Department of Primary Industries

Managing competition and lucerne persistence with sowing configuration

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Key findings

- Lucerne target establishment density for dryland environments should not exceed 50 plants/m^2; or 28 plants/m of drill row.
- Changing row configuration did not increase lucerne persistence.
- Sowing lucerne with a cover crop reduced final lucerne density by 39%.
- Lucerne mortality is affected more by summer conditions than the presence of winter-growing companion species, such as phalaris or subterranean clover.

Introduction

Lucerne is a key pasture species underpinning mixed farming enterprises in southern and central NSW. Optimising lucerne productivity and persistence offers substantial benefits to both grazing livestock and subsequent crops in the rotation. Confining lucerne to particular drill rows could help manage competition between pasture components or crop species when undersowing, and improve lucerne persistence. The re-configuration of most seeders is relatively easy and represents a negligible increase in pasture establishment costs. However, very little objective data exists to determine the extent to which drill row configuration at sowing affects lucerne persistence.

Site details

Location	Riverina and central west NSW
Riverina sites	Three sites at Eurongilly, Mirrool and Wagga Wagga; all sown in May 2012.
Central west sites	Six sites at Bogan Gate, Condobolin and Cowra; all sown in April–May 2013 and repeated in 2014.
Riverina treatments	• Lucerne only in every drill row [Luc-only] • Lucerne/subterranean clover in mixed rows [Luc-sub(mix)] • Lucerne/subterranean clover in alternate rows [Luc-sub(1:1)] • One row of lucerne to every two rows of subterranean clover [Luc-sub(1:2)] • Phalaris/lucerne in mixed rows [Phal-luc(mix)]* • Phalaris/lucerne in alternate rows [Phal-luc(1:1)] * • One row of phalaris to every two rows of lucerne [Phal-luc(1:2)]* * Note: Subterranean clover was included in every drill row
Central west treatments	• Lucerne/subterranean clover in mixed rows (pasture only) • Crop only (wheat, barley, canola or lupins) • Pasture–crop mix in every drill row (mix) • Pasture–crop in alternate drill rows (1:1)

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Sowing method	The same cone seeder was used for all experiments: • 25 cm row spacings • Narrow points and press wheels.
Seeding rate	Seeding density, of all species remained constant for a given area. That is, if the number of drill rows into which a species was sown was halved (i.e. the 1:1 treatments), the concentration of seed of that species within a drill row was doubled.
Fertiliser	Broadcast at the surface.
Replicates	Each treatment was replicated three times.

Cultivars and sowing rates

Riverina sites

- Lucerne (sown alone or with subterranean clover): 3 kg/ha (50% cv. Aurora, 50% cv. Genesis)
- Lucerne (sown with phalaris): 1.5 kg/ha (50% cv. Aurora, 50% cv. Genesis)
- Phalaris: 1.5 kg/ha (100% cv. Sirolan)
- Subterranean clover: 4 kg/ha (cultivars sown in equal proportions by weight)
    - » Eurongilly: cvv. Gosse, Goulburn, Coolamon
    - » Mirrool: cvv. Trikkala, Bindoon, Dalkeith
    - » Wagga Wagga: cvv. Riverina, Bindoon, Coolamon

Central west sites

- Wheat cv. Suntop: 23 kg/ha (68 kg/ha at Cowra)
- Barley cv. Hindmarsh: 23 kg/ha (68 kg/ha at Cowra)
- Canola cv. Stingray: 0.6 kg/ha (2.4 kg/ha at Cowra)
- Lupin cv. Mandelup: 40 kg/ha (80 kg/ha at Cowra)
- Lucerne cv. Pegasus: 3 kg/ha (8 kg/ha at Cowra)
- Subterranean clover: 6 kg/ha (cultivars sown in equal proportions by weight)
- cvv. Seaton Park and Izmir at the Bogan Gate and Condobolin sites
- cv. Coolamon at Cowra (at 8 kg/ha)

Full details of this study are available online: Sowing configuration changes competition and persistence of lucerne (*Medicago sativa*. L) in mixed pasture swards (Hayes et al. 2021).

Results

Final lucerne density at the Riverina sites

There was a significant effect of site × sowing configuration on lucerne density in years one and three of the pasture phase.

Lucerne density was higher at the Eurongilly site at both sampling times compared with Mirrool and Wagga Wagga (Figure 1a).

Lucerne density in treatments sown with phalaris was approximately 50% of that where lucerne was sown alone or with subterranean clover, reflecting the reduced sowing rates when phalaris was added to the sward (Figure 1b).

