



# Carbon and water fluxes in crops:

## Impact of nutrient addition

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PLANT INDUSTRY / SUSTAINABLE AGRICULTURE FLAGSHIP

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# Project information

**“Maximizing crop yield in the HRZ of WA through efficient use of water and nutrients”**

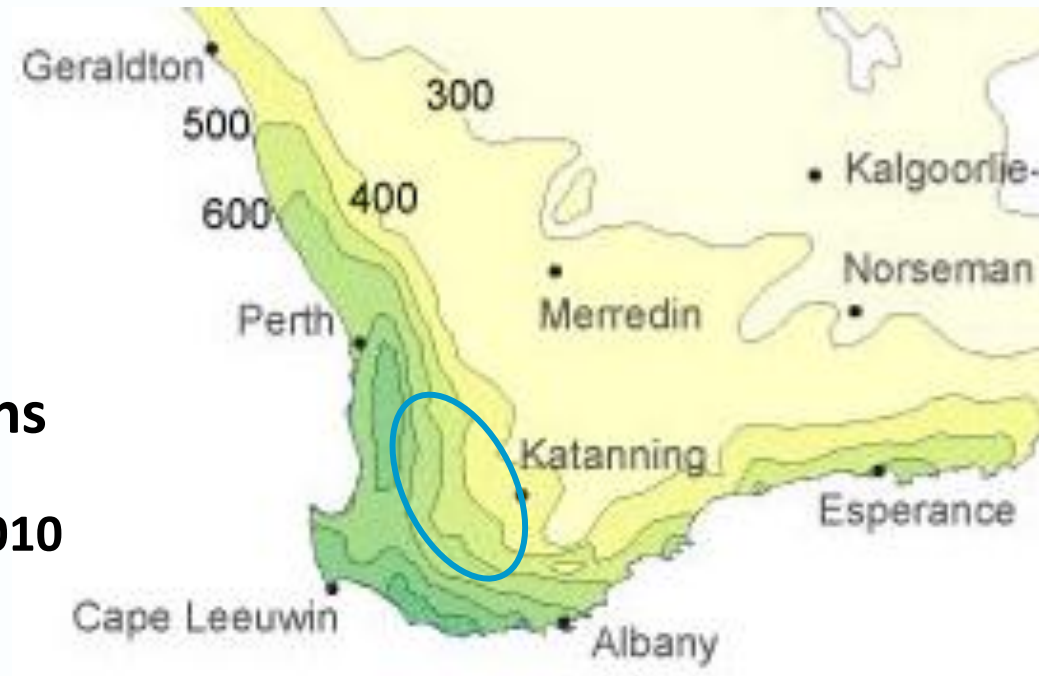
**Focus on region between Perth and Albany, WA**

- Annual rainfall 450-650 mm

**July 2010 to June 2013**

**WUE of cereals and rotations**

- Experiments commenced in 2010



# The issue

- **Crop production is expanding into previously ‘too wet’ areas**  
Rainfall concentrated in winter months – waterlogging
- **Potential for grain yields >6 t/ha, but actual yields are about 3 t/ha**
- **Conservative management, or poorly adapted varieties?**
- **Source or sink (head size) constraining crop grain yields?**
- **Investigate role of canopy size and growth rate on daily water use and carbon uptake at the paddock scale – to use data collected to critically appraise APSIM (cropping system model)**

