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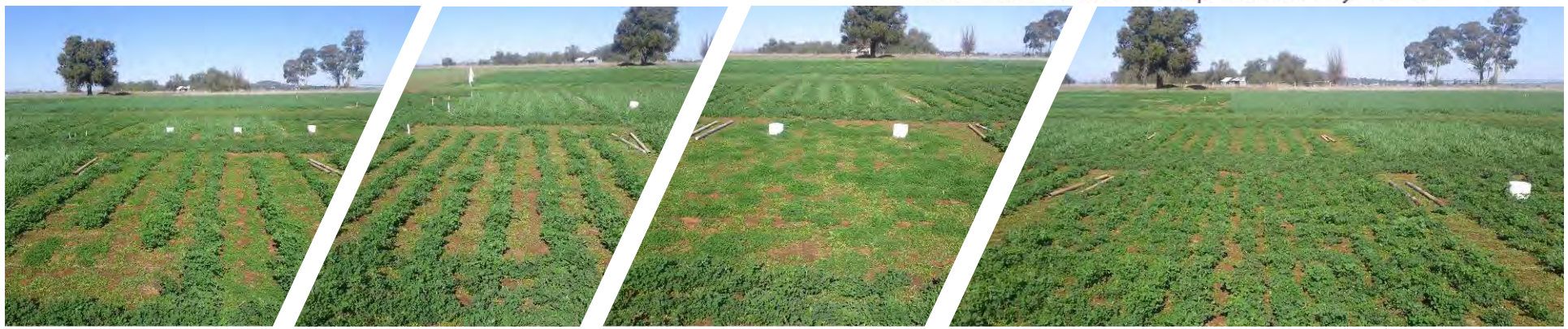
Perennials for better crop-livestock systems

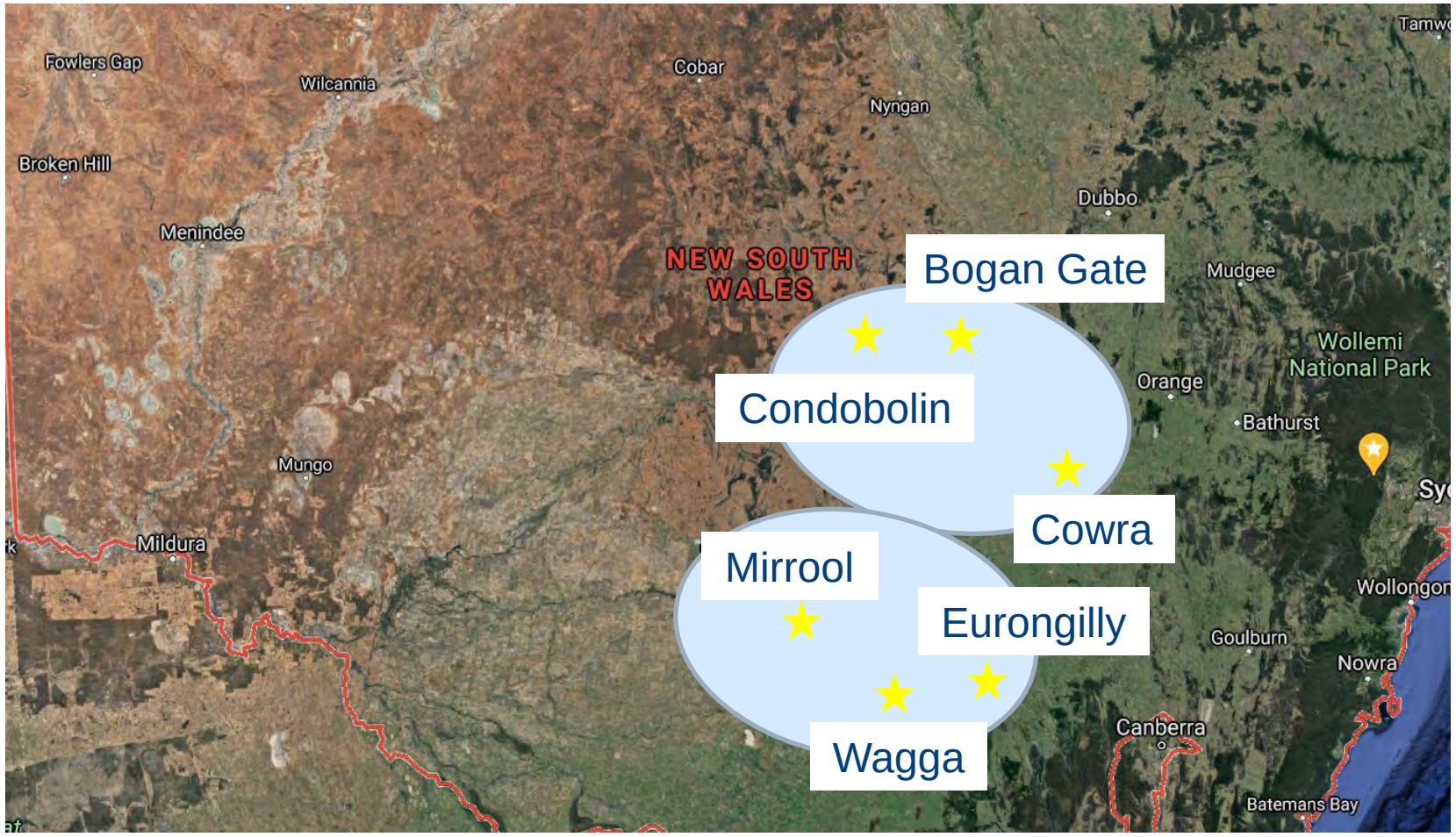


Richard C. Hayes,
Matthew T. Newell,
Keith G. Pembleton,
Mark B. Peoples &
Guangdi D. Li

Managing competition and lucerne persistence with sowing configuration

Can lucerne persistence be improved by changed spatial configuration at sowing?

Approach: 6 sites, 9 field experiments



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Riverina experiments

- n = 3
- 10 treatments
- Combinations of lucerne, phalaris or sub clover
  - Hayes *et al*. 2017, 2020
- Species sown concurrently, autumn 2012
- 25 cm row spacing
- No fertiliser in the drill row

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Key findings: Lucerne density – Central West

