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Improving pulse nodulation in stressful environments

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Stressful environments

Inoculation responsive sites

Low pH

- Bean, lentil, vetch & pea symbioses sensitive < pH 5.5
- Affects nodulation and persistence of rhizobia
- New rhizobia strains better than WSM-1455

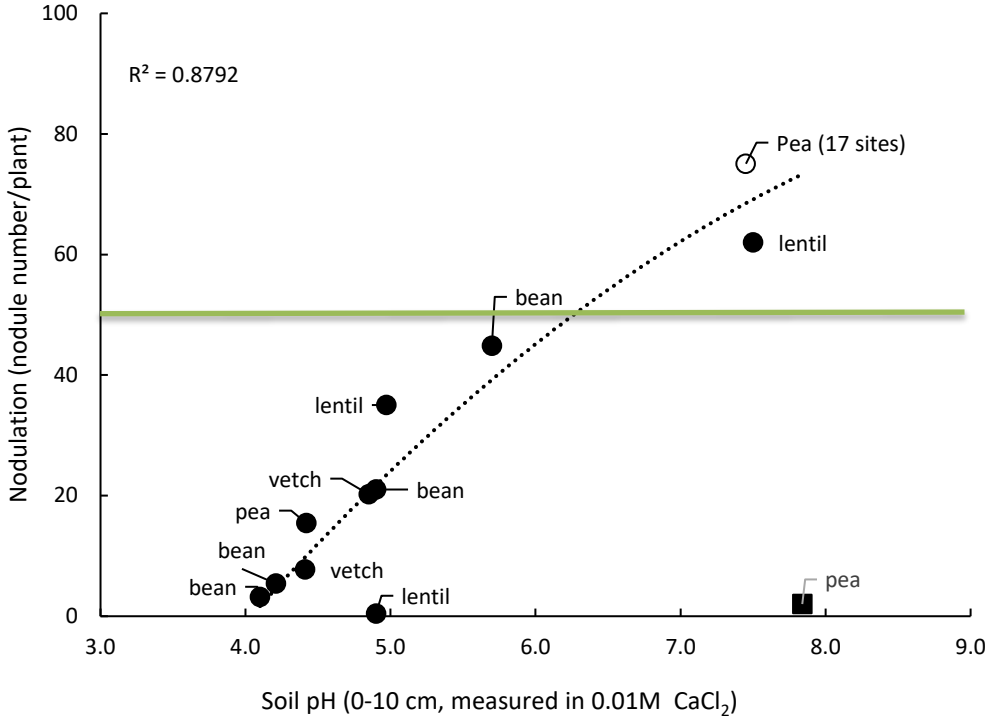
Dry sowing

- Insufficient moisture for plant germination
- Manage cropping program and early break advantage
- 2016: No guidelines for inoculation when dry sowing

Low soil pH

Impact of soil pH on legume nodulation

E/F legumes inoculated with WSM-1455 (Group F)

