Amelioration of Subsurface Soil Acidity Using Organic Matter and Lime

Riverina & NSW Joint Branch Workshop

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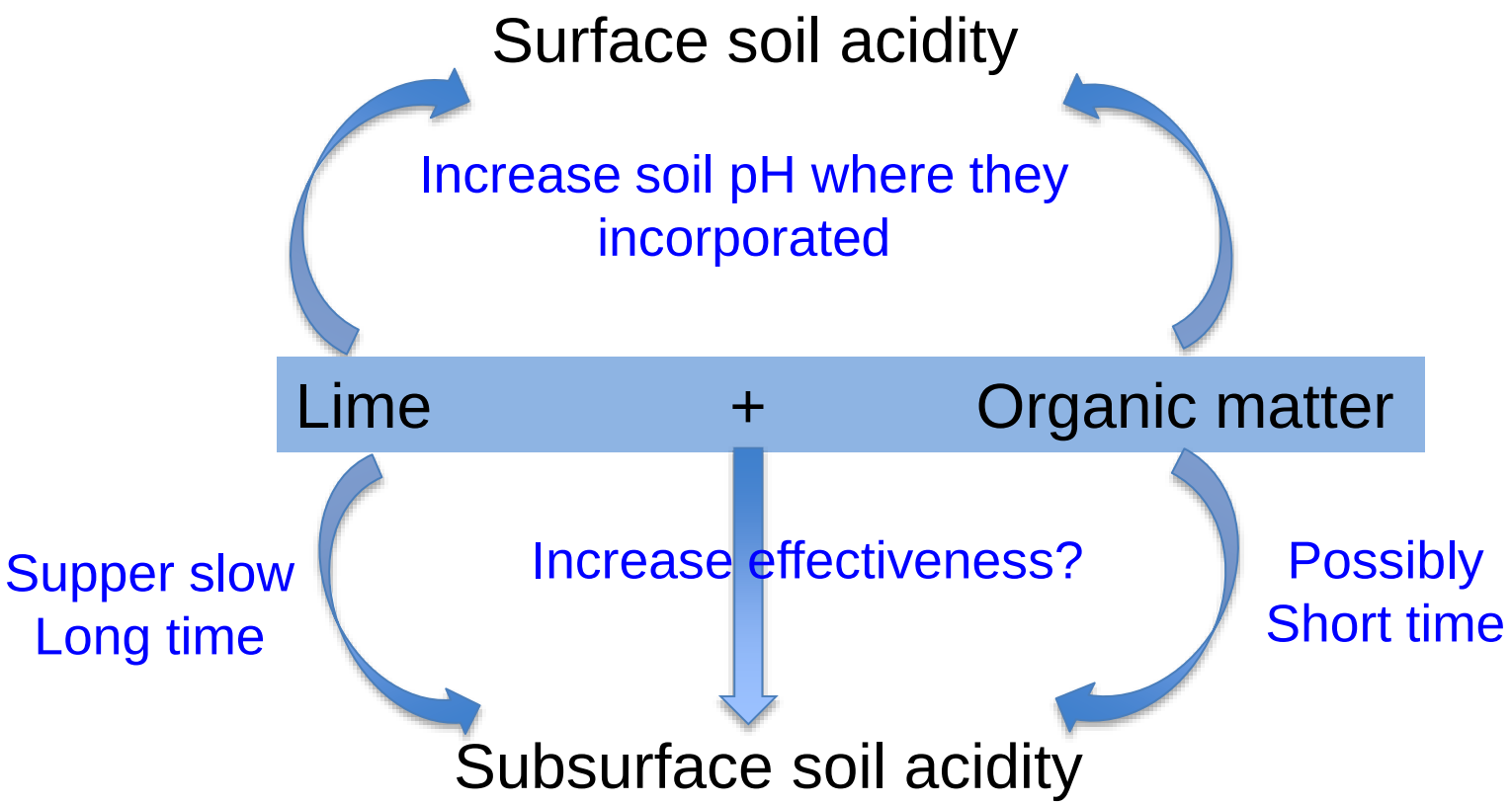
Background



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Background

Soil pH profile after 31 days incorporation with lime or fine ground lucerne pellets (LP) under controlled conditions

Soil layer (cm)	Control	1st layer		2nd layer		3rd layer		1st & 2nd layers		2nd & 3rd layers		1st, 2nd, & 3rd layers	
	None	lime	LP	lime	LP	lime	LP	lime	LP	lime	LP	Lime	LP
1st (0-10)	4.6	5.2	5.1	4.6	4.6	4.6	4.6	5.1	5.5	4.6	4.6	5.2	5.5
2nd (10-20)	4.2	4.2	4.5	5.4	5.5	4.2	4.2	5.4	5.7	5.4	5.7	5.4	5.8
3rd (20-30)	4.2	4.2	4.4	4.2	4.5	4.7	5.4	4.2	4.9	4.7	6.0	4.7	6.2
4th (30-40)	4.4	4.4	4.6	4.4	4.6	4.4	4.6	4.4	4.9	4.4	4.9	4.5	5.5

(Moroni *et. al*., 2018)

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Research questions

- Can surface incorporation of organic matter increase subsurface soil pH?
- Does surface incorporation of organic matter in combination with lime improve the effectiveness of the amelioration of subsurface soil acidity?

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Experiments

- **Glasshouse experiment:** test the effects of organic matter (lucerne pellets) sizes in combination with or without lime on subsurface soil pH and plant growth

- **Field experiment:** study the effects of surface incorporation of lucerne pellets in combination with or without lime on subsurface soil pH and plant growth under field conditions