There was little reduction in lucerne density from years 1–3 in the phalaris-based swards, but density declined in the lucerne only and lucerne/subterranean clover swards with time. This was especially evident in the Luc-sub(1:2) treatment indicating that intraspecific competition (lucerne competing with itself) led to increased lucerne mortality associated with the concentration of lucerne seed from

three drill rows into just one. There was little evidence of interspecific competition from phalaris or subterranean clover affecting lucerne persistence.

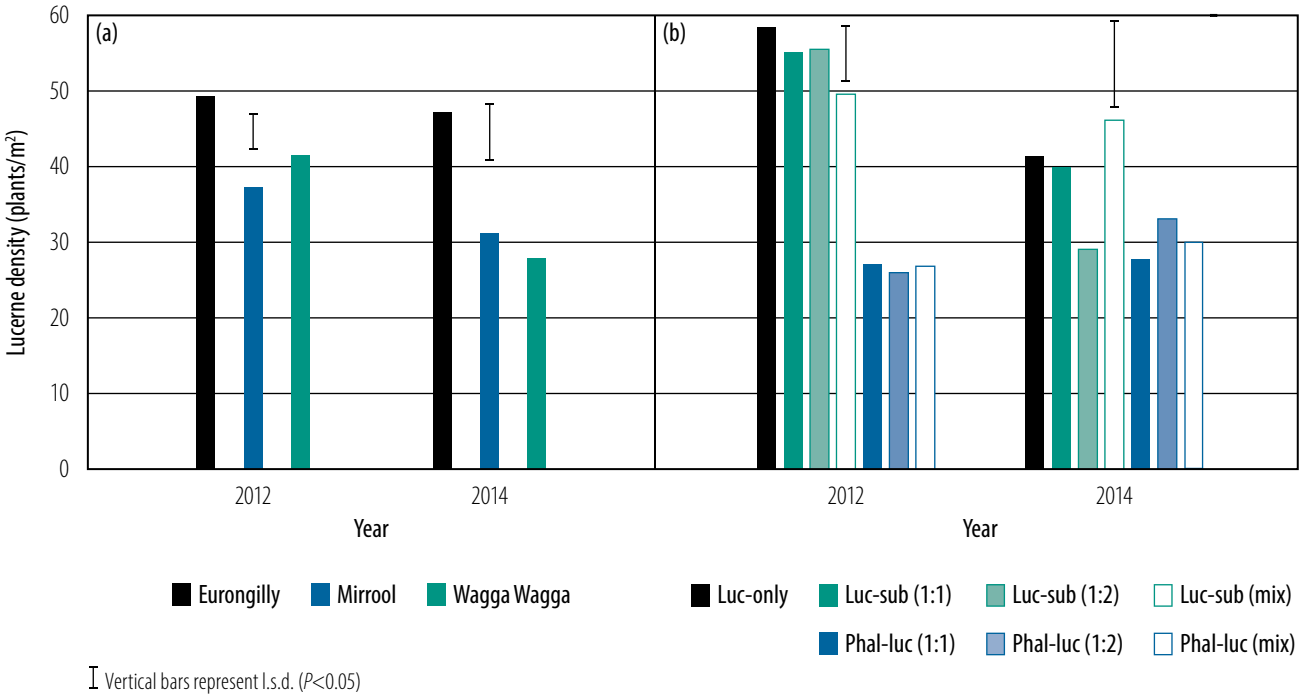


Figure 1 The effect of a) site, and b) row configuration on lucerne density at the start (2012) and at the conclusion (2014) of the Riverina experiments.

Final lucerne density at the central west sites

At each site, lucerne density was higher in the 2014-sown experiments compared with the 2013-sown experiments where stands were one year younger at the time of sampling (Figure 2, see also Figure 5b).

Averaged across sites, lucerne density was 39% greater ($P<0.05$) in the pasture-only treatment (27.4 plants/m^2) compared with where it was sown with a crop, regardless of whether the crop was sown in mixed (19.7 plants/m^2) or alternate rows (20.4 plants/m^2) with the pasture.

Averaged across sites, the final lucerne density was significantly higher where it was sown in mixtures with lupins (30.1 plants/m^2) compared with where it was sown with wheat, barley or canola (19.3, 20.7 and 22.3 plants/m^2, respectively).

There was no significant crop × row configuration interaction ($P>0.05$).

Lucerne populations had generally declined to densities of 10–20 plants/m^2 after four years in the 2013-sown experiments in the central west, and to 20–30 plants after three years in the 2014-sown experiments (Figure 2).

Lucerne densities generally remained higher in the pasture-only treatments compared with where wheat was sown with the pasture, regardless of whether the wheat was sown in mixed or alternate drill rows, especially at Cowra in the 2014-sown site where there was no decline in density during the pasture phase.

