

Biserrula's benefits to crop production

Each topic has been addressed to a certain extent in this bulletin. At this point, it is important to mention some general guidelines in relation to the type of farming systems for which the two cultivars of biserrula were developed. Firstly, maintaining a large soil seed bank is essential to sustain productive pastures. For this reason, in the year biserrula is first grown the aim is to create a large soil seed bank that will persist through crop phases of different lengths.

Casbah was developed to suit the more intensive grain production systems typical of the lower rainfall areas. Hence, this short-season cultivar has a very high proportion of hard (impermeable) seeds of which only a small percentage becomes ready to germinate each year. On the other hand, Mauro[®] is softer seeded than Casbah and was developed to persist through longer pasture phases in grain and livestock production systems of higher rainfall areas. Now, independently of the cultivar and the length of the crop phase, in the case of Casbah it is safer to grow a crop in the year after biserrula is established and more so if pasture seed yield was low. In the case of Mauro[®] a grain crop can be grown in the year after sowing but it is not essential.

In terms of crop species, any crop can be grown in rotation with biserrula. Biserrula can replace lupins in soils where this crop cannot grow as biserrula is adapted to a broader range of soil types. Biserrula also works well before a canola crop as it helps to reduce input costs.



Biserrula self-regenerating after wheat

Benefits of biserrula in crop rotations

- nitrogen fixation
- effective control of herbicide-resistant weeds
- effective control of grasses that host pathogens of cereal diseases
- break disease and insect cycles
- improved organic matter
- reduced water leakage and nutrient leaching compared with other annuals.

Biserrula's benefits to crop production



Biserrula regenerating after canola

From biserrula to crop

Paddocks after a biserrula phase are expected to be weed-free but some of the biserrula will self-regenerate each year. This is not generally a problem as biserrula can be killed with most in-crop herbicides.

Farmers experience biserrula in crop rotations

'The first year we sowed biserrula, it was a dry year. We had to put sheep on it earlier than what we wanted as other paddocks of ryegrass/subclover were bare. There wasn't a lot of biserrula bulk but it still managed to set seed. I think that you can be a bit harder on it than what you can on a volunteer pasture. It even managed to come back after two years of crop, which I was very impressed about'.⁸

'Subclover is dwindling away under the heavy cropping, whereas biserrula will come back after up to five-six years crop. It could even work as a green manure type crop, I might try this in the future'.⁸

Biserrula's benefits to crop production

'Our rotation is too short for subclover so we have gone with others such as biserrula'. Pastures are being improved mainly for cropping benefits such as rotation. It also works for us in the rotation on the paddocks that are not productive for intensive cropping. If we didn't have sheep we would still grow it, we would just green manure it'.²⁷

'With a pasture you want to be able to do up to 5 years crop and still have it come back, I have seen biserrula do this well, whereas the subclover has struggled. If I didn't have sheep I would green manure it'.⁸

'There isn't a problem when you go from a biserrula pasture back to crop as the herbicides that we use in wheat and barley kills it'.⁸

'In the crops it is working well, it is not an issue at all in the cropping phase as none germinate'. It must be the herbicide that is controlling it during the crop phase as it can't be used on biserrula'.²⁷

Economics of farming systems with biserrula

The research results in previous sections show the ways in which biserrula can contribute to make grain and livestock production systems more productive and sustainable. How these changes impact on profitability is essential for farmers to consider adopting this practice. Therefore, this section briefly discusses the drivers of profitability in mixed farming systems and grain production systems with biserrula.

Modelling studies, assuming correct agronomic practices are implemented on an average rainfall year, have shown that biserrula can substantially improve the profitability of different farming systems.

Drivers of profitability in mixed farming systems with biserrula^{13, 20, 23}

- increased pasture growth rate in suitable soil types
- improved pasture quality
- increased stocking rates
- increased sheep turnoff
- increased area of cereals at the expense of pulses and oilseeds
- filling feed gaps with quality feed
- availability of green feed early and late in the season and
- lower costs of supplementary feeding.