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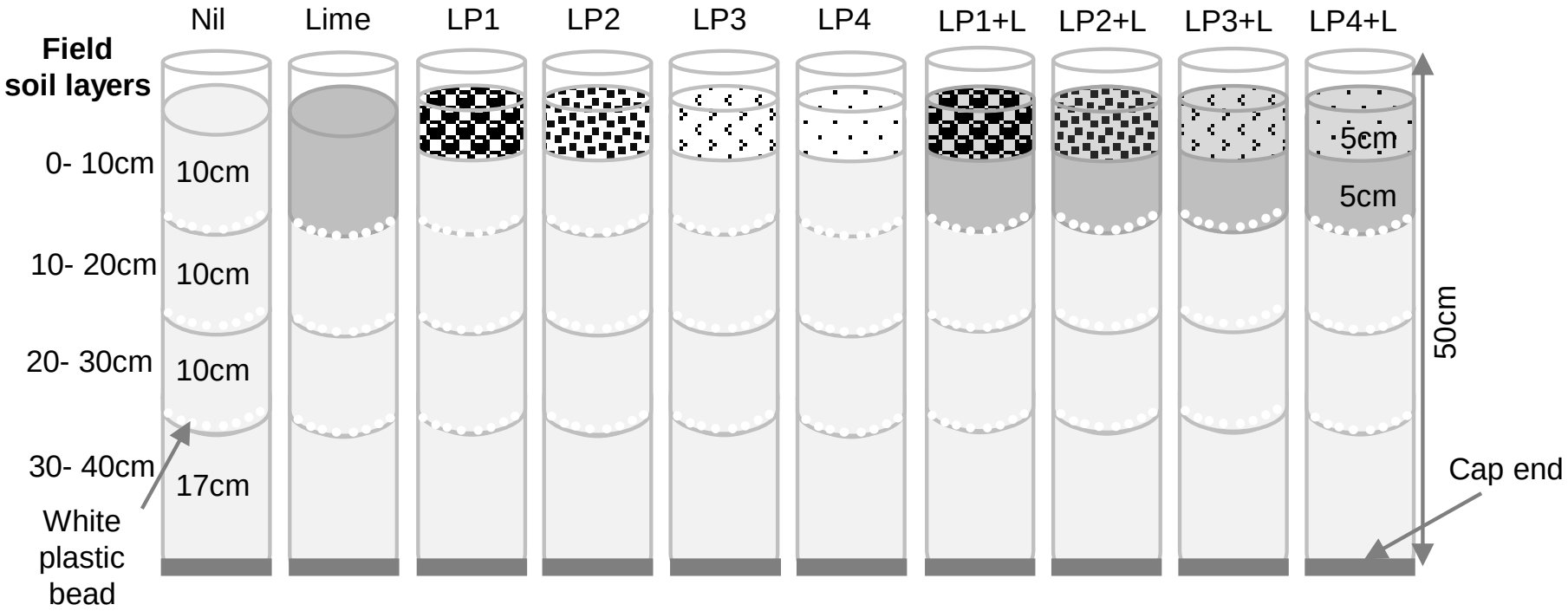
Glasshouse experiment



Lucerne pellets (LP) sizes

LP1	LP2	LP3	LP4
~2cm	~1cm	~0.5cm	0.1-0.2cm

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Glasshouse experiment

- Wheat cv. Dart, acid soil resistant cultivar, sown
- Watered by weight at 100% field capacity
- Harvested 14, 21, 28 and 35 days after sowing

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Key results of glasshouse experiment

