Lime - the foundation for soil fertility

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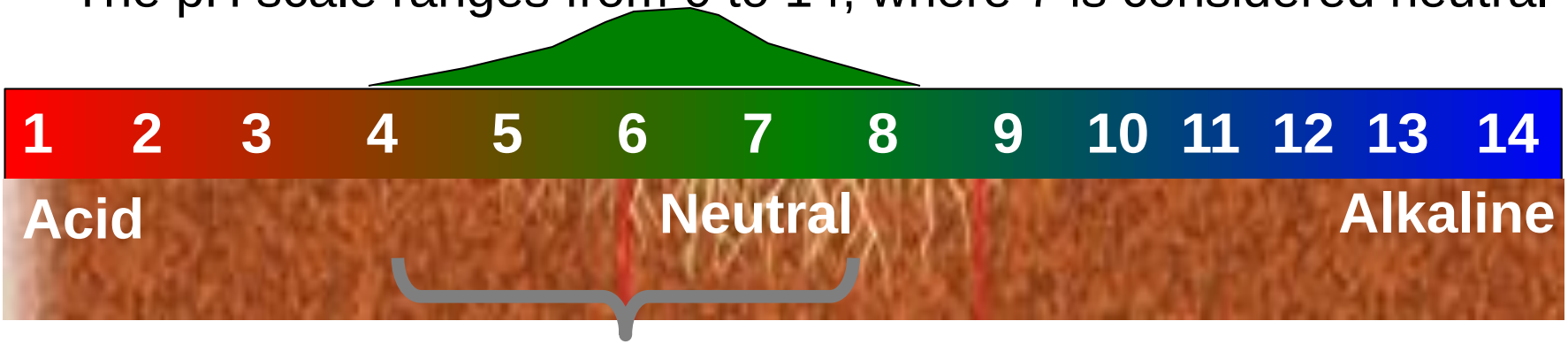
Soil Fertility Conference 2015

'Fertiliser for growth in grassland farming systems'

Agriculture and Food Development Authority

What is soil pH?

- **Soil pH** is the single most important chemical property of the soil
  (like soil texture is to the physical properties)
- pH is a measure of hydrogen ion concentration (H^+) soil solution.
- The pH scale ranges from 0 to 14, where 7 is considered neutral



Typical pH range for Irish soils

- The pH scale is exponential

  pH 6 is **10X** more acidic than **pH 7**

  pH 5 is **100x** more acid than **pH 7**

  Therefore every 0.1 pH drop is a significant

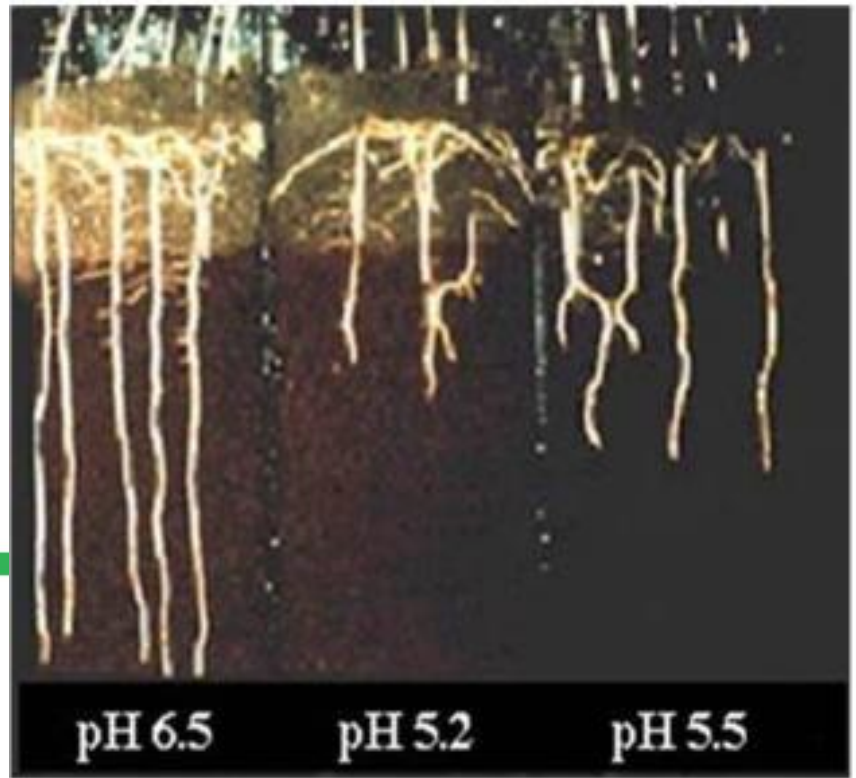
What effect does too much acidity have?

