Department of Primary Industries and Regional Development

GOVERNMENT OF WESTERN AUSTRALIA

Protect
Grow
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Alternative legume pastures: how they benefit WA cropping and what's on the horizon

Murdoch University

LEGUME RHIZOBIUM SCIENCES

Department of Primary Industries and Regional Development

Legumes in Australian agriculture

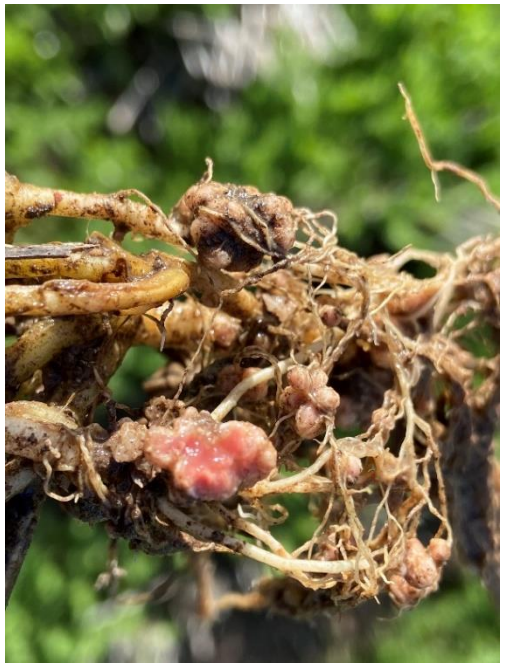
More than a century ago J. L. Thompson (1895) described benefits of legumes

- improved soil conditions of deep-rooted and ‘air feeding crops’
- improved weed control and productivity of following cereal crops
- improved management (diseases, insects, livestock and spread of economic risk)

A challenge to successfully integrate into Farming System

- growing legumes has declined
- cropping with reliance on synthetic N and pesticides,
- moving away from livestock and growing **“canola”.**

With the increase of the cost of carbon-based fossil fuels …. will we see more legumes grown?



Legumes: Challenging growing conditions

"High proportion of soils which are not conducive to successful legume farming"

These soils are characterised by;

- low organic matter
- low clay
- Low mineral fertility
- Low soil pH

Changing Environment

- Less annual rainfall
- Increasing temperatures

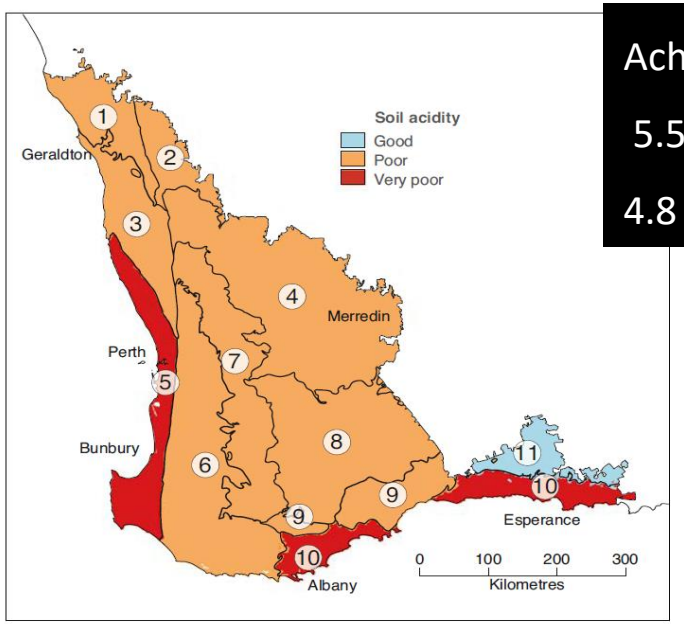


Figure 2.1.1 Resource condition summary for soil acidity.

