

Influence of fine particle application (FPA) of urea and urease inhibitor (NBTPT) on N and water use efficiency in grassland using isotopic techniques

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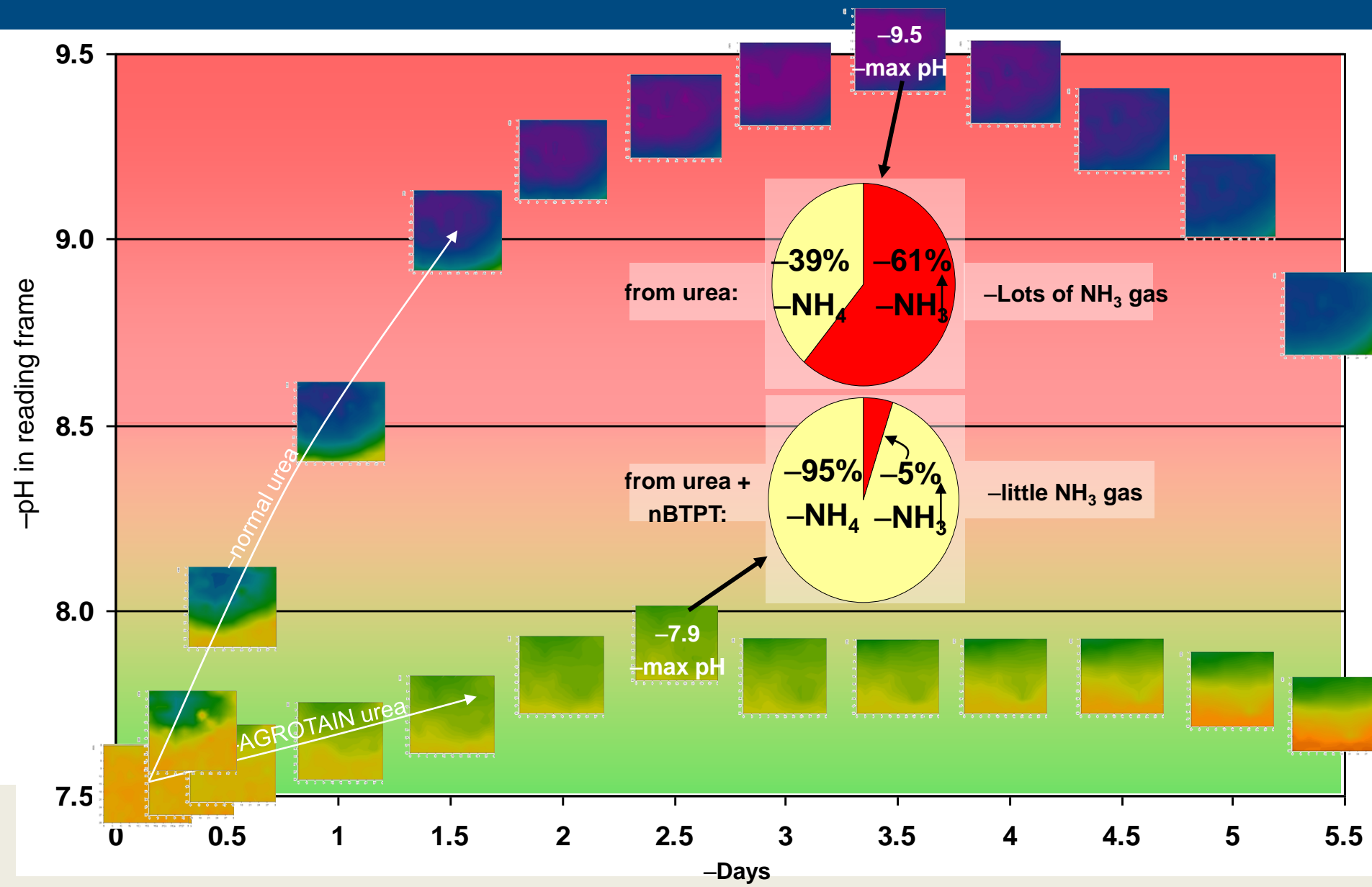
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Background