Lucerne pellets (LP) sizes

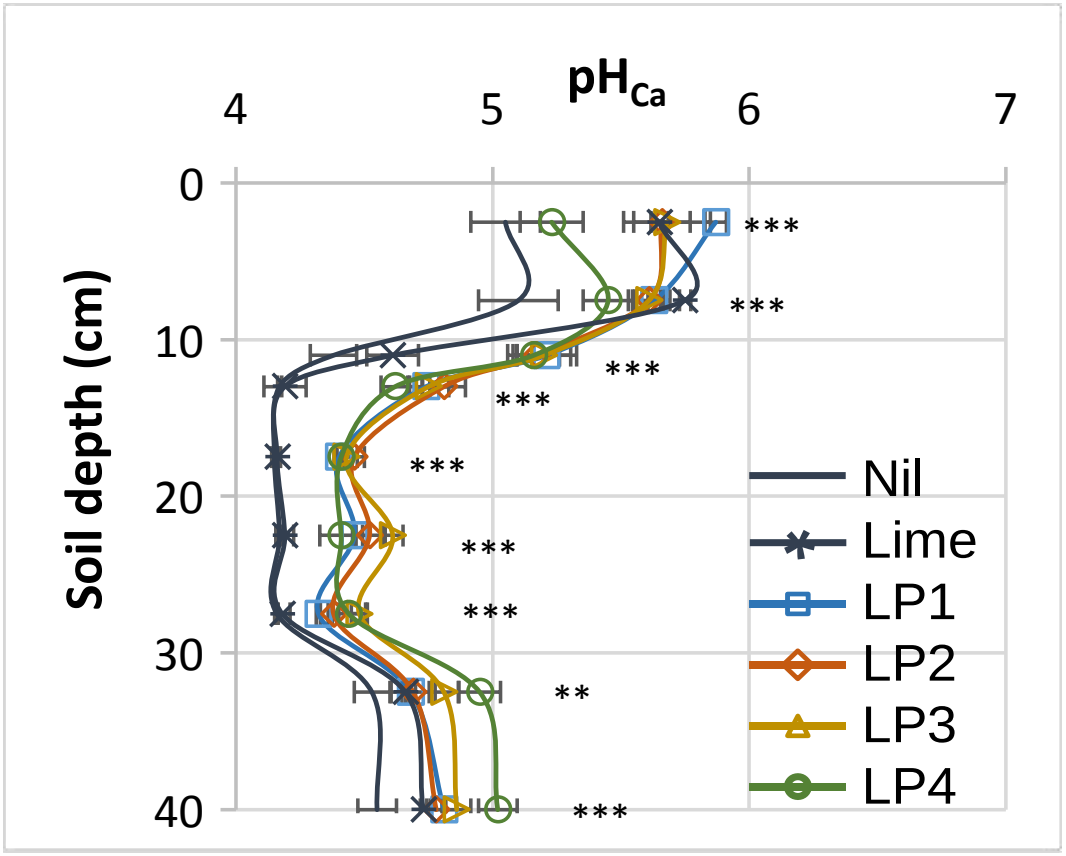
LP1
~2cm

LP2
~1cm

LP3
~0.5cm

LP4
0.1-0.2cm

Soil pH profile after 14 days incorporation



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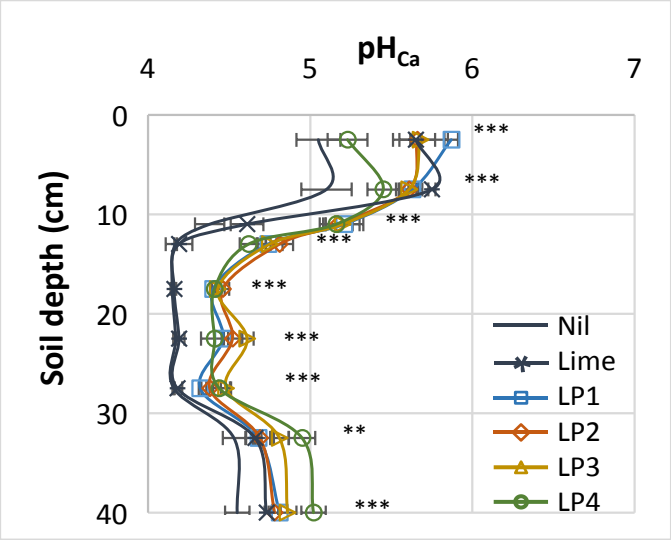
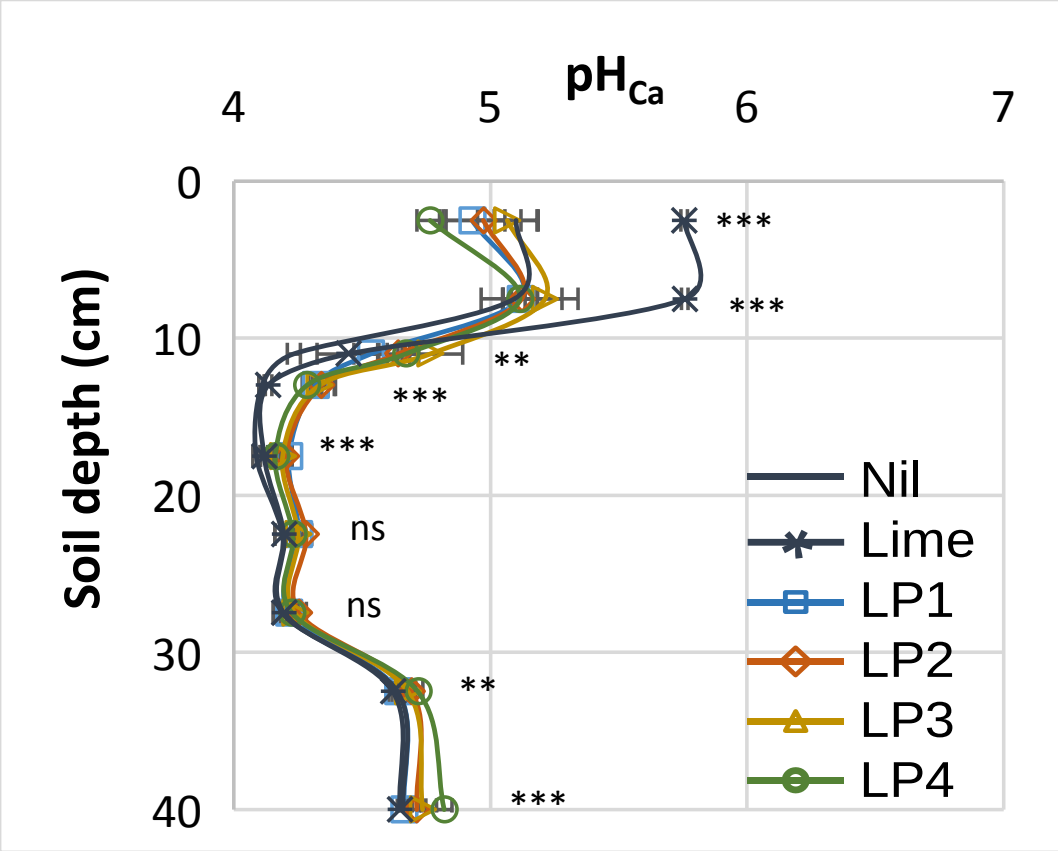
Key results of glasshouse experiment

14 days



35 days



pH in LP treatments decreased after 35 days

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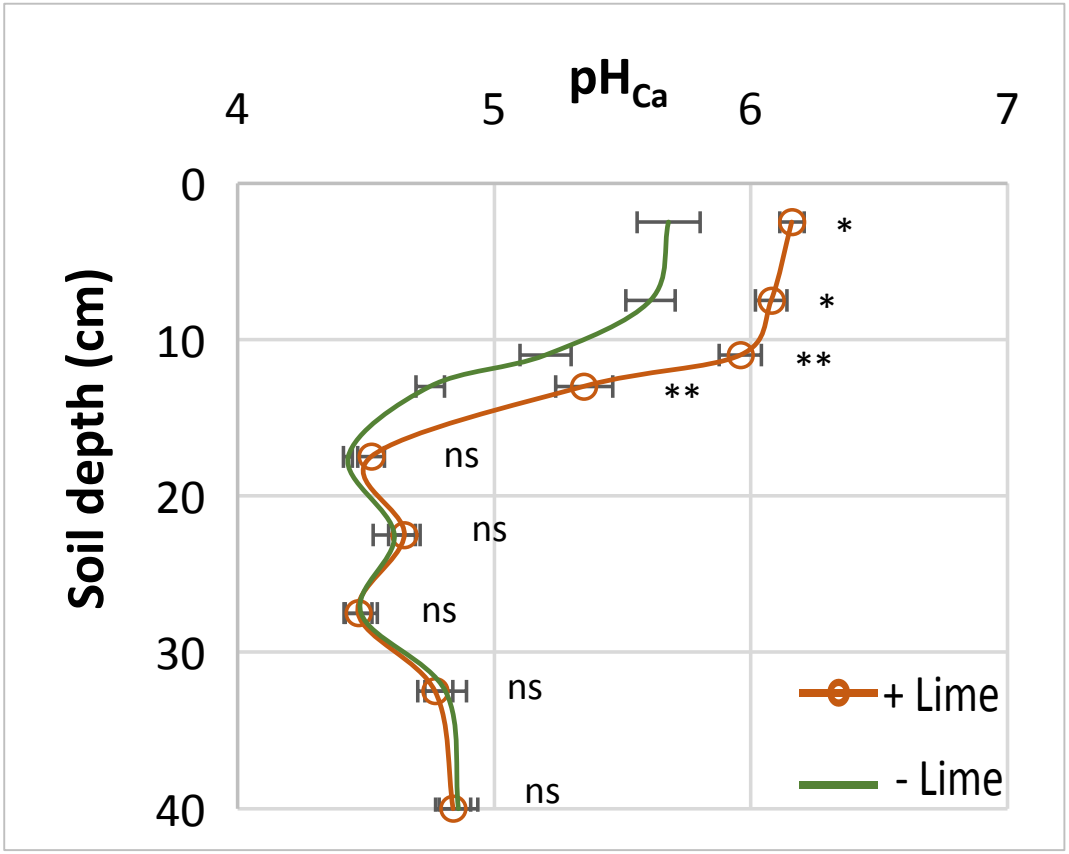
Key results of glasshouse experiment

How incorporation of LP in combination with lime?