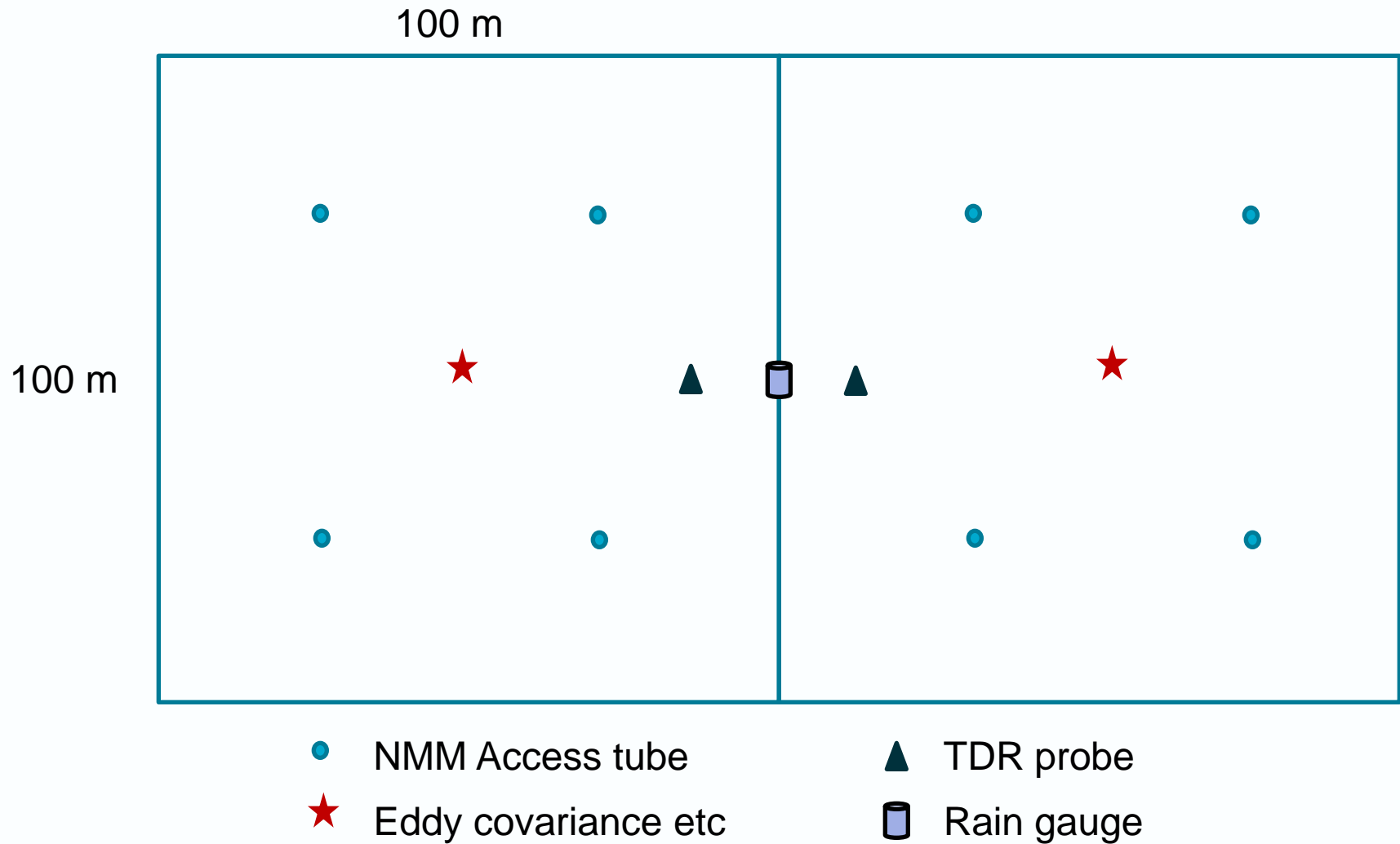


# Landscape

**Gently undulating, occasional lone eucalypts**



# Site layout



# Treatments

## 2010

**Wheat sown on June 10**

**Nitrogen applied:**

**June 10 - sowing**

**13 kg N/ha to both plots**

**July 20 - 4-leaf stage**

**28 kg N/ha to west only**

**September 3 - 1<sup>st</sup> node**

**28 kg N/ha to both plots**

## 2011

**Canola sown