Knowing Your Nodules

Monaro Legume Nodulation Survey

NSW GOVERNMENT Local Land Services South East

MFS MONARO FARMING SYSTEMS

mla MEAT & LIVESTOCK AUSTRALIA

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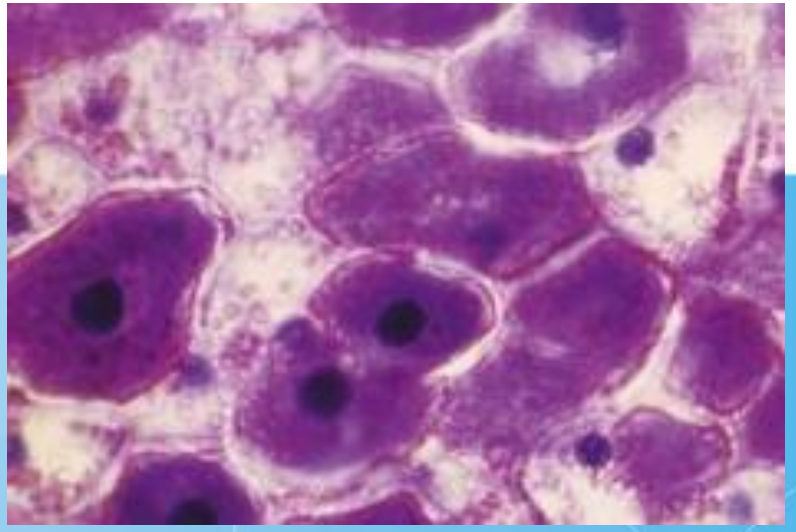
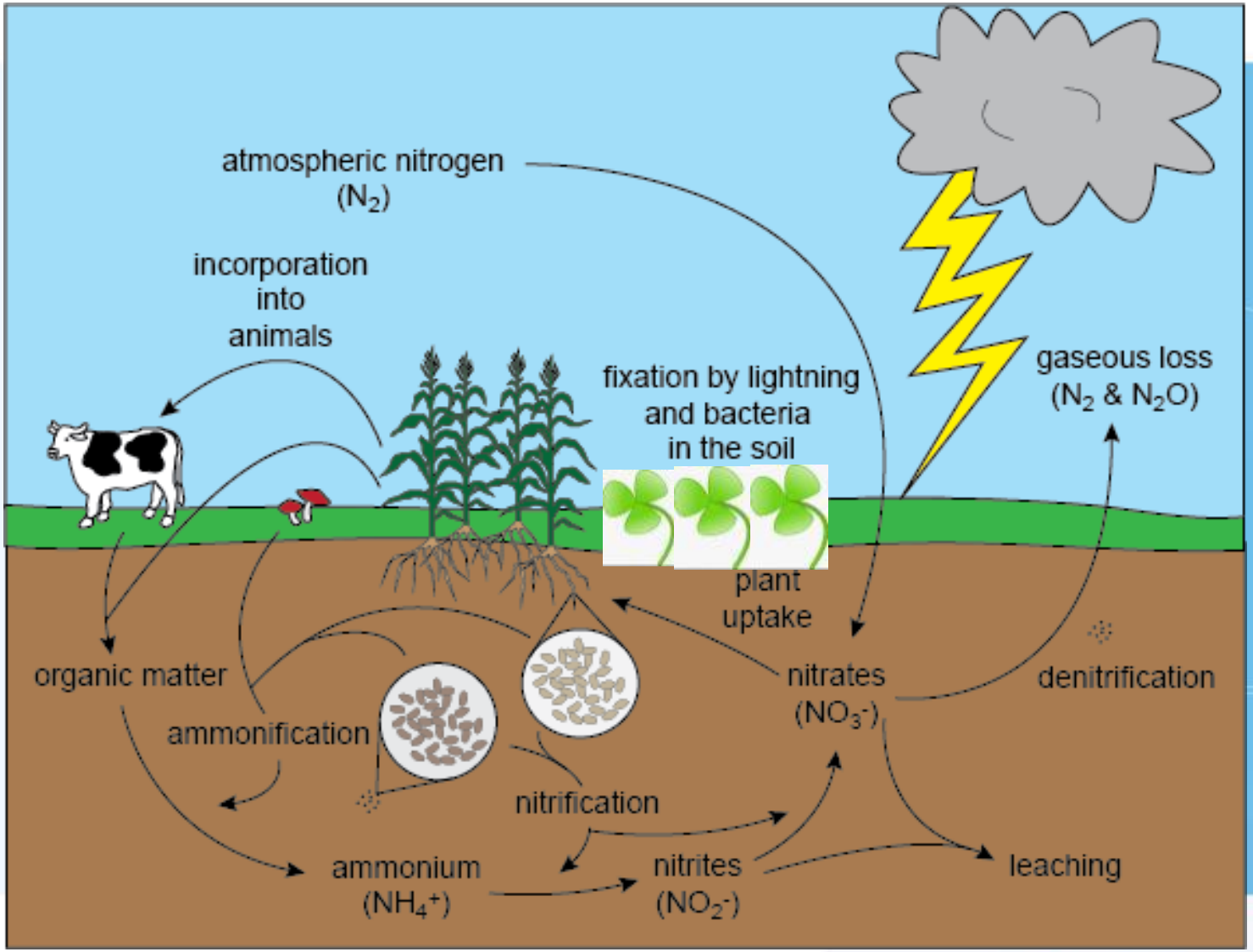