Biserrula increases profitability of mixed farming systems

In mixed systems the studies highlighted the significance of the extended growth cycle of biserrula compared with subclover and annual grasses. This advantage allows livestock to sustain or increase further weight gains as they can access high quality green feed for several weeks longer. The availability of this additional feed at such time of the year is critical as it coincides with the period between the senescence of unimproved pastures and the availability of crop stubbles.^{13, 20, 23}

The impact of soil type on the profitability of biserrula is also significant. The increase in dry matter production as a result of higher pasture growth rates can increase profitability by \$13–71/ha in comparison with that on less suitable soils. The soils included in the model were: rocky red brown loamy sand/sandy loam, brownish grey granitic loamy sand, deep sandy surfaced valley, shallow sandy surface valley soil and loamy sand over clay.²³

Drivers of profitability in grain production systems with biserrula^{3, 13, 25}

- replacing lupins on paddocks with herbicide-resistant ryegrass
- replacing lupins where crop production is low due to pests and diseases
- replacing volunteer pasture in rotations with wheat
- replacing subclover in crop rotations of different intensity
- replacing lupins on paddocks with a mix of soil types
- substituting grain legumes to increase flexibility in management
- lower risk than in cropping rotations including grain legumes

In grain production systems biserrula is a type of insurance for the rotation. In the case of long-term wheat/lupin rotations with low yields and high costs of production due to herbicide-resistant ryegrass, a biserrula phase can be as profitable as intensive cropping rotations.

A comparison between biserrula and volunteer pasture grown in rotation with wheat showed that self-regenerating biserrula pastures are more profitable because of the increase in wheat yield and quality. The analyses also showed that in the event that biserrula failed to persist, re-seeding it every pasture phase is viable if wheat yields are of the order of 2 ton/ha.³ A biserrula



Biserrula increases flexibility and lowers risks of grain production systems

phase instead of lupins is also less risky, particularly on farms with a mix of soil types.²⁵ Farmers growing biserrula suggest that lupins are a higher risk crop and that losses from a grain legume can be far greater than those from a biserrula pasture.

Understanding how biserrula functions and affects other components of the farming system is essential to realise its potential benefits. This involves following the guidelines for establishment and management of biserrula discussed in this bulletin. Farmers applying this technical knowledge will be able to reap biserrula's benefits over the whole farm providing favourable environmental conditions occur.

Economics of farming systems with biserrula

'You get better results from growing biserrula and remove the exposure of losses that lupins give, so gross margins and profit are better with biserrula than lupins'.¹⁴

'Biserrula is a great replacement for lupins as it thrives year in year out whereas the lupins don't grow well and when they do they are full of radish and ryegrass. Biserrula on the other hand is sown once and then it regenerates even in mongrel years'.²



Farmers' experiences with biserrula

'Photosensitivity has nothing on lupinosis; biserrula defeats lupins all-round'

Levett

Key messages

- Photosensitivity is no harder to manage than lupinosis.
- Biserrula works better in the system than lupins as it decreases crop costs and is flexible, with high nitrogen benefits.
- Weed populations are decreasing along with the crop yields being significantly better on the biserrula paddocks.

Background

Cameron Levett and his father Max began growing biserrula in 2000 on Max's property, at the time they had a lot of stock and were looking for a better feed source than volunteer pastures. It also had the benefit of providing an alternative for lupins. Cameron sees lupins as a total failure on medium-textured yellow soils with high costs and herbicide-resistant weeds. He now grows biserrula instead of lupins in his rotation and believes he has a simpler and more sustainable system.

Farm statistics

Location: Carnamah

Farm size: 6000 ha

Rainfall: 330 mm

Enterprise: crop 70 %, pasture 30 %

Stock: usually 6000 ewes and 4000 lambs

Area to biserrula: 4500 ha

Soil type: pH 6.5, red deep york gum soils

That first year

Preparation	Roundup® @ 1 L/ha as a knockdown and the sheep get the rest of the weeds
Sowing rate	5 kg scarified seed per hectare and slurry inoculant
Technique	Air-seeder with knife points and no harrows, just dusted the ground 1–2 cm, not every point touched the ground but could see that it had definitely scratched the ground
Fertiliser	None with the seed
Stock	Grazed as sowing, they leave the biserrula and eat the weeds out, especially radish

Farmers' experiences with biserrula

Management

Grazing

Cameron is impressed with the way that biserrula handles the stock. In spring, sometimes he ends up with large quantities of biomass when the pasture grows rapidly and he cannot increase the stocking rate to match the feed on offer. 'When the spring flush comes along, you need to triple your stocking rate'.¹⁴

Cameron does not rotate his stock on biserrula pastures as the extent to which photosensitivity occurs is smaller and its effects nothing compared to lupinosis. When he observed this problem, it was on a highly productive biserrula-dominant pasture where 60–80 sheep were affected out of 10 000. 'if you see photosensitivity put them on cereal stubble ... only a few sheep are affected and it is just like scabby mouth really, even grass seeds can be worse than photosensitivity'.¹⁴

Pest/disease

Cameron is happy with the way in which sheep control herbicide-resistant radish on biserrula paddocks. He controls aphids with a boom spray as he found that a mister was ineffective.

