



Growing biserrula to improve grain and livestock production



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Department of
Agriculture and Food



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Foreword

Biserrula pelecinus is a new genus of pasture legume which was developed for commercial agriculture by a team of Perth-based legume pasture scientists in the early 1990s. *Biserrula* is an annual pasture legume that is found in natural grasslands of the Mediterranean Basin, frequently on acidic soils derived from granite. It was this feature that first caught the eye of researchers who were attempting to develop species that could tolerate the soil stresses of acidity and low moisture-holding capacity. These stresses are common in WA and when they occur together they are problematical for the survival of annual medics and clovers. *Biserrula* has subsequently been shown to possess a number of important features that give it advantages over the traditional pasture species in mixed farming systems.

Biserrula can nodulate reliably upon acidic, sandy loam soils, and as such can be sown with confidence on soils where annual medics fail to nodulate. A major reason for this is that *biserrula* has very specific acid-tolerant nodule bacteria (rhizobium) that survives well and colonises these soils. *Biserrula* also has a root system that rapidly penetrates to depth. This allows it to extract water from deeper in the soil profile than many other annual species. One consequence of this is that *biserrula* can extend the length of the growing season by accessing deep moisture. This characteristic also gives it some protection during dry autumn conditions, because the tap root is rapidly developed. This rooting characteristic allows it to be sown on soils that are too dry for reliable production from annual clovers.

Further to these attributes, *biserrula* produces large quantities of hard (impermeable) seeds. The seasonal and annual patterns of seed softening ensure the soil seed bank of *biserrula* is one of the most resilient of all pasture legumes so far studied. This characteristic makes it ideally suited to intensive cropping systems as enough seed is produced in one season to grow a productive *biserrula* pasture after as many as three consecutive grain crops. Although the seeds are produced above ground, like medics, *biserrula* can be grazed in much the same way as medics and subterranean clover as there is an abundance of feed at the time of season when the pods are presented to the animals. Further, a large amount of the mature seed will pass intact through the digestive tract.

Biserrula is an excellent source of biological nitrogen for subsequent crops and can also play an important role in weed management systems. The latter attribute arises because the plant is less palatable than most weeds during spring, so the weeds are selectively removed. With sowing rates of around 5 kg/ha *biserrula* is one of the cheapest pasture legumes to establish. *Biserrula* can be distinguished from *serradella* because it has distinctive fern-like leaves, pale purple to blue flowers and a serrated pod containing up to 20 small yellow seeds.

The two cultivars of *biserrula* currently available, Casbah and Mauro[®] differ by several weeks in maturity, allowing the species to be grown across environments with annual rainfall between 325–700 mm.

Foreword

This management package consolidates the technical information about growing biserrula and documents a number of case studies where growers have successfully incorporated biserrula into their farming systems. Key features include establishment of biserrula, grazing management—particularly to reduce the risk of photosensitisation in sheep—value to subsequent crop production and economic impact.

The manual is intended to be a practical guide for farmers and their advisers to assist them in making decisions about the value of biserrula in their farm business and how to optimise the management of biserrula to ensure potential benefits are realised.

The effort of all the contributors to combine the information in an easy-to-read document is to be commended.

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Description of biserrula

Key messages

- Casbah and Mauro[®] are the first commercial cultivars of biserrula (*Biserrula pelecinus*) worldwide.
- The descriptions of the cultivars differ as specific traits of wild populations were selected to fit cropping rotations of different intensity.

Origin

Cultivars	Casbah	Mauro [®]
Seed and rhizobium collection	By P Beale, A Lahlou and M Bounejmate in Morocco in 1991	By A Loi, SJ Carr and M Porqueddu in Sardinia in 1995
Development and selection	By A Loi, JG Howieson and SJ Carr at the Cooperative Research Centre for Legumes in Mediterranean Agriculture (CLIMA)	By A Loi at CLIMA and field tested within the National Annual Pasture Legume Improvement Program (NAPLIP)
Release	1997	2002

Climate adaptation

Rainfall range	Casbah 325–500 mm Mauro [®] 450–700 mm
Drought tolerance	Moderate-high in comparison with other annual pastures
Frost tolerance	Sensitive, frost will reduce seed production

