



Evapotranspiration and Soil Water Balance for Corn in a Perennial Living Mulch

Tyson E. Ochsner

Plant and Soil Sciences, Oklahoma State University,
Stillwater, OK

Kenneth A. Albrecht

Agronomy Department, UW-Madison

John M. Baker

USDA-ARS, St. Paul, MN

Background

- Corn production in a perennial living mulch of kura clover
 - Zemenchik et al. (2000) and Affeldt et al. (2004)
- Kura clover (*Trifolium ambiguum* M. Bieb.)
 - Perennial legume
 - Rhizomatous
 - Winter hardy



Photo from Forage Resources CD, ISU Press



1st suppression, April 18
Bands killed, April 25
Corn planted, April 25

May 1, 2006



2nd suppression, May 31
Sidedress N, June 6

June 20, 2006



August 30, 2006



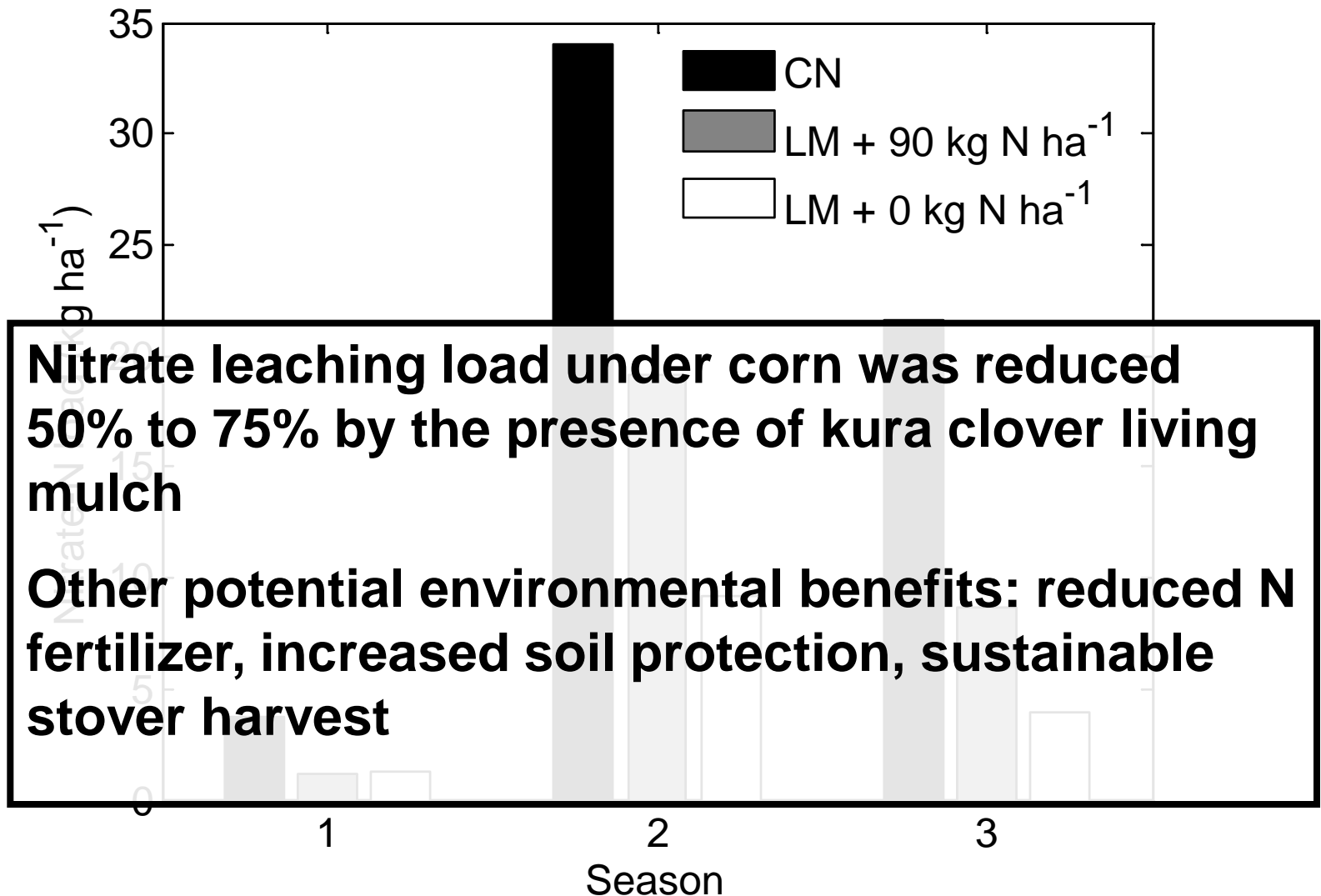