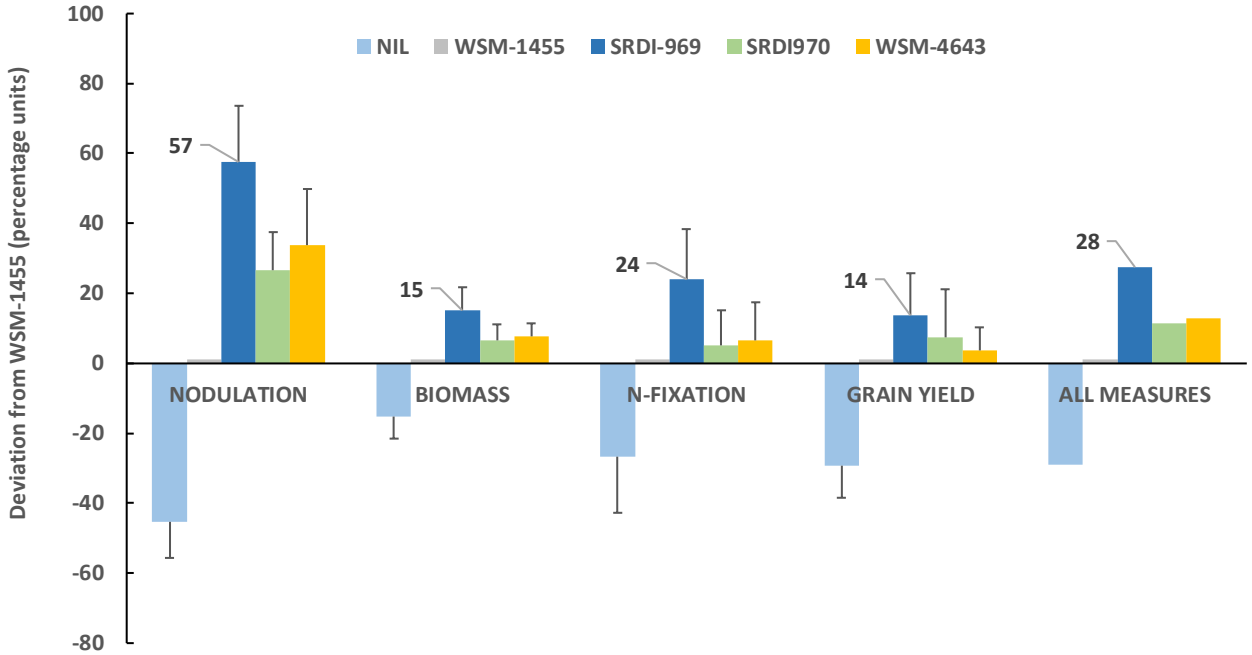


New strains of rhizobia

Strain	Origin	Soil pH_{Ca}
WSM 1455 (Group F inoculant)	Greece (released 2002)	8.0
SRDI 969	Riverton SA	4.7
SRDI 970	Katanning WA	7.3 (limed)
WSM 4643	Italy	5.5