Plant root injury:(H^+ & Al_3^+)

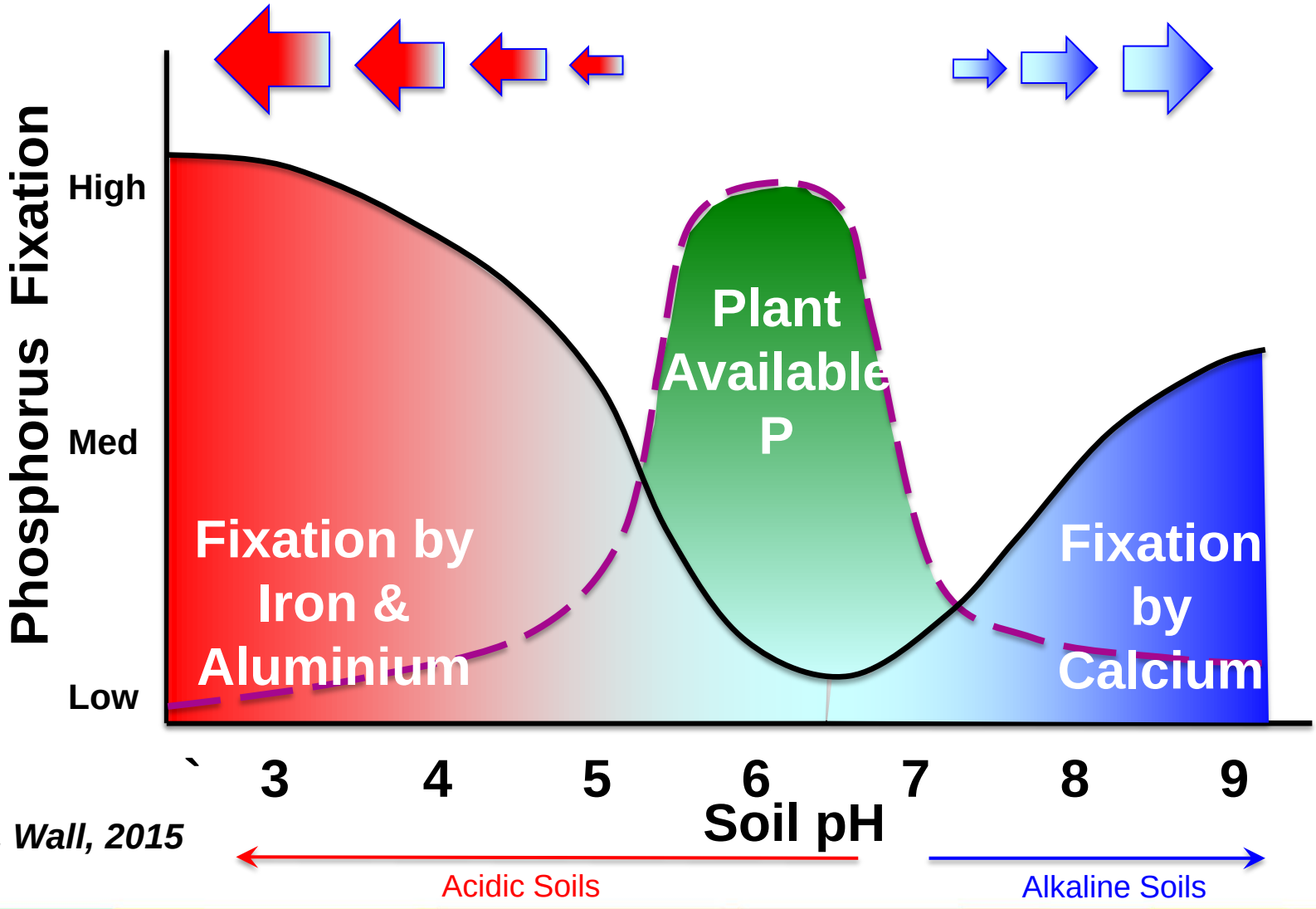
- changes in root membrane permeability
- leakiness or loss of organic substrates & absorbed cations
- Increases Al_3^+ availability which is toxic to plant roots)
- root tips can die and lateral root development is supressed

Plant tops:

- reduced transport of nutrients from roots



Effect of soil pH on soil P availability



D.P. Wall, 2015

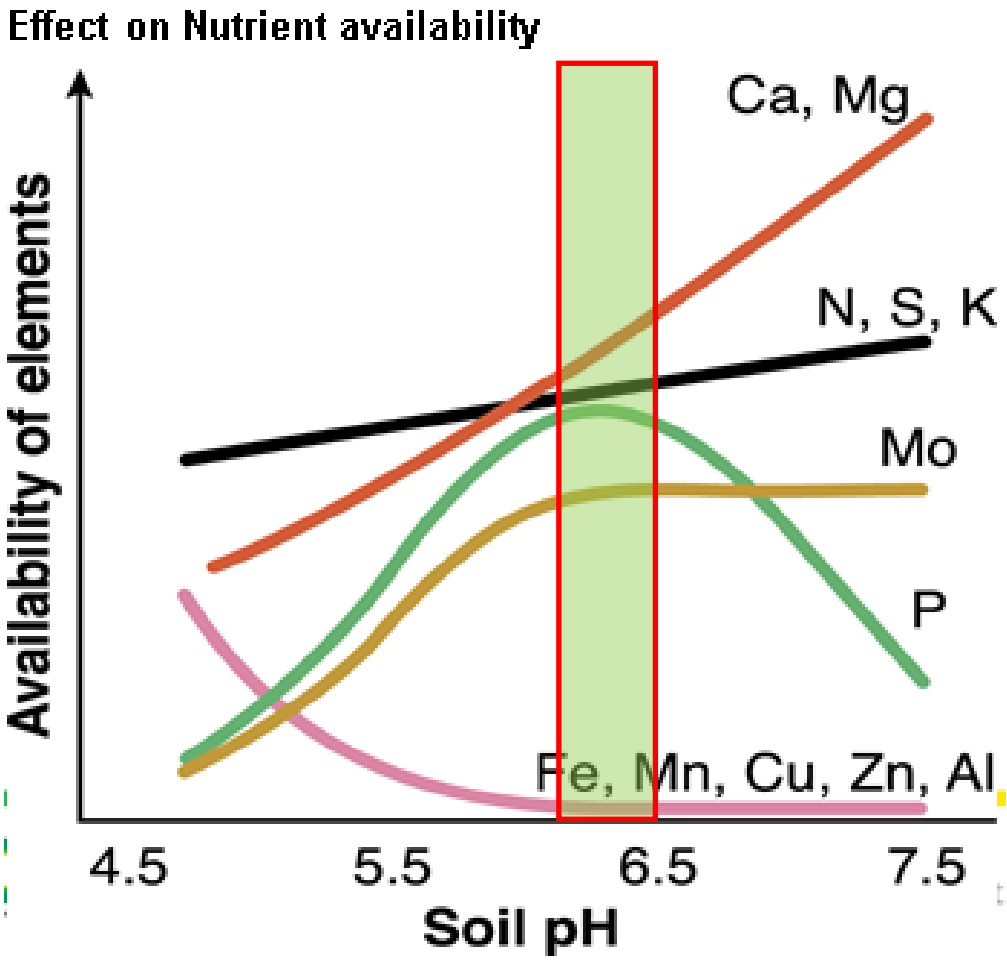
Why is lime important ?

Neutralises acidity to correct soil pH

Supplies essential plant nutrients Ca (and Mg)

Enhances soil biology and fertility

- Organic activity in soil depends on soil pH
- Release of nutrients from organic matter in soil
- Optimises nutrient availability (stored and freshly applied nutrients)



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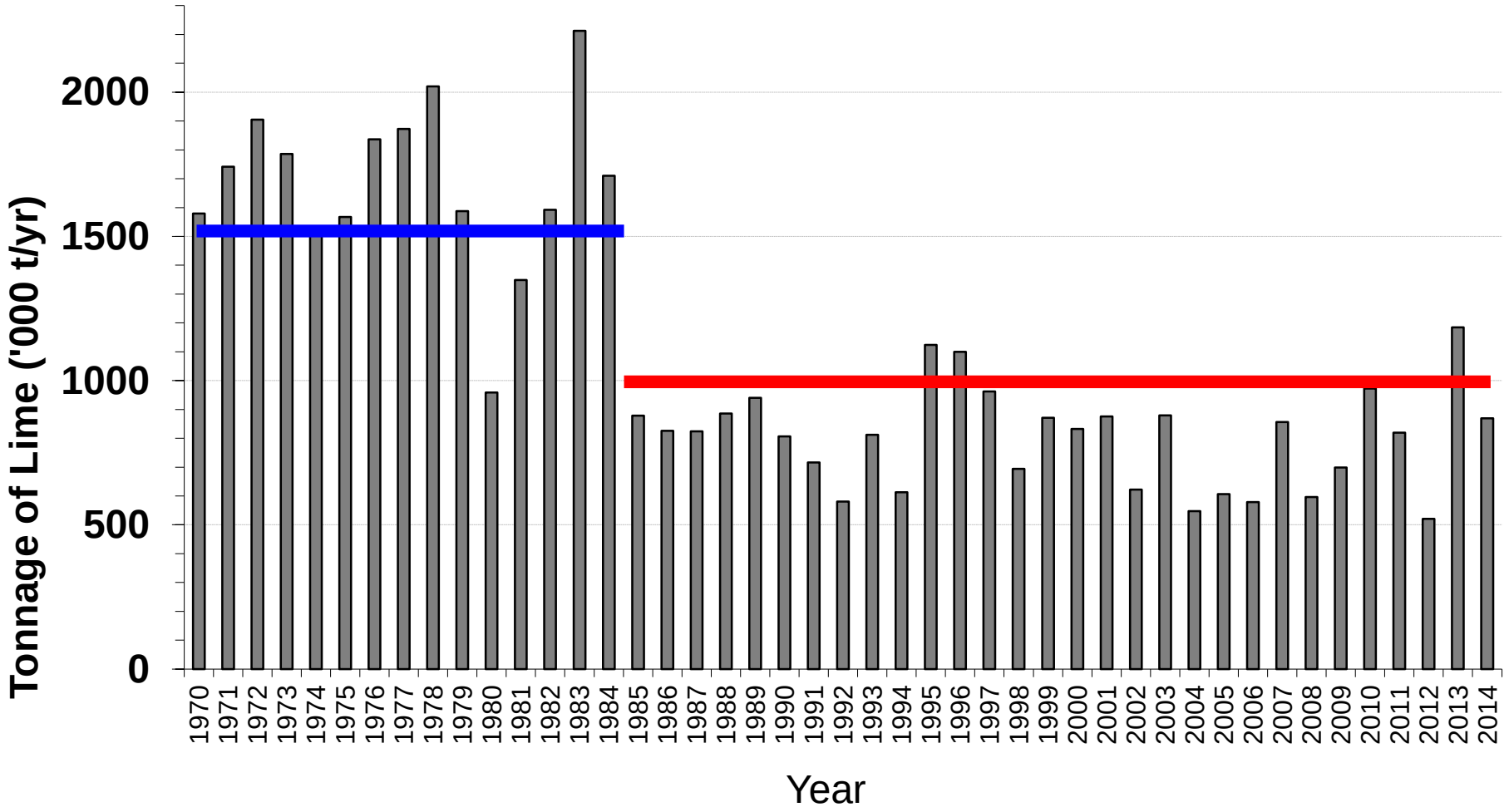
Lime usage 1970 -2014



