Legume establishment in southern and central Queensland.

Focussed on the Brigalow Belt

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Queensland Pasture Resilience Program

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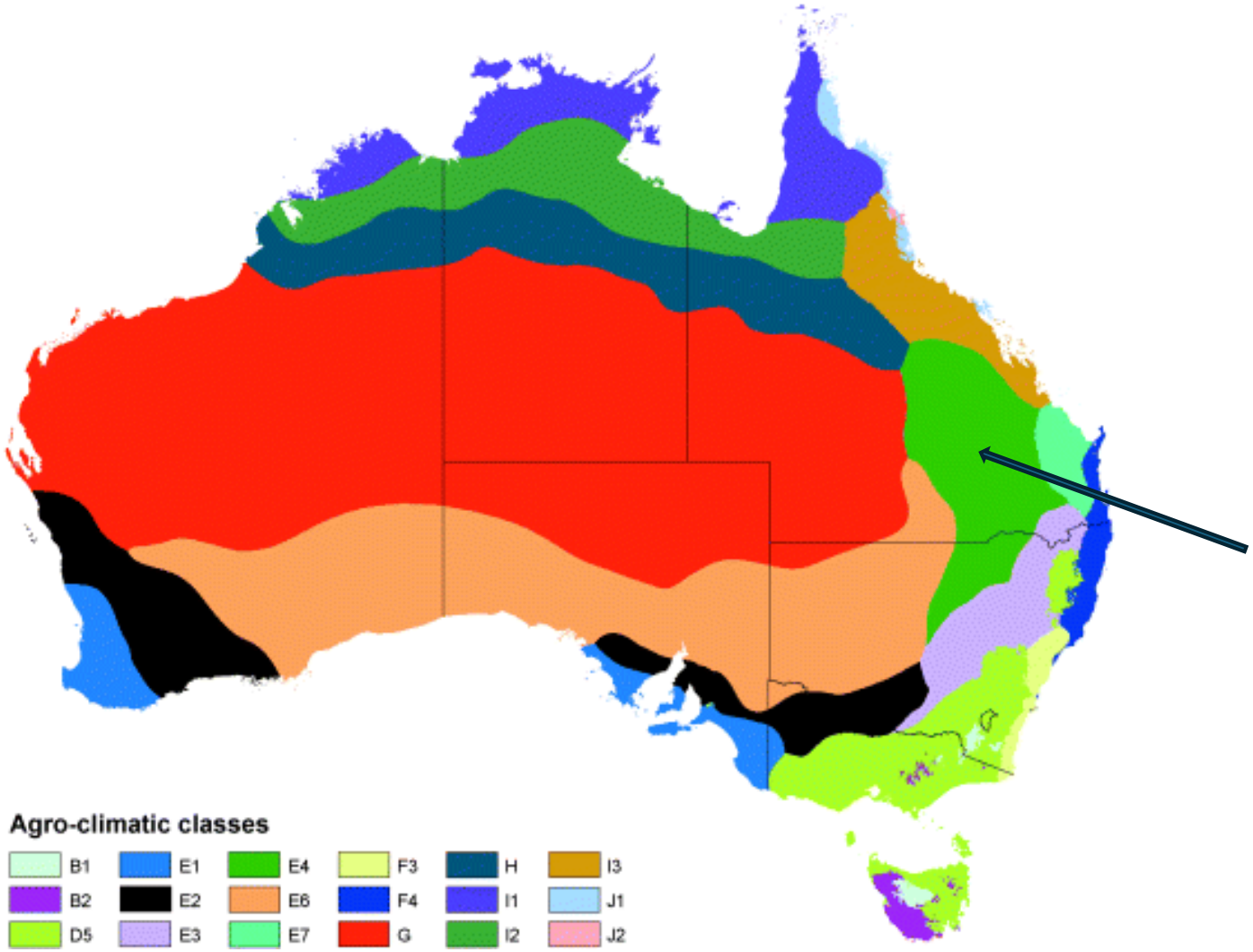
Legume establishment Part 1:



Part 1: Southern and central Qld.

Part 2: North Qld.

Southern and central Queensland:

- Focussed on the Brigalow Belt
- Principles apply elsewhere

Overview

Legume content for high production

Research results - legume establishment

- Commercial results

Brigalow belt compared to other climate zones

- Storing soil moisture is critical

Establishment in different pasture situations

Legumes - “Huge potential”

Improved animal performance LWG (diet quality)

- Stylos (in native pastures): additional 40-60 kg/head/yr
- Leucaena: additional 60-90 kg/head/yr

Nitrogen fixation and cycling

- Leads to improved grass growth and better quality
    - 40-100% in “rundown project” trials
    - 10-30% in native pastures

Higher productivity

- Up to 60-160% increase in live-weight gain per hectare
- Doubling of gross margins

Successful legume establishment?

High production needs high legume content!

Rules of thumb:

Need the paddock to *look like* about 50% legume

- **>10% of total DM** production to get an animal live-weight gain response (Orr, 2005)
- **20-50% of total DM** produced coming from the legume to maximise production
- **> 4 plants /m²** (depends on the size of individual plants of different legume species) (Orr, 2005)
- Need good plant nutrition for high production

Research results in the Brigalow Belt

Establishing legumes into competitive grass pastures

6 Agronomy trials:

- Location: Wandoan, Goondiwindi, St George
- Soils: Brigalow clay, Poplar Box (loamy soils)

