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NSW Agriculture

Getting the best from old man saltbush

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INTRODUCTION

Awareness is growing of the need for perennials to be re-introduced into the landscape, to stem, or reverse, the rate of land degradation. However, reintroduction of perennials into agriculture will not occur unless they have the potential to provide positive financial returns or demonstrate significant positive environmental benefits. Forage shrubs are a group of plants that offer this potential, particularly old man saltbush (OMSB).

Conflicting perceptions about the value of OMSB to the pastoral and farming industries have developed in recent times and these need resolution. Disappointing experiences with OMSB usually stem from unrealistic expectations of the potential of OMSB or the level of management that prevailed.

This Agfact outlines the potential of OMSB for each of the different functions that it can fulfil in its capacity as an environmental or productive plant. It is important that the reader is focussed on their reason (or reasons) for wanting to establish plantings well before commencing operations, particularly if cost recovery is important.

Figure 1. A remnant stand of OMSB that has persisted despite grazing by rabbits and domestic stock. Note recent recruitment of young plants and excellent pasture cover.

BACKGROUND

Historically, the 'saltbush' country has been held in high esteem by pastoralists, especially the sheep graziers (Figure 1). However, recent research using shrubs grown on saline land has cast doubt on the value of shrubs such as OMSB as a fodder. Forage shrubs have a multi-functional role and their many attributes, both positive and negative, need to be considered carefully in assessing their potential. Some of the attributes of OMSB are listed in Table 1.

Table 1. Some potential uses of OMSB when grown on non-saline and saline soils

Attribute	Non-saline soils	Saline soils
Productive capacity	Moderate	Low
Environmental benefits	Moderate-High	High
Suited for grazing with pasture	Yes	No
Extends feed availability	High	Low
Value as sole drought fodder	Marginal	No
Management needs	Critical	Not so critical

As well, OMSB grows more slowly than annual pastures, but offers a more consistent supply of feed. The quality of feed it supplies makes it suitable for use in a production ration rather than as drought sustenance as the concept of using forage shrub stands as living haystacks has little appeal with most landholders. Rather they see stands as requiring diligent management and are best used as part of a whole farm management strategy. Stands need to be grazed regularly to maintain plant vigour as well as keeping the plants within grazing height of the animals. The high protein, moderately digestible nature of OMSB requires an addition of a high-energy feed source to the diet if maximum production is to be achieved, especially if the leaf has a high salt content. This can be in the form of good quality grass pasture or grain.

ABOUT OMSB

Suitable growing areas

OMSB appears highly suited to a broad region through central NSW (Figure 2). It is unlikely that 'on farm' plantation development of shrubs will take place in areas receiving less than 300 mm annual average rainfall unless there is supplemental water available due to unreliability of rainfall and low production potential. Hence the 300 mm isohyet is seen as the approximate western limit for plantation stands. The eastern limit for plantations is about the 350 metre altitude line, which roughly follows the break between the slopes and tablelands. Above this altitude the winters are too cold and long, and the soils become less suitable. Plants are usually dormant from late May to late August as little growth is evident when mean daily temperatures drop below 13°C. Optimum growth occurs between 30–35ºC. OMSB will grow on most soil types, although production is poor on heavy clays and the plants prefer alkaline soils. They do not tolerate highly acid soils (pH<5). The plants are very drought tolerant and provide a source of green feed year-round with no loss of feed incurred through trampling. Growth is driven by the rainfall received as plants respond to wet periods by continuing growth at a steady rate well into the next dry period. They will tolerate shallow, intermittent flooding, but not deep or prolonged inundation during the summer.

Competitive ability

OMSB is a poor competitor as a seedling and its natural distribution is restricted to those soils where it is able to establish sufficiently to maintain its population. When establishing the seedlings it is important to realise that they are non-competitive with other species and must be protected from nearby pasture and weeds during the establishment phase. Cropping lands are ideal areas to establish stands as they are often free of weeds and stumps. Also little additional machinery is usually required by farmers for establishment and management of shrubs.

It is extremely salt tolerant and will grow in most saline environments (<25dS/m), but the rate of growth declines as salt levels rise. Production in these situations is usually markedly lower than in similar non-saline areas where good pasture or crops are able to be established.

