Paddock Priorities and other factors that might be affecting nodulation

Belinda Hackney – CWLLS, Forbes

Key issues

- Identifying what you have
  - Priorities
- Choosing tactics
  - Altering what you have
  - Changing what you have

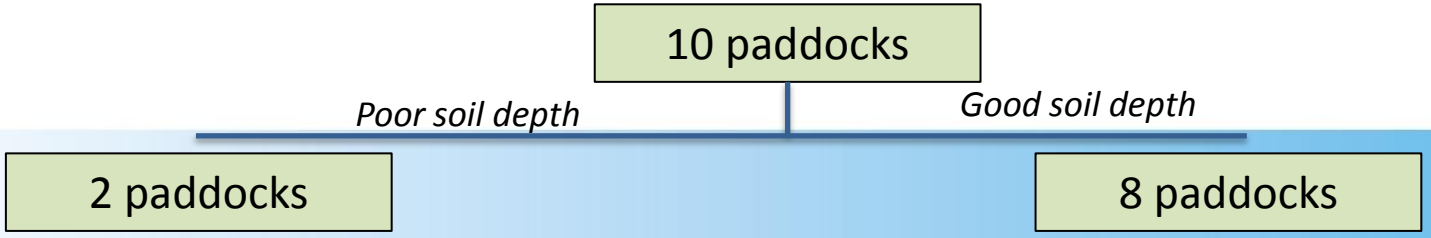
Paddock priorities

- Given 10 paddocks on your farm, how do you prioritise where to allocate inputs?

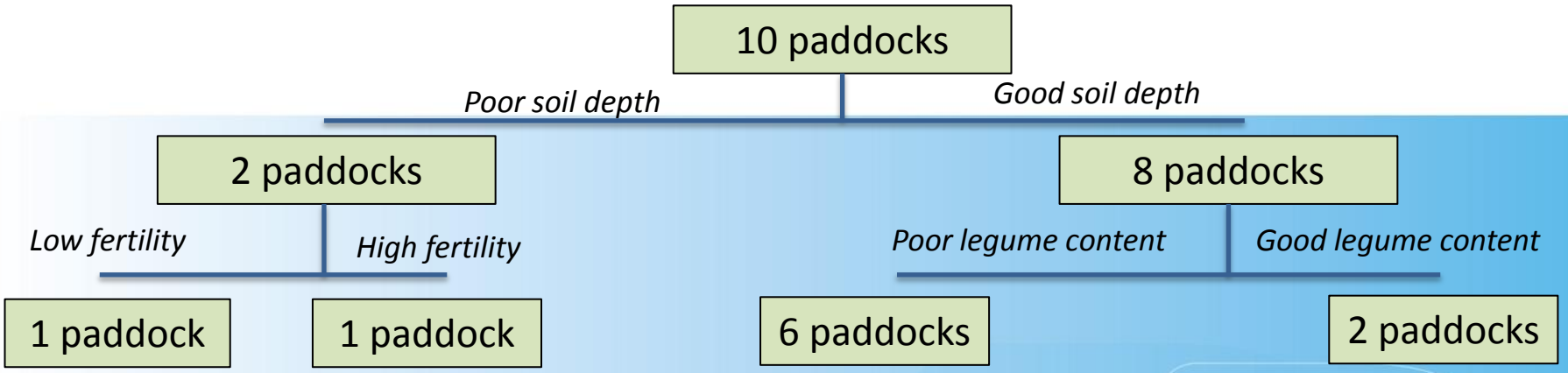
Paddock priorities…….an example

10 paddocks

Paddock priorities



Paddock priorities



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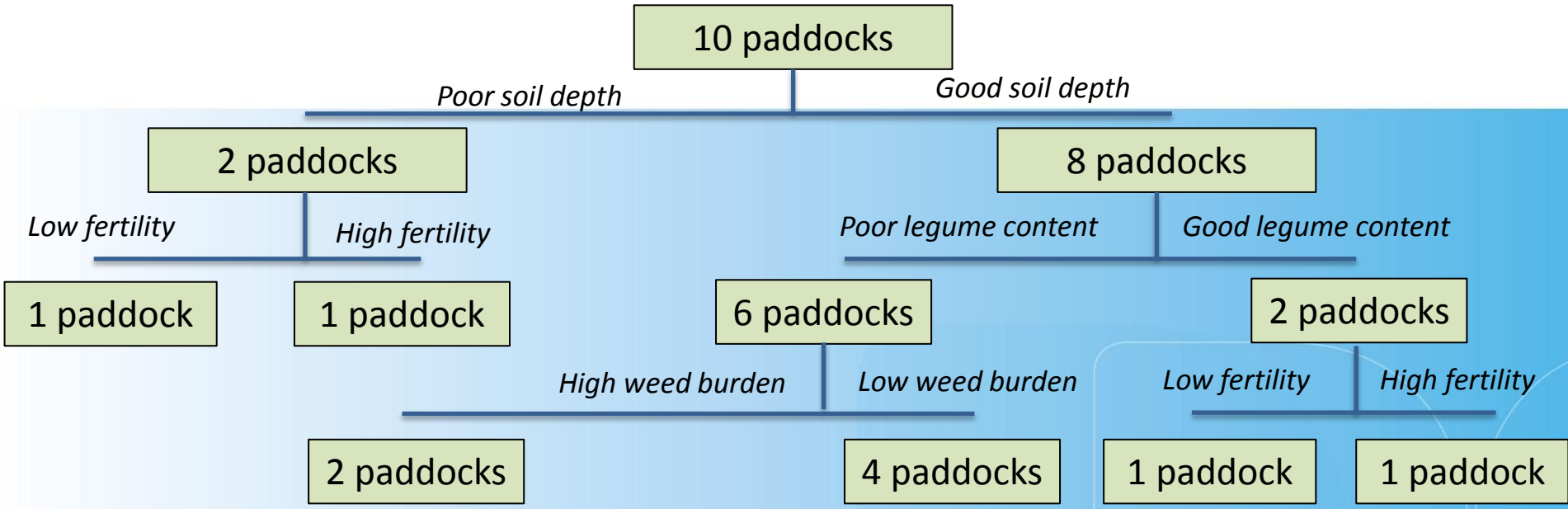

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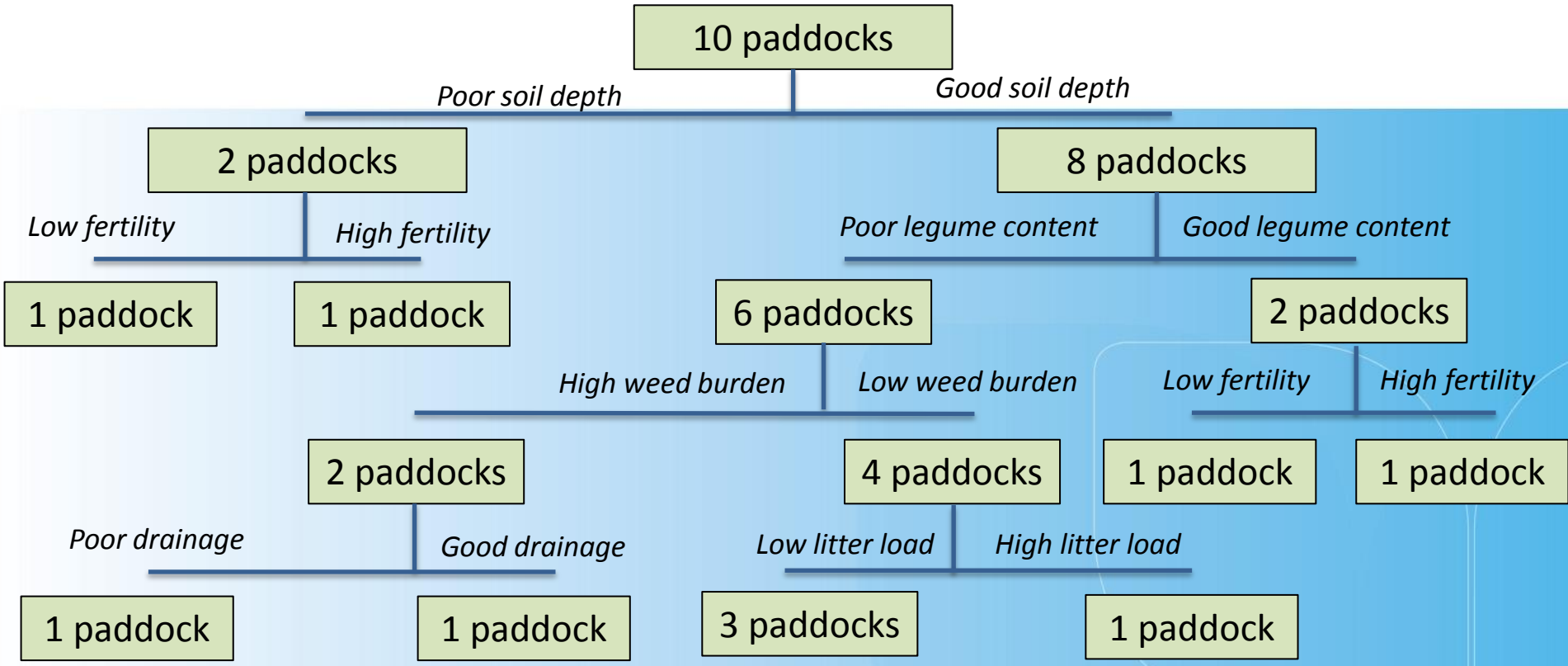

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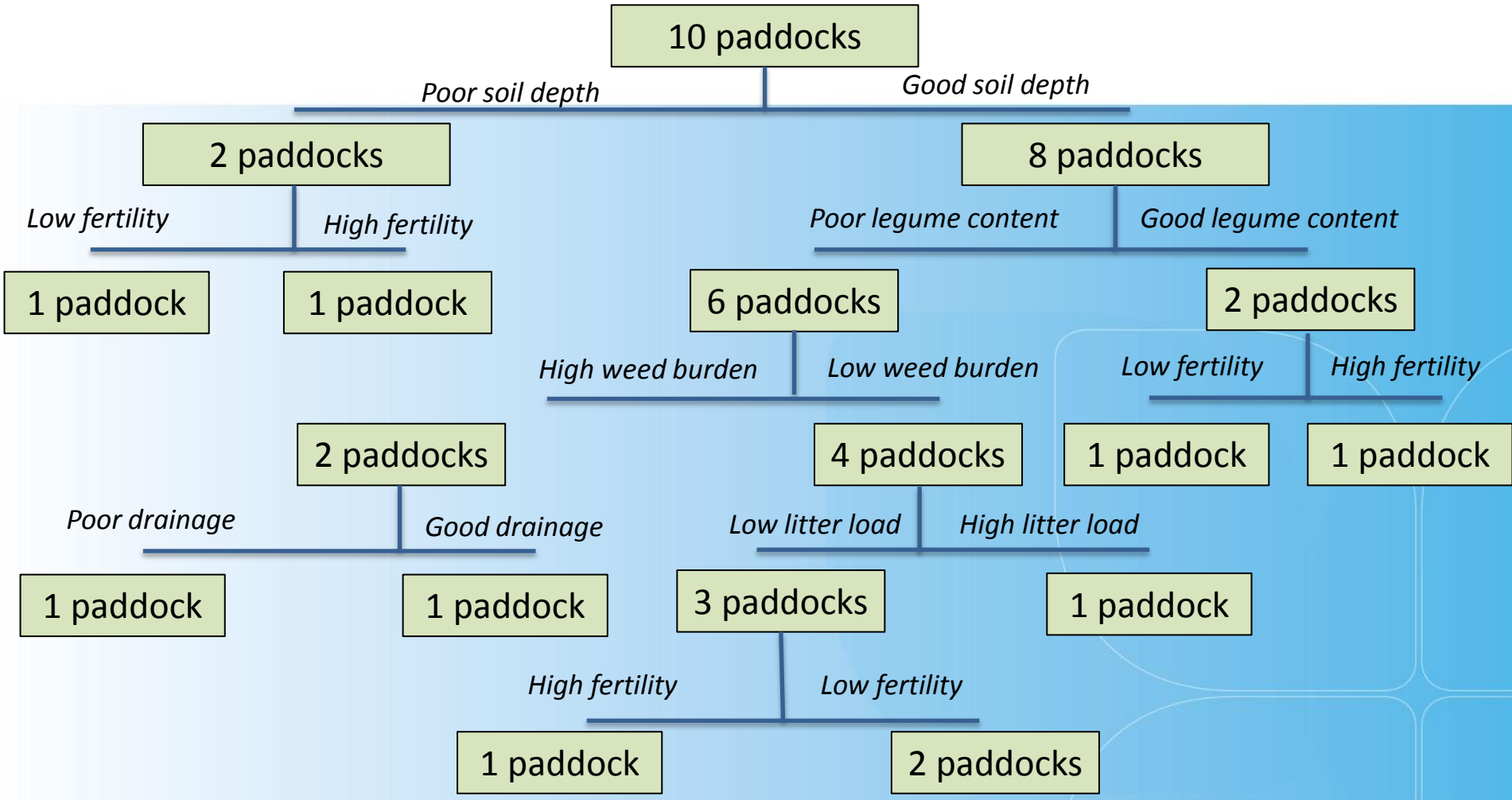

