

How do I better utilise legumes in pastures in the mixed farming zone?

The issue:	Australia's feedbase is underproductive due to a sub-optimal mix of species in pastures and the lack of persistence of sub-clover and annual medics. Therefore, there is low nitrogen (N) fixation, particularly in mixed cropping and livestock enterprises.
The impact:	Low legume content reduces N supply to pastures and restricts response to applied phosphorus (P) and sulphur (S). Poor-performing pastures reduce livestock productivity.
The opportunity:	By growing pastures with a sufficient legume component, producers can improve persistence and productivity, grow free nitrogen and extend the growing season.

Legumes, which include clovers and medics, are a family of broadleaf plants which, in association with Rhizobium bacteria, are able to fix nitrogen from the atmosphere and make it available to other pasture species. The nitrogen fixed by legumes then boosts the performance of non-legume species in the pasture and produces higher quality dry matter, providing a nutritious feedbase.

Common legumes traditionally grown in the mixed farming zones are subterranean or sub-clover, annual medics and lucerne. However, with sub-clover and annual medics failing to persist and climate variability impacting production, hard-seeded annual legumes such as arrowleaf clover, biserrula, bladder clover, gland clover and serradella are providing increased value.

MLA-funded research has found hard-seeded legumes present an opportunity for mixed farming enterprises to grow a more resilient, flexible, highly productive feedbase and are a suitable replacement for sub-clover.

What are the benefits of growing pasture legumes?

A hard-seeded legume-based pasture can:

- offer free nitrogen which improves the productivity of other pasture species, the persistence of the pasture and the nutritional content of the whole pasture
- fix free nitrogen for the cropping phase of the rotation
- extend the production window
- improve pasture resilience to climatic conditions and seasonal variation due to their deep roots and/or capacity to produce sufficient seed for regeneration in subsequent years, even under adverse growing conditions
- provide more options for weed control in preparation for the cropping phase
- improve overall soil health
- regenerate after the cropping phase without re-sowing (species and variety-specific)
- produce hard seed which can be harvested using standard grain harvesting equipment, reducing costs
- be sown outside the crop sowing window with summer (unscarified or in-pod seed) and dry sowing options
- be sown within the cropping phase using low-cost techniques, such as twin seeding (unscarified or in-pod seed) with a cereal crop
- produce high quantities of nutritious winter feed
- provide similar and, in some cases, higher weight gain in ewes and lambs in winter and spring compared with lucerne, lucerne/phalaris and volunteer pastures
- be used for a high quality hay (particularly bladder clover) offering similar and, in some cases, higher weight gains than sub-clover or lucerne/oaten hay.

How do I choose the right pasture legume?

Start by fully assessing your livestock needs, how the pasture will be utilised, the feed gaps in your system and where it fits in the paddock rotation. Look to local trial data, and support and advice from agronomists on variety performance in the area.

Other factors to consider are:

- availability of seed
- capacity to sow it and manage establishment
- paddock history and preparation.

Four golden rules

1. Use the right species and cultivar: do the research on what is doing well in your area.
2. As for any new pasture sowing, make sure weed seed bank population has been reduced by preventing seed set of weeds for two and preferably three years prior to sowing the new pastures.
3. Minimise residual herbicide risk: avoid using residual herbicides in the previous crop or in summer spraying.
4. Choose the right soil type: match the soil type with the species.

How do I grow them and where do they fit?

There are various options for incorporating hard-seeded pasture legumes in your system. These include:

1. Sow them as a standalone pasture using scarified seed in mid to late autumn. Standalone sowing produces the highest seed yield and seed size, leading to improved persistence and production.
2. Summer sowing involves the sowing of unscarified or in-pod seed in mid to late summer. The high summer temperature breaks down some of the hard seed and seedlings emerge on opening autumn rain. Not all hard-seeded species and varieties are suitable for summer sowing. Ensure an appropriate, robust inoculant delivery system capable of surviving high summer temperatures is used to facilitate nodulation.
3. Twin sowing is a method where a crop and pasture are sown in a one-pass operation. Unscarified seed or in-pod seed is sown with the final crop. The sowing

year is simply a seed softening year for the legume seed and therefore the crop can be sown at the normal rate. The legume will emerge in the following autumn. Hard-seeded French serradella and bladder clover are suitable for use in summer sowing.

4. Sow with a cereal crop for establishment the following year. This technique is called cover cropping and involves using a reduced rate of cereal seed. This offsets the cost of pasture establishment by using a single operation and having a crop to harvest at the end of the first year.
5. Sow into an existing grass-based pasture. For any legume, either traditional or new hard-seeded species, it can be difficult to achieve adequate establishment in existing pastures due to competition from established pasture species.



Scarified and podded bladder clover seed



French serradella

Getting it right

Once a seed bank is established, an ongoing pasture-crop rotation can be established. The length of the cropping phase that can be implemented will depend on the hard-seed characteristics of the legume species and variety of legume within species.

MLA-funded research (B.PSP.0013) found that if good establishment methods were used, the small (generally much smaller than sub-clover or annual medics) and hard-seeded nature of these legumes (arrowleaf clover, biserrula, bladder clover and gland clover) enabled a large seed bank to be established for reliable regeneration.