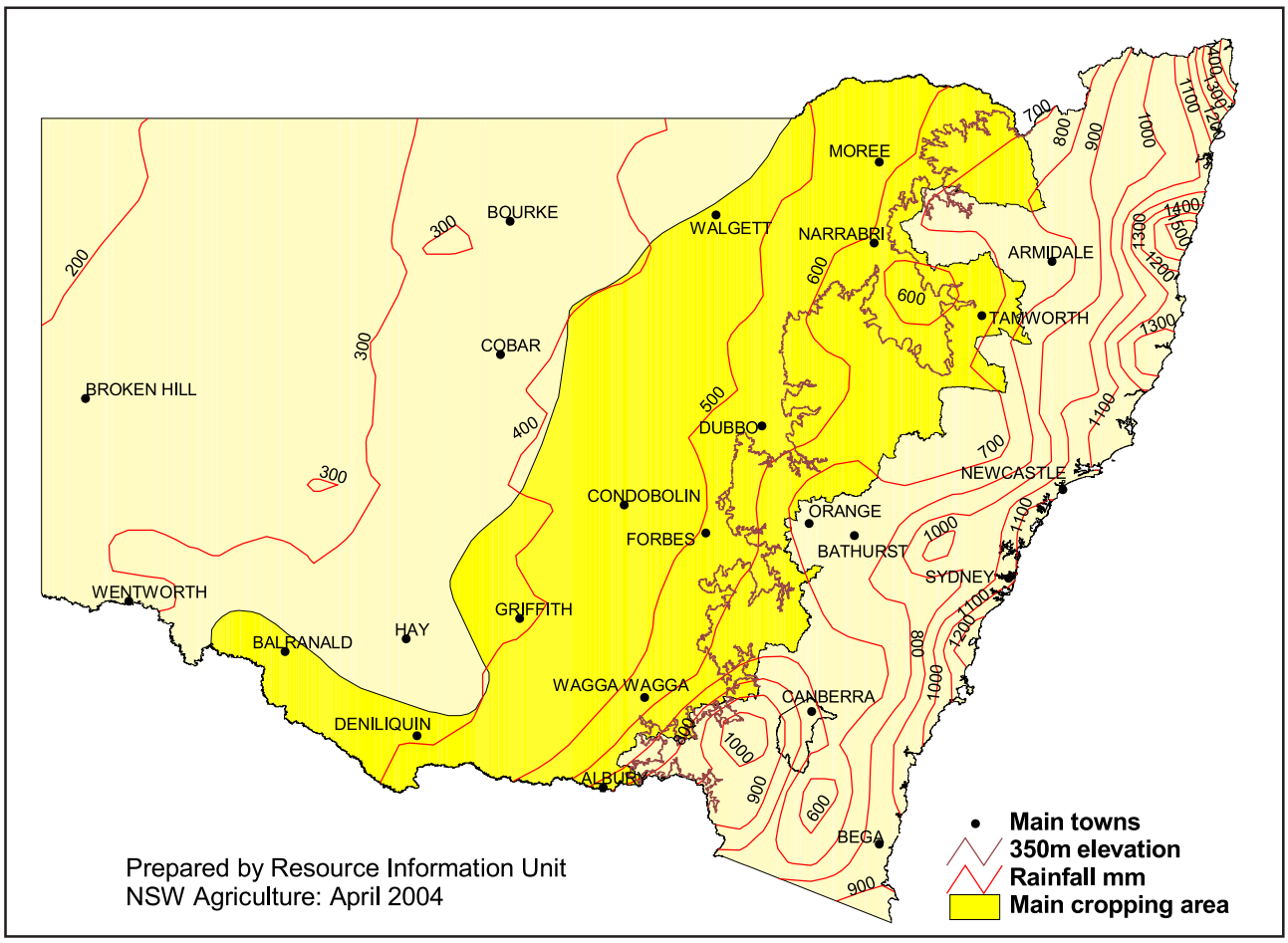


Figure 2. Area suited to plantation establishment of OMSB — west of the 350 metre elevation (above sea level) to the western edge of the main cropping area.

Attributes

OMSB is a woody perennial shrub that grows to about two (2) metres tall and four (4) metres in diameter in its natural environment. It is extremely drought and salt tolerant and is long-lived (greater than 100 years). Part of its drought tolerance is due to its ability to accumulate salt in its leaves as it extracts water from the soil, consequently leaf material is very high in salt compared to most other pasture species. Once established, the plants provide shelter and high protein forage for animals. Off ground feed in the form of green leaf is available to animals over considerable periods, often extending into prolonged dry or drought periods.

Energy

Research has shown that saltbush grown on non-saline soils still has a high non-digestible component predominantly consisting of ash. Energy is calculated on a dry matter basis, which incorporates ash, which actually contains zero energy. Energy needs to be calculated on the dry matter portion minus the ash (Table 2). The ash content of most saltbush on non saline areas may vary between 10–30% (average 15%) depending on soil characteristics, and may be as high as 40% on highly saline areas. Accordingly energy figures calculated on dry matter which includes ash are actually only 70–80% of the figures shown.

Protein

Although saltbush has similar crude protein content to lucerne (Table 2), approximately 50% of this exists as Non-Protein Nitrogen (NPN) which can only be converted to digestible protein when there is a good supply of energy available. Saltbush has a protein level which can exceed 20%, but due to a lack of energy supply when fed as a full ration, approximately sixty percent (12–13% crude protein) is utilised.

Salt

The high salt load of saltbush (>10%) compared to native pasture (3–6%) plays a major role in its poor utilisation. It is suspected that the high salt content of saltbush reduces the absorption of Volatile Fatty Acids (VFA — a major source of energy) in the rumen, possibly due to either impairment of microbial activity or shorter residence time of feed in the rumen due to higher water intake (Weston et al, 1970).

Table 2. Nutritive values of selected feed stocks.

Species	Metabolic Energy (MJ / kg DM)	Crude Protein (CP%)	Digestibility (DMD%)
Annual grasses (dry)	4–6	4–7	44–80
Perennial grasses (dry)	7–9	8–12	51–60
Medic pasture	7.5–11	16–20	50–77
Wheat	13	12	86
Oats	10.5	10.5	73
Lucerne hay	8.5	17	63
Oaten hay	9.3	5.8	54
Saltbush	8–11[a]	15–20[b]	55–70

a – energy calculated on total dry matter minus ash
b – Up to 50% of N exists as non–protein nitrogen which is not readily utilised without adequate energy

The need for a mixed diet

Sheep can tolerate approximately 150 g of salt a day (cattle less) (Master et al 2001) before productivity drops. At a concentration of 15% salt, their maximum intake would be reached after eating 1 kg of saltbush dry matter, 0.5 kg below their feed intake requirement. This also assumes the other dietary components are salt-free and illustrates the need to provide other sources of feed with saltbush to dilute salt intake to achieve optimum production.

Production potential in non-saline soils

Production patterns

Production following establishment of woody perennials is often more rapid than that experienced over a longer production period. This is due to the untapped nutrient and moisture supply deep in the soil profile beyond the reach of annuals. It usually takes about four years for the stands to utilise this resource, resulting in an inflated production from the stand. This may be extended if seasonal conditions have been above average or the area flooded, but once the resource is depleted production then becomes a function of incident rainfall. On most soil types edible material produced is about 4 kg of leaf and twig per millimetre rainfall per hectare. For example, annual average production from a stand (of 2500 plants/ha) in a 400 mm rainfall zone would be about 1.6 t/ha. However, this would vary depending on the pattern of distribution and intensity of rainfall events received. Prolonged heavy rainfall that wet deep into the profile promotes the greatest response, especially if the rainfall is in summer and conditions are humid. By comparison, lucerne in the same environment produces about 7 kg/mm rainfall/ha.

As the stand ages, production may drop as more wood accumulates in the stand and has to be maintained by the plants as well as an increased likelihood of nutrient depletion.