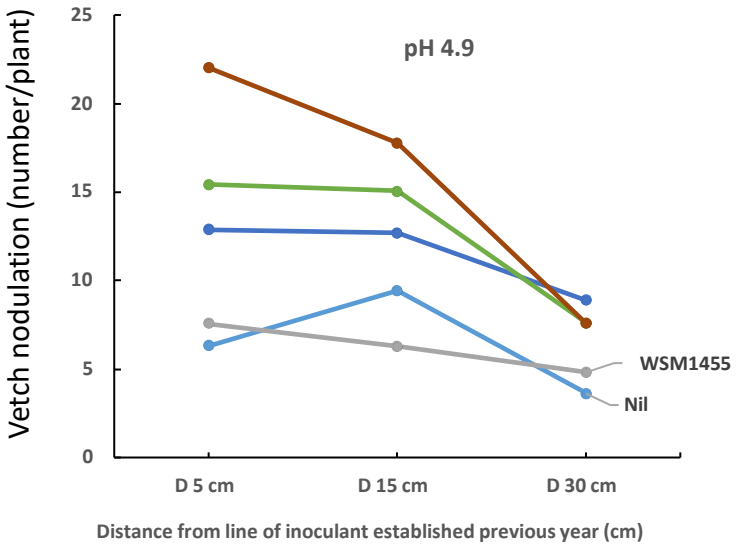
Pulse crop performance

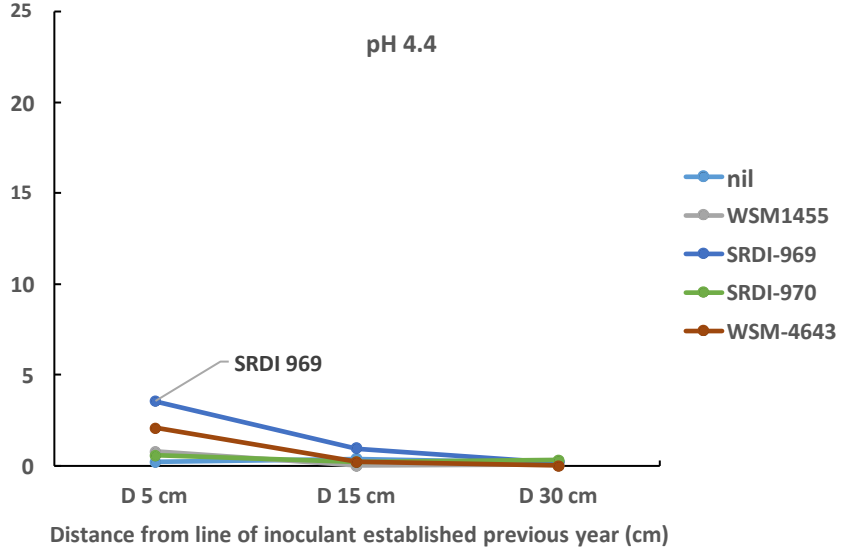
At up to 19 sites, median pH 4.7



Rhizobia strain colonisation of soil

Two sites, pH 4.9 and 4.4.
Nodulation of vetch, one year after rhizobial introduction





Summary of acidic soil work

Inoculation & rhizobia

- Inoculate
- New rhizobia better, but there are limits
