

Chapter 8

Fodder shrubs

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Fodder shrubs

Tim Wiley

Tagasaste and saltbush are the main fodder shrubs used in Western Australia:

- they increase total feed production and animal carrying capacity on difficult soils
- they supply green feed in autumn
- they enable deferred grazing of annual pastures after the break of season
- they use more water than annual pastures and therefore reduce recharge to the groundwater
- they help control wind erosion.

The two main types of fodder shrubs used in WA are tagasaste (*Chamaecytisus palmensis*), which is grown mostly on pale deep sands and saltbush (*Atriplex* spp.), which is grown mainly on salt-affected land (Saltland pastures – Chapter 9).

There are a number of other fodder shrubs.

The native legume *Acacia saligna* has been tried as a fodder shrub, but poor palatability and a short lifespan have limited its use. *Leucaena* (*Leucaena leucocephala*) is a tropical legume grown under irrigation in the Kimberley region. The evaluation of other fodder shrubs such as perennial lupins, tree medic (*Medicago arborea*) and the native *Rhagodia* species has been very limited and they are not being used commercially in WA.



Well managed alleys of tagasaste

8.1 Tagasaste (*Chamaecytisus palmensis*)

Features

- drought-tolerant fodder shrub
- well suited to deep sandy soils
- can replace supplementary feeding in autumn, but animals will only maintain weight
- feed quality and animal growth rates in winter and spring are similar to annual pastures
- can be grazed continuously by cattle
- sheep should not graze tagasaste for more than six weeks at a time
- requires hard grazing or cutting in the first half of the year to prevent flowering.

Tagasaste or tree lucerne (formerly *C. proliferus*, *Cytisus proliferus*) is a woody perennial legume shrub that originates from La Palma in the Canary Islands off the north-west coast of Africa. Tagasaste was first introduced into Australia in 1879.²¹⁰ While several people originally championed the use of tagasaste, it was not until intensive research and development on the West Midlands sandplain in the 1980s that farmers planted tagasaste on a large scale.

Tagasaste was initially developed to supply feed to sheep during the autumn-early winter feed gap. In this situation, tagasaste was profitable as it replaced the need to supply stock with supplementary feed.²⁹² There are several sandplain farms in the West Midlands with extensive areas of pale deep sands where about 50% of the farm is planted to tagasaste.⁴⁴³ On these farms tagasaste supplies the majority of the feed and is grazed year-round by cattle.

Tagasaste is a productive, drought-tolerant perennial pasture option in areas receiving >325 mm, especially on pale deep sands where the growth of annual crops and pastures is poor. There are currently about 100,000 ha of tagasaste in WA, mainly in the northern agricultural region. Tagasaste plantations have persisted and been productive under grazing for at least 20 years on deep sands in the West Midlands. Intensive grazing management that is designed to prevent flowering does not appear to weaken the plants or limit their life span.

Tagasaste has naturalised along roadsides and adjacent bushland in most areas where it has been planted from Badgingarra to Esperance. It is also a serious invader of disturbed bushland on lateritic soils in high rainfall areas.¹⁶²

Tagasaste for autumn feed

A whole farm systems experiment carried out at 'Dunmar', Badgingarra by the Martindale Research Project found that planting 10% of the farm to tagasaste could replace the need to hand feed sheep in autumn.²⁹² The tagasaste was locked up for 11 months and then grazed by 100 sheep/ha for about four weeks, which was equivalent to an average stocking rate of 8 DSE/ha over the year compared with 1-2 DSE/ha on volunteer annual pastures.

The tagasaste had to be mechanically cut each year as the 11 months regrowth was beyond the reach of the sheep. This system was profitable, despite the cost of mechanical cutting as it replaced grain feeding.⁴³⁸

Year-round grazing

Some sandplain farms have large plantations of tagasaste.^{211, 386, 443} In such cases the tagasaste forms the bulk of the feed supply and is grazed throughout the year.