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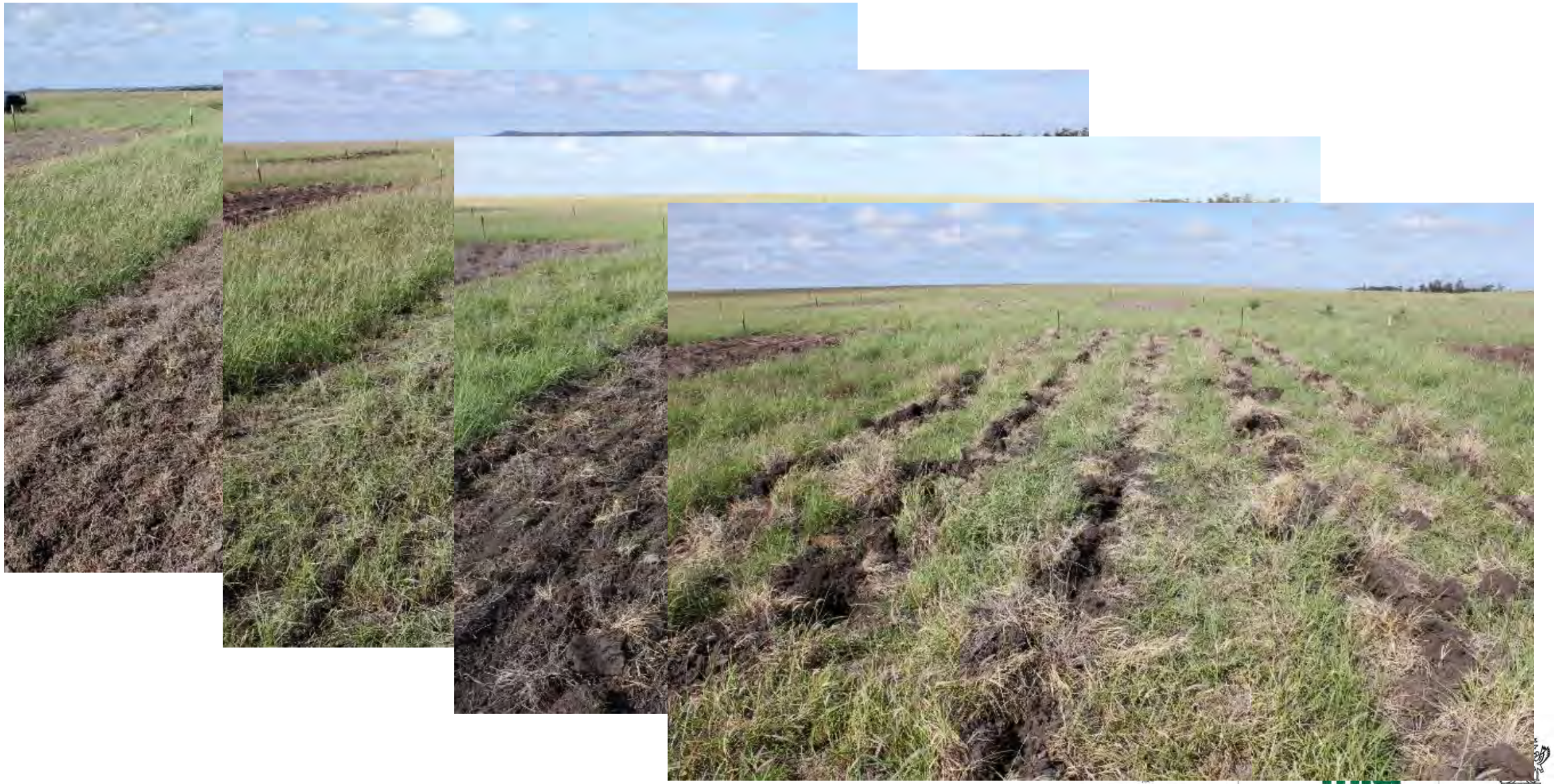
Fallowing and seed bed preparation trials

Fallow period	Seedbed treatment	Post plant weed control
No disturbance	None	Nil
Disturb at plant	Slash	Nil
	Deep rip	Nil
	Cultivate (tynes)	Nil
	Cultivate (discs)	Nil
	Spray	Nil
Short fallow (2-4 months)	Zero tillage	+/- Selective herbicide
	Cultivate	+/- Spinnaker
	Cultivate then spray	+/- Selective herbicide
Medium fallow (4-6 months)	Zero tillage	+/- Selective herbicide
	Cultivate	+/- Spinnaker
Long fallow (9-12 months)	Zero tillage	+/- Selective herbicide
	Zero tillage	Selective herbicide 2 summers
	Cultivate	+/- Spinnaker
	Cultivate	Spinnaker 2 summers