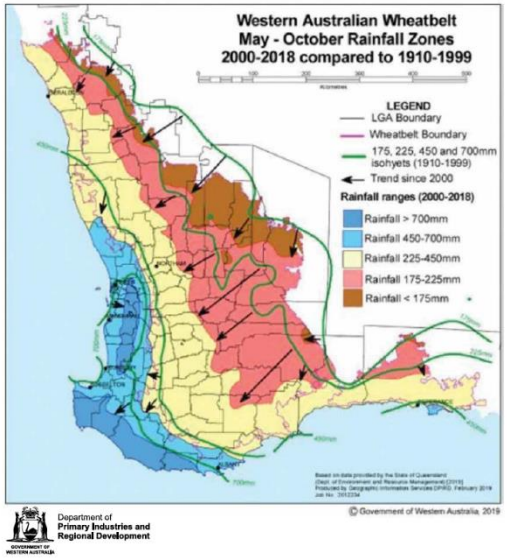
Achieving Targets of

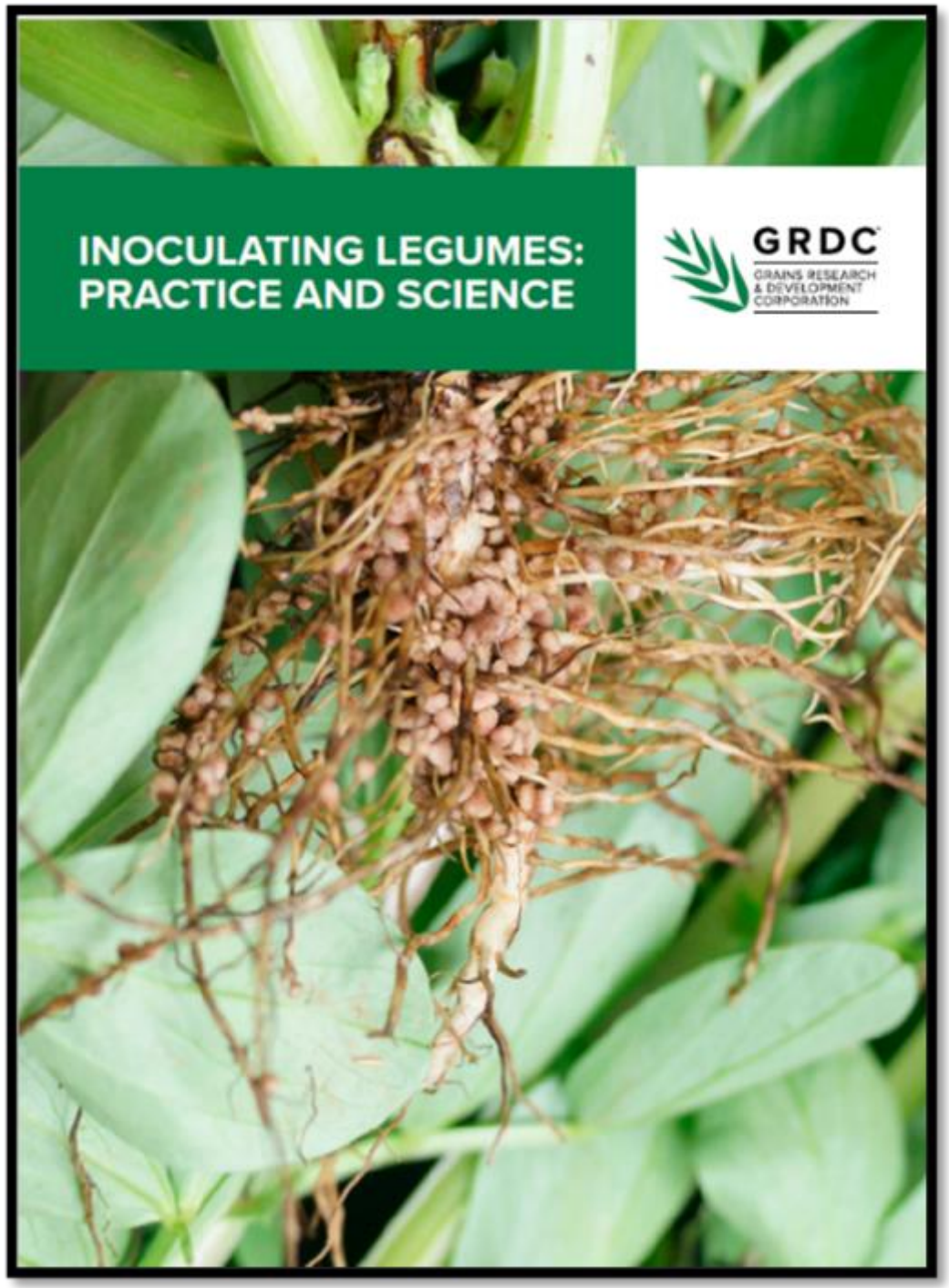
5.5 (0–10 cm) $pHCaCl_2$

4.8 (10–30 cm) pHCaCl2

Report card on sustainable natural resource use in agriculture, DPIRD 2013

FIGURE 10 Western Australian Wheatbelt May-October Rainfall Zones 2000-2018 compared to 1910-1999