on May 4**

**Nitrogen applied:**

**May 4 - sowing**

**13 kg N/ha to both plots**

**August 18 - bolting**

**74 kg N/ha to west plot**

**37 kg N/ha to east plot**

## 2012

**Wheat**

**TBA**



# Nitrogen application



# Measurements

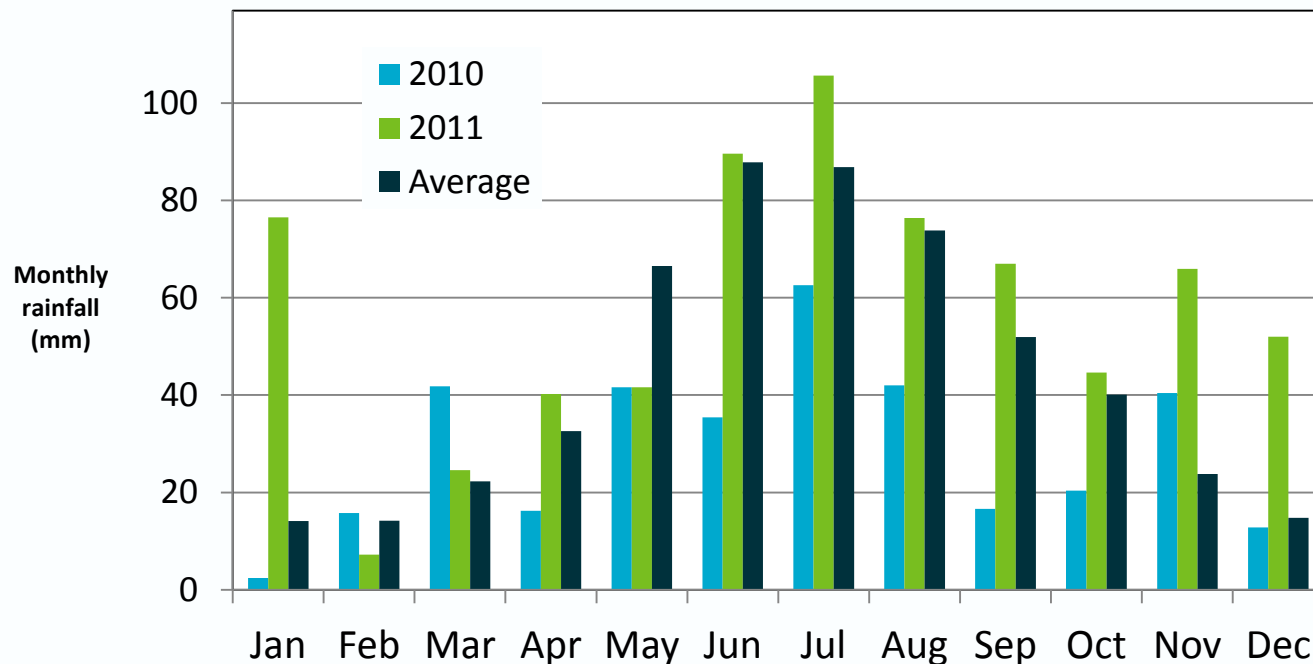
## Leaf to plot to paddock scale

- CO<sub>2</sub> and water flux
  - Eddy covariance using Licor LI-7500 and R3-50 sonic anemometer (Gill Instruments, UK)