Fallowing and seed bed preparation trials



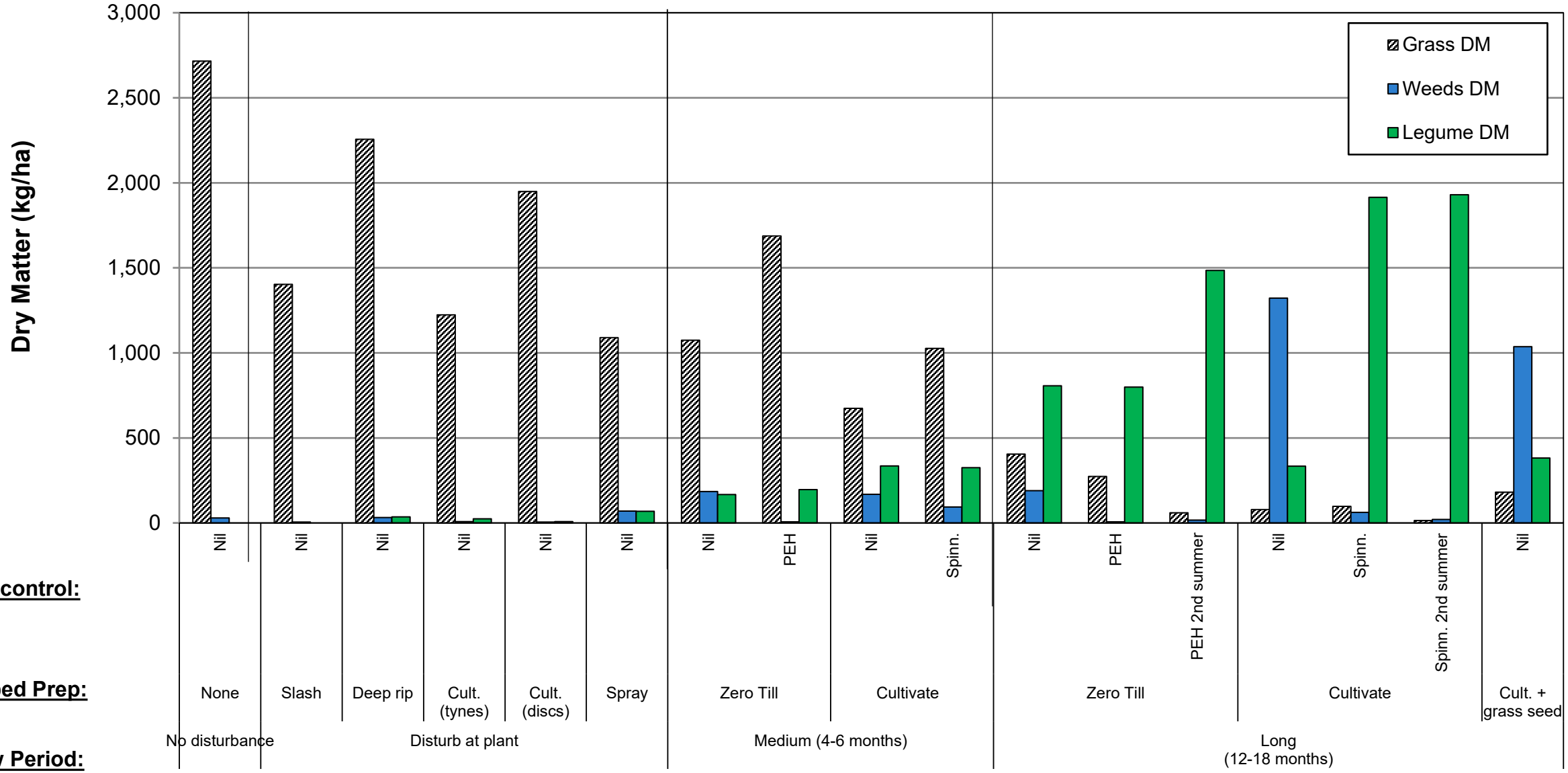

Can you spot the legume?
Single pass rip at planting

A closer look..


Same day, medium fallow plot..