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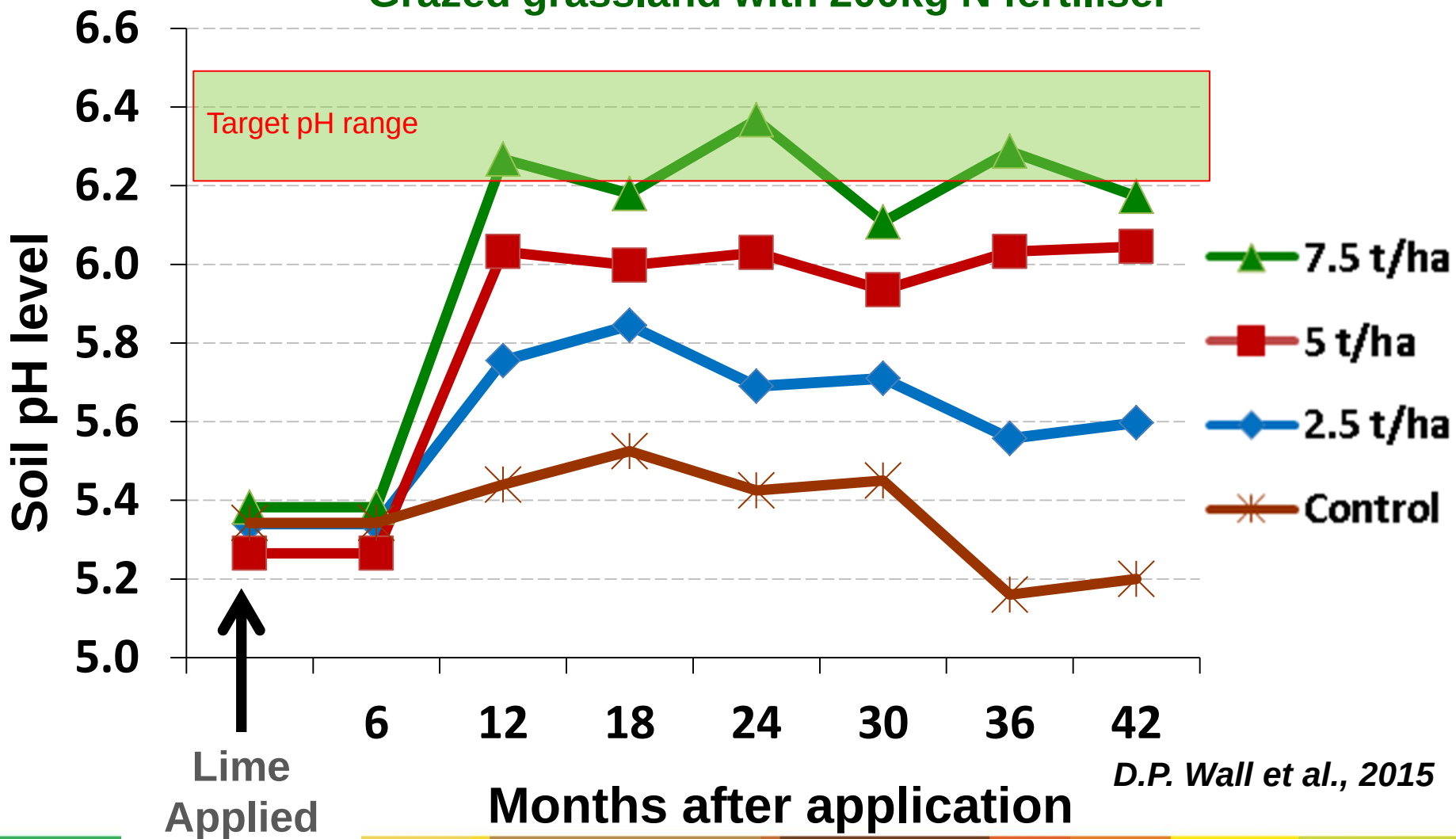
Main lime sources available

Lime $CaCO_3$ + Acid $2H^+$ = Calcium Ca^{+2} + Carbon Dioxide CO_2 + Water H_2O

1. **Ground Limestone** *(60% carbonate **$CaCO_3$**)*
   - *Finely ground to react with soils*
   - (35%) <0.15mm & (65%) <3.35mm
2. **Magnesium Limestone** *(40% MgCO3 60%CaC03 = 64.5% carbonate)*
   - *Higher neutralising value /slower to react / Use on Mg deficiency soils*
3. **Granulated Liming Products**
   - *Seasonal soil pH regulation / Similar to Fertilisers*
4. **Burnt Lime *(CaO)***
   - *Reacts faster?.*
5. **Hydrated lime *(Ca (OH_2))***
   - *Reacts very rapid.*