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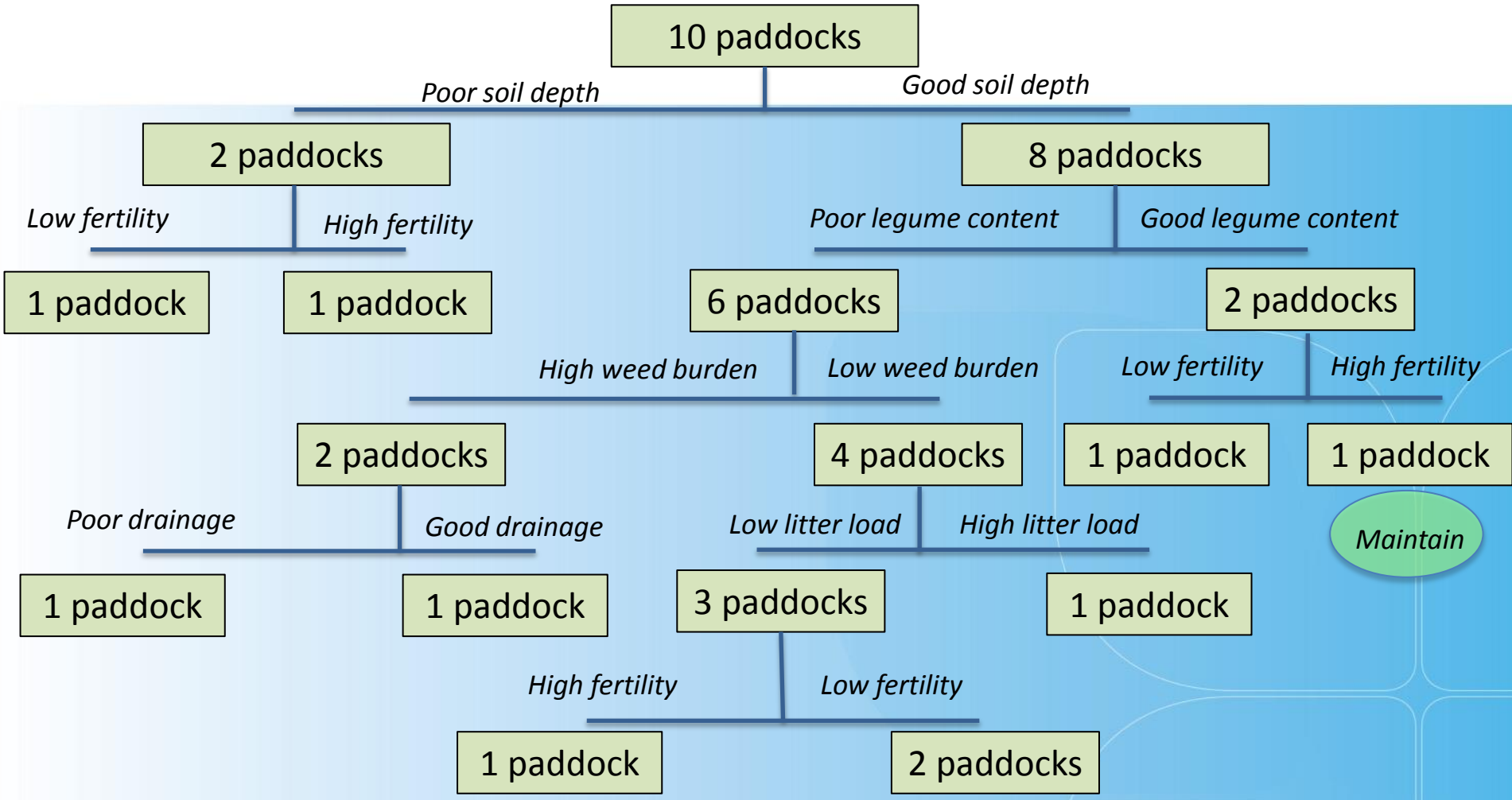

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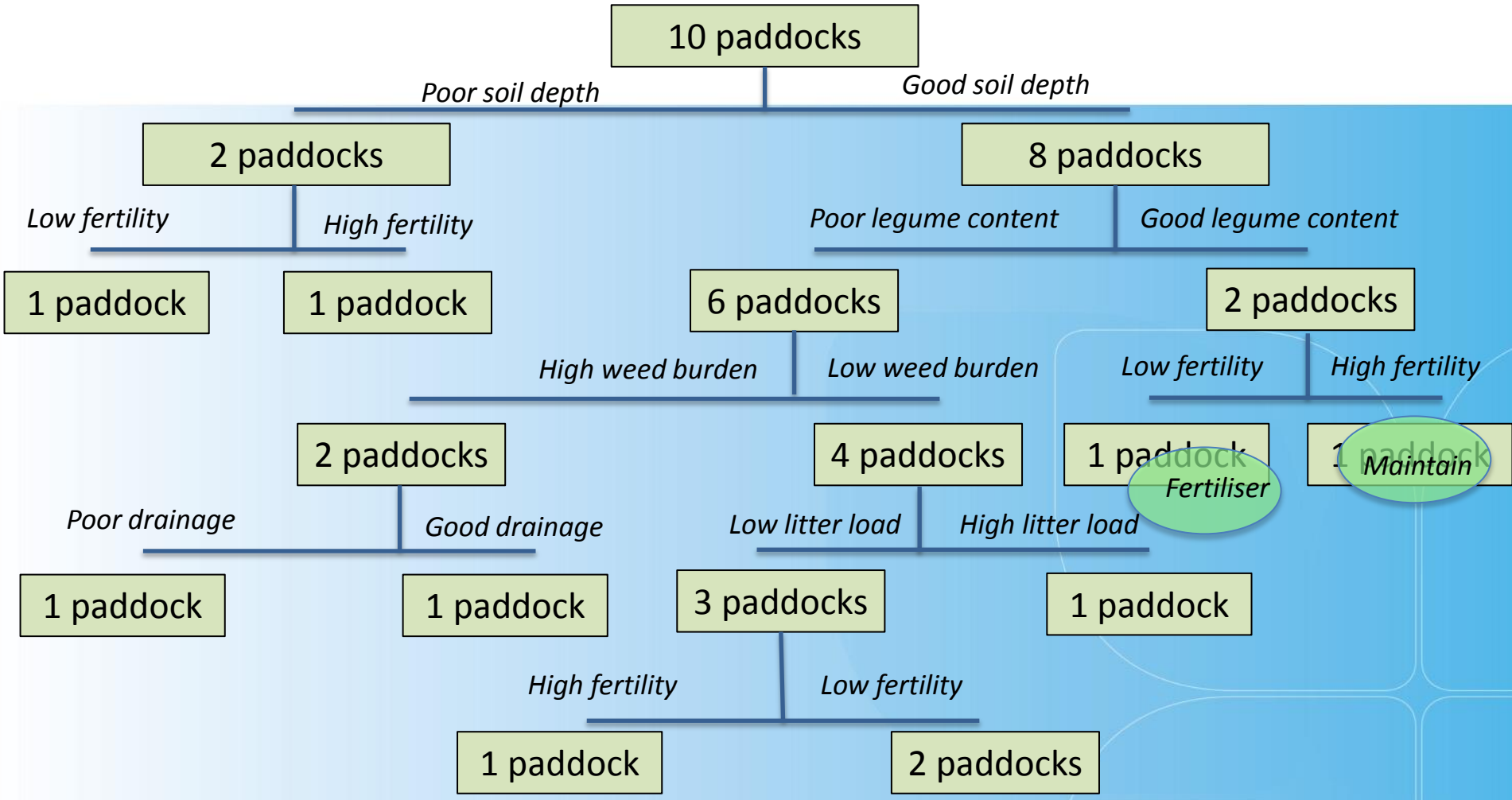

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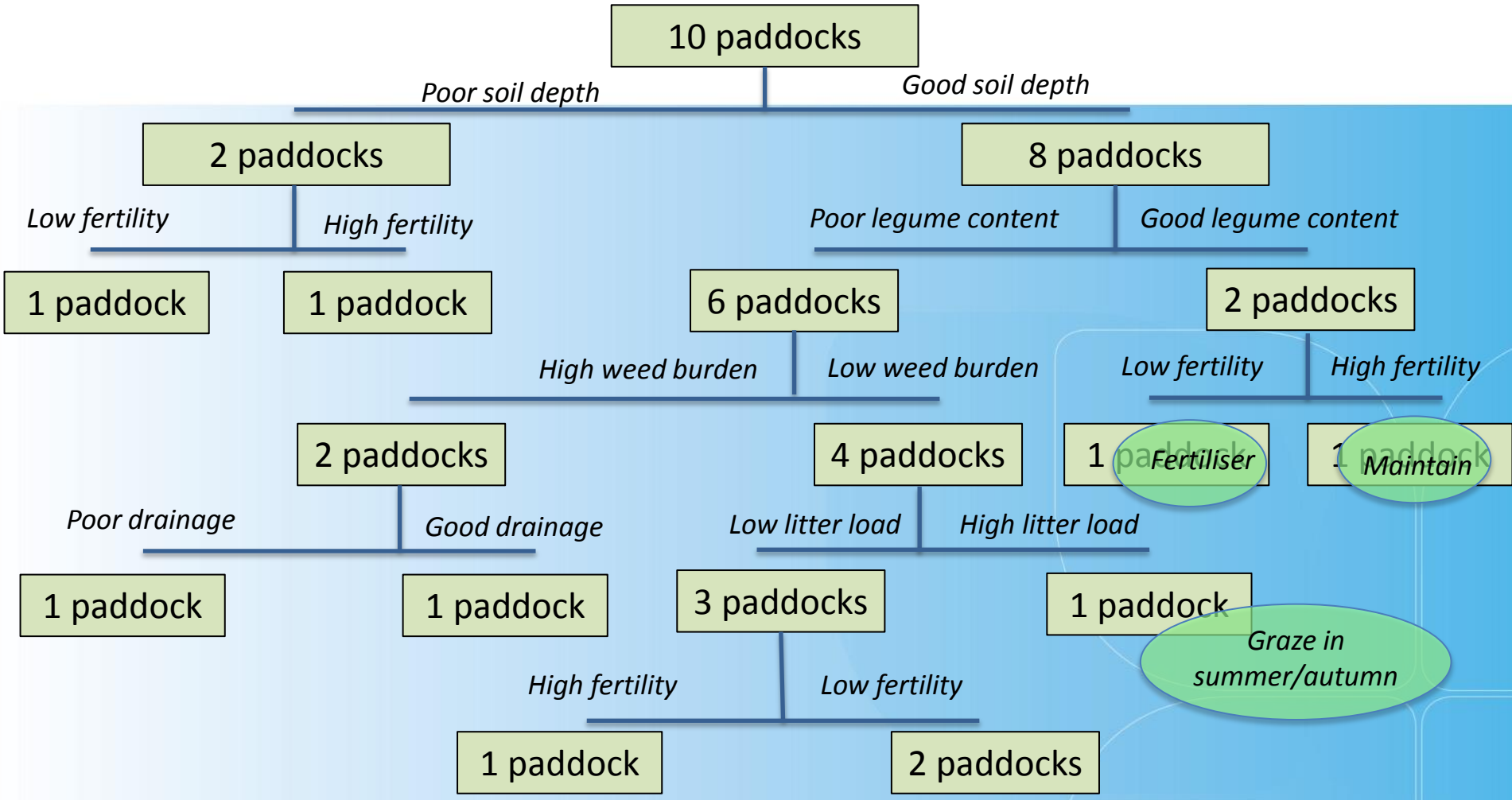

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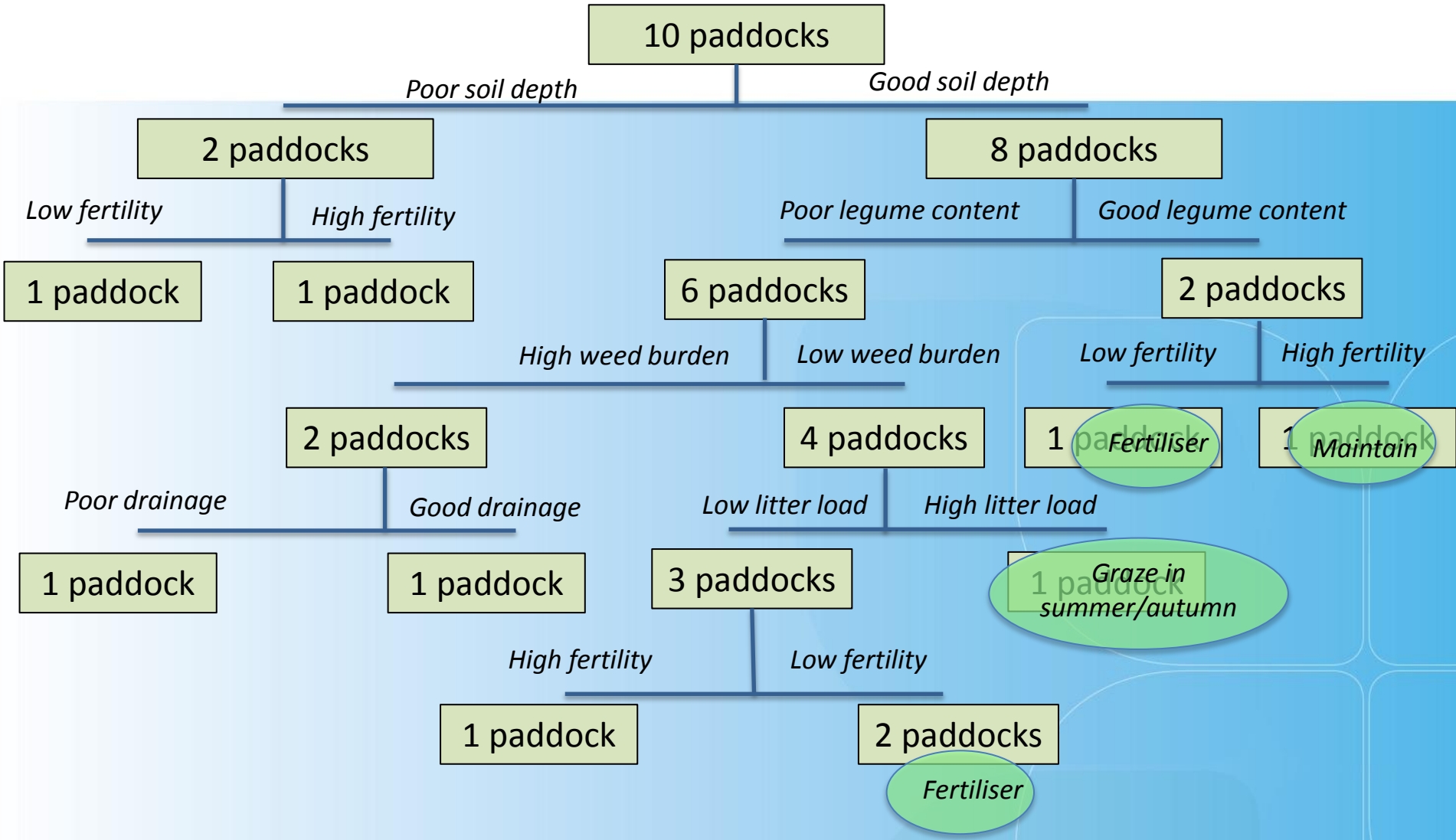
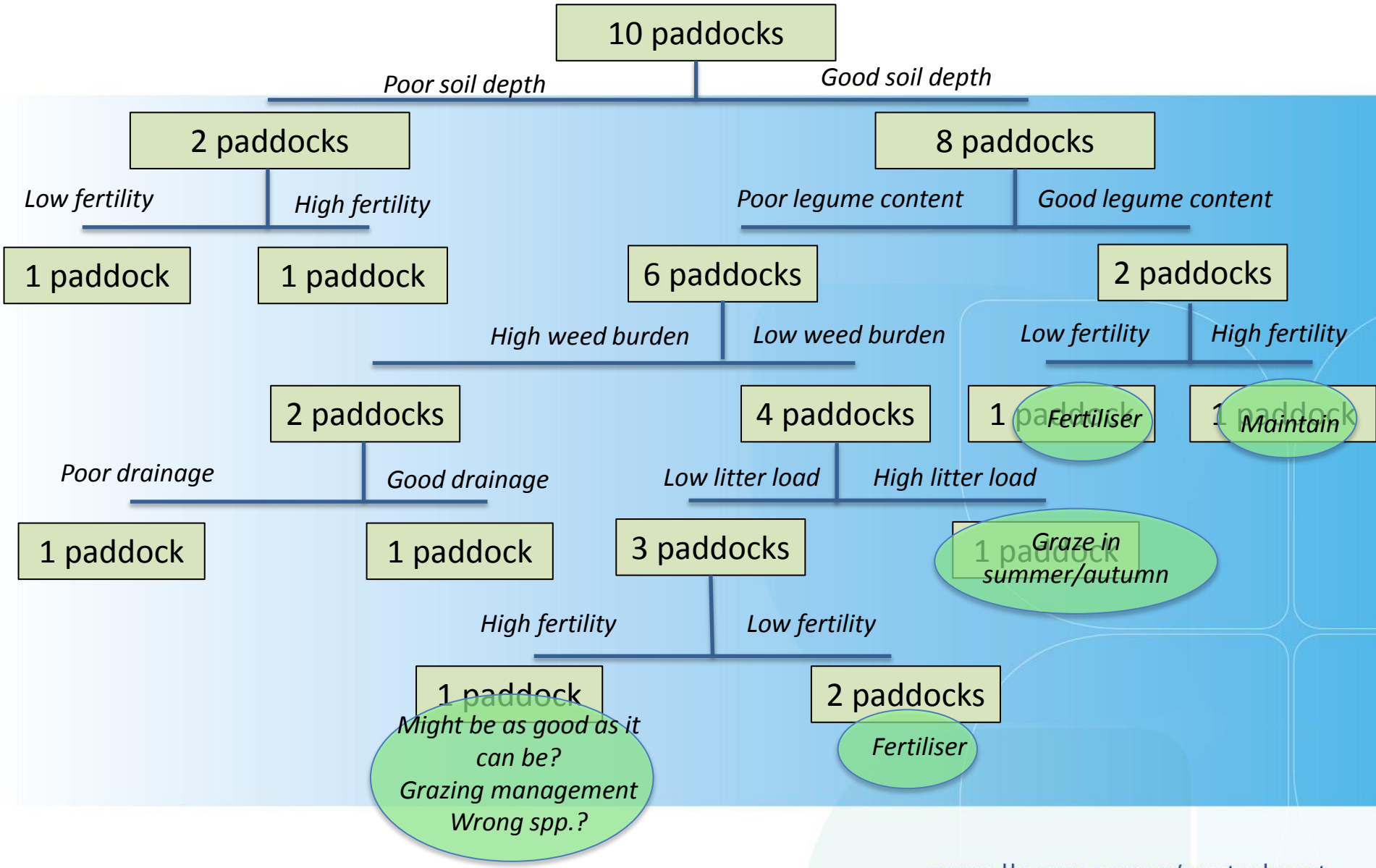


