THE USE OF FAST- GROWING WOODY ENERGY CROPS FOR BIOREMEDIATION OF SEWAGE EFFLUENT

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Objectives of WaterRenew

Test different woody energy crops for efficacy in wastewater polishing in the UK

- **under different climates**
- **on different soils**
- **using different irrigation systems**

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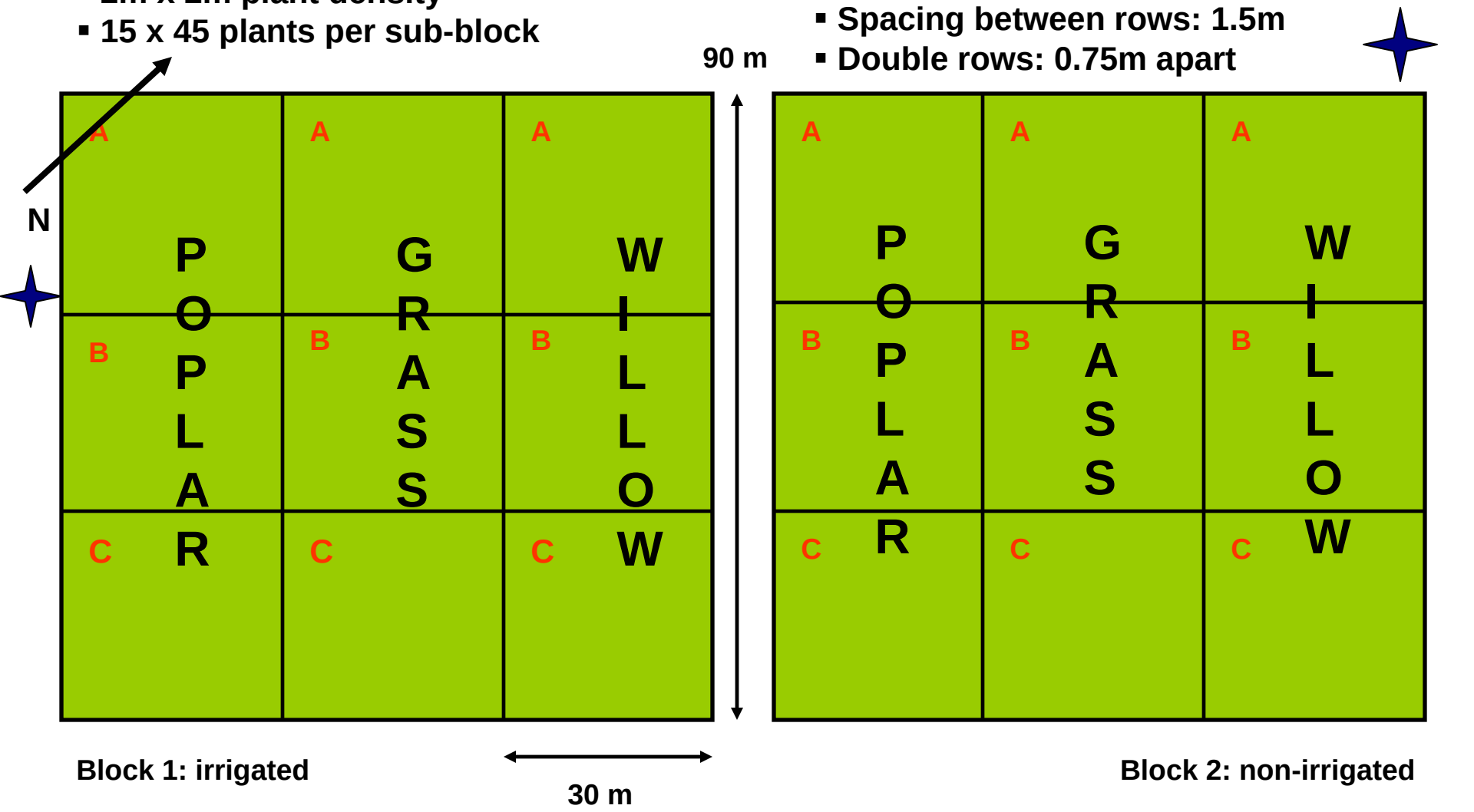
Trial site
Blk2
Blk 1
Culmore WWTW