Rapid estimates of feed on hand

Good management requires the ability to quickly assess the amount and quality of feed that is on hand at any time. When using OMSB as part of the ration it is also essential that the amount of pasture available to be used with OMSB is also known. This section describes some quick techniques that can be adopted to assist in getting a better estimate of the amount of feed on hand for both pasture and shrub.

- Pastures

Quick estimates of how much feed is on hand can be done in several ways. The most accurate and time consuming method is by cutting quadrats and weighing the samples. But, they say a guess is the best method if it is right and a lot quicker. The method we use is not far removed from that. There is no need to know production to the last kilogram so we have a broad-based approach where we estimate production on a square metre basis and convert it to tonnes per hectare (Figure 3).

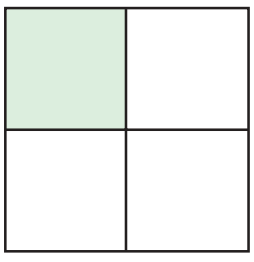


Figure 3. Divided metre square quadrat used to estimate pasture production. The shaded section selected as the most representative of the pasture.

One hundred grams (100 g) of production per square metre is equivalent to one tonne per hectare. A good handful of dry pasture weighs about 25 g, but if the pasture is green some adjustments are needed to the calibration.

Using the Prograze method of throwing a square metre quadrat and selecting the most representative

quarter is a good method to adopt. The first step is to estimate how many handfuls there are in the selected square (the shaded area in Figure 3). That will tell you the pasture on hand, for example, 3 handfuls would be 300 g/m2 (4*25*3) or 3 t/ha.

- OMSB

The simplest and best method for estimating available feed of plantation stands of OMSB is by measuring the diameter of the plant. This is closely correlated to the amount of edible forage. You will need to measure at least 15–20 typical plants in the paddock and calculate the average diameter from these. If there is a lot of variability in plant size, it is a good idea to measure in a few locations around the paddock. When measuring the diameter ignore single branches which protrude. If you want to get an idea of production over time measuring the same marked plants each time may be an option.

This method can be applied to plantation stands of OMSB provided the following management criteria have been adopted:

1) plants are grazed at least once annually and then spelled until fully re-leaved.
2) plants between 35 cm and 250 cm in diameter are within the range which this method is effective.

Plants which have grown above sheep grazing height (> 1.5 m high) can have a substantial amount of leaf material at the top of the plant (up to 300 kg/ha) and if it is not removed by slashing or pruning it will reduce total production especially in the lower portion of the plant and give a misleading estimate.

Estimating yield

Estimating the yield of edible forage can be achieved by one of two methods once average plant diameter and stand density (plants per hectare) have been calculated. Plant diameter is estimated by taking a series of measurements (say 10) from typical plants within the stand and averaging.

- Refer to Table 3 for appropriate diameter and planting density (no need for calculations), or
- By using the following equations:

Edible Dry matter (g/plant)
= 9.5 x (diameter in cm) – 340

The next step is then to multiply that value by the plant density of the stand.

Edible dry matter (kg/ha)
= (g/plant x planting density)/1000

e.g. if plant density = 2000/ ha and average shrub diameter = 1.10 m

9.5 x 110 – 340 = 705 g/plant

to calculate kg/ha, multiply by planting density and divide by 1000

= (705 g/plant x 2000)/1000
= 1410 kg/ha

A correction may be needed periodically to account for deaths.

Criteria for stock removal

Not all of the edible material should be utilised and grazing should cease when there is 5–10% remaining (Figure 9). This will ensure rapid recovery by the plants and it is vitally important that leaf is retained in autumn grazings to assist plants to get through the winter dormant period. Repeated severe defoliations will result in plant deaths.

Fertiliser needs

Nitrogen is likely to become the first nutrient to limit growth as there is a big demand due to the high protein content of OMSB leaves. Phosphorus may also need to be added to maintain potential growth, particularly on acid soils where plant available P levels are low. To ensure that growth is not limited by lack of nutrients, it is possible to monitor leaf nutrient levels and add fertiliser as required. It is also important to be mindful of the underlying pasture and its nutrient needs. A dense actively growing pasture sward can seriously deplete availability of nutrients to OMSB and restrict growth. At Condobolin, a pasture sward of 1 t/ha that grew during the spring period completely inhibited any OMSB growth in newly planted seedlings.

IS OMSB THE RIGHT PLANT FOR YOU TO GROW?

When introduction of forage shrubs is contemplated a complexity of issues need to be considered by the landuser. Potential users need to understand the attributes that forage shrubs bring and how the benefits, or limitations affect not only the short-term production goals, but also the long-term environmental well being of the landscape. A summary of the many attributes of OMSB is listed in Table 4.

Integration with other farming practices

The presence of OMSB can have a positive environmental impact on the whole property if it is managed wisely. Tactical grazing strategies that use forage shrubs as feed sources to allow spelling of other paddocks at critical flowering and seeding times can result in greater diversity and/or improvement in

Table 3. Estimation of OMSB yield (kg/ha of edible leaf and twigs) using average plant diameter (cm) and planting density (plants/ha)

	Number of plants / hectare								
Diameter (cm)	**1**	**500**	**1000**	**1500**	**2000**	**2500**	**3000**	**3500**	**4000**
50	0.139	69	139	208	278	347	416	486	555
60	0.234	117	234	351	469	586	703	820	937
70	0.330	165	330	495	659	824	989	1154	1319
80	0.425	213	425	638	850	1063	1276	1488	1701
90	0.521	260	521	781	1041	1302	1562	1822	2083
100	0.616	308	616	924	1232	1540	1848	2156	2464
110	0.712	356	712	1067	1423	1779	2135	2490	2846
120	0.807	404	807	1211	1614	2018	2421	2825	3228
130	0.902	451	902	1354	1805	2256	2707	3159	3610
140	0.998	499	998	1497	1996	2495	2994	3493	3992
150	1.093	547	1093	1640	2187	2734	3280	3827	4374
160	1.189	594	1189	1783	2378	2972	3567	4161	
170	1.284	642	1284	1926	2569	3211	3853	4495	
180	1.380	690	1380	2070	2760	3449	4139		
190	1.475	738	1475	2213	2950	3688	4426		
200	1.571	785	1571	2356	3141	3927			
210	1.666	833	1666	2499	3332	4165			
220	1.762	881	1762	2642	3523				
230	1.857	929	1857	2786	3714				
240	1.953	976	1953	2929					
250	2.048	1024	2048	3072					

composition of the pasture paddocks. This is especially beneficial if the tactics result in a greater proportion of perennials in the pasture.