Paddock priorities



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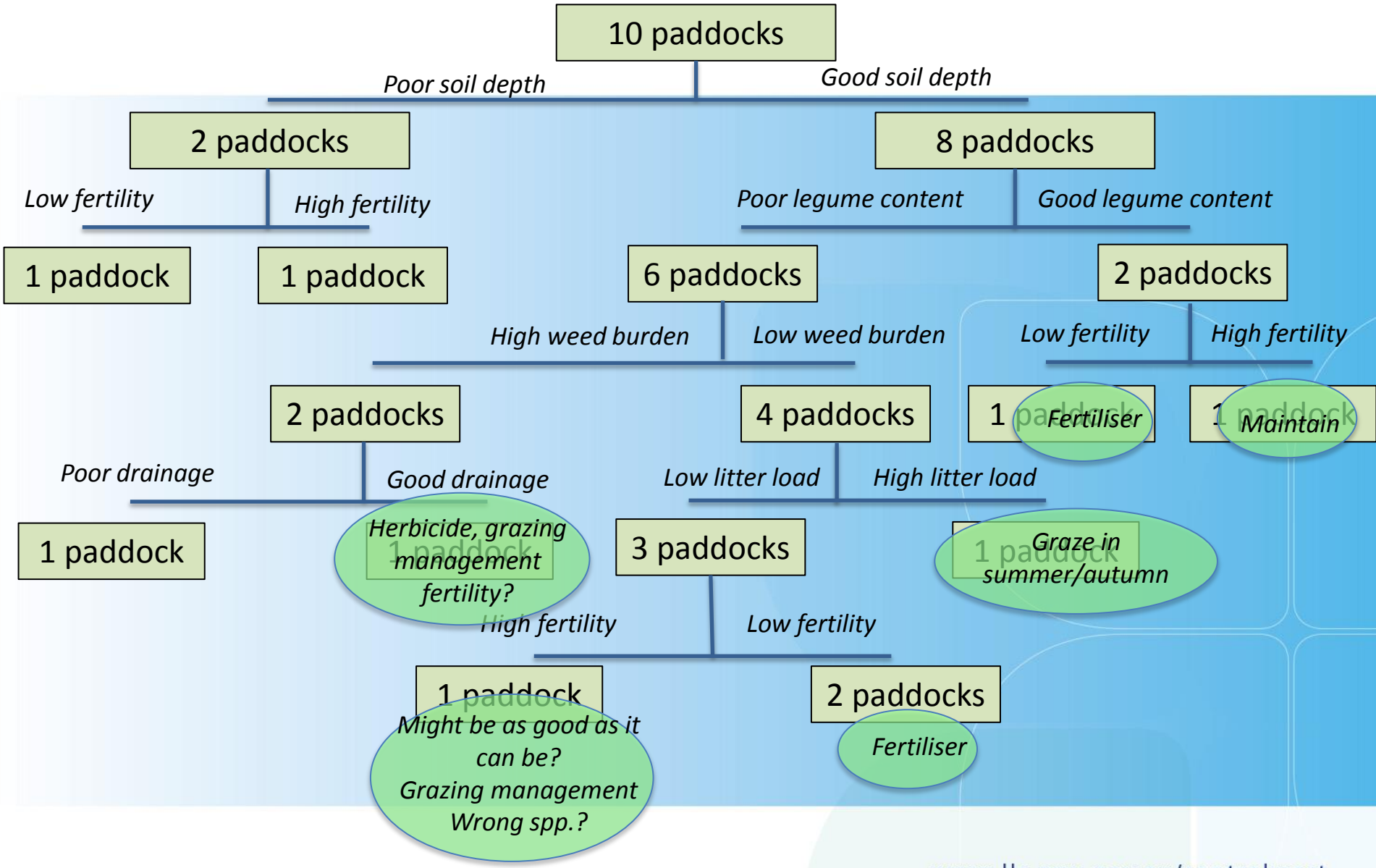

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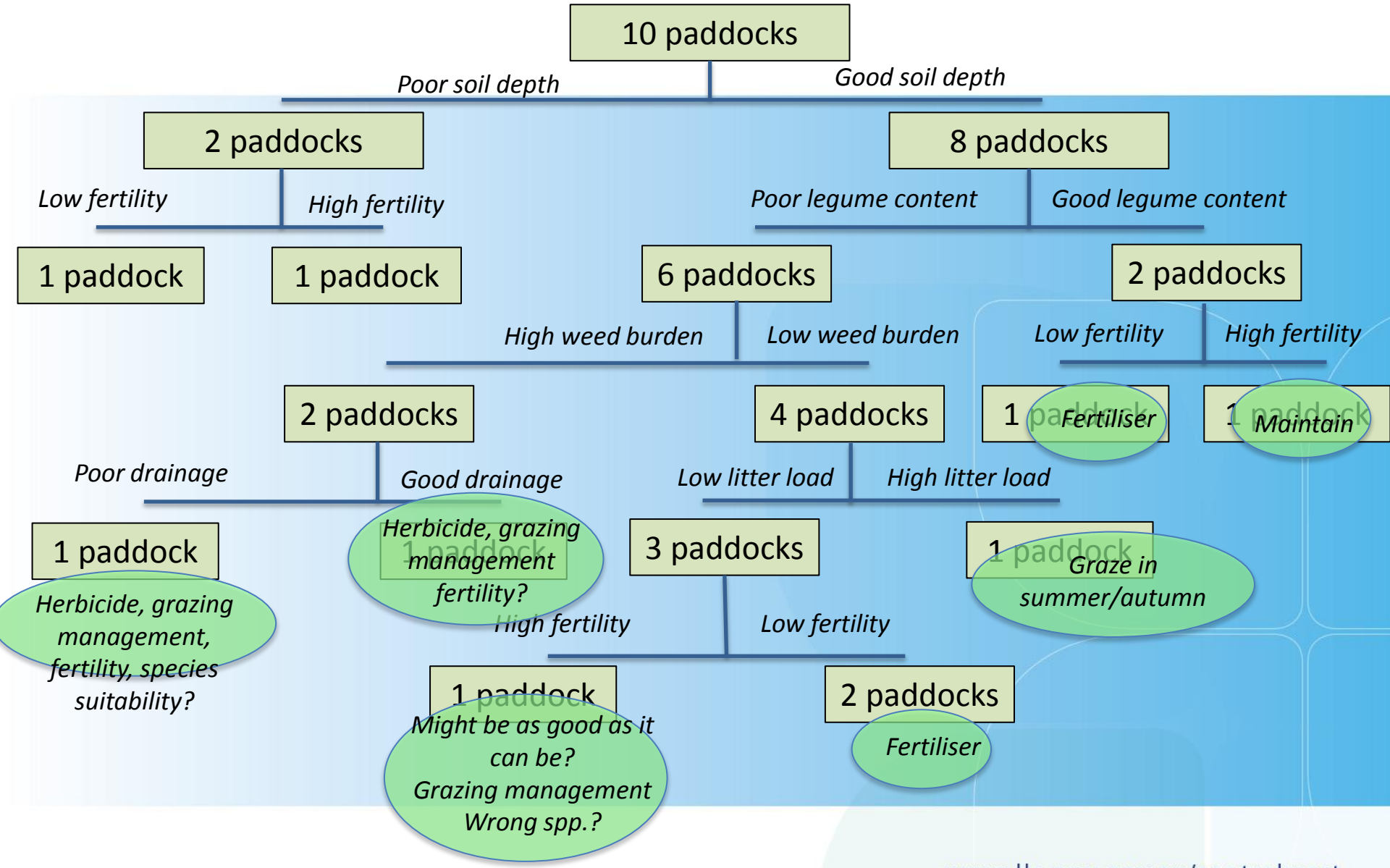

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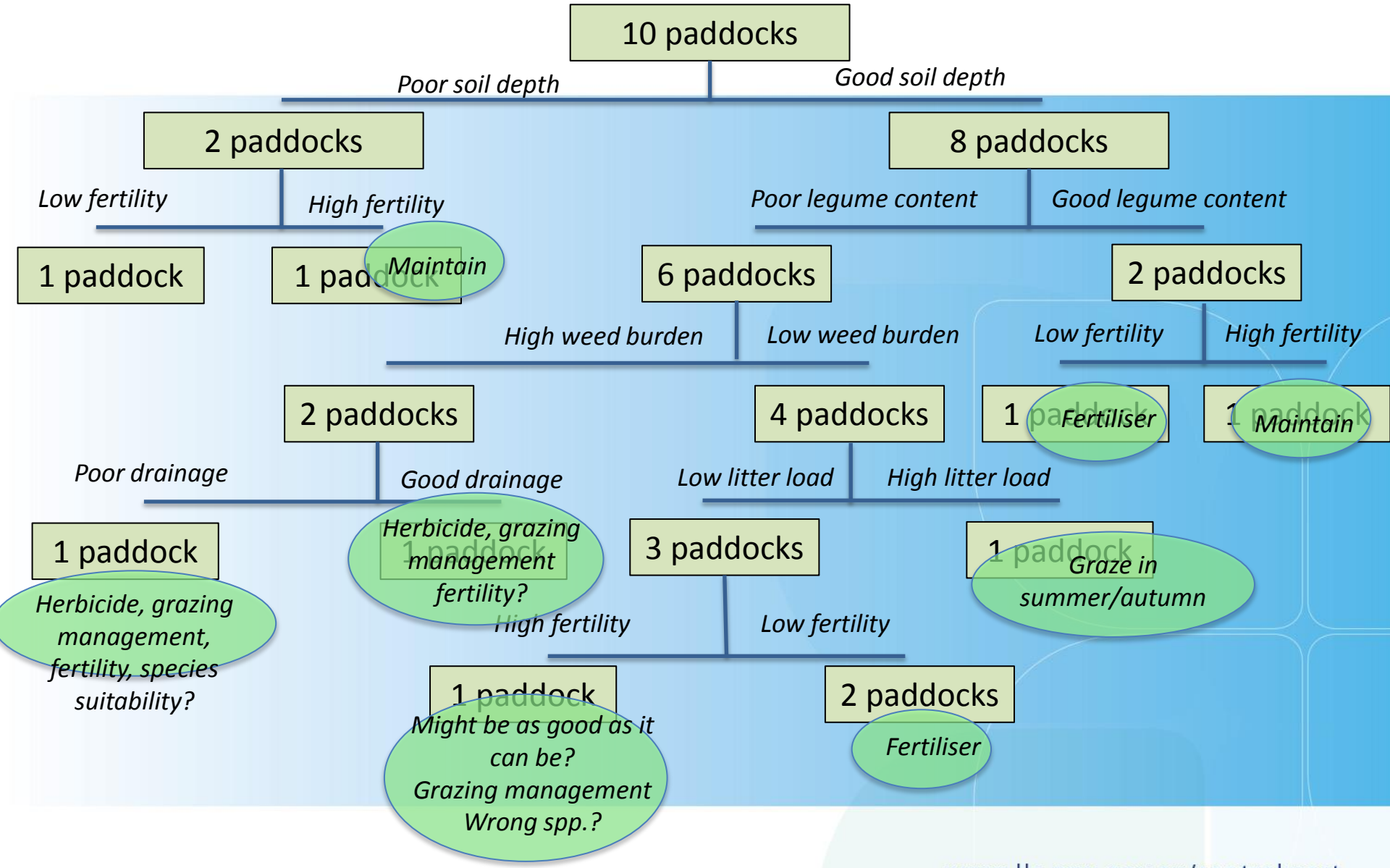