- Soil colonisation restricted, re-inoculation still needed
- Likely release of rhizobia strain 2021

Large responses to rhizobia strain & inoculation rate measured

Lime application

- Liming needed, negligible nodulation at pH 4.2
- Promote root growth
- Avoid nutrient toxicities

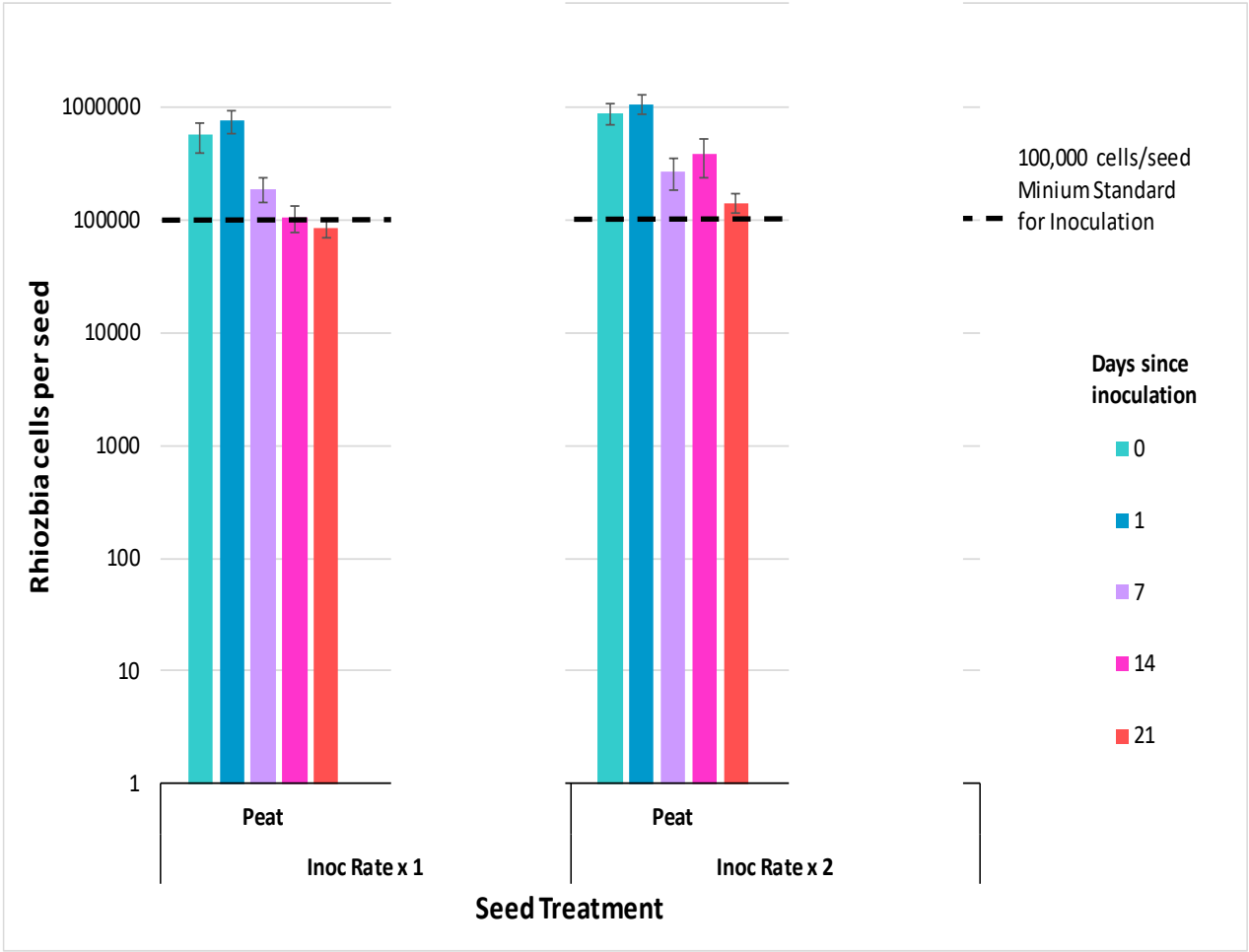
Impact of decreasing pH from 5.0 (left) to 4.0 (right) on bean roots