August 30, 2006



Silage harvest, Sept. 16
Grain harvest, Oct. 10

October 11, 2007

Nitrate-N leached beyond 1-m depth



Nitrate leaching load under corn was reduced 50% to 75% by the presence of kura clover living mulch

Other potential environmental benefits: reduced N fertilizer, increased soil protection, sustainable stover harvest

Yields

- Living mulch system produced 14 – 19 Mg ha⁻¹ sustainably harvestable biomass
- Living mulch reduced corn yield 14% in 2006 and 20% in 2007
- Is soil water a main limiting factor?

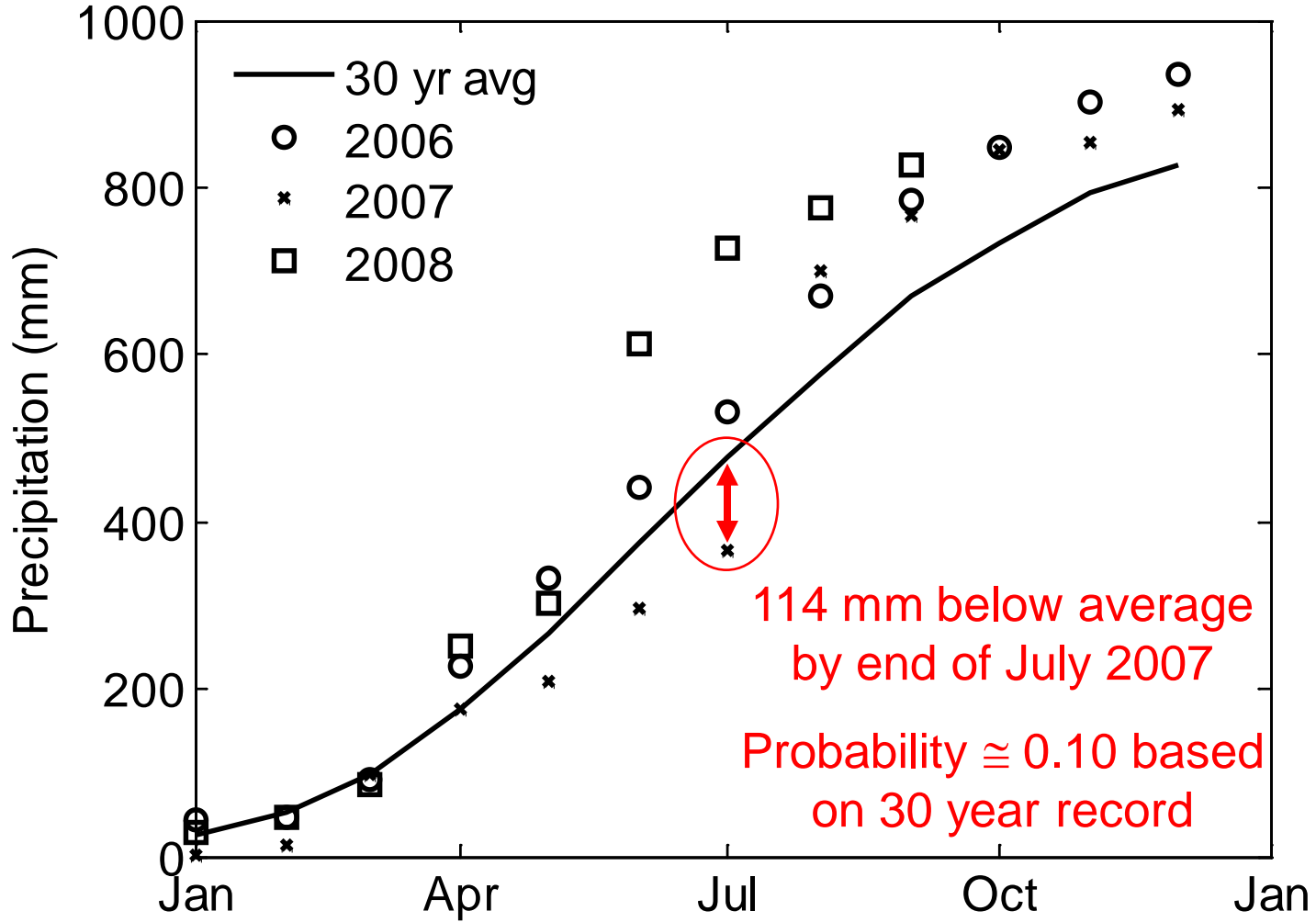
Trt.	Grain yield ¹		Silage yield ²	
	2006	2007	2006	2007
	Mg ha ⁻¹			
CN	15.3 ^a	14.5 ^a	21.9 ^a	20.8 ^a
LM + 90 N	13.1 ^b	11.6 ^b	18.7 ^b	16.2 ^b
LM + 0 N	12.3 ^b	9.2 ^c	17.4 ^b	13.8 ^b