Knowing Your Nodules

- Nodulation Survey and Nodule Results
  - Jo Powells, South East LLS
- Rhizobia Identification and MALDI ID
  - Dr Sofie De Meyer, Murdoch University W.A.
- Soil Constraints and N-Fixation
  - Dr Susan Orgill, NSW DPI
- Paddock Management, other factors that might be affecting nodulation
  - Dr Belinda Hackney, Charles Sturt University
- Case Studies from the Monaro Survey and Where To From Here……

The N cycle

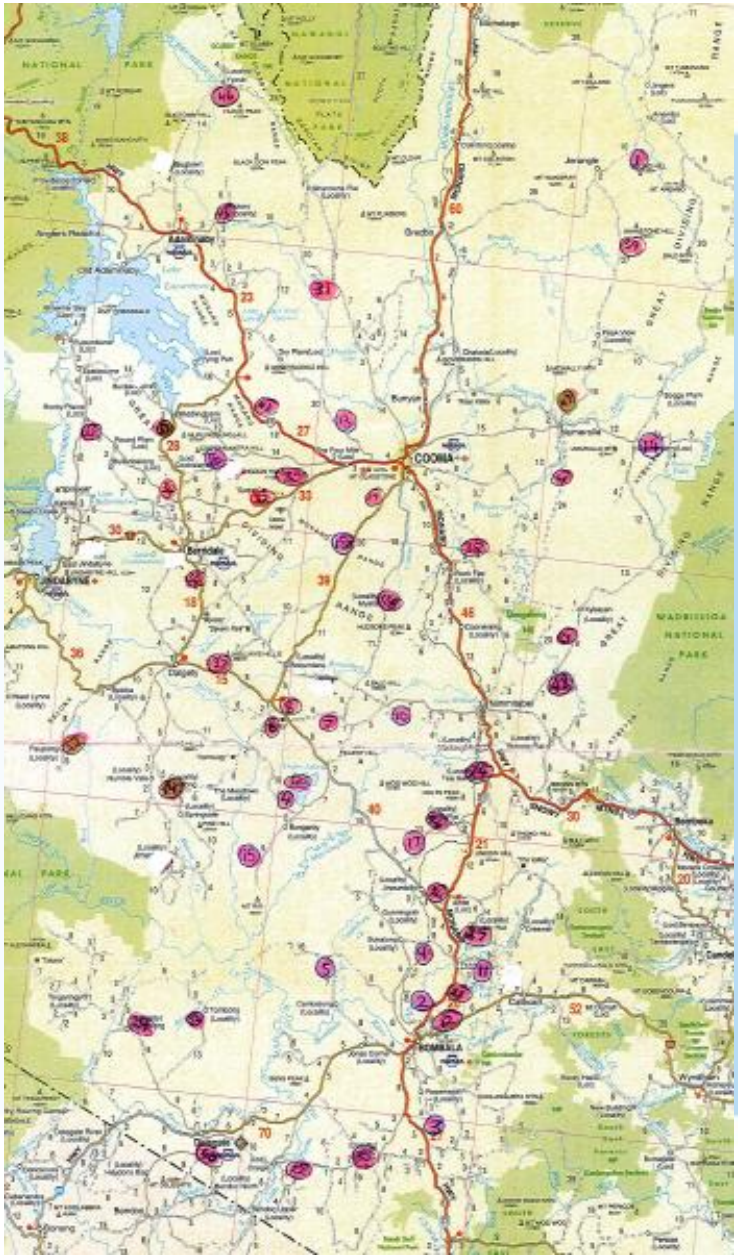


http://www.shmoop.com/ecology/nitrogen-cycle.html

What did we want to find out?

- What is the current nodulation status of legumes across the Monaro?
- Is a healthy looking legume plant (above-ground) actually fixing nitrogen?
- Are the current rhizobia strains performing or not?
- Can we manipulate nodulation & nitrogen fixation in existing pastures?
- What are the limiting factors affecting legume production (including nodulation) and how can we address them?