Poplars
- 2 varieties
- 2m x 2m plant density
- 15 x 45 plants per sub-block

Willows
- 7 varieties, random mix
- Density: 15,000 plants/ha
- Spacing between rows: 1.5m
- Double rows: 0.75m apart



Experimental field Culmore, Co. Londonderry

Field diary

- Planted May 2005
  - Poplar: ‘Hassendens’ and ‘Hooghorst’
  - Willow: ‘Tora’, ‘Stott’, ‘Beagle’, ‘Olaf’, ‘Resolution’, ‘Endeavour’ and ‘Terra Nova’
- Willow cut winter 2005/06
- Irrigation started June 2007
- Final harvest in autumn 2008

Sampling and monitoring

Soil water samples:

- Prenart® soil water samplers (60 cm depth)
- Sampling fortnightly

Groundwater samples:

- Borewells, 4-6 m depth
- Sampling monthly

Soil samples

Tissue samples

Total biomass estimation after final harvest

Chemical characteristics of sewage effluent

(average values from samples collected over a year)

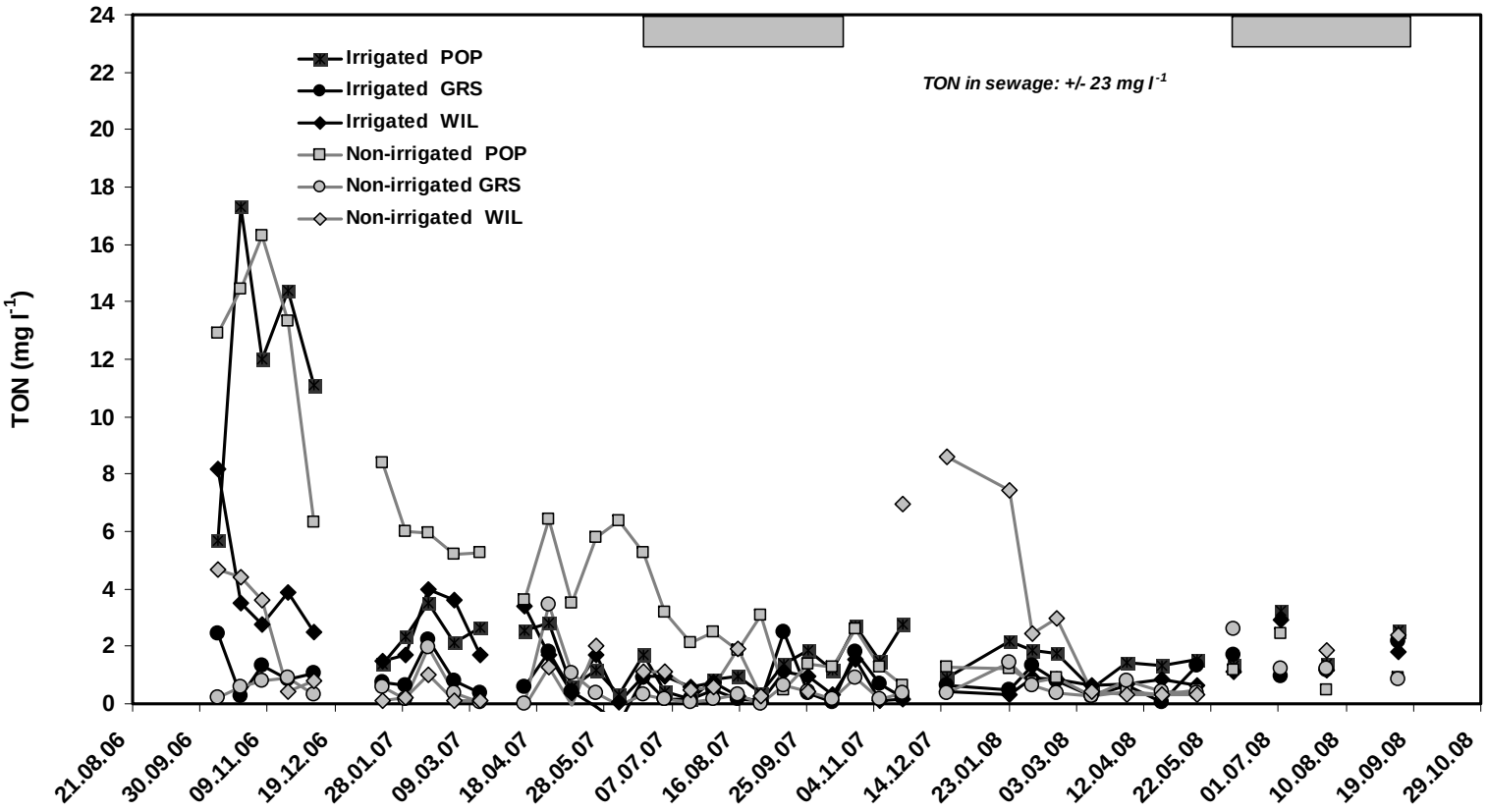
	mean	st.dev.
pH	7.2	0.2
EC (dS m^{-1})	21.8	13.5
TON (mg l^{-1})	25.4	8.2
P (mg l^{-1})	11.2	4.4
K (mg l^{-1})	36.6	22.4
Ca (mg l^{-1})	50.6	21.4
Mg (mg l^{-1})	53.3	42.2
Na (mg l^{-1})	256.9	117.1