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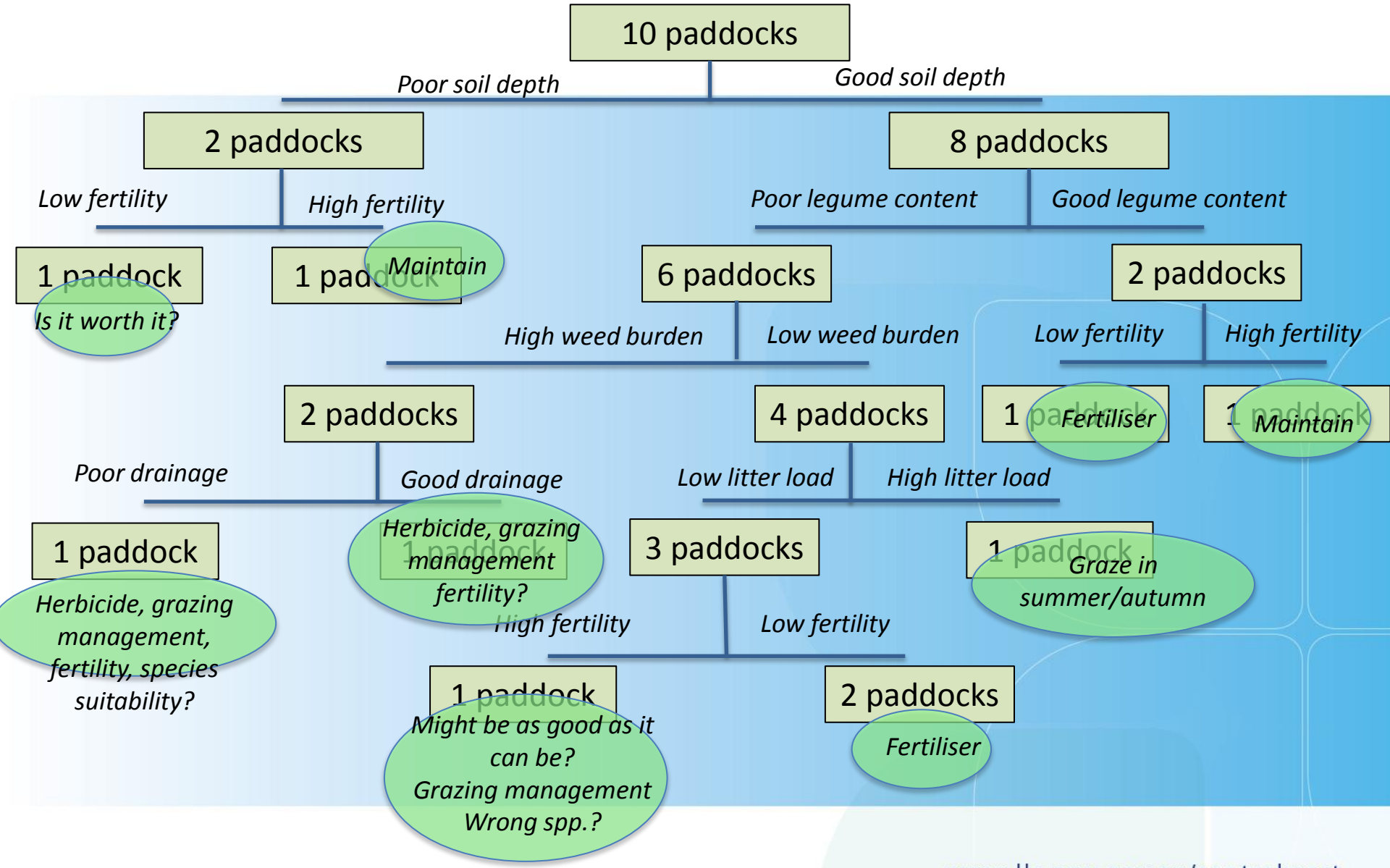
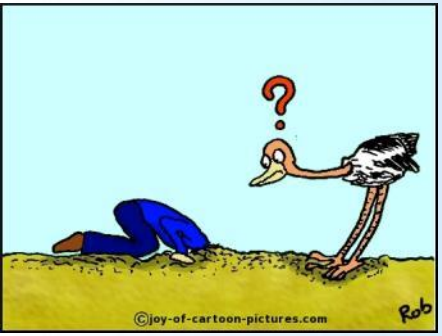


Options

- Procrastinate



- Renovate

- Manipulate

- Maintain

Options

Renovate

Choose wisely – create exploitable differences

- **Preparation**
- **Species choice**
  - **tolerance to limitations**
  - **hardseededness/maturity time**
  - **dormancy**
  - **appropriate mixes**
- **Fertiliser choice**
- **Legume inoculation**
- **Sowing rate**
- **Sowing technique**
- **Sowing depth**
- **Sowing time**

Manipulate

Exploitable Difference

- **Grazing**
- **Grazing plus herbicide**
- **Selective herbicides**
- **Non-selectives**
- **Non-selective herbicides selectively**
  - **+/- grazing**
- **Introduction of other species**
  - **Broadcast**
  - **Drill**
- **What's the baseline**
  - **Different species and potential**

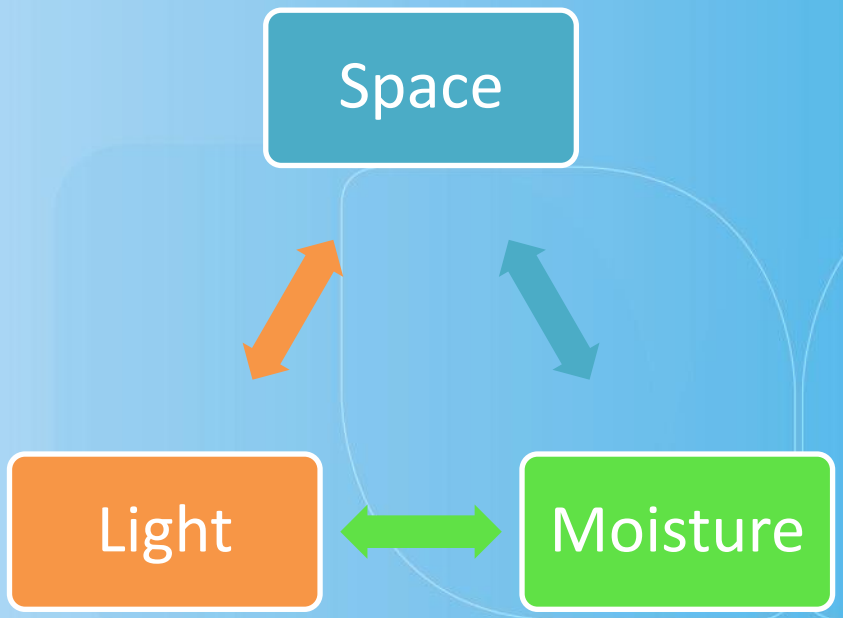
Introducing other species into established pastures

Common questions – ‘What can I grow with established……’

- Perennial pasture – grass or lucerne

Need to think about:

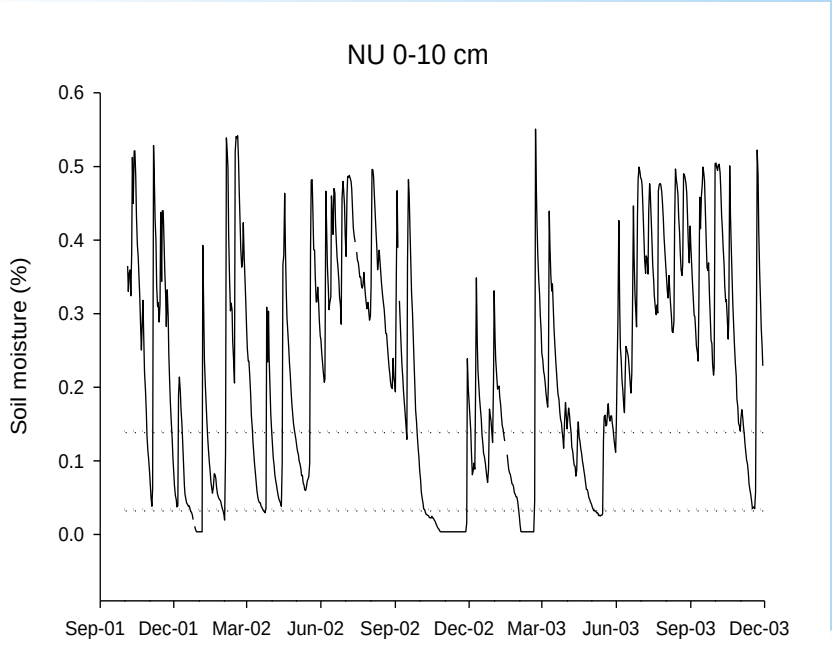
- Site preparation
  - ground cover
  - retarding existing pasture?
- Moisture availability
- Method of introduction
- Rate of introduction

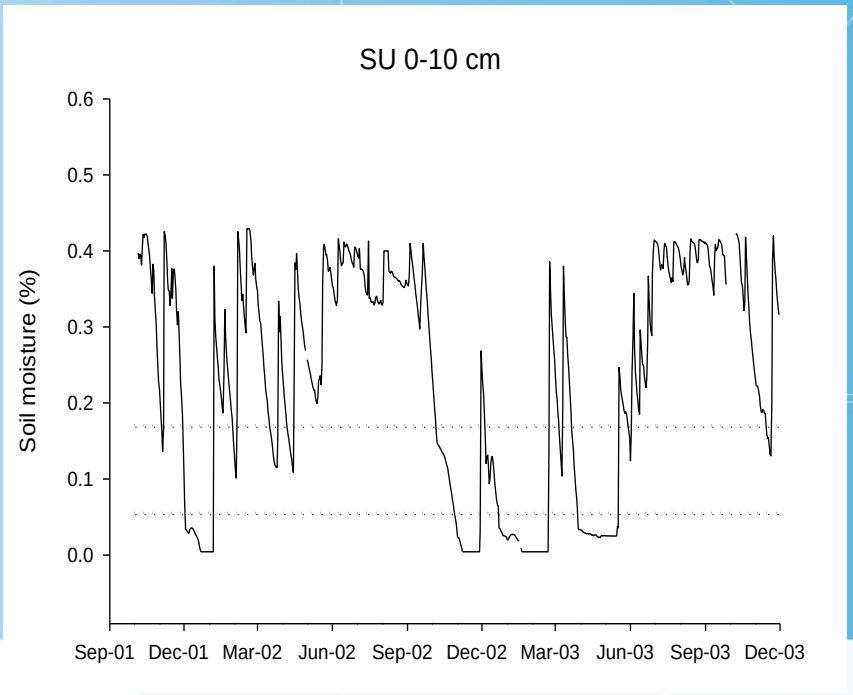


Introducing other species into established pastures - moisture

Common questions – ‘What can I grow with established……’

- Perennial grass
- Lucerne

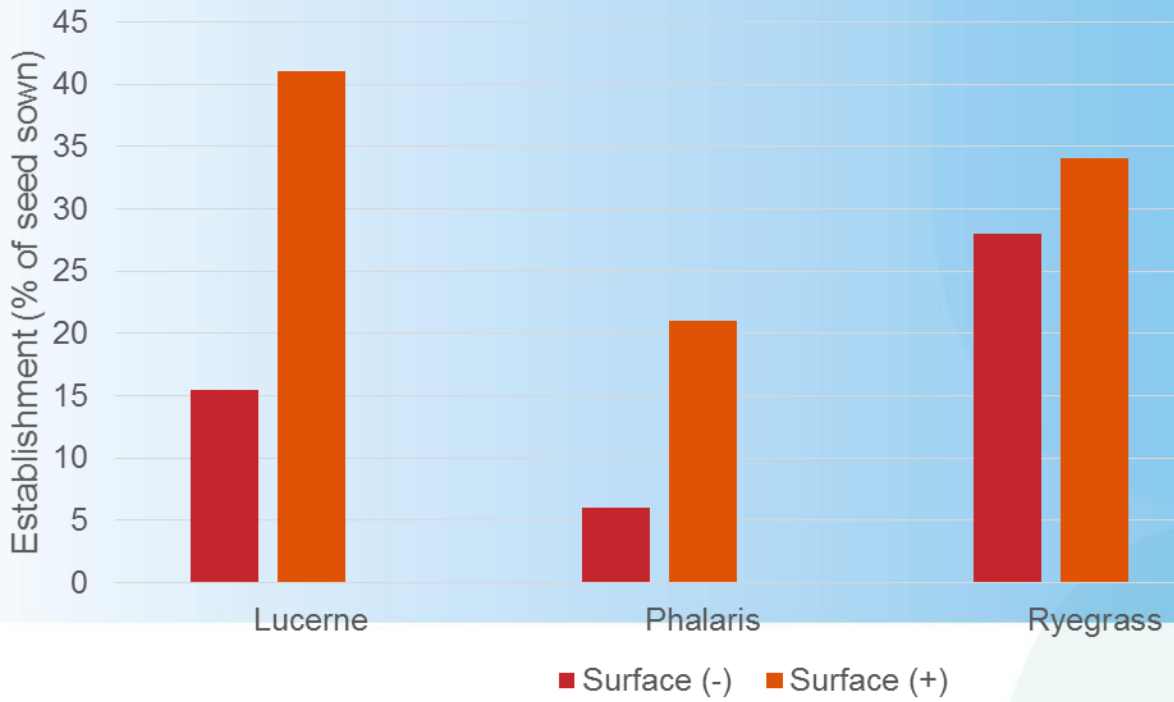




Source: Hackney (2009)

Introducing other species into established pastures – method of introduction

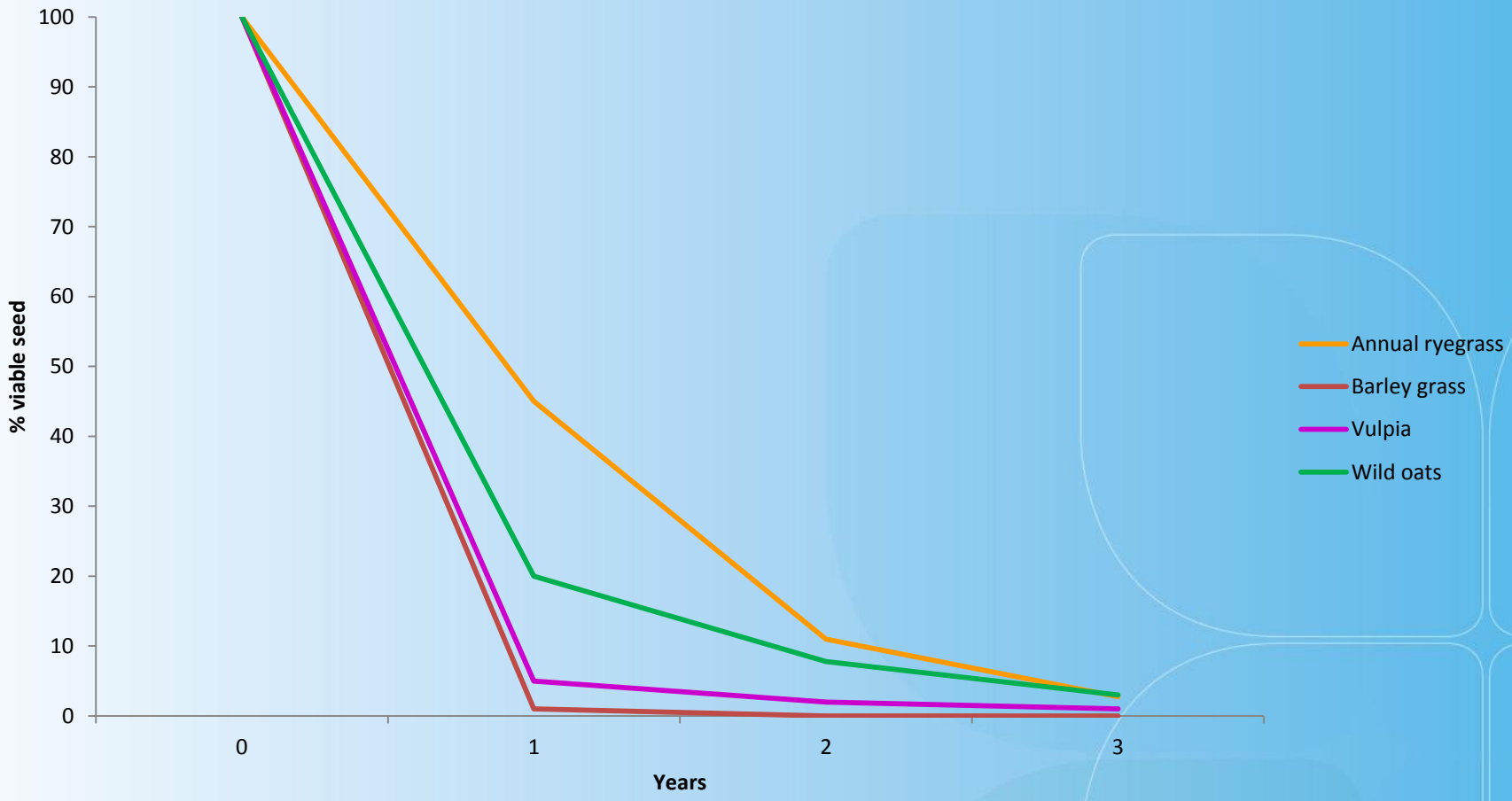
- How are you going to introduce new species?
  - Surface broadcast
  - Disturbance
  - +/- retard existing pasture?
  - Rate – more later