Benefits

Livestock

Cameron got lambing percentages of 110–130 per cent after ewes were grazing biserrula, which is the highest Cameron has seen, so he thinks that photosensitivity does not affect fertility.

Cameron has been able to increase stocking rates when the seasons are good. In dry years, he can sustain his stock better on biserrula pastures than on subclover volunteer pastures. Cameron suggests that reasons for this may be due to the higher protein content (17 per cent) of biserrula, which was seen after he had feed tests done.

Weed control

For Cameron the level of weed control that can be obtained by growing biserrula is the most beneficial characteristic, however, 'sheep are needed to get the best out of the biserrula'.¹⁴

Herbicide-resistant radish is being controlled by stock as 'it is the first thing that they eat and they leave the biserrula alone'.¹⁴ Biserrula gives the radish a break from herbicides which Cameron likes and he believes that it is easy to graze out of the biserrula. [Early in the season] 'I had 500 sheep on a 600 ha paddock, they ate the radish and kept the paddock reasonably clean but when the spring flush came I needed to triple the stocking rate so that the biserrula growth was eaten'.¹⁴

Rotation

Cameron believes organic carbon and nitrogen would have been improved in paddocks with heavy stands of biserrula. 'Biserrula would be able to stand with soil fertility alone without the weed benefits. It is also helping to decrease weed populations, which in turn improves crop yields significantly and decreases cropping costs'.¹⁴

Farmers' experiences with biserrula

Nitrogen

'The whole package of biserrula is much underestimated for long-term use. It's not just the weed control but it is also the nitrogen that is produced and the stock feed bulk. It is still worth growing biserrula for nitrogen with urea at \$600/ton'.¹⁴ He believes that the nitrogen production of biserrula is greater than that of lupins due to biserrula's larger biomass production. With the dry years he says that it is hard to tell how much nitrogen biserrula produces but it is noticeable several crops after biserrula. He estimates that there is enough nitrogen produced to meet the needs for a 2-ton wheat crop.

Difficulties

His biggest failure with biserrula was due to ineffective control of aphids in early spring, which resulted in very little seed set. 'We used a mister instead of a boom spray, we definitely should have used the boom spray with a bigger water rate'.¹⁴

Cameron sows the biserrula in dry conditions despite this practice carries considerable risk of failure. In dry years he has lost money sowing biserrula but believes he would have lost much more if it had been lupins (Table 9). Establishment costs in biserrula are lower than in lupins in part because he does not fertilise the biserrula.

Table 9 Comparing costs of establishment of biserrula and lupins in Carnamah WA

	Biserrula	Lupins
Seed	5 kg/ha @ \$3/kg = \$15/ha	Pickled seed 70 kg/ha @ \$300/ton = \$21/ha
Inputs	Inoculant = \$20/ha	Herbicide = \$12/ha
Area	Dry sown 3000 ha	If sown 3000 ha
Loss	\$60 000	\$99 000
Source	¹⁴	

Cameron would rather manage photosensitivity than lupinosis as he believes its effects are little compared with lupinosis or any other common livestock health issues such as scabby mouth.

Farming system

Cameron has substituted lupins with biserrula in wheat rotations. He says that the biserrula is excelling on red loamy valley soils where lupins fail, so it is giving him more options than the wheat/lupin rotation. Cameron also believes that he could make meadow hay from the biserrula on these soils as it really bulks up.

In a perfect world Cameron thinks that biserrula would suit a 60 per cent crop and 40 per cent biserrula rotation without any volunteer pasture as he believes that there is no need to worry about photosensitivity. He says that 'the long-term gain of biserrula is better than a few photosensitivity issues, especially when lupins are harder to manage with lupinosis than biserrula with photosensitivity'.¹⁴

Farmers' experiences with biserrula

Economics

Cameron firmly believes that biserrula will improve farm profits around his area. To estimate the contribution of biserrula to the system he considers 'whatever nitrogen is worth and how much biserrula is produced and compares it to whatever it costs to get and apply urea for a couple of years'.¹⁴ Cameron has saved on costs of urea for two years on some of his crops growing in rotation with biserrula. He would usually apply 100 kg urea for a potential 2-ton wheat crop. After a biserrula phase, he is still getting the same yield without any urea application. 'You get better results and remove the exposure of losses that lupins give, so gross margins and profit is better with biserrula than lupins'.¹⁴