Its presence also provides an opportunity for improving overall feed quality as well as availability throughout the year. This may allow a change of enterprise to provide greater economic returns while maintaining vegetative stability. For example, with prime lambs reared on lucerne and natural pastures, problems of feed availability can occur in extended dry periods as a result of leaf drop by lucerne. OMSB supplies a similar quality and quantity of feed as lucerne and can overcome these problems.

Potential productive uses

The ability to turn off finished products is probably the best way to minimise the adverse impact of our variable climate. OMSB can help this ability. Stands can readily be assessed to see how much green feed is available and management can be adjusted accordingly without the need to rely on regular rainfall. However stands need to be managed correctly and in conjunction with other available dry or green fodder. To achieve this, strategic placement of stand/s on the property is important in the planning stages to ensure that the right mix of feeds can be provided.

When considering the introduction of OMSB there are several factors that should be taken into account, apart from the initial high cost of establishing a stand. The first is how best to utilise the feed source in terms of its quality and quantity and the second, how to best manage it to obtain the greatest benefit. OMSB provides greatest nutritional value when grazed in conjunction with other pasture species or other supplementary sources (e.g. grain). Hence, there is a need to identify where and how OMSB can be incorporated into an existing grazing management strategy in order to complement and enhance pasture and livestock production.

Table 4. Complexity of attributes that need considering when planning to establish forage shrub stands.

Consideration	Positive attributes	Negative attributes
Environmental	– permanent planting	– cool temperature dormancy
	– deep deep-rooted	– acid soil intolerant
	– ideal for dryland salinity control	– unsuited to waterlogged soils
	– wind protection	– may provide harbour for rabbits
	– sink for carbon sequestration	
Stock management	– provide year-round feed	– slow growth
	– reliable supply	– moderate digestibility
	– feed not wasted or fouled	– needs high energy supplement
	– high protein	– animals need to be trained
	– high quality product potential	– needs good quality water
	– not favoured by native or feral animals	– potential Ca:Na imbalance in stock
Plantation management	– able to access feed on hand	– ties up land from other uses
	– fills seasonal feed gaps very well	– expensive to establish
	– head-up grazing – less worms	– needs good management
	– greater flexibility in stock type	– can't handle pasture competition
	– a tool to improve pastures in other paddocks	– needs fertiliser
		– possible high Na, N and oxalate %
		– needs a high quality or value product to be profitable

A number of use options include:

Maintain shrubs as a drought reserve
The concept of utilising OMSB as a 'living haystack' is now considered to be of little value as other feed sources are better suited as drought forage and often much cheaper to provide. Oats is a good example of a better drought feed option as it is cheap to produce, easy to store and has saleable utility if not required on farm. We would not advocate this 'living haystack' option unless there are extensive plantings of OMSB on the property and adequate grain supplements are available.

To obtain the greatest production from OMSB the plants need to be grazed on a regular basis irrespective of seasonal conditions, as opposed to keeping them as a drought reserve where grazing occurs only in severe feed shortages. As this may be only once every 3–5 years, plants grow out of reach of stock, become woody and leaf material becomes unpalatable during the intervening period. Furthermore, stock need to adjust to them over a period of time, and this coupled with the high cost of establishment of OMSB warrants greater levels of utilisation to achieve economic benefits.

Managed to overcome seasonal or short-term feed gaps
Areas with seasonal rainfall (summer or winter dominance) have a period of low rainfall and subsequent feed shortage at some period during the year. OMSB provides a source of high protein green feed that can be grazed on an annual basis to overcome these seasonal feed gaps. The establishment of OMSB to overcome seasonal feed shortages and maintain nutritional quality, usually with a grain or pasture supplement, is presently the most common utilisation strategy. An example of the benefit of maintaining nutritional supply throughout the year is prominent in the wool industry's target of consistent fibre strength. As autumn feed gaps are commonplace in much of the southern area planning to incorporate OMSB as part of an extended feed supply would be most useful. Longer exposure to animals by rotating grazing through several small blocks improves efficiency. In the northern parts, a winter-spring feed gap more commonly needs to be filled (see section on animal management).

As part of an integrated production system
The incorporation of OMSB into a holistic management approach to property management has potential for wider application. The utilisation of OMSB as a grazing tool to provide management flexibility and sustainability also benefits other farm enterprises. For example, utilising 75% of the bush to bridge the feed gap each year, and maintaining 25% as a drought reserve, overcomes annual concerns such as full ration grain feeding as well as providing the security of a drought reserve if the seasonal break does not come. Indirectly, there may be other benefits to those pasture paddocks that are rested whilst stock are predominantly grazing saltbush.

Used as a pasture spelling tool
The use of shrub stands as a spelling tool has similar principles as managing for seasonal feed-gaps, however the objective here is the enhancement of other pastures with more desirable species by spelling them at crucial times. This indirectly benefits livestock. By identifying favourable pasture species and knowing their growth cycle, graziers are able to remove stock at critical periods to allow selected species to flower, set seed and establish. OMSB is capable of carrying large numbers of stock in a limited area for short periods without serious detriment to stock, allowing large areas of land to be rested. Again for best results, an extended period of grazing OMSB (that is, stock moved serially through several paddocks) will give best results, especially if a grain supplement is also provided to satisfy metabolic energy requirements. Spelling of grass paddocks following new plant recruitment is also an important consideration to allow new plants to become firmly established and set seed.