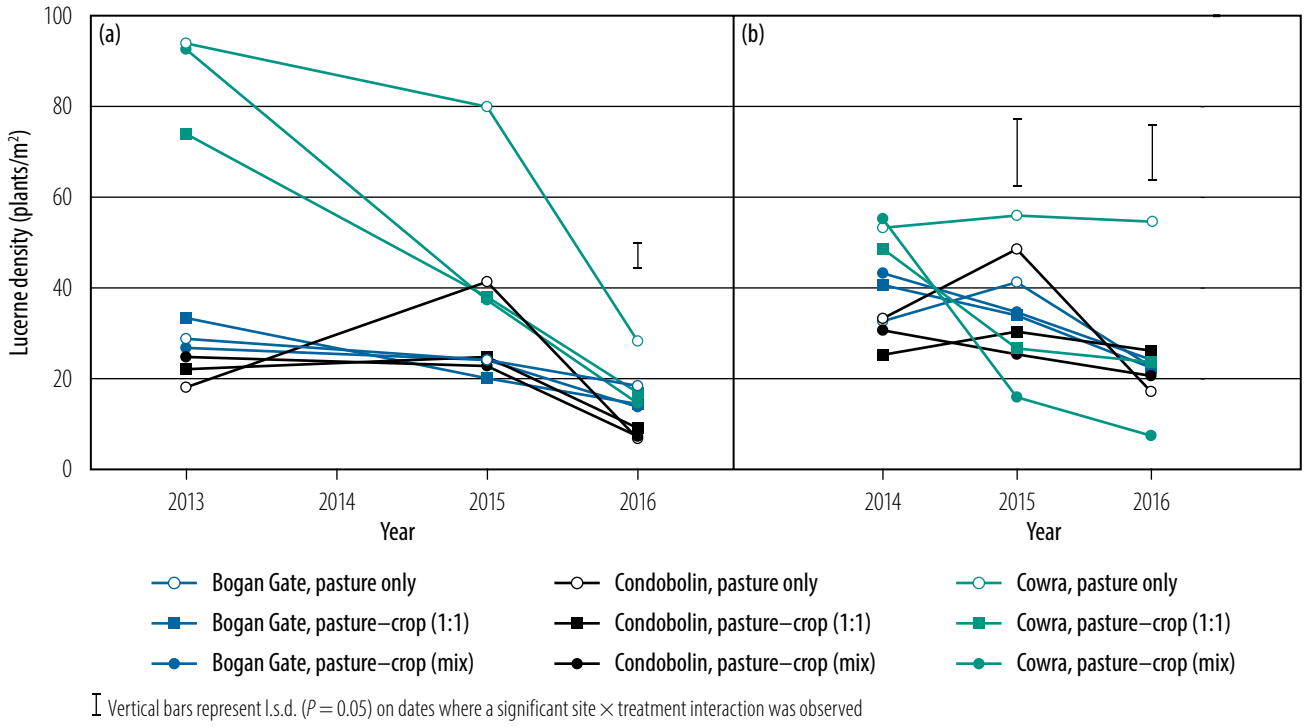


Figure 2 Change in lucerne density through time due to spatial configuration associated with wheat crop only at experiments sown at three sites in the Central West in a) 2013, and b) 2014.

The summer of 2013–14 was the driest at each of the sites compared with any other year, especially at the Riverina sites (Figure 3).

All sites in the central west received ≥100 mm rainfall in each of the years with little apparent difference at Cowra compared with the other sites.

By contrast, Cowra was consistently the site with lower summer temperatures, especially in the final two years (Figure 4). This probably contributed to superior lucerne persistence at this site in the pasture-only treatment (Figure 2b).