'Biserrula does well when wheat does well and will not perform in years when wheat doesn't perform'.¹⁴



'Biserrula is a great replacement for lupins, subclover and annual medics'¹⁴

Interview by Natalie Hogg on 25th February 2009

Farmers' experiences with biserrula

'Biserrula reducing money spent on stock feed'

Bear

Key messages

- Biserrula is cheap and easy to establish and is a great replacement for lupins.
- It needs to be treated like a wheat crop in the first year and then it will persist and regenerate well on its own. It will look after itself.
- Keep weeds under control with sheep or spray.

Background

Phil Bear and his wife Michelle began growing biserrula in 2001 at Moonjin, their property. Phil was initially planning to grow a serradella mixture but as Charano[®] was expensive he opted for biserrula, which was cheaper. Since then Phil has continued to grow biserrula as it has been so successful for him. It is easy to establish providing weeds are kept under control in that first year. Phil targets the lower performing paddocks and believes that they have turned around and he expects to be able to crop them again in the future.

Farm statistics

Location: Dowerin

Farm size: 3600 ha, 3000 ha arable

Rainfall: 300 mm

Enterprise: crop 50 %, pasture 50 %

Stock: 3500 sheep

Area to biserrula: 900 ha

Soil type: various

That first year

Preparation	Knockdown before seeding and treat biserrula like a wheat crop
Sowing rate	5 kg/ha with Cadiz in first year and just biserrula in other years, inoculant
Technique	Burgo air-seeder and bar at 6 km/hr with Agmaster points and boots got rolling harrows which are lifted up. Knives are in the ground but lifted up a bit from where they are for wheat.
Fertiliser	Sometimes fertilise depending on prices, so not lately. Top-dress pastures
Stock	On and off at a fairly high stocking rate, move them out once they have been in there around 3–4 weeks
Pest control	Grass-selective herbicide during the year, used the weed-wiper

Farmers' experiences with biserrula

Management

Grazing

Phil stocks his biserrula paddocks at a fairly high rate and uses a rotational system. Sheep are removed from the pasture after three to four weeks. One year when he had lambs and ewes on a biserrula paddock he observed photosensitivity. The lambs were affected but the ewes did not appear to be affected at all. 'It isn't that much of an issue'.²

Pest/disease

'I do a knockdown at the start of the year, either before it germinates or is sown'.² Phil chooses not to spray-top so that the biserrula can set seed and keep growing later into the season.

'Radish is controlled by our stock and I am happy with the way they control it, it means I don't have to spray for radish'. Weed-wiping works very well for ryegrass control, it killed a bit of the biserrula but not a lot and the ryegrass control I got was good'.²

Phil looks for aphids around spring time as they require control. 'When there is a bit of a dry spell it starts to shrivel, you need to have a good look and see if it is aphids or the dry spell'.² In 2008 the biserrula was affected by aphids but after spraying it rained and the biserrula recovered and damage from the aphids was not noticeable.

Benefits

Phil's biserrula paddocks are doing better than those with subclover, which he says are struggling. 'If we get summer rains the clover comes up quickly but then dies off, whereas the biserrula eventually comes up but holds on until the proper break comes'.² Phil also mentioned that the biserrula does better in a dry year. 'It managed to establish well in dry years when nothing else did, it would have been a disaster if we didn't have the biserrula. It has helped me to maintain my flock size, as it provides good quality dry feed'.²

Phil perceives biserrula as a replacement for lupins as when this does not grow well it is full of radish and ryegrass. 'Biserrula is sown once and then it thrives year in year out. It establishes in mongrel years, so when we get a good year imagine how easy it will be'.² Phil believes that lupins at \$300/ton are easier and cheaper to buy.

Free nitrogen from biserrula is a bonus to Phil's farm. 'I am definitely decreasing nitrogen application on the biserrula paddocks, I put about 10 units of nitrogen down the tube and that's it'.² On the other paddocks where Phil is not growing biserrula he has to come back with another 25–30 units of nitrogen. 'I grow biserrula for \$20/ha, I can't put out enough urea for \$20/ha'.²

Phil has found the biserrula to be versatile as he has been able to sow it early or late. I can do whatever with it and it works. 'It also helps that feed stays green for longer'.²

Farmers' experiences with biserrula

Difficulties

'Just need to be mindful of aphids and keep an eye on stock to see if there is any photosensitivity'.² He also mentioned that in the dry months biserrula does not hold the soil as well as subclover does, so it can cause soil erosion if the stock is left on it too long.