Set-stocked natural stands
This is the most common method employed in the drier pastoral zones of NSW and South Australia. It is also used in other areas such as along the lower reaches of the Bogan River and in the Riverina. Some of the best remaining saltbush and bluebush country has been set-stocked since settlement and it appears to be the most stable method of grazing, provided the stocking rate is correct (Figure 1). This method relies on conservative stocking rates and a management philosophy of maximising output on a 'per animal' rather than on a 'per area' basis. Lambing percentages are usually greater than 100%. Management options employed by some managers include skipping a mating during droughts or double lambing in exceptional seasons. Some producers have taken advantage of this natural system and have been able to market their product as 'Organic' as reliance on chemicals can be avoided.

Environmental benefits
When assessing the merit of changing management strategies on a farm it is usually only the direct cost of implementing the change and the immediate dollar benefits received that are considered. Incorporating,

or increasing the proportion of forage shrubs on a farm can result in other indirect benefits. These benefits are difficult to assign a dollar value to, but they can provide an overall long-term benefit to the property that is also in the 'public' good. Agriculture has become well aware of the importance of environmental stability and the impact that poor management options can have in the long-term. The threat of dryland salinity as a result of pursuing agricultural products based on production from annual crops and pastures is now being realised, particularly in areas with undulating topography and shallow, sandy-textured topsoils. The introduction of perennials can enhance landscape stability by modifying many environmental attributes.

OMSB has several environmental applications the most common being its establishment in saline areas to reduce watertables and revegetate salted land. Being a salt accumulator OMSB is able to grow in areas of extreme salinity, gradually altering conditions allowing other pasture species to establish. OMSB also provides excellent shelter and in hedge formations provides an excellent windbreak. Although it is not recommended as a forage plant in these situations some foraging may be possible as total vegetative cover and production will be enhanced compared to the do nothing option. As well as its use in colonising saline land, saltbush can also be planted to stabilise erodable surfaces such as scalded gullies and dune crests.

Water balance

- Increased water use

Detailed information on timing and pattern of water use in the soil profile is not readily available for most of the native forage species. Some information is available for other woody and semi-woody species grown in the western agricultural parts of the region which can be used as an interim guide. These are all summer growers with a similar growth period to the forage shrubs. Fast growing species like lucerne and blue mallee are able to exploit stored soil moisture down to at least 3.5 m depth in the second year after establishment, whereas slow growing species like jojoba take 3 years to reach the same amount of leaf cover and water use. The water use ability of OMSB appears to be intermediate to the two species above.

- Increased moisture retention

It is believed that areas with good shrub cover generally intercept and retain more rainfall than do shrub-free areas. This increase in percolated water occurs as a result of a cut in overland flow of water after heavy downpours, greater debris on the surface to trap moisture and to a major reduction in the wind crossing the soil surface and evaporating water from the topsoil. The increase in net water intake at the surface does not mean a greater deep-drainage component as all the water will be utilised by the shrubs before it escapes down the profile.

- Lowering of watertables

Some plants have the ability to lower watertables and have been widely promoted for that function. OMSB has been widely used in irrigation areas and on sandy soils where shallow watertables are a common feature of the landscape. Its effectiveness in lowering watertables depends largely on the salinity of the groundwater and on soil texture. Where the groundwater is highly saline its effectiveness is greatly reduced as little water is transpired. Further, the forage produced is high in salt content and not suitable as stock feed, but the plant provides important environmental benefits.

Wind reduction

- Increased protection to soil against erosion

Shrub stands offer increased protection from wind and water erosion. Natural stands offer better protection against wind erosion than do plantation stands because of the random distribution of plants. Plantations established using curved rows provide better protection than ones established with straight rows. The level of protection afforded against water erosion depends on the amount of pasture cover and litter allowed to accumulate, slope of land and line of planting. Generally plantations aligned across the contour will give greatest protection against overland flow of water, particularly if there is a good litter cover.

- Increased animal protection

Small clumps or 2–3 rows of OMSB planted in alley systems provide good protection to stock from cold winds, while extensive plantings provide excellent protection. The greatest protection is afforded to ewes and lambs, or to off-shears, during cold changes in the weather. Mustering stock is generally not a problem in either natural or plantation stands.

The downside of this is a potential increase in fly strike in sheep under certain climatic conditions. There has been a report from a landholder who has experienced severe fly problems in a flock that was grazing a dense stand of OMSB during a bout of hot, humid and stormy conditions in summer. He attributed the problem to lack of wind and a build up of humidity within the plantation. Stock on other parts of the property did not have the same problem at that time.

STARTING A PLANTATION

Planning layouts

It is important to assess the role and needs of OMSB along with the existing property layout well in advance of planting. It is important to ascertain how much OMSB needs to be planted to meet the needs of stock and where plantings on the property should be made to facilitate best management and obtain greatest returns. The extent of plantings on each farm is difficult to estimate here but usually 10–15% of farming area is the maximum area required. Good stock management is the key in obtaining best results from OMSB and these are discussed later. Plantings can either be as blocks of plants in small paddocks or in alleys (several rows of OMSB in strips across larger paddocks).

Planting Configurations

- Block plantings

The advantage of blocks is that the area of bush is confined to small areas freeing up the management of other land and fencing is kept to a minimum (Figures 4 and 5). Independent access to several adjoining pasture paddocks is also possible, increasing management flexibility. Subdivision of the block into small areas also increases managerial control of providing better diet mixes of saltbush and pasture.

- Alleys

These on the other hand, provide a better mix of shrub and pasture for stock and still permit cropping of the intervening areas, but grazing of bush is restricted during the cropping periods (Figure 6). The alley system has potentially greater environmental benefits for drying the soil profile as well as providing greater protection to pastures and stock from wind damage. The close proximity of pasture to shrubs makes it easier to provide a well balanced ration for stock. The down side is that at times options for shrub management may be curtailed by lack of access to the paddock, e.g. during cropping.

Planting density

The nominal planting density for block plantings is about 2500 plants/ha, commonly planted in rows spaced 3.0 metres apart with intra-row plant spacings of 1.2 metres. Variations to this often alternate wide and narrow row spacings (e.g. 4-2-4 m) as this permits easier access to the paddock for mustering and weed control. The same procedure is adopted for alley plantings, however the width of the plantings (usually 3 or 4 rows) and the alley width may vary considerably from place to place.