Ground limestone effect on soil pH

Grazed grassland with 200kg N fertiliser



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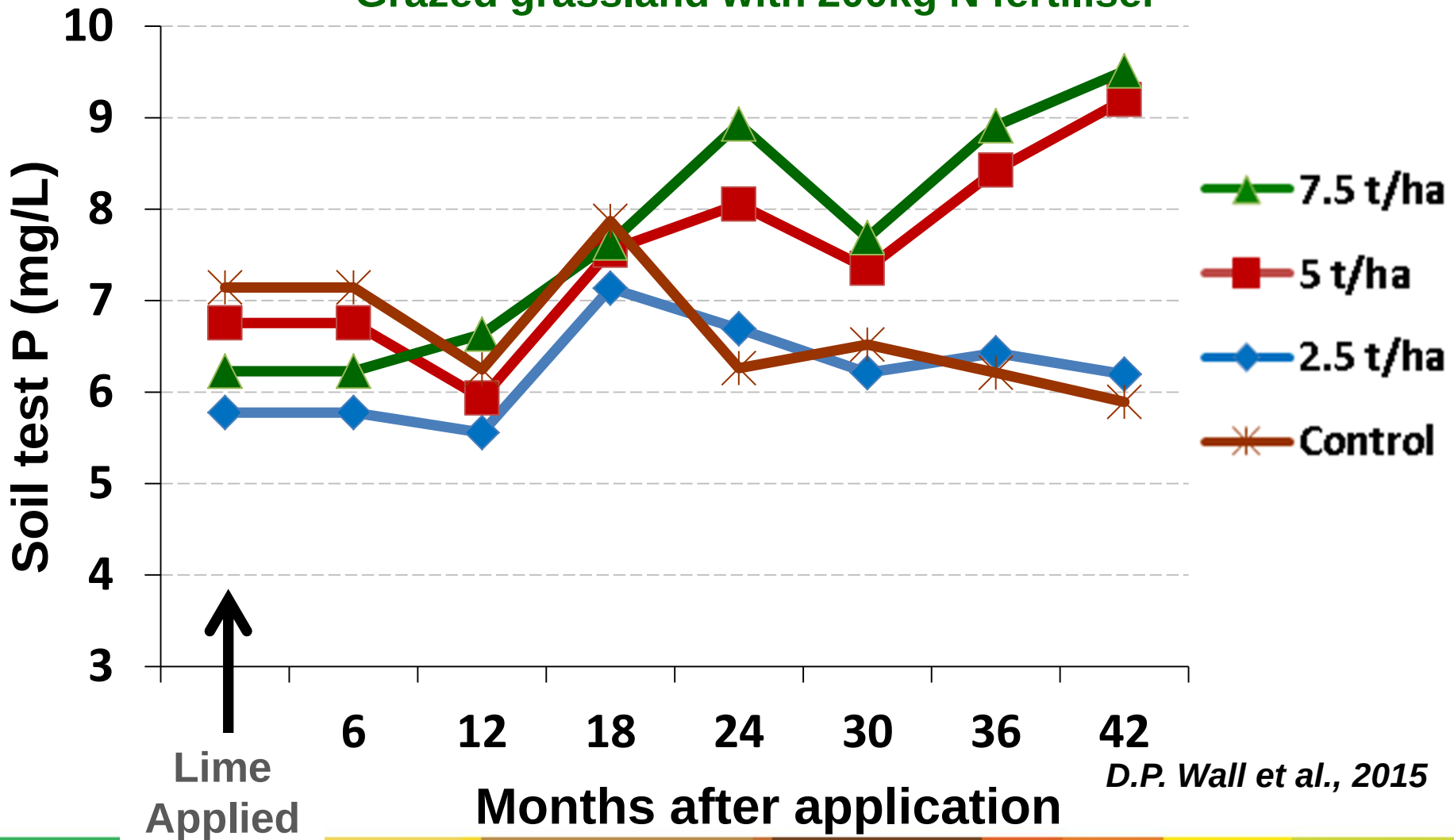
Ground limestone effect on soil P levels