¹ 15.5% moisture

² Dry matter

Tukey's HSD comparison along cols., p<0.05

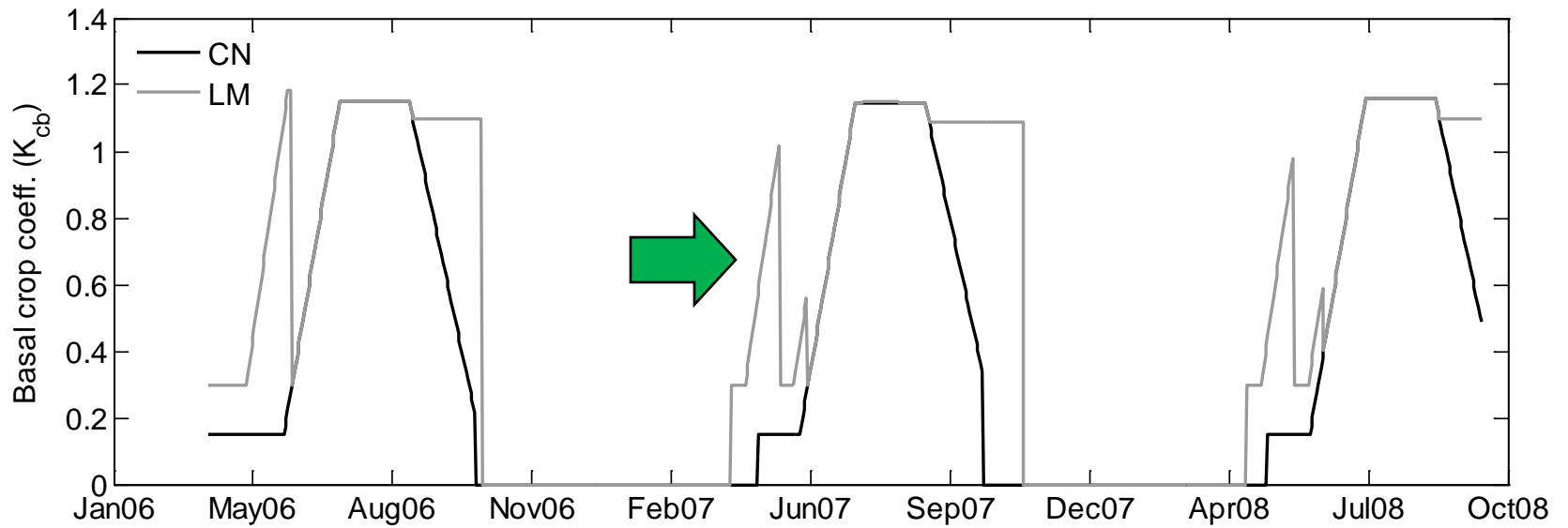
Precipitation



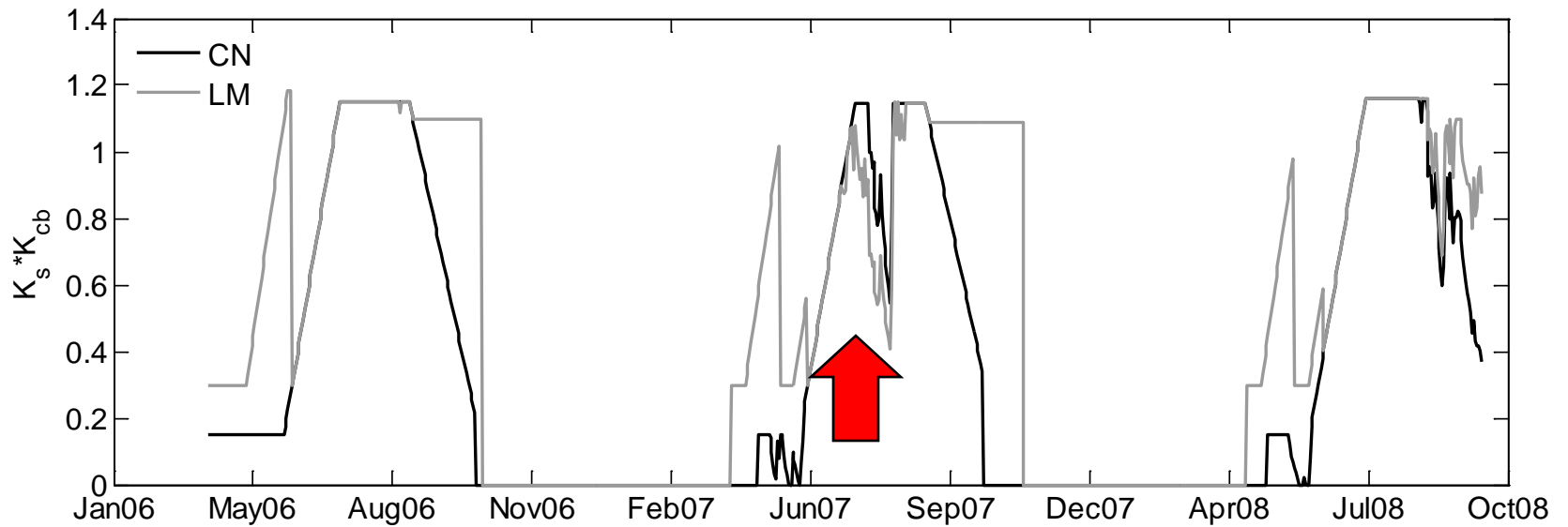
Evapotranspiration

- On-site weather station, Bill Bland, UW-Madison
- Reference ET (ET_0) by Penman-Monteith method (FAO-56)
- $ET_c = (K_s * K_{cb} + K_e) * ET_0$
- K_s = water stress coeff.
- K_{cb} = basal crop coeff.
- K_e = evaporation coeff.
- Implemented in Matlab