Survey Locations



- North – Slap Up, Yaouk
- South – Delegate Station
- West – Rocky Plains
- East – Countegany

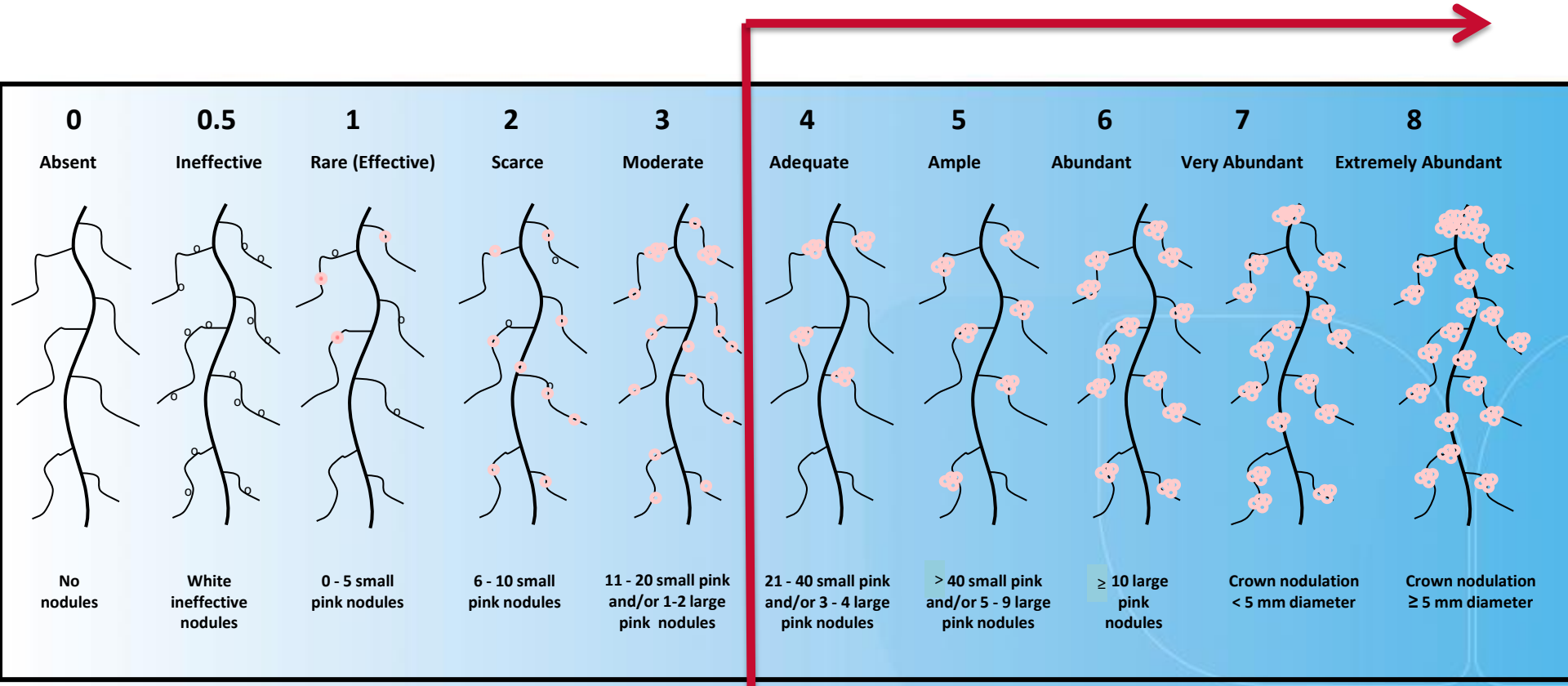
Site methodology

- A 20m X 20m grid was established on a representative area within the selected site (paddock).
- A GPS reading was taken at centre of the grid.
- Soil samples (0-10cm) collected and bulked together for a site sample.
- Pasture composition was assessed.
- “Chunks” of pasture & soil collected and taken away.

Methodology – what you didn't see!

- The "chunks" of pasture & soil were carefully washed by hand with a minimum of 15 legume plants retained.
- Nodule scores were assigned to each of the 15 legume plants from each site.
- 2 legume samples from the 15 washed samples were then photographed, root material (including nodules) removed and sent to the Centre for Rhizobium Studies for MALDI-ID processing.

Nodulation scores



Source: Ron Yates, DAFWA

Monaro Legume Survey Results

- Average nodulation score for the survey was **2.6**
- Average nodulation scores ranged from **1.1** to **5.1**
- Individual plant scores ranged from **0** to **8**
- On an individual plant basis (not site average), **83%** of plants had less than adequate nodules (score <4/8)
  - **44%** of plants had scarce, ineffective or no nodules (score <2/8)
  - **17%** of plants had ineffective or no nodules (score≤1/8)

Previous results in other LLS regions

- Spring 2015, 140 paddocks surveyed across Central West and Riverina LLS regions
  - Central West (60 paddocks)
    - 22% of paddocks had no nodules
    - 63% of paddocks scored <2 /8
    - 90% of paddocks scored <4 /8
    - Average score **1.8** /8
  - Riverina (80 paddocks) – average score **2** /8
- Spring 2016, Central Tablelands LLS region (30 paddocks) – average score **2.3** /8

Low scoring plant

Adequate scoring plant

And the top ten (well 11) nodule scoring sites are…..