Grazed grassland with 200kg N fertiliser



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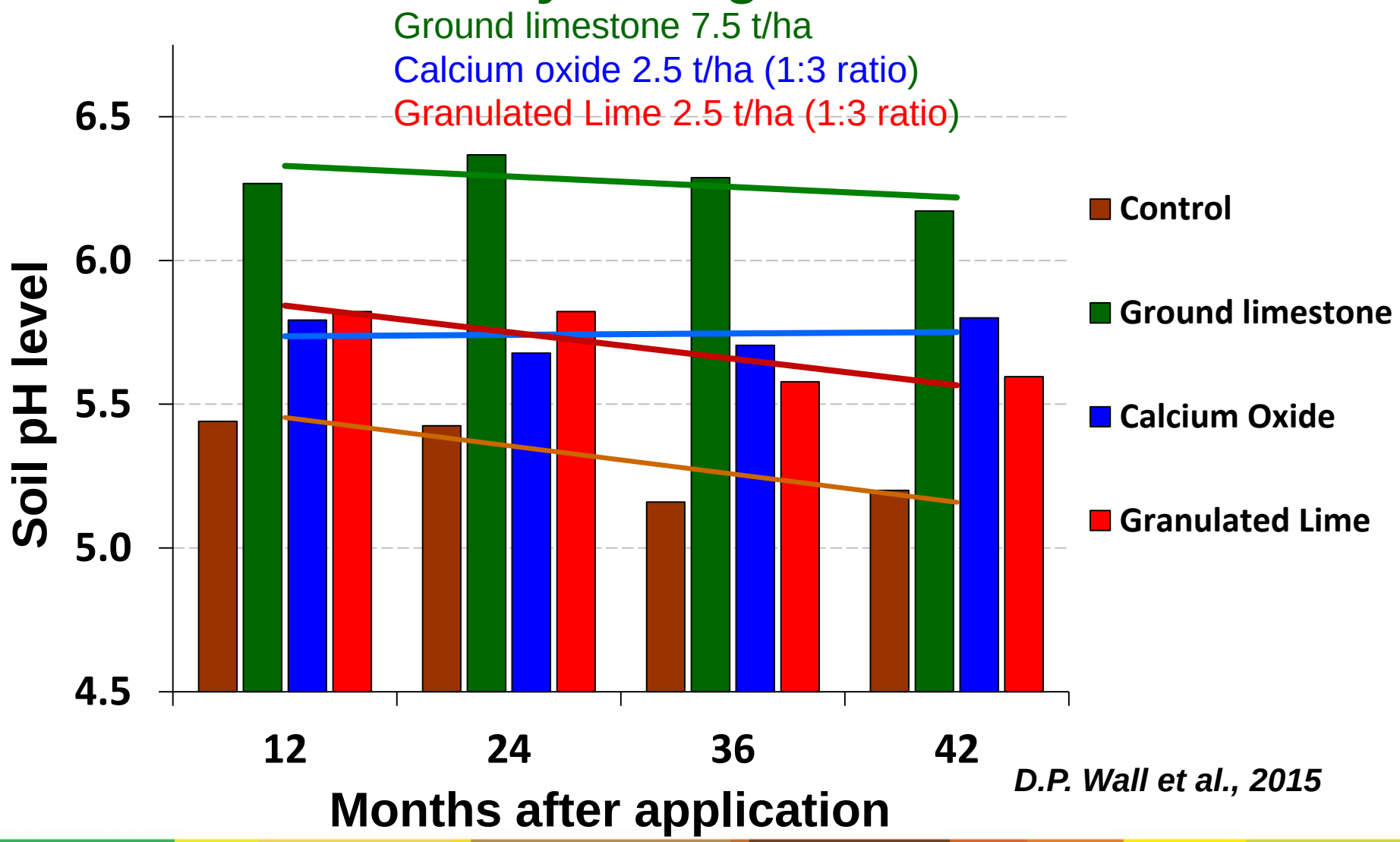
Efficiency of Bag Lime Products



