured for yield in August, followed by sheep grazing on un-cut plots, with a second yield measurement in October.

Yield and palatability trial 2014

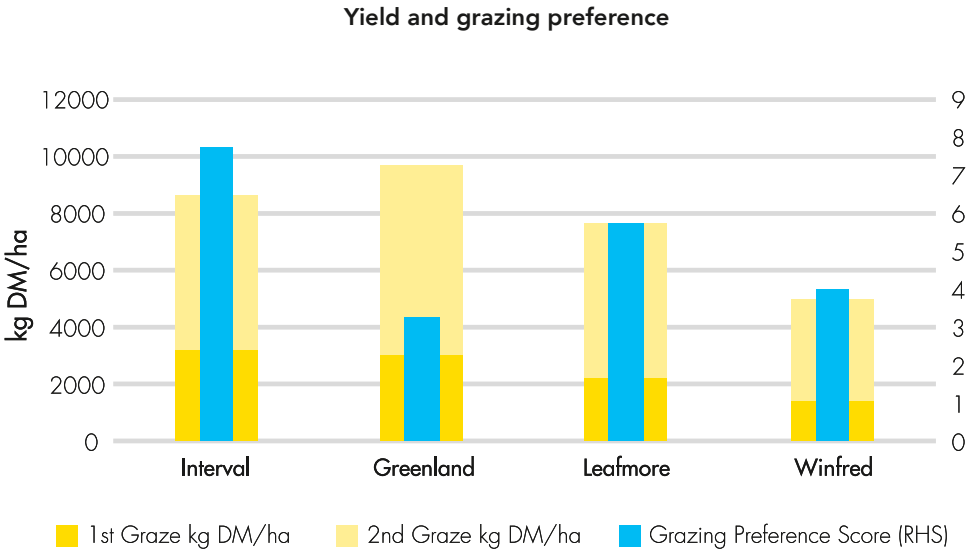
- Replicated plot trial (4 reps) planted at Howlong on 23rd April 2014
- Sowing rate: 4kg/ha
- Excellent planting conditions, followed by good growth conditions through autumn-early winter
- 13th August (16 WAS) – trial cut to measure yield at a simulated first grazing opportunity (half plot), then sheep introduced to graze the site including the un-cut half of plots with a grazing preference score taken
- 15th October (25 WAS) – second cut to measure yield at a simulated second grazing.

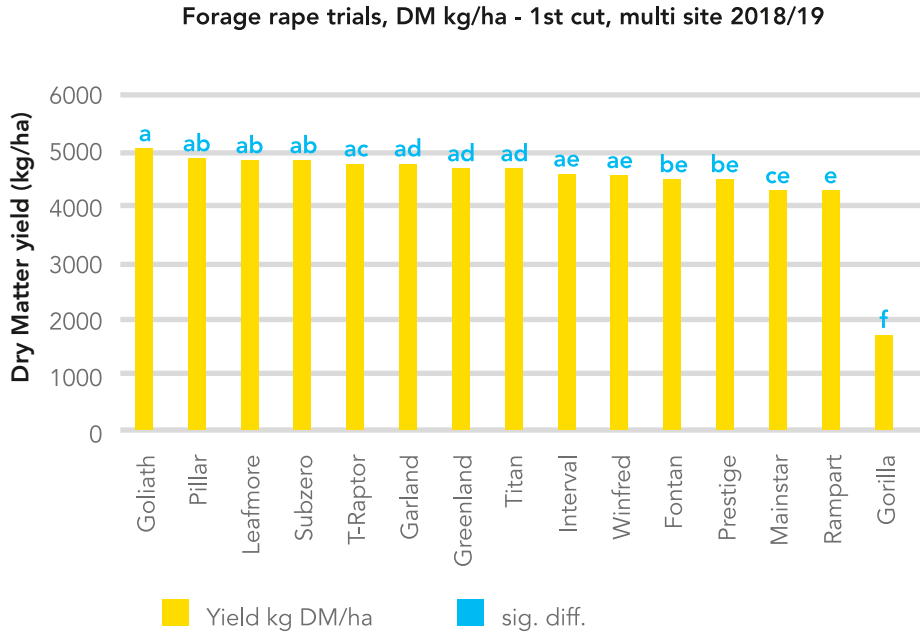
	DM Cut 1 13/08/14			Grazing Preference Score 1 to 9=best 15/08/14			DM Cut 2 15/10/14			Dry Matter Total kg/ha		
Variety	kg/ha	Sig*	Rank	Score	Sig	Rank	kg/ha	Sig	Rank	kg/ha	Sig	Rank
Interval	3,216	a	1	8	a	1	2,149	b	3	5,365	b	3
Greenland	3,004	a	2	3	c	4	3,688	a	1	6,692	a	1
Leafmore	2,199	b	3	6	b	2	3,220	a	2	5,419	b	2
Winfred	1,481	c	4	4	c	3	2,051	b	4	3,532	c	4
Trial Mean	*2,475*			*5*			*2,777*			*5,252*		
LSD (5%)	*418*			*1*			*690*			*671*		
%CV	*9*			*9*			*13*			*7*		

*Entries with the same letter are not significantly different

Half-plots harvested for dry-matter yield

Sheep introduced to graze remaining plot area





Yield and feed quality trials Warragul and Kongwootong VIC 2018/19

- Replicated plot trials (4 reps)
- Sowing rate: 4kg/ha
- Spring sown into fair-OK moisture, and had some followup rain, although with relatively dry summer/ early autumn.
- 1st harvest Warragul 76 DAS, Kongwootong 88 DAS
- Trials are on-going to develop 2nd harvest and feed quality information.

Brassica crop protection

For good reliable results, brassica crops should be grown on a solid program that addresses threats from weeds and pests. The planning for a crop should include some anticipated prior knowledge of the likely weed spectrum and probable pest issues.

The following outline crop protection program is intended for guidance and general principles. Seek specialised advice for your situation. Inspect your crops regularly, and at least twice weekly in establishing crops, especially during warmer months when pests are typically most active and in larger numbers. Importantly, note that synthetic pyrethroids (SPs) and many organo-phosphate (OPs) have wide-spread resistance from diamond back moth (DBM, Plutella) and cabbage white butterfly (CWB). The new option Success® Neo Insecticide containing Spinetoram is an excellent tool for in-crop caterpillar control. Weed control options have been very limited, but the release of ForageMax® Arylex® active Herbicide has offered productivity gains in rape and turnips.

Success® Neo Insecticide

Insecticide for forage brassicas

Success® Neo INSECTICIDE

- ✓ Diamondback moth
- ✓ Cabbage white butterfly
- ✓ Cabbage cluster caterpillar
- ✓ Cabbage centre grub
- ✓ Heliothis
- ✓ Native Budworm

- 7 day stock withholding period for grazing.
- No more than 2 applications per crop.
- Read label for specific instructions and registration details.