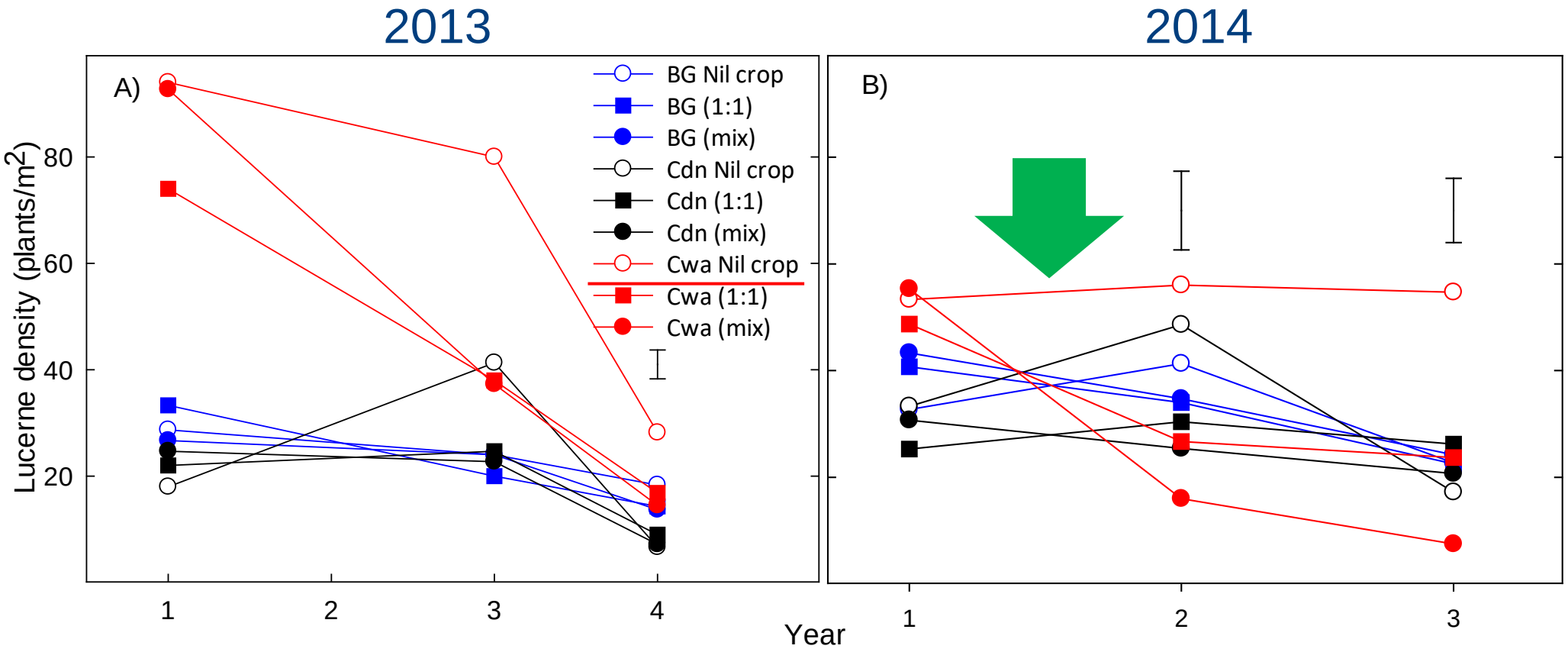
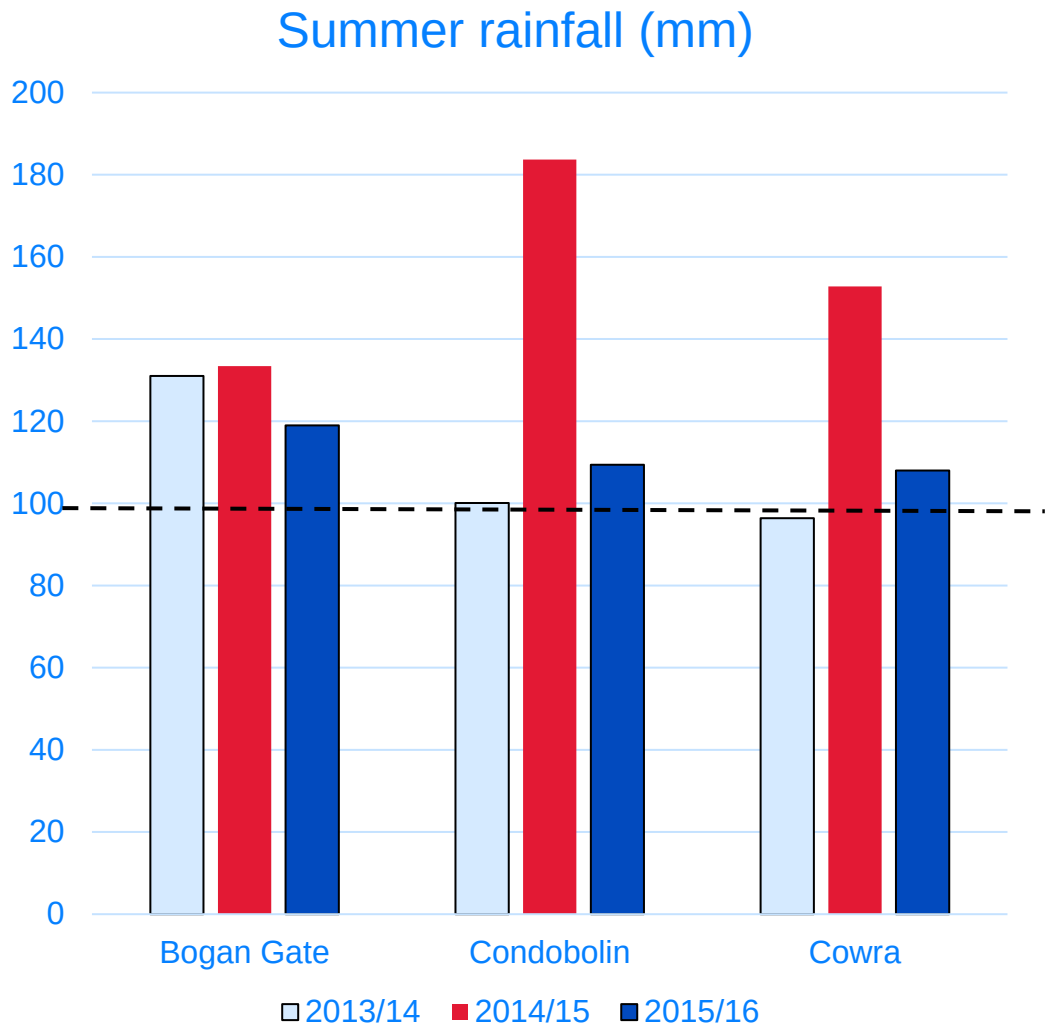
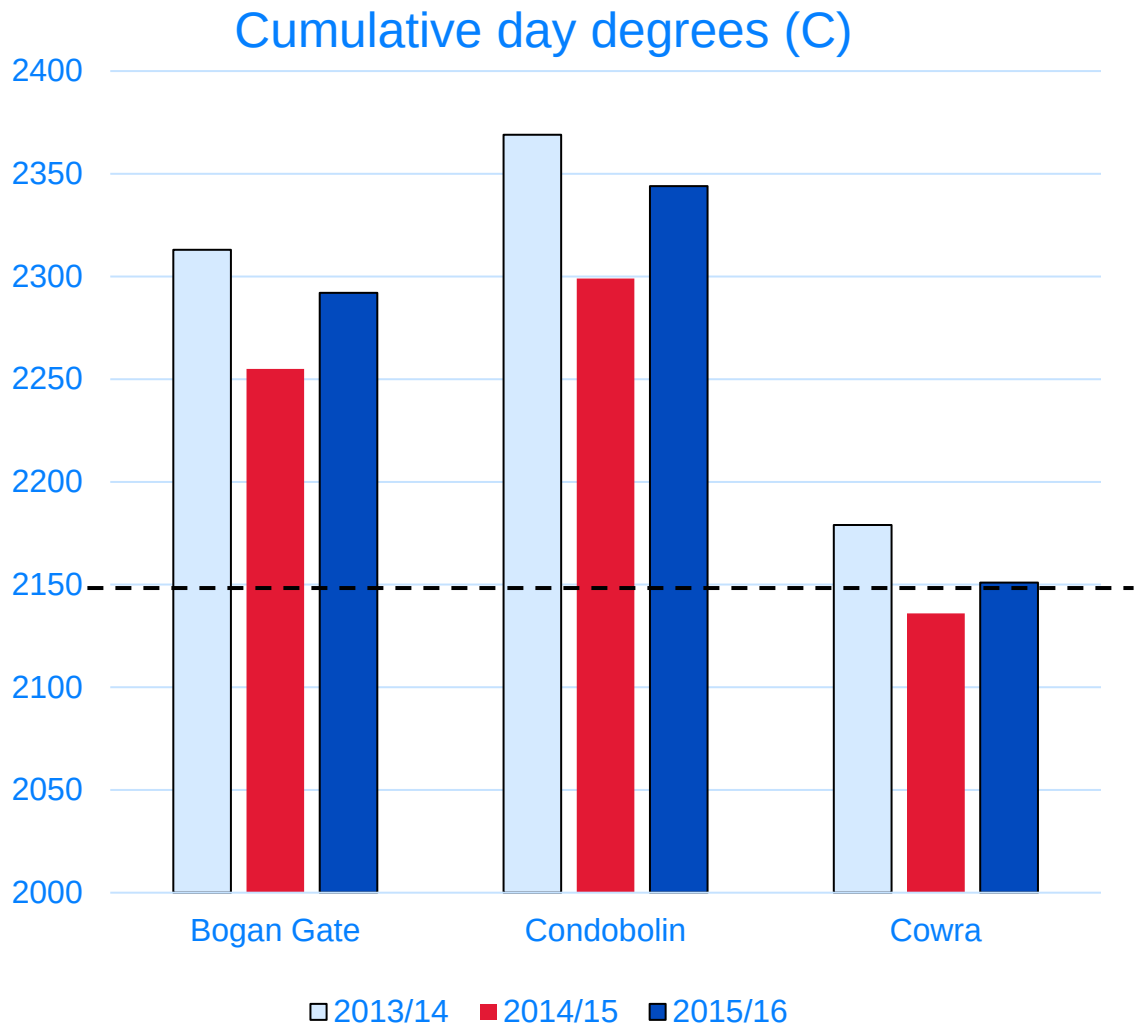


Fig. 1. Change in lucerne density through time due to spatial configuration associated with wheat crop only at experiments sown at three sites in the Central West in A) 2013, and B) 2014.
Error bars show l.s.d. at *P* = 0.05 on dates where a significant site x treatment interaction was observed. **Abbreviations**: BG, Bogan Gate; Cdn, Condobolin; Cwa, Cowra; Past-only, Pasture-only; 1:1, Pasture-crop (1:1); (mix), Pasture-crop (mix).