Surface incorporation of lucerne pellets in combination with lime increases effectiveness of the amelioration



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Key results of glasshouse experiment

Incorporation of ground lucerne pellets (LP4) affected plant growth negatively

LP4 LP3 LP2 LP1 Lime Nil

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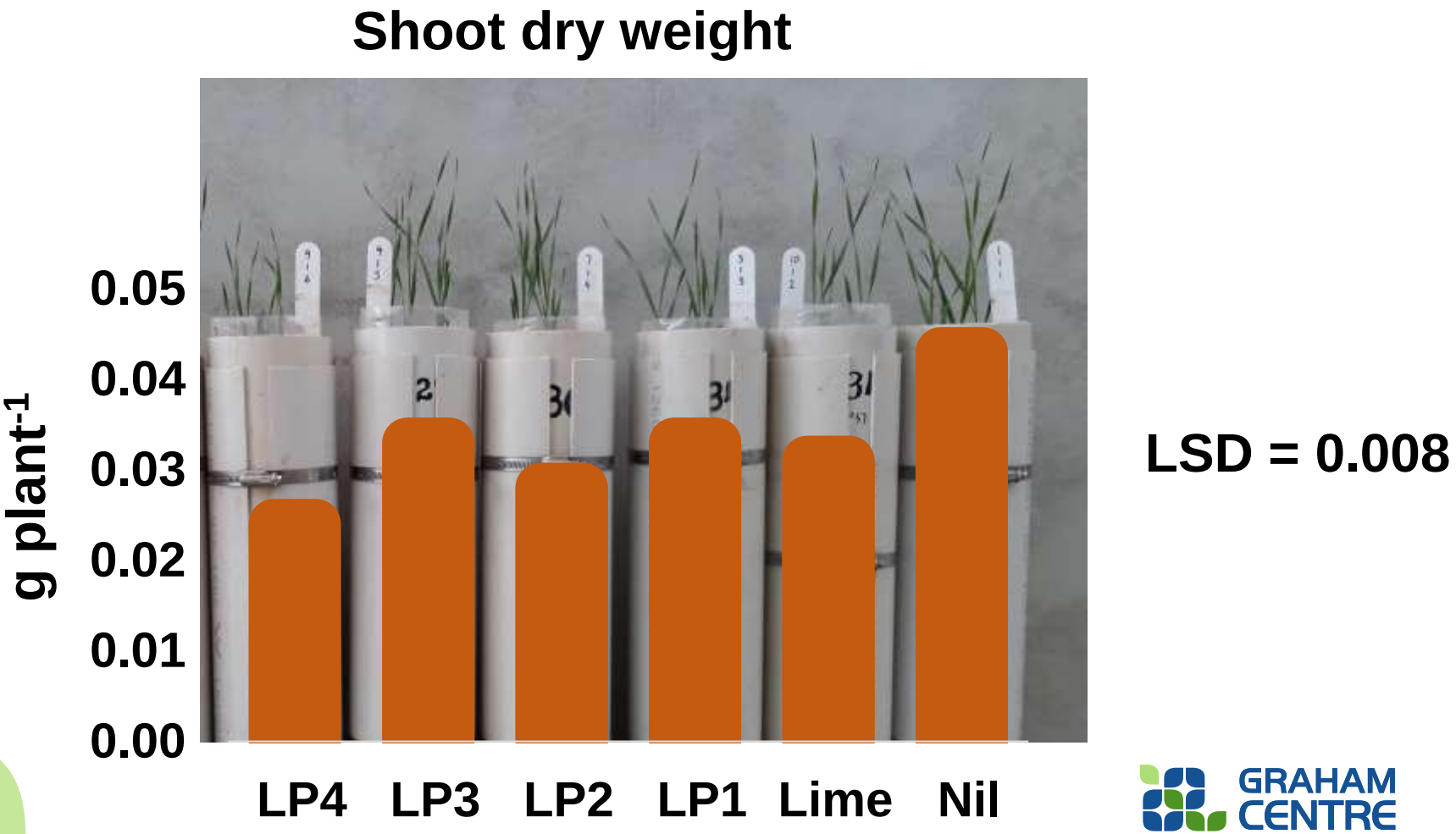
Key results of glasshouse experiment



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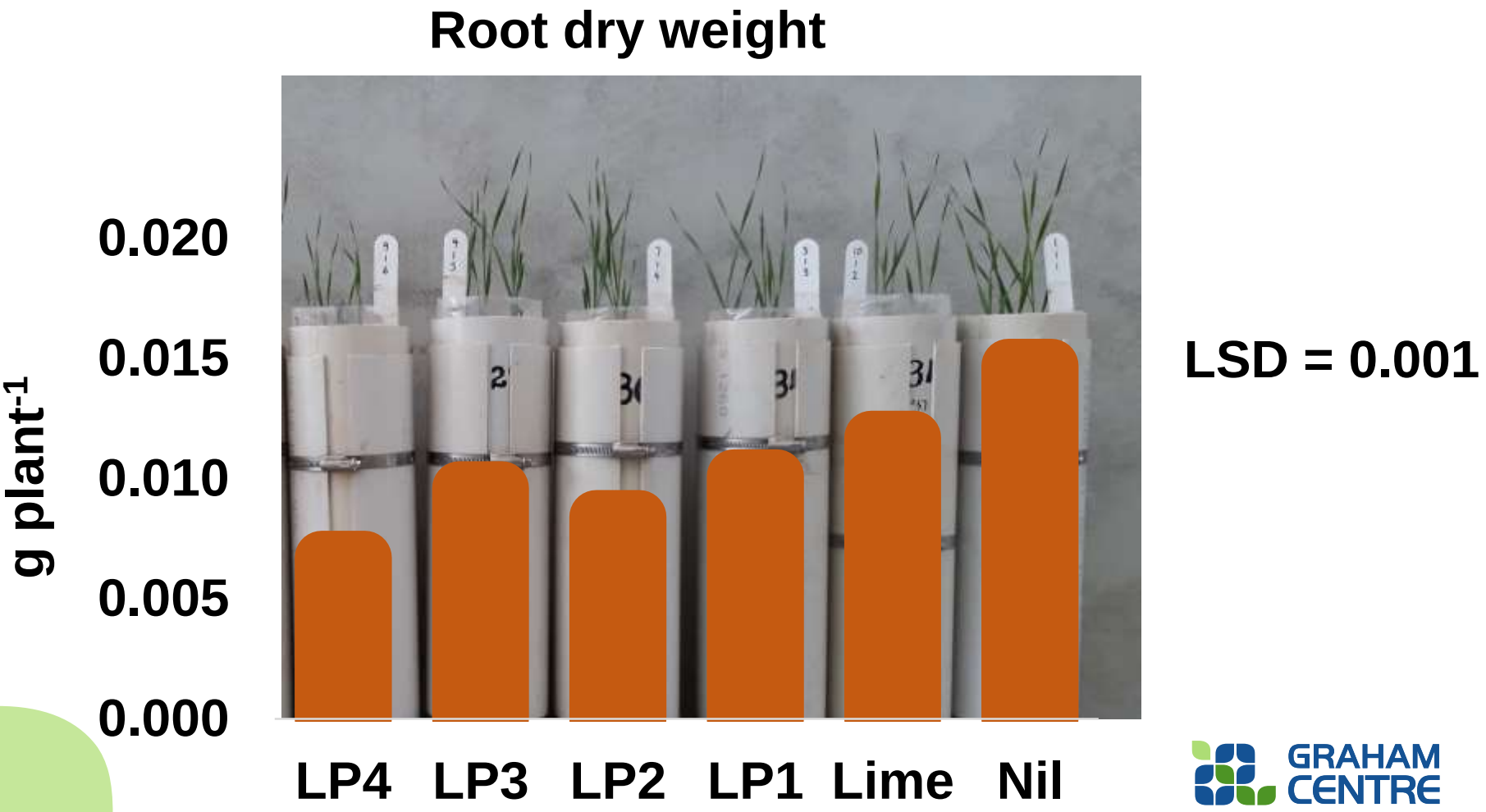
Key results glasshouse experiment



