MEAT & LIVESTOCK AUSTRALIA

meatup FORUM

For the latest in red meat R&D

Simple and effective legume pasture systems – getting the most out of it

Alison Frischke

Birchip Cropping Group

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Simple and effective legume pasture systems

Dryland Legume Pasture Systems project

- Why legume pastures are important

  soils, livestock, crops, whole farm profitability
- Pasture legume options and traits
- Establishment

  sowing systems, rhizobia, sowing rate, depth, pasture mixes
- Harvesting seed and regeneration
- Tools and further information

Seraph medic at Lawloit 2021

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Dryland Legume Pasture Systems (DLPS)

Rural R&D for Profit

Legume pastures benefit soils

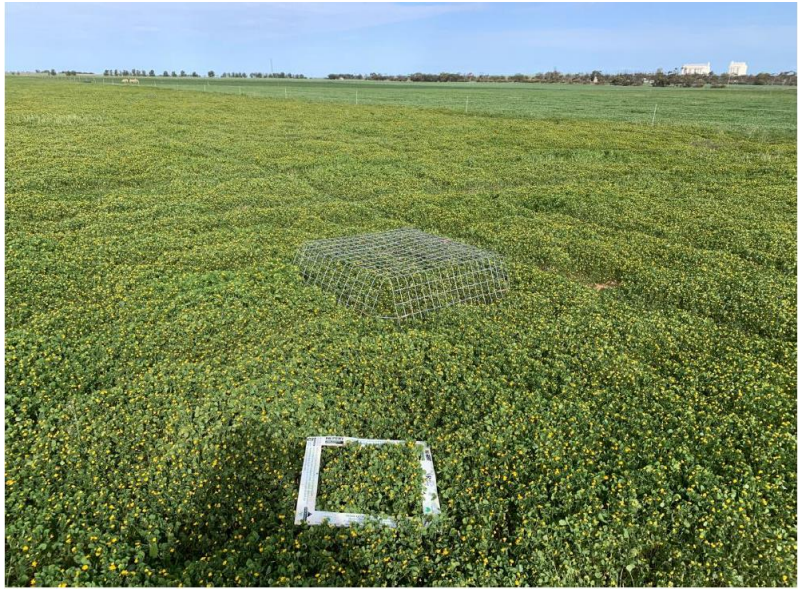
- Soil organic carbon stocks have declined – also other nutrients stocks, esp. N
- If you want to change soil health, you must grow and retain biomass
- C and N are needed to feed soil microbes

  (organic matter turnover, nutrient cycling, soil structure, disease control and agrochemical breakdown)
- Legume pastures provide an opportunity increase SOM/C and N faster than grain crops and their stubbles
- Rebuilding soil C and N is slow - include legume pastures over the long term
- Relies on careful grazing management

Legume pastures benefit livestock

- Legume pastures – higher digestibility and protein in spring, can extend green feed available
- Sheep liveweight gains were excellent on all hard seeded pasture legumes and vetch
  - Grazing value determined by feed available
  - Better performance than on lower protein cereal stubbles

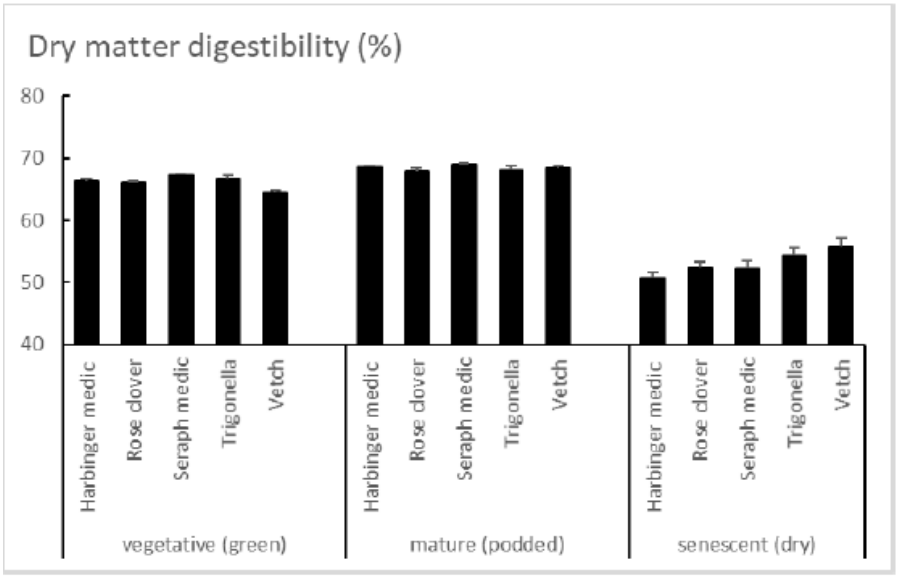
Class	Energy (MJ ME/day)	Protein (%)
Dry ewe, early pregnancy – 60kg	9	6 - 8
Ewe, 4 weeks before lambing	14.5	8 - 10
Ewe, lamb at foot	21.5	12 - 14
Weaners (200g/day)	10 - 21	14 - 20