Climatic conditions – Central West





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Final lucerne density – Central West

Excavated 8540 plants from
1m x 1m quadrats (n = 382)!

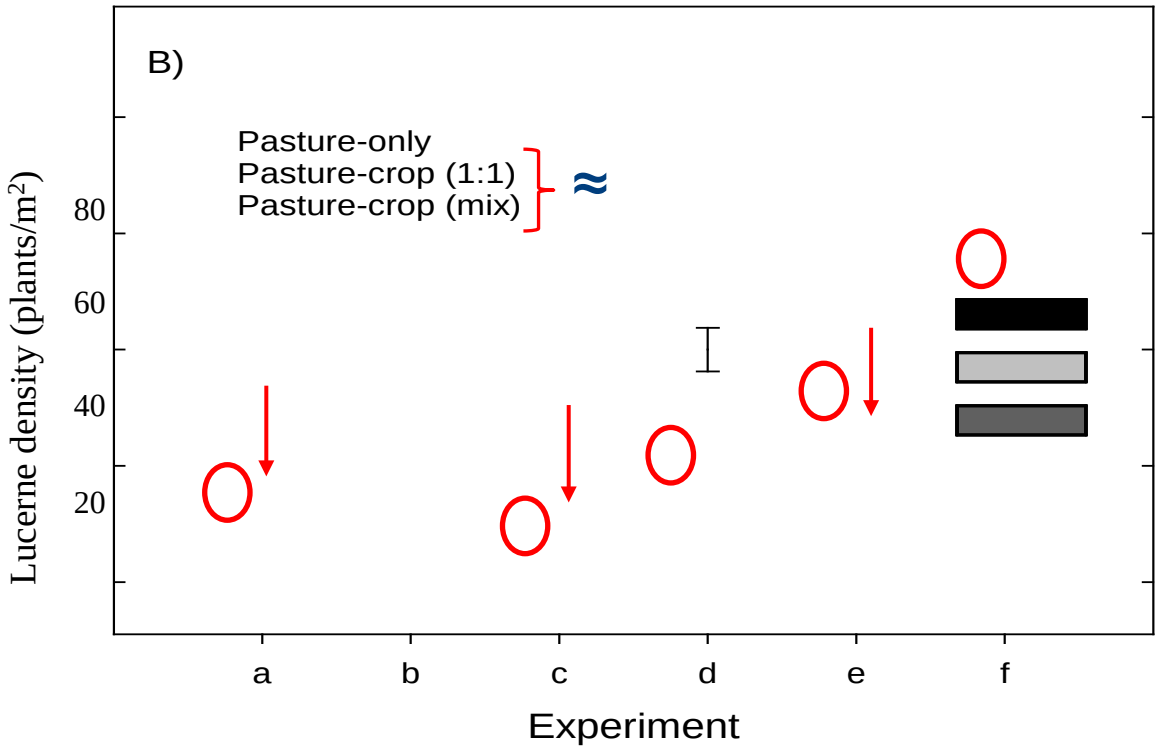

Fig. 2. Site x spatial configuration effects on final lucerne density across the six experiments in the Central West.
Data from individual experiments are marked according to letter; Bogan Gate sown in 2013 (a) and 2014 (b), Condobolin sown in 2013 (c) and 2014 (d), Cowra sown in 2013 (e) and 2014 (f).

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Summary – Central West sites

- Lucerne in all experiments (except Cowra 2014) ↓ with time
- The presence of a cover crop in yr 1 ↓ final lucerne density by 39%
- No advantage to lucerne persistence of separating from crop (at 25 cm spacings)
- Lucerne density was maintained in summers with ≥ 100 mm rainfall and ≤ 2150 day degrees

Lucerne density, Riverina

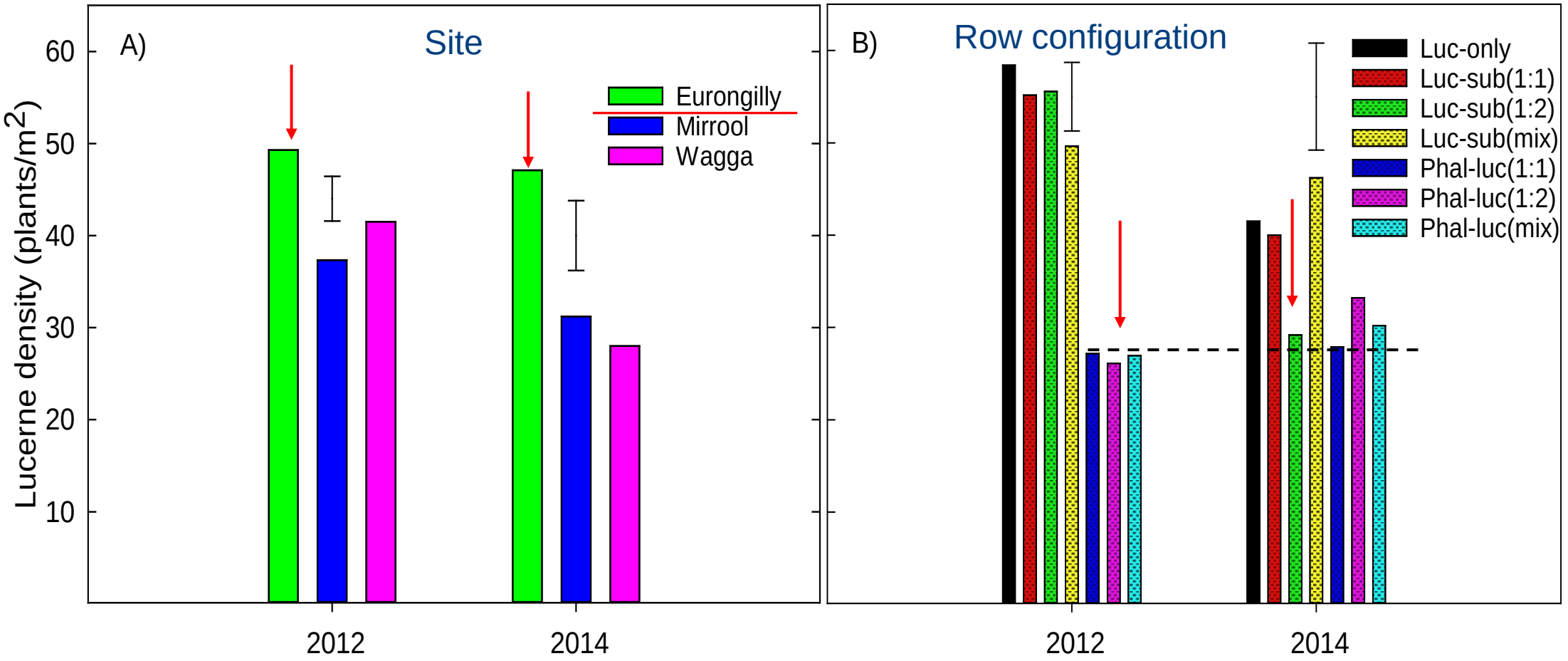

Fig. 3. The effect of A) site and, B) row configuration on lucerne density at the start (2012) and at the conclusion (2014) of the Riverina experiments. Error bars show l.s.d. at *P* = 0.05.