Some evidence suggests that lower planting densities (about 2000 plants/ha) are nearly as productive (and cheaper to establish). However, if this is adopted it is advisable to maintain intra-row spacing and broaden the row spacings as this helps to make planting and weed control operations more efficient and cheaper. OMSB with planting densities as low as 400 plants/ha are feasible, especially where no grain supplementation is contemplated but the proportion of pasture needs to be increased.

It is important to consider the likelihood of subsequent recruitment of new plants as well as deaths of those originally planted. When planting at the lower densities it may be wise to consider increasing the initial number of plants to allow for any loss in numbers during the establishment phase and during the first few years of production.

Establishment methods

There are some general requirements for successful establishment. These involve ensuring adequate weed control and soil moisture levels, at least during the establishment phase. There are two methods of establishing stands; by direct-seeding or by transplanting seedlings.

Direct seeding

This method has been used extensively on sandy soils in South Australia and Western Australia with mixed

Figure 4. Block planting of OMSB with good pasture growth in access area.

Figure 5. Good regrowth from well-managed OMSB block planting.

Figure 6. Alleys of OMSB used in conjunction with cropping and grazing.

success. The technique relies on the ability to scalp the soil of weed seeds at sowing followed by a reliable period of favourable rains to firstly germinate the seed then allow it to establish quickly. Much of the wheatbelt of NSW appears unsuited to this technique as many soils are too heavy in texture and rainfall is too unreliable to get consistent soil moisture conditions to allow germination and then establishment of seedlings, hence it is regarded as a high risk operation here.

Seedlings

These can either be 'bare-rooted' (Figure 7) or supplied as a 'speedling' (a seedling raised in the nursery and supplied with a small plug of soil around the roots). Detailed descriptions of the methods of establishing stands of OMSB are given in an Agfact titled *Establishing shrubs and trees in the central-west of NSW* or *Bare root seedling production*, a fact sheet from Primary Industries, SA. Speedlings are normally produced and supplied through commercial nurseries while bare-rooted plants are normally produced 'on-farm'.

PLANTATION MANAGEMENT

Once stands of OMSB have been established it is important to consider the welfare of both the plants and the stock in the subsequent management of the farm. There are many aspects to be considered to optimise production from OMSB. Initially, size or age of bush is important. Plants are usually large and strong enough to graze at 9–12 months. The first grazing (Figure 8) should be carefully monitored to ensure that the plants are defoliated to the desired level quickly and that no damage is done to the main branches. It is suggested that about 15% of leaf be left at the first grazing to ensure rapid recovery.

On subsequent grazings, defoliation can be down to 5% of leaf in most instances (Figure 9), however if grazing is near the onset of winter, then it is advisable to defoliate only to the 10% level. In all cases, the duration of grazing should not exceed 21 days as

Figure 7. Nursery of 'bare rooted' seedlings ready for planting.

Figure 8. Typical shrub fully leafed prior to grazing.

Figure 9. Same shrub with 5% leaf remaining after grazing.

continual grazing weakens plants and there is a risk that new growth will be removed before plant reserves can be restored.

There are a number of reasons why OMSB needs to be grazed regularly and undertaken irrespective of seasonal conditions. If seasonal conditions are good and plant growth is rapid the plants can quickly grow to a height where stock can not reach the tips, making the feed unavailable. There will then be a need to prune or 'top' the plants (Figure 10). Regular grazing, even with sheep, keeps plants within 'bite height' of the animal and reduces the need to prune. Plants can be pruned or topped mechanically by using reciprocating or rotary mowers. When pruning it is advisable to cut the sticks as low as possible, initially about 60 cm above ground, and gradually raise the height at subsequent events as the plantation ages. Where cattle are run, they can be used to reduce plant height. Grazing should take place at 6 to 12 month intervals and certainly no longer than every 18 months. Some evidence shows that better utilisation of bush occurs when grazing is at closer intervals.

Paddock size is also important, irrespective of planting configuration. Management should aim at providing the correct balance (OMSB and pasture or grain) in the ration for the animal's need as well as completing the grazing in a period of less than 3 weeks. The flock or herd sizes normally run on the property need to be considered when determining subdivision and paddock size. Four to eight paddocks of OMSB to rotate stock through are needed if optimum production is to be obtained. Access to water and water quality also needs careful consideration.

Figure 10. Poor management has led to excessive top-growth occurring between grazings.

PESTS

Impact of pests and diseases

Observations made from field trips and a literature review shows that a wide range of plant and animal pests affect the growth of shrub stands. Some of the main impacts are from:

Weeds

The presence of pasture cover (including weeds) at, or following, planting is a major impediment to successful establishment and subsequent growth of a stand. It is well known that OMSB is unable to compete with fast growing annuals for nutrients and water, particularly during the cooler months and young plants are subsequently shaded out. Therefore it is important to understand critical levels of competition to maximise total production. The impact that weeds may have at various stages of stand development are summarised below:

- At establishment

The survival and growth of speedlings planted at Condobolin in autumn 1997 was severely affected by a pasture growth of about 1 t/ha in the following spring compared to plants that were kept weed free for the same period (Figures 11 & 12). This is a major impact that cannot be ignored and highlights one of the reasons why direct seeding is often unsuccessful despite apparently good seasons.

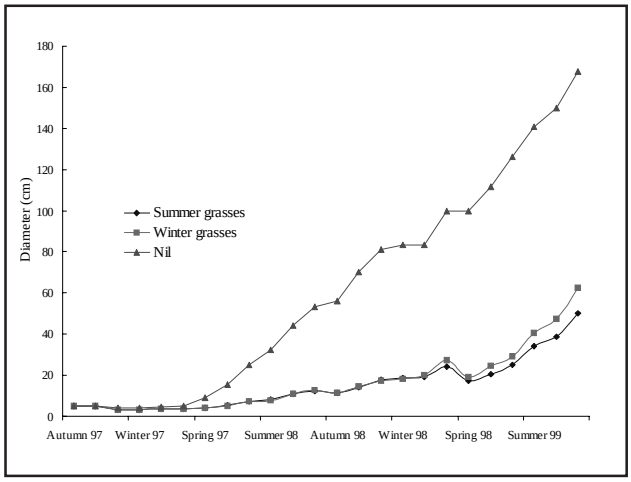


Figure 11. Impact of summer and winter growing pastures on young OMSB growth as shown by changes in plant diameter.