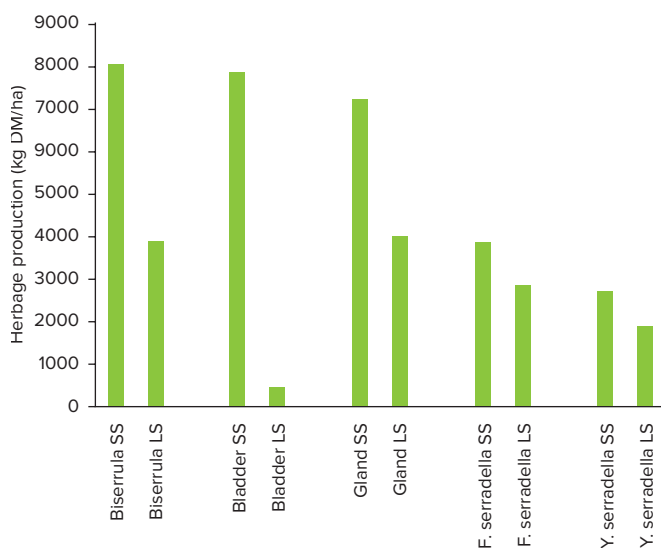
Sowing time and pasture production

Timing of sowing is important – summer sowing allows plants to establish and utilise higher autumn temperatures, producing a greater leaf area and therefore high quantities of dry matter before cooler temperatures arrive.

Earlier sowing can also provide greater competition against weeds. Scarified seed can be dry sown ahead of the autumn break or after the autumn break if an additional weed knockdown is desired.

Later sowing generally decreases first-year herbage production as plants grow slowly if they emerge in cold conditions of late autumn and winter. Later sowing can also significantly reduce seed production.

Figure 1: Herbage production (kg DM/ha) for biserrula, bladder clover, gland clover, French serradella and yellow serradella. SS = summer (February) sown in pod. LS = Sown (May) as scarified seed



Seed preparation and inoculation

Appropriately inoculated legumes will be more successful in forming an adequate number of nodules and reaching nitrogen fixation potential. The appropriate inoculant group must be used for each legume species. The inoculant contains the appropriate strain of rhizobia for specific legume species.

Arrowleaf clover, bladder and gland clover require Group C inoculant (the same as sub-clover), biserrula requires Group BS inoculant and serradella requires Group S. If you are sowing a mixed pasture, for example one that contains gland clover and serradella, it is critical to use both Group C and Group S inoculant.

The form of inoculant is also a critical consideration. Peat and freeze-dried inoculants need moist soil for survival. Clay-based granular inoculant is suitable for use in dry soil conditions and can be drilled into the soil.

Sowing depth

The new legume species are small seeded, generally much smaller than sub-clover, and therefore should be sown no deeper than 10mm.

Sowing rates

Summer sowing and twin sowing rate of in-pod seed (serradella) is 20–30kg/ha and for unscarified seed (arrowleaf, bladder clover, biserrula and gland clover) 12–15kg/ha. A long-life granular inoculant must be used at 10kg/ha to help establish good rhizobia in the root zone.

Scarified seed can be sown at 5–10kg/ha for a monoculture, or 4–6kg when being sown in a mix with grasses or lucerne.

Fertiliser

After assessing soil tests, establish which fertiliser is needed for that soil type. Generally hard-seeded legumes need at least 10kg of P/ha applied at sowing, with a similar rate of sulphur. If molybdenum deficiency is known, this should be rectified at sowing and treated every five years. Potassium deficiency can also be an issue on light sandy soils.

Weed control

There should be a minimum of two or, preferably three years of absolute weed control prior to sowing a pasture. This is usually achieved by a combination of cropping and herbicide use.

Check herbicide labels carefully to ensure herbicides to be used in the cropping clean-up phase do not have the potential to cause residual damage in the establishing pasture.

Don't break the (seed) bank

Maintaining a high seed bank is crucial to growing pastures which will regenerate quickly after the cropping phase, or persist as a standalone pasture.

Getting it right involves:

- allowing seed set in the establishment year and then every two to three years following
- understanding the breakdown patterns of seeds under various conditions
- using livestock to ingest and spread the seed during grazing
- avoiding overgrazing during flowering to allow the development of pods.

How do I incorporate cropping?

It is recommended a cereal crop is sown into a hard-seeded legume pasture the year after establishment using minimum tillage machinery. Cropping utilises nitrogen fixed by the legumes and allows time for hard seed to break down. If a reasonable seed bank has been developed in the establishment year, regeneration will be ensured in year three. Very hard-seeded legumes like biserrula and yellow serradella can withstand three or four successive crops and still regenerate adequately.

In terms of weed control in the newly sown pasture, do not assume the new legume species are tolerant to herbicides used on traditional pasture species. Consult an agronomist for advice.

Some species such as biserrula are less palatable than some problematic cropping weeds such as annual ryegrass. Therefore, using biserrula may offer potential for control of ryegrass and some other weeds during the pasture phase.