Tagasaste varies seasonally in growth rate and feed quality (see below), but these fluctuations are much smaller than with annual pastures. Where fodder shrubs supply the bulk of the feed there is still a need to adjust the animal enterprise to match the seasonal pattern of feed supply and quality.

The combination of feed supply and quality means that 80% of the animal liveweight gain from a tagasaste plantation comes from just six months of the year. Farmers should maximise stock numbers/grazing pressure from just after the break of the season through to late spring. Stock numbers should then be reduced through summer by selling finished livestock and using other feeds such as crop stubbles.



Tagasaste flowers



Tagasaste pods

Seasonal growth pattern

Tagasaste grows rapidly after the break of the season in autumn, especially in April and May while the weather is still warm. Growth slows down during the low temperatures in June and July, but the plants do not become dormant (Figure 8.1).

The highest growth rates occur in spring when there is adequate soil moisture and warm weather. The growth rate slows down over summer as soil moisture becomes more limiting. Tagasaste

Description

- when properly managed tagasaste is a multi-stemmed spreading shrub
- when not managed tagasaste becomes a large shrub or small tree 5-8 m
- drooping branches with trifoliate leaves on short petioles
- inflorescence is white, and is predominantly cross-pollinated
- seed pods are black, flattened, 4-5 cm long and contain 8-12 seeds.

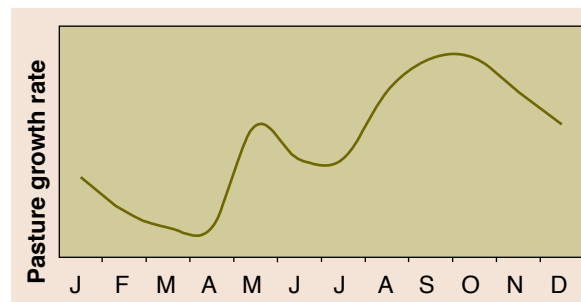


Figure 8.1 Typical seasonal variation in the growth rate of tagasaste

is also affected by high temperatures. When the temperature exceeds 35°C the leaves close up and show signs of wilting, however these symptoms disappear as the plants recover in the evening.

The feed quality is highest in winter and spring and then declines steadily over summer and autumn (Figure 8.2). By late autumn tagasaste on its own is only adequate for maintaining animals. During the growing season from May to October animal growth rates on tagasaste should be similar to those on green annual pasture, e.g. cattle growth rates of 1.0-1.8 kg/head/day. Leaves have a dry matter digestibility (DMD) of 70-82%, while fine stems have a DMD of 50-60% and large stems 40-50%.^{47, 86}

Establishment

Tagasaste can be established either by direct seeding or by planting seedlings.^{7, 438} Direct seeding is cheaper but requires more attention in terms of weed, insect and vermin control. Seedlings can be tougher once they are established, but are susceptible to planting shock

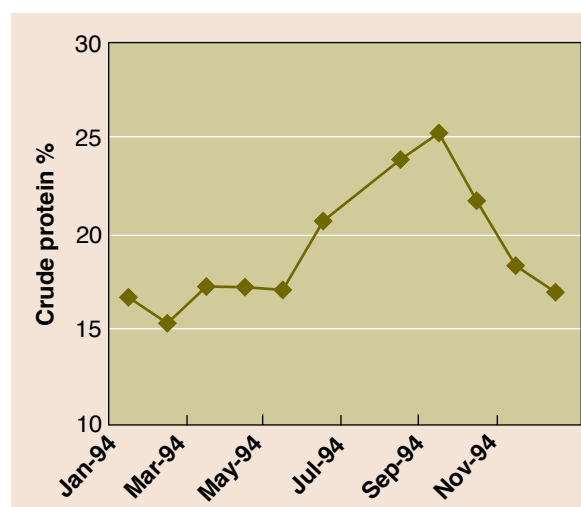


Figure 8.2 Seasonal variation in the crude protein percentage in the edible fraction of tagasaste, *Badgingarra* (T. Wiley unpublished data)



Tagasaste shoot growth on well managed plants

and are also more expensive. Potted seedlings cost 50 cents to \$1 each with 1,000 to 1,500 plants required per hectare depending on the row spacing. Bare-rooted seedlings are cheaper than potted seedlings, but are still more expensive than direct seeding.