Canon

Goondiwindi Clay - Legume, grass and weed dry matter (DM) at 12 months



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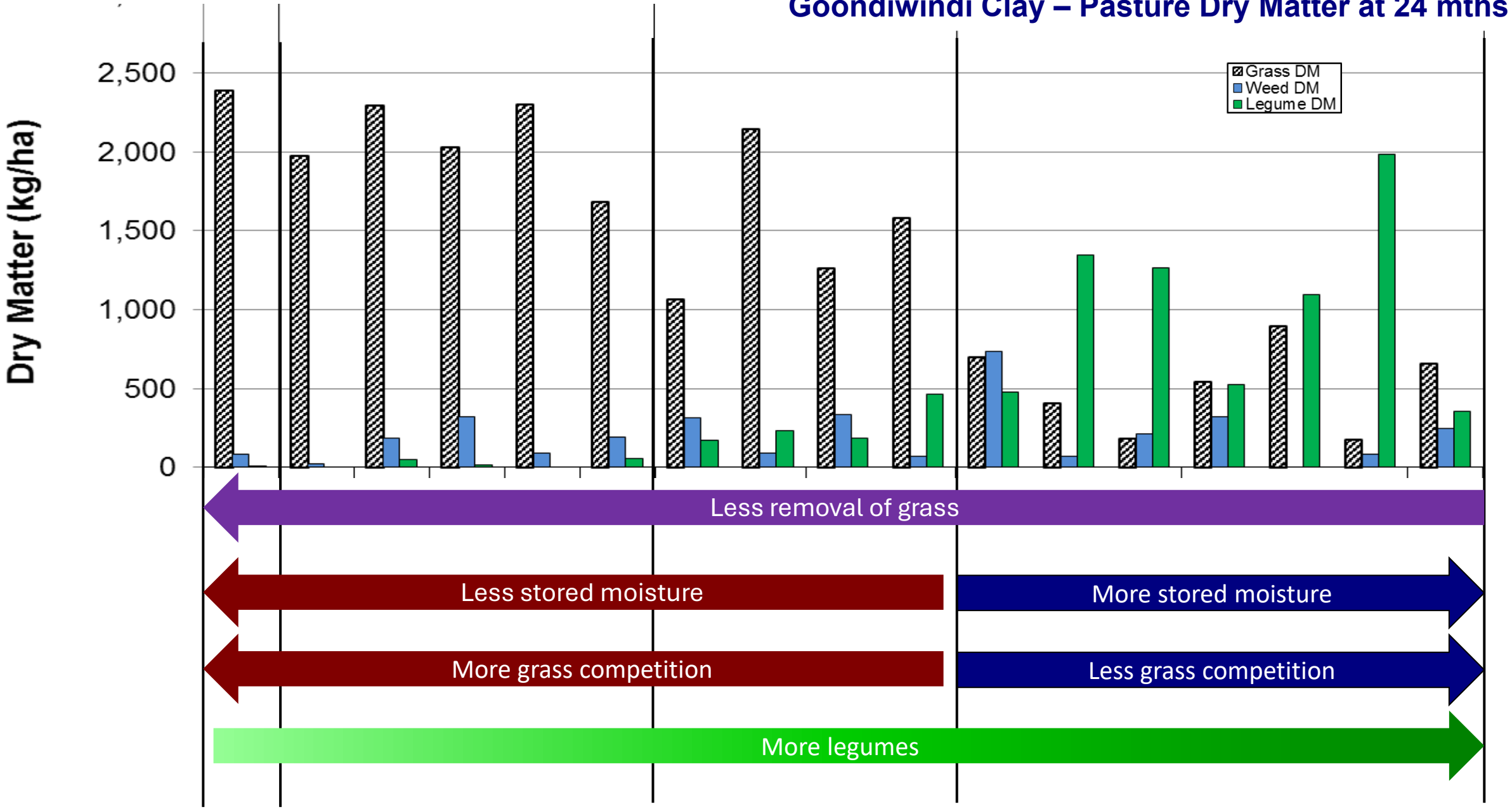
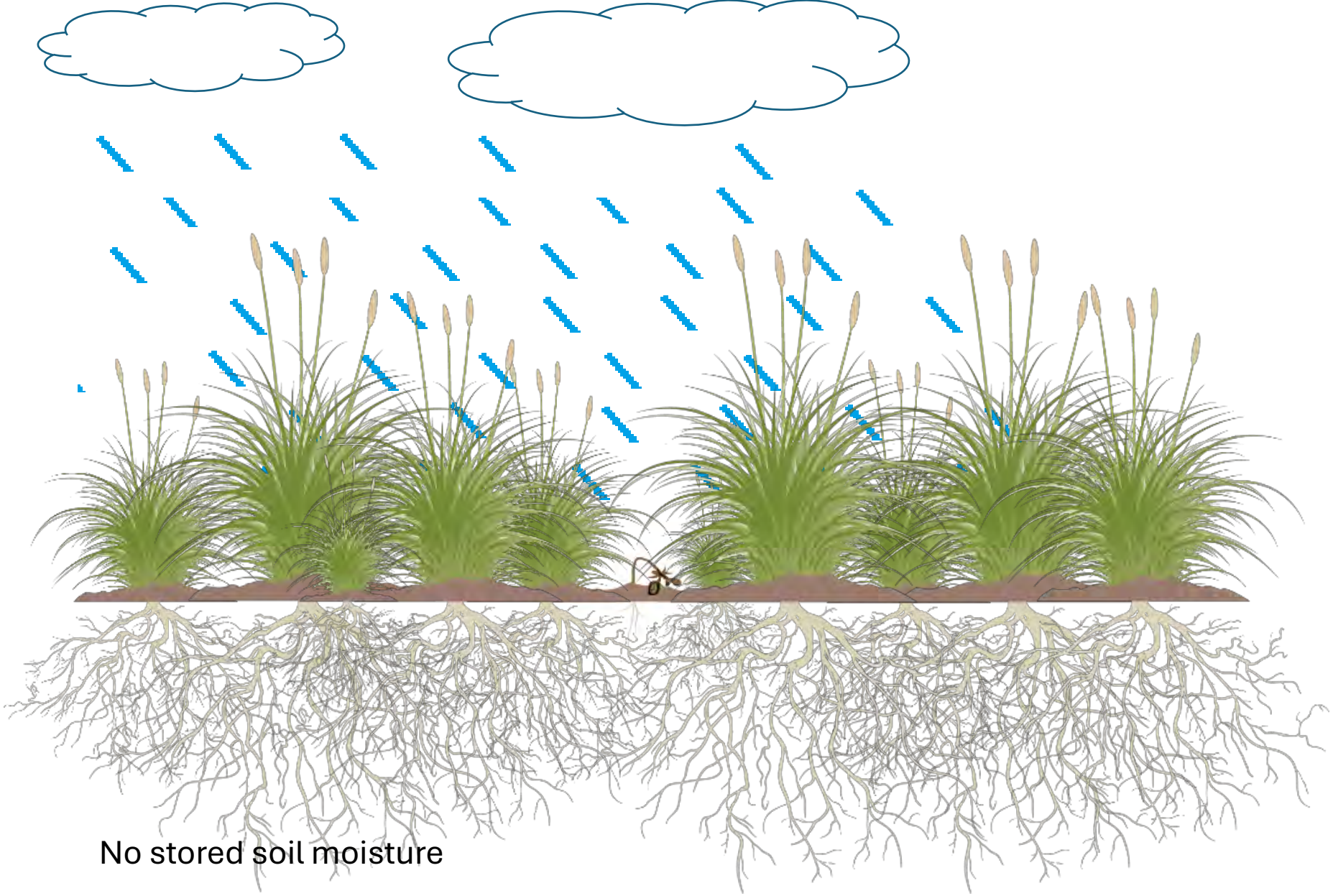
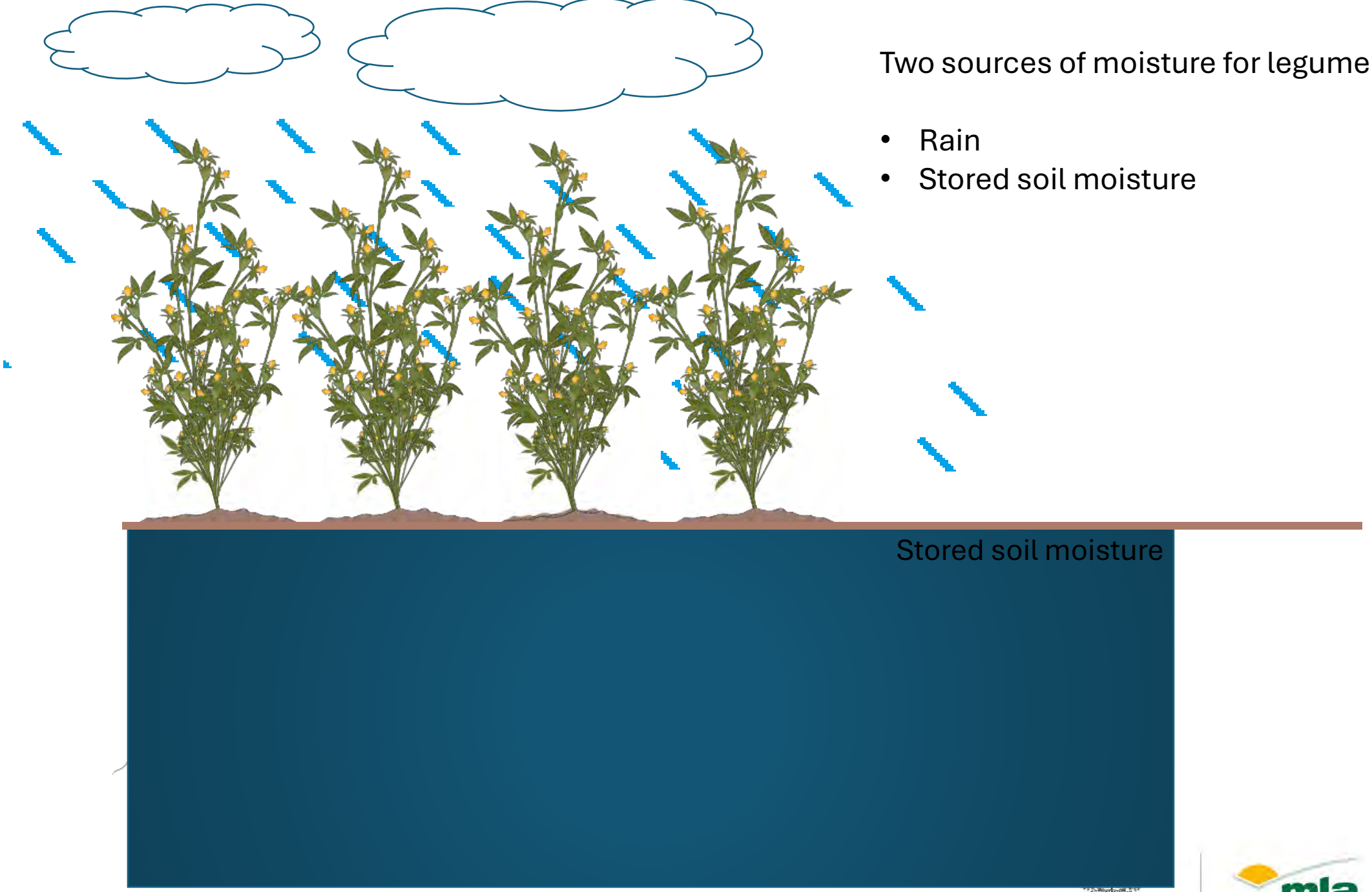
Establishment methods