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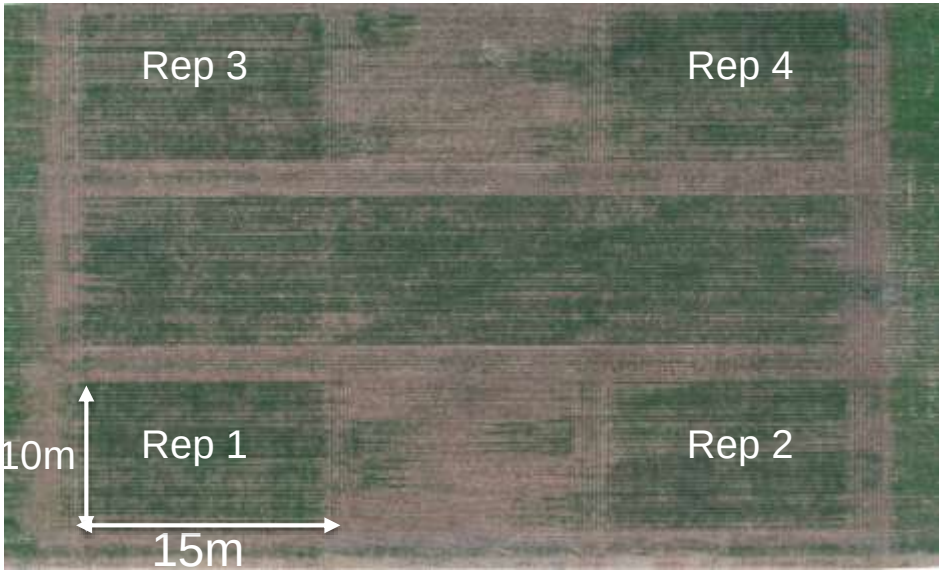
Field Experiment

- 4 treatments: nil, lime (L) (2.5 t/ha), lucerne pellets (15 t/ha) (LP) and lucerne pellets in combination with lime (LP+L)
- 2 genotypes: Gregory and Lancer, acid soil resistant and sensitive cultivars, respectively



Each replicate included 2 genotypes and 4 treatments

- The amendments incorporated into ~5cm of the soil profile

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Field Experiment

Incorporation of the amendments into ~5cm of the soil profile

Before incorporation

After incorporation

1. Broke ~5cm surface layer
2. Run through by rotary hoe
3. Manually applied the amendments
4. Incorporated by rotary hoe

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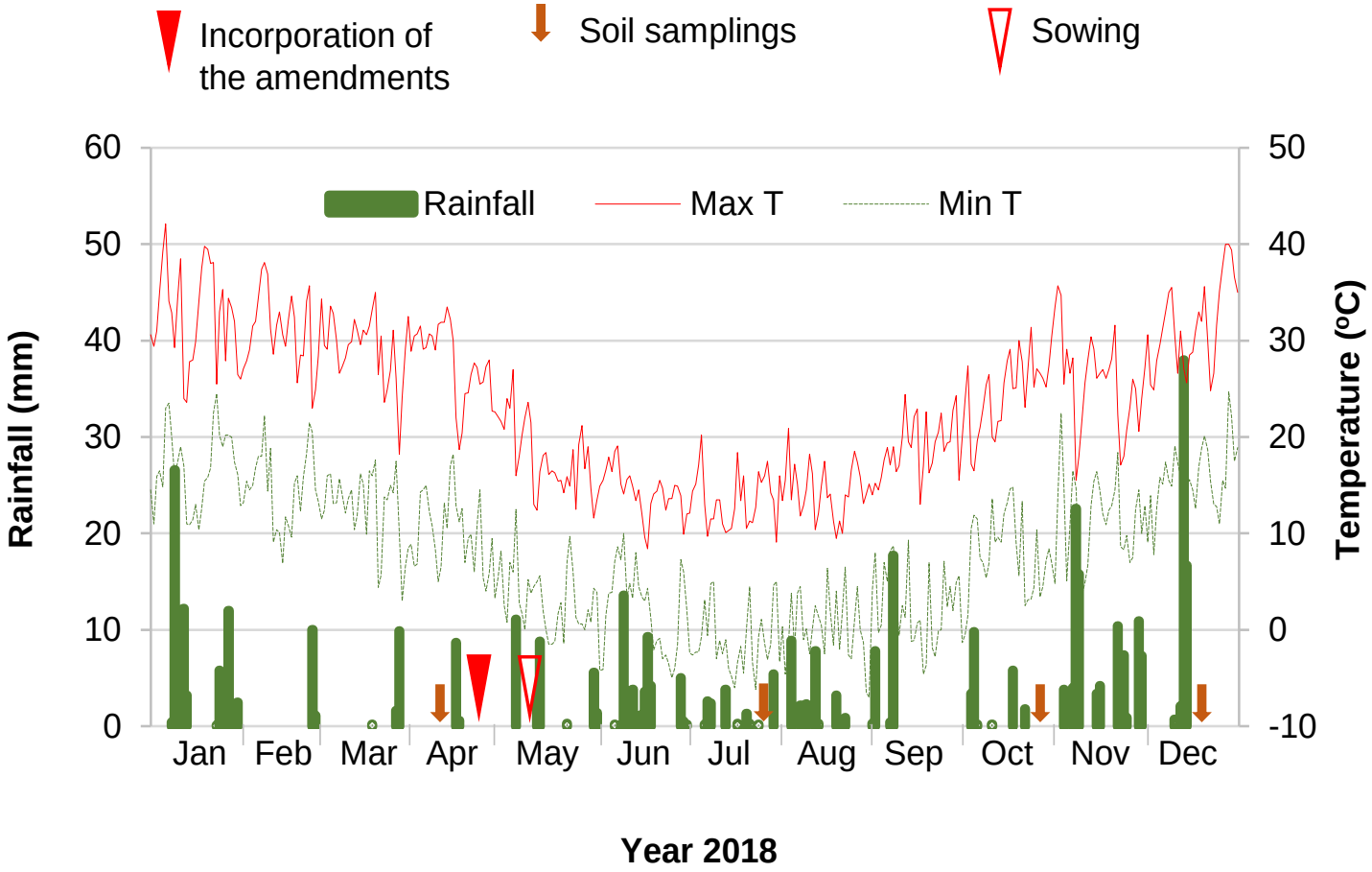
Weather conditions