Source: Dowling et al. (1971)

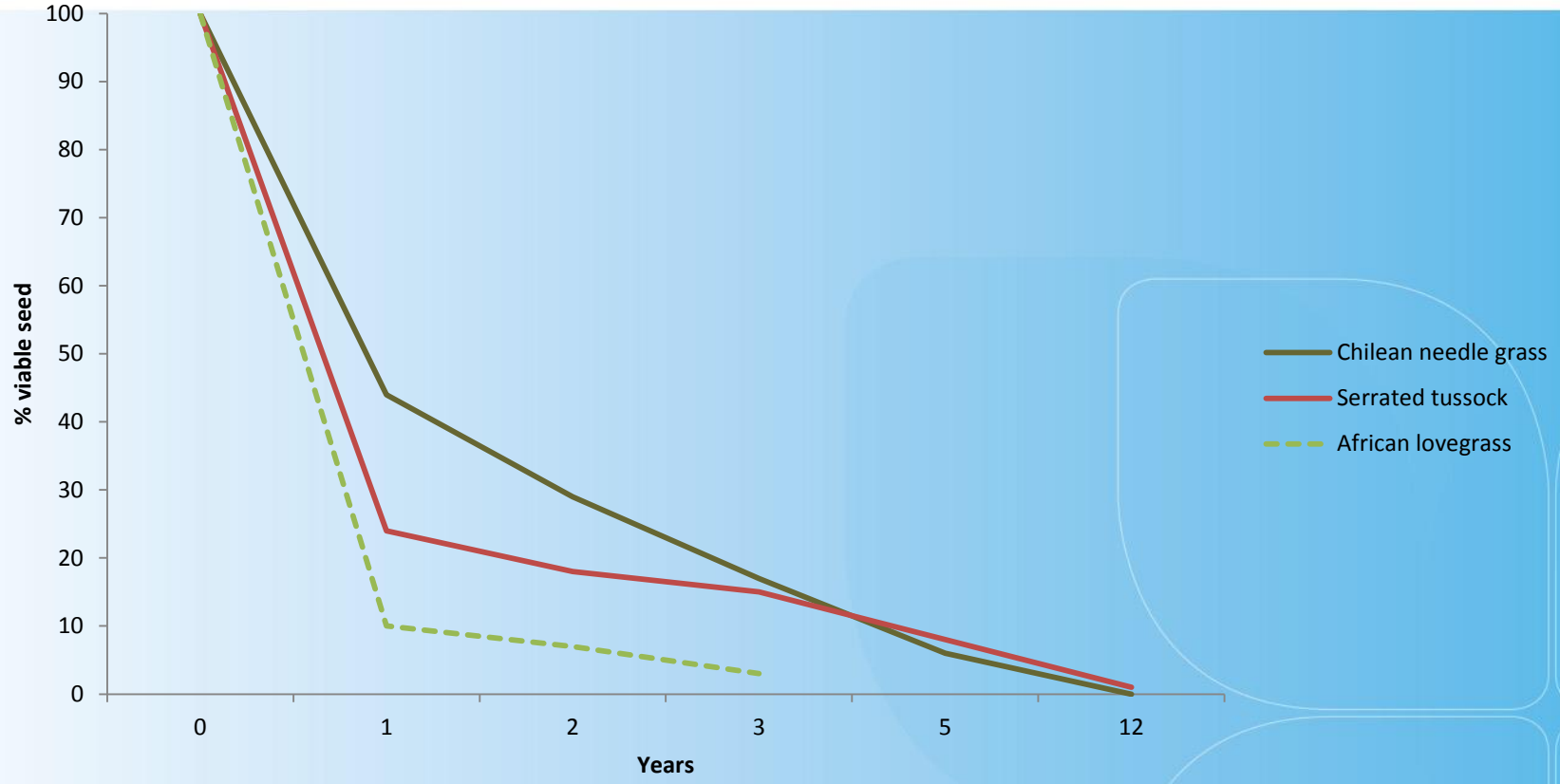
Sowing new pastures

Weed seed bank-annual grasses



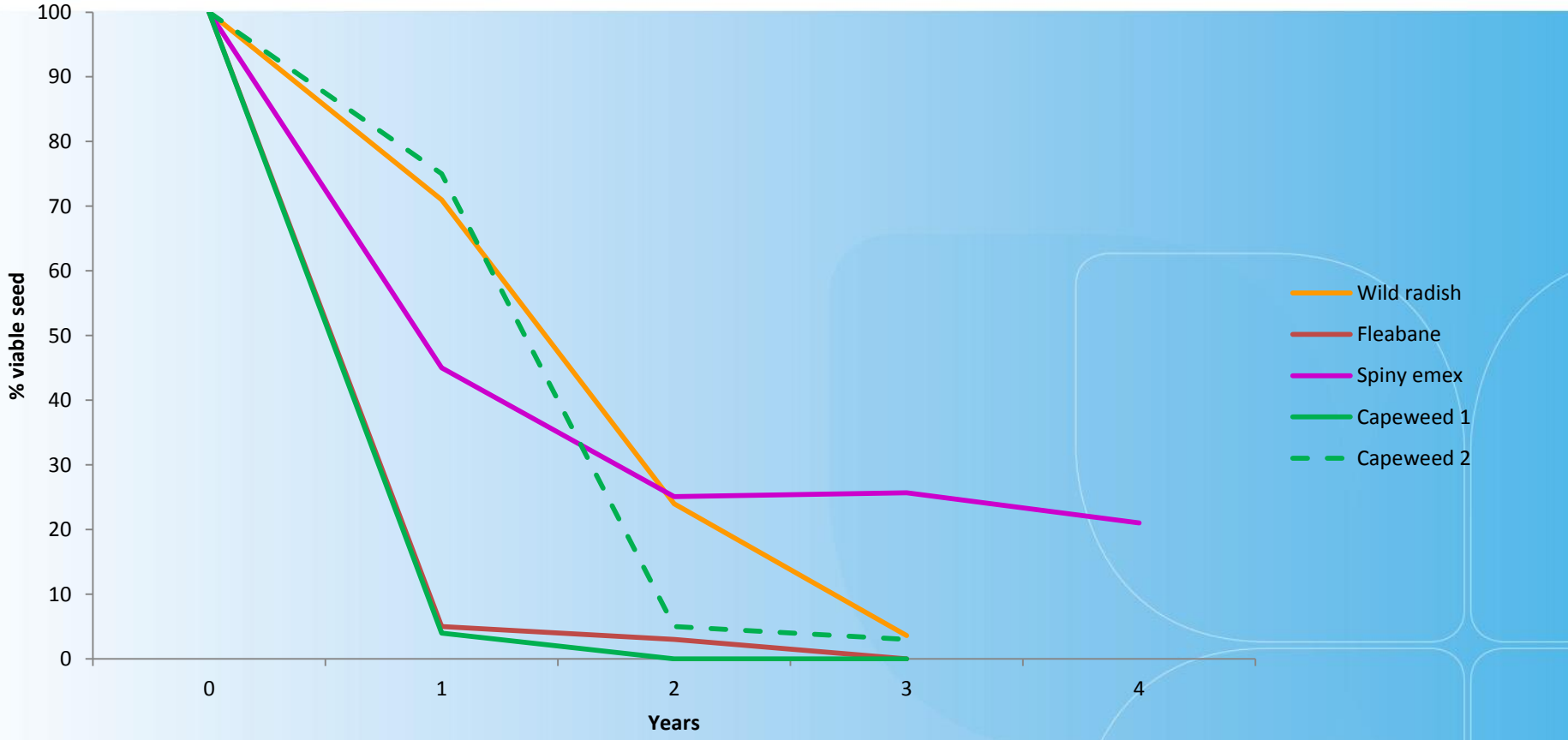
Sources: Dowling et al (1991); Peltzer and Mason (1999);

Weed seed bank – perennial grass weeds



Sources: Gardener et al. (2003); Lamoureaux et al. (2006), Maze et al. (1993)

Weed seed bank – broadleaves



Sources: Cheam (1987); Dunbabbin and Cocks (1999); Peltzer and Mason (1999); Green et al. (2010)

Remember……

- No herbicides to selectively remove annual grass weeds from perennial grasses in the year of establishment

- Get broadleaves under control ahead of time so use only ‘soft’ options in first year to maximise seed set

Species choice – tolerance to limitations

•It's about what you ***can*** grow given the limitations of paddock….not necessarily what you ***want*** to grow.

•Think about:

- Soil physical conditions (depth, WHC, dispersion, waterlogging)
- Soil chemical conditions (pH, pH at depth, P, S……)
- Aspect, slope

≠

Legume tolerances and characteristics

	Rainfall (mm)	pH_{Ca}	Waterlogging tolerance	Hardseed (%)	RLEM tolerance	Native bud worm tolerance	Maturity (flowering)	Bloat risk
Subclover	>350	4.5-8.0	sub-poor brachy- poor yann - good	Most <25 Most <25 Most <40	No	Yes	85-160	High
Lucerne	>375	5.0-7.5	Poor		No	Yes		High
Bladder clover	>350	5.0-8.0	Poor	50-60	No	Yes	110-120	High
Gland clover	>350	4.5-8.0	High	40-50	Yes	Yes	100-120	High
Arrowleaf clover	>400	4.5-7.5	Poor	40-50	No	Yes	130-180	Moderate-high
Balansa clover	>350	4.8-8.0	Very high	Variable	No	Yes	95-130	High
French serradella	>325	4.0-7.5	Poor	0-50	No	No	90-130	Nil
Yellow serradella	>300	4.0-7.5	Poor	60-95	No	Moderate	95-140	Nil
Biserrula	>325	4.2-7.0	Poor	70-90	No	Yes	110-135	Low??
Sulla	>400	5.5-8.5	Poor	Low	No	Yes	~120	Nil

Hardseededness and maturity time - legumes

- Hardseededness comes into play after the first year of seed set
  - Bought seed is generally scarified
  - Hard seed means the seed has a seed coat that is impermeable (resistant) to water penetration
  - Hard seed break down affected by
    - Moisture
    - Temperature
  - Choose higher hard seed varieties in harsher/more variable climates
- Maturity time
  - Refers to time to flowering
  - Choose shorter season for harsher/more variable climates
  - Caution – getting too extreme in subclover selections
- Serradella and biserrula indeterminant -will flower and produce seed while moisture available

Indeterminant plants, maturity time

	Early spring seeds/m^2	Late spring seeds/m^2	Total seeds/m^2
Biserrula	2715	3258	5973
Gland clover	2046	0	2046
Bladder clover	760	0	760
Subclover	250	0	250

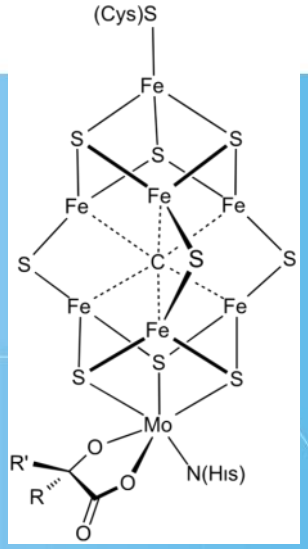
Source: Hackney and Quinn 2016

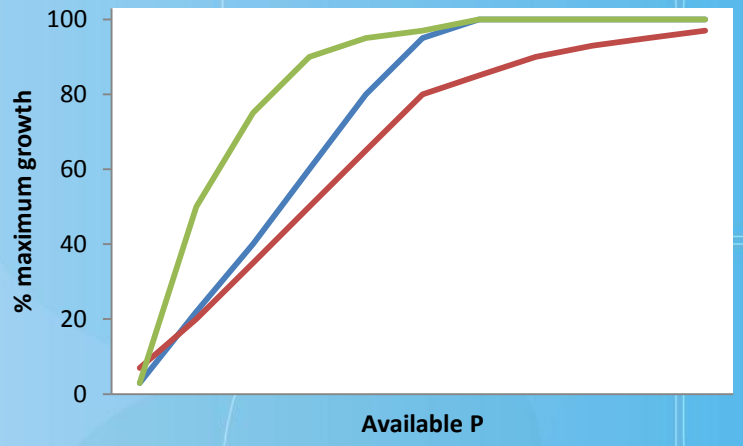
Choosing mixtures

- Think carefully when choosing mixtures
- With complex mixtures there can be difficultly in:
  - matching herbicides to all pasture components
  - grazing to suit persistence needs of pasture components
  - maintaining balance – grass/legume ratio
  - initial dominant species may initially outcompete and interfere with establishment of long term persistent species
  - simple is often better