ForageMax® Arylex® active Herbicide

Broad-leaved herbicide for forage rape and turnips

ForageMax® Arylex® active HERBICIDE

- ✓ Capeweed *(Arctotheca calendula)*
- ✓ Cleavers *(Galium aparine)*
- ✓ Deadnettle (Lamium amplexicaule)
- ✓ Fat hen (Chenopodium album)
- ✓ Fleabane (Conyza spp)
- ✓ Fumitory (Fumaria spp)
- ✓ Mexican poppy (Argemone Mexicana)
- ✓ Milk thistle (Sowthistle) (Sonchus oleraceus)
- ✓ Rough Sowthistle (Sonchus asper)
- ✓ Prickly lettuce (Lactuca serriola)
- ✓ Volunteer legumes
- ✓ Many other weeds

- Apply from 4–8 leaf stage in rape and turnips.
- 14 day stock withholding period for grazing.
- No more than 2 applications per crop.
- Read label for specific instructions and registration details.

It is highly recommended that a competent agronomic service be engaged to assist with making chemical recommendations and that suitable equipment and application techniques are employed.

Preparation

Knock-down herbicide + knock-down insecticide:
e.g. glyphosate + chlorpyrifos
Kill off existing cover and remove residual pest populations. This is especially important for many caterpillar pests. If fallowing, consider a second application again, immediately before seeding.

Sowing

Use seed coated with an approved insecticide. This will aid early control of some sucking and biting insects including mites.

Consider using a molluscicide (slug-bait) with the seed, especially in damp conditions, clay or loam soils, where direct drilling or where there is some plant trash remaining. Hatchling slugs and snails can wipe out emerging crops, and do not need to emerge from the drill-row themselves.

Establishment

Check for cutworms and slugs/snails as the crop emerges. DBM will start egg-laying from the cotyledon stage of crops, and emerging grubs can quickly take out a very young crop. Apply selective insecticide once the eggs hatch and grubs start feeding. This may be 10–14 days after the crop is sown. Often a second spray is warranted 3–4 weeks later: continue monitoring as egg-laying will continue through dry, warm weather.

Selective insecticides are highly preferred as they tend not to target beneficial and predatory insects. Once crops have reached at least 4 leaf stage, check to see if weed control is needed. Selective grass herbicides may be used early, but check the grazing program as stock withholding periods may be long. Rape and turnip crops may have many broad-leaved weeds selectively controlled with ForageMax herbicide. Particularly dry-stressed crops may be subject to an early aphid attack. Control should be taken with urgency as the aphids may carry a number of brassica viruses that will further stunt the crop. Continue to monitor and address slugs or snails in required.

Later crop management

Continue to look for cutworms, heliothis, DBM and CWB. Well-grown crops will cope with a small population of grubs, but more than one or two per plant may constitute an economic threat in most circumstances. Aphids are relatively common in maturing crops. If there are just a few plants on the dry edge of a paddock, it is rarely worth addressing. Downy mildew may affect crops as they mature and powdery mildew becomes active in older crops in mid-late summer. Mildew can affect animal acceptance. Sowing resistant varieties and sound crop nutrition will help. Fungicide options are limited. Significant brassica diseases are described on page 27. As temperatures cool through autumn insect activity declines, and later planted crops will have fewer issues with caterpillar and grub pests. Slug and snail activity may however increase with cooler, damper conditions.

Turnips
Brassica rapa

Summer turnips offer nutritious, highly palatable feed. They are a vigorous, fast maturing crop and may be grazed 10–12 weeks after sowing. With good crop nutrition and management, crops may hold on and maintain their quality for a considerably longer period. Slower to mature, keeper types are also available, and are more typically used for grazing in later autumn and winter. Tankard-shaped varieties are suited to dairy and beef operations as they are easily pulled out during grazing. Globe-shaped types generally hold better in the ground and can be used for sheep as well as cattle.

Fit and use pattern

Turnips are best sown under good nutrition through spring and early summer, although late summer crops may also prove very useful. A higher plant density will offer earlier grazing and more leaf, but lower drought tolerance, while sparser crops have a longer period until maturity, larger bulbs and greater tolerance of dry periods. With close management re-grazing after defoliation is possible, but usually turnips are grazed on a break for highest possible utilisation through summer and early autumn.

Turnips are also an excellent option for providing high volume of forage during a pasture renewal program. Break-fence grazing, weed control and attention to crop nutrition provide a good basis for seed-bed preparation for a subsequent pasture or autumn crop.

Dynamo
Stubble turnip

550mm+ **pH 5.5–8.0** **Most soil types**

Sowing Rates	
Irrigation / high input	2.5–3kg/ha
Good dryland	2–2.5kg/ha
Marginal dryland	1–2kg/ha
In a forage mix	1kg/ha

Dynamo is a globe-shaped turnip providing a high-yielding summer crop. It offers large volumes of low cost, quality feed when pasture quality and quantity declines. Dynamo produces a good level of bulb (around 45% of total yield), giving it an advantage in seasons when high levels of leaf diseases or pests are present. Ready to graze 10–14 weeks after sowing. Suits dairy systems, sheep and cattle.

Sowing and Grazing Window

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Plant		▶	●	●	●	◀						
Graze					▶	●	●	●	◀			

▶ Earlier than ideal, but acceptable ● Optimum sowing time ◀ Later than ideal, but acceptable

Kale
Brassica oleracea

Kale is a long maturing crop that can provide very high yield at modest cost. It is an erect plant, with the stem providing a high proportion of the feed on offer. Feed value is usually somewhere between that of turnips and rape. Kale keeps well in the cooler months and grazing time can be flexible. Most varieties are quite tall and suit cattle only.

Fit and use pattern

Kale is normally sown from late October to January to provide feed from mid-autumn through winter. There is re-growth potential of 100–150mm of stem is left, although the first grazing constitutes the main target yield. There are hard-stemmed and soft (marrow) stemmed types available. Hard-stemmed types often have poor utilisation unless sown at very high plant densities, whereas marrowstemmed types are somewhat higher in overall feed quality, stock acceptance and utilisation. Soft-stemmed varieties may also be considered for silage (kaleage). Kale is resistant to club rot and is a good option for a second brassica in a rotation.

Caledonian
Kale

650mm+ | pH 5.5–8.0 | Most soil types

Sowing Rates	
Irrigation / high input	6kg/ha
Good dryland	5kg/ha
Marginal dryland	4kg/ha
In a forage mix	1–3kg/ha

Caledonian is a tall, high yielding kale that provides excellent winter feed for cattle. Caledonian is a marrow stem variety, with soft nutritious stems that offer better ME and greater utilisation than other tall kales. The main difference is in the lower part of the stems. It has good winter hardiness and, like all kales, has good club root tolerance. Maturity in 5–7 months.

Sowing and Grazing Window

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Plant		▶	●	●	●	◀						
Graze								▶	●	●	●	◀

▶ Earlier than ideal, but acceptable ● Optimum sowing time ◀ Later than ideal, but acceptable

Brassica grazing management

Brassicas require careful grazing management, particularly while they are being introduced to stock. Most animal health issues happen in the first few days of feeding.

Introducing animals

Animals coming from other feed need time to adapt to a brassica diet, so introduce them slowly from an initial 1–2 hours a day up to their maximum daily allowance over 7–10 days. This helps prevent problems like scouring, acidosis and nitrate poisoning due to a sudden change in diet. During the introductory period, animals should be initially put on to the crop when they are reasonably full, to slow the rate of intake, until they have adjusted to the diet.

The brassica portion of the diet should not exceed 70–80% of total intake, while lactating dairy cows should not exceed 30%. Where brassicas make up the majority of daily intake, a source of fibre (e.g. hay, straw, silage) should be offered to slow the rate of brassica intake, and help maintain rumen function. It is best to feed this fibre source before allowing stock access to the brassica. Stock may also need additional trace elements such as copper, selenium, iodine and magnesium. Check with your local vet for details. Always offer plenty of clean water to ensure DM intakes do not drop.