In WA, most stands are direct seeded in winter. In the mature stand there needs to be a plant every 2 m within a row to create a hedge row. With direct seeding, there should be about 10 plants/m of row 6-8 weeks after seeding. Seedling numbers decline over the first year with many stands ending up with about 1 plant/m of row. This density is adequate and productivity is not reduced until the density falls below one plant to every 2-3 m of row.

Site selection

Tagasaste is adapted to deep, well drained soils. It is particularly suited to the highly leached, pale deep sands where annual crop and pasture growth is poor. The deeper the sand the greater the soil volume for the tagasaste roots to explore and the better the plant growth. Tagasaste roots have been measured to a depth of 10 m on a pale deep sand at New Norcia. These sandy soils have a limited water and nutrient holding capacity but this is compensated for by the deep soil profile. A sand with a water-holding capacity of 40-50 mm/m of soil can store 400-500 mm within the root zone of tagasaste. Physical or chemical properties that limit the rooting depth of tagasaste will reduce production, persistence and water use.

Tagasaste does not tolerate waterlogging or salinity and requires at least 1 m of well drained soil to persist and be productive. When there is

a fresh watertable below 1 m then tagasaste is capable of high growth rates and will transpire up to twice the average annual rainfall.²⁰⁹

Tagasaste will not tolerate extreme soil acidity and high aluminium as is common on the Wodjil sands in the eastern wheatbelt. The soil pH_{Ca} should be 4.0-7.5.

Tagasaste can be grown successfully on a wide range of soils including loamy and fine-textured soils. However, fine-textured soils can restrict root growth and are vulnerable to winter waterlogging.

Frost affects tagasaste by burning the tips of the most actively growing shoots. Established plants will not usually be killed by frosts, except where fresh regrowth is burnt off. Seedlings are sometimes vulnerable to frost damage.

Rhizobium and nitrogen fixation

Tagasaste is promiscuous, so does not have highly specific rhizobial requirements. It will form effective nodules with a wide range of Rhizobia, including the native or background strains that are present in the soil. Seed can be inoculated with a commercial strain of Rhizobium, i.e. 'Tagasaste special' CC1502, but it is not essential. Tagasaste can fix atmospheric nitrogen, however like all legumes it is cheaper for the plant to extract nitrogen from the soil when it is available. In an older stand much of the plant nitrogen can be recycled from the soil profile rather than being fixed by the rhizobia. In a young stand high rates of N fixation (83-390 kg N/ha) have been reported.⁴⁰⁰

Seeding method

Tagasaste is planted and seeded with specialist machines that scalp away the topsoil to form a furrow. The scalping helps to remove weeds from near the seedlings and also to collect water. Generally no further weed control is required, but the seedlings need to be monitored closely for insect damage. Deep ripping below the seed along with scalping help to ensure that tagasaste seedlings survive their first summer (Figure 8.3).

Fertiliser application in the first year

Applying fertiliser at seeding may have limited benefits on plant establishment, however fertiliser

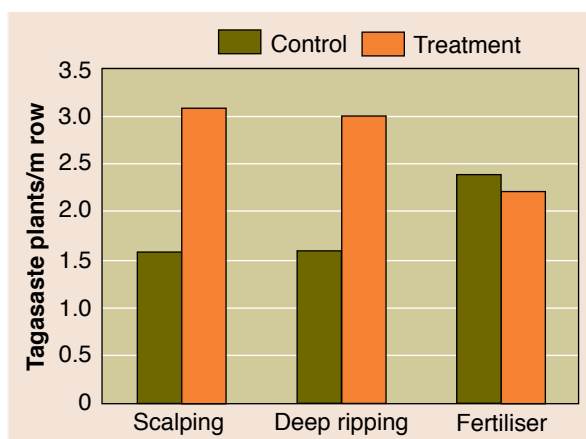


Figure 8.3 The effect of scalping, deep ripping and fertiliser application on the persistence of tagasaste when direct seeding. Plant counts were made in autumn of year 2⁴³⁴