Dry sowing

Insufficient moisture for plant germination

Survival of rhizobia as peat on seed

- Peat slurry applied to seed
- Simulated dry sowing
  (2% w/w moisture)



Field efficacy of rhizobia inoculation as peat on seed

Bean @ Wanilla

pH_{Ca} 4.4 & dry 30 days

Chickpea @ Lameroo

pH_{Ca} 7.8 & dry 18 days

Lupin @ Mintaro

pH_{Ca} 5.0 & dry 7 days

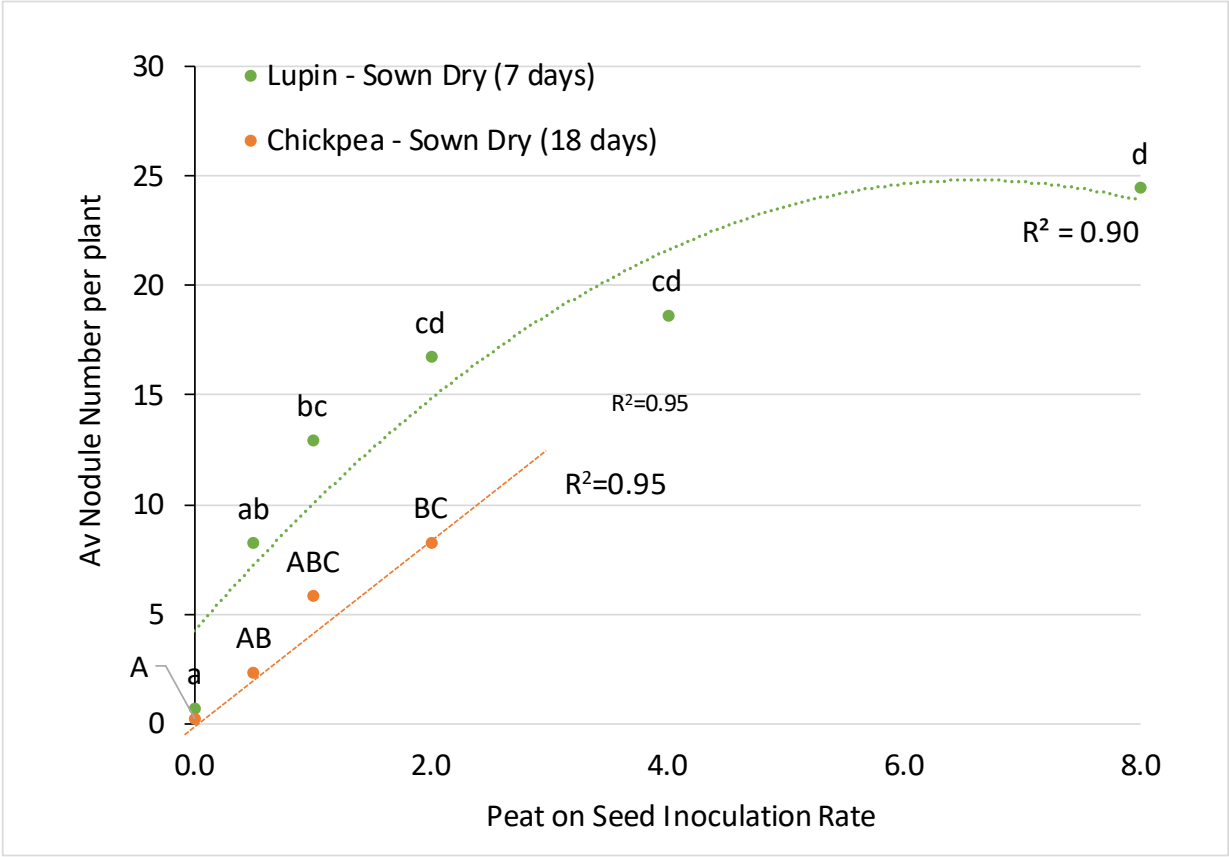
2 x std rate

1 x std rate

WSM1455

Field efficacy of rhizobia inoculant as peat on seed

Increasing rate of peat applied to seed increased nodule number per plant.