Irrigation

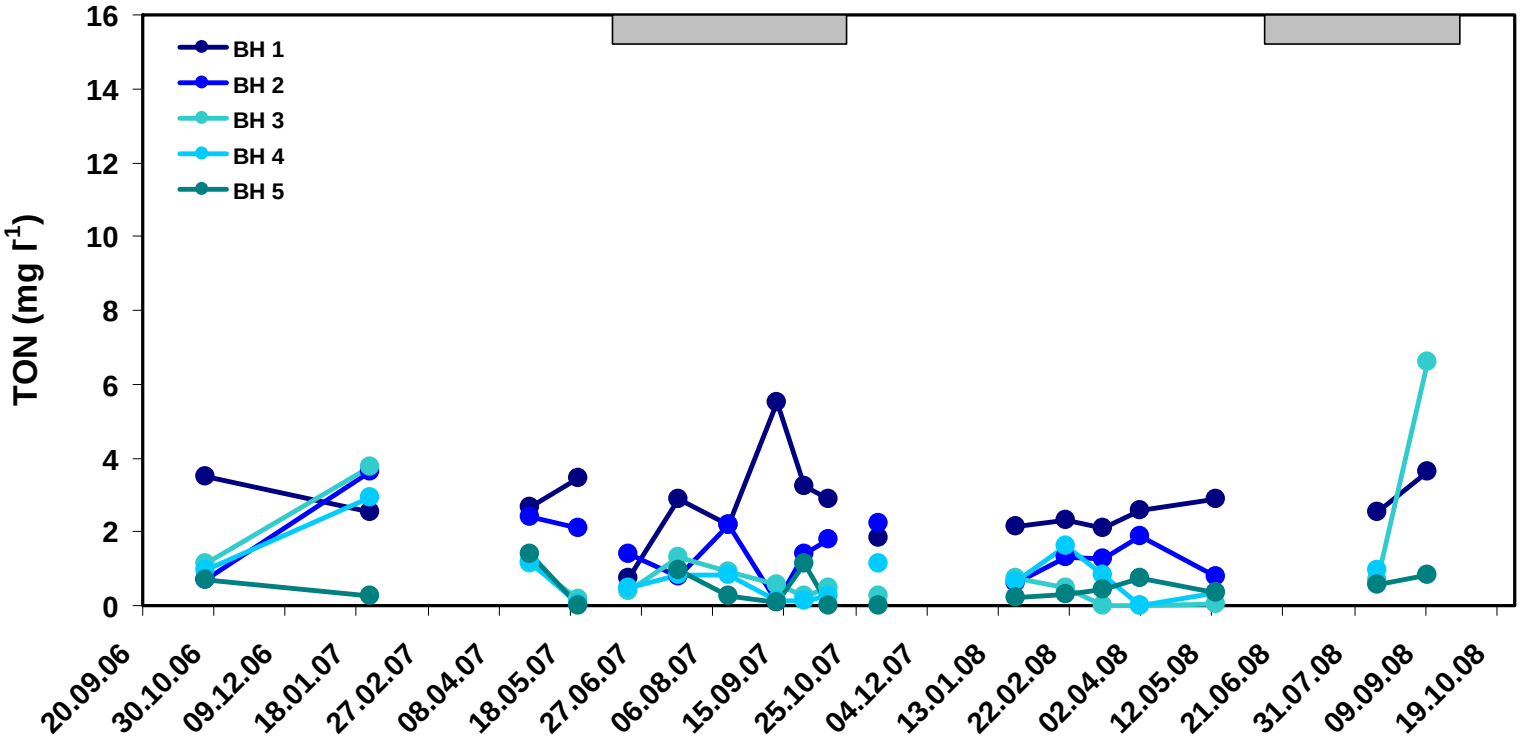
- **Irrigation: 5d week-1, 3h per crop, cycles of 10 min per 30 min**
- **Volumes:**