applied in the first spring once the seedlings are established can be beneficial.⁴³⁵ For small seedlings the fertiliser is only applied along the scalped furrow rather than being spread over the whole paddock. Superphosphate and potash fertiliser can improve seedling growth greatly but this may not necessarily result in more plants surviving summer (Figure 8.4).

Applying potash fertiliser can improve seedling growth, but high rates can kill seedlings. Muriate of potash should be applied at 25 kg/km of row (or 25 g/m of row) while rates above 50 kg/km of row can kill tagasaste seedlings.

Pest and insect control

Young tagasaste seedlings are susceptible to attack by insects, grazing animals or rabbits in their first year. Newly emerged seedlings are at risk from redlegged earthmite, lucerne flea and a

range of caterpillars. Spraying the entire paddock at seeding with an insecticide is cheap insurance. Regular inspection of the paddock is also required as new pests can invade the paddock.

In coastal areas wingless grasshoppers hatch in spring. If the hatching sites are identified early then the grasshoppers can be controlled before they become mobile and spread over large areas. New tagasaste paddocks should be inspected regularly for grasshoppers from October until the end of December.

Rutherglen bugs are one of the most serious pests of tagasaste and other shrub/tree seedlings. The adult form of this insect is commonly seen during harvest and is referred to as 'radish flies'. These small grey insects are attracted to radish plants and fly off in large numbers when approached. However it is the juvenile form of the Rutherglen bug that kills seedlings. These are very small brown to black bugs that are difficult to see, as they tend to hide underneath leaves and only move when disturbed. The juveniles are sap-suckers and can kill seedlings quickly in warm conditions. Their numbers tend to peak during harvest when farmers are often too busy to inspect tagasaste carefully. Whole paddocks of tagasaste can be destroyed.

Grazing management during establishment

Grazing by livestock or rabbits needs to be controlled during the establishment year. Seedlings should be cut or lightly grazed when they are about 10-11 months old or 25 cm high to encourage the development of multi-stemmed shrubs tolerant to grazing.

Livestock disorders

The feed value of tagasaste is affected by the presence of phenolic compounds (tannin-like compounds), which are produced by tagasaste in response to stress. The phenolic content is lowest in winter and peaks in summer and autumn (Figure 8.5). Phenolics can interfere with the microflora in the rumen of sheep and cattle. High concentrations in summer and autumn reduce feed intake, so animal growth rates decline.

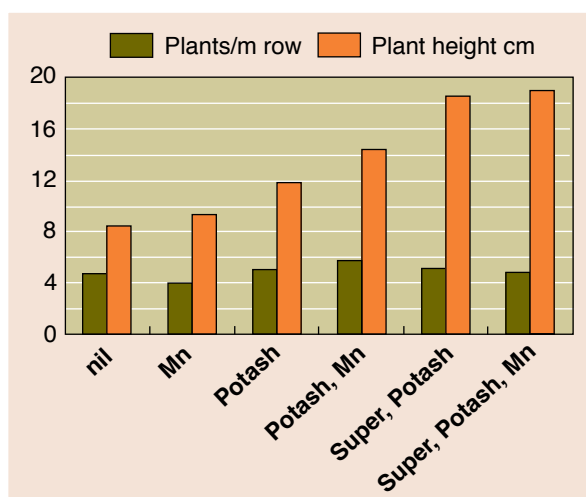


Figure 8.4 The effect of fertiliser on the growth and establishment of 5-month old tagasaste seedlings⁴³⁵