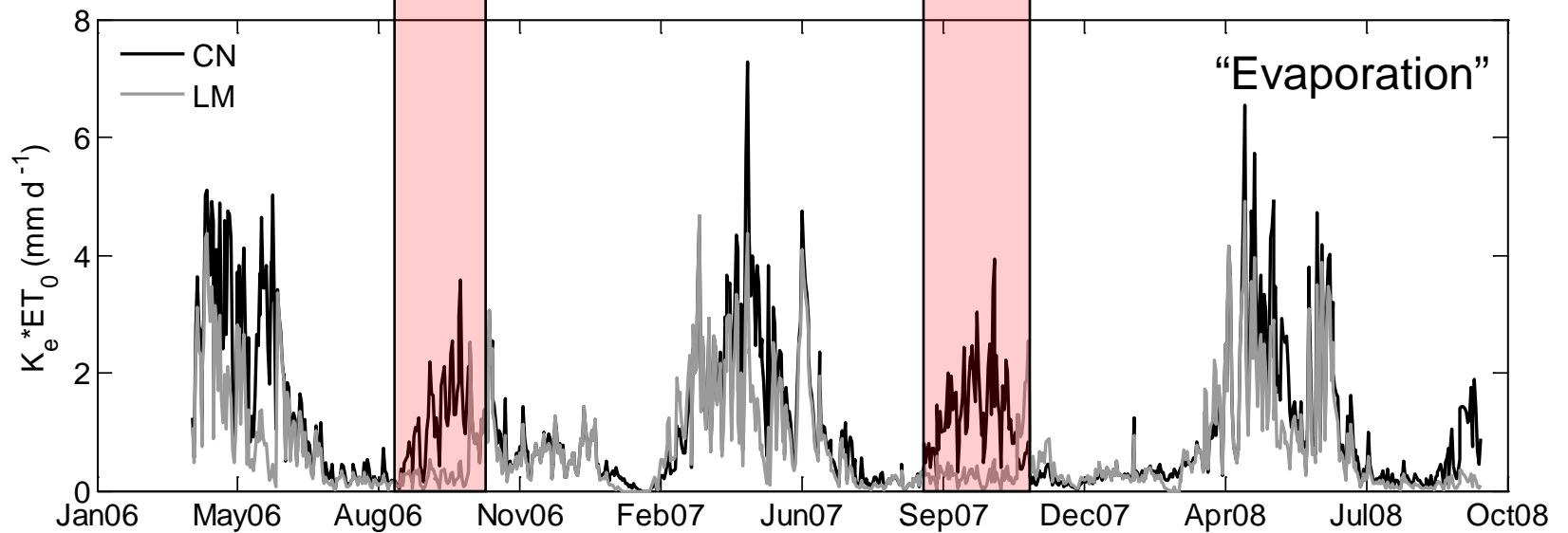
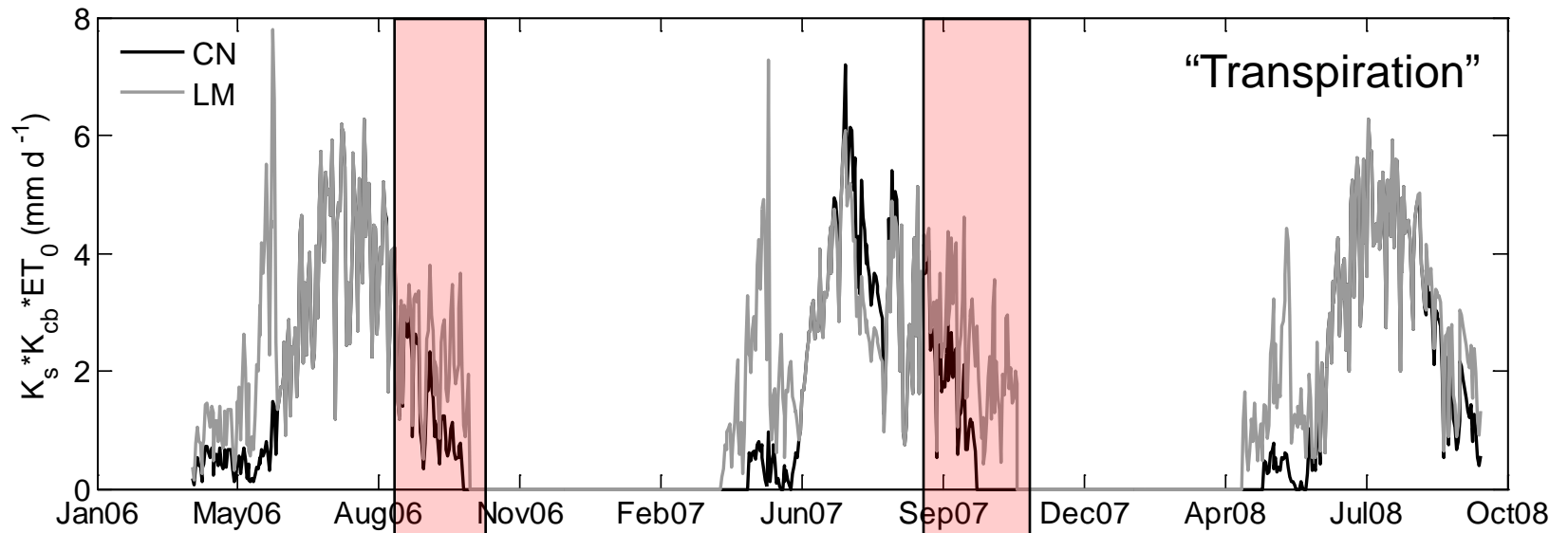