	Total	Poplar	Grass	Willow
$m^3\ d^{-1}$	120.32	35.71	42.74	41.87
$m^3\ wk^{-1}$	601.64	178.56	213.71	209.37
$m^3\ wk^{-1}\ ha^{-1}$		**491.5**	**587.4**	**584.2**

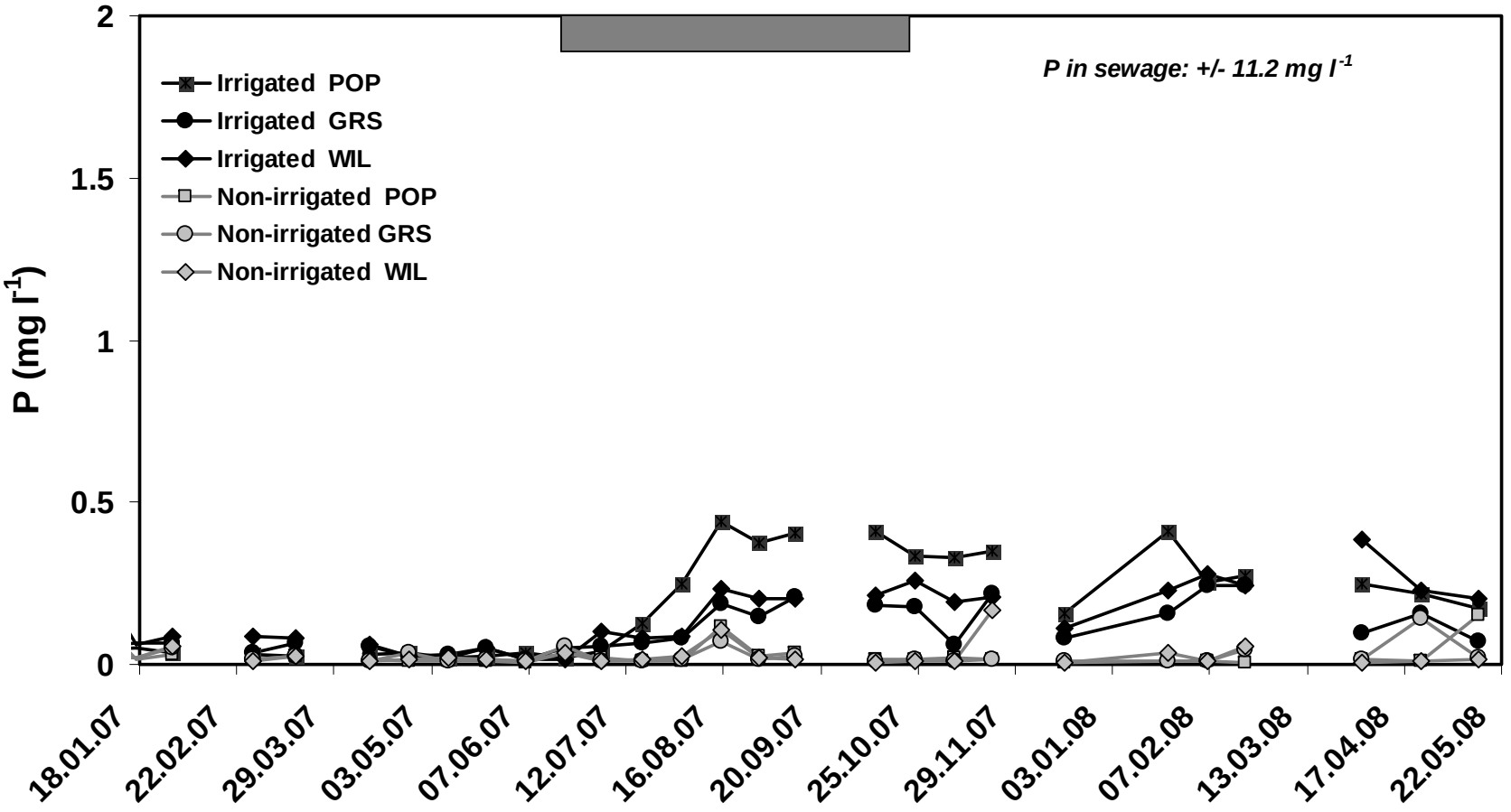
Total oxidised nitrogen in soil water