  - Chamber system
- Leaf (canopy) temperature using IR sensors and air temperature
- Leaf area and dry matter (every 2 weeks)
- Soil water content
  - NMM, TDR, HH TDR





# Seasonal conditions – Kojonup P.O.



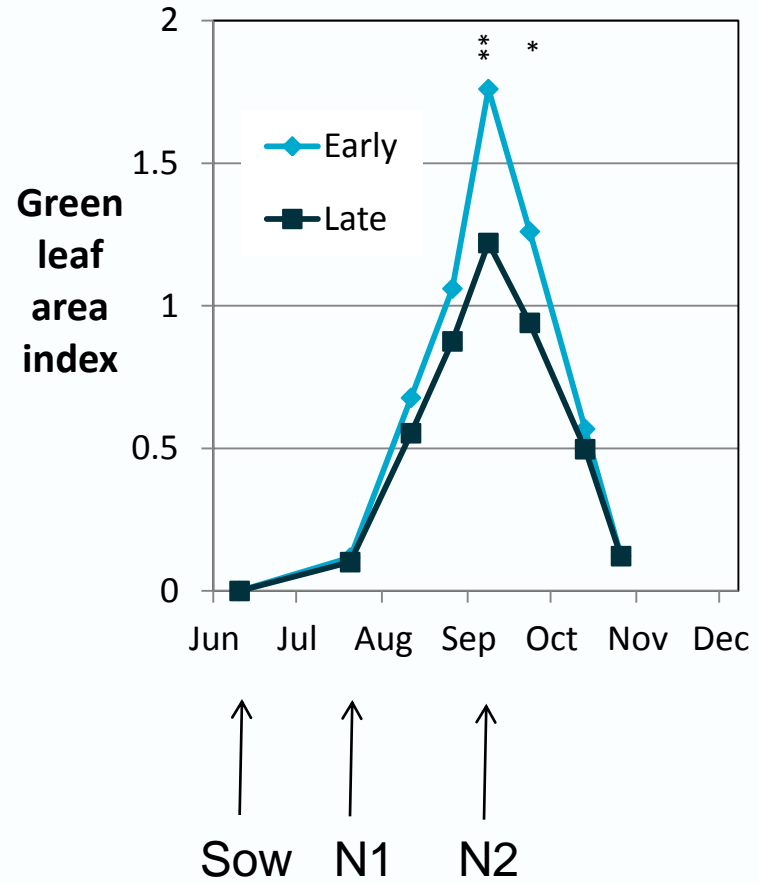
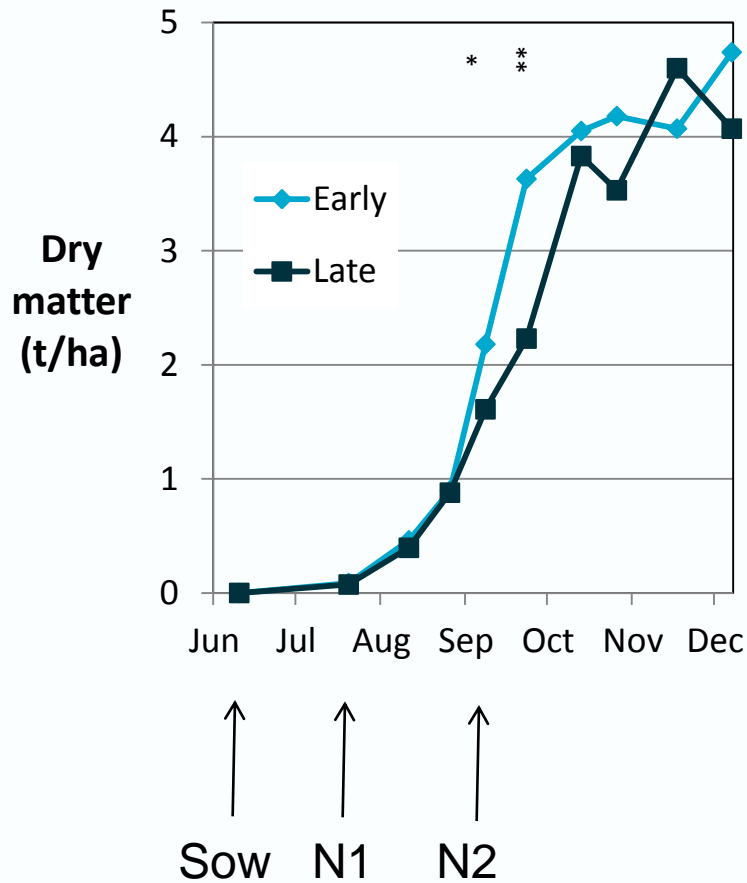
	Average	2010	2011
Annual	529	348	691
May - Nov	431	219	491