Living mulch increases early season ET



Living mulch reduced July 07 ET by 20%



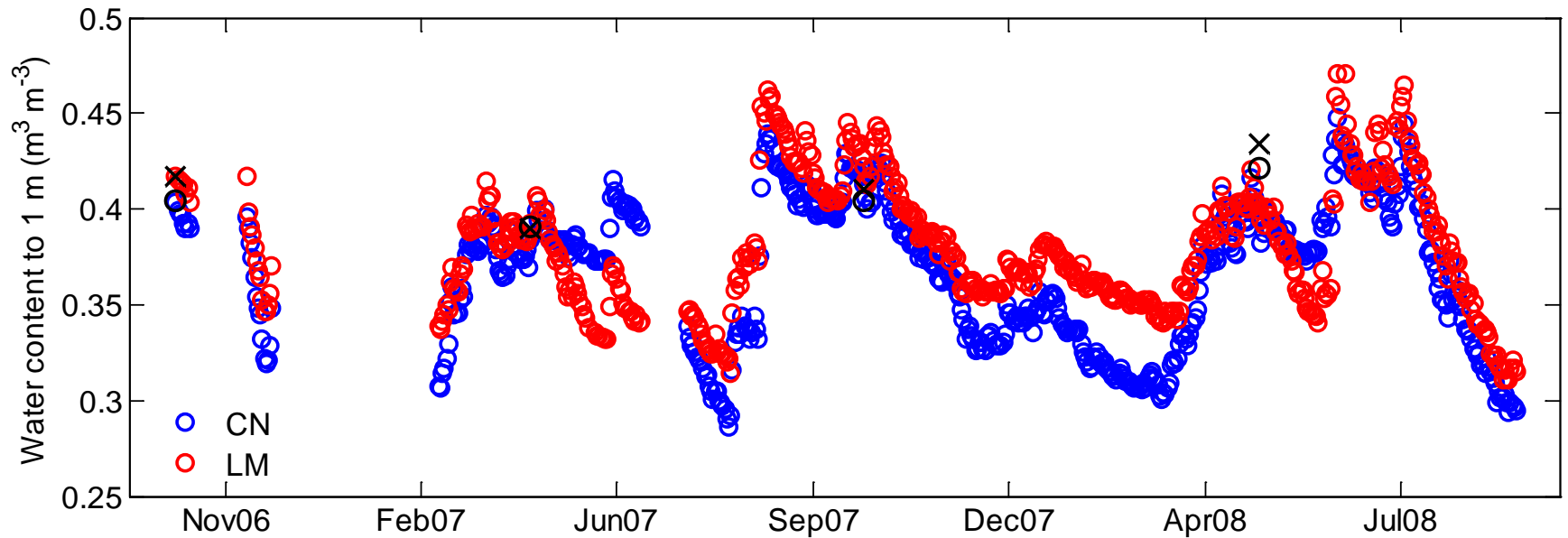
Evaporation differences offset transpiration differences in the late season

Soil water balance

- Minimal plot disturbance required
- 1-m long vertically installed coated TDR sensors
- Automated daily soil water content measurements to 1-m depth



Profile water content



- Soil typically slightly wetter under living mulch
- Only drier during early season

2007 growing season