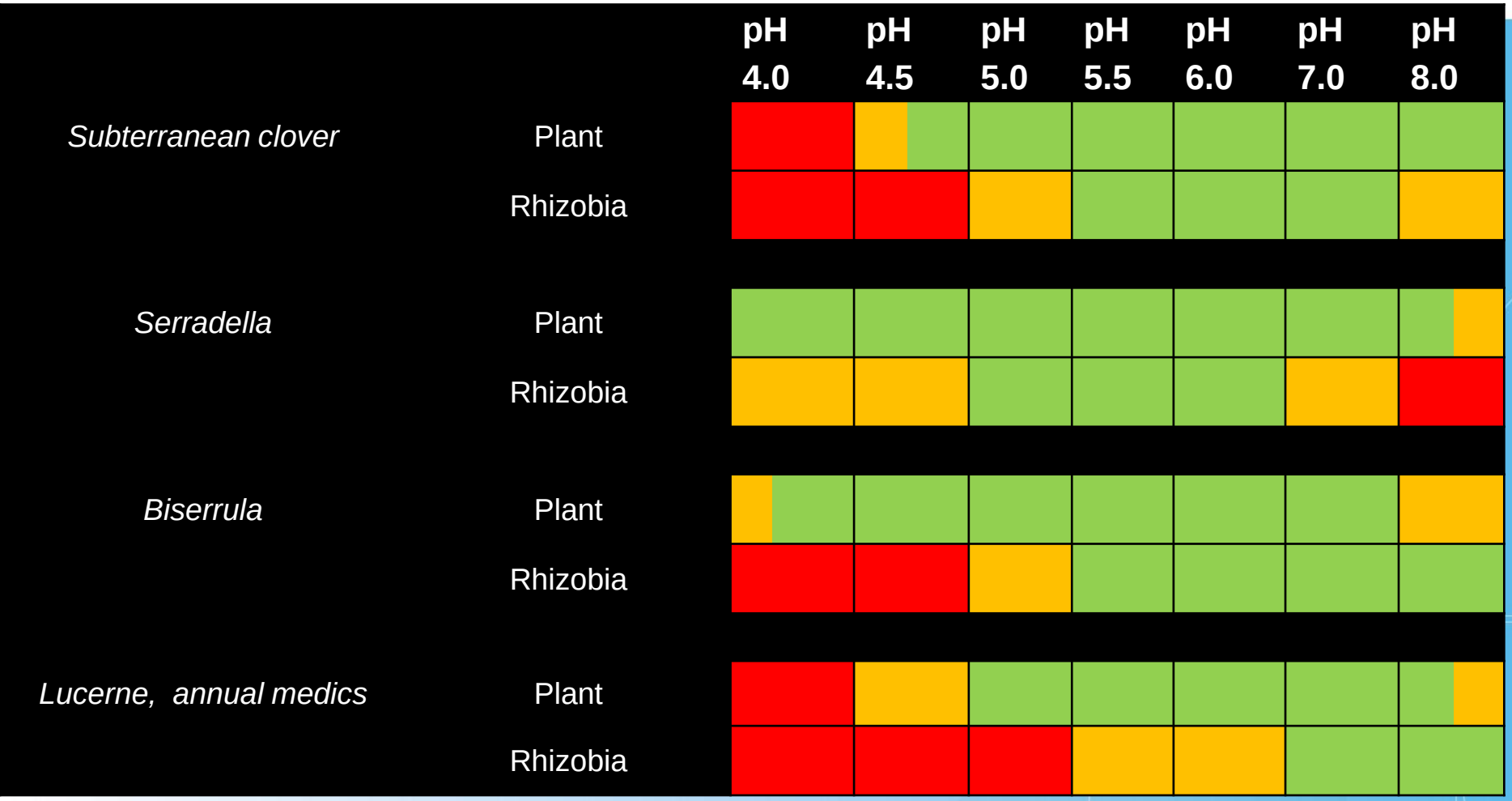
Fertiliser for pasture sowing and maintenance

- Cropping fertilisers (e.g. MAP and DAP) commonly used at pasture establishment
  - Contain plenty of N and P……but
  - No S
  - More than 90% paddocks deficient in S
- Starter fertiliser containing N, P and S for sowing
  - seeds only have sufficient N to supply seedlings for 7-10 days
  - don't forget about Mo for legumes in deficient areas
- Maintenance and building fertility
  - soil test – P, PBI, S (not accurate for trace elements)
  - No production benefit in applying fertiliser above critical levels





Legume inoculation



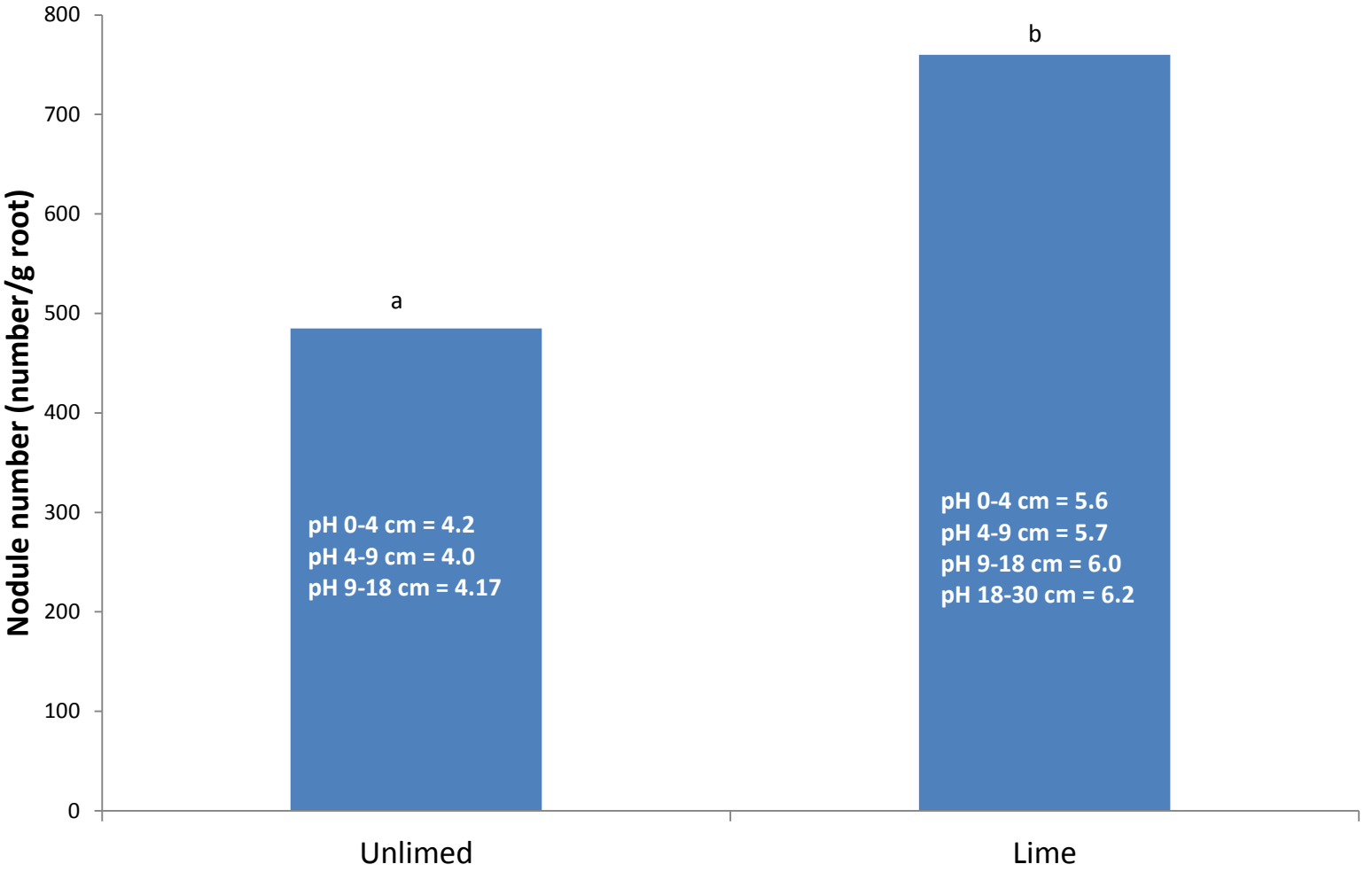
Red = poor Orange = sub-optimal Green = optimal

Source: Ron Yates, DAFWA; various

Improving life for rhizobia

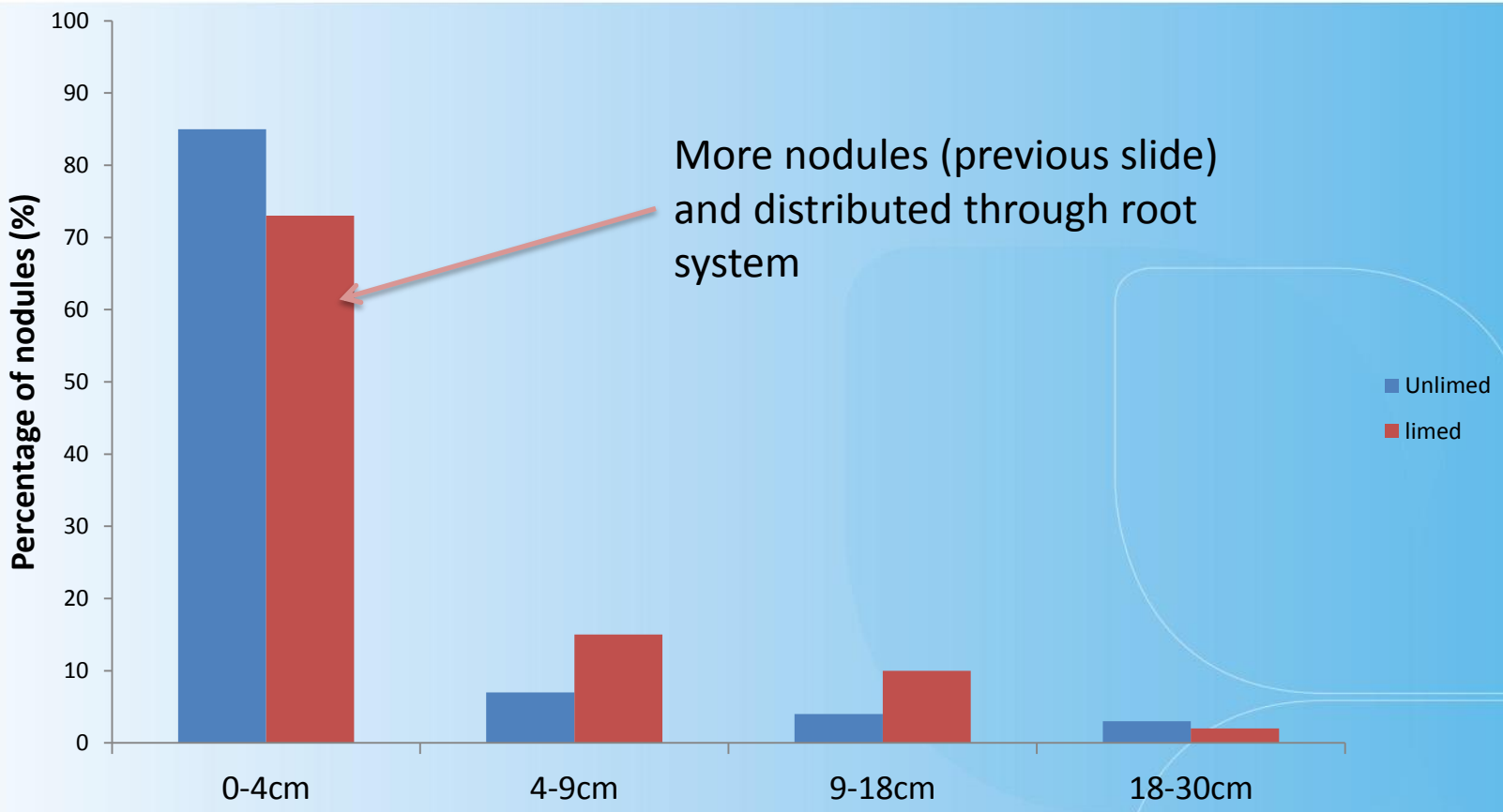
- Most rhizobia activity in top 20 cm soil with majority in the top 10 cm
- A relatively small change in pH via liming may induce significant change in nodulation and nitrogen fixation
- Non-legumes without access to nitrogen can’t perform at their best

Improving life for rhizobia



Richardson et al. (1988)

Improving life for rhizobia



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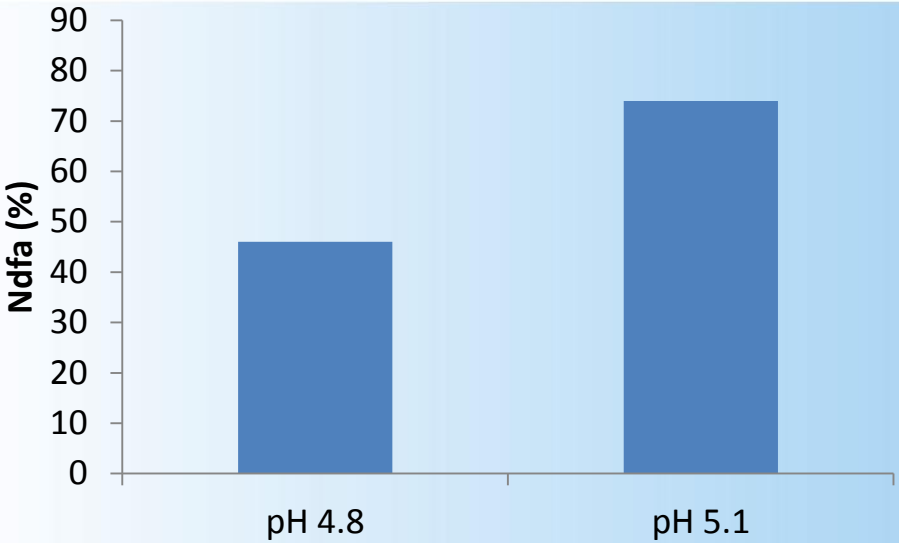
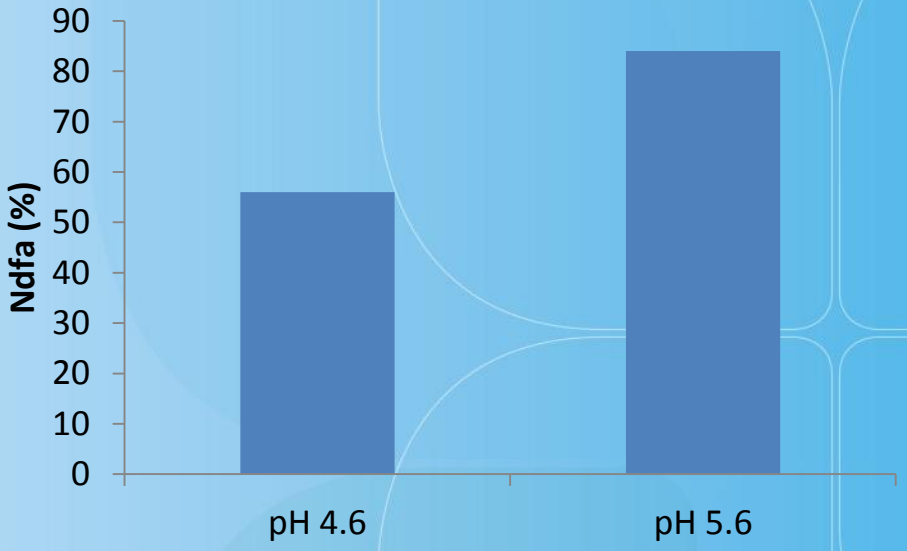


Unkovich et al (1996)