# Wheat density and yield - 2010

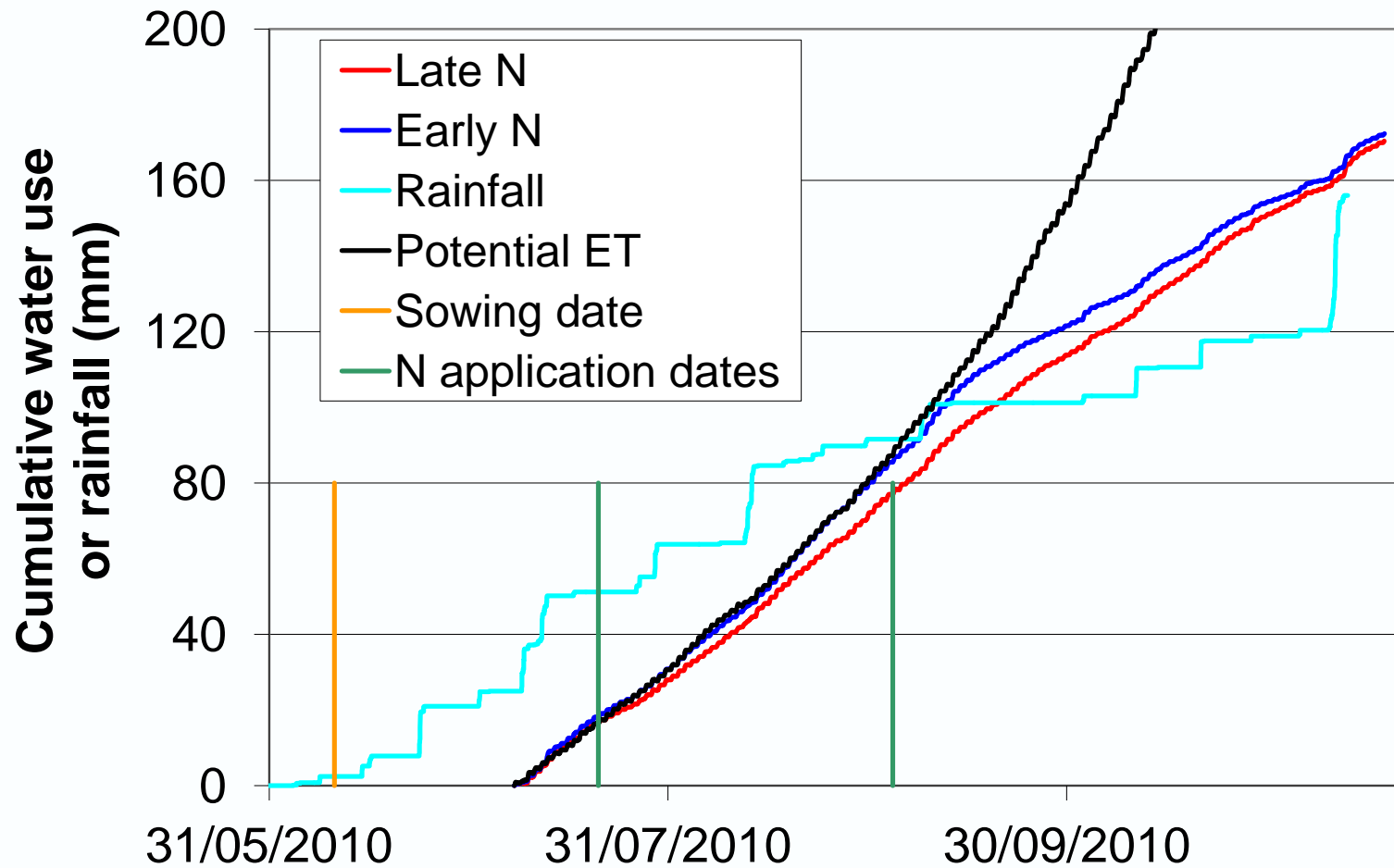
	Early N	Late N
Plant density (/m <sup>2</sup> )	92	88
Yield(t/ha)	2.1	1.9
Dry matter (t/ha)	4.7	4.1
Harvest Index (%)	45	46
1000 grain weight (g)	33.3	34.6*