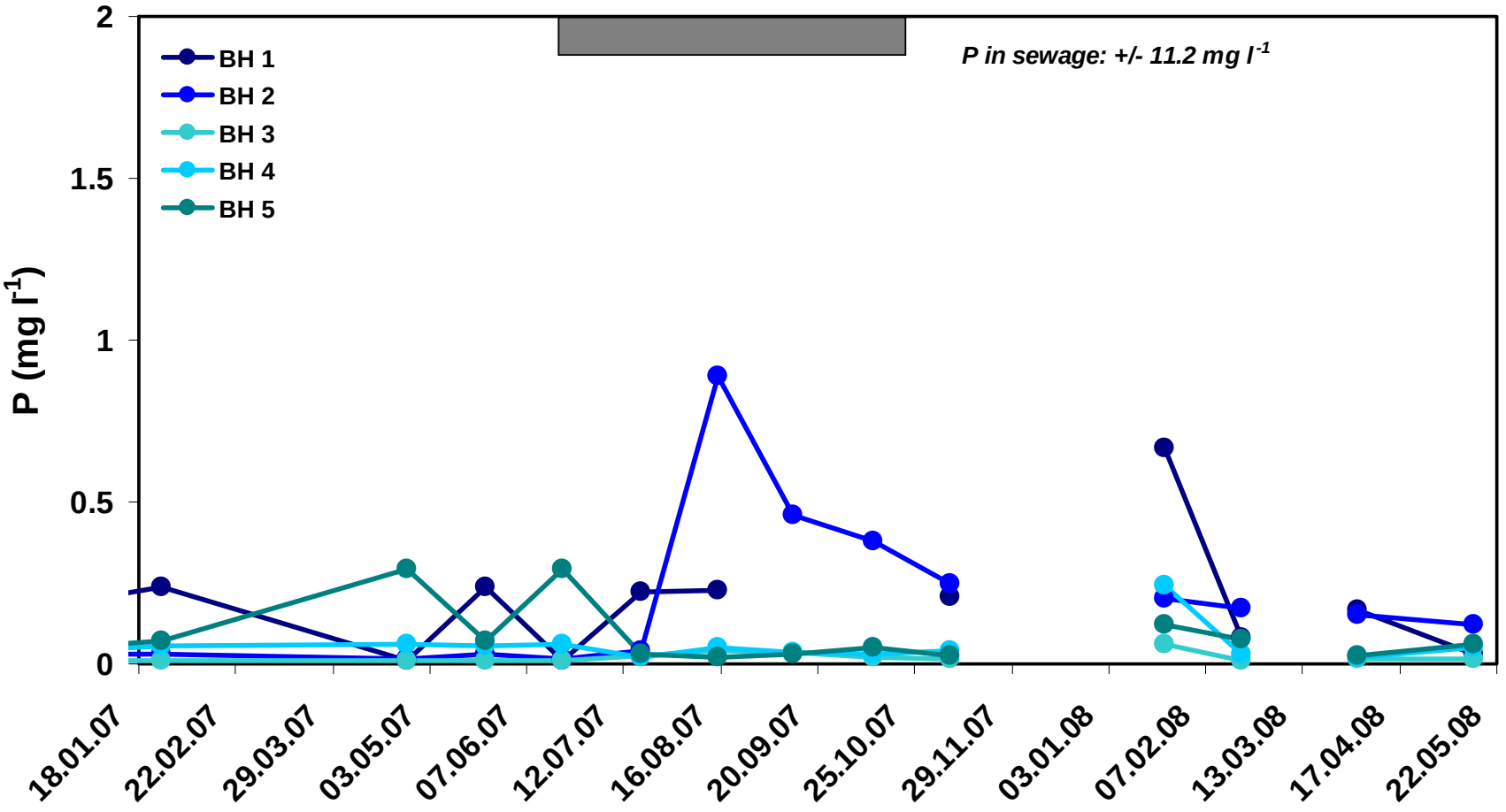
Total oxidised nitrogen in groundwater



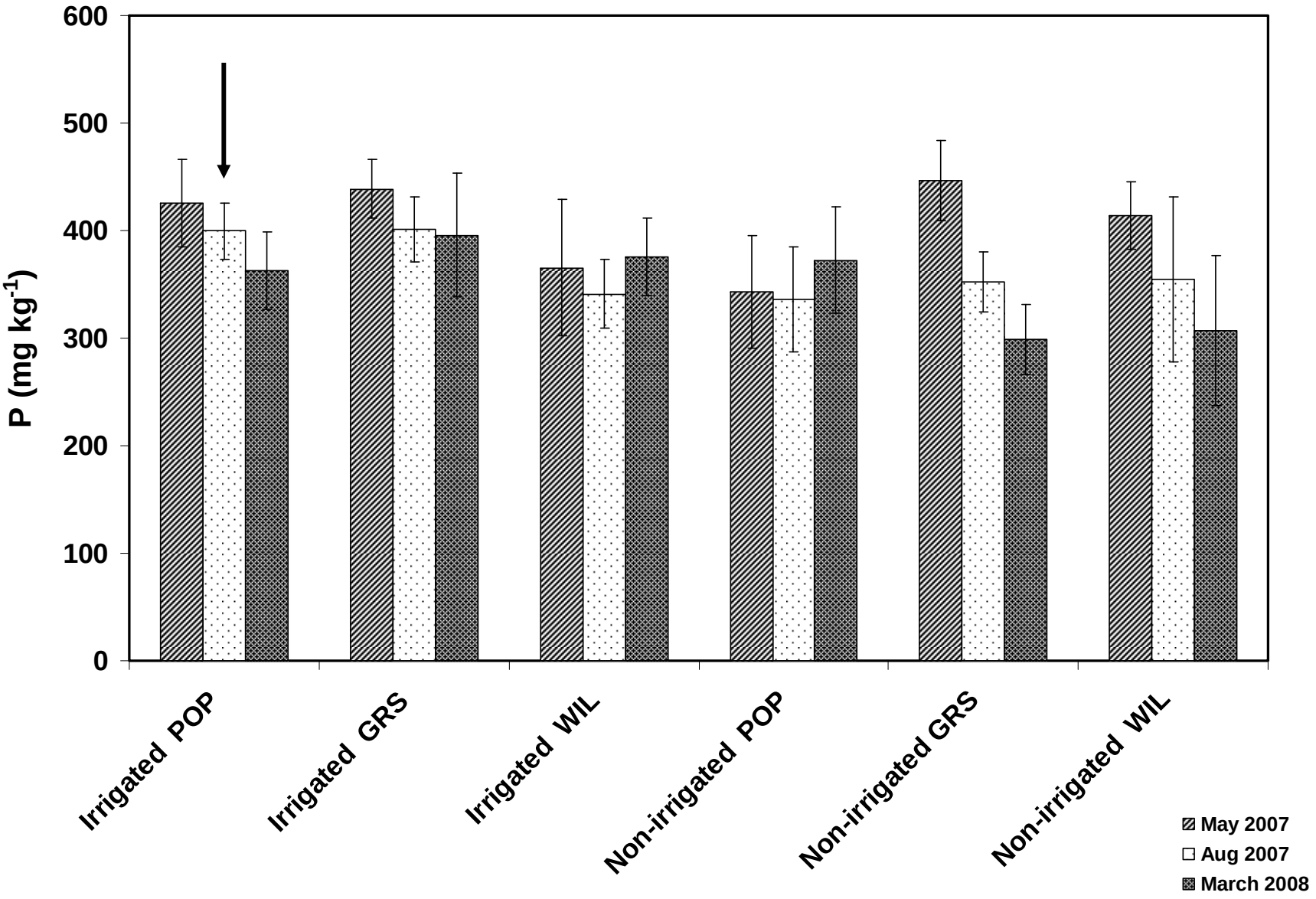
Phosphorous in soil water