Soil adaptation

Soil type	Loams and clay loams Gravelly and loamy sands Sand over clay
pH (calcium chloride)	4.2–7.5
Waterlogging tolerance	Nil
Salt tolerance	Nil
Aluminium tolerance	Moderate
Rhizobium	Biserrula specific



Description of biserrula

Plant traits

Form		
Seed	colour	Yellow
	shape	Heart-like
	weight	Casbah \approx 1.2 mg Mauro [Ⓛ] \approx 1.3 mg
Pod	colour	Brown (fully matured)
	shape	Flat with serrated edges, soft texture
	seeds per pod	Casbah \approx 20 seeds Mauro [Ⓛ] \approx 15 seeds
Cotyledons	type	Aerial
Leaf	shape	Compound leaf (fern-like) with a V-shaped indentation in the tip of each leaflet
Flower	colour	Pale purple to blue
Roots	length	2 m or longer in unrestricted soils
Development		
Growth cycle	Annual	
Seedling emergence–flowering	Casbah 100–105 days Mauro [Ⓛ] 115–120 days	
Flowering–pod maturity	\approx 4 weeks	
Hardseededness	Casbah higher proportion of hard seeds than Mauro [Ⓛ]	
	Both cultivars with slow seasonal and annual patterns of seed softening	



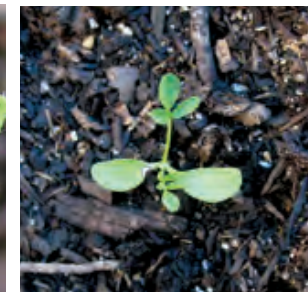
Biserrula seeds



Pods of Casbah and Mauro[Ⓛ]



Biserrula leaf



Biserrula cotyledons and first true leaf



Biserrula roots with nodules



Biserrula flower and immature pods

Description of biserrula

Productivity

Dry matter production	5000–7000 kg/ha is typical Over 11 000 kg/ha recorded in stands managed for seed crops
Seed yield	300–1500 kg/ha (depending on total dry matter and harvesting method)
Feed availability	Earlier than subclover as seedlings can survive false breaks Extended by up to 4 weeks at the end of the growing season compared to subclover
Feed palatability	During the green feed period, stock can preferentially graze weed species out of the biserrula pasture



Biserrula is a prolific seed producer

Nutritive value

Component	Vegetative	Reproductive	Senesced
Dry matter digestibility (%) ^{26, 28}	81	76	63
Metabolisable energy (MJ/kg dry matter) ^{26, 28}	11.7	10.9	8.7
Crude protein (%) ²⁹	28	17	13
Neutral detergent fibre (%) ²⁹	22	25	45
Acid detergent fibre (%) ²⁹	15	16	30

Management of biserrula

Key messages

- Biserrula should be managed as a grain crop when first sown on any paddock as the future productivity of the stand depends on seed yield in the year of establishment.
- Casbah is a public variety and can be freely bought and sold.
- Mauro[®] is protected under the Plant Breeders Right Act 1994 and the propagation of seed can only be carried out by agreement with licensees.

‘[Biserrula] is easy and cheap to establish and is persistent, all it requires is to keep weeds under control so that it can establish properly in that first year’.²

Site preparation

Paddock selection	Avoid paddocks treated with sulfonylurea (SU) herbicides in the previous year
	Avoid deep infertile sands or soils subject to waterlogging (see soil adaptation)
Weed control	Spray-top in previous spring or choose paddock where broad-leaved weeds were controlled well in a cereal or canola crop
	Best establishment is achieved if weeds can be controlled prior to sowing with a knockdown herbicide. This applies particularly to broad-leaved weeds such as doublegees
	Apply knockdown prior to establishment
	There are no chemicals registered to control broad-leaved weeds in biserrula. If livestock is available, use heavy stocking rates for short periods



Management of biserrula

Establishment

Inoculation	Essential with 'Biserrula Special' rhizobium Biserrula cannot use background rhizobia from other legumes	
	Seeds coated with peat-based inoculant and lime pelleted Or, dry and peat-based granules mixed with seed and drilled at sowing	
	Re-inoculate if a new strain of biserrula rhizobium is produced	
Sowing	time	Autumn to early winter Low rainfall areas: at the break of season (if weed control started in previous year) High rainfall areas: if required delay sowing to achieve good weed control with a knockdown herbicide
	rate	5 kg/ha is adequate in most cases but can vary between 2–10 kg/ha (lower rates when used in mixtures)
	depth	Shallow sowing is critical, preferably < 2 cm
	method	Preferably drilled. Seed can be top-dressed on the soil surface and covered with trailing harrows
Fertilisation	Phosphorus and potassium are the most important; apply according to soil tests	