Significant differences identified by \* in the 'Late N' column

# Crop growth and leaf area

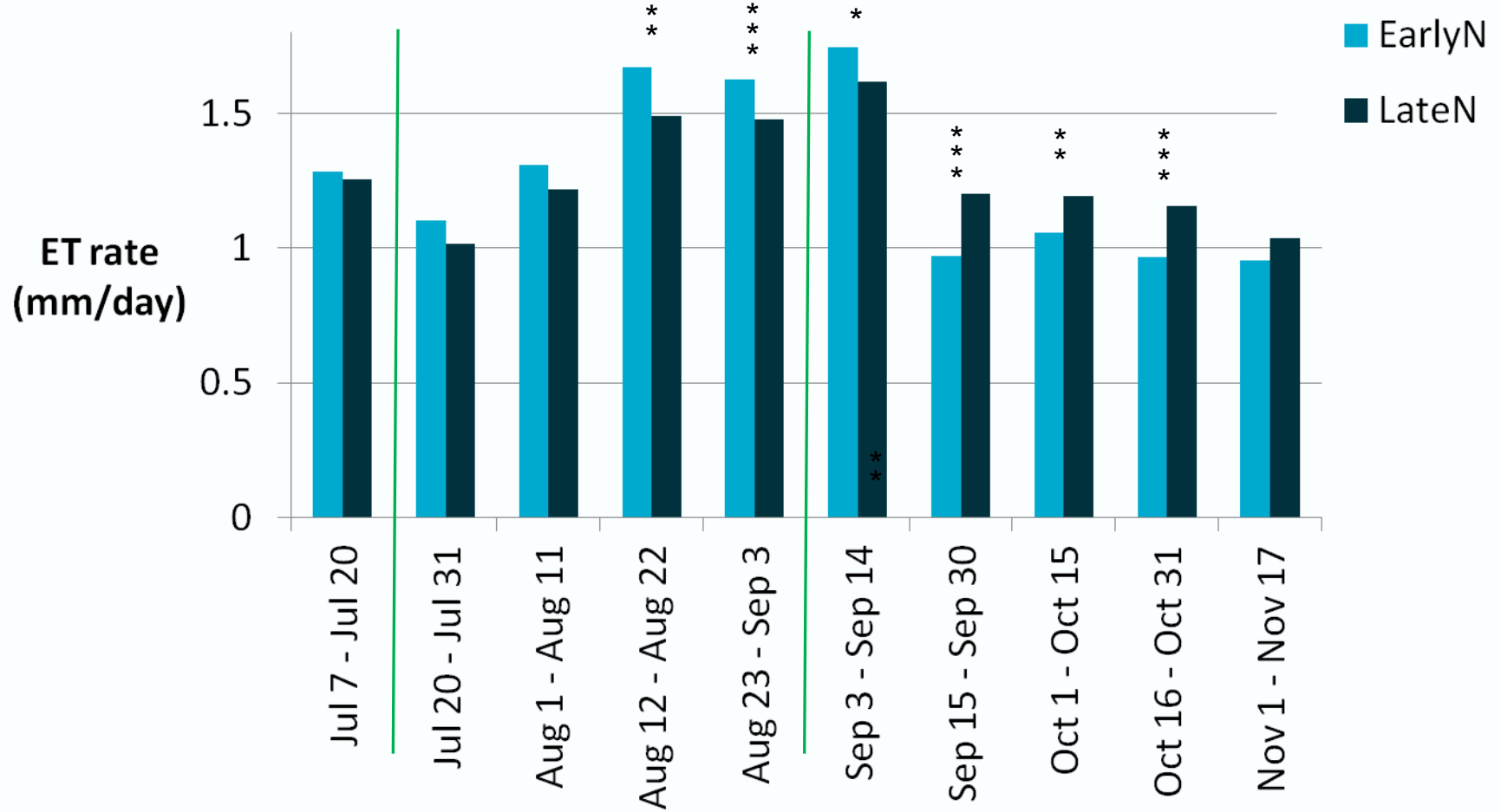


# Paddock-scale water use

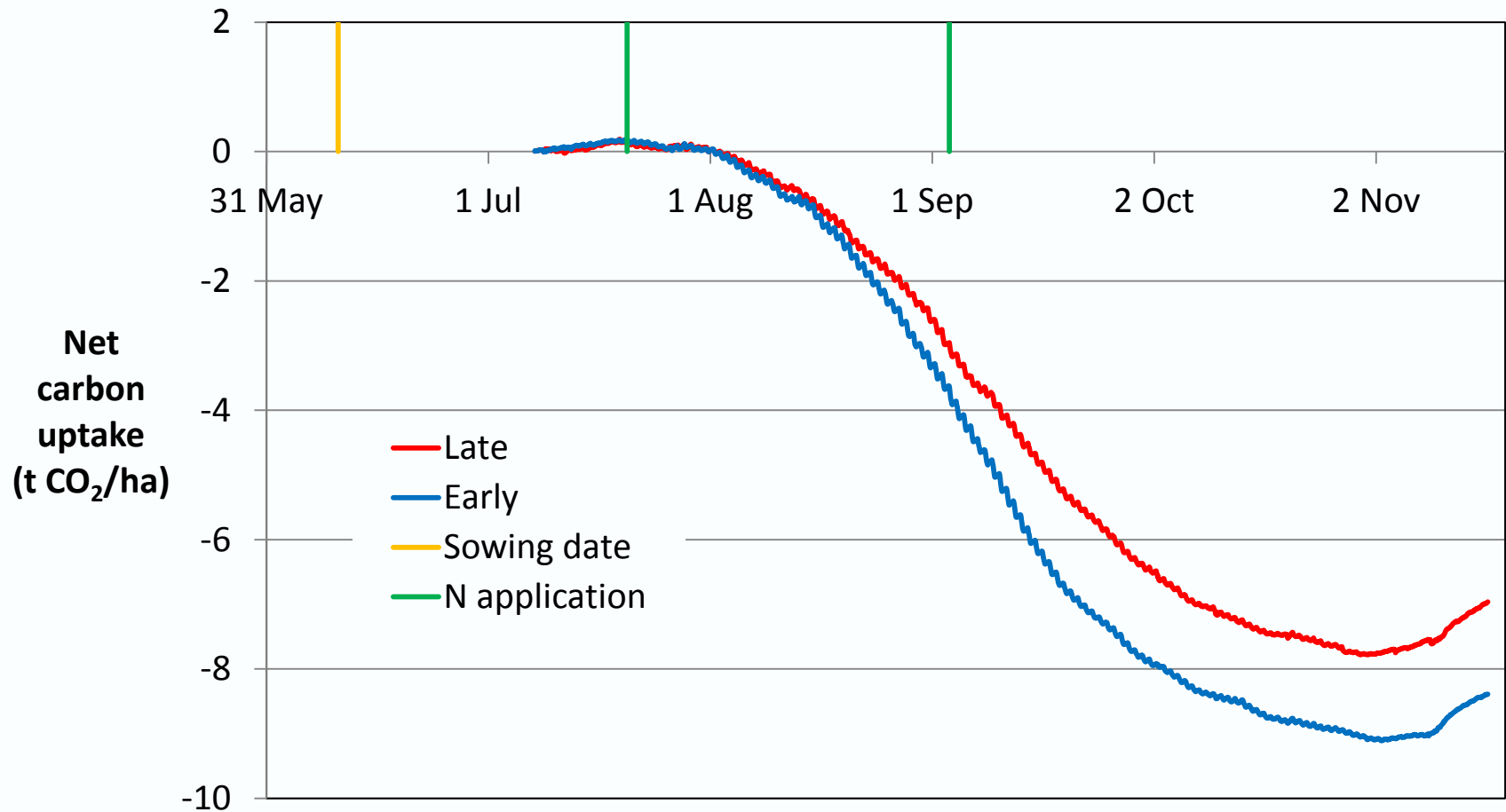




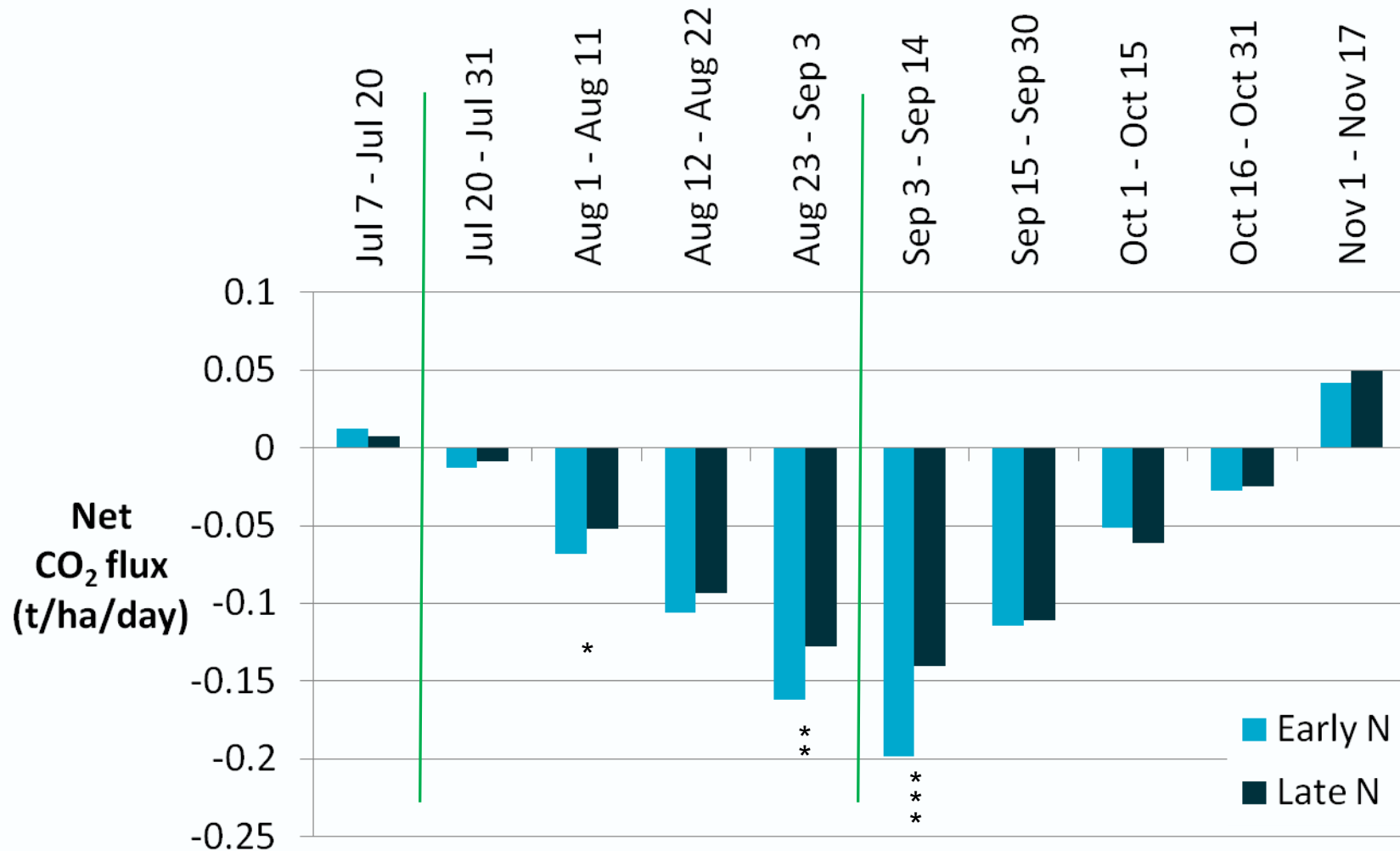
# Total daily ET



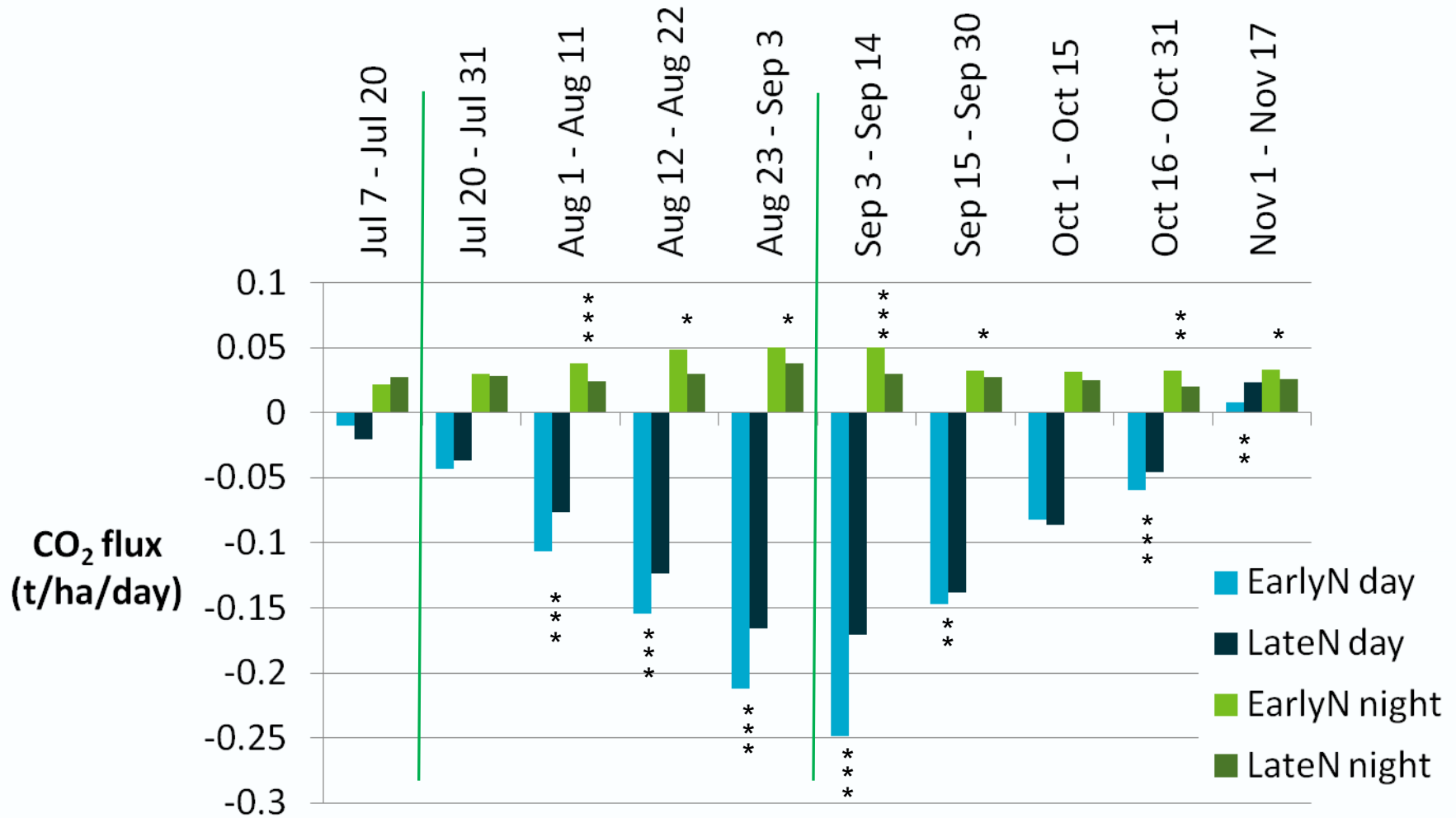
# Paddock-scale net CO<sub>2</sub> uptake



# Net daily CO<sub>2</sub> flux



# Day and night CO<sub>2</sub> flux





# Conclusions

## After N addition:

- Significant difference in above-ground biomass and LAI seen after 6 weeks.
- Significant difference in ET observed after 4 weeks i.e. before visible differences were seen in above-ground crop growth.
- Significant differences in daytime and night time CO<sub>2</sub> fluxes were observed after 2 weeks, but differences were in opposite directions. Net daily fluxes were largely unaffected until 6 weeks after N application.

**Dry seasonal conditions make it difficult to answer the ‘source or sink’ question, but these results demonstrate the ability of Eddy Covariance to discriminate between N fertiliser treatments.**

**Nitrogen application increases net CO<sub>2</sub> uptake.**

**Does increased use of nutrients improve sequestration of C in soil?**

# Plans for 2012

**One more year of data collection**

**Wheat, early vs late nitrogen**

**Canopy temperature**

- Any good infra red sensors out there? Ours keep failing!
- Crop stress and transpiration

**Good data for modelling**

**Daily data for daily crop models**

# Thank you

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