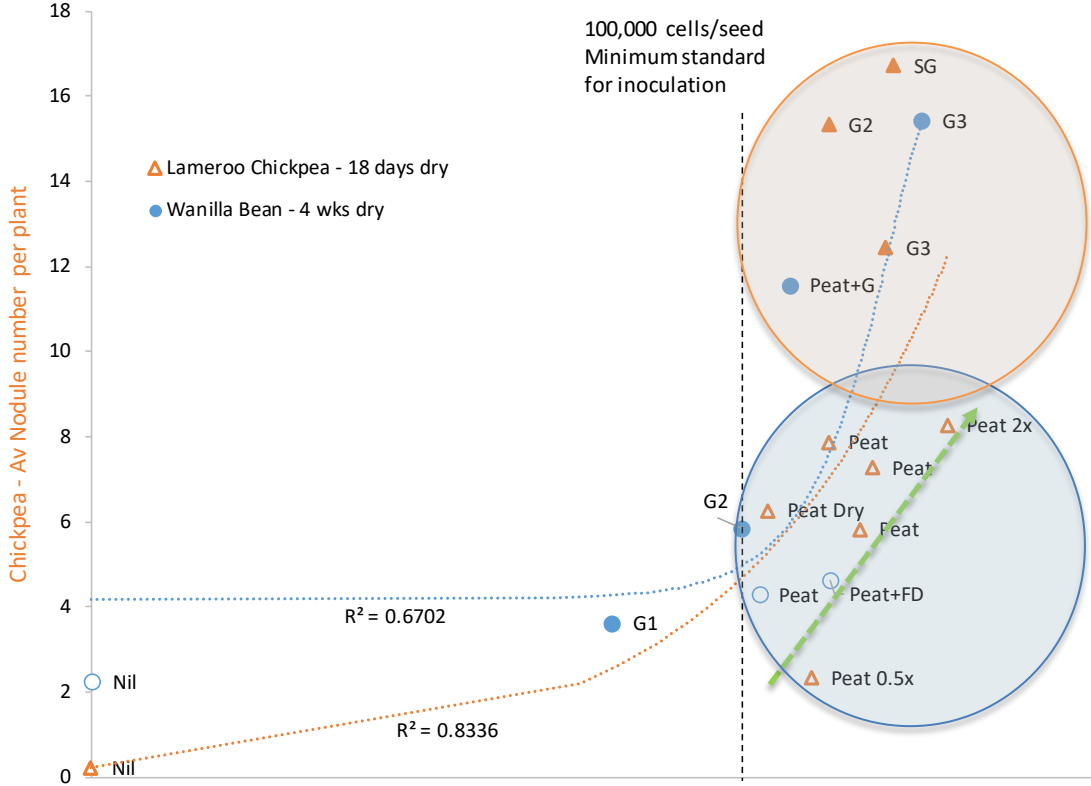


Field efficacy of rhizobia inoculants when dry sowing

High count granules can provide good nodulation when dry sowing

Performance of granules has been variable

Granules



Inoculation for dry sowing
Factors optimising / Limiting Success

Optimising	Limiting
More Rhizobia Double Rate Peat High Count/Quality Granules	**Days Dry (>7)**
Lower soil temperatures (May Sowing - 15degC)	**Low pH (<5.5 CaCl2)**
	Seed Chemicals

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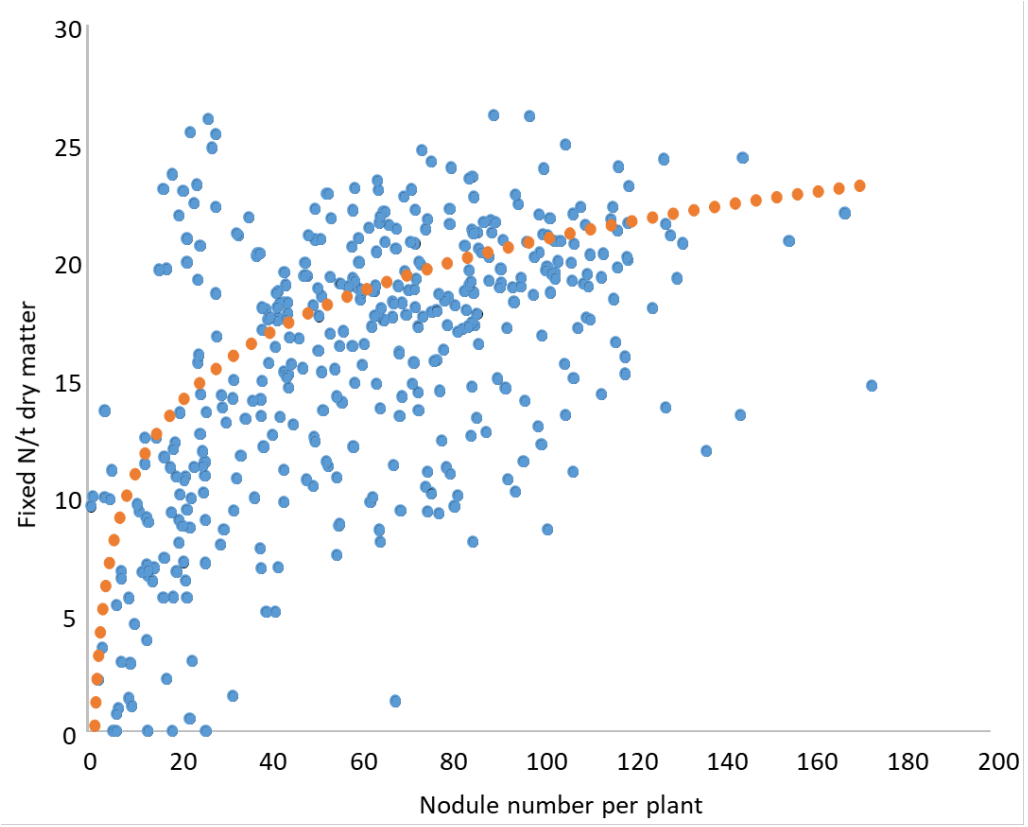
HART FIELD SITE GROUP