Total 2018: 417mm

Total growing season: 260mm

3 months after incorporation: 85mm

6 months after incorporation: 164mm

8 months after incorporation: 318mm

Data from Cootamundra airport (34°63'S, 148°49'E) station, site number 073142, approximately 20km away from the experiment location (http://www.bom.gov.au/)

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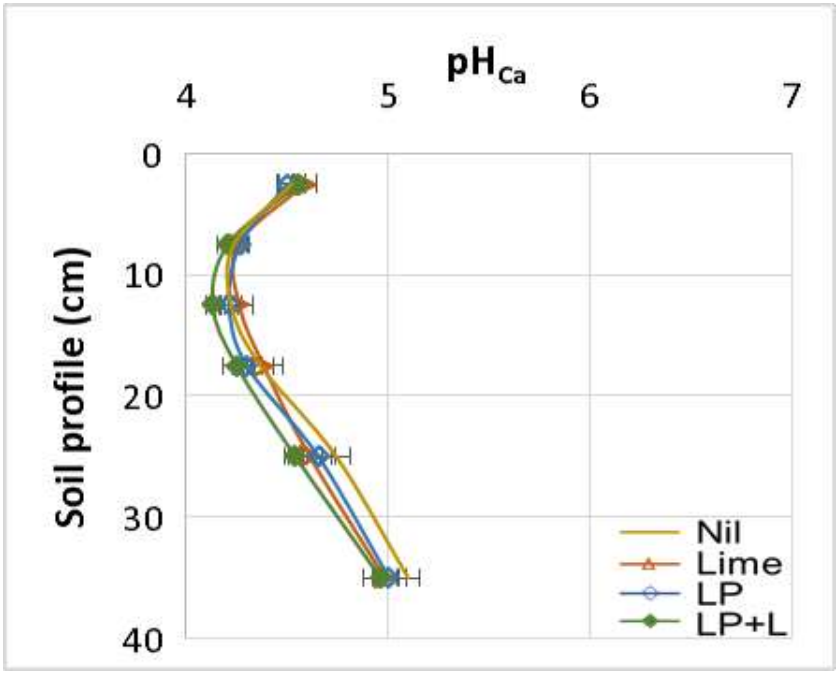
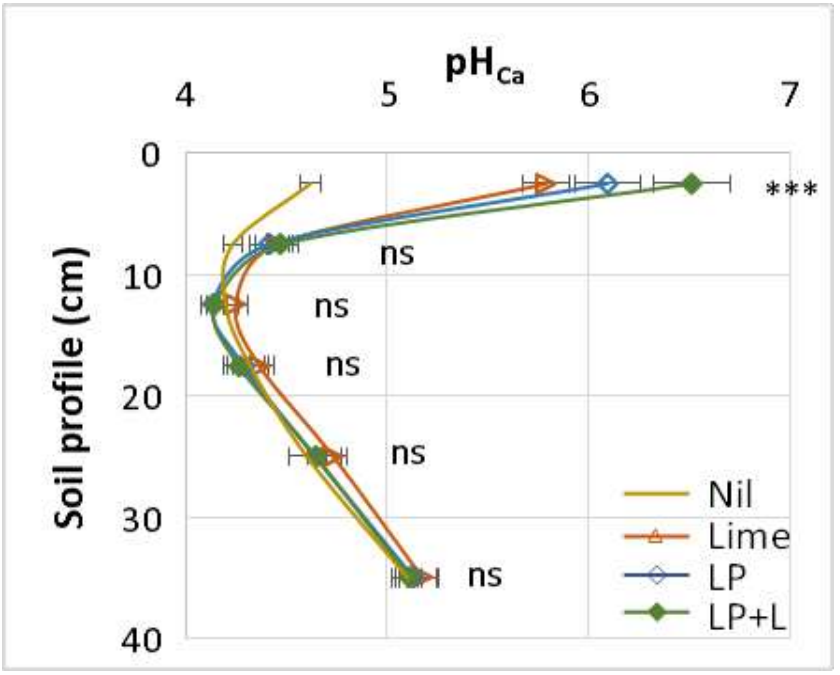
Key results of field experiment

pH profile at before and 3 months after incorporation



Before incorporation



3 months after incorporation

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Irrigation the field experiment

A mini-plot, 2.5m^2 within each plot was irrigated equivalent to 70mm of rainfall at booting stage (5 months after incorporation)

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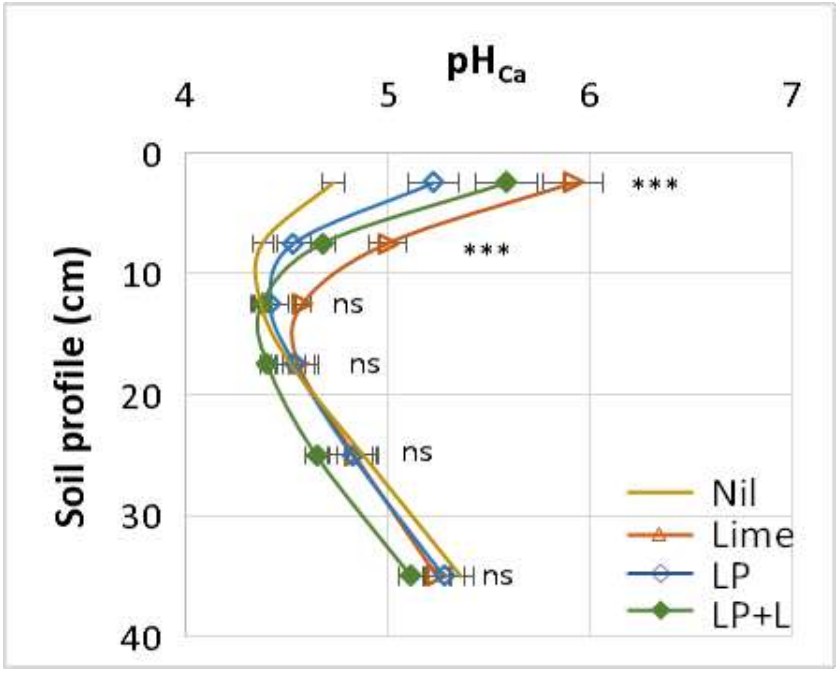
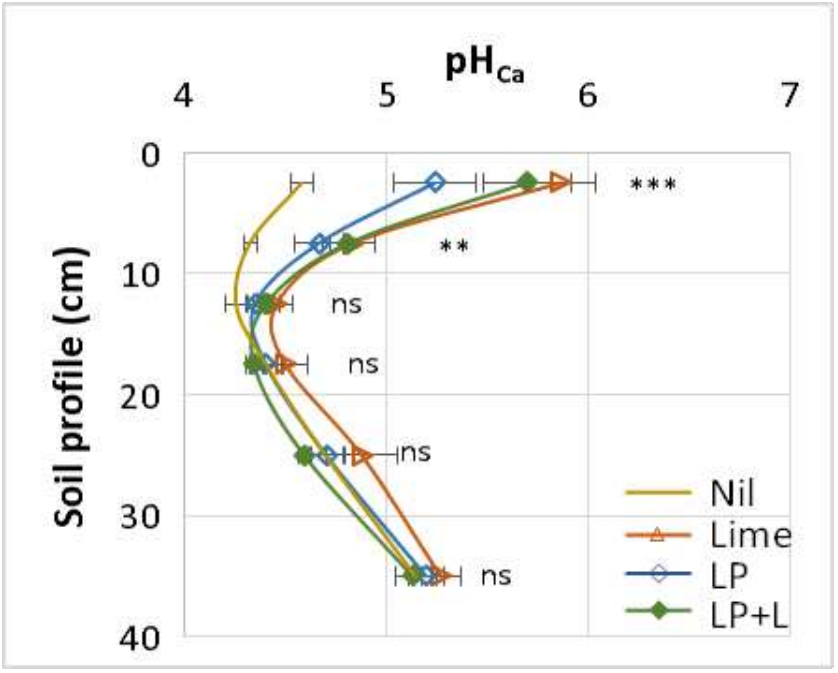
Key results of field experiment