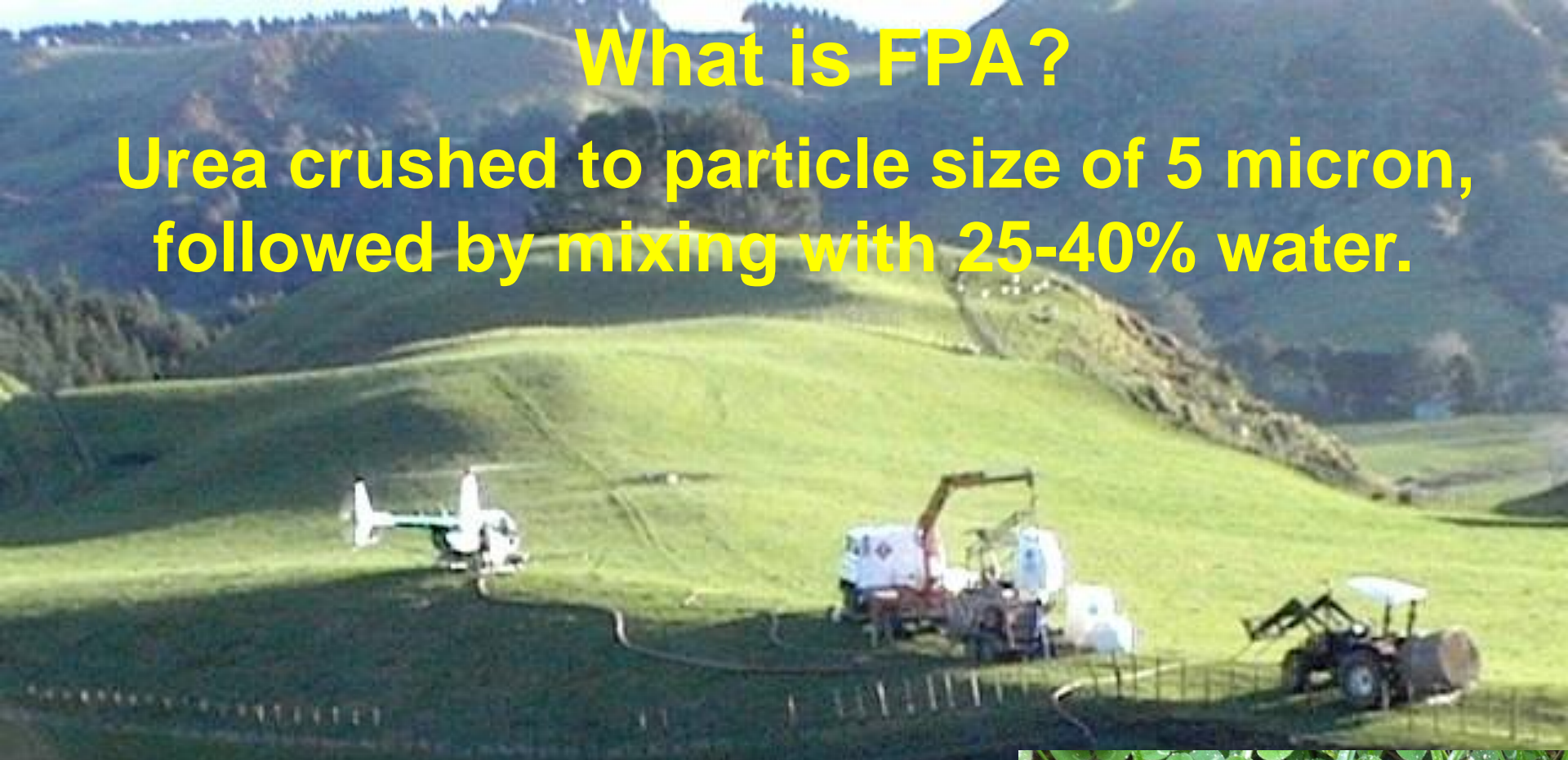
- Urea is the predominant (80%) form of chemical N fertilizer in New Zealand.
- N losses from urea (50-60% of the applied N) may be reduced through:
 - A reduction in volatilisation with the use of urease inhibitor:
 - N-(n-butyl) thiophosphoric triamide (nBTPT);
Trade-name Agrotain®.
 - An improvement in irrigation and fertiliser use efficiency with the use of FPA

How urease inhibitor prevents ammonia losses



What is FPA?

Urea crushed to particle size of 5 micron, followed by mixing with 25-40% water.