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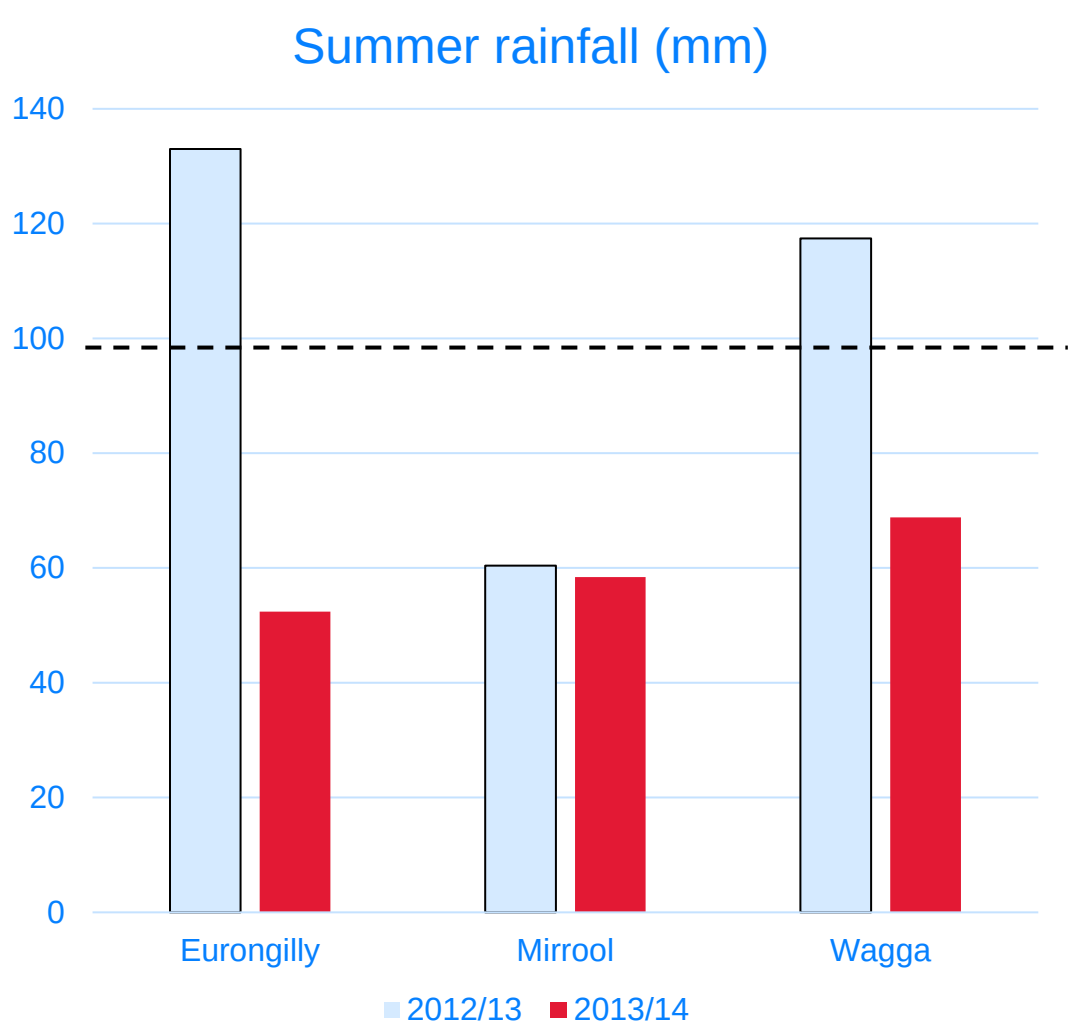
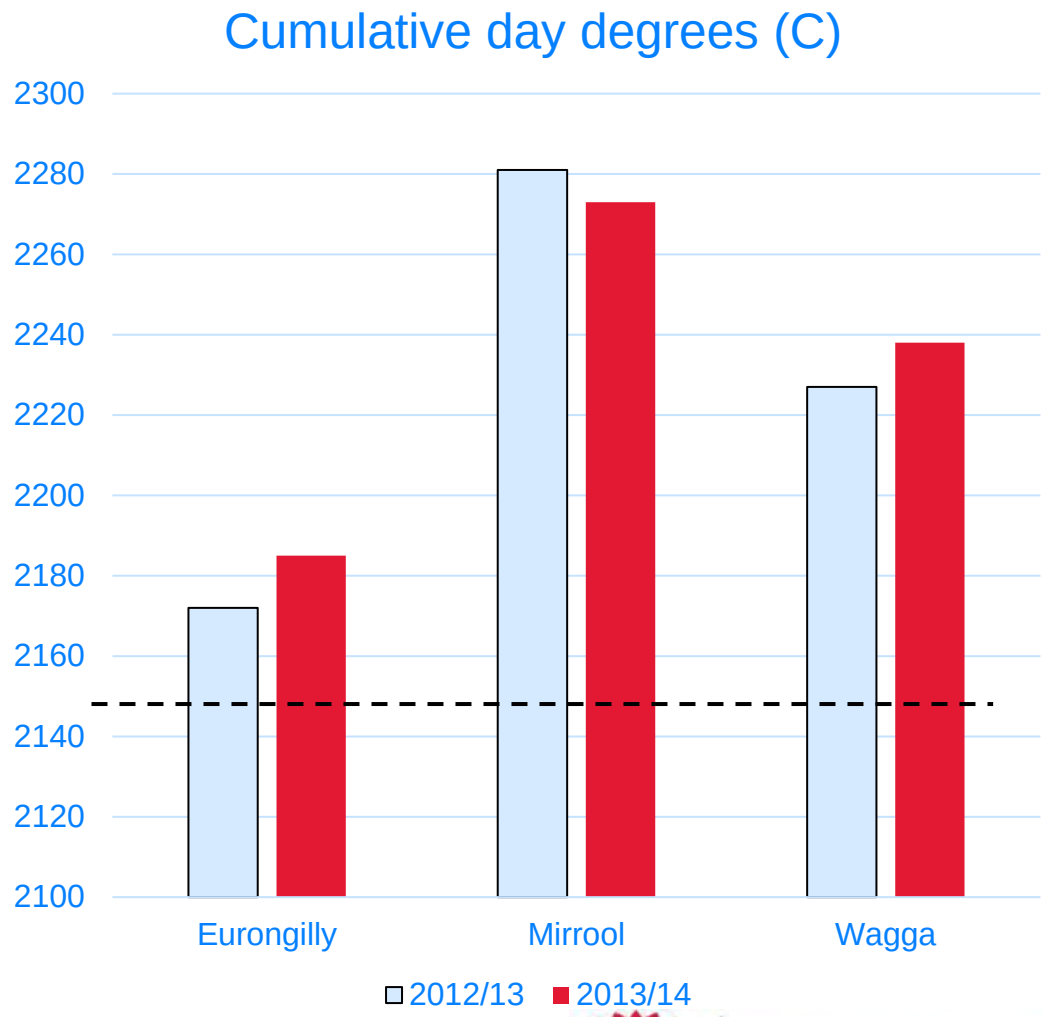
Climatic conditions - Riverina





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Establishment density = 55 plants/m^2

Plant location – end of pasture phase

‘On’ lucerne dril row

‘Close to’ lucerne dril row

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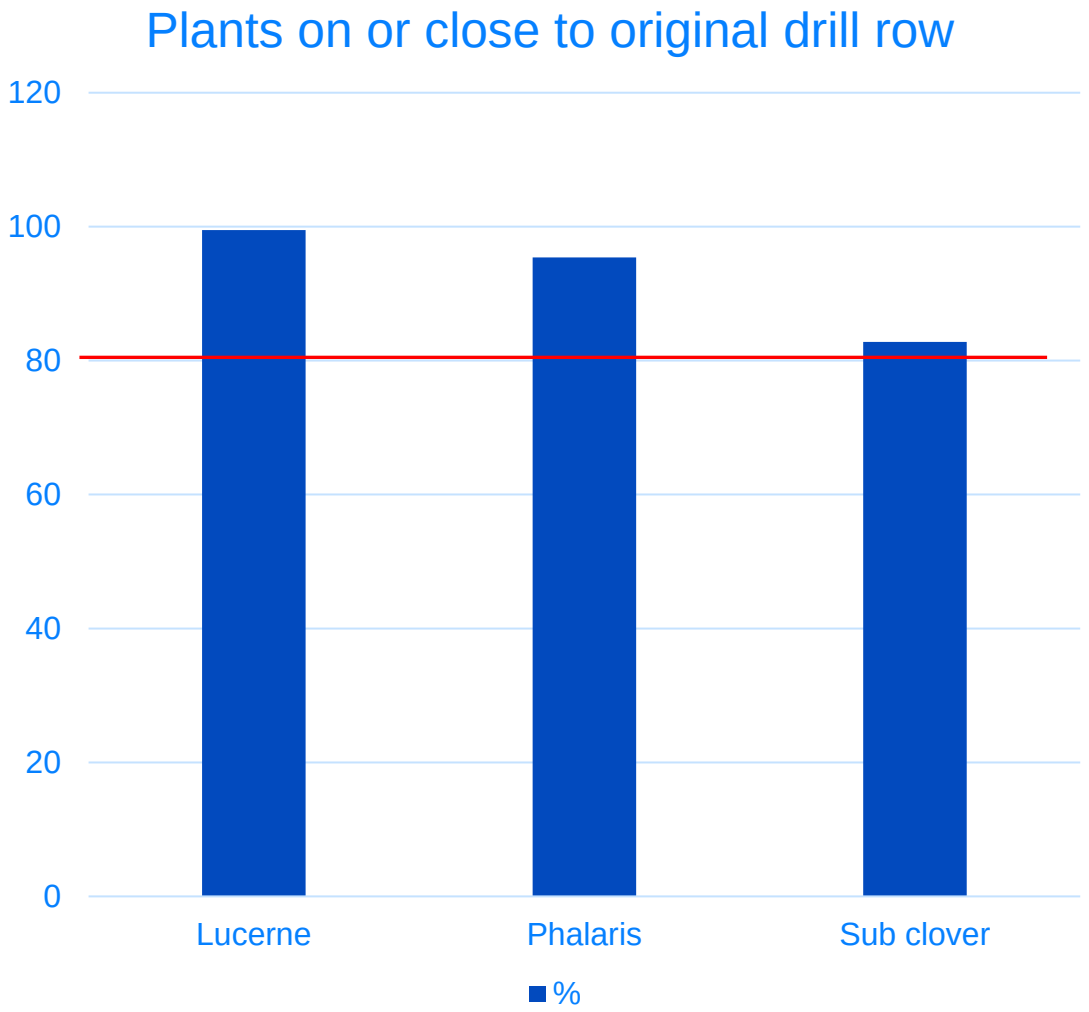
Plant location – Riverina (year 3)