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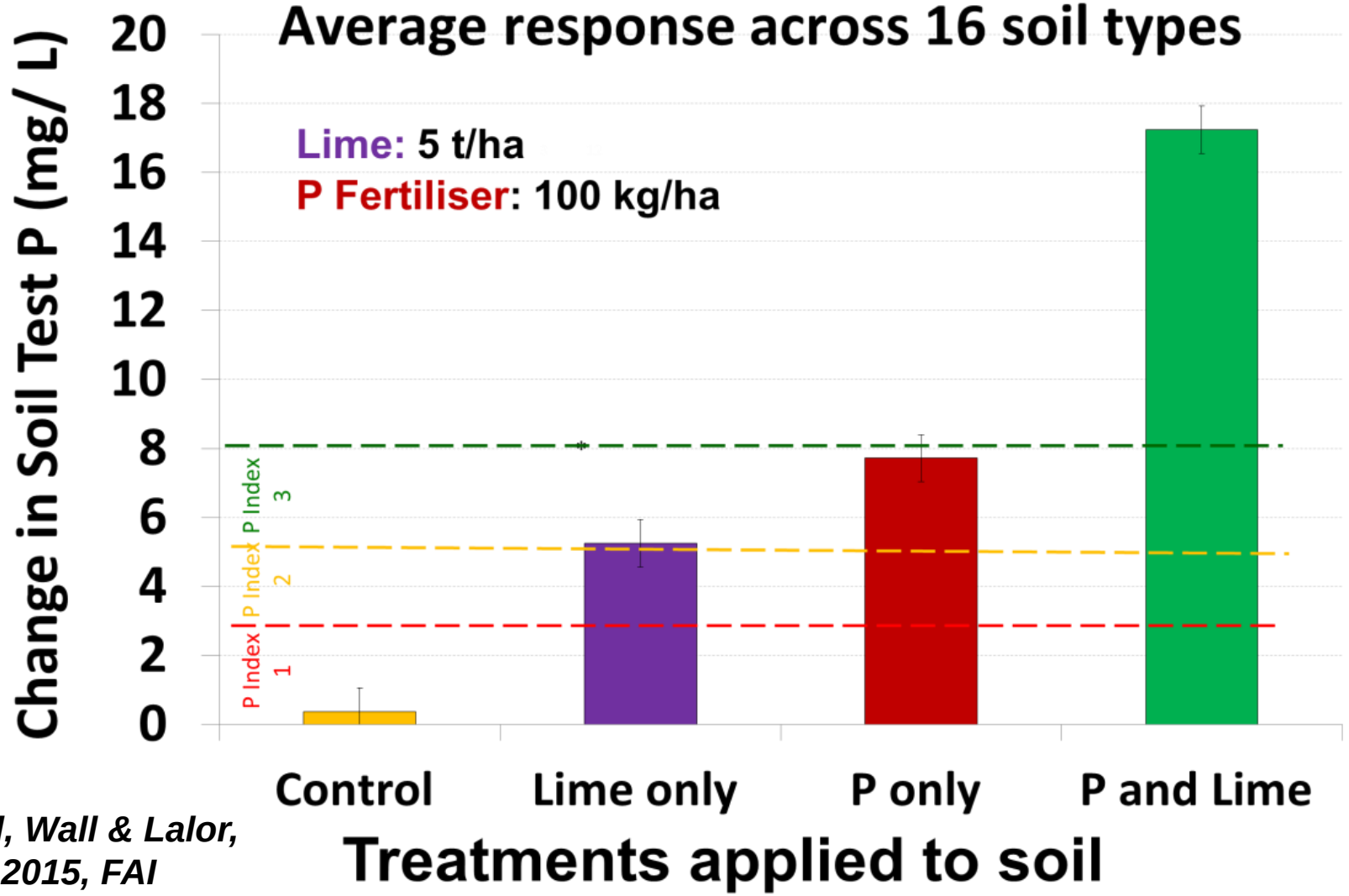
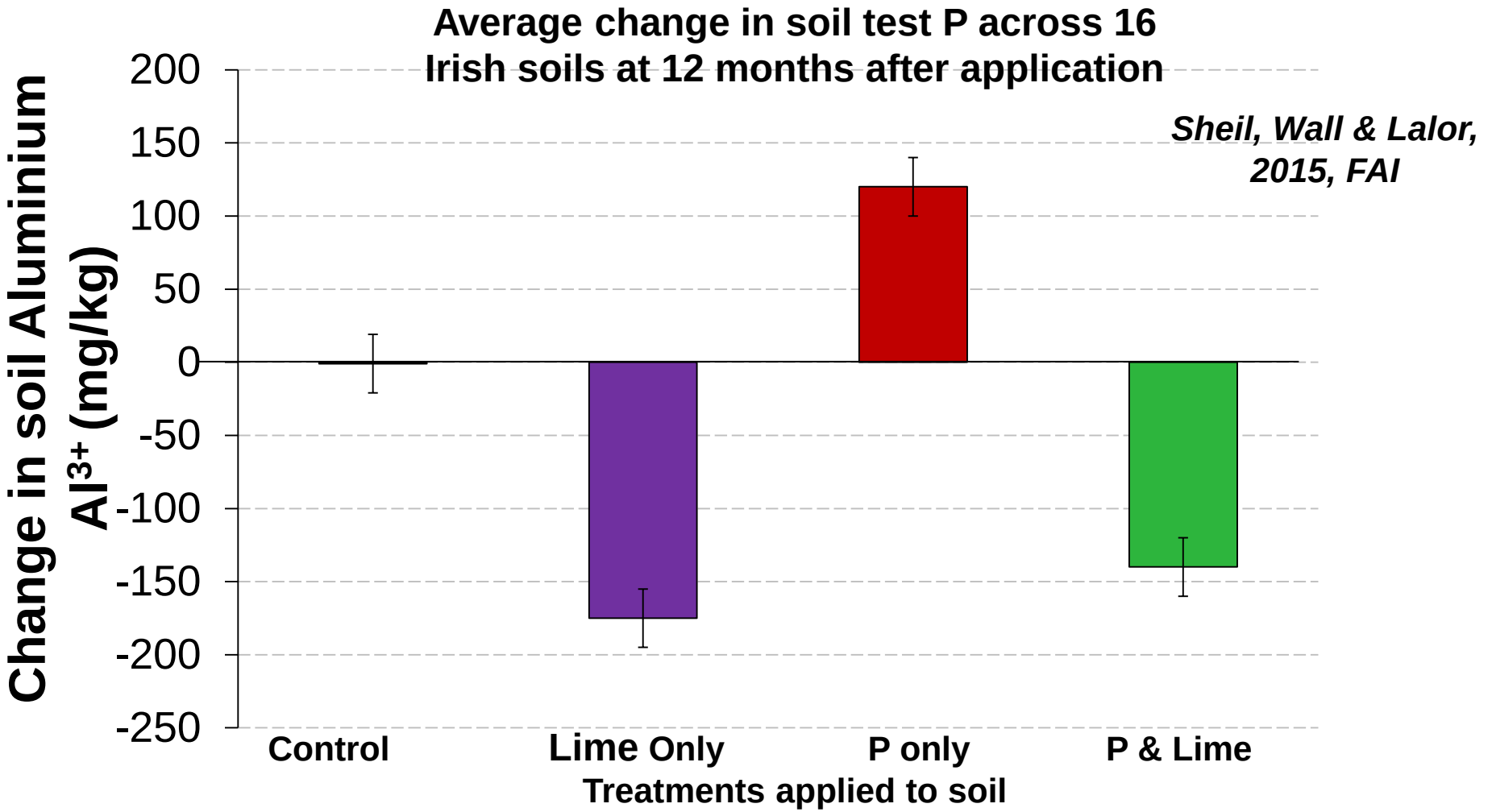
Effect of P and Lime of soil P availability