- On mature plants

Rows of OMSB were established by fallowing the land 1 metre either side of the planting row prior to planting and then keeping it weed-free for 12 months following planting to allow establishment. Treatments then allowed pasture to encroach onto the fallow on half the plots, but kept bare on the other half. After 18 months the difference in growth between the treatments amounted to 50% improvement with no weeds.

Being native to Australia, OMSB provides food and shelter for many potential predators and there are occasional reports of severe damage to natural stands. The significance and impact of these attacks tends to be episodic and dictated by seasonal conditions. Insect, mammal and fungal attacks have all been reported as causing periodic large scale damage.

Insects

- Scale (*Pulvinaria maskelli*)

Attacks the stems and shoots of OMSB and bladder saltbush draining moisture causing widespread dieback and can result in death. Forty hectares of OMSB near Carinda has been reported as destroyed from a heavy scale infestation.

- Leafhoppers (*Austroasca merredinensis*)

These insects attack the leaves and green stems draining moisture from the plant, resulting in a distinct yellowing of leaves and reduction in growth and vigour of plants.

- Borers

Larvae of some weevil species have been found in OMSB that attack the older wood by burrowing up the centre of stems, resulting in dieback. They appear to have an annual impact and are most noticeable each autumn-winter. They do not appear to be a major problem in well managed stands.

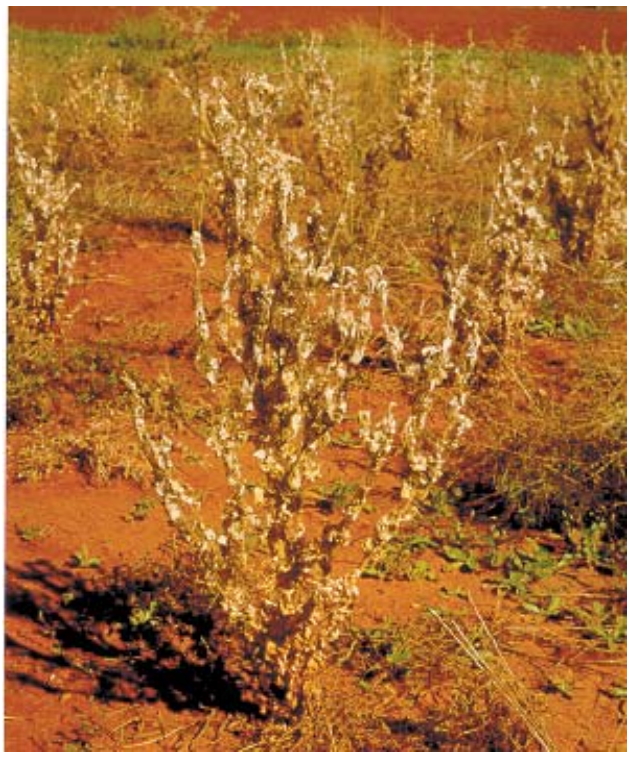
Figure 12. Impact of pasture/weeds on establishment — compare poor growth of plants in mid-ground with those in background.

- Moths and butterflies

Defoliation of OMSB by several species of caterpillar (larval stage of moths and butterflies) during spring becomes particularly evident during periods when there is a shortage of green feed. The larvae of the Pasture day moth (*Apina callisto*), the Weed web moth (*Achyra affinitalis*) and the Chequered blue butterfly (*Theclinestes serpentata*) (Figure 13) are three of the more common and widespread species which attack saltbush. The impact of these pests on saltbush production in a commercial scale plantation is not likely to be large in most years (Figure 14).

Figure 13. Chequered blue butterfly, a potential pest in OMSB.

Figure 14. Complete loss of grazing caused by insect attack on established seedlings.



Vertebrates
During establishment hares and birds, particularly the sulphur-crested cockatoo regularly destroy many plants by biting the young plants off just above ground level. Rabbits are capable of similar damage on mature plants during extremely dry periods and have been observed ringbarking OMSB. Feral goats will graze OMSB but are more than likely attracted to the rested pasture growing between the plants, kangaroos are also fond of the pasture but seem to avoid the bush if pasture is available.

Fungal Diseases
It is difficult to estimate the impact of these diseases on saltbush as identification of a causal pathogen is not easy. The widespread dieback of saltbush (predominantly bladder saltbush) that occurred on the Riverine plain in the late 1970s and early 1980s initiated a detailed study to determine if fungal flora were responsible for this phenomenon. This research identified 70 fungal pathogens associated with saltbush, none of which could be identified as the causal link responsible for the dieback, nevertheless the impact was significant.

ANIMAL MANAGEMENT

Stock familiarisation
This is clearly the area least understood with regard to management of OMSB. Although production data from prolonged grazing of bush using large mobs of stock is being collected, further, more detailed studies are required.

The most efficient livestock production from OMSB occurs when stock are acclimatised to eating it and where it constitutes a portion of the diet for extended periods. Initially, stock need to become familiar with the plant and learn to browse it in conjunction with grazing pastures. An acclimatisation period is also necessary to allow the stomach flora of the stock to adapt to digesting the plant. These processes will take several weeks and care needs to be taken to ensure that stock are not 'starved' and production compromised during this period. Once stock are familiar with OMSB they readily browse it on return grazings after a break from bush, but they will still require a short acclimatisation period for their stomachs to adjust. Continuous supply of OMSB for longer periods by moving stock through several paddocks of OMSB gives best results. 'One-off' short-term grazings often give poor responses as animals are poorly equipped to handle the bush. Young stock will need to be trained to browse the bush by older stock.