However, we have been successful through science (breeding/rhizobiology) and adoption

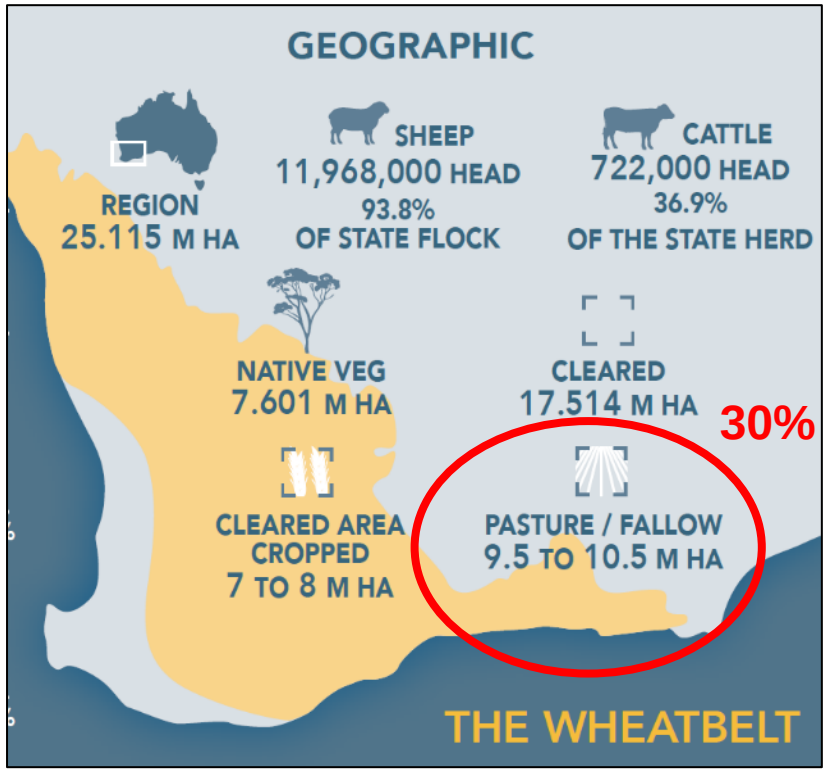
Growing legumes can be difficult but there is plenty of information

Total amount of N fixed is estimated at 3.5 million tonnes, value for the industry of **$3.5 billion**

What about pasture legumes WA?