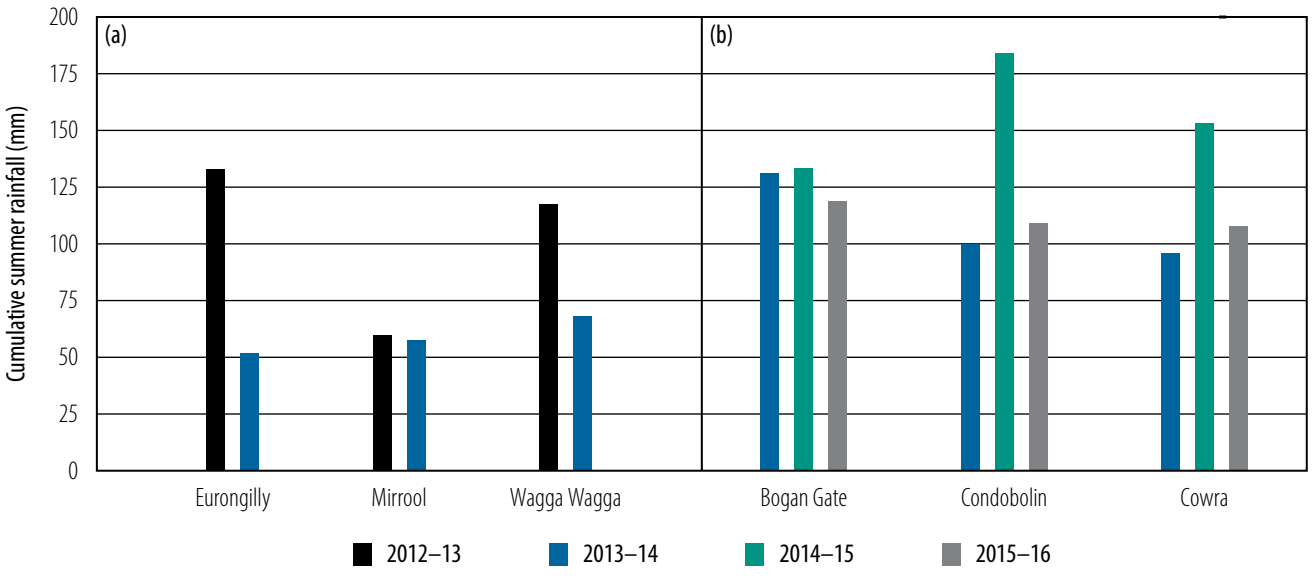


Figure 3 Cumulative summer rainfall (mm) received at a) the Riverina, and b) the central west sites during the experiment.

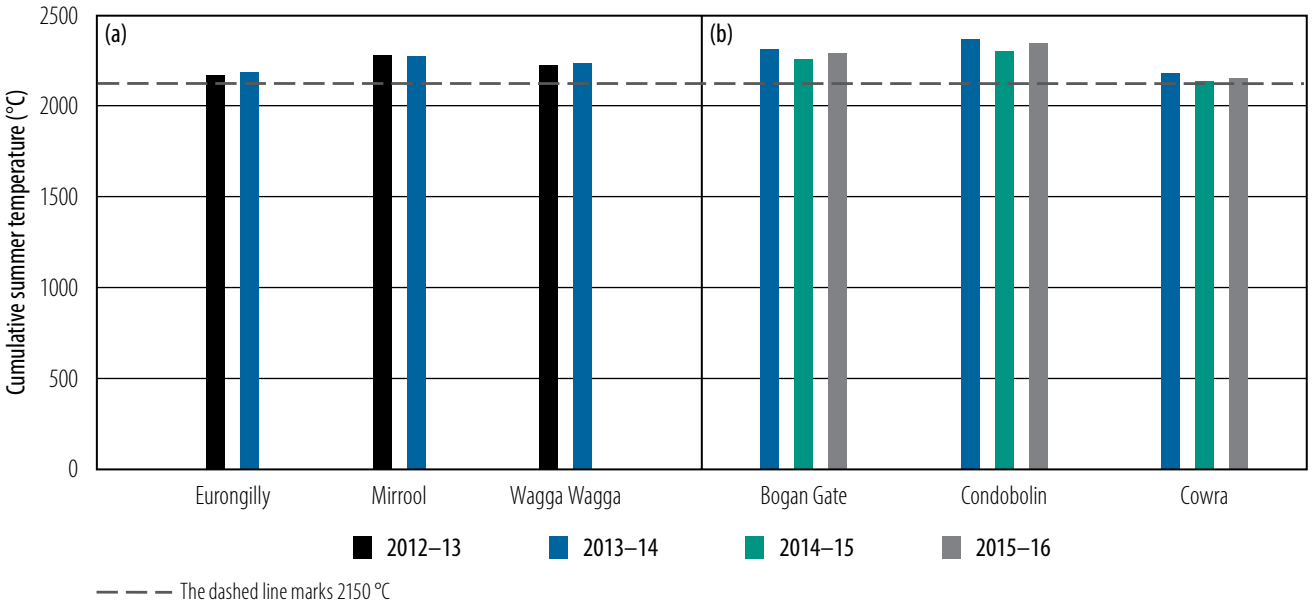
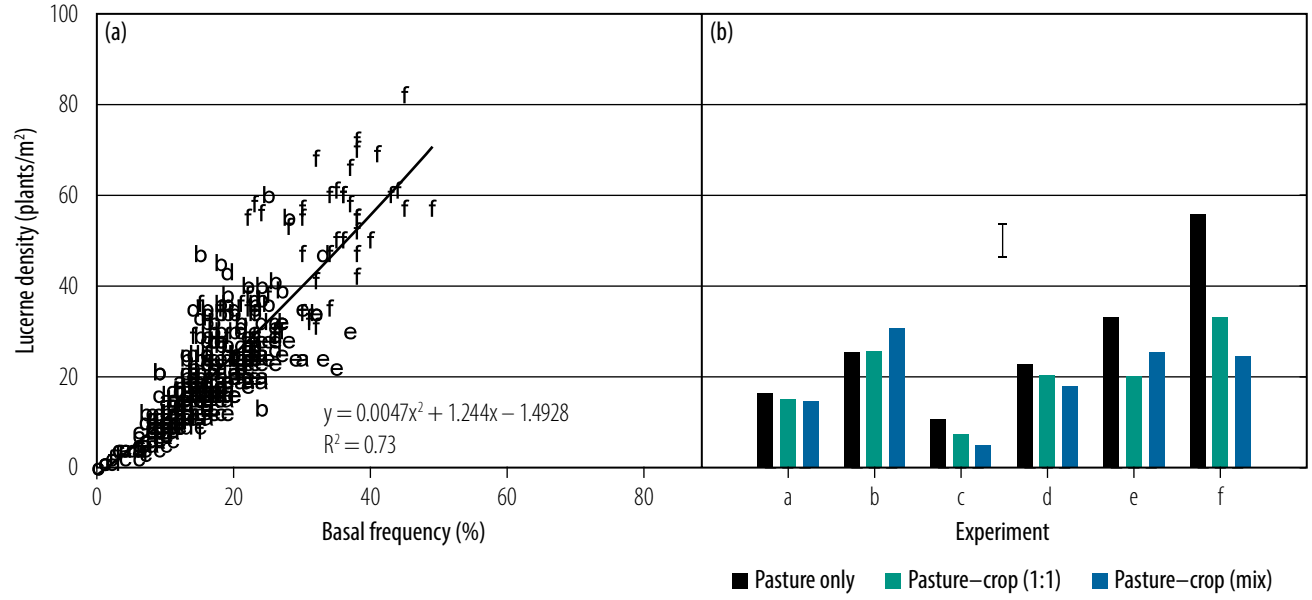