Transition around calving

Feeding pregnant stock brassicas too close to giving birth can lead to metabolic problems. Ideally, animals should be transitioned back to a grass based diet two weeks before calving or lambing.

Monitor stock

Stock should be regularly monitored while grazing brassica crops to check if they are meeting condition/live-weight targets. If animal performance targets are not being met consider if there are any underlying health issues or if not, DM allowance may need to increase. Feeding levels should be monitored to make sure animals are receiving enough. (Check the amount of feed still available in the afternoon, after morning break shifts). Occasionally, some animals, no matter how much brassica they are offered, simply do not do well on these crops. These animals should be removed and put back onto pasture.

Crop utilisation

Utilisation of brassicas is highly variable, depending on the soil type, climatic conditions, brassica type and desired animal performance. There is generally a trade-off between utilisation and animal performance. Where high weight gains are required, lower utilisation must in many cases be accepted. Utilisation of brassica crops may range from less than 50% to more than 90% on turnips and soft-stemmed kales. As a rule of thumb typical utilisation of brassicas in dry conditions is 80% and if increased live-weight gains are required, utilisation of 70% or less should be accepted. In mixed grazing it may be useful to give a mob of fattening lambs the pick of the crop at a low utilisation percentage and then offer the remainder to a dry stock class.

Break feeding is the best method of feeding brassicas, as it allows a higher level of control over animal intake, utilisation, crop regrowth potential and how long the crop will last for. Offering long phases of the crop, with small, frequent shifts so that actual break size is minimised, results in less trampling and wastage, and higher crop utilisation. Where a crop has regrowth potential, such as a rape or leafy turnip, back fencing is recommended to maximise yield potential.

Crop allocation

It is important to set targets for stock performance so the correct feeding level can be calculated for brassica crops.

To check allocations are correct, grazing needs to be monitored, because stock are the final judge as to whether estimates of DM yield, break size and crop utilisation are correct. Making the stock work to eat the remaining stem or bulb residue means the allowance is too low, and they will likely not gain condition. Accurate yield estimates, break measurements, and estimating crop residuals are essential for allocating the desired animal allowances.

Typical utilisation of brassicas in dry conditions is 80% and if increased live-weight gains are required, utilisation of 70% or less should be accepted.

Brassica animal health

Brassicas can sometimes cause animal health issues, but these can be minimised or avoided through good management. Animal health should be closely observed, especially when stock are being initially offered a new forage crop. Most problems are observed within a few days of commencement of grazing, especially if animals are introduced when they are hungry. Stock should be closely monitored, have access to a reliable supply of good quality drinking water and have the option of run-off areas. Animals should be removed if any problems occur. Clinical signs of distress may also indicate a more wide-spread or chronic sub-clinical issue.

Rape scald / photo-sensitivity

The reddening of skin on ears and faces of lambs grazing rape and on white skinned cattle especially. To minimise this ensure the crop is fully mature prior to grazing, when purple colouring can be seen on the edges of rape leaves. Animals showing signs of scald should be removed from crop and offered shade. This condition may be exacerbated by feeding crops off too early, as too high a percentage of the diet, under-stocking, and the possible complications from issues such as mycotoxins from facial eczema, mouldy fodder or infected grain. Green topped turnips may make stock more susceptible than purple types.

Red water

Caused by the SMCO (S-methylcysteine sulphoxide) content of brassicas. It is most common in kales, which contain the highest SMCO levels, but all brassicas contain SMCO. Animals with red water pass damaged red blood cells in their urine, which can lead to loss of appetite or poor growth rate. Care must be taken with sulphur based fertilisers which elevate SMCO levels. The SMCO level increases when plants flower. Sheep are more tolerant of SMCOs than cattle. Avoid high rates of sulphur in fertiliser programs, particularly with kale crops.

Bloat

Bloat can occur when feeding frosted brassica crops, as plant material breaks down more quickly. This can be avoided by shifting breaks after the frost clears. Bloat may either be in the common 'frothy' form, or gaseous form due to animals having access to a fast intake of high quality feed. The overall ration should also be considered, along with offering a slow introduction to forage crops, introducing animals to the crop after they are reasonably well fed, and providing alternative sources of fibre to assist rumen function.

Nitrate poisoning

Can occur in any type of brassica crop with high levels of nitrate, and can cause stock death. Test kits are available from vets. Introduce stock slowly to the crop and supply alternative feed such as straw, hay or silage to reduce the rate of intake of the brassica. Nitrate issues may occur on many forage types and is often associated with crops grown on or after high legume pastures, ex-vegetable production paddocks with residual fertiliser or after a long dry period with high N mineralisation. Cloudy, over-cast conditions can create an increased risk. Nitrate levels typically decrease during the day, so feeding stock later in the day may reduce the risk, as well as ensuring animals are introduced to new, lush crops in a gradual fashion and when they are less hungry.

Acidosis / Grain poisoning

Acidosis typically occurs where stock are being offered grain or other high energy feed at the same time as grazing brassicas. Acute cases have occurred on rape crops, especially where the crop green leaf has been consumed, leaving the stalks and leaf-ribs behind, and stock re-introduced to consume a high proportion of the remnant leaf petiole which is very high in sugars. Stock failing to meet performance targets may have a sub-clinical level of acidosis.

- Wait until the crop has matured – typically purpling of the margins of mature leaves, after 8–10 weeks or so.
- Introduce animals slowly over a period of 7–10 days. Break fencing or a small paddock may assist.
- Animals may not have grazed brassicas before, and may take a few days to start accepting it.
- Typical percentage of diet is 70–80% maximum as brassica for beef cattle and sheep and dry dairy stock, 30% maximum for lactating dairy stock.
- Have ample clean drinking water available.
- A source of fibre may be needed to assist rumen function - e.g. straw, dry feed, silage.
- Consider back-fencing or rotational grazing, with areas rested to allow potential re-growth.
- Animal performance may benefit from additional trace elements such as Cu, Se, I, Mg.
- Stock should be up-to-date with vaccinations.
- Monitor stock regularly and provide run-off areas or an opportunity to readily remove stock if problems arise.

Brassica crop allocation

Estimating the yield of a brassica crop is critical for allocating the correct break size and animal allowance. Knowing the number of stock to be fed, their intake requirement, likely percentage utilisation, crop face length and crop yield is vital. A similar approach may be used for other forages such as cereals, chicory, millet, sorghum and pastures generally.

Fresh weight

Joining both ends of a 3.54m length of poly pipe will give a circle with an area of 1m^2. This circle should then be placed over representative areas of the crop. Everything within the circle should be harvested, placed in a bag and weighed to give the fresh weight. For bulb crops sown in rows it may be more appropriate to harvest part of a row. Row width will determine length sampled, e.g. for 30cm wide rows, a 3.33m row sample length will give an area of 1m^2. Sampling should be repeated at least five times across the paddock to gain an average fresh weight. The more variable a crop the more samples need to be taken. The fresh weight may be multiplied by 10,000 to convert from kg/m^2 to kg/ha.