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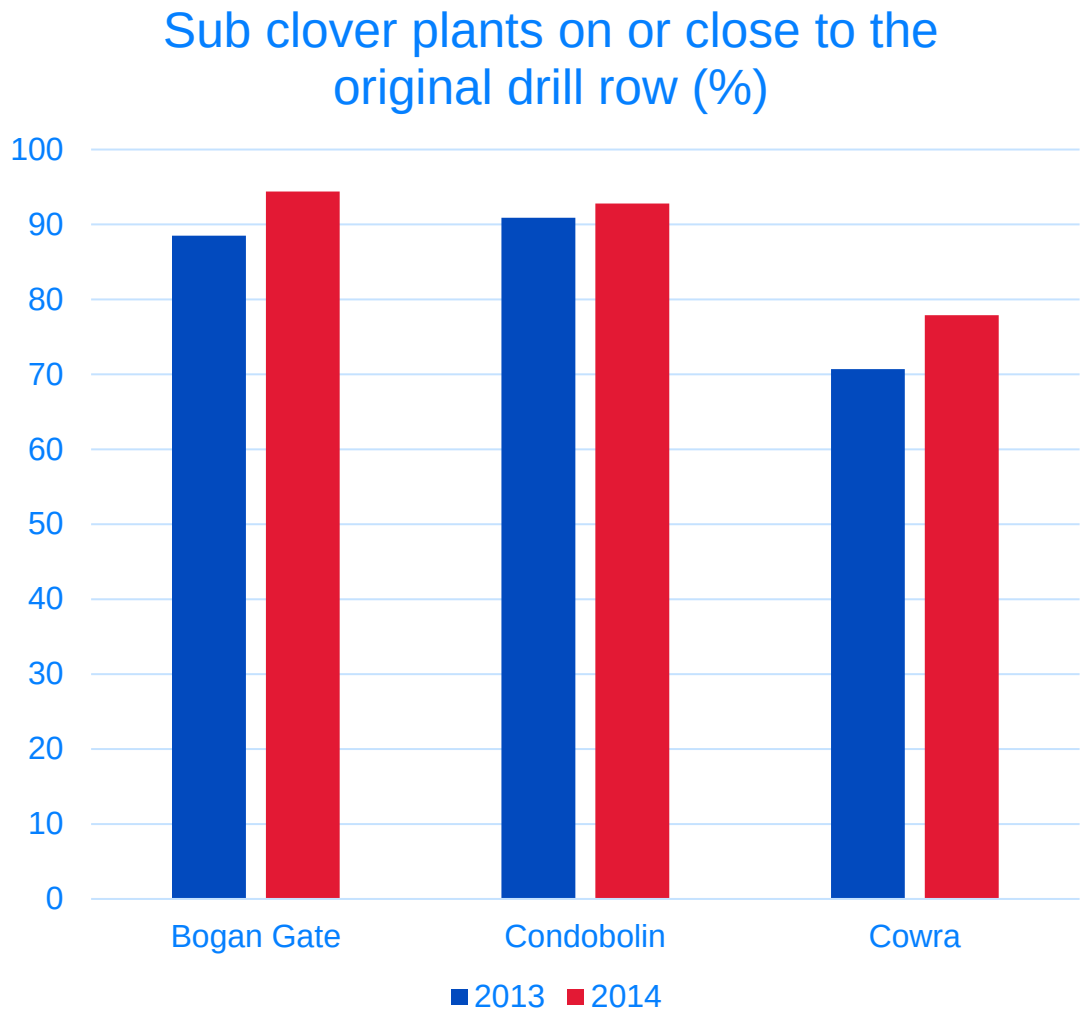
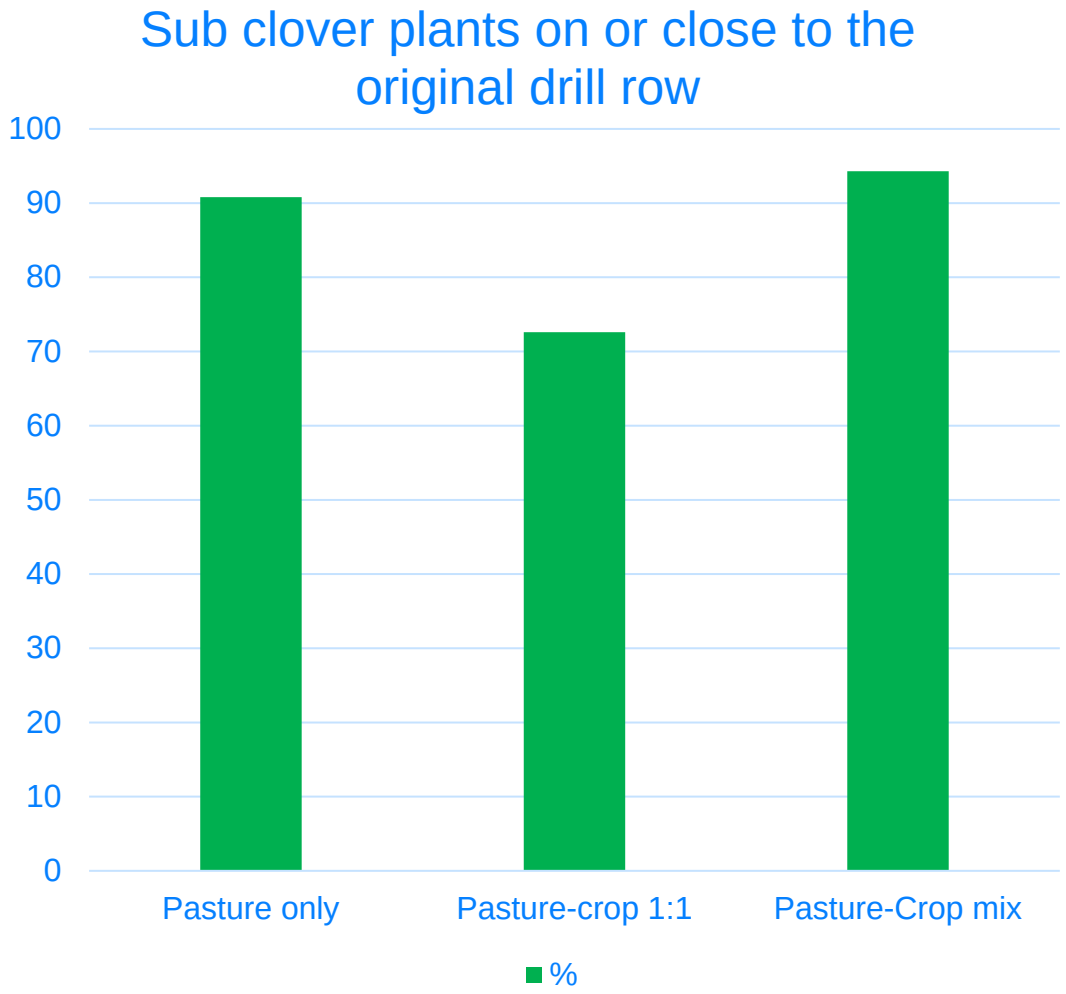
Plant location – Central West





The majority of plants stayed on or close to the original drill row during the pasture phase, especially in hotter environments.