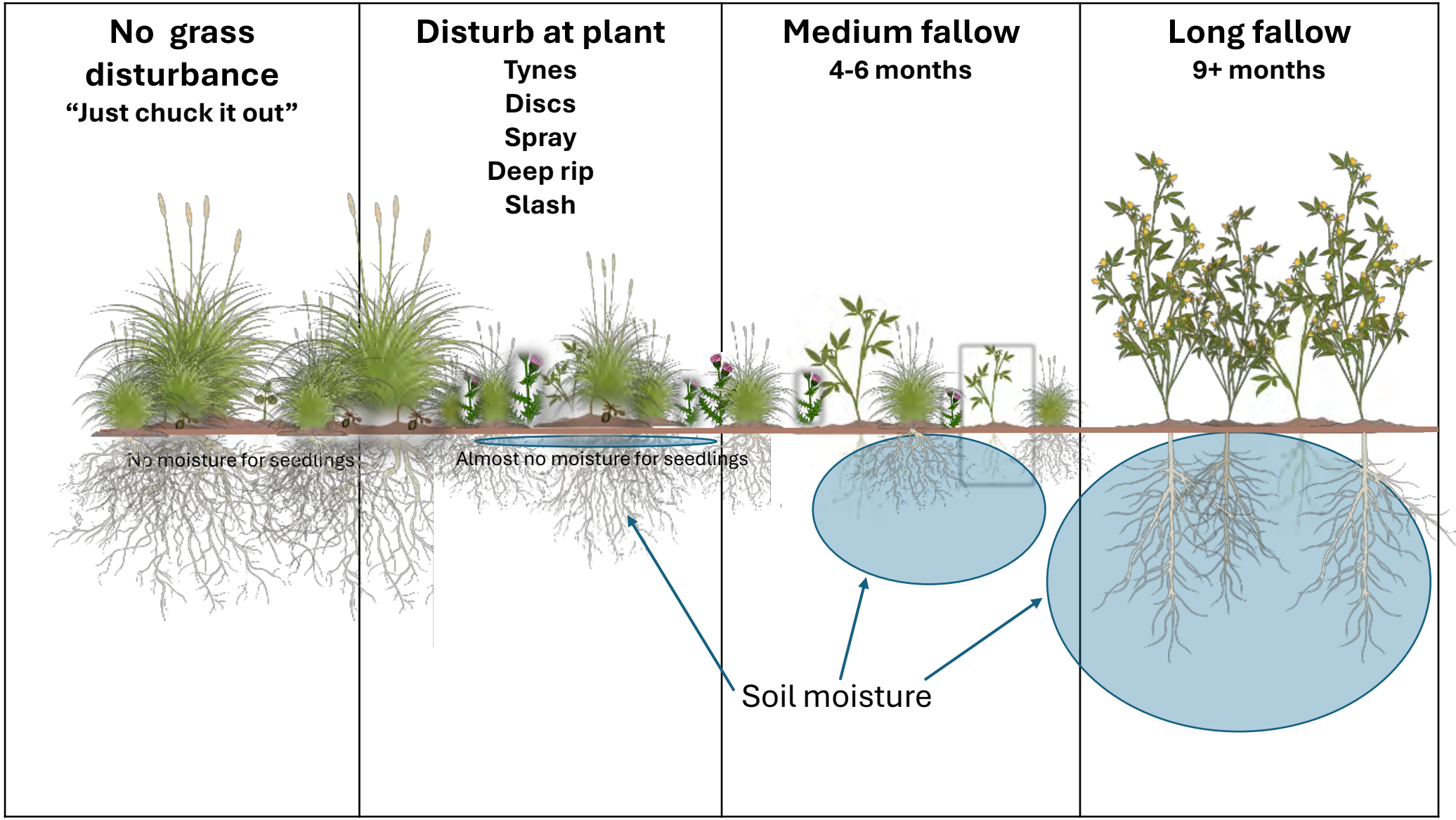
No stored soil moisture



Two sources of moisture for legume seedlings:

- Rain
- Stored soil moisture

Stored moisture is critical!