Establishment

The primary goal with any legume-based pasture is to maximise seed set in the first year to ensure a large and resilient seed bank for long-term regeneration.

Generally, pastures sown in late autumn and early winter will not produce sufficient feed for grazing in the first year. In very dry years it is best to leave them ungrazed.

Managing the seed bank

Care is needed when grazing in the flowering period to avoid removing seed heads prior to seed formation, particularly in the establishment year. Arrowleaf clover can be particularly sensitive to overgrazing during reproductive growth stages due to its prominent seed heads. After the establishment year, good seed set should be supported every two to three years.

Summer grazing

As these legumes produce high quantities of dry matter in spring, there can be dry residue available for summer grazing. Livestock can also be useful in spreading seed. The smaller the seed, the greater the proportion of seeds that survive ingestion with biserrula, gland and arrowleaf clover having a higher proportion of seed that escapes digestion, compared to bladder clover and French serradella.



Biserrula should be grazed to no less than 1,500kg DM/ha, arrowleaf clover to 2,000kg DM/ha and bladder clover to 1,700kg DM/ha to ensure adequate seed production. In seasons with poor growing conditions, forego grazing to ensure seed production.

Serradella success

Esperance, WA, based producer group Association for Sheep Husbandry, Excellence, Evaluation and Production (ASHEEP) ran a three-year MLA Producer Research Site investigating using serradella and bladder clover in kikuyu pastures.

The trial found serradella to be an ideal partner for kikuyu and boosts kikuyu production via nitrogen fixing.

Tips for establishing legumes in kikuyu, as determined by the research site findings, include the following:

- Hard-seeded serradellas can be sown as a pod into kikuyu pastures in summer, or as a scarified seed in winter. Summer sowing can lead to increased dry matter production in winter.
- A viable seed bank is essential. If the seed bank is poor or conditions are dry, suppress the kikuyu using herbicides or hard grazing, and sow legumes following a season break.
- In wet years, with a good seed bank, legumes will establish well as long as the kikuyu has been grazed hard in the autumn.
- Herbicides need to be well managed. Kikuyu displaces weeds, but if kikuyu is suppressed then weeds can re-establish and dominate the pasture, impacting legume establishment and pasture production.

As part of a Producer Research Site managed by the Fitzgerald Biosphere Group Inc, producers examined if a serradella or bladder clover oat mix increased winter feed quality in kikuyu pastures.

It found while straight kikuyu pasture produced the highest feed quantity, it was only marginally higher in digestible fibre than the other pasture compositions. It also found using knife points with double disc openers and press wheels was the most successful method of establishment. The serradella established a better stand than the oats and disturbing the soil led to regeneration of clover from the seed bank.

The bladder clover persisted slightly better than the serradella when sown into a 10-year-old kikuyu stand.



Grower Ashton Hood in summer pod sown Margurita Serradella in WA

In a tight rotation

An MLA Producer Research Site run by Stirlings to Coast Farmers Inc assessed hard-seeded legumes in a tight crop-pasture rotation. It also investigated establishment methods and early season dry matter production and its impact on seed regeneration.

The Stirlings to the Coast southern region of WA has variable summers, which are often wet and mild, compared to the general hot summers of other WA regions.

It found:

- summer sowing of French serradella (in pod – particularly Margurita) was the most robust, productive and cost-effective system
- results from twin sowing trials were inconclusive
- some hard-seeded yellow serradellas were less suited to summer pod sowing and the variety Santorini was better sown as a bare scarified seed into moist soil and treated as a crop
- dry sowing of serradella scarified seed in early autumn provided the least successful results with lower pasture density, quality and overall biomass
- autumn sowing of scarified seed clashed with the sowing of grain crops
- late-maturing serradellas have reduced pod set if spray topped for ryegrass late in the season
- tight rotations mean management of herbicides is paramount to avoid resistance issues, however well managed pasture phases can reduce herbicide use intensity for specific herbicide groups
- claying to ameliorate the non wetting properties of the region's sandy soils was confirmed as beneficial for the regeneration of pastures.

More information

Download the [MLA Pasture Health Kit](#)

[Using French serradella to increase crop and livestock production](#)

[Using bladder clover to increase crop and livestock production](#)

[Using biserrula to increase crop and livestock production](#)

These publications contain advice on sowing techniques, weed management, fertiliser, variety selection and paddock management.

ASHEEP: asheep.org.au

Fitzgerald Biosphere Group Inc: fbg.org.au

Stirlings to Coast Farmers Inc: scfarmers.org.au

DPI&RD WA's: [Twin sowing and summer sowing: alternative techniques to introduce annual legumes into pastures](#)

YouTube videos:

Murdoch University's: [Successfully sowing legume pastures in summer, WA](#)

GRDC's: [Summer sown hard seeded Serradella](#)

[How to conduct a soil test and How to interpret a soil test fact sheet](#)

[Persistent pastures resource hub](#)

[MLA southern feedbase hub](#) – for information on soils, pastures, legumes and weed control

Murdoch University's: [Centre for Rhizobium Studies](#)

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Meat & Livestock Australia
Level 1, 40 Mount Street
North Sydney NSW 2060
Ph: 02 9463 9333
mla.com.au