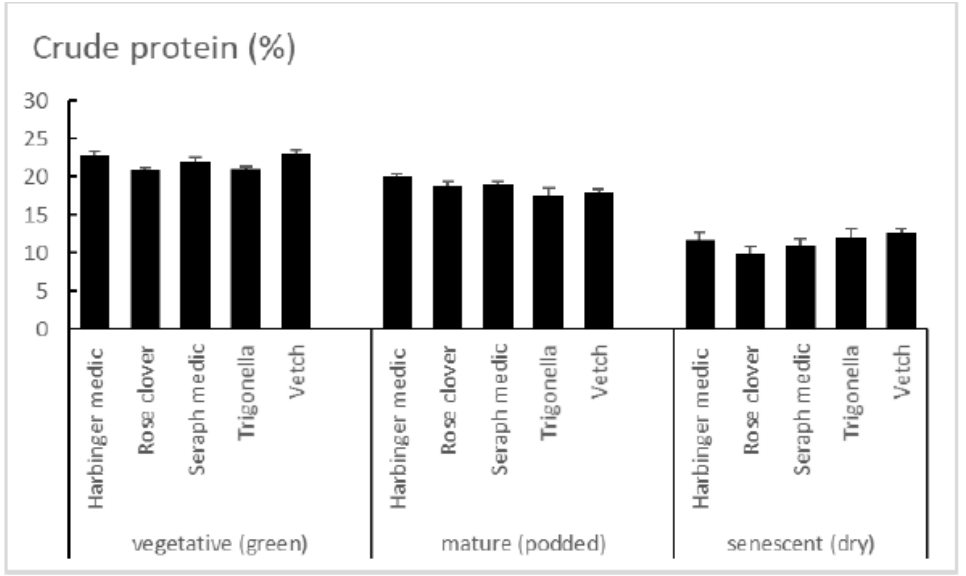


Seraph medic, Minnipa 2019

MEAT & LIVESTOCK AUSTRALIA

Legume pastures benefit livestock





(SARDI Minnipa, 2019)

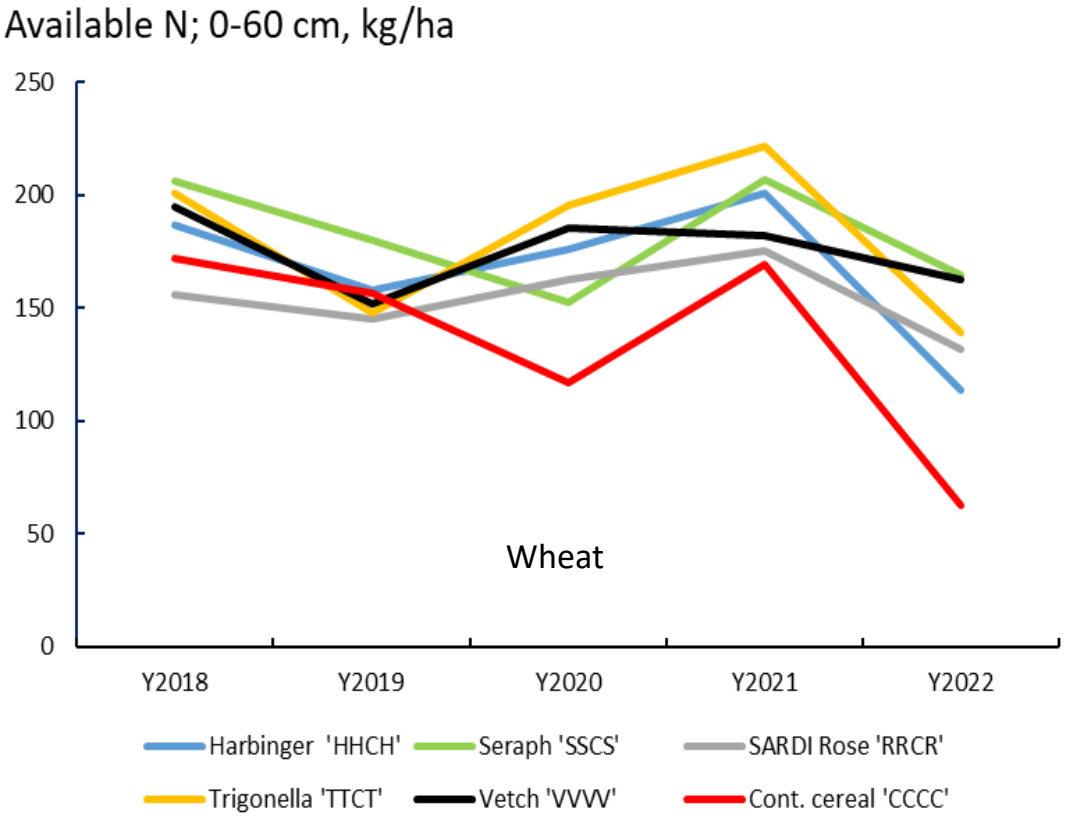
meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Feed quality of legume and cereal forages

	Metabolisable energy (MJ ME/kg DM)	Crude protein (%)	Dry matter digestibility (%)
Young cereal	> 12	> 25	> 80
Vetch hay	8.0 – 11.0	12.0 – 20.0	60 - 70
Field pea hay	5.1 - 12.5	4.5 – 23.1	38 - 82
Medic hay	7.8 - 9.7	14.0 - 24.0	58 - 71
Lucerne hay	9.0	> 19.0	>65
Cereal hay	7.5 – 9.0	6.0 – 12.0	55 - 75
Field pea straw	6.0 – 7.0	< 5.0	35 - 50
Cereal straw	5.0 – 9.5	< 4.0	35 - 50

Legume pastures benefit crops



Available soil N under different rotations

Minnipa Ag. Centre

N levels ranged from

62 kg N/ha in the continuous cereal treatment to

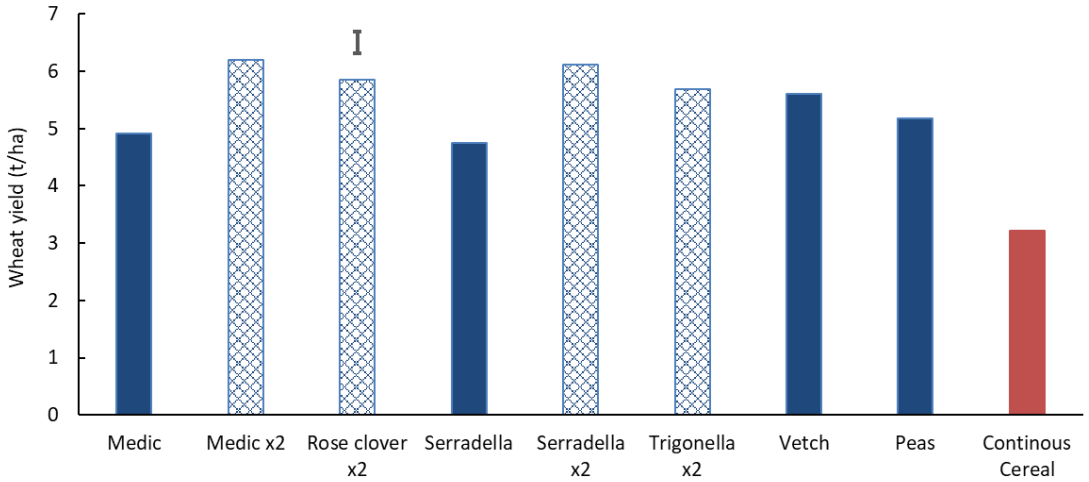
164 kg N/ha in Seraph medic and vetch treatments.

(SARDI Minnipa)

MEAT & LIVESTOCK AUSTRALIA

Legume pastures benefit crops

Lameroo, 2020



(Flohr and Llewellyn, CSIRO)

Across trials, after 1-year pasture:

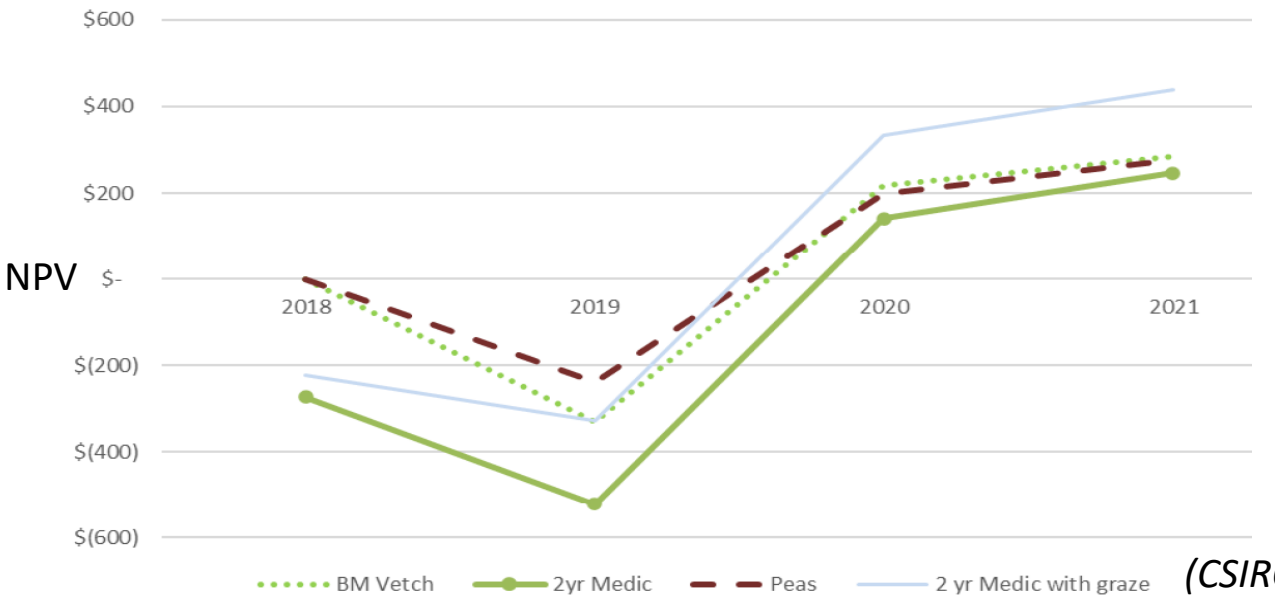
- Ave increase in soil N was 36 kg N/ha
- Ave yield increase was +0.65 t/ha (24-34%) compared to continuous cereal
- Grain protein increased by 0.7%
- In a good year, much larger benefits measured

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Legume pastures benefit whole farm profitability

ROI from legume phases ($/ha cumulative discounted cashflow) relative to continuous cereal sequence, Lameroo



(CSIRO)

Similar returns (NPV) from medic after 4 years, but seedbank also established

Even without grazing the value of benefits to subsequent cereal yield exceeded the costs of establishment phase

If modest grazing value in medic establishment years is assumed Y1 $50/ha, Y2 $150

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Legume pastures benefit whole farm profitability

Nitrogen long term simulation modelling (APSIM)

- Can ↓fertiliser N required to maintain a target N bank for cereal over the long term
- Grain legumes contribute 14-38 kg N/ha, while brown manure legumes 18-70 kg N/ha (DLPS trials measured 35-41 kg N/ha)
- ↑ intensity of grain legumes ↓cereal yield due to greater N exports and water use, while brown manure conserved water and ↑ grain yield

Whole-farm scale analysis (MIDAS)

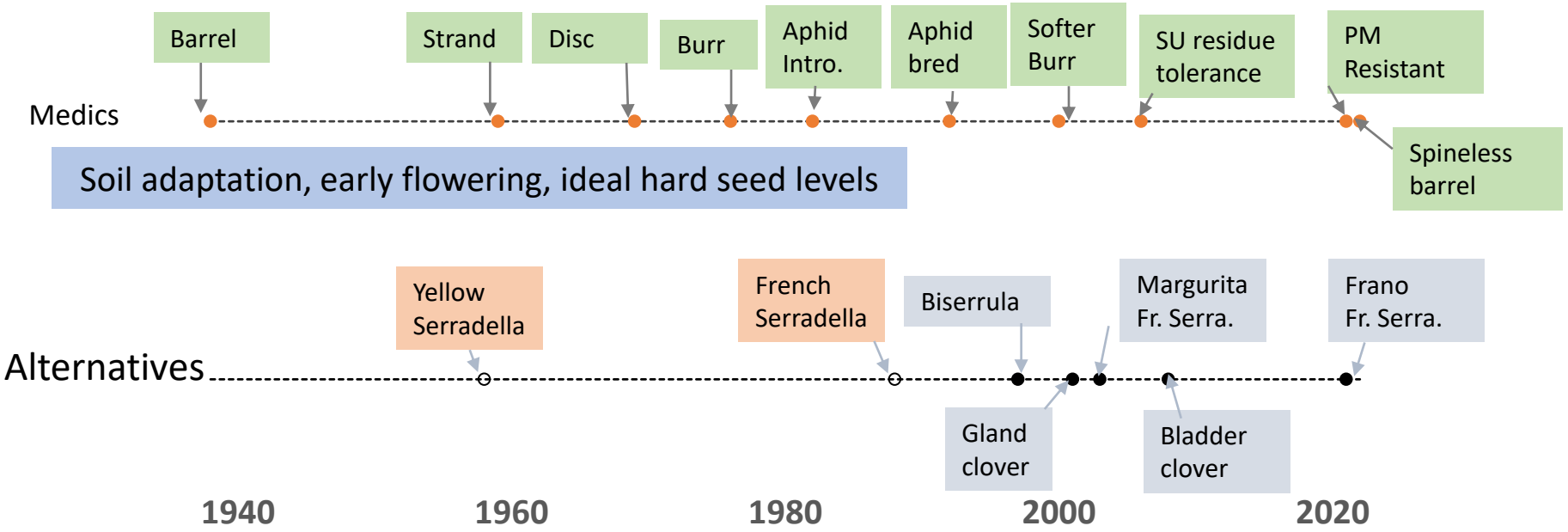
- Adding baseline medic led to ↑profit > 20% compared to continuous cropping
- Improving with Seraph strand medic and lifting sward legume content to 70% has potential to ↑ whole-farm profit by a further 26%
- Forage-only vetch lead to only slightly less profit
- Bladder clover showing some potential with higher digestibility (quality) attributes

Typical ley pastures need to:

- Have high levels of hard seed, regenerate after 1-3 years of crops
- Germinate on opening rains
- Provide high quality feed to livestock
- Benefit following crops
- Low cost and reduce economic risk

Ewes and lambs on medic, SARDI, Minnipa

Timeline of pasture development



meatup FORUM

(*D. Peck, SARDI*)

mla MEAT & LIVESTOCK AUSTRALIA

Legume pasture options

Traditional pastures (vacuum harvested seed)

Annual medics [Seraph]

(strand, disc, barrel, spinless burr)

Alternative pastures (aerial harvested seed)

French serradella (Margurita, Frano)

Rose clover (SARDI Rose)

Bladder clover (Bartolo)

Trigonella (APG5045)

Biserrula (Casbah)

Gland clover (Prima)

Arrowleaf clover (Cefalu)

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

DLPS trial locations

Trial (blue markers) and demonstration (red markers) sites in South Australia and Victoria.

Typically
Low rainfall
Dune-swale system

Alkaline topsoils and subsoils
or
Deep neutral sands

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Traits important to legume success

1. Seed and seedling vigour
2. Seasonal herbage production and N fixation
3. Time of flowering
4. Seed production
5. Suitable to livestock
6. Suitable to common soil constraints
7. Suitable hardseed level
8. Tolerance to pests and diseases

What environment are they being bred for?

Rainfall
- How much
- When

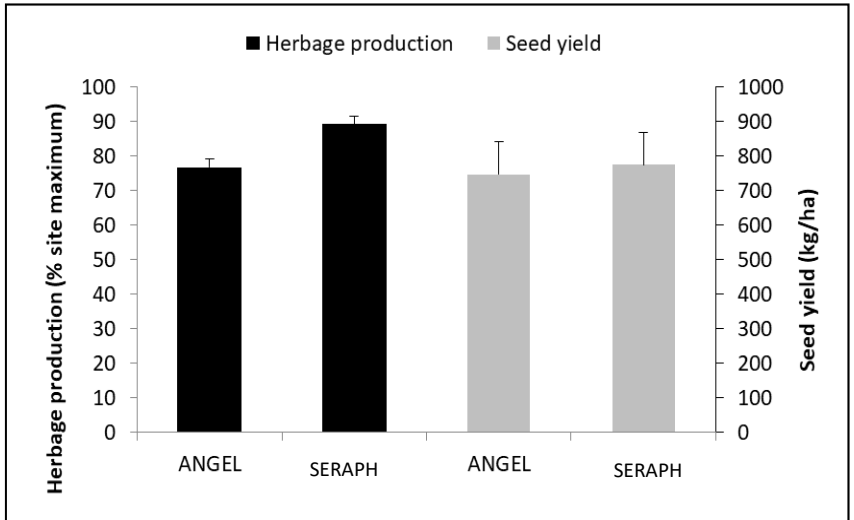
Soil type
- pH
- Texture

Failure to pass one or more of the above = poor performance

Seraph strand medic

- Released 2021
- 15% more DM than older cultivars, without the constraints of PM or SU
- Powdery mildew resistant
- Tolerant of SU and Intervix residues
- BGA resistant

15 sites



PM can cause large losses in DM

Seraph medic, Minnipa

Benefit of overcoming a constraint

Tolerance of SU herbicide residues

tolerant susceptible

SU residues persist for 1-5 years

75% reduction in DM 2 years after SU applied

Current medic cultivars tolerant of SU residues:
Sultan-SU, Seraph,
Jester-SU, Penfield

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Suitability to different soils

Adaption to:

- Rainfall (flowering time)
- Soil type (texture, pH, drainage)
- Cropping system (hard seed level)

Species may have traits you want
(eg. ability to harvest pods and summer sow)
but if not suited to your soil type ≠ successful

Lighter sands - disc (Tornafield) and strand (Seraph) medics

Heavier loams - barrel (Penfield, Emperor) and burr (Scimitar and Cavalier spineless burr) medics

meatup FORUM

Suitability to different soils

French Serradella is not suited to
soils with high pH

If interested in new species sow test strips up and down a slope
(pH and soil texture will change)

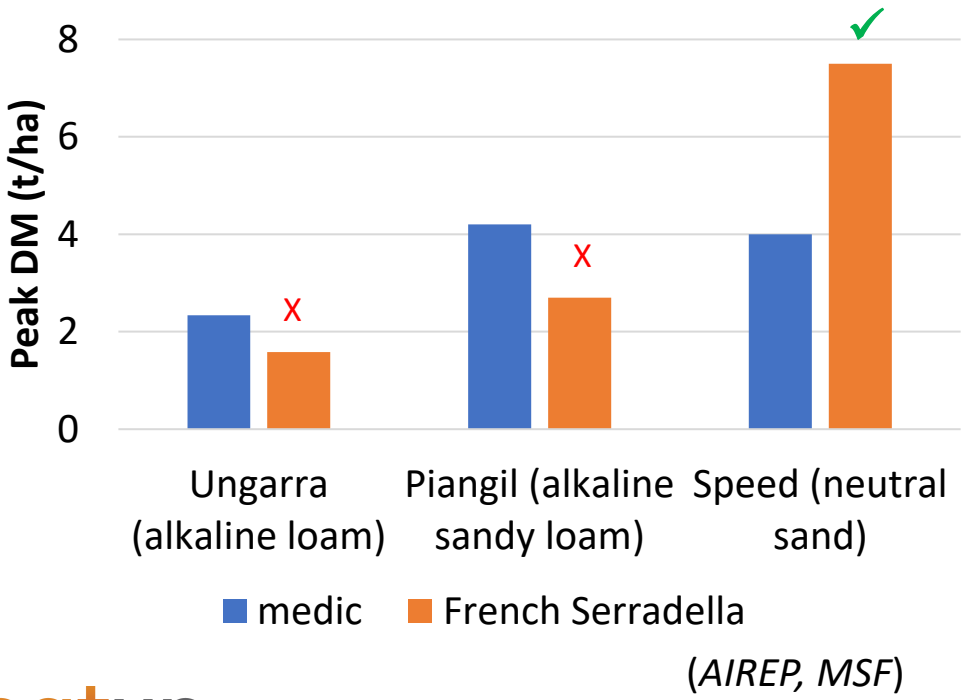
(*SARDI, Minnipa*)

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Suitability to different soils

French serradella goes well on the right soil type



(*AIREP, MSF*)

At Ungarra and Piangil, grow medic

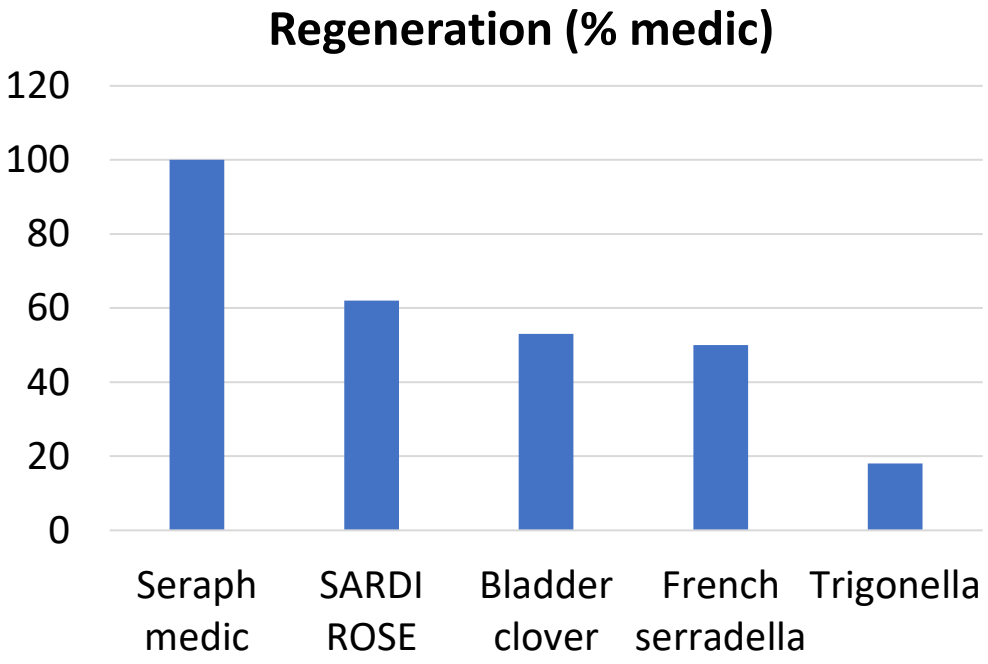
But at Speed, French serradella outperformed medic

Also seen on neutral sands in Vic southern Mallee (*BCG*)

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Regeneration after crop – consider the long term



Survival of seed through livestock:

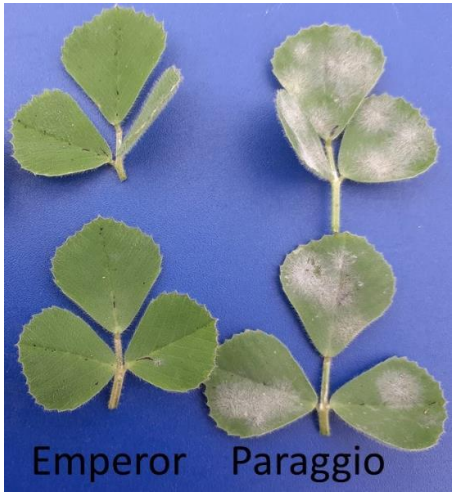
- small seeds are more likely to pass through
- larger seed of rose clover, cavalier burr medic, bladder clover had good survival
- grazing killed most of the turnip, wild radish and annual ryegrass seeds ingested

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

New medic cultivars released in 2022

Emperor barrel medic



- Mid season
- PM resistant
- Boron tolerant
- Phoma resistance

Penfield spineless barrel medic

- Early season
- SU residue tolerant
- Boron tolerant

mla MEAT & LIVESTOCK AUSTRALIA DONOR COMPANY
S&W SEED COMPANY
SARDI SOUTH AUSTRALIAN RESEARCH AND DEVELOPMENT INSTITUTE

Future releases

- **Spineless burr medic** – boron tolerance
- **Disc medic** – improved N fixation
- **Arrowleaf clover** – early flowering, increased production

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Legume species: overview of key attributes

Species	Alkaline soils	Suitable hardseed	Harvest seed/pod	Tol. SU residues	Aphid Resistance	Boron tolerant	Bud worm	Early flowering
Barrel medic								
Strand medic								
Burr medic								
French serradella								
Yellow serradella								
Bladder clover								
Biserrula								
Rose clover								
Arrowleaf clover								

(SARDI)

Annual medic

Pro's

- Best biomass production of regenerating legumes
- Two thirds biomass of vetch
  - But… if there's an early break, medic can outperform vetch
  - But… vetch sets seed in late Aug/early Sept, medic grows for longer into spring before setting seed
- Early maturity relative to other legumes
- Can be established from novel establishment (twin sowing/summer sown)

Con's

- Harvesting on farm pod/seed (but there is SAGIT research underway…)

French Serradella – Margurita/Frano

Pro's

- Excellent establishment from twin/late summer (Feb) sowing
- Excellent production on neutral – acidic sandy soils (and loams if not waterlogged)
- Seed yield and harvestability

Con's

- Moderate production on other soil types (alkaline/red loam)
- Late maturity – unreliable seed set (due to native bud worm)
- Persistence through the cropping phase

(M.Moodie)

Hardseeded French Serradella
Alternative for lupin soils

- Shared inoculant group with lupin (G/S)
- Poor persistence but seed easily harvestable
- Low sowing rate: <20 kg/ha (cf. 75-100+ kg/ha)
- Opportunity for Twin or Summer sowing on suitable soil types
- Grow Vetch/Medic or late fallow remainder of paddock
- Maintain stubbles cover on vulnerable soils
- Grazing, hay or manure

Vetch

Pro's

- Suitable for 1 year, intensive cropping systems
- Very good biomass production
- Can harvest own seed

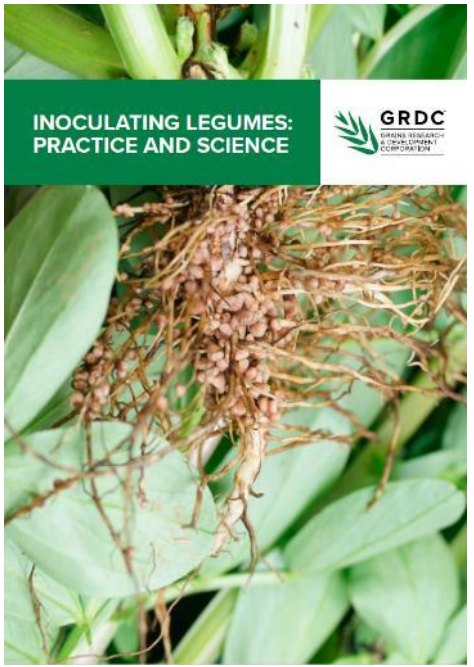
Con's

- Susceptible to RLEM, cowpea aphid, native bud worm
- Soft seed, won't regenerate (common vetch <3%)

Trigonella balansae

- Pro: Valuable feed (similar to vetch), supported good levels of sheep production
- Con: But needs better persistence to be a ley pasture

Establishment: Ensure correct rhizobia is used



Further information:
Inoculating Legumes - GRDC

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Pasture legume inoculant groups

Inoculant group	Common name of legume	Rhizobial genus	Rhizobial species
AL	**Lucerne, strand & disc medics**	Sinorhizobium	meliloti
AM	**Annual medics except above**	Sinorhizobium	medicae
B	**Perennial clovers**	Rhizobium	leguminosarum sbv. trifolii
C	**Annual clovers**	Rhizobium	leguminosarum sbv. trifolii
D	**Greater lotus**	Rhizobium	loti
E and F	**Vetch also pea, bean & lentil**	Rhizobium	leguminosarum sbv. viciae
S and G	**Serradella also lupin**	Bradyrhizobium	lupini
Biserrula	**Biserrula**	Mesorhizobium	ciceri

(R.Ballard, SARDI)

Medic and vetch are nodulated by different rhizobia groups

Serradella can be inoculated with S or G

Likelihood of inoculation response

Medics

Rhizobia common in soils with recent medic history and high pH soils. However, inoculation responses are common in SA/Vic Mallee

Soil rhizobia often less effective than inoculant rhizobia, but difficult to displace. ‘Promiscuous’ disc medics being developed

Strand medics have fewer nodules

Clovers

Rhizobia common in soils with clover history
Bladder and gland clovers still responsive to inoculation

Likelihood of inoculation response

Serradella

- Rhizobia will be absent if serradella or lupin not previously grown
- Rhizobia are tolerant of acidic soils
- Symbiosis intolerant of free lime
- Nodulation best where lupin has been grown

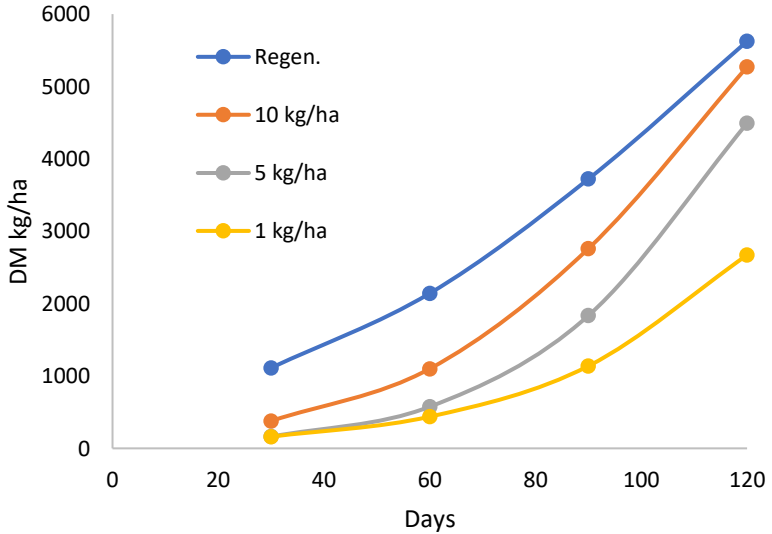
Biserrula

- Rhizobia very specific
- Rhizobia likely to be absent
- Inoculation mandatory in SA/Vic
- Use higher rates

Pasture Establishment Year

Sowing rate – autumn sowing of ‘soft’ seed

Barrel medic



5 -10 kg/ha is recommended

2 – 5 kg/ ha often used

Use higher rates if grazing is important

* 5kg seed is ~ 25% of establishment cost

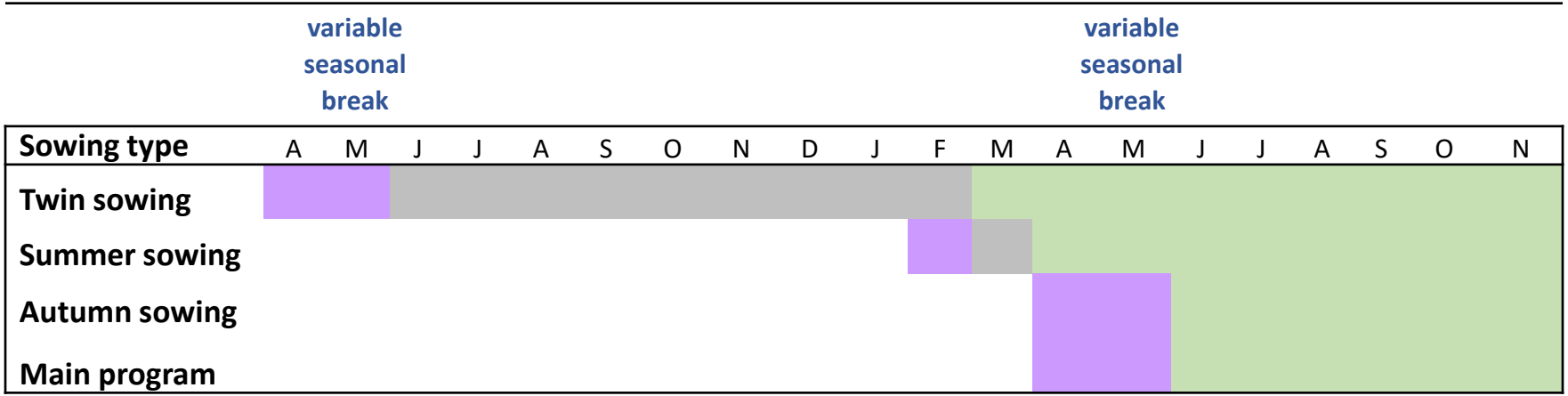
Regenerating medic pasture is equivalent to >50 kg/ha seed

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Pasture Establishment Year

Time of sowing



Widely used in WA and NSW – serradella and bladder clover (*CSIRO*)

Reliant on hard seed

Benefits: harvest seed & plant late summer, focus on crops when break comes

Provide earlier feed than autumn sowing

Higher seed set in dry springs

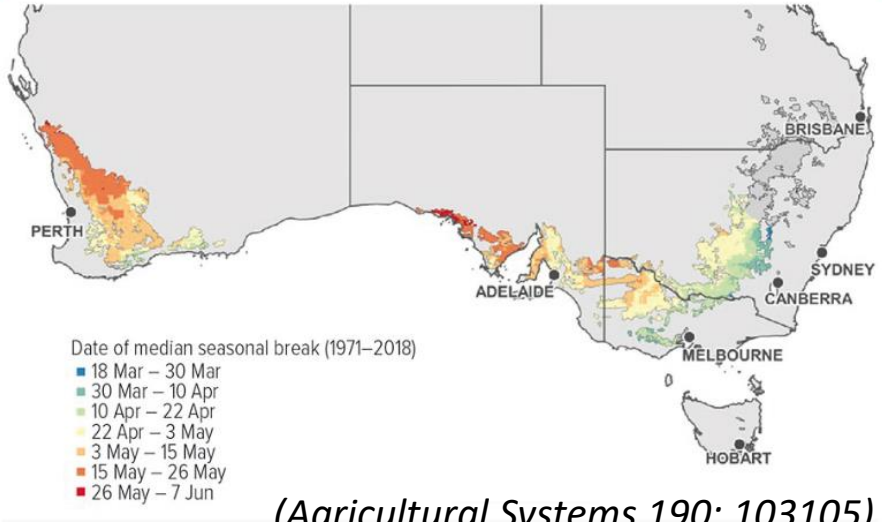
Can it be used elsewhere?

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Legume pasture sowing systems

Figure 2: Median seasonal break (1971–2018) in cropping regions throughout southern and western Australia based on the seven-day rolling sum of the rainfall to evaporation ratio.



(Agricultural Systems 190: 103105)

Location	State	Median	25-75th percentile range (days)	Median 7-day rain sum (mm)
Piangil	Vic	1 May	56	23
Lameroo	SA	11 May	40	21
Waikerie	SA	7 May	37	21
Roseworthy	SA	1 May	39	27
Minnipa	SA	24 May	37	22

Sowing opportunity = sum of 7-day rainfall > sum of 7-day evaporation between 1 March and 30 July

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Legume pasture sowing systems

Summer sowing needs higher sowing rates – basic maths

Seed pods are less than 50% seed and rates of 'softening' vary

Species	Percent seed in pod	Percent softening	Target soft seed kg/ha	Pods required (kg/ha)
French serradella*	50	60	5	17
	50	60	10	33
Medic**	33	20	5	75
	33	20	10	150

(D. Peck, SARDI)

Sowing depth

Sow shallow <3cm
(1cm safer due to infill)

Vetch can be sown >3cm,
but will ↓ biomass >5cm deep

*French serradella and bladder clover softening is inhibited by light. Sow pods at 1-2cm depth.
**Medic softening can be improved with storage.

Nutrition

- Mixed farms typically piggyback off residual P and from the last crop
- If there's been successive crops/good seasons some MAP or DAP will add P
- If crops respond to micronutrients, pastures probably will too, eg. Zn

Powdery mildew

- Lots around last year
- Summer rainfall starts it spreading, then colder months hide it. It then pops out again in spring, seen in 2021 and 2022
- Choose varieties with good PM resistance

Grazing

- Can early spring graze in first year if you sow early, bulk up, then graze before first flower. Longer grazing will reduce seed set
- Will reduce biomass, but conserves moisture for seed set

Pasture Establishment – Weed Control

- Weed control is paramount to establishment, particularly with pasture mixes
- Autumn sowing provides opportunity to control weeds
- Important to control weeds when they are small because herbicides are slow acting
- Create competition using narrower row spacing and higher sowing rates

- Group C: Bromoxinyl registered for pastures. Will damage medic, but serradella less so
- Group I: Buttress registered for medic & serradella, some damage expected
- Group B's: All registered with medic & serradella. Broadstrike favoured for medic, Spinnaker for serradella

meatup FORUM

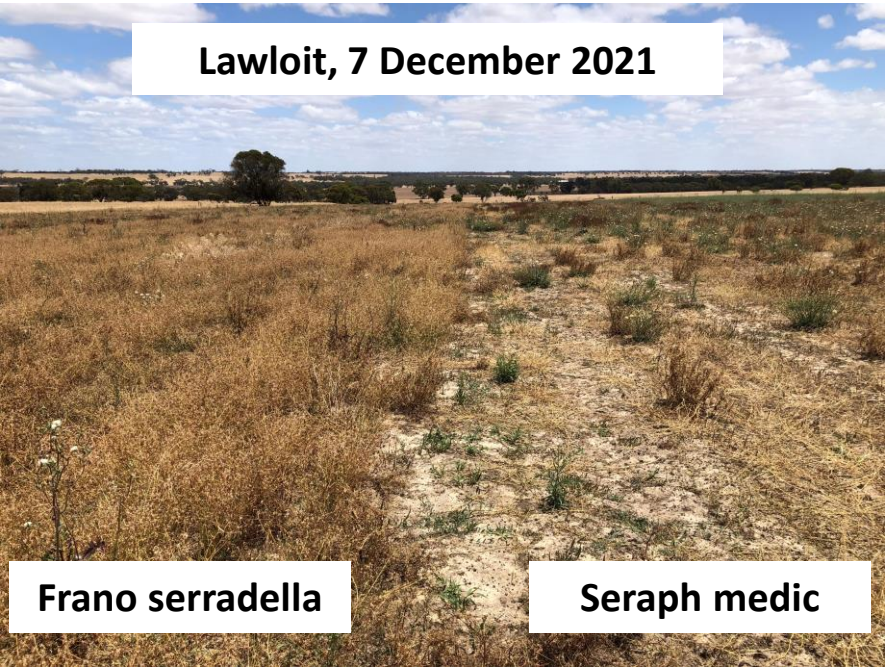
mla MEAT & LIVESTOCK AUSTRALIA

Legume pasture sowing systems

- Summer and twin sowing works best with an early break
- In SA/Vic trials summer sowing worked well for some species, but results differed across sites/environments (but not always well adapted)
- Autumn sowing was most reliable for all species (Medic can be SS, but no adv)

- Weeds: twin sowing > summer sowing > autumn sowing
- Seed depth and furrow infill is a risk – twin sowing not recommended until addressed
- Seasonal break timing is a limitation for adoption of novel sowing methods, but there is still a benefit of sowing outside the main sowing program (earlier)

Harvesting seed



Aerial seeded legumes

- Can be harvested with headers, eliminating the need for extra machinery (vacuum harvesters, harsh on soil)
- Low cost seed source
- Also subject to consumption

Medics

- Considered unable to be harvested
- Trialling early desiccation
- Some pods are falling off, but plants are still 50% green
- Needs higher rates of sowing
- Must be prepared to store it for 2 years

Seeds count up the heat they've had – need alternating temperatures, a silo will heat enough

(SAGIT - EPFS Summary 2021 and 2022)

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Monitoring tool: Pasture Paramedic

Decision-making tool that allows rapid assessment of pasture condition and identify requirements for renovation or rejuvenation

meatup FORUM

mla MEAT & LIVESTOCK AUSTRALIA

Take home messages

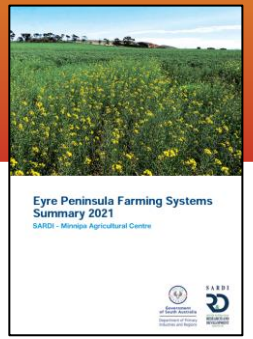
- First year main goal is to achieve **high seedset** – using **earlier sowing** and **higher seeding rate** will allow light grazing up to first flowers

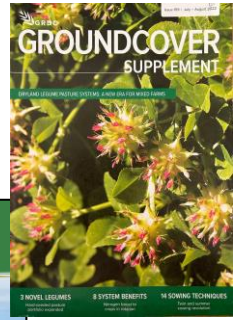
- Consider if sowing alternative pasture legumes have a role to play on your farm – read up on varieties offering **higher production** and **adaptive traits** suited to your farm **soils and rainfall – trial on small areas**

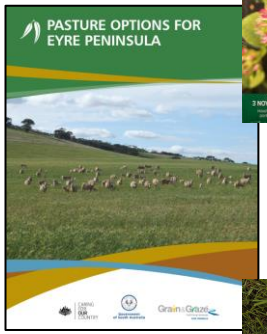
- Use the **Pasture Paramedic** tool for quick paddock assessment of legume pastures, and to help decide best management actions for rejuvenation or renovation.

Tools and resources

- Eyre Peninsula Farming Systems Summaries
  - EP Grain & Graze and Dryland Legume Pasture System trials
- GRDC website, Groundcover supplement Issue 159
  - Research and farmer experiences from DLPS across Aus
- Pasture Options for Eyre Peninsula
  - Grain & Graze 2
- Pasture paramedic
  - Pasture condition assessment and decision-making tool







meatup FORUM

mla
MEAT & LIVESTOCK AUSTRALIA