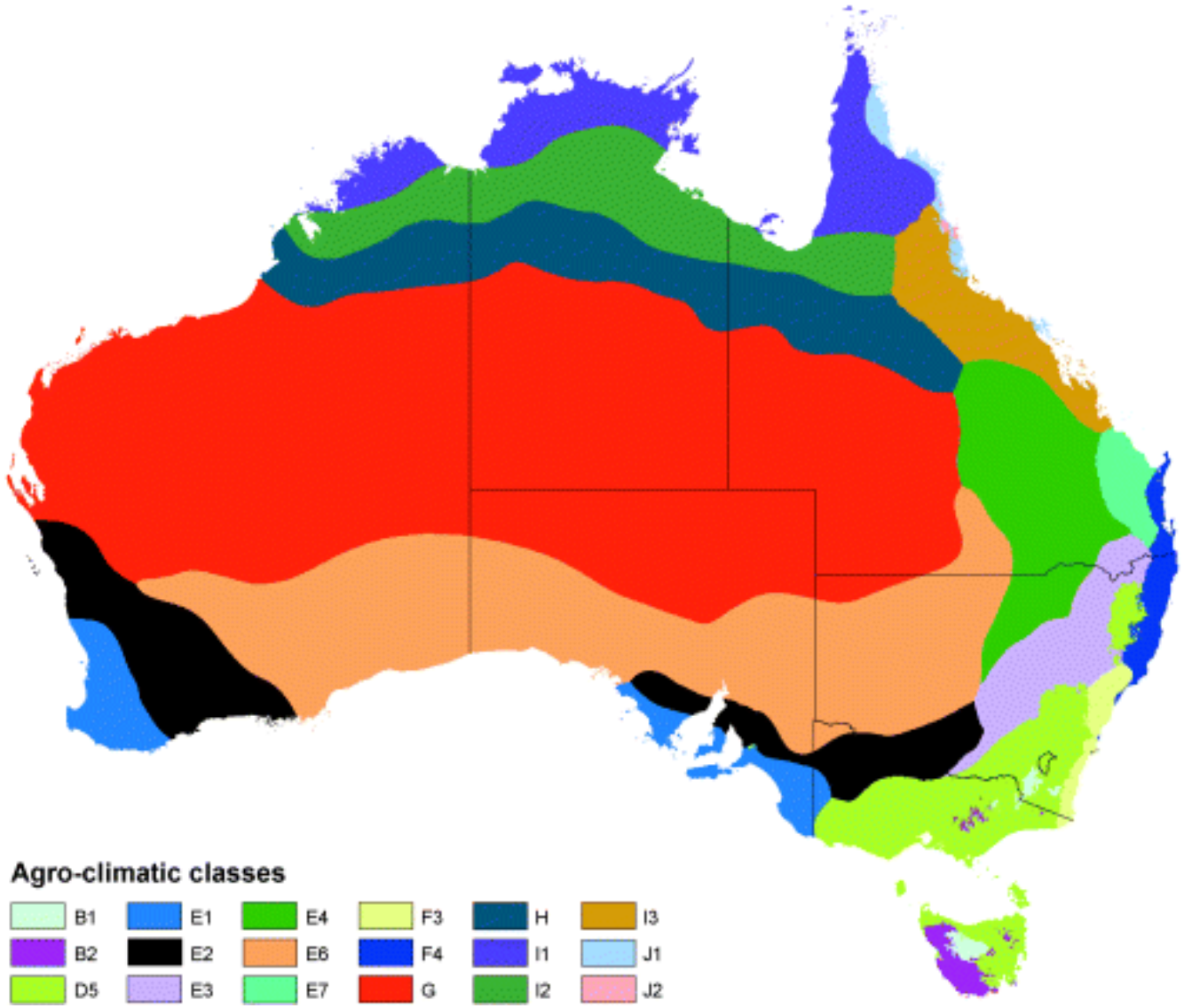
Moisture matters…

Relying only on rain, seedlings struggle to compete with deep grass roots.

Seedlings die when they run out of water...

…and the chance of enough follow-up rain *soon enough* is slim…

Brigalow Belt: Unique Climate



Code	Name
A	Very cold
B	Cold
C	Cool, dry
D	Cool, wet
E	Warm, seasonally wet/dry
F	Warm, wet
G	Warm to hot, very dry
H	Hot, dry
I	Hot, seasonally wet/dry
J	Hot, wet

Hutchinson *et al* 2005

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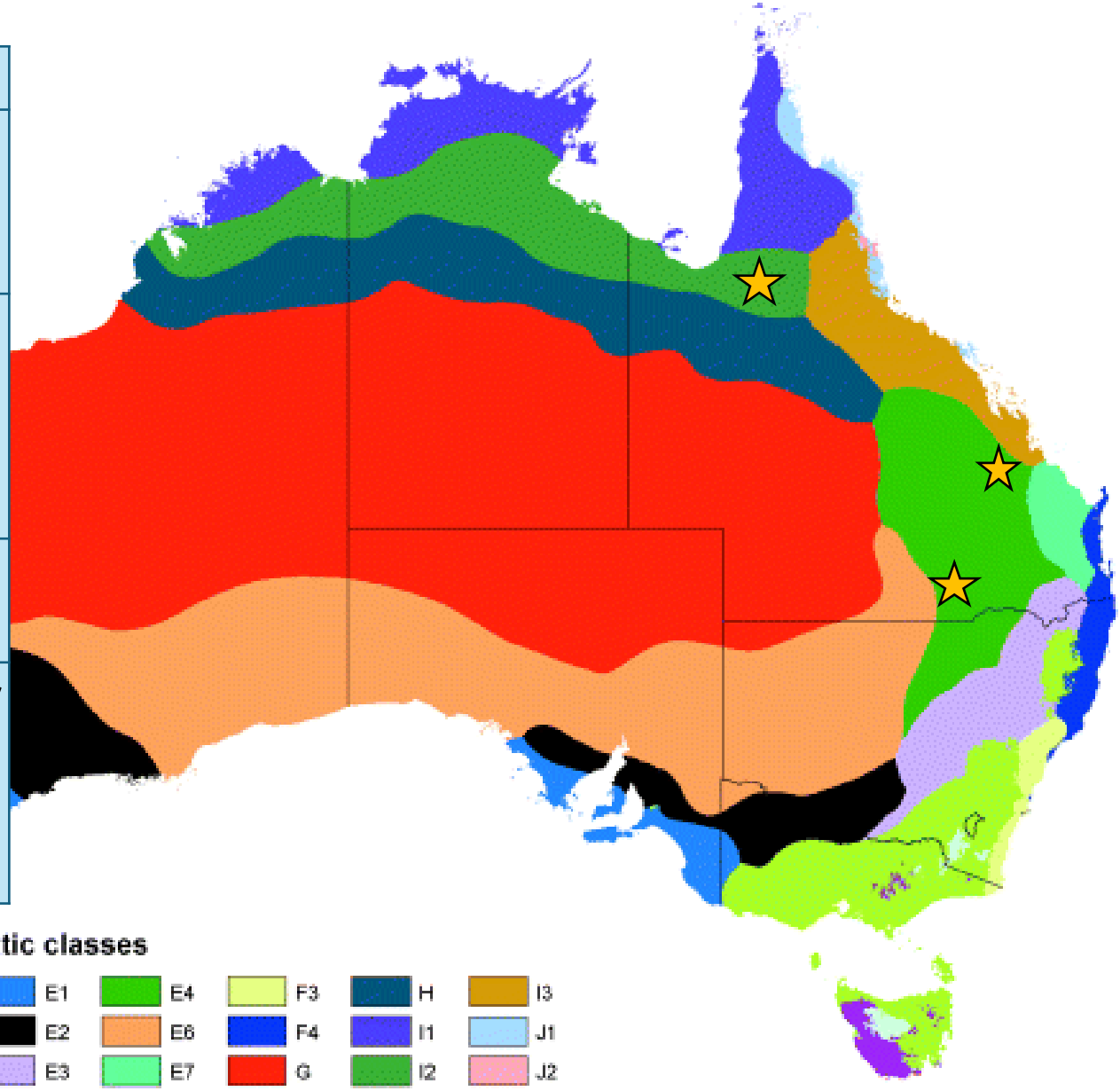
Brigalow Belt: Unique Climate