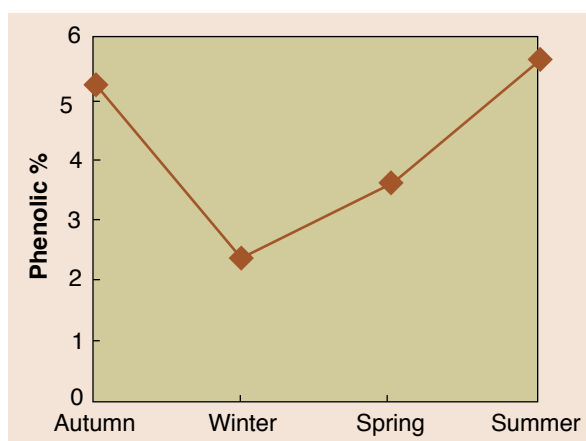


Figure 8.5 Seasonal variation in the concentration of phenolic compounds in the edible fraction of tagasaste (C. Oldham and T. Wiley unpublished data from Dunmar 1995)

Phenolic compounds interfere with the protein metabolism in the rumen and this can lead to animals becoming deficient in protein, even though the crude protein levels in the tagasaste never fall below 15% in autumn. Feeding a high protein supplement such as lupins to animals on tagasaste in autumn will overcome this problem and stimulate the animal's appetite.³⁹⁷

In autumn, the mineral concentration in the leaves of tagasaste can be less than the minimum necessary for grazing animals. If growing animals in autumn, supply a well balanced salt-based mineral lick.

'Tagasaste staggers' can occur in cattle. The condition will only become apparent when the cattle are moved, with affected animals dropping behind the mob and staggering and collapsing if forced to keep moving. However, if left alone, the animals will recover. The cause of this condition is unknown and it can occur at any time of the year.

Cows grazing tagasaste during late pregnancy can occasionally give birth to calves affected by a unique form of leucoencephalomalacia. Most affected calves are born dead or die soon after birth. Affected calves born alive exhibit consistent, sudden and wild swinging and twirling of the tail, giving rise to the name 'dancer calves'. Other factors may be involved because the majority of cows grazed on tagasaste in late pregnancy give birth to normal cows. On two occasions mature cows grazing tagasaste have died with a severe disease affecting the liver and kidneys. No definite cause was ever established.

Mature stand management

Once established, tagasaste usually only requires fertilising, good grazing management and the occasional cutting for persistence and production. Mature shrubs are comparatively free of pests and diseases. They are the last plants to be attacked by grasshoppers or locusts and they readily recover even when all the foliage is eaten.

Fertiliser

Phosphorus fertiliser drives the feed and animal production from tagasaste plantations (Figure 8.6). Trials at the Dunmar Research Station found there was an additional kilogram of cattle liveweight produced for every kilogram of superphosphate applied.^{100, 434, 439}

Established tagasaste (i.e. >three years old) does not respond to potash fertiliser even on highly leached sands. Tagasaste typically delivers low soil test results for potassium (K), because the shrub's extensive root system can recycle K from depth. Phosphorus and trace elements are far less mobile in the soil and are usually concentrated close to the soil surface.

Plant tissue testing is the only reliable method for testing the nutrient status of tagasaste. Samples collected in spring will show the shrub's phosphorus status and also whether any trace elements need to be applied.⁴³⁶ Pluck about 10 shoots (10 cm long) from at least 20 plants for tissue testing. Fertilise in autumn to maintain >0.32 mg P/kg when tested in spring.

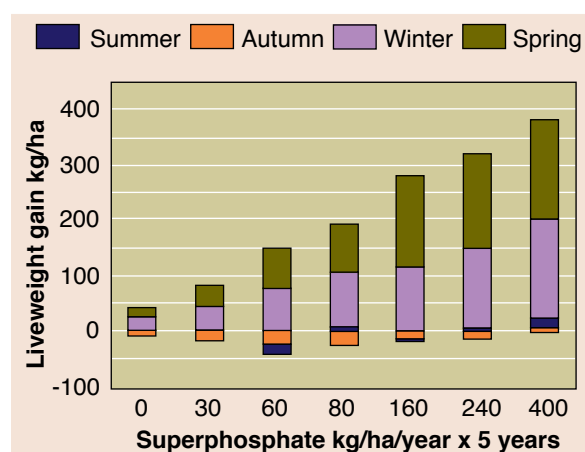


Figure 8.6 The effect of superphosphate on cattle production from a tagasaste plantation¹⁰⁰