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Photos from Mirrool…

Lucerne:Sub 1:1, Feb 2014

Lucerne:Biserrula 1:1, June 2014

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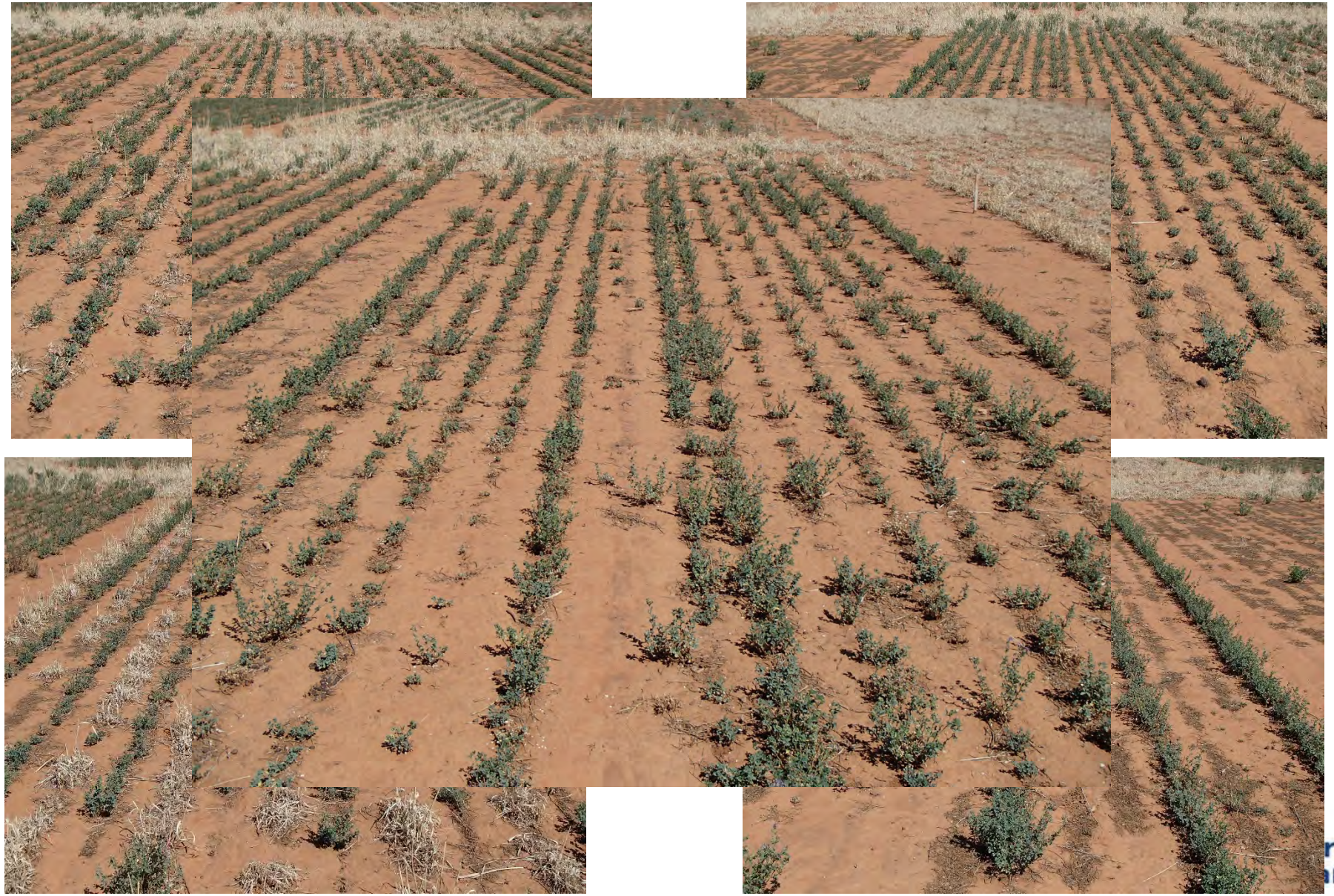
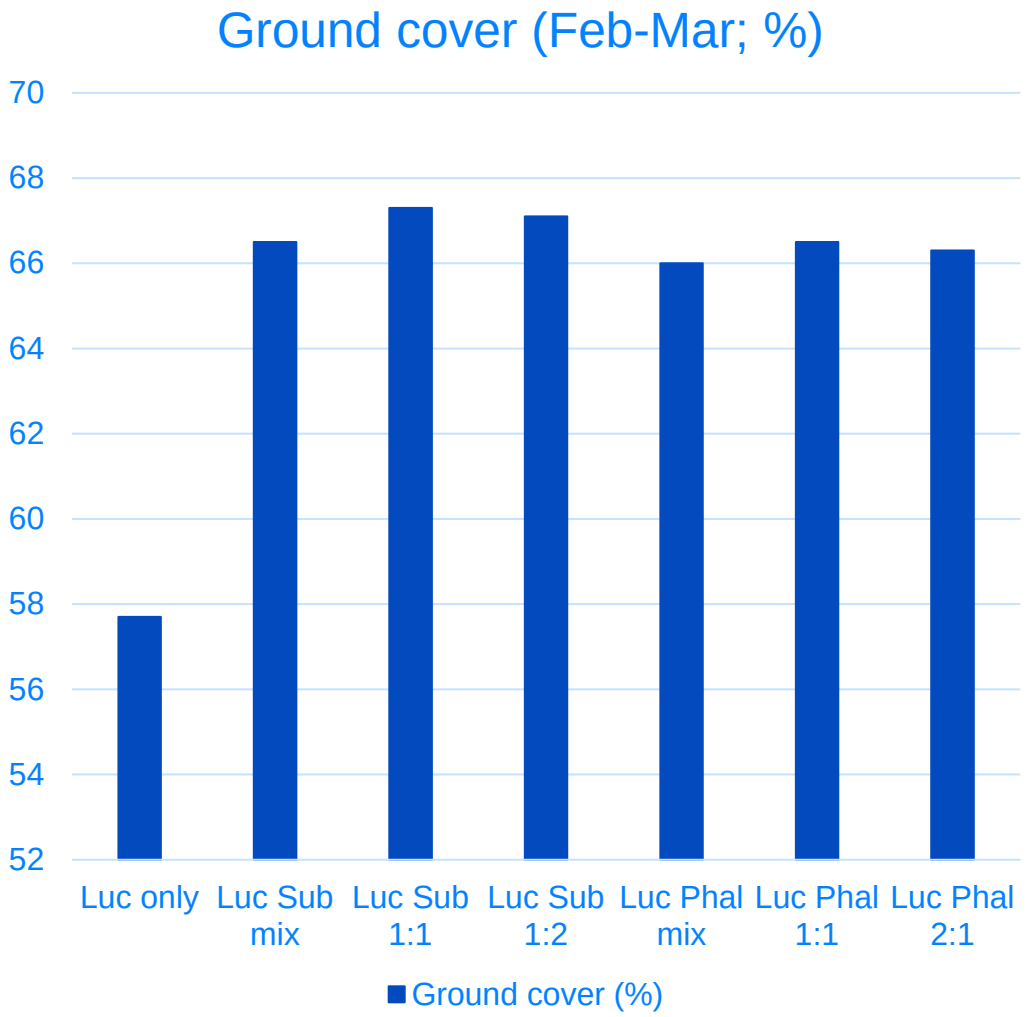
Pure vs. mixed lucerne swards