Code	Agro-climate
E3	Most plant growth in summer, although summers are moisture limiting. Temperature limits growth in winter
E4	Growth is limited by moisture rather than temperature and the winters are mild. Growth is relatively even through the year
E7	Moisture is the main limit on crop growth. Growth index lowest in spring
I3	Monsoonal. Plant growth determined by moisture availability. This has cooler winters than I1 and I2 with a growing season lasting at least six months



Hutchinson *et al* 2005

Challenging climate for sowing legumes

For summer-dominant rainfall areas

Minimum = How often (% years) do we receive minimum germination rain (25 mm / 3 days)?
Good = How often (% years) do we receive good germination rain (50 mm / 5 days)?

Normanton (FNQ)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum germination rain	96	92	83	26	5	11	3	1	4	7	45	86
Good germination rain	88	83	68	15	1	5	2	0	1	3	19	69
Banana (CQ)												
Minimum germination rain	76	72	53	30	39	41	28	19	26	56	68	77
Good germination rain	48	51	33	9	17	16	13	6	9	22	43	44

St George (SQ)												
Minimum germination rain	57	52	49	30	38	36	29	22	30	36	41	53
Good germination rain	36	33	19	12	18	11	9	6	12	12	19	26

Low risk Acceptable risk High risk Extreme risk

https://climateapp.net.au/

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3. Sowing time – planting window with stored moisture
(Summer growing)

Minimum: How often (% years) do we receive minimum germination rain (25mm/3days)?
Good: How often (% years) do we receive good germination rain (50mm/5days)?

GOONDIWINDI	Jan – Feb – Mar
Minimum germination rain	94
Good germination rain	73

MILLMERRAN	
Minimum germination rain	98
Good germination rain	87

DALBY	
Minimum germination rain	94
Good germination rain	79

Low risk Acceptable risk High risk Extreme risk

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Broadcast or drill???? Trial results

Benefits from drilling

- Loamy soils - hardsetting or crusting
- Firm surfaces – Zero Tilled fallows
- High pasture or stubble cover e.g. undisturbed pasture

Negative results from drilling

- Seed can be sown too deep - soft soils, machinery sinking
- Fluffy soils where raindrop impact fills in furrows

No real difference

- Clay soils - self mulching soils without high stubble cover
- Cultivated and/or fallowed seed-beds

3.2 Soil surface condition

“Fine but firm”

- Fluffy soil is prone to crusting, drying too quickly and hard to control depth

Ground cover

- Retains surface moisture longer
- Reduces surface temperature
- Can reduce seed to soil contact
- Impact post emergence weed control

Avoid crusting on susceptible soils

- Don’t cultivate excessively
- Ground cover (raindrop impact)
- Surface roughness

Seedlings in wheel tracks

Crusting soils - challenge

Crusting soils - challenge

Establishment method – trade offs

Cultivated or herbicide fallows (whole paddock):

Highest cost = commercially most **reliable**

No fallows (no disturbance or one pass cultivations):

Lowest cost = un-reliable

- Low legume numbers = negative returns

Strips (cultivated or herbicide):

compromise between **cost & reliability**

$$$ Economic analysis:

- Higher cost establishment is justified because of higher returns and reduced risk
- Quicker establishment generally higher overall returns (NPV)
- Fallowed strips may give higher B/C ratios than whole paddock