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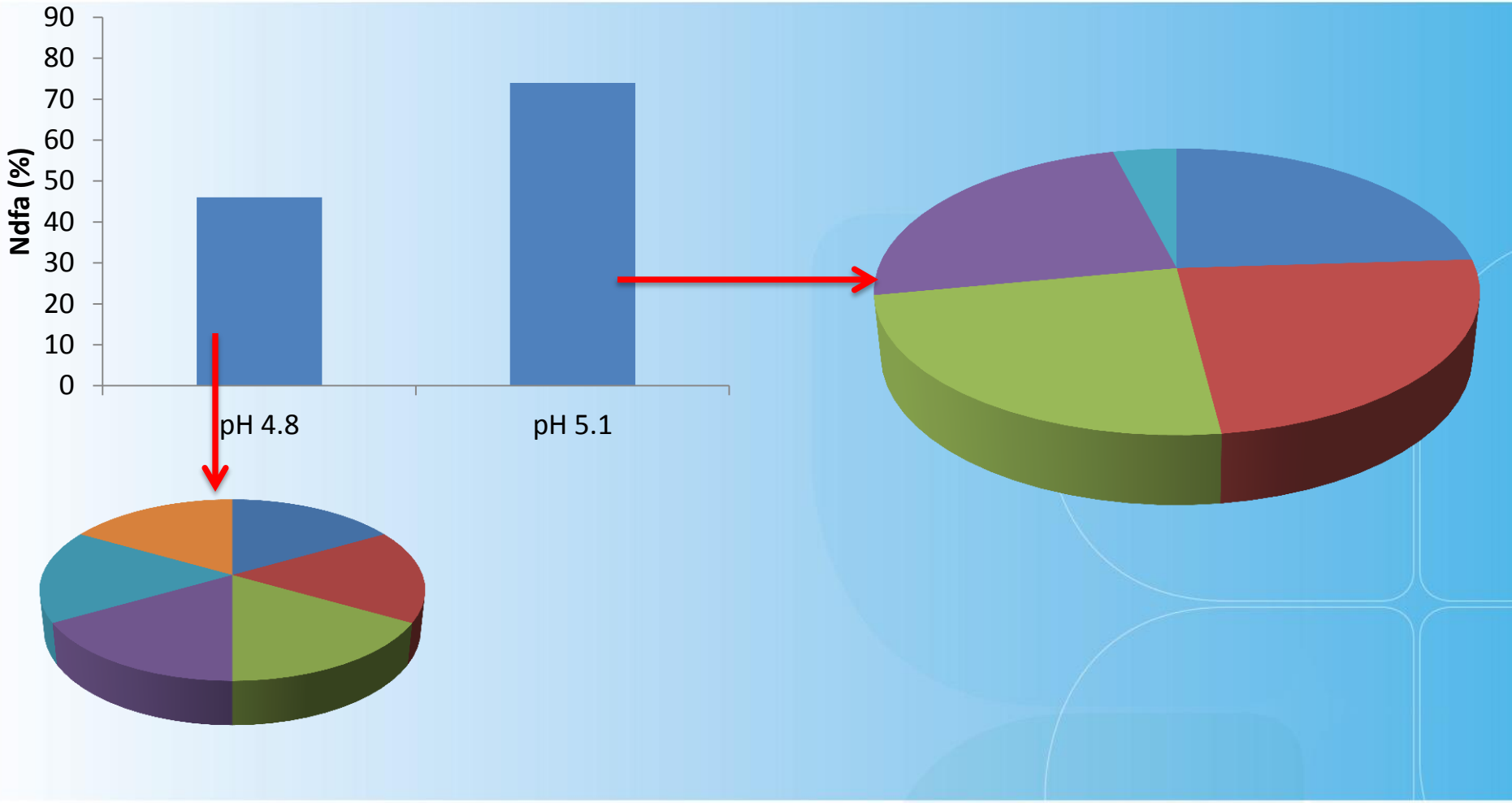


Unkovich et al (1996)

How long do un-protected rhizobia live?

Event	Time Elapsed (**hours**)	**Number & %** Surviving per seed
At Inoculation (inoculant applied to seed in a 0.75% methylcellulose slurry)	0	1,445,000 * (100%)
Lupins **mixed** in vertical feed mixer and augered into truck	1	141,200 # (9.8%)
Transported to field and augered into air seeder box (**sampled from seeder box)**	4.75	11,200 # (0.8%)
Planted by air seeder	4.8	6,761 # (0.5%)
Recovered from soil	22.5	1,175 # (0.1%)

* Theoretical number derived from number in inoculant slurry.

Numbers determined by MPN method.

Reference: Roughley et.al 1993 Soil Biol. Biochem.25:1453-1458.

Preparation – how much seed is in an old pasture?

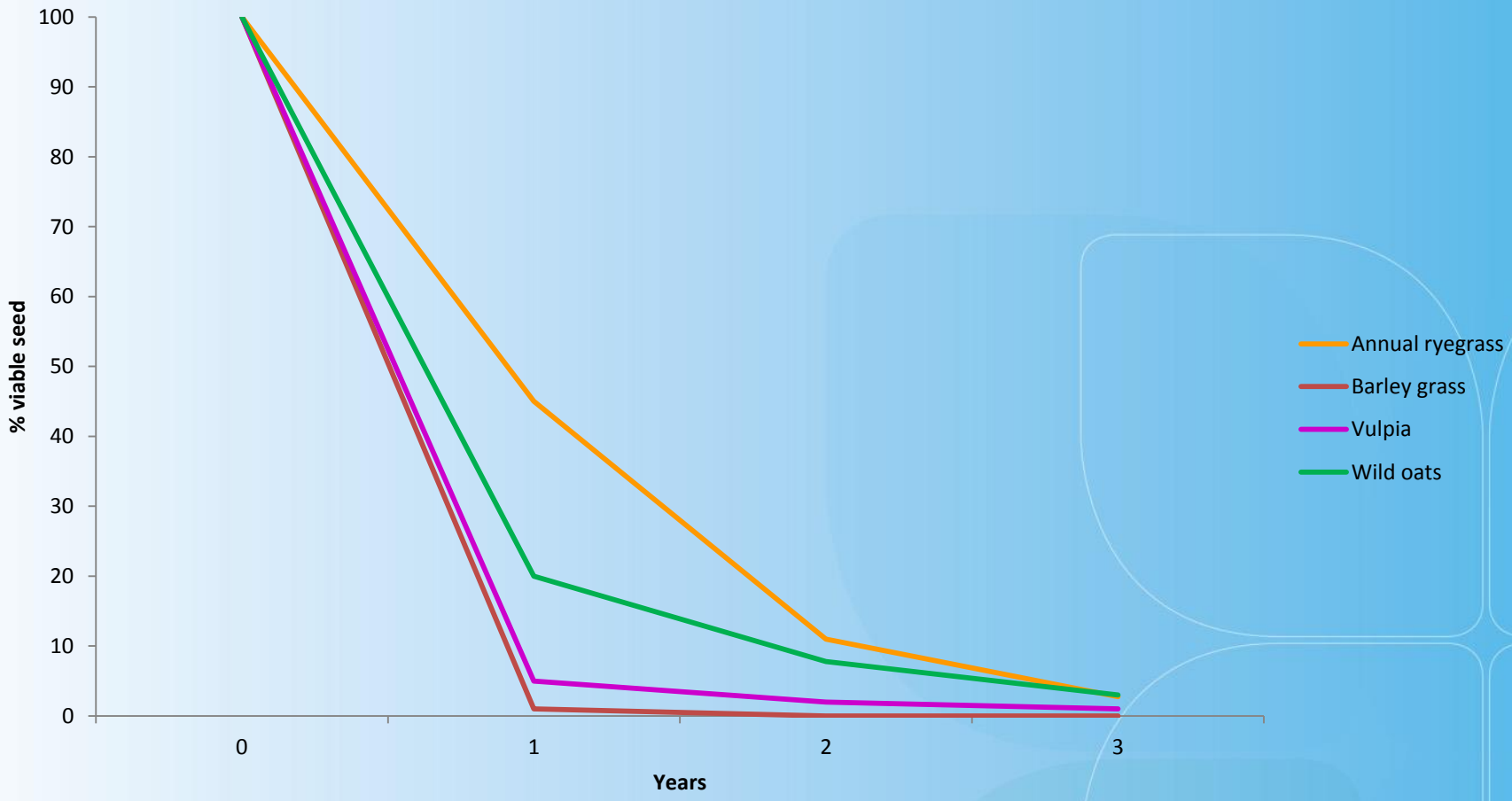
What is the weed seed level in a pasture?

Table 3.1 Germinated seed found after three years of either continuous grazing or where hay was cut each spring in an old (degraded) phalaris pasture in southern NSW.

Treatment	Phalaris	Sub clover	Annual grasses	Broadleaf weed	Other legume	Toadrush
Continuous grazing	158	3660	5859	1020	895	3263
Spring hay cut	0	1450	668	419	215	215

Source: Bowcher 2002

Weed seed bank-annual grasses



Sources: Dowling et al (1991); Peltzer and Mason (1999);

Preparation – how much seed is in an old pasture?

What is the weed seed level in a pasture?

	Annual grass	Broadleaf weed
Continuous grazing	5859	1020
Spring hay cut	668	419
'Ideal' clean	59	10

Sources: Dowling et al (1991); Peltzer and Mason (1999); Bowcher (2002)

Sowing rate – how much do you use?

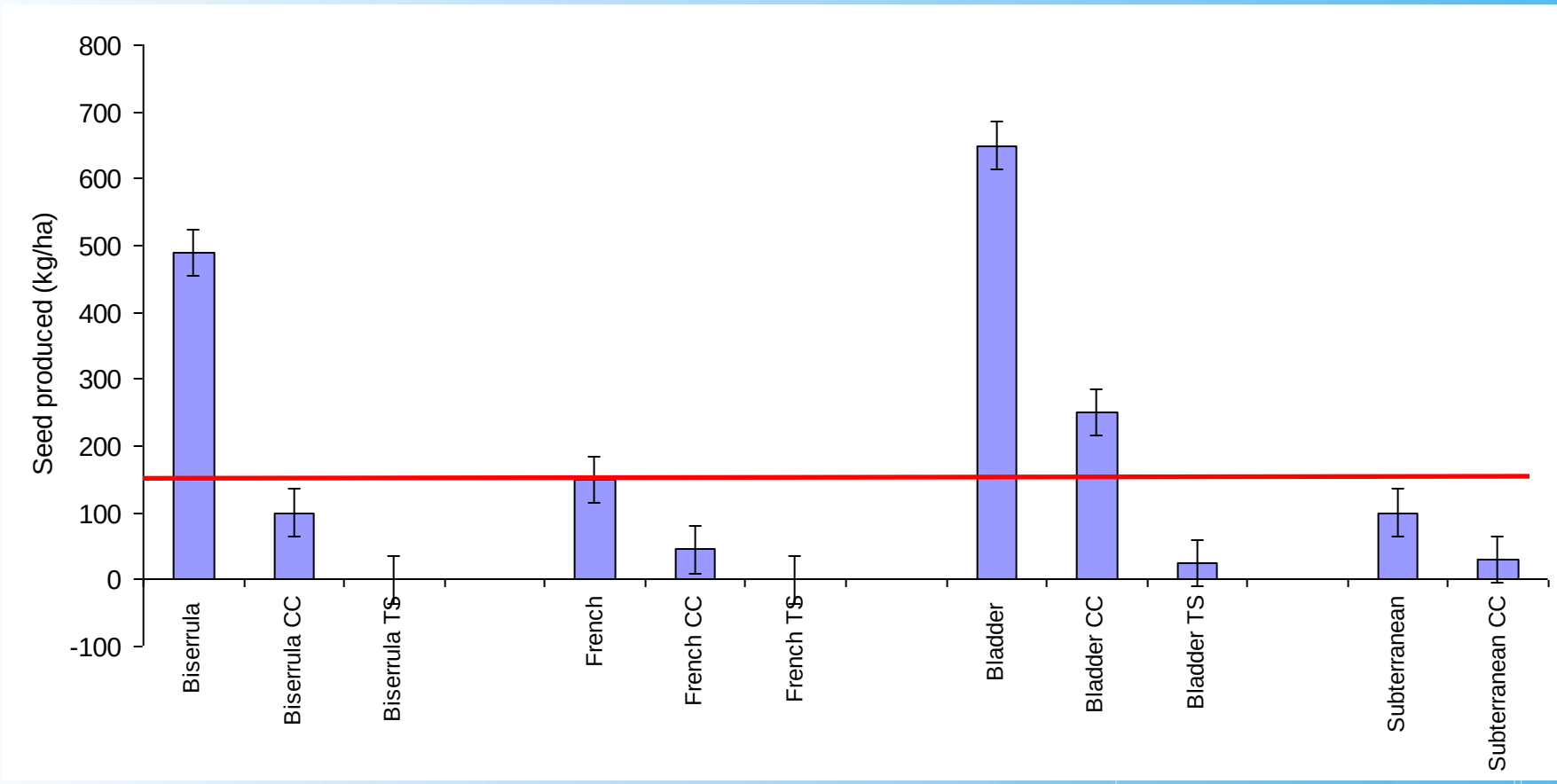
- Sowing rates compared to weed seed bank are low
- Sub clover sown at 4 kg/ha
  - 120 000 seeds/kg x 4kg/ha = 480 000 seeds/ha
    = 48 seeds/m2
- Phalaris sown at 3 kg/ha
  - 650 000 seeds/kg x 3 kg/ha = 195 seeds/m^2

	Annual grass	Broadleaf weed
Continuous grazing	5859	1020
Spring hay cut	668	419
'Ideal' clean	59	10

Sowing technique

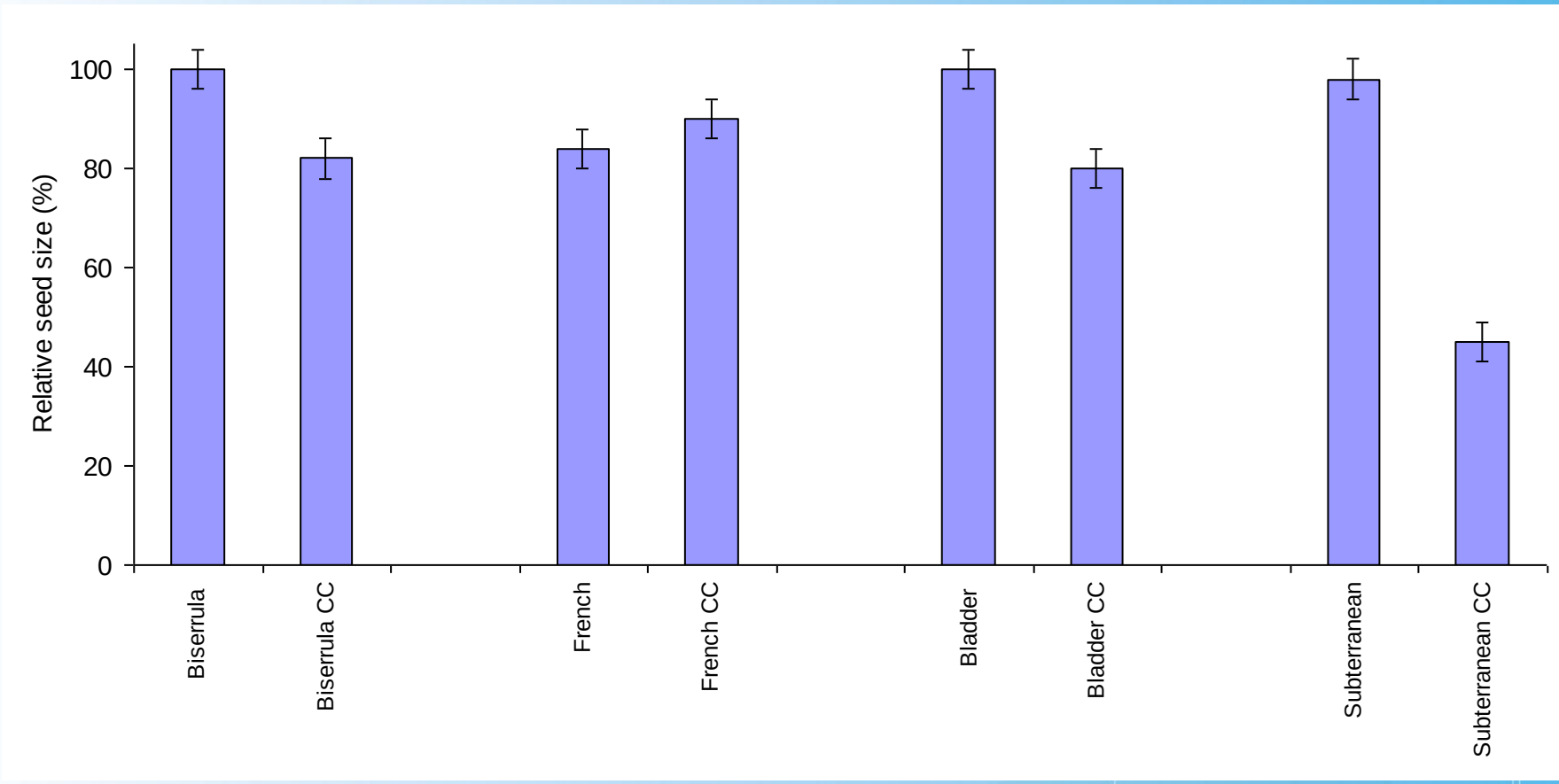
- Options
  - Stand alone
  - Undersowing/cover cropping
  - Summer sowing (need unscarified/in-pod seed)
  - Twin sowing (need unscarified/in-pod seed)