pH profile at 6 months after incorporation



Non-irrigated



Irrigated

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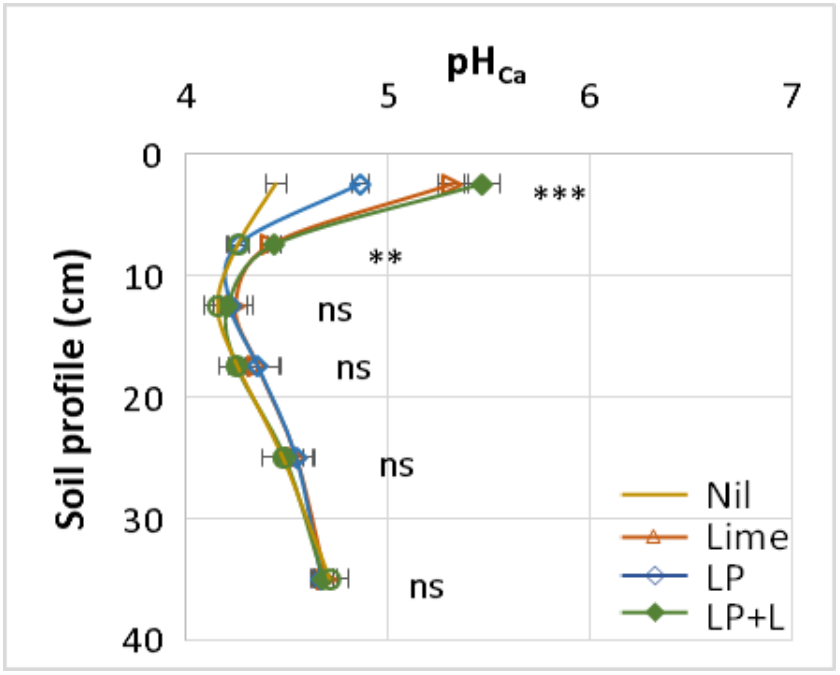
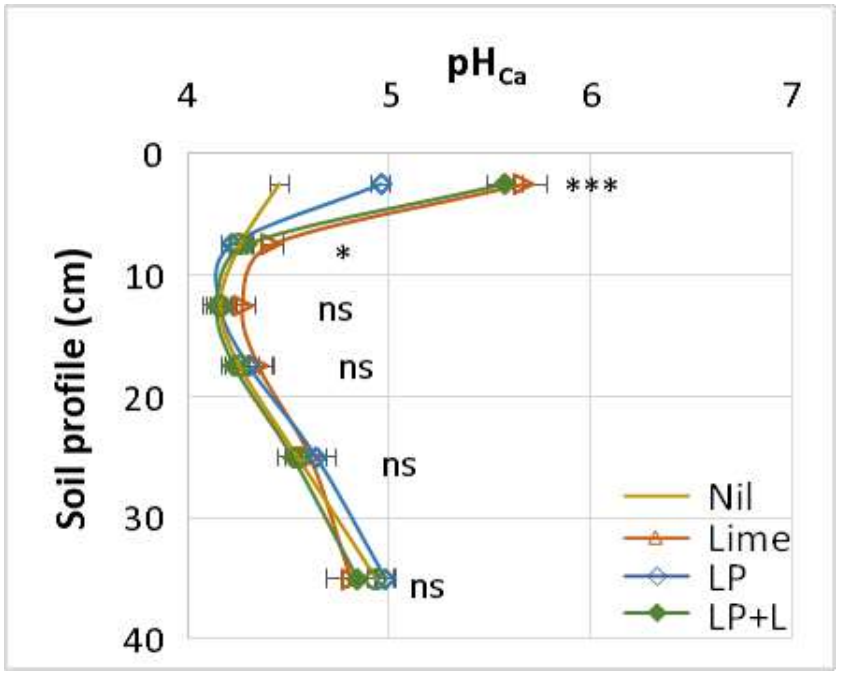
Key results of field experiment

pH profile at 8 months after incorporation (at harvest)