Insect control

Aphids	Control is essential, especially for seed production
Red-legged earth mite	Control is essential prior to sowing until 3-leaf stage
Lucerne flea	Biserrula tolerates moderate infestation
Budworm	Biserrula tolerates moderate infestation

Weed control

Grazing	Grazing biserrula is an excellent non-chemical option for weed control, including herbicide-resistant weeds
Chemical	No herbicides are registered for use in biserrula pastures
	Avoid spray-topping in the establishment year as it can decrease seed yield by up to 85 per cent
	Weed-wiping combined with grazing can control ryegrass and wild radish effectively



Biserrula-dominant pasture

Management of biserrula

Grazing

Establishment year	Low stocking rate allows maximum seed set Sheep should be removed at flowering and not replaced until after pod maturity
	Approximately 45 per cent of seed survive ingestion by sheep (more in cattle) Seed is spread in manure
Established stands	Biserrula tolerates significant grazing pressure Winter grazing promotes prostrate growth Moderate grazing after flowering will allow seed set
	Summer grazing has little impact on future plant density and long-term persistence

Seed harvesting

Machinery	Biserrula can be harvested with a grain harvester but major modification to the drum is required
	Seed can also be successfully harvested with specialist suction harvesting equipment



Biserrula seed in sheep pellet

Companion species

Casbah and Mauro ^{db}	Both cultivars grow well in mixtures with subclover, serradella, gland clover, rose clover and perennial and annual grasses
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Farming systems

Casbah	Suited to intensive crop/pasture rotations Should be cropped the season after establishment year Can persist through a multiple crop phase
Mauro ^{db}	Suited to longer pasture phases Can persist as a permanent pasture



Harvesting biserrula seed



Biserrula mixed with barley

Management of biserrula

Rules of thumb

- Avoid paddocks that are:
 - waterlogged
 - saline
 - deep infertile sands
 - frost prone
 - treated with SU herbicides in the previous season.
- Control weeds prior to biserrula establishment.
- Manage biserrula like a crop in the establishment year:
 - inoculate
 - fertilise
 - control weeds
 - control insects.
- Graze heavily in summer.
- Crop the paddock the year after biserrula is established.
- Control aphids to ensure good seed production.
- Reduce risk of photosensitisation in stock by:
 - grazing rotationally
 - monitoring stock while biserrula is flowering.

Main uses

Farmers grow biserrula in Western Australia to:

- Make crop production more sustainable and profitable
- produce nitrogen
- control herbicide-resistant weeds like ryegrass and radish
- replace lupins and subclover in intensive cropping systems
- Increase livestock production
- fill feed gaps in summer–autumn
- extend length of growing season
- produce prime lambs.

Biserrula's contribution to livestock production

Key messages

- Biserrula pastures extend the period of green feed at both ends of the annual growing season and provide quality feed for livestock.
- Photosensitisation in livestock grazing biserrula can be managed by monitoring through flowering and removing stock from pasture if early symptoms occur.

Extended period of green feed availability

Biserrula is a valuable alternative pasture legume, especially for farming systems with livestock, as it can potentially extend the period of available green feed at both ends of the growing season. This relative advantage over other annual pastures is explained by seed and seedling attributes at the beginning of the growing season and by root depth at the end.

Well-managed stands of biserrula produce large amounts of seed which are stored in the soil seedbank. Biserrula's seasonal and annual patterns of seed softening are such that a proportion of the seed is permeable to water and ready to germinate in autumn. Seeds germinate rapidly on the opening rains and established seedlings have a stronger capacity to survive false breaks than subclover seedlings.



Sheep grazing a biserrula pasture in spring 2007 at Tincurrin

At the end of the growing season, biserrula's deep roots (up to 2 m in length) can access water from the soil below the root zone of annuals with shallower roots and produce green feed for up to four more weeks compared with subclover.

These plant traits make biserrula a good source of forage that farmers can use tactically to fill feed gaps at the end of the growing season, before crop stubbles become available, and early in the following season.

'The bulk [of biserrula] that we have left on the paddock in summer is like a hay crop'.¹⁶