Dry matter % (DM)

Three samples per crop should be taken to determine the DM%. For each sample take some whole plants (representative of the crop) and chop into small segments. Weigh the sample to determine fresh weight and then dry at 60–90°C for 24–48hrs, until the weight stops falling. Then weigh the dried sample.

Example: The dry matter % can be calculated by dividing the dry weight by the fresh weight:

Fresh weight of sample	**= 112g**
Dry weight of sample	**= 16.8g**
Dry matter %	**= 16.8g ÷ 112g**
	= 15%

Crop yield (kg DM / ha)

Once the fresh weight yield and the dry matter % are known the crop yield in kg dry matter per hectare can be calculated.

Example:
Fresh weight yield = 90,000kg/ha
Dry matter % = 15%
Crop yield (kg DM/ha)
= Fresh weight (kg/ha) x Dry matter % (DM%)
= 90,000kg/ha x 15% (0.15)
= 13,500kg DM/ha
= 1.35kg DM/m^2

Dairy example of crop allocation

A 5ha (200m x 250m) paddock of turnips with a yield of 13.5 t DM/ha (= 1.35kg DM/m^2) 180 cow herd with a daily intake of 18kg DM/head/day, being fed 30% of their ration as rape at 80% utilisation.

Each cow (on average) needs	18kg DM/hd/day	
% of ration allowed	30% (0.3)	
Each cow therefore needs to eat	18kg DM x 30%	= 5.4kg DM turnips/hd/day
% utilisation	80% (0.8)	
Each cow needs to be offered	5.4 ÷ 80% =	6.75kg DM turnips/hd/day
Crop yield	1.35kg DM/m^2	
Each cow needs to be offered	6.75 ÷ 1.35	= 5m^2 turnips crop area/hd/day
180 cows need to be offered	180 x 5	= 900m^2 turnips crop area/hd/day
If fenced along the 200m face, break width	900 ÷ 200	= 4.5m break width

In this example, a 5ha turnip crop with 13.5t DM/ha yield will feed 30% of the ration for 55 days.

The following equation summarises calculation of break width:

$$\text{Break width m} = \frac{(\text{animal requirement DM/hd/day}) \times (\text{\% of ration allowed}) \times (\text{number of stock})}{(\text{utilisation \%}) \times (\text{DM yield kg/m}^2) \times (\text{length of break m})}$$

Calculations may be performed for all situations. Typical brassica % of diet is 70–80% maximum for beef cattle and sheep and dry dairy stock, 30% maximum for lactating dairy stock. Many crops will continue growing during the grazing period and yield may need to be re-assessed at appropriate intervals. In lax-grazed, extensive situations without break fencing, allow for some concurrent growth during the period of grazing.

Common brassica pests

		Description	Damage	Control
Cabbage white butterfly (CWB) Pieris rapa		White (male) to cream (female) butterfly up to 50mm wingspan. Caterpillars are bright green, chubby, slow and 2–30mm long, pupae 15mm long and grey-brown.	Females lay eggs on the undeside of leaves. Initially creamy-white and turning orange before hatching. Only attack plants in the brassica family. Usually slower to damage crops than DBM, but can be devastating in younger crops.	Monitoring and an integrated spray program. SP insecticides have limited value.
Diamondback moth (DBM) Plutella xylostella		Small slender grey moth to about 10mm long. Grubs up to 9–12mm long are grey-green, slender and very wriggly.	Females lay about 100 oval yellow eggs, usually on the underside of leaves. Hatching the grubs enter inside the leaf until around 3–4mm long. Larvae feed only on brassicas. Badly affected crops appear to have a 'shot-gun' effect.	Monitoring and an integrated spray program. SP and OP insecticides are largely ineffective.
Aphids (many species)		Grey cabbage aphid and green peach aphid are the most prevalent. Wingless adults are about 2mm long they range from yellow to dark green to grey. Winged adults may also be present, often a darker colour.	Initially aphids cause damage through sucking the sap of especially younger leaves, often in stressed plants. Aphids are also important vectors of many harmful brassica viruses.	Use seed treated with correct systemic insecticide, monitoring, and an integrated spray program.
Greasy, pink, brown (true) cutworms Agrotis spp.		Often one of 3–4 species, including Bogong moth. Adults grey-brown from 36 to 45mm wingspan. Larvae up to 50mm long, grey to dark grey, often pinkish, plump, found just at or below soil surface, often curled up.	Eggs laid in moist, loose soil. Young larvae may chew foliage, larger caterpillars cut stems of seedlings at ground level. Mostly feed at night. Also feed on other crops including establishing pasture. May be found virtually year-round.	Cultivation and knock-down insecticide before sowing. Monitoring of early crops stages. Chemical control.
Chevron cutworm Diarsia intermixta PHOTO CREDIT: DONALD HOBERN		Males brown-orange, females mauve, to 38mm. Caterpillars quite fat, to 30mm, shaded dark-brown-black on top and pale underside.	Eggs dome-shaped and ridged, laid in small clusters. Usually do not cut young foliage at the base, instead eat foliage or roots and bulbs. Usually found at the base of plants during the day. Also feed on many other crops.	Cultivation and knock-down insecticide before sowing. Monitoring of crops through life-span. Chemical control.
Heliothis Helicovera spp. PHOTO CREDIT: CESAR AUSTRALIA		Adults brown with a light pattern to 25mm. Wings held flat. Caterpillar larvae from 1.5mm to 50mm. Light brown with dark heads, developing stripes as they age.	Eggs single or in small clusters. 1mm diameter, white, domed become orange-brown prior to hatching. Will chew large holes in leaves. Also feed on many other crops	Cultivation and knock-down insecticide before sowing. Monitoring of crops through life-span. Chemical control.
Wireworm and false wireworm Elateridae spp and Gonocephalum spp. PHOTO CREDIT: CESAR AUSTRALIA		Wire-worm: Dark-grey-brown-black oblong. Also known as click beetle. False wireworm: Adult similar colours but oval shape. Cream-yellow-golden larvae. Distinctly segmented body.	Eggs laid on or just below surface. Eat germinating seeds and roots of young seedlings. Usually in upper 5cm of soil. Adults may chew and ringbark seedling stems. Often a pest of weedy or trashy sites, especially lo/no till situations.	Cultivation and fallowing. Knoock-down insecticides. Suitable seed coating insecticide.
Mites (RLEM, BOM, TSM) (several species) PHOTO CREDIT: CESAR AUSTRALIA		Red legged earth mite, blue oat mite, two spotted mite.	Especially problematic in emerging and seedling crops. Mites will suck the nutrients from swelled seeds, and young plants. If plants are older, a typical whitening/silvering of part or all of the leaves is evidident.	Use seed treated with correct systemic insecticide, monitoring, and an integrated spray program.
Slug and snails (many species) PHOTO CREDIT: CESAR AUSTRALIA		Slugs may be black-grey to yellow-brown, from1mm to 35–50mm. Eggs often clusters in soil and trash 1–1.5mm soft, white-transluscent. Snails of various sorts including garden snails and conical (pointed).	Newly hatched, very small slugs may feed within drill-rows and not emerge to take surface baits. Damage may occur to all parts of plants at any stage. Seedlings especially vulnerable. Older leaves typically have oblong windows rasped out.	Sow seed with an approved slug-bait in problem situations. Montitor and re-apply if needed. Cultivation will assist initially.