Cattle grazing tagasaste

Tagasaste growing on pale deep sands can be deficient in manganese (Mn). These are the same soils where Mn deficiency causes split-seed in white lupins. Manganese deficiency is permanently treated once 40 kg/ha of manganese sulphate has been applied. Symptoms of Mn deficiency are best seen in winter and spring when tagasaste is actively growing. Deficient plants are yellow, but characteristically this symptom is not uniform across all plants. A distinctive feature of Mn deficiency in tagasaste is that pale yellow plants will be growing next to dark green plants.

The requirement for copper and zinc has not been determined, but it is probably good practice to re-apply these trace elements every 5-10 years.

Grazing

Grazing management can affect the persistence and production of tagasaste and both over-grazing and under-grazing can be a problem.

Tagasaste can tolerate very hard grazing provided the plants are then allowed to recover.⁴³⁹ With intense grazing sheep can remove every leaf from tagasaste plants. Six weeks after heavy grazing commences new buds start to form on the branches. If the sheep are left in for more than six weeks and allowed to remove the new buds then plants can die. Cattle can be set-stocked successfully on tagasaste as they are unable to graze as tightly as sheep and do not remove the new buds.

When cattle are set-stocked on tagasaste the plant develops a 'broccoli' form with a dense covering of short shoots and leaves. Trials comparing continuous grazing with cattle against a three-month rotation found there was no difference in either tagasaste growth or animal production.²⁵⁵ On the other hand, production from a tagasaste stand was reduced when grazing only once a year compared with every four months.⁴³⁴

Under-grazing can also reduce the productivity and long-term survival of tagasaste, as grazing helps to prevent the plant from switching from the vegetative to the reproductive phase. Once tagasaste plants start their reproductive phase the growth rate slows and the plants become less palatable to stock. Plants that are allowed to flower in spring will drop their leaves and stop growing in the following summer. The leaves become less palatable while the bark seems to become more palatable. 'Bark stripping' normally only occurs on plants or limbs that have flowered. If tagasaste is hard grazed and/or cut in the first half of the year it will not flower that year.

The long-term effects of grazing on the persistence of tagasaste are not yet fully understood, but it appears that plants can be maintained permanently in the vegetative state without causing damage. More plants seem to die in plantations that regularly flower.



Aerial photo of tagasaste alley farming

Cutting tagasaste

Under-grazing results in large tagasaste shrubs that grow beyond the grazing height of stock. Sheep can graze to a height of 1.2-1.5 m but once the tagasaste gets beyond this height it will slowly turn into a 'tree' form with minimal grazing value. Cattle can graze to about 2 m but the tagasaste can still get out of control if not grazed regularly.

Tagasaste can be cut back using 0.9-1.5 m circular saw blades mounted on articulate arms. These machines are capable of cutting about 2 ha of tagasaste per hour. Cutting machines with smaller circular saw blades or reciprocating knives are slower and can only handle thin stems.

Tagasaste is usually cut with two passes to form a cone-shaped hedge. Cut tagasaste to a height of about 1 m for both sheep and cattle. Tagasaste can be cut at almost any time of the year, but it is best done when there are animals in the paddock to use the cut material. However, do not cut tagasaste when severe frosts or insect attack are expected. In fact, anything that causes defoliation of fresh regrowth in shrubs that are just recovering from complete defoliation may cause death.

Very large tagasaste shrubs (trees) can be cut to bring them back into production but care must be taken to avoid killing them. Large trees are cut in two passes. One side of the row is cut and left for about six months to allow new shoots to branch from the trunk. Once new branches have established then the other side is cut.