Objectives

To assess the effect of urea with nBTPT applied in FPA, and irrigation on:

(i) N-use efficiency

(ii) Water use efficiency

Methodology

- **Ryegrass grown in a growth cabinet:**
 - 20°C, 70% relative humidity (RH), during the 16-h light period
 - 15°C, 70% RH during the 8-h dark period.
- **^{15}N labeled urea (10%) applied to ryegrass leaves in FPA form at 25 kg N ha⁻¹**

Methodology (continued)

Treatments:

1. Control (no N)
2. Control + leaf irrigation after day 1
3. Urea applied on day 0
4. Urea applied on day 0 + leaf irrigation after day 1
5. Urea + nBTPT applied on day 0
6. Urea + nBTPT + leaf irrigation after day 1

Methodology (continue)

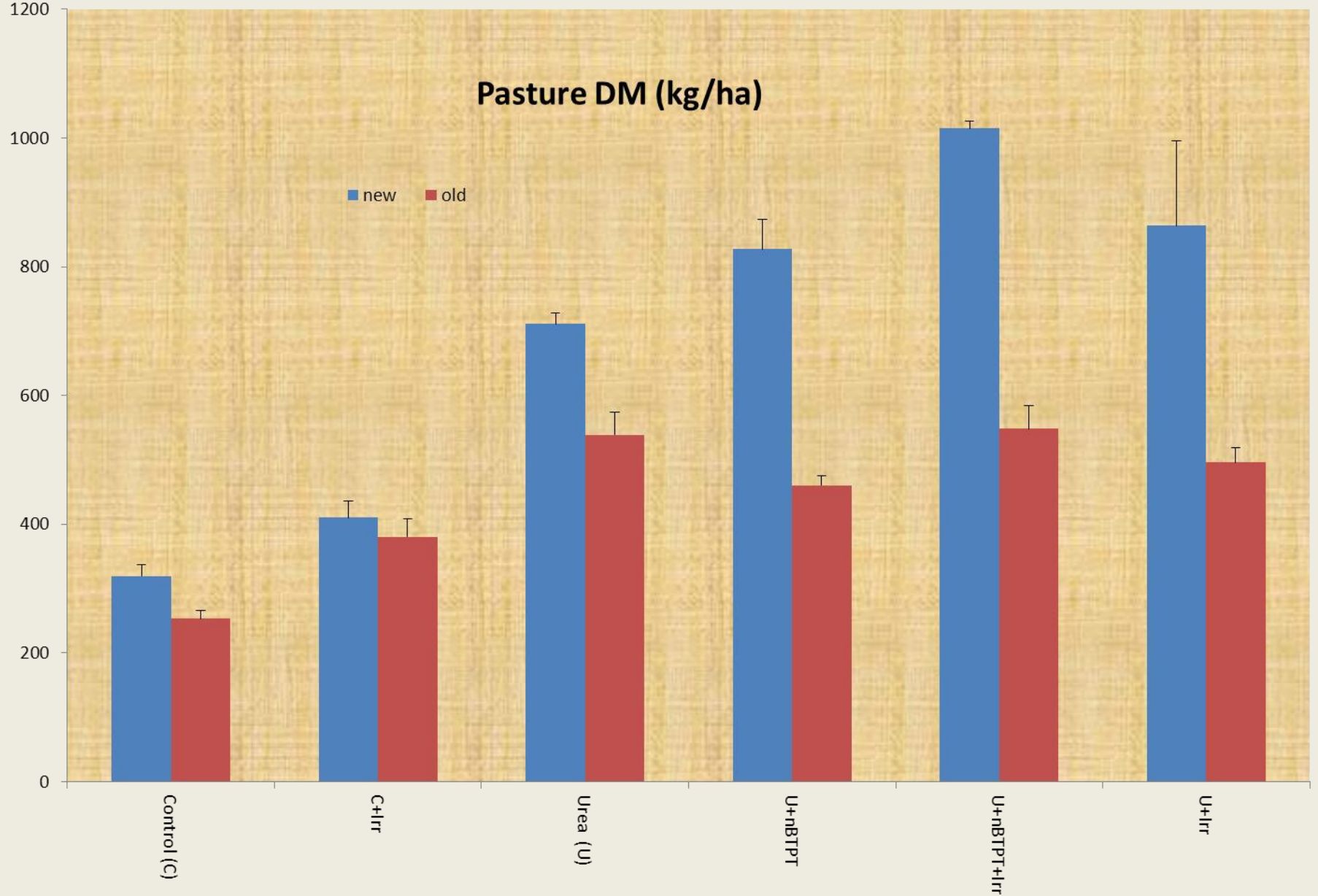
Measurements:

- Leaf-level gas exchange and on-line photosynthetic ^{13}C and ^{18}O measured before and 21 days after treatments in both young and old leaves

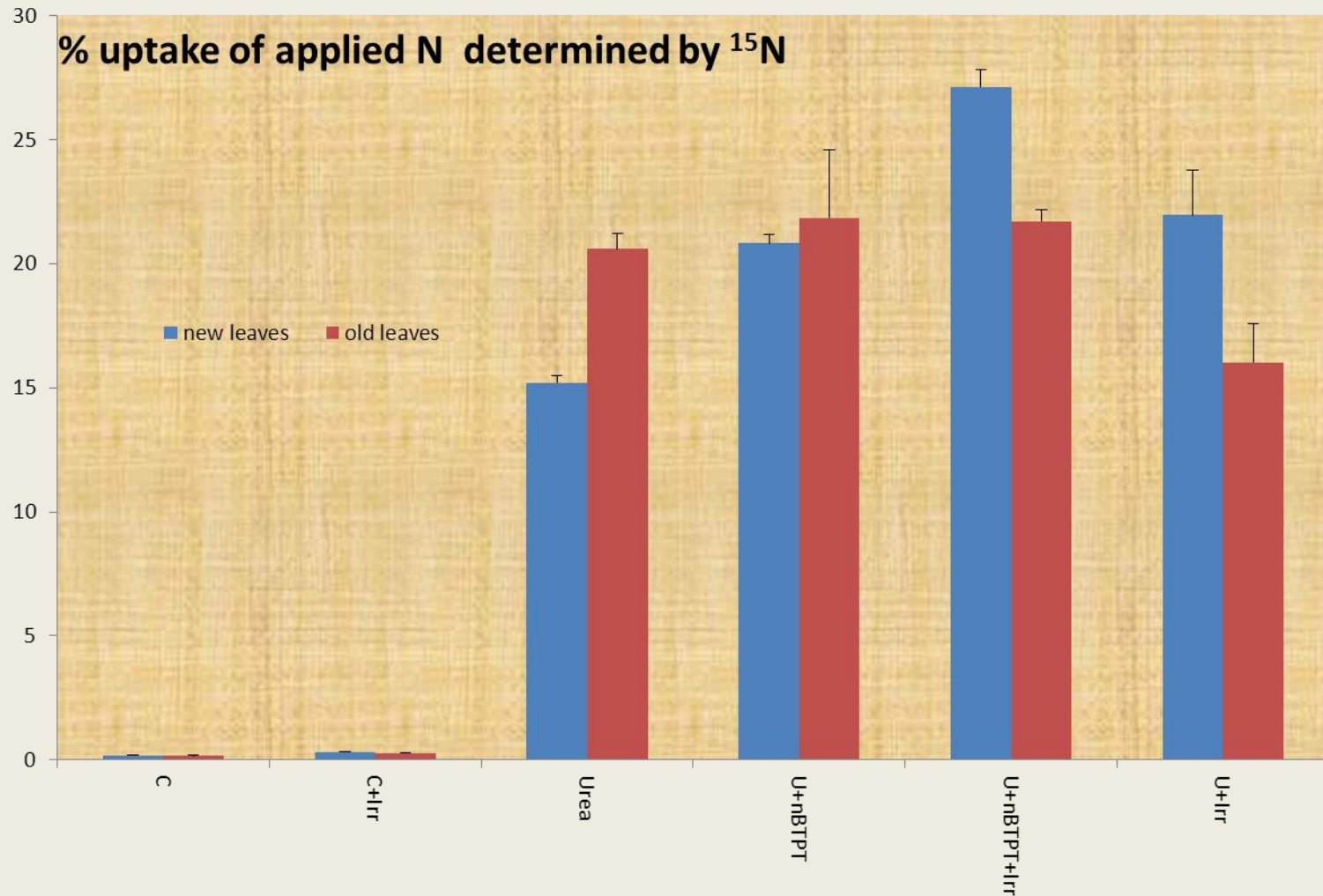


Results

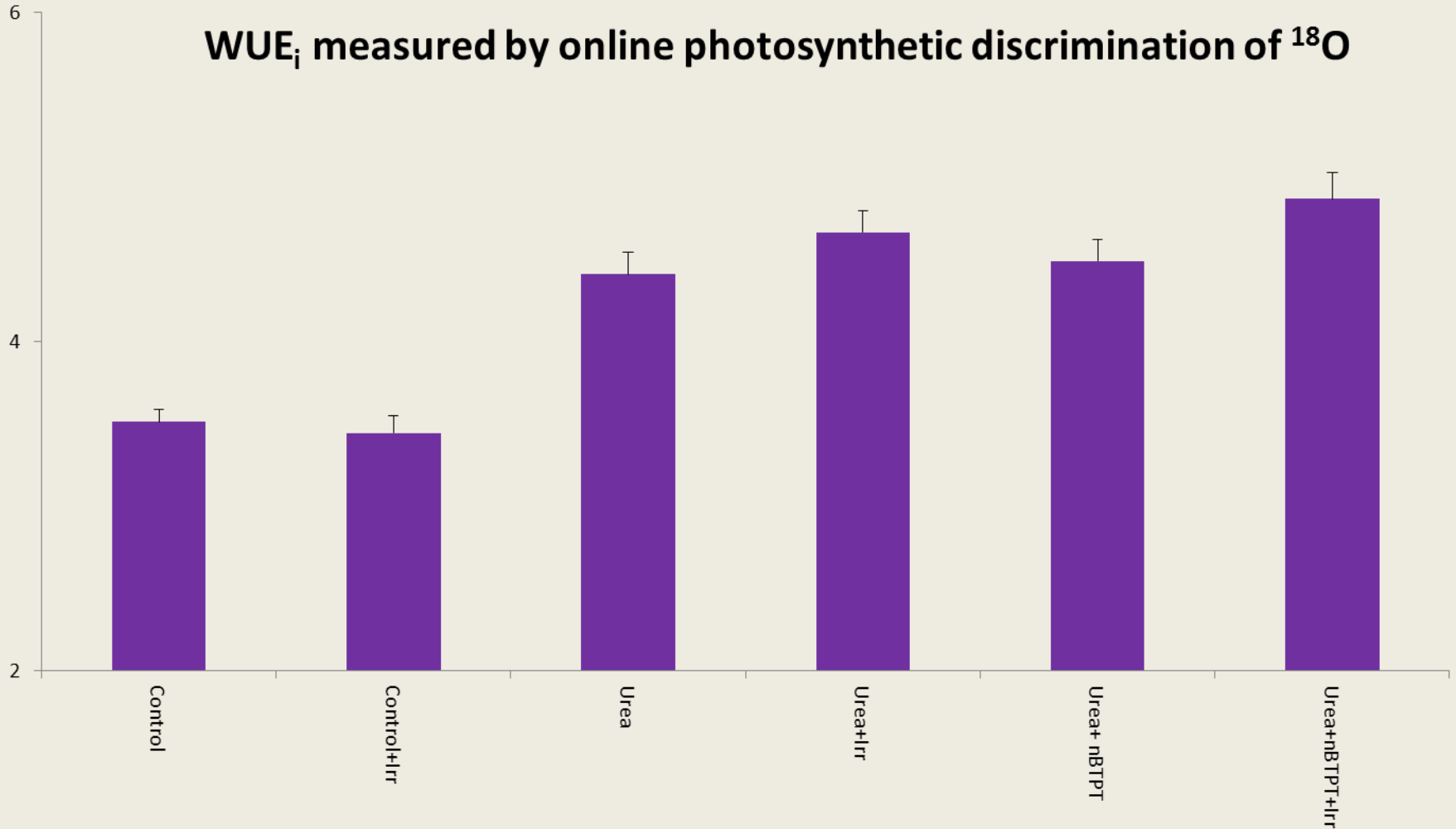
Pasture dry matter



% Fertiliser N Utilization



Water Use Efficiency (WUE_i)



Conclusions

- ^{15}N technique allowed us to measure %N utilization in both young & old leaves.
- Applying urea with urease inhibitor (nBTPT) in FPA form showed better pasture growth, N uptake efficiency, and water use efficiency compared to urea alone.
- Applying leaf irrigation after FPA application further improved pasture growth, better fertilizer-N recovery and high water use efficiency.
- On-line carbon isotope discrimination was strongly correlated to WUE_i , suggesting that discrimination may provide a good record of changes in WUE_i .