Ground cover - Riverina



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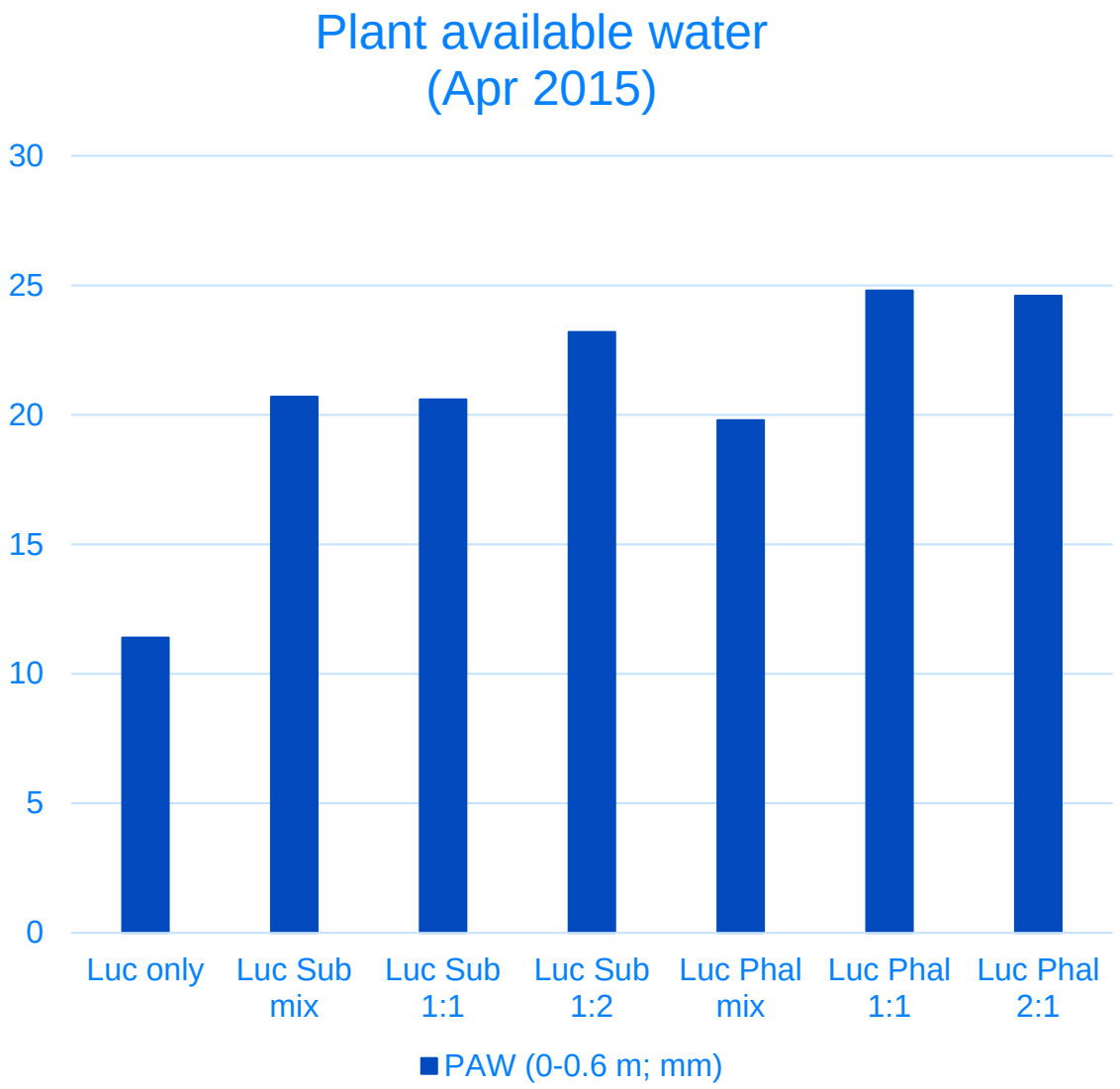
Soil water, Wagga



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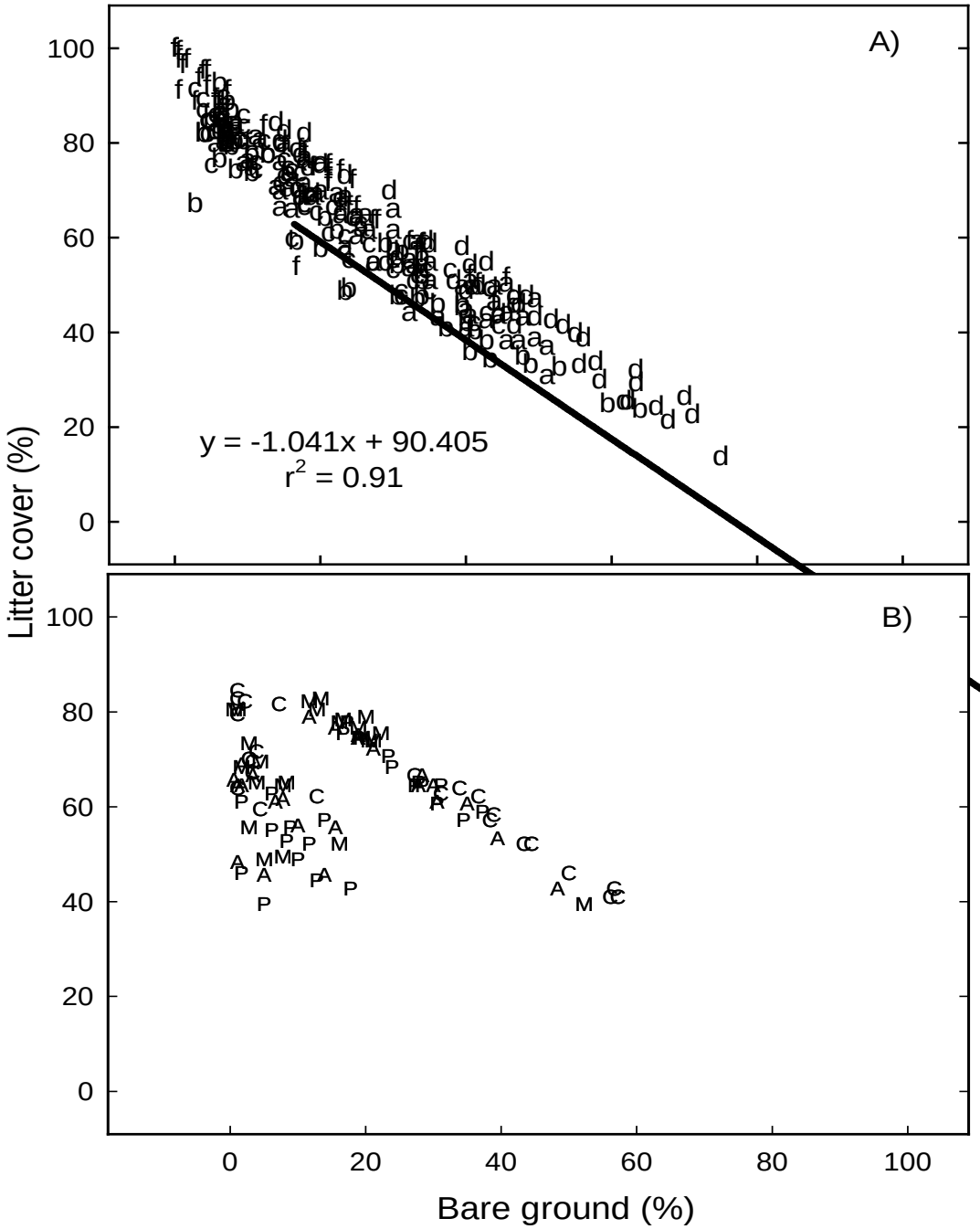

Relationship between bare ground and litter cover (Central west sites; n=288)

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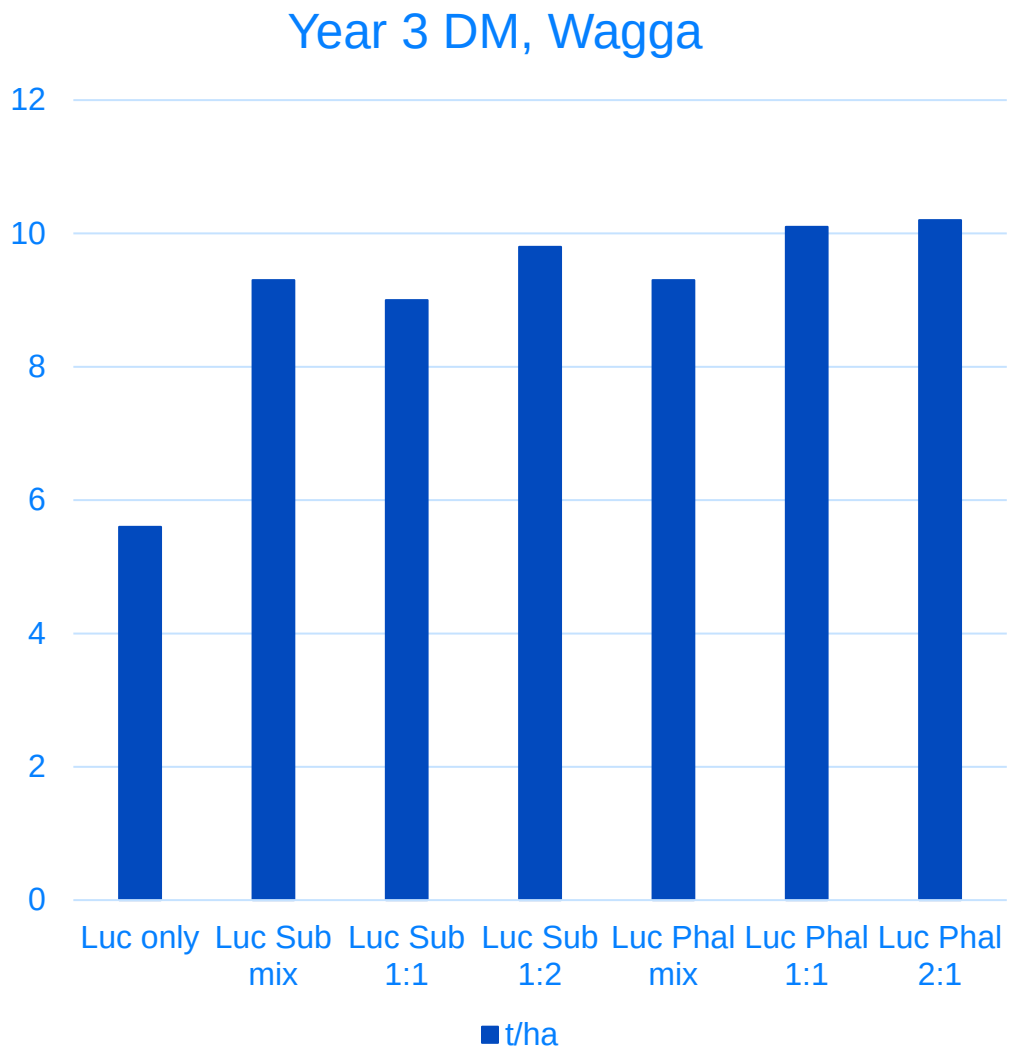
Cumulative DM (t/ha), Wagga