Tagasaste that is only grazed by sheep will need to be cut mechanically once each year to keep it under control. With cattle it is possible to graze the tagasaste so that it is kept short and never needs cutting, however this may not be the best management for either the cattle or for the whole farm feed supply.⁴³⁷ The optimum management with cattle may result in the tagasaste requiring a 'hair cut' every few years.

Plantation versus alley farming

Fodder shrubs are established either in plantations or in 'alley farming' systems with wide spaces between rows. Tagasaste plantations generally have a row spacing of 6-12 m, which results in direct competition between the shrubs and the annual pasture growing between the rows.⁴³⁴

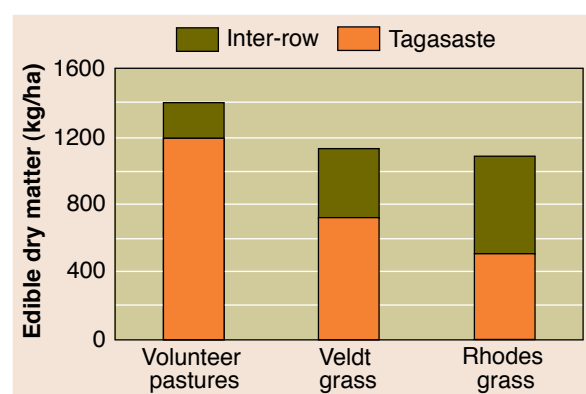


Figure 8.7 The effect of inter-row pasture on the total feed produced in a tagasaste plantation with 6 m spacing between the rows⁴³⁹

Increasing the production of inter-row pasture will often lead to a similar reduction in production from the fodder shrub, so there may be no net increase in feed from the paddock. When perennial grasses were established between rows of tagasaste at Dunmar the grasses competed directly with the fodder shrubs. In this example, there was a reduction in the total feed supply from the plantation when production from the inter-row increased (Figure 8.7). In plantations, paddock management should focus solely on the fodder shrub.

At wider row spacings (>12 m), or 'alley farming', the inter-row pasture is crucial to the production from the whole paddock, as it provides the majority of the feed. Management needs to focus on both the fodder shrub and the inter-row pasture, which can make management more complex. Compromises often have to be made, e.g. the tagasaste rows may need hard grazing in autumn to prevent them flowering later in the year, while the inter-row pasture should be rested to prevent erosion.

Maximising the feed production from all components in an alley farming systems is often difficult. It may be easier to move stock between paddocks with fodder shrub plantations and other feed sources rather than to have them growing together. With tagasaste most trials have failed to show any benefits to the grazing animals from having access to other feed in the inter-row. An exception was for blue lupins when they supplied lupin seed to sheep grazing tagasaste in autumn.⁴³⁹

Animal production

The liveweight gain of animals grazing tagasaste can vary significantly depending on the soil type, fertiliser applied, season and management factors.¹⁰⁰

With tagasaste, liveweight gain can range from small losses in autumn to growth rates in winter and spring that are similar to other green feeds. During winter and spring cattle liveweight gains can be more than 1.5 kg/head/day. Animal growth rates decline progressively over summer. By autumn, animals may only be maintaining weight, or even slowly losing weight. The decline in animal production over summer is due to reduced feed intake caused by increasing levels of phenolics (tannin-like compounds). Supplementing animals

on tagasaste in autumn with lupins will stimulate their feed intake and growth rates.³⁹⁷

The fertiliser experiment at Dunmar produced 386 kg liveweight gain/ha/year in a 450 mm rainfall zone or about 1 kg of liveweight gain for each millimetre of available rain (i.e. total rainfall – 100 mm). A similar result was achieved near Jurien Bay where the tagasaste produced 400-450 kg liveweight gain/ha/year over five years in a 600 mm rainfall zone.

Seed production

Tagasaste commences flowering in mid-winter and mature seed is shed in early December. Most of the pods shatter on the first hot day in December with a low relative humidity. Seed is collected by stripping pods from tagasaste plants by hand in late November to early December. The pods are then spread on a concrete floor, left to shatter and the seed is sieved from the pods.