Starved breeding or growing stock are particularly susceptible to do poorly if introduced to saltbush when in poor condition and where there is an absence of pasture. There have been several reported cases of breeding animals aborting and lactating stock abandoning their young. Animals such as these, with an increased metabolic requirement, will need to be heavily supplemented with a high energy source when introduced to saltbush, especially in the absence of pasture.

Prescribing a ration
Animals have difficulty in handling OMSB as the sole feed source due to the high salt intake. Further, a proportion of the protein component of OMSB will be wasted due to the animal's inability to digest it under these circumstances. The optimum amount of OMSB in the diet appears to be about 30% of daily feed intake, with the remainder being pasture or stubble. Good quality dry pasture or stubble make an excellent fill for the animals as well as increasing the efficiency of production. Poor quality straw or stubble hay should be supplemented with grain if this is the only available fill for stock. Where grain is fed to sheep optimum production is reached with daily intakes of about 200–300 grams.

Setting paddock sizes
When planning the layout of plantings it is important to consider how the plants are intended to be managed. When block plantings are contemplated, care needs to be taken to allow access to adjoining pasture paddocks simultaneously.

Stock managers need to consider duration of grazing and match this with other available feed (pasture or grain), flock or herd size and availability of good quality water and how it relates to paddock size. The cost of sub-division fencing and new watering points are points to consider here. Number of stock in a flock or herd will be largely dictated by whole farm size and enterprise mix, as well as which group/s will have access. Grazing times of about three weeks per paddock before moving to the next paddock appears optimum. Therefore the number of paddocks planted to OMSB will depend on the length of continuous grazing that is planned, remembering that return grazings are likely to be at 6- or 12- monthly intervals.

General management
What also needs to be considered is how the stands will be managed during an extended period of good growing conditions. It is most important that the plants are not allowed to put on excessive growth as this will result in poorer quality feed ultimately being

available to stock as well as necessitating the added cost of pruning to bring plants back to a size that animals can graze.

Water supply
The consumption of water by sheep may increase by 2–3 times (up to 12 litres/day in summer) when placed on a diet high in saltbush: whilst for cattle, their water consumption will increase to 70–140 litres/day. Water quality is also an important consideration when grazing livestock on saltbush. Generally, salt levels below 12,500 ECe (8000 ppm) for sheep, and 7500 ECe, (4800 ppm) for cattle are considered adequate for stock on grass pastures. However, when grazing saltbush salt levels in water below 1600 ECe (1000 ppm) are required for maximum saltbush consumption.

Health issues
The main health issues with OMSB are oversupply of salt and protein if the diet is not balanced with an adequate energy source from pasture or grain and or good quality water supply. However, there are indications that other health issues may arise where stands are grown on acidic soils, resulting in calcium deficiencies in stock. At this stage this issue is not widespread and can be addressed if observed.

- Other Compounds in Saltbush

Nitrates – Nitrate poisoning of young stock has been suspected as the cause of death after young hungry animals were allowed to graze a OMSB planting devoid of a pasture understorey. In these situations it is likely that much of the nitrogen is not converted to protein in the rumen and is absorbed directly into the blood stream.

Oxalates – These cause precipitation of insoluble calcium in the rumen and the kidneys. The consequence is kidney damage, rumen stasis, gastroenteritis, calcium deficiency and possible death. Poisoning in sheep and cattle has been reported when pastures contain 7–8% oxalate. Many saltbushes contain levels approaching the toxic threshold, 3.3–6.6%, however reports of toxicity are rare. Possibly because high oxalate concentrations lower voluntary feed intake of the offending plant material. There are reports that 3% oxalate levels will depress feed intake significantly.

Tannins – When present, from 2–4% in the diet protect protein from rumen degradation and increase the absorption of essential amino acids whereas at high levels (4–10%) it depresses voluntary feed intake. *Atriplex* spp. have been reported to contain low levels of tannin <1%.

ECONOMIC RETURNS

In 2000, a study was completed that evaluated the investment in a forage shrub plantation as a drought preparedness strategy for landholders in the central-west of NSW compared to the existing tactical grain feeding for drought management. A representative farm was established and a partial budgeting procedure was used in a benefit-cost analysis framework to compare alternatives. Proposals were not only assessed for the change in expected returns from the introduction of OMSB but were also assessed considering the impact of climatic variability for the central west of NSW. In the analysis three methods of establishment were considered. The costs of establishment of stands (at 2500 plants/ha) were $190 for direct seeding; $203 for bare-rooted, and $550 for speedlings respectively. No increase in carrying capacity of the property was expected, rather an increase in reliability of finishing animals and gain in best market price is expected, or alternatively the landuse could confidently change to prime lamb production because of a more reliable feed supply.

It was found that landholders could potentially benefit from the introduction of a forage shrub plantation, establishing two and a half percent of the property using the bare-rooted technique, when compared to the existing strategy of tactically grain feeding. However, when the area of saltbush was increased to 5 percent of the property the existing tactical grain feeding strategy was desirable. In all cases, it was found that the existing tactical grain feeding strategy was desirable when compared to the speedling and direct-seeding alternatives.

Since that study was completed commodity prices for livestock products have increased dramatically and a re-appraisal of the initial study has been undertaken. The value of wool has increased by about 100%, and ewes and lambs from between 35 and 40% from 2000 values. Feed grain was also costed out at 25% higher than in 2000. The net result is a huge increase in livestock gross margins. These have increased by about $30 per ewe for wool sheep. By introducing OMSB and/or changing to prime lamb production further increases can be made, with per ewe gross margins increasing to over $53 for prime lambs which are run in conjunction with OMSB. The environmental benefits have not been costed into these returns as they are not easily assessed in '$' terms.

A detailed economic analysis can be obtained by referring to the *Integration of alternative forage sources in drought management* final report referenced below.

CONCLUSION

When considering the merits of introducing OMSB onto a farm it is readily seen that there are many issues that need to be addressed before a final decision can be soundly made. The most important points are to be sure that you are growing it for the right reasons and that the projected returns match the cost of establishment. It is hoped that the points raised here will assist the reader to arrive at the right decision, as well as assist management of the stands once they are established. The section on stock response and management on OMSB is grossly deficient of sound information, but these matters are priority issues for further research.

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