Most common legume establishment methods

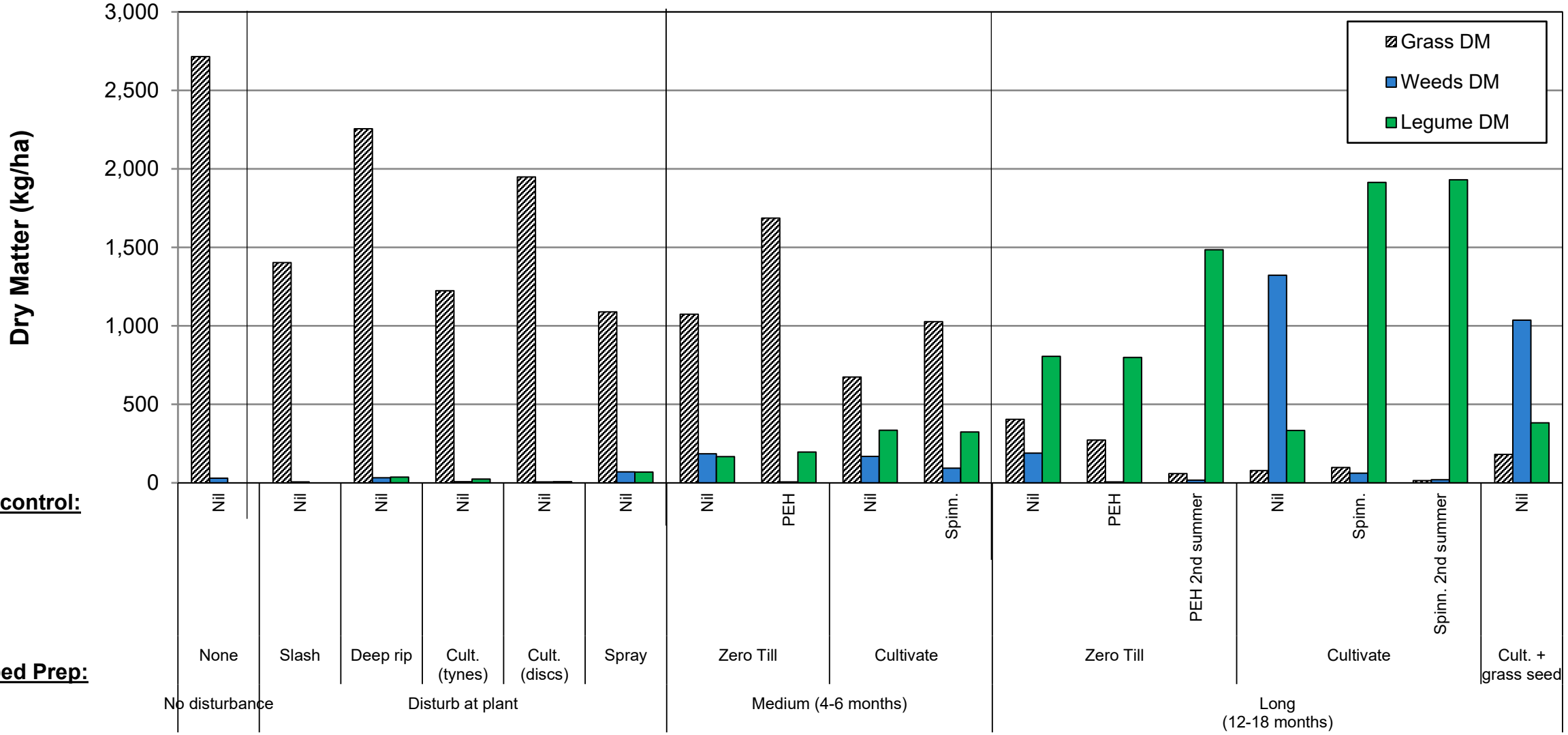
Industry routinely recommends and uses

low cost = *<u>low reliability</u>* establishment techniques

Most commonly used (& recommended) techniques are:

- Broadcast or fly into existing grass with no seedbed preparation
- One pass cultivation while seeding

Industry standard



Poor recommendations

Most commonly used (and recommended) techniques:

Have **<u>failed</u> to produce good legume establishment** when **sown into competitive grass pastures** in ***<u>most</u>* years** in the Brigalow belt

But… more successful in monsoonal or coastal environments

Legume BMP planning timeline

Kill grass

Sow

Emergence

High seed production

High pasture production

1. Initial planning	2. Seedbed /Fallow	3. Sowing	4. Early growth	5. Survival & thickening-up	6. Long-term production
1.Which paddock 2.What legume 3.What method	1.Kill grass (weeds) 2.Store moisture 3.Reduce seed bank 4.Fertilise	1.Timing 2.Soil surface 3.Seed quality and rate 4.Rhizobia 5.Sowing method	Aim: large plants setting seed before end of growing season. 1.Weeds 2.Grazing 3.Insects	Aim: High density, seed production and managed grazing. 1.Grazing management 2.Weeds	Aim: High production and persistence 1.Manage grazing to optimise legume content 2.Fertilise to maintain production

What method: Good condition sown grasses

Sown grass pasture in good condition

Good grass species

- Keep the grass
- Establish legumes in strips

High grass competition

- Long fallows

Arable

- Either cultivation or zero tillage

What method: Poorer condition sown grasses

Sown grass pasture in poorer condition

- Rundown and declined land condition

Grass species

- Patchy? Poorer grasses?
- Renovate whole paddock
- Sow grass seed

“Moderate” grass competition, moderate water holding soil

- Medium fallows (whole paddock)

Soil surface condition

- Scalded/crusted – surface roughness

What method: Non-arable land

Things to consider:

- Why it is non-arable, broadly:
  - Machinery access: Rocky, Steep, Trees
  - Erosion risk: Erodible surface, erodible sub-soil, steep
- Grass competition
- Seed to soil contact

Machinery access:

- Work on accessible bits
  - Pilot plots
  - Strips between trees/rocks
  - Spread can be slow
- Low grass competition
  - Broadcast after minimal disturbance (e.g. fire)

Erosion risk:

- Erodible surface: Maintain cover
  - Minimum or zero tillage
  - Strips on the contour
  - One pass planting
- Erodible sub-soils: do not expose
  - Shallow cultivation only
  - Maintain cover
  - Do not use long fallows

What method: High risk, low production potential

Sodic duplex

- ***Legume adaptation?***
- Gullying and scalding risk

Steep lands

- Erosion risk
- Shallow soils

Focus on other paddocks

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Legume recommendations and SUMMARY!!

The right legume in the right situation

- Climate
- Soil
- Persistent and productive

Good establishment

- Good agronomy:
  - More water, more often and more of it used to grow legumes
  - Fertiliser if needed
- Managed grazing – allow legumes to fully establish

High long-term production

- Appropriate grazing management
- Soil fertility – most commonly Phosphorus and Sulphur

Legume workshop

Addresses each step in the –’ Legume BMP timeline’:

- Principles and management recommendations
- Document legume management plans for your property

Next Workshop: Miles, 20th November

[FutureBeef events page]

More information:

FutureBeef webpage: https://futurebeef.com.au/

- Dedicated legumes content being developed

Queensland Pasture Resilience Program

- More info on FutureBeef webpage
- “Queensland pastures newsletter”

DPI statewide pasture extension team

- Call: 13 25 13
- Email: info@daf.qld.gov.au

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Conclusions

Plant legumes

- Well adapted, productive varieties available

Poor establishment is the most common reason for failure

- High legume content = high production
- Very low legume density = no animal production gains

Multiple steps to ***reliably*** establishing and maintaining productive legume pastures

- Spend more time and effort
- Stored soil moisture is critical in the Brigalow Belt

Questions??

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