Seed can also be gathered from underneath mature tagasaste plants by sieving the seed from the sand. This method results in lower quality seed than picking fresh seed by hand.

Tagasaste seed is very hard and must be treated to improve germination. Large quantities of seed can be scarified mechanically at seed works. Small amounts of seed can be scarified by scratching the surface with sandpaper or by using the 'hot water treatment' (i.e. seed is dropped into water that has just been boiled and left in the water until it has cooled).

Cultivars

Tagasaste is an out-crossing species so there will be a wide range of plant types within any plantation. Commercial tagasaste seed is a mix of many different forms of tagasaste.

'Cleavers Easy Graze'¹⁰ was selected by a WA farmer for its prostrate or weeping form. These plants are shorter than conventional tagasaste and should require little or no mechanical cutting. However they are currently only available as potted seedlings and are therefore more expensive than direct seeded 'normal' tagasaste. It is still too early to determine if the weeping tagasaste is as productive as the normal sized plants.

8.2 Other fodder shrubs



Cattle grazing leucaena

Golden wreath wattle (*Acacia saligna*)

Acacia saligna is a leguminous shrub or small tree (2-8 m) native to WA. It grows on a wide range of soils from deep sands to clays. It is highly drought-tolerant and will persist and grow where the average annual rainfall is 250 mm, but prefers 350-600 mm. It has very good waterlogging tolerance and moderate salinity tolerance. It is also highly tolerant of low pH and high aluminium and will grow on the extremely acidic wadjil soils in the eastern wheatbelt. On these soils, tagasaste roots are restricted by soil acidity.

A. saligna is a productive shrub and once established it recovers well from hard grazing. With its wide adaptation to difficult soils and low rainfall *A. saligna* would seem to have considerable potential as a fodder shrub, however its low palatability limits its fodder value. At times livestock will readily eat *A. saligna* even in preference to other feeds, however at other times of the year the same plants can be totally unpalatable with animals starving rather than eating the leaves.

The low palatability is mainly attributed to the high levels (10.5-13.2%) of condensed tannins (CT) that reduce animal intake, feed digestibility and nitrogen retention in ruminants. The CT content of the leaves vary with the age of the plant, the age of the foliage, soil fertility, soil pH, high temperatures and other stresses on the plant.¹⁹⁰

A. saligna is not a reliable, edible feed source and is no longer being sown as pure plantations solely for stock feed. It continues to have a role on farms for the landcare, stock shelter, wind break and wildlife habitat benefits. *A. saligna* has weed potential and is not recommended for growth beyond its native range.

Leucaena (*Leucaena leucocephala*)

Leucaena is a tropical legume fodder shrub from Mexico. In northern Australia it is grown mostly on loamy and clayey soils where the annual rainfall is above 600 mm. Leucaena is grown under irrigation in the Kimberley region. Under favourable conditions leucaena is very invasive and it is now a common weed of wetlands and riverine sites in the Kimberley and has been recorded from Pilbara south to Exmouth.¹⁶²

Leucaena has had very limited testing in southern WA. Any role is likely to be restricted to frost-free areas with mild to warm climates, as leucaena is susceptible to light frosts and requires warm temperatures (25-30°C) for good growth.³⁸² It is reported to have low seedling vigour, which could affect the persistence of plants over the first summer.³⁸²

Leucaena has a highly specific *Rhizobium* requirement and requires inoculation with CB3060.

Leucaena management is very similar to that for tagasaste. It has been grazed mostly by cattle and will require mechanical cutting if the plants get too tall.

Leucaena contains an amino acid, 'mimosine', in the leaves and seeds that can be toxic to stock. This problem can be overcome by inoculating the animals with bacteria that break down the mimosine in the gut. Livestock only need to be inoculated once and the bacteria are readily passed on to any new animals that join the mob.

More information on leucaena is available from the Queensland Department of Primary Industry website or the FAO Grasslands Index website.