Common brassica diseases and disorders

		Description of condition	Caused/favoured by	Control or address by
Damping Off Pythium spp., Phytopthora spp., Rhizoctonia spp.		Seedlings fail to emerge / rotting of seed; or poor crop emergence with stunted and wilting seedlings. Brown-watery lesions on lower stem. Seedlings collapse and die.	Wet soil / continous wet conditions. Existing weeds and trash harbouring the spores.	Longer rotations. Improve soil structure / drainage. Reduce plant trash. Control weeds prior to sowing. Fungicide seed treatment.
Downy mildew Peronospora spp.		May infect seedlings, leaves and stems. Black dots on young leaves, with leaf yellowing and reddening. Older leaves with yellow-tan lesions and black speckling. Grey sprulation on underside of leaves. Leaves may die prematurely, leading to significant yield loss.	Spores may remian in soil or plant trash, or hosted by weeds. Rapid build up in moist, mild weather.	Cultivation, weed control, good crop rotation. Grazing may limit spread. Fungicide options may be available.
Club root Plasmodiophora brassicae		Tap roots are thickened and distorted, often forming into a large gall. Roots unable to properly access nutrients and water thus plants wilting and not growing, often in patches through a crop. Plants fail to develop and may die.	Low pH. Tight brassica crop rotations. Brassica weeds not controlled in pastures/other crops. Wet conditions favour spread.	Crop rotation - avoid tight or back-back brassicas. Increase soil pH. Improve drainage. Kale is more resistant than other brassicas.
Sclerotinia (white mould) Sclerotinia spp.		Decaying material at the base of the plant, often older leaves that are senescing. A wet, soft rot with a covering of white cottony fungus. Black sclerotes may be formed.	Uncertified, infected seed. Tight crop rotations. Moist, cool conditions. Heavy crops with poor air circulation. Older leaves dying off.	Longer crop rotation. Lower plant density / wider row-spacing. Maintain crop nutrition to preserve older leaves. Defoliate with grazing.
Powdery mildew Erysiphe spp.		Powdery, white-light grey patches. Largely on upper leaf surface initially then often spreads to entire leaf. Stems may be affected too. Will cause fast, early yellowing of older leaves thus reducing yield and stock acceptance.	Most prevalent in older varieties. Weeds and pest debris will host over-winter the pest. Usually appears late summer and autumn in drought-stressed crops.	Newer varieties have improved tolerance. Maintain good crop moisture and nutrition. Fungicide options may be available.
Blackleg (dry rot) Leptosphaeria maculans		Plants become stunted and start to wilt. Leaf margins redden and eventually form grey spots with large numbers of black speckles. Stem and stalks develop large bruised brown-purple-black lesions and entire stem may be dark grey-black when cut open. Badly affected plants may fall over.	Wet, windy weather. Spread by wind and in water sources. Rarely an issue in true forage rapes. Canola often far more susceptible.	Fungicide seed treatment. Avoid tight crop rotations and canola stubbles. Fungicide seed treatment. Foliar fungicide options may be available but rarely required.
Boron deficiency		Leaves, petioles and stems become brittle and split or crack easily. Roots may split. Stems and bulbs develop hollow sections. Main growing point may die and plant develop stunted side shoots.	Light, sandy soils subject to drying out. Very low or very high pH. B not included in fertiliser program.	Select sites with good moisture holding capacity. Include B in planting fertiliser at appropriate rates. B foliar sprays.
Molybdenum deficiency		Mo needed for nitrogen metabolism, so early signs similar to nitrogen deficiency. Distorted leaf margins follow, and they progressively die back. Younger leaves at heart of plant become narrower and more affected as they try to form.	Acidic soils. Low soil Mo or Mo availability. Mo not applied for some time.	Mo program on farm. Seed treatment that includes Mo. Mo foliar sprays. Improve soil pH to at least 6.0, pref 6.5+.
Manganese toxicity		Yellowing of the margin of older leaves, and eventual death of leave margin, combined with cupping of leaves. Red-brown mottled inverveinal necrosis, followed by dead patches and black managese spots.	Waterlogging/poorly drained sites. Acidic soil / sub-soil. High Mn sites.	Site selection. Drainage. Liming to improve (lift) pH.

Images courtesy of Agriseeds NZ and Cesar Australia.

Chicory
Cichorium intybus

Chicory is a persistent leafy herb typically persisting 2–3 years with a large tap root. It performs best in fertile, free draining soils in regions of greater than 550mm rainfall. It has potential for high dry matter yields of excellent quality with most growth through warmer periods.

Fit and use pattern

Chicory is often used as an annual (summer) forage in combination with millet, clover or forage brassicas. Chicory is chiefly used as a spring-sown option, although there are good applications for early autumn sowing. Commander chicory has been developed and selected for high performance situations that demand:

- Fast establishment
- Outstanding DM yield
- Upright growth habit to enable high utilisation
- Low crown to help cope with wet conditions and treading damage
- High tolerance of sclerotinia root rot.

Whilst there are a number of more prostrate cultivars available, they do not match the yield potential nor have the combination of these attributes. As chicory is largely used as an 8–10 month forage crop, fast establishment, high yield and superior utilisation are the key factors driving performance.

Chicory requires a well prepared seed bed and soil temperatures of greater than 10^{O}C for successful establishment.

Renewing poor performing pasture paddocks through a chicory break crop also provides an opportunity for grass herbicide applications to reduce the burden of many problem weeds. Chicory does not host many pasture pests, like black beetle or Argentine stem weevil, so it reduces these pests for the following pasture. Chicory contains two defensive chemicals, lactucin and lauctucopicrin, which make it less susceptible to butterfly and moth damage compared with alternatives like turnips. Morrow red clover and Storm white clover are very good options for spring sowing with chicory.

Grazing management and animal husbandry

Once chicory is established at about the 7–8 leaf stage, it can be grazed. Chicory should be rotationally grazed on a 4–6 week rotation and will require added nitrogen for maximum performance. Pre-grazing covers should exceed 25cm (~2800–3000kg/DM/ha), aiming for a 5cm (1000kg/ DM/ha) post grazing residual. At 2800kg/DM/ha cover chicory plants have replenished taproot reserves to fuel vigorous regrowth after grazing. Back-fencing should be used to protect regrowth where stock are on the same paddock for more than three days. Facial eczema and bloat are not a problem on chicory crops. There is evidence to suggest problems with internal parasites are substantially reduced in stock grazing chicory compared to ryegrassbased pastures.

DM yield combined over four trials 2010–2013

Entry	Establishment	Summer	Autumn	Total
Commander	109a	109a	106a	110a
Punter	109a	110a	104ab	110a
Commander + Tuscan	101ab	109a	105a	109a
Puna II	104ab	105a	106a	105ab
Chico	104ab	104a	100ab	103ab
Choice	97ab	100a	97b	98b
Tuscan	93b	66b	97b	70c
Trial Mean (kgDM/ha)	697	2085	803	3582
LSD (5%)	113	243	71	371

(Relative to trial mean 100%, over four trials Te Awamtu 2010–11 and 2011–12, Cambridge 2011–12, Ashurst 2012–13)

Commander
Chicory

550mm+ | pH 4.5–7.5 | Most soil types

Sowing Rates	
Irrigation / high input	6–10kg/ha
Good dryland	4–6kg/ha
Marginal dryland	2–4kg/ha
In a forage mix	2–3kg/ha + 2–3kg Morrow Red Clover + 2–3kg Storm White Clover

- Chicory for high performance sites
- 15–20% higher yield than prostrate types
- Performs all year round including winter
- Fast establishment and regrowth after grazing
- Erect growth habit offers high utilisation
- Responds to summer rain and irrigation
- Low crown gives good persistence over 2–3 years.