Sheep do a reasonable job in controlling the broad-leafed weeds. They do alright with the turnip until it turns woody, so Phil believes that this could be an issue.

Farming system

'The second year always has to be a crop year. One year we got caught when we didn't do this and there wasn't much biserrula that came up. If you crop it the second year, then the third year it is thick as anything and you have that much seed there for other years'.²

Economics

Phil can see the benefits of growing biserrula as his poor performing paddocks have improved and could carry more sheep and get better wheat yields in the long term. 'It is a sustainability thing, if we get half of the farm in, it will make life easier'.²



Interview by Natalie Hogg on 20th September 2009

Farmers' experiences with biserrula

'Biserrula helping the fight against resistant ryegrass and other weeds'

McDougall

Key messages

- Preferential grazing of the non-biserrula components of the pasture is allowing for weed control without the need for herbicides.
- Ryegrass numbers have gone from 1000 plants/m² to a paddock that we can now crop.
- Biserrula produces enough nitrogen to grow a canola crop on 30 kg of Agstar per hectare.

Background

John and Gordon McDougall from Acadia, a 5000 ha property near Tincurrin, began to grow biserrula in 2000. The initial reason for growing the biserrula was to try and manage the Select®-resistant ryegrass, which is found over the farm. They chose biserrula because of its lower palatability compared with weeds expecting sheep to graze them out of the pasture and leave a more dominant biserrula stand. 'We had around 1000 plants/m² of ryegrass, which was what we wanted to address. We are controlling the resistant ryegrass by grazing biserrula'.¹⁶

Farm statistics

Location: Tincurrin

Farm size: 5000 ha

Rainfall: 300 mm

Enterprise: Crop 70 %, Pasture 30 %

Stock: 6000 sheep plus lambs

Area to biserrula: 360 ha, rotated.

Soil type: medium to heavy country, duplex soils, sandy gravel and off white sands.

That first year

Preparation	Knockdown
Sowing rate	4 kg/ha in early April
Technique	Air-seeder
Fertiliser	Double the amount of super that is put on crop (April)
Stock	Late in the season stock went on
Pest control	Grass-selective herbicide and insecticide for the aphids

Farmers' experiences with biserrula

Management

Grazing

John and Gordon are happy with the feed biserrula provides early in the season. When other sources of feed become available they begin to graze rotationally with large mobs to keep the biserrula fresh and short.

They suggest:

- Keep biserrula low from the beginning to avoid photosensitivity
- Graze continuously with rotating mobs. Broad-leaved weeds such as turnip and radish can be controlled by the sheep alone in most years.
- The chances of photosensitisation are lower if the biserrula stand is weedy.
- Remove stock at flowering/seed set for higher seed production.
- Having a laneway helps with rotational grazing for larger mobs.

Pest/disease

Spray aphids in spring and control weeds, with a knockdown herbicide, at the start of the season.

Benefits

'The advantage with biserrula is its persistence and that it is relatively management free, spraying of aphids in spring and weeds at the start of the season being the only management that is required'.¹⁶

Livestock

'Stock numbers have not increased due to the dry years.

However the bulk that we have left in the paddock in summer is like a hay crop. Biserrula is able to provide early feed. Towards the end of the season when it is flowering and setting seed we remove stock and this also allows for more bulk to be available for summer grazing'.¹⁶

Weed control

'We had around 1000 plants/m² of ryegrass on the now biserrula paddocks. We establish biserrula then we go back to crop, we then grow three years of biserrula to really clean it up and then go one in one out, which helps control the ryegrass. Weed-wiping works well on the ryegrass in the biserrula, it is hard to remove the broad-leaved weeds (turnip and radish) if you don't graze the biserrula. It is better to control weeds early and we graze continuously with rotating mobs, by doing this the broad-leaved weeds are controlled by the sheep alone in most years'.¹⁶

Rotation

John and Gordon always crop the year after biserrula establishment and then they usually do two to three years biserrula then a crop. On the ryegrass-resistant paddocks they grow three years of biserrula to really clean it up and then go one in one out which they say 'works well to control the ryegrass. ... we even found that after four years in crop the biserrula still comes back'.¹⁶