MINNIPA AGRICULTURAL CENTRE

SARDI PULSE AGRONOMY TEAMS

AGRICULTURE VICTORIA

Nodule number and N-fixation

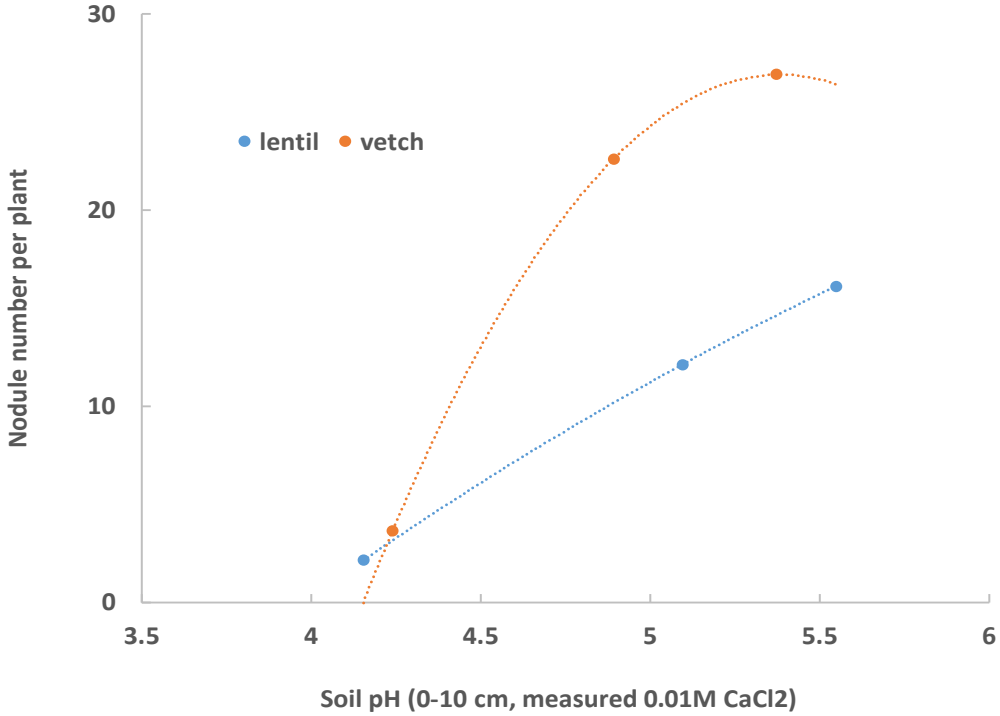


Selection of acid tolerant rhizobia for bean/lentil

- 11 field trials in 2018 (19 since 2015)
    - bean, lentil, pea, vetch
- Inoculation treatments applied as peat slurry to seed
    - Peat (no rhizobia)
    - WSM-1455 (Group F for bean)
    - SRDI-954, 969, 970, 1000
    - WSM-4643 (Ron Yates, DPIRD)
- Measured
    - Nodulation
    - Maximum dry matter production (mid pod fill)
    - N_2-fixation
    - Grain yield

Relative legume sensitivity

Comparison of lentil and vetch. Wirrabarra SA. pH 4.2



Survival of rhizobia as peat on seed.

Average soil temperature ° C (2000-2016)

		Month	
	Depth	April	May
Roseworthy	5cm	21	16
	10cm	19	15
Minnipa	5cm	21	16
	10cm	20	15
Loxton	5cm	22	17
	10cm	21	16