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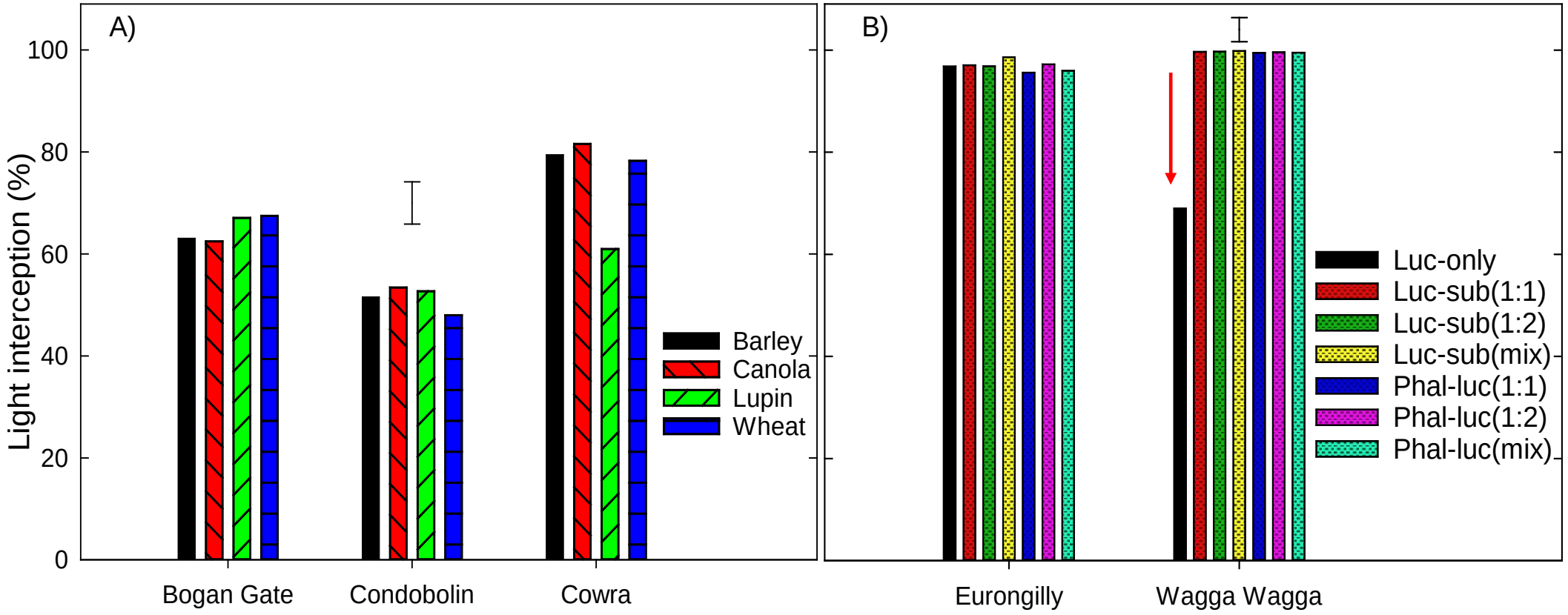
Light interception data



The effect of crop and pasture type on light interception sampled in spring 2014 at A) the Central West (year 1), and B) Riverina sites (year 3).

Pure lucerne swards = poor resource-use efficiency

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Implications: Targets for establishment

- Maintaining >50 plants of lucerne in dryland stands is possible (eg Cowra 2014) but unlikely in these hot-summer environments.
- Therefore, shouldn't aim to establish >50 plants/m^2
- Estab. densities ≤ 28 plants/m row should be targeted
- **These benchmarks will help growers/advisors gauge success**
- Row configuration will not help to increase lucerne density

Implications: Increasing productivity

- Lucerne productivity is correlated with density
- Cover crops ↓ lucerne density by ≈ 40%
  - Competition for light in year 1
- Otherwise, density is driven by summer conditions
- Phalaris/sub clover had little effect on lucerne density
  - Phalaris/sub have ↓ activity over summer

Suggestion: Productivity ↑ of lucerne swards in dryland environments seems more likely by tweaking companion species than by trying to increase the density of lucerne

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In an ideal world…

1. Sow lucerne into standing stubble
2. Sow on as narrow a row spacing as possible
3. Monitor lucerne establishment density
4. Sow with winter growing companions
    1. Phalaris?
    2. Annual legumes (small-seeded)
5. ‘Sow’ the annual legumes in the lucerne row & between the row (scatter plates, residual seed bank)

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Thanks to:

Susan Langfield, Richard Lowrie (NSW DPI) & Tony Swan (CSIRO)

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Estimating lucerne density

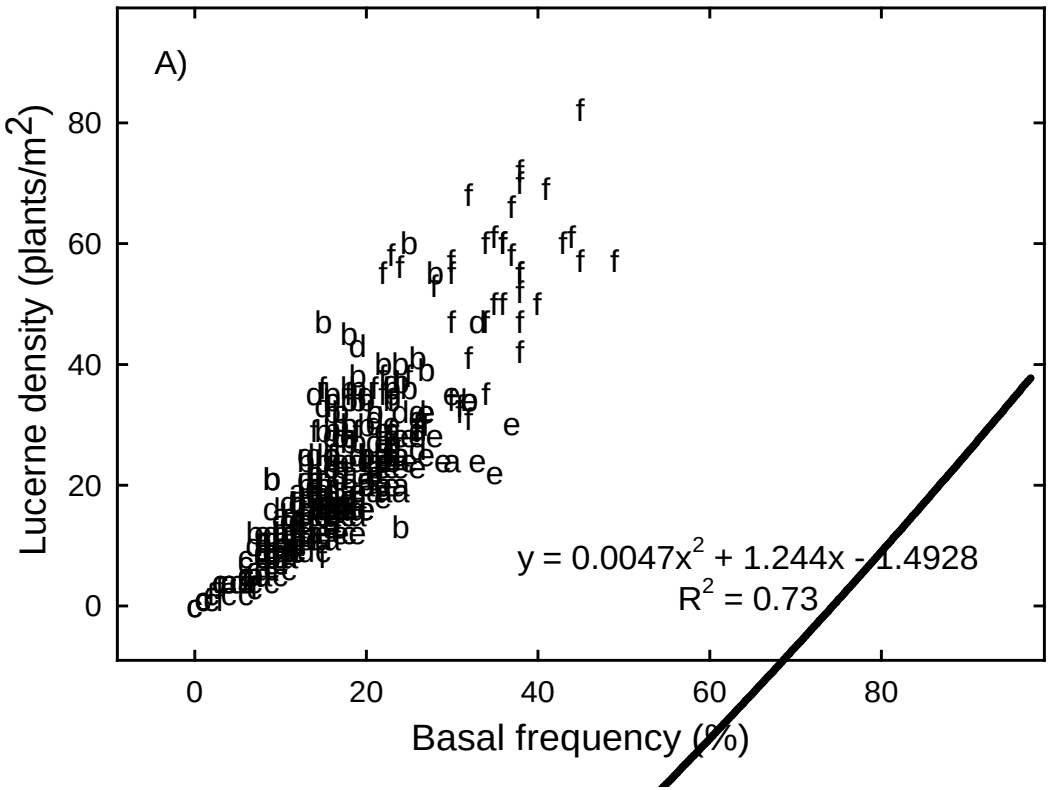

Fig. 4. The relationship between basal frequency and lucerne density (n=382)

Key message: Basal frequency over-estimated density by up to 30% in the range 15-82 plants/m²

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