Non-irrigated



Irrigated

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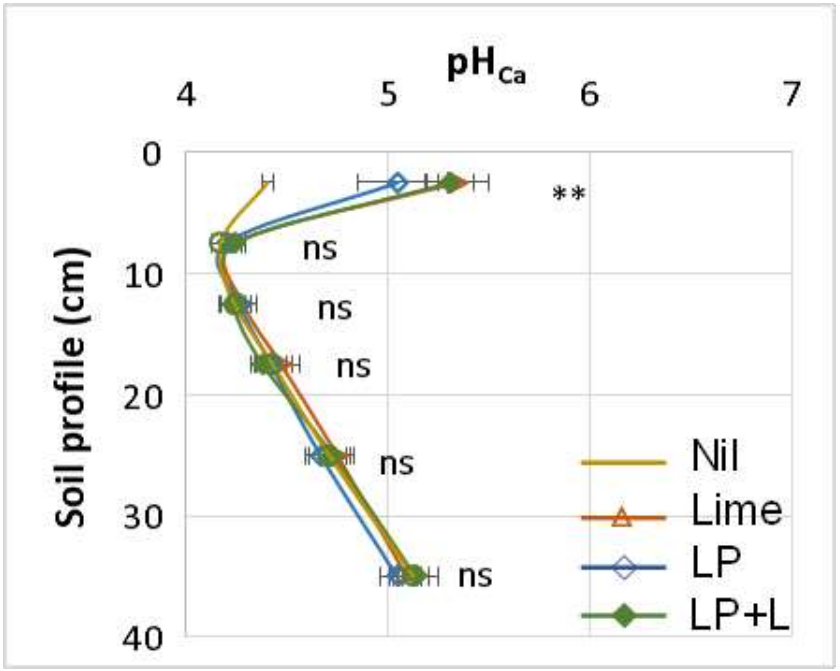
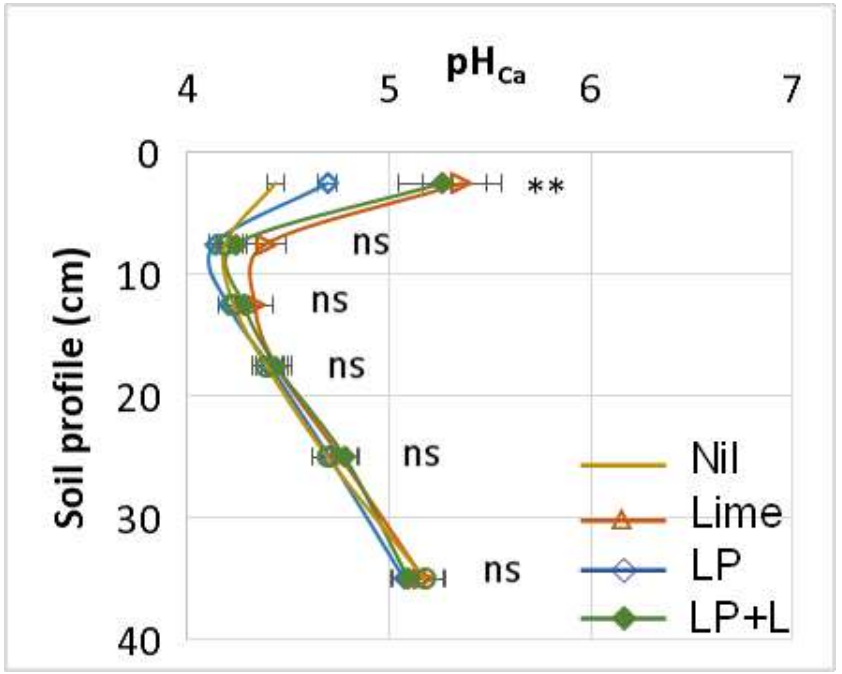
Key results of field experiment

pH profile at 12 months after incorporation (second season)



Non-irrigated



Irrigated

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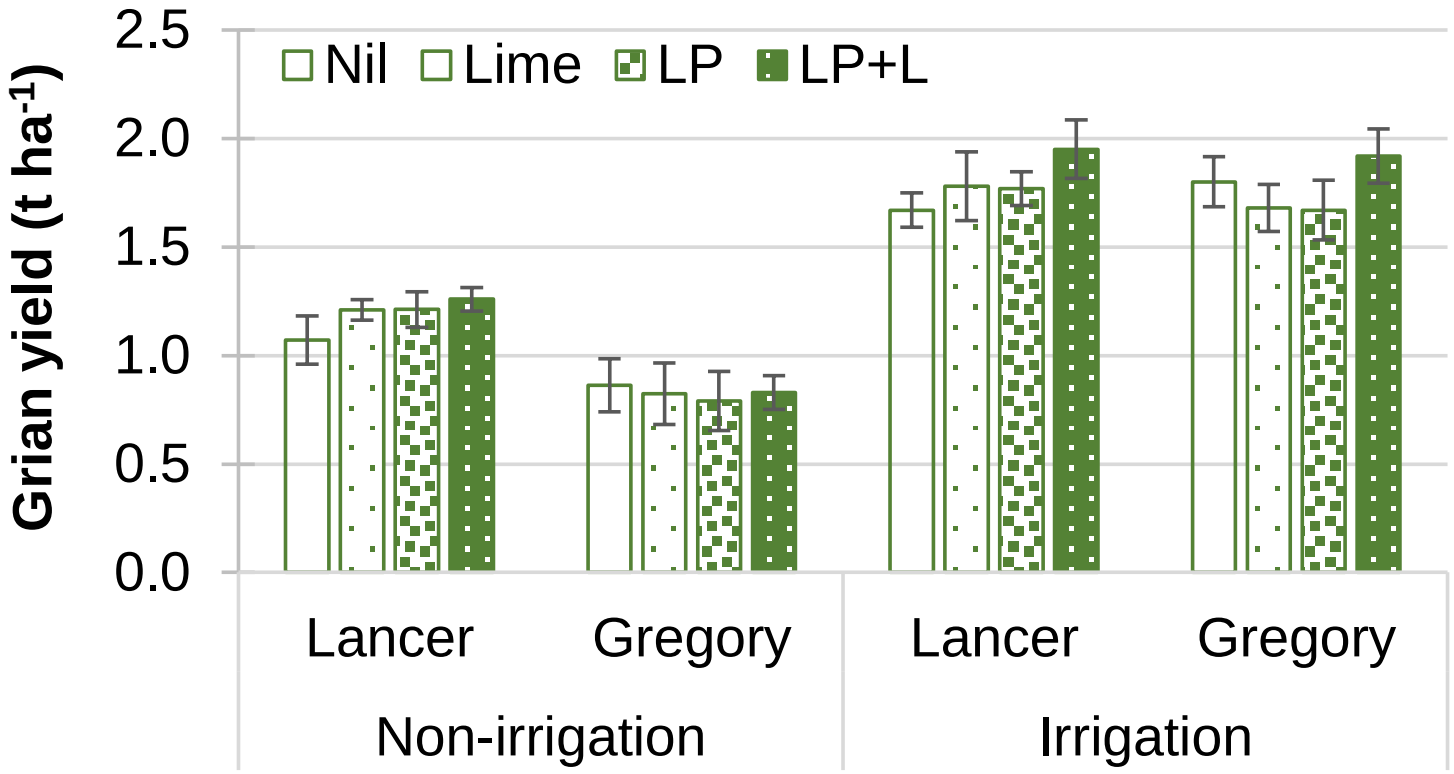
Key results of field experiment

Grain yield of the two cultivars



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Conclusions

- Surface incorporation of organic matter increased subsurface soil pH upon water infiltration
- The incorporation of organic matter in combination with lime increased the effectiveness of the amelioration of subsurface soil acidity
- However, subsurface soil pH did not increase under field conditions due to insufficient rainfall to infiltrate into subsurface soil layer
- The incorporation of either LP or lime did not significantly improve grain yield in the first year of incorporation

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