Sowing and Grazing Window

		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Spring sown	Plant		▶	●	●	●	◀							
	Graze					▶	●	●	●	●	●	●	●	◀

▶ Earlier than ideal, but acceptable ● Optimum sowing time ◀ Later than ideal, but acceptable

Forage sorghum

Sorghum spp.

350mm+ (summer dormant) | pH 4.8 – 7.0 | Most soil types

Sorghum is a warm climate, annual grass used for strip grazing, silage and hay, capable of very high yields under the right conditions. Suited to both irrigated and dryland situations, there are many varieties and sub-types to choose from to suit your conditions.

Fit and use pattern

Forage sorghum is largely used as a standing feed or summer fodder crop for beef and dairy but there is also some scope for use in sheep enterprises. In southern Australia, cool tolerant varieties should be used. Sorghum should be sown when soil temperature is over 16°C and rising. This is usually in a short period from early November to mid-December, although relatively frost-free areas may sow from around mid-October or earlier. Sorghum will often offer a first grazing at around 8–10 weeks after sowing. There is good scope for a second grazing of regrowth or an early autumn silage crop. Alternatively, the crop may be taken around late summer for one large silage or hay harvest. Growth rates will rapid decline with the onset of cooler late autumn conditions.

Grazing management and animal husbandry

Crops or regrowth less than 50cm high or under drought or other stresses may create issues with prussic acid poisoning, depending on the condition of the crop and the variety. Avoid offering sorghum to hungry stock, and introduce them slowly. Sulphur lick blocks should always be used, and stock closely monitored initially.

Sowing rates

Sowing Rates	
Irrigation / high input	11–15kg/ha
Good dryland	6–10kg/ha
Marginal dryland	2–5kg/ha

*Dryland planting rates based on good stored soil moisture at time of sowing.

Seed Treatments

A range of seed treatments is available. Please contact your Barenbrug Territory Manager for details.

Companion species for forage sorghum

There are some potential benefits from considering a companion species: usually in the form of a legume to confer improved protein levels in forage and, especially, to improve the feed quality of conserved fodder.

In sub-tropical and northern areas, cowpeas and lablab may be included when sowing a sorghum crop. In warm temperate areas, soy beans may sometimes be considered, whilst in southern states, success has been had with mixes that include Persian clover, common vetch as well as field peas. There are limitations to the performance of, and circumstances where, a co-species may be beneficial, although it may be worth considering.

Sowing and Grazing Window

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Plant		▶	●	◀						
Graze					▶	●	●	●	◀	

▶ Earlier than ideal, but acceptable ● Optimum sowing time ◀ Later than ideal, but acceptable

Nudan
Forage sorghum

Nudan is characterised by prolific tillering and fast recovery following grazing or cutting. Its fine stems make it ideal for smaller livestock such as sheep and also for hay production. This ensures ease of management, particularly over large areas in periods of wet weather when cutting may be delayed.

- Sudan x Sudan grass hybrid
- Lower prussic acid levels
- Suited to intensive sheep, cattle, and dairy for grazing
- Excellent leaf to stem ratio
- Flexible planting window (early-late) and fine stems ensure low waste
- Fine stemmed and soft-leaved for improved conservation quality
- Reduced wilting time through fine-stemmed nature
- Best choice for quality hay production.

Lush
Forage sorghum

Lush is a fine stemmed forage sorghum with reliable, proven productivity.

It is well suited to intensive systems, or over large areas for sheep and cattle grazing, or for hay production.

Whilst Lush is a quick feed option that suits early grazing, Lush is a versatile all-rounder hybrid, ideally suited to either intensive or range grazing. It can also be used for greenchop or for making hay, or round bale silage. It may also be considered for stand-over feed.

- Sorghum x Sudan grass hybrid
- Exceptional forage yields with rapid re-grazing intervals
- Suited to dryland or irrigation
- Low prussic acid levels
- Fine stemmed when managed correctly
- Increased utilisation
- Easy to manage over large areas
- Ideal for grazing, silage or hay production.

Revolution BMR
Forage sorghum

Revolution BMR sets the standard for high quality, productive summer feed. The 12 gene brown mid-rib technology offers improved intake through reduced dietary fibre. Revolution BMR is the best choice for producers requiring high volumes of summer feed together with peak productivity. This variety is suited to early sowing with rapid establishment and excellent re-growth capacity. Its leafy and fine-stemmed nature will aid production of quality silage or hay.

- BMR Sorghum x BMR Sudan grass hybrid
- BMR trait for reduced dietary fibre intake.
- Vigorous hybrid with fast establishment
- Low prussic acid – recommended for early sowing
- Fine-stemmed and leafy
- Fast regrowth
- Highly palatable
- Grazing, green chop, silage or hay.

Hunnigreen
Forage sorghum

Hunnigreen is an ultra late maturing, sweet sorghum that will produce leafy growth later into the season when other varieties are starting to bolt. The extended period of vegetative growth offers flexibility in grazing programs and opportunity for a number of harvests as silage or greenchop in suitable environments. For maximum regrowth, retain at least 15cm of stubble when grazed or cut for silage. Hunnigreen is ideal for bale or pit silage and is the best choice for stand-over feed into late autumn and early winter.

- Sweet Sorghum x Sweet Sorghum hybrid
- High energy feed with superior sugar content
- Late quality and reduced ergot risk
- Suited to beef grazing, carry-over feed and silage
- Reduced ergot risk from late flowering
- Excellent for areas with extended seasons
- Grazing, green chop, silage or stand-over feed.

Millet

Millets offer reliable forage prospects and may also be taken for silage or hay. They are usually sown in late spring as they do not tolerate frost. They are most frequently used as a summer forage or hay/silage crop in summer irrigated areas, and reliable dryland situations. They may be sown alone or mixed with rape, turnips or chicory, or with cowpeas or lablab in warmer zones. They are typically ready for grazing in about 6–8 weeks after sowing. In contrast to sorghum, these species are free of prussic acid.

Japanese/Shirohie millet
Echinochloa esculenta

375mm+ | pH 4.8 – 8.0 | Most soil types

Sowing Rates	
Irrigation / high input	20–25kg/ha
Good dryland	10–15kg/ha
Marginal dryland	5–8kg/ha

Sowing Rates in Mixes	
Rape mix	8–12kg millet, 1–2kg rape/ha
Chicory mix	6–10kg millet, 2–4kg chicory/ha

A warm-season, fast growing annual grass. Needs soil temperatures of 14°C and rising for good germination. Often grain producing varieties are referred to as 'Jap' millet. The variety Shirohie has improved forage attributes, is the most widely used for grazing and fodder, and is the most useful variety for southern areas.