Figure 4 Cumulative summer temperature (day degrees °C) at a) the Riverina, and b) the central west sites during the experiment.

Estimation lucerne density with basal frequency

A total of 8540 plants were excavated from 382 quadrats at the six sites at the conclusion of the experiments to determine final lucerne density. There was a strong correlation (P<0.001; R^2 = 0.73; n = 382) between lucerne density and basal frequency (Figure 5a). When all sites and treatments were included, basal frequency generally reflected lucerne density up to around 15 plants/m^2, but underestimated lucerne density by 20–25% in the range of 15 to 30 plants/m^2 and by 25–30% in the range of 30 to 80 plants/m^2.



I Vertical bars represent l.s.d. (P = 0.05)

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).

Figure 5 a) The relationship (P<0.001) between basal frequency and lucerne density (n = 188), and b) site × spatial configuration effects on final lucerne density across the six experiments in the central west.

Summary

Spatial sowing configuration had no effect on lucerne persistence in alternate row configuration (1:1) compared with lucerne sown in every drill row. However, where lucerne was confined to every third row (1:2 configuration), there was an increase in mortality attributable to intraspecific competition at lucerne densities greater than 28 plants/m of drill row. A lucerne sowing rate of ~6 kg/ha, when delivered to every drill row at 25 cm row spacings, is likely to achieve maximum lucerne production in the semi-arid environments tested, but subject to the chance event of receiving favourable conditions in the period after sowing to maintain adequate lucerne densities.

Favourable conditions at the Cowra site included cumulative summer rainfall exceeding 100 mm and cumulative summer day degrees below 2160 °C. In drier environments, where the frequency of favourable seasonal conditions is likely to be lower, we suggest that more emphasis should be placed on the winter-growing species as opposed to the lucerne component of the sward to improve productivity, as interspecific competition from winter-growing forage species had little effect on lucerne persistence.

By contrast, interspecific competition from vigorous cover crops established in year one consistently increased lucerne mortality compared with where pastures were sown without a cover crop.

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Reference

Hayes RC, Newell MT, Pembleton KG, Peoples MB and Li GD 2021. Sowing configuration changes competition and persistence of lucerne (*Medicago sativa* L.) in mixed pasture swards, *Crop and Pasture Science*, online early, https://www.publish.csiro.au/CP/CP20270, viewed 12 April 2021.

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