Sheil, Wall & Lalor, 2015, FAI

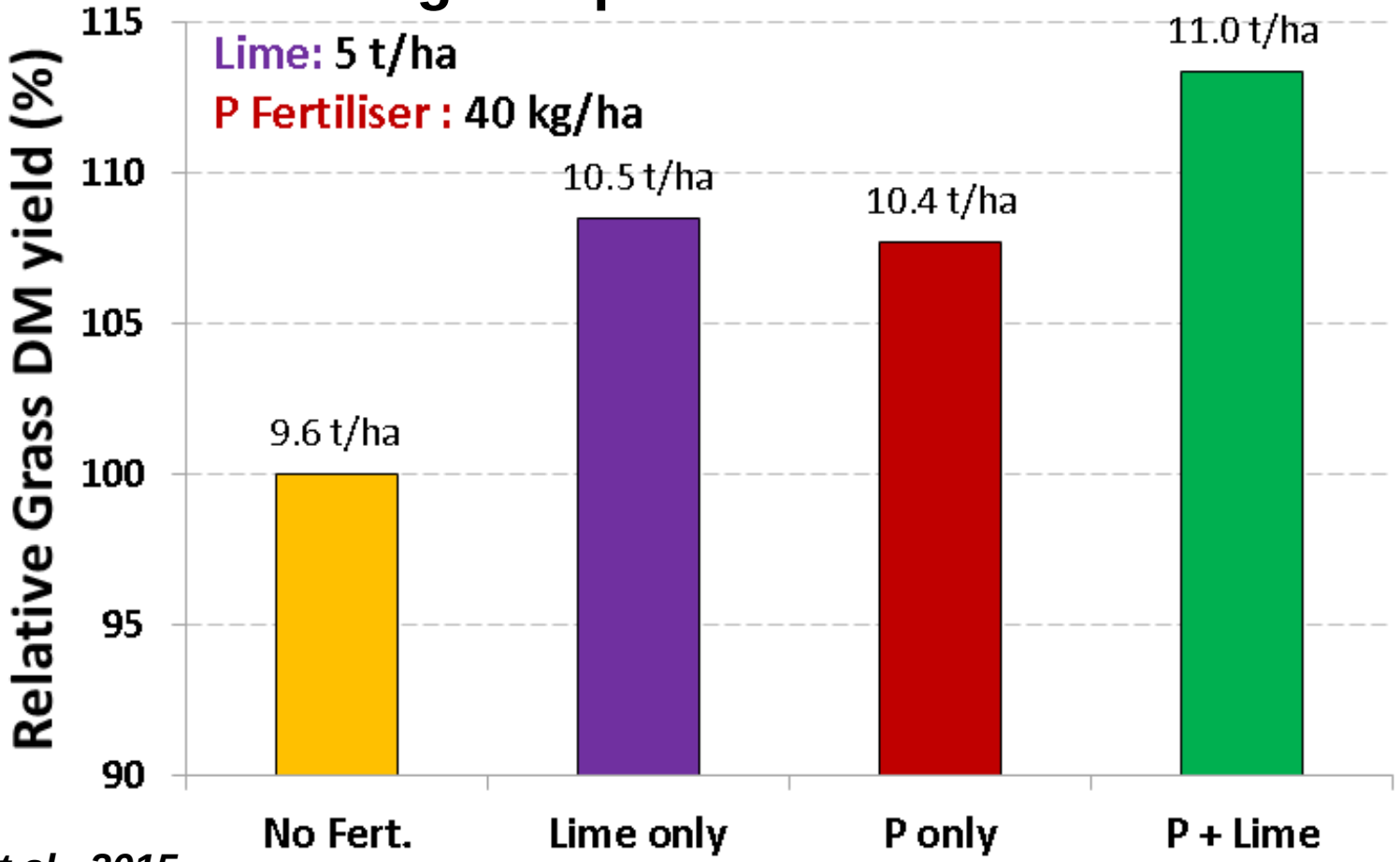
Effect of Lime on Aluminium availability



* *Increasing soil pH (less acidity) decreases available Al concentrations and reduces Al-P bonding (fixation)*

Effect of P and Lime of grass yield

Average response across 2 sites



D.P. Wall et al., 2015

Average soil pH: 5.2 6.4 5.2 6.4

Lime - Best Management Practice

- **Target mineral soils is pH of 6.3 for grassland (*for peats pH 5.5*)**
- **Apply lime based on the soil test report**
- **Split lime applications when required rates exceed 7.5 t/ha**
- **Caution! reduce lime rates on high molybdenum (Mo) soils so that pH does not exceed 6.2.**
- **Ground limestone is the most cost effective source of lime and can be applied throughout the year when the opportunity arises.**
- **As a rule of thumb: leave ≥3months between lime application and following with Urea or slurry application**
- **Maintaining soil pH at the target level will increase the release of soil nutrients.**
- **Lime is the foundation of soil fertility and is a primary step to take following soil sampling.**

Wall, D.P. et al. Teagasc, Soil Fertility Conference, 2015