Sowing and Grazing Window

		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Spring sown	Plant		▶	●	●	●	◀							
	Graze					▶	●	●	●	●	●	●	●	◀

▶ Earlier than ideal, but acceptable ● Optimum sowing time ◀ Later than ideal, but acceptable

Cowpeas
Vigna unguiculata

Cowpeas are a very versatile summer forage that provide good grazing, silage and hay potential. They are easy to establish and known to improve soil fertility through nitrogen fixation. Cowpeas are tolerant of heat and modest rainfall sites down to 500mm per annum, although most suited to 750–1000mm rainfall areas. They should be sown after the last risk of frosts has abated. Cowpeas will perform best in well structured and lighter soils, although heavier soil types that offer good drainage are also suitable. Cowpeas will be more suited to acidic soils than lablabs. Cowpeas are often sown in combination with other annual forages such as millets, maize or forage sorghum. Seeds are variable in size and shape – square to oblong shapes with 5,000 – 15,000 seeds/kg. Growth habit is variable depending on cultivars, with prostrate types to around 50cm, and upright varieties to about 1m.

Fit and use pattern

Plant from mid-October when soil temperatures reach a consistent 18^{O}C. Seed should be inoculated with Group I strain rhizobium. Sowing depth should be around 3–5cm. Seed is soft so germination is usually rapid. Earlier plantings produce the most feed potential.

Insect concerns may include bean fly, thrips, heliothis, mirids and aphids which should be attended to if required. In wet years or higher rainfall environments, there may be increased incidence of fungal issues.

Grazing of cowpeas offers no particular health concerns for livestock. Grazing should be light enough to retain much of the frame of the plant to help assure good regrowth potential. Wider row spacing will help to reduce plant losses through trampling. Hay cutting should occur when the crop is at peak flowering, around 70–90 days after sowing.

Cowpeas are usually regarded as a summer annual as winter growth is slow and frost will finish the crop.

Ebony
Cowpea

400mm+ | pH 4.5–7.5 | Wide range

Sowing Rates: 5,000 - 8,000 seeds/kg	
Drilled, irrigation/high rainfall	25 – 35 kg/ha
Drilled, marginal dryland	15 – 20 kg/ha
Broadcast, situation dependant	25 – 50 kg/ha

30–60 cm row spacings, 10–15cm between plants

- Bred as a superior, more prostrate, forage type
- Provides multiple grazing opportunities
- Prostrate growth habit withstands harder grazing
- Improved root and stem rot resistance
- Great source of N-fixation in summer rotation
- Nil prussic acid poisoning issues
- Suitable to use with millets and forage sorghum
- Soil conditioning benefits as green manure crop.

Companion species

Planting cowpea or Lablab with sorghum or millet as a combination crop can add some real benefits: adding nitrogen to the system for increased yield, providing a more balanced ration for grazing stock, and adding quality to hay and silage cuts through increased protein and lower fibre percentages. Planting rates for the components of a combination crop should be 50–60% of the recommended rates for the individual varieties.

In grazing situations, due to cowpea's prostrate growth habit, it will manage to regrow adequately should conditions allow. Under silage or hay cutting, the cowpea component will likely be largely removed as the capacity for regrowth is limited: the subsequent harvests dominated by the millet or sorghum. Regrowth will be enhanced if the cut is made at least 20cm above the soil surface, preferably 25cm.

Cowpea and Lablab varieties	
Ebony cowpea	Good phytophthora resistance, suited to higher rainfall, coastal areas. Large seed (5–8,000 seeds/kg)
Red Caloona cowpea	Erect variety, fast maturity, lower dry matter yields, phytophthora resistant, smaller seed size. (12–15,000 seeds/kg)
Black Stallion cowpea	Selected from Red Caloona with dark seed, higher forage yield and later maturity.
Meringa cowpea	Older, long season type with lower forage potential. Often used in cane rotations. Outclassed by Ebony.
Sustain LS® lablab	New Rongai type bred for higher leaf density, reduced vine thickness, more seeds/kg and late maturity.
Dolichos lablab	Legacy and generic name for lablabs.

Lablab
Lablab purpureus

Lablab is a warm season short-lived perennial plant that is mostly used as a one year forage or rotational crop. It has trailing stems that are variably twining or climbing reaching 3m – 6m in length. Lablabs have very good grazing, silage and hay potential, and are more tolerant of wet sites than most varieties of cowpea. Lablab is quite drought and heat tolerant although is susceptible to frosts. It is a very palatable feed and will improve soil health and productivity through nitrogen fixation. The main commercial cultivars are Rongai and Highworth

Fit and use pattern

Plant from mid-October when soil temperatures reach a consistent 18°C. Growth is best at temperatures between 18°C and 35°C. Seed should be inoculated with Group J strain rhizobium. Sowing depth should be around 4–6cm, although can be planted 7.5–10cm if chasing moisture. Insect concerns are similar to those of cowpeas.

Lablab should offer grazing from around 90 days after sowing. Grazing should be light enough to retain much of the frame of the plant to help assure good regrowth potential. Wider row spacing will help to reduce plant losses through trampling. Lablab makes excellent hay, with similar feed quality to that of lucerne. A conditioner mower should be used to assist the dry-down of the coarse stems.

Lablab will persist into a second year if the crop is well managed and frost-free.

Sustain LS®
Lablab

600mm+ | pH 5.0 – 7.5 | Most soil types, well drained

- Rongai dolichos lablab proprietary type
- Late maturity
- Higher leaf density than standard varieties
- Reduced vine thickness to standard types
- More seeds per kilogram
- Ideal companion legume species option.

Highworth
Lablab

600mm+ | pH 5.0 – 7.5 | Most soil types, well drained

- Shorter season variety: three to six weeks earlier than Rongai
- Purple flowers, black seeds, 5,000 seed/kg
- More erect growth habit.

Rongai
Lablab

600mm+ | pH 5.0 – 7.5 | Most soil types, well drained

- Longer season variety
- White flowers, brown seeds, 4,000 seeds/kg
- More prostrate growth habit.

Sowing Rates	
Drilled, Irrigation/high rainfall	20 – 25 kg/ha
Drilled, marginal dryland	15 – 20 kg/ha

Row width: 75–120 cm row spacings, 30–50cm between plants

Seed treatment

Tailored seed coatings are primarily used to enhance seed establishment, the delivery of rhizobia for legume inoculation and to improve handling and ballistics properties for aerial seeding. Barenbrug offers a range of seed technology options that have been developed for specific plant species.

There are generally two types of coatings available:

- Lime-based coating: Typically used for legumes and tropical grasses (resulting in a 'build-up', ie. weight gain of the seed)
- Film-coating: Typically used for grasses or field crops to deliver a chemical seed coating (negligible weight gain for the seed).

AgriCote™

Barenbrug's premium seed coating technology AgriCote™ is available for pasture legumes, tropical grasses and forage herb species. It is designed to deliver significant advantages to plant establishment through insect protection (Gaucho), fungicide protection, inoculant bacteria (on most legumes) and micro-nutrients. This coating technology also significantly improves the handling aspects of some seeds, enabling more efficient distribution across the paddock, which is particularly important for aerial application of some tropical species.

Gaucho film coat

A film-coat of Gaucho insecticide is designed to protect seedlings from biting and sucking insects (including red-legged earth mites) for up to four weeks during establishment. Gaucho Film Coat offers 'stress shield' benefits, which help to protect treated plants during extended dry periods. Gaucho Film Coat also includes a fungicide which protects the seed against fungal diseases.