- 4
- 6
- 8b
- 14b
- 18a
- 19
- 26
- 30
- 40
- 43a
- 47

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Factors affecting nodulation & N-fixation

- Specificity
- Soil texture
- Soil pH
- Soil fertility
- Herbicides
- Waterlogging
- Fungicides
- Insecticides
- Time since last inoculation
- Desiccation
- Time of sowing
- Drought

Monaro Legume Survey
Case Studies

theast

Site 40

Site 40

- Average nodulation score **5.1**
- Newly sown pasture sown in Autumn 2016
  - Plantain
  - Subterranean clover
  - White clover
  - Red clover
  - Arrowleaf clover
- Previous year sown to canola

Site 40

Site 40

- Average nodulation score **5.1**
- Soil pH ($CaCl_2$) **5.0**
- KCL Sulphur **13**
- Phosphorus Availability Index **1.9**
- Mixture of current group C and old group C rhizobia found
- Nitrate Nitrogen **5**
- Ammonium Nitrogen **5**

Site 50

Site 50

- Average nodulation score **1.1**
- Native pasture
  - Microlaena (weeping grass)
  - Stipa (corkscrew)
- Subterranean clover broadcast in 1969

Site 50

southeast

Site 50

- Average nodulation score **1.1**
- Soil pH ($CaCl_2$) **4.6**
- KCL Sulphur **2**
- Phosphorus Availability Index **0.4**
- Rhizobia results pending
- Nitrate Nitrogen **1**
- Ammonium Nitrogen **10**

Site 30

east

Site 30

- Average nodulation score **3.9**
- Introduced pasture sown autumn 2010
  - Lucerne
  - Phalaris (Australian)
  - Subterranean clover
- Dicamba (group I) used 2 months prior to sowing
- Lemat used for aphid control 3 months post sowing

Site 30

heast

Site 30

- Average nodulation score **3.9**
- Soil pH ($CaCl_2$) **4.2**
- KCL Sulphur **5**
- Phosphorus Availability Index **0.8**
- Current group C rhizobia found in both subterranean & white clover
- Nitrate Nitrogen **1**
- Ammonium Nitrogen **6**
- Possibly waterlogging?

Site 39

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Site 39

- Paddock undergoing pasture improvement, previous year under wheat.
- Dicamba (group I) and Brushoff (group B) applied early February
- Pasture sowing delayed due to dry autumn, all sub clover volunteer.

- Average nodulation score sprayed area **2.5**
- Average nodulation score unsprayed area **3.3**

Site 39

Site 39

- Soil pH ($CaCl_2$) **4.3**
- KCL Sulphur **2**
- Phosphorus Availability Index **1.2**
- Sprayed area had current group C, current group B and old group C rhizobia
- Unsprayed area had current group C rhizobia
- Nitrate Nitrogen **8**
- Ammonium Nitrogen **7**
- Possible herbicide effect?

Site 43a

Site 43a

- Paddock also undergoing pasture improvement, previous year under wheat.
- Flagship (Fluroxypyr, group I) applied mid-January and mid-March.
- Pasture sown early April.

- Average nodulation score sprayed area **3.7**
- Absence of lateral root development and nodules in the first 2cm of the legume roots.

Site 5

Site 5

- Improved perennial pasture sown in 2005 .
- Part of the paddock limed at 2.5T/ha in 2004, other remained unlimed.
- Paddock has been managed the same since, most recently fertilised with Mo single super at 150kg/ha.

- Average nodulation score limed area **1.9**
- Average nodulation score unlimed area **2.9**

Site 5

- Soil pH ($CaCl_2$) limed **5.4,** unlimed **4.7**
- KCL Sulphur limed **10,** unlimed **21**
- PAI limed **0.6,** unlimed **0.9**
- Both areas had the current group C rhizobia
- Nitrate Nitrogen limed **5.8,** unlimed **1.1**
- Ammonium Nitrogen limed **18,** unlimed **12**
- Possible liming effect still after all these years?

Site 5dd

Monaro Legume Survey

- Soil nutrients (especially sulphur & Mo)
- Soil pH
- Herbicide use pre-sowing
- Still finding old strains of rhizobia in paddock legumes, re-inoculate?
- 2016 was a wet winter and had slow start to spring, waterlogging effects?

Acknowledgements

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- All our participating farmers across the Monaro!