Establishment technique and seed yield



Source: Hackney et al. (2013)

Sowing technique and seed size

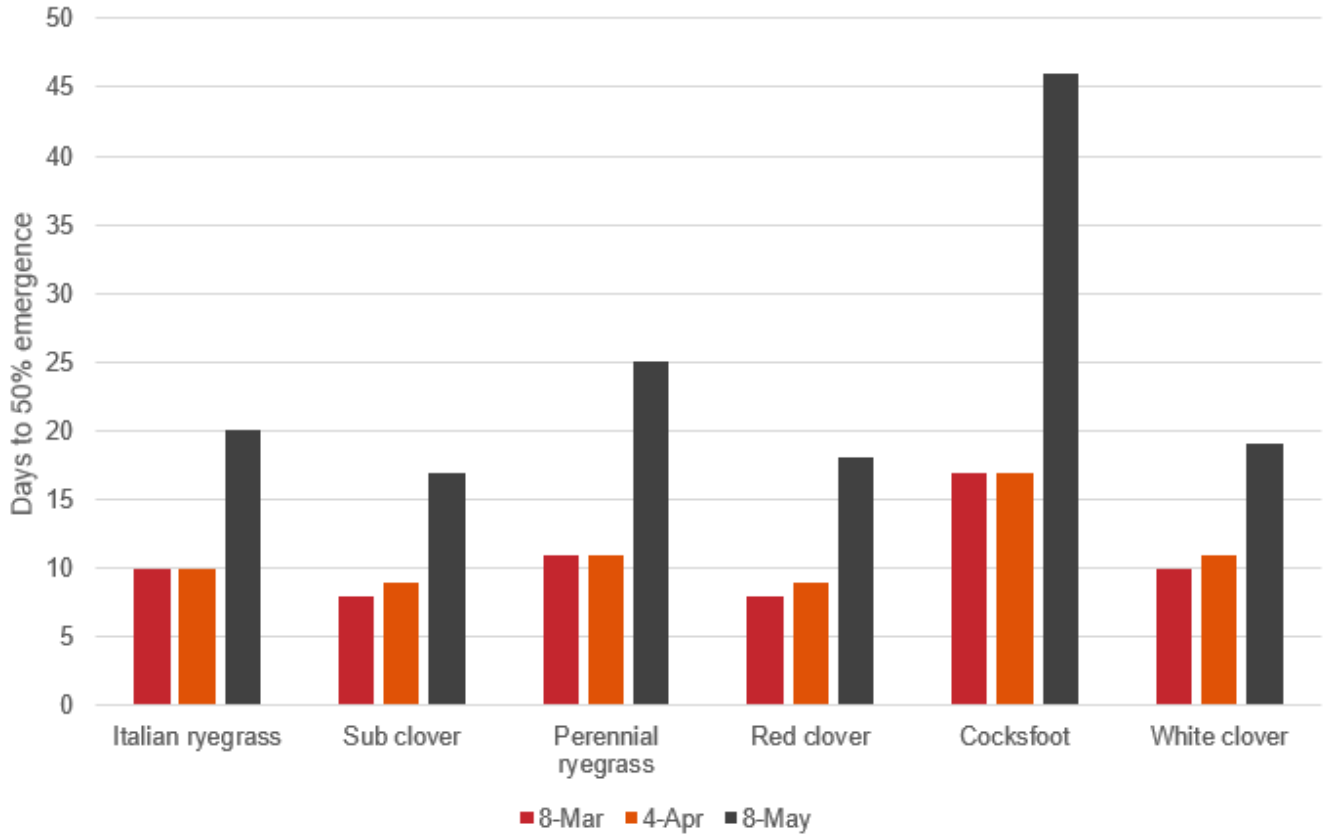


Source: Hackney et al. (2013)

Sowing time – when do you sow?

- Annual legumes
  - need to be sown in autumn (preferably early)
  - ***NOT*** Winter – too cold
  - ***NOT*** spring – not enough time to set seed
  - ***options now for summer sowing……more later***
- Perennial grasses and lucerne
  - autumn
  - late winter/spring
  - think about annual companion legumes
    - after??
    - before??
- Pastures containing perennial grasses will tend to run to grass dominance over time
  - legume seedbank and management for legume regeneration critical

Sowing time – when do you sow?



Moot et al. (2000)

Sowing - depth

- Most pasture seed quite small:
- Subclover – 130 000 seeds/kg
- Balansa clover – 1 500 000 seeds/kg
- Lucerne – 500 000 seeds/kg
- Cocksfoot – 1 300 000 seeds/kg
- Phalaris – 650 000 seeds/kg

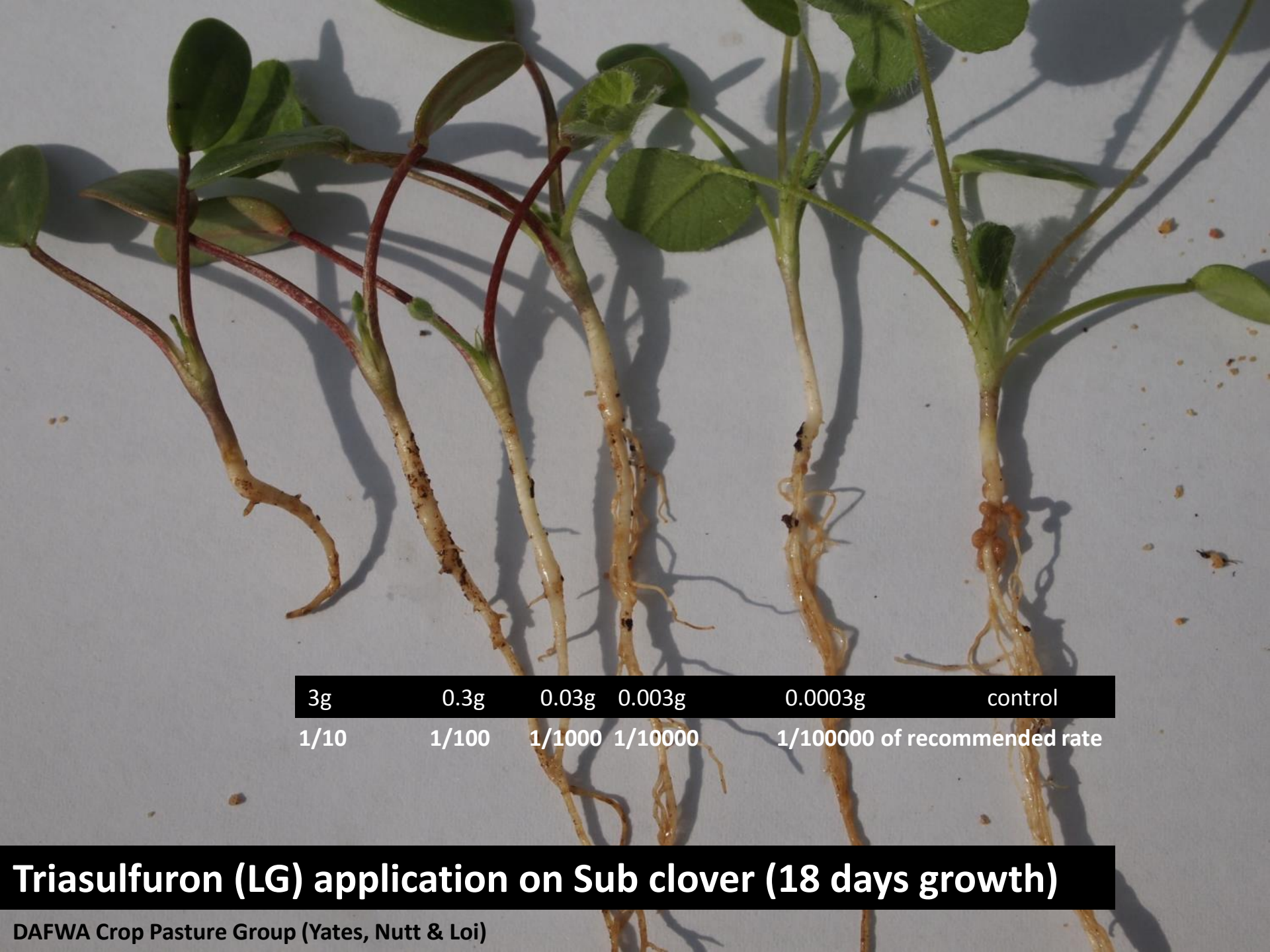
- Sowing depths > 1 cm can result in significant reduction in emergence

Sowing - scale

- Better to do a small area well than a large area poorly
- Don’t compromise on
    - Preparation
    - Species/variety choice to suit paddock limitations
    - Rate of sowing
        - Don’t lower rate to increase area
        - Seed nurseries can help get around this problem
    - Timing – if it’s getting too late, don’t do it.

Beware……

Chemical residues



Triasulfuron (LG) application on Sub clover (18 days growth)

DAFWA Crop Pasture Group (Yates, Nutt & Loi)

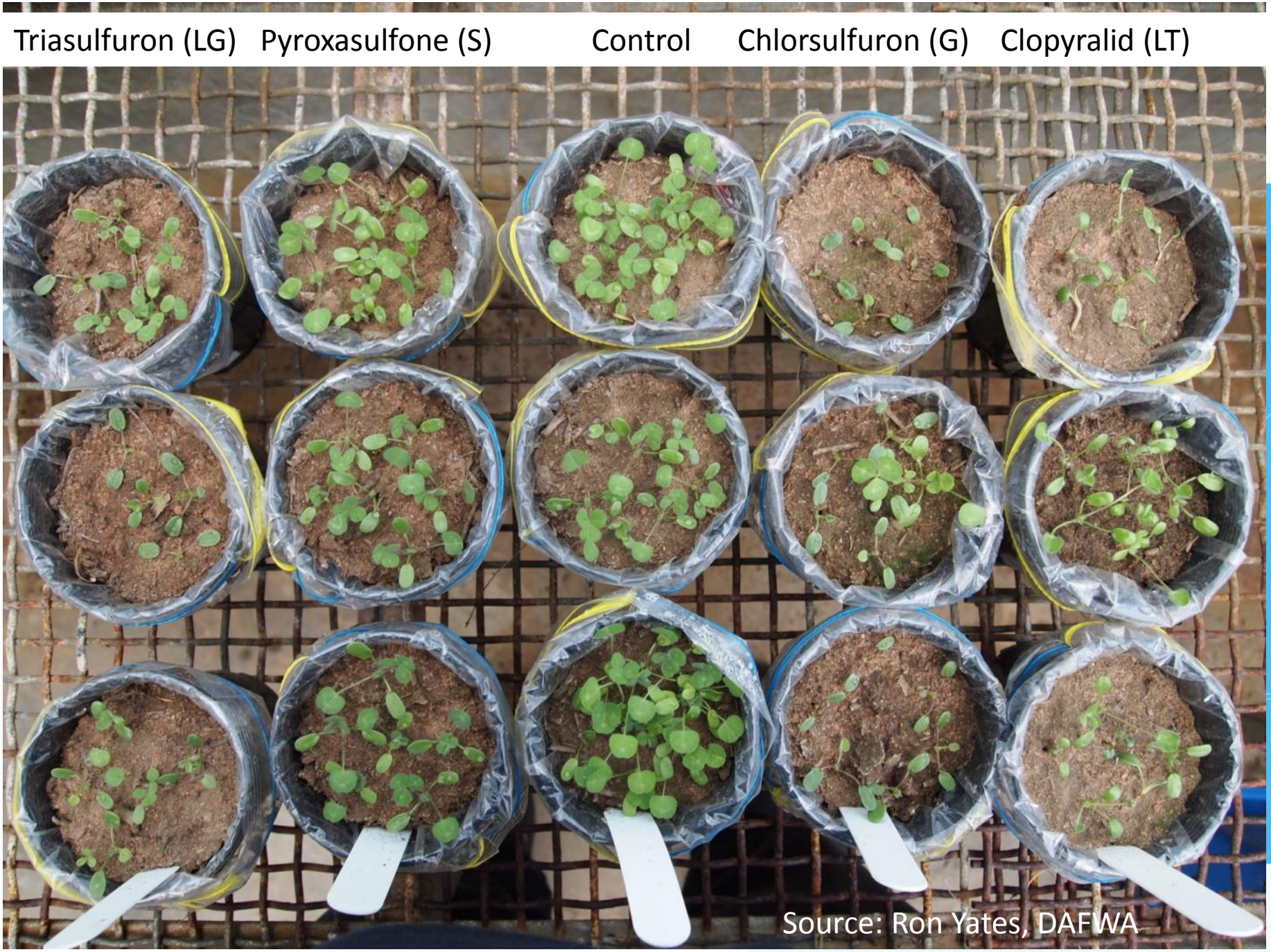

Triasulfuron (LG)
Pyroxasulfone (S)
Control
Chlorsulfuron (G)
Clopyralid (LT)
Source: Ron Yates, DAFWA

Photo: Jo Powells

Photo: Jo Powells

Summary

- Prioritise
- Know paddock limitations and what you can practically and economically do about them
- Manipulation only possible where there are exploitable differences
- If sowing new pasture, select to create exploitable differences
- Choose what you ***should*** grow
- Timing, timing, timing…….