Poncho® Film Coat

Poncho Plus insecticide is designed to protect seedlings from chewing as well as biting and sucking insects for up to four weeks during establishment. It includes the active ingredient in Gaucho Film Coat that offers 'stress shield' benefits, which help to protect treated plants during extended dry periods. Poncho Film Coat also includes a fungicide which protects the seed against fungal diseases.

OptiCote™

Offers both fungicide and insecticide protection for sorghum and corn crops. A film coating of Vitavax® and Gaucho is used on corn. Thiram and Gaucho/Cruiser® are used for sorghum.

OptiCote PLUS™

Consists of the ingredients of OptiCote as mentioned above, but also includes Concept II seed safener, for the use of Dual Gold herbicide in sorghum.

Untreated vs Treated

Summer Forages
Quick Reference Guide

Variety		Leafmore	Interval	Falcon	Dynamo	Caledonian	Commander
Type		Hardy Rape	Tall Rape	Leafy Turnip	Summer Turnip	Soft-stem Kale	High Yield Chicory
Stock classes[1]		D, B, L, W	D, B	D, B, L, W	D, B, L, W	D, B	D, B, L, W
Fodder options		-	-	-	-	Kaleage	Silage
Sowing rate (kg/ha)[2]	High input/irrig.	3 – 4	3 – 4	5 – 8	2	5 – 6	6 – 10
	Good dryland	3	3	4 – 5	1.5	4	4 – 6
	Marginal dryland	2.5	2.5	2 – 3	1	3	2 – 4
	In a mix (typical)	0.5 – 2.0	0.5 – 2.0	0.5 – 2.0	0.5 – 1.0	1 – 2	1.5 – 3.0
Sowing time[3]	Spring/Summer	Aug-Dec	Sep-Dec	Aug-Dec	Sep-Jan	Nov-Jan	Aug-Nov
	Autumn	Feb-Apr	Feb-Apr	Feb-Apr	Feb-Mar	-	Feb-Apr
Suggested min 9am soil Co at sowing date		8 – 10	8 – 10	8 – 10	10 – 12	10 – 12	8 – 10
Weeks to first graze[4]		8 – 10	10 – 12	6 – 8	10 – 12	20 – 24	7 – 10
Re–growth capacity[5]		Excellent	Good	Excellent	Nil	Limited	Excellent
Guide to number of grazings typically possible		3 – 4	1 – 3	3 – 4 +	1	1	Many
Total yield potential		Mod-High	High	Mod-High	High	V. High	High
Feed seasonality	Spring	Yes	Yes	Yes	-	-	Yes
	Summer	Yes	Yes	Yes	Yes	Yes	Yes
	Early Autumn	Yes	Yes	Yes	Yes	Yes	Yes
	Late Autumn/Winter	Yes	Yes	Yes	-	-	Yes
Nutritional features[6]	Whole crop %DM	14 – 15	14 – 15	14 – 15	9 – 10	16 – 18	16
	Whole crop ME	11 – 13	11 – 13	11 – 13	11 – 13	11 – 12	11 – 12
	Whole crop CP%	17 – 20	17 – 20	17 – 20	14 – 16	14 – 18	11 – 13
	Whole crop NDF%	22 – 25	22 – 25	16 – 19	22 – 28	22 – 28	18 – 24
	Leaf % of DM	65	65	65	55	25 – 40	-
	Leaf ME	11 – 12	11 – 12	11 – 12	11 – 12	11 – 12	-
	Leaf CP%	18 – 20	18 – 20	18 – 23	18 – 20	19 – 21	-
	Stalk/Bulb % of DM	35	35	35	45	60 – 75	-
	Stalk/Bulb ME	10 – 11	10 – 11	10 – 11	12 – 13	10 – 12	-
	Stalk/Bulb CP%	15 – 17	15 – 17	13 – 16	12 – 14	10 – 17	-
Co–species compatibility[7]	Rape/Leafy Turnip				fair	fair	good
	Turnip	fair	fair	fair		fair	good
	Kale	not suited	fair	not suited	fair		not suited
	Chicory	good	good	good	good	fair	
	Millet	good	good	good	good	not suited	good
	Forage Sorghum	not suited	not suited	not suited	not suited	not suited	rare
	Forage Maize	good	good	not suited	not suited	not suited	rare
	Cowpea/Lablab	not suited	not suited	not suited	not suited	not suited	rare
	Clovers	good	good	good	good	fair	good
	Ann./Italian ryegrass[8]	good	good	good	fair	not suited	good

Shirohie	Nudan, Lush and Revolution BMR	Hunnigreen	Ebony	Sustain LS, Rongai and Highworth
Millet	Forage Sorghum	Forage Sorghum	Cowpea	Lablab
D, B, L, W	D, B, L	D, B, L	D, B, L, W	D, B, L, W
Silage, Hay	Silage, Hay	Silage	Silage, Hay	Silage, Hay
20 – 25	11 – 15	11 – 15	15 – 20	20 – 30
10 – 15	6 – 10	6 – 10	10 – 15	15 – 20
5 – 8	2 – 5	2 – 5	-	-
3 – 12	3 – 10	3 – 10	5 – 10	10 – 15
Oct-Dec	Oct-Dec	Oct-Dec	Sep-Dec	Sep-Dec
-	-	-	-	-
14 – 16	14 – 16	16 – 18	18+	18+
7 – 10	7 – 10	7 – 10	7 – 10	8 – 10
Excellent	Excellent	Excellent	Good	Good
2 – 3 +	1 – 2 +	1 – 2 +	Many	Many
Mod-High	High-V. High	High-V. High	Mod-High	Mod-High
-	-	-	-	-
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
-	-	Standover	-	-
20	20	20	20	20 – 24
8 – 9	9 – 10	9 – 10	9 – 10	9 – 10
10 – 14	15 – 18	15 – 18	16 – 20	16 – 20
55 – 70	50 – 60	50 – 60	36 – 44	42 – 46
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-
good	not suited	not suited	not suited	not suited
good	not suited	not suited	not suited	not suited
not suited	not suited	not suited	not suited	not suited
good	rare	not suited	rare	rare
	rare	rare	good	good
good			good	good
rare	rare	rare	good	good
good	good	good	good	
good	good	not suited	not suited	not suited
good	rare	not suited	not suited	not suited

1. D Dairy, B Beef, L Lamb/Intensive sheep, W Wool/extensive sheep
2. Sowing rates and relative success will depend on Higher rates for high production expectations.
3. Earlier pre–summer dates will largely only suit warm–temperate areas. Cooler areas should sow towards the end of the window. Summer–Autumn sowing dates are the reverse: cooler areas sow earlier for best results.
4. Typical minimum growth times with suitable moisture and growing conditions. Slow germination and plant stresses will likely delay crop development.
5. Plant potential due to specific characteristics, provided moisture, nutrients and management are adequate.
6. Indicative figures only. Plant density and growing conditions may markedly affect nutritional factors.

   Chicory, Millet and Sorghum figures refer to leafy, vegetative growth with minimal stem, prior to onset of reproductive phase.
7. Crop grow characteristics typically observed, and resulting comments made as suggestions for best outcomes.
8. Ryegrasses will only suit spring sowing in cool– mild summer situations. Co–species may reduce ryegrass potentail density over time.
9. In cool, southern areas, sorghum and Persian clovers have been successfully sown together, and forage maize with Interval rape appears to have good potential.

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