Herridge (2022)

Pasture Legumes WA



Farming Systems Research and Development in WA
(Ryan, Ewing and Roberts 2020)

Estimated annual N fixed by legume pastures WA

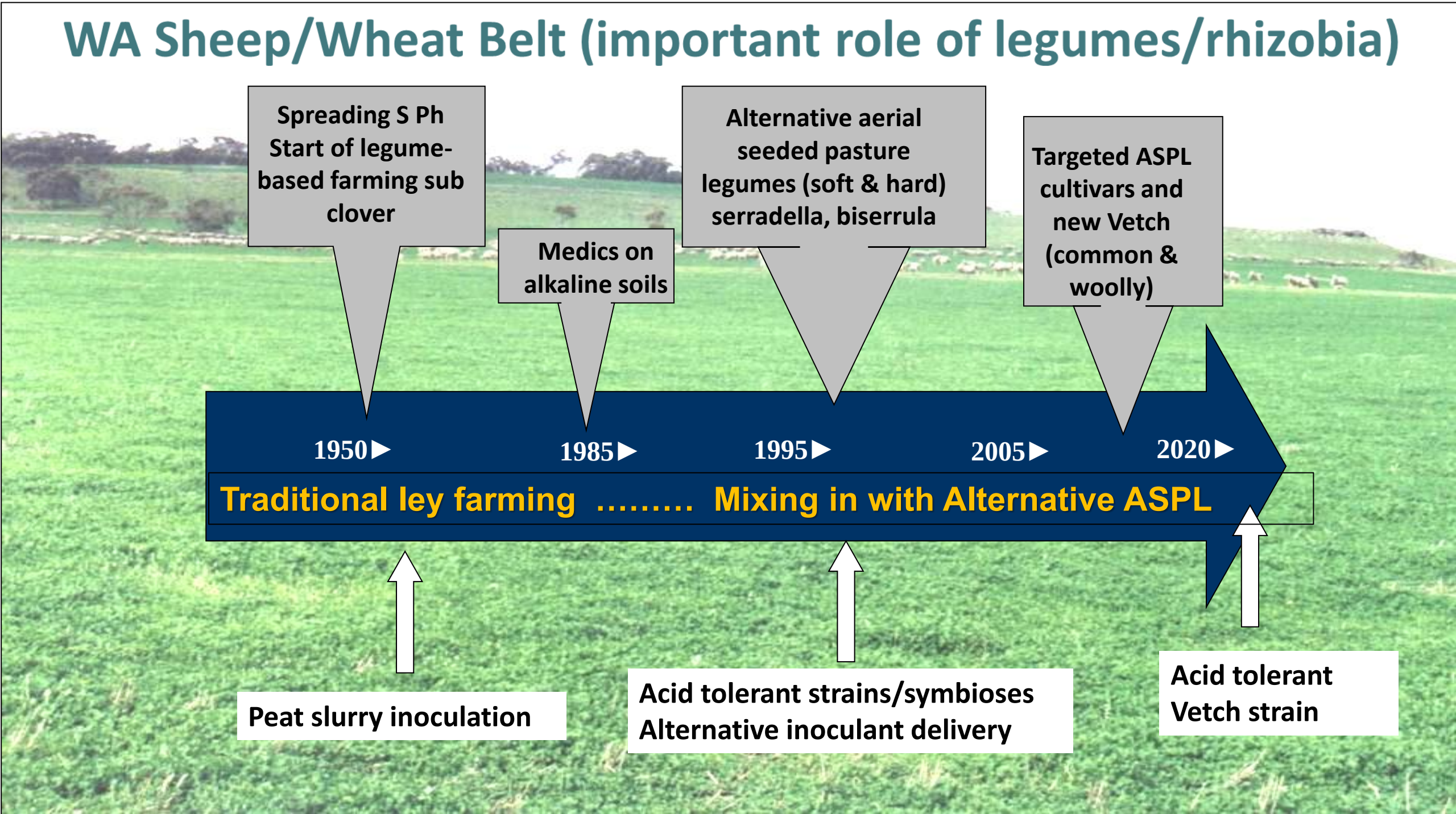
sub, medics, clovers, serradella, biserrula, vetch, etc

Content	Low legume	Medium legume	High legume	Total
Estimated N Fix	10kg N/ha/yr	50kg N/ha/yr	100kg N/ha/yr	
Pasture M ha	2	0.8	0.5	3.3
N Fix (t N/ha/yr)	20,000	40,000	50,000	110,000
Price Aus$ M	$20 M	$40 M	$50 M	**$110 M**

Urea $1000/t

Nitrogen contribution of $110 M

WA Sheep/Wheat Belt (important role of legumes/rhizobia)



Some reasons for this transition to ASPL?

Quinlivan and Francis (1976)

"lack of farmer confidence in sub clover in WA due to poor persistence through drought and susceptibility to pests and disease"

- seed banks diminishing (Subs & Medics)
- more intensive cropping
- "false breaks" low levels of hard seed
- accumulation of diseases and pests
- use of herbicides (residues)
- relying on specialised harvesting
- increasing seed costs and lower availability

Burr burial

Pod drop

Adoption New Alternative Pasture Legumes

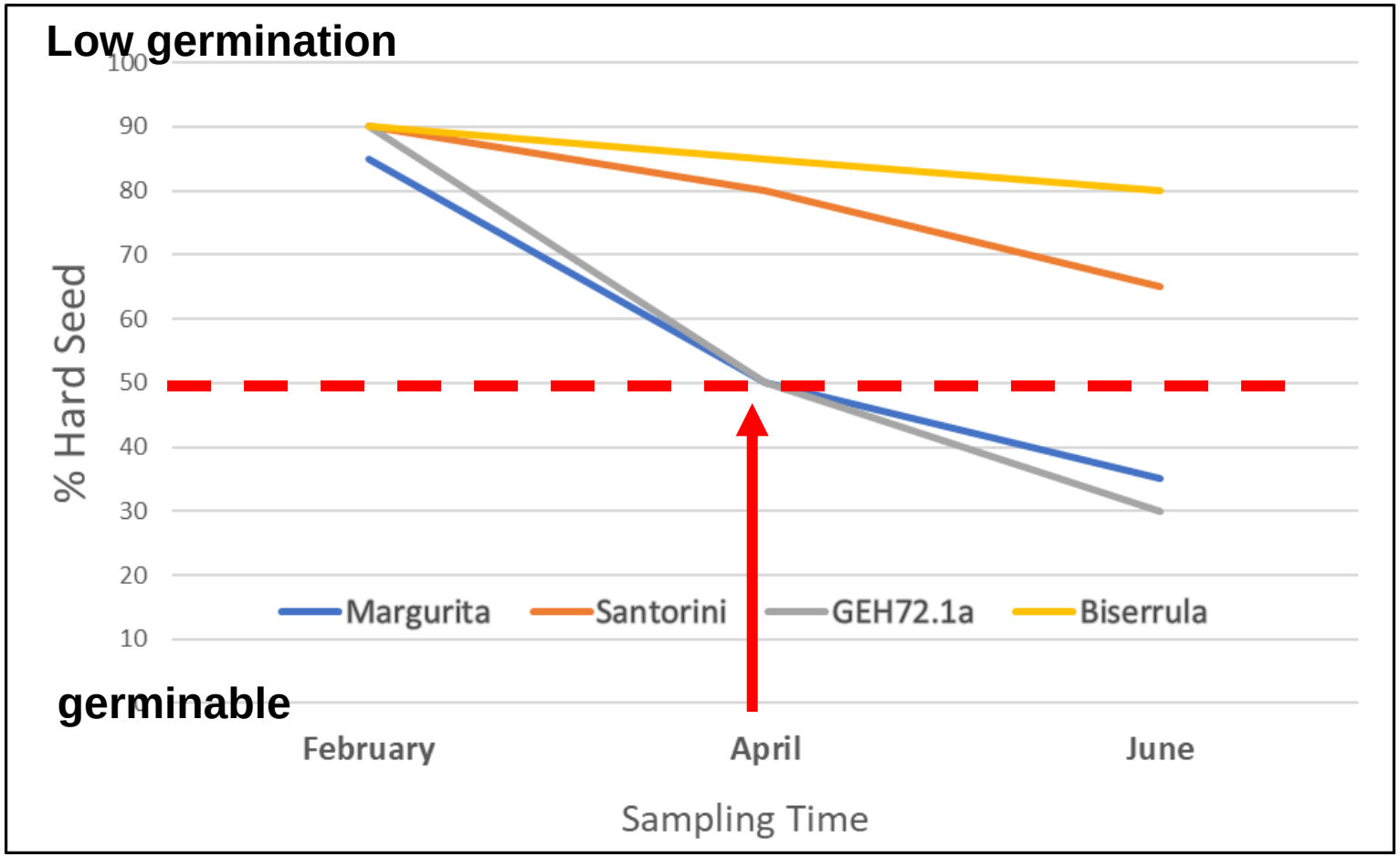
Aerial seeding/pod retentive cultivars that could be harvested and processed - **“On Farm”**

Other desired attributes

- Deep rooted (longer growing)
- Tolerance to pest and diseases
- Tolerance to soil pH extremes (plant and rnb)
- Tolerance to grazing and small seed (escape digestion)
- Range of low and high hardseed breakdown

Summer Sowing

- Seed can be readily harvested on-farm (pod retentive)
- Doesn't require additional processing – stored in Silo
- Sub/medic is compromised
- sown into dry soil at higher rates (late summer)
- possesses suitable natural hard seed dormancy break-down



(Nutt et al., 2021 & Howieson et al., 2021)

Where to next with HSL's

- Limited cultivars that are suitable that are header harvestable and for summer sowing
- opportunities to increase options throughout the **agro-ecological zones**

Dryland Legume Pasture Systems (2017-2022)

Target area 350mm below

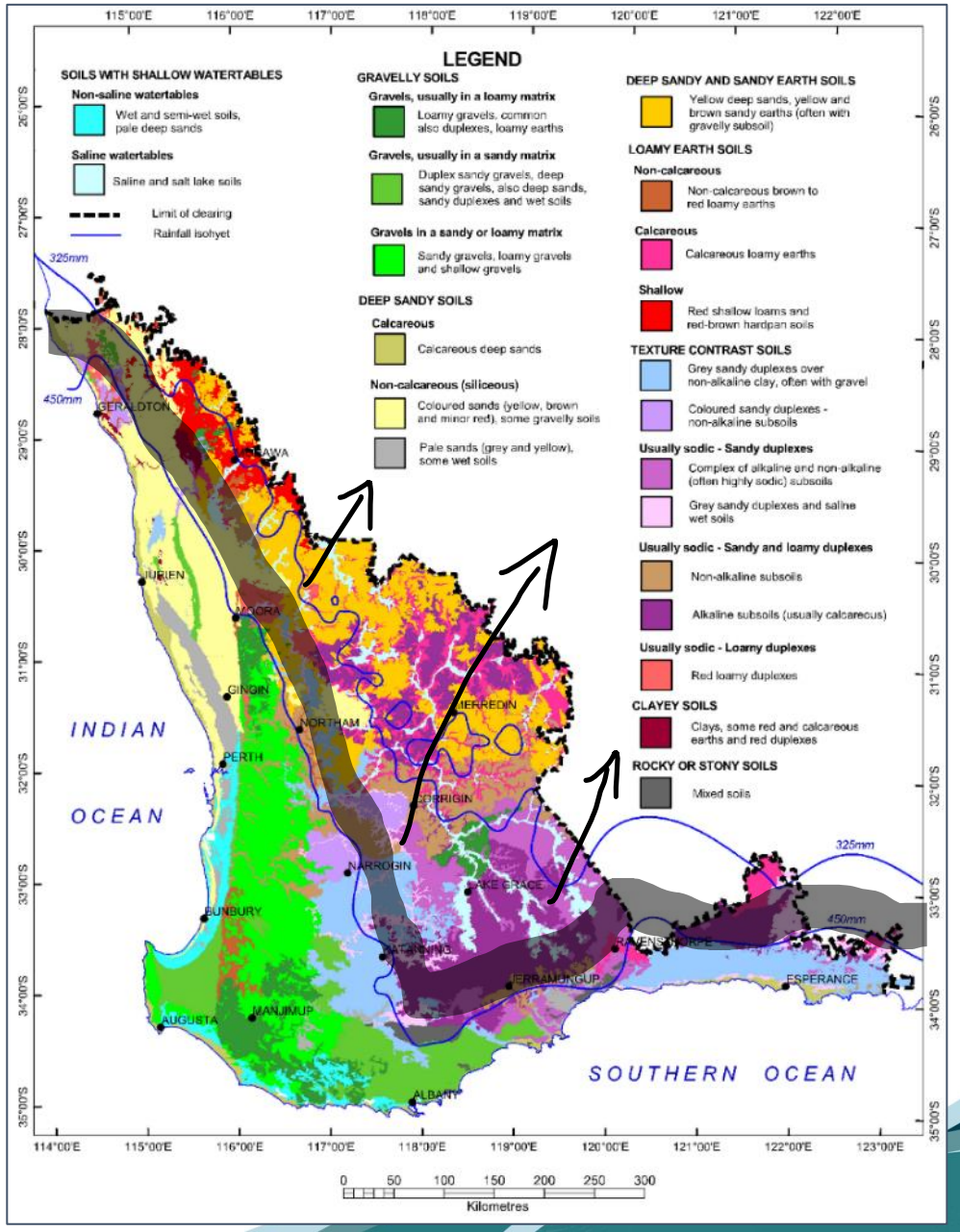
Approximately ≈ 8 M ha arable
(variable soil types but containing fine textured alkaline)

Benefits of HSLs have never been fully evaluated and minimal cultivar options

Challenge

Discover climate resilient plants

- aerial seeded and pod retentive
- deep-rooted behaviour
- shorter season (90-100 DTF)
- suitable hard seed break down profiles
  “summer sowing”



Suitable HSL's cultivars

Three HSLs cultivars developed, one commercialised and the others to follow.

1. French serradella (*Ornithopus sativus*) cv. **Fran$_2$o** for the acidic-neutral soils (sands to loam)

Bred by Dr Brad Nutt (90 days to full flowering) , estimated sowings 10K – 20K ha (2022)

Case Study (Fran$_2$o)

Clint Butler (Narembeen)
(300km east of Perth, AAR = 330mm)

Feb 2020 - 40 ha established
(grazed - seed set - harvested)

May 2021 - Wheat cv. Chief (20 units N)
3.4t – usually 60-80 units N

Mar 2022 - early rains, regeneration,
200 ewes and 190 lambs

Jul/Aug 2022 - sheep removed (peak
biomass 5 t/ha dry matter)

Nov 2022 - header harvest 0.8 t/ha pod

Fran$_2$o for mixed farms in **low and medium** rainfall areas

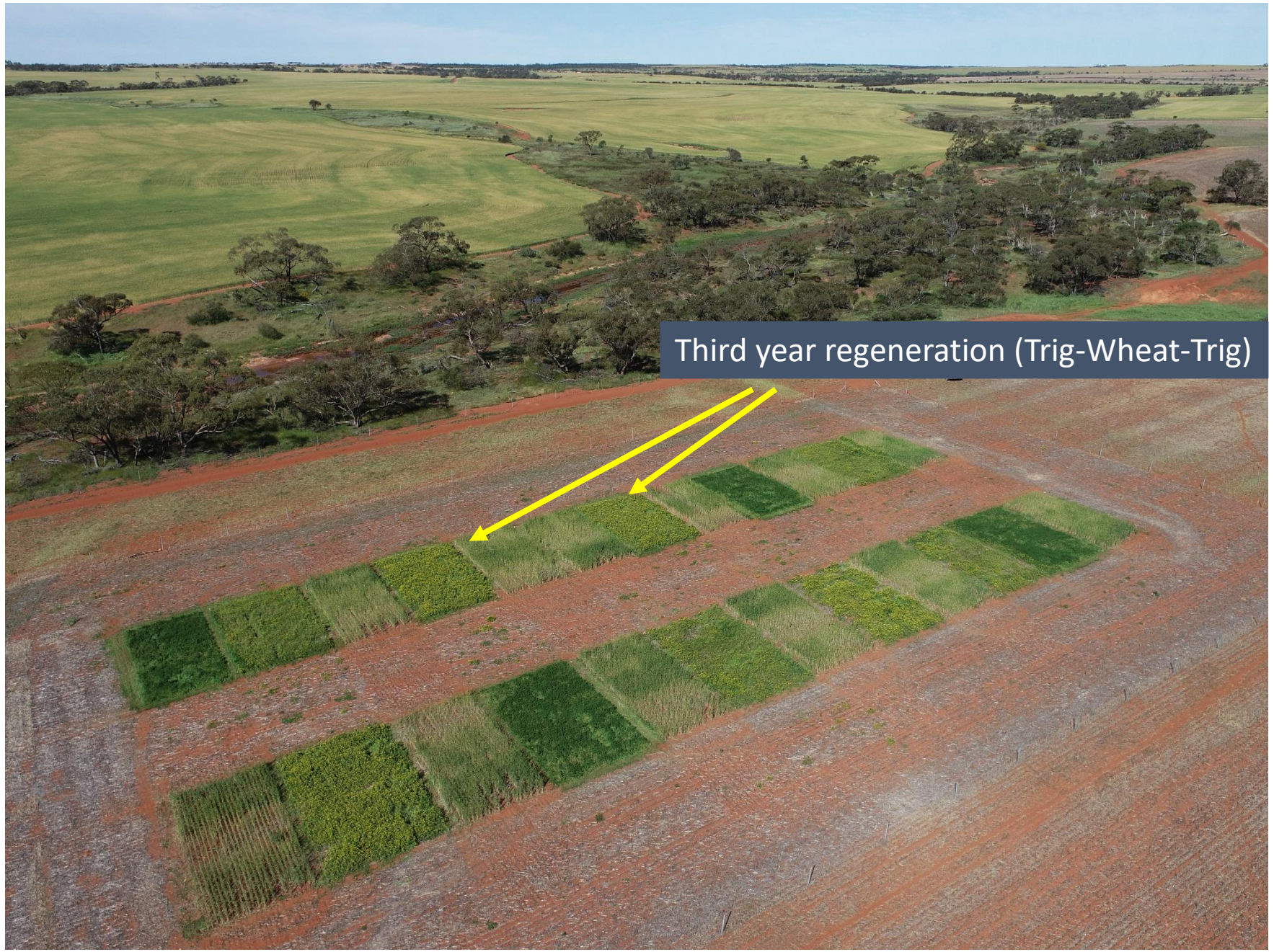
- low-cost establishment
- legumes on demand

Not released

2. Trigonella (*Trigonella balansae*) for non acidic soils (sandy loam – clays)

(76 days to full flowering) , Hard seed breakdown suited to summer sowing

Complementary to Medics



Proof of concept (farm scale)

- Header harvest
- Summer sowing
- Regeneration

September 2022, Canna

3. Bladder clover (*Trifolium spumosum*) for non acidic soils (sandy loam – clays)

(95 days to full flowering) , very high and clean seed production (hard)

combination of silo storage then summer sowing - Proof of concept (farm scale)

1st December, Nyabing

Proof of concept (farm scale)

- Air seeder (7-10ha)
- Header harvest

Summary

- Annual pasture legumes contribute significantly to WA cropping systems
- Increased N through N-fixation in the farming system (reducing inputs)
- Increased cereal proteins
- Break crop (lower pathogens, weed control, recycling of P and K)
- Reducing C footprint and adding to C sequestration
- ASPL's (hard-seed) overcome adoption barriers - low-cost pasture options seed produced "**on farm**" and "**Summer Sown**"
- provide "**legumes on demand**" - regeneration from a soil hard seed bank (flexibility) – recognising challenges with no livestock
- More **options** are needed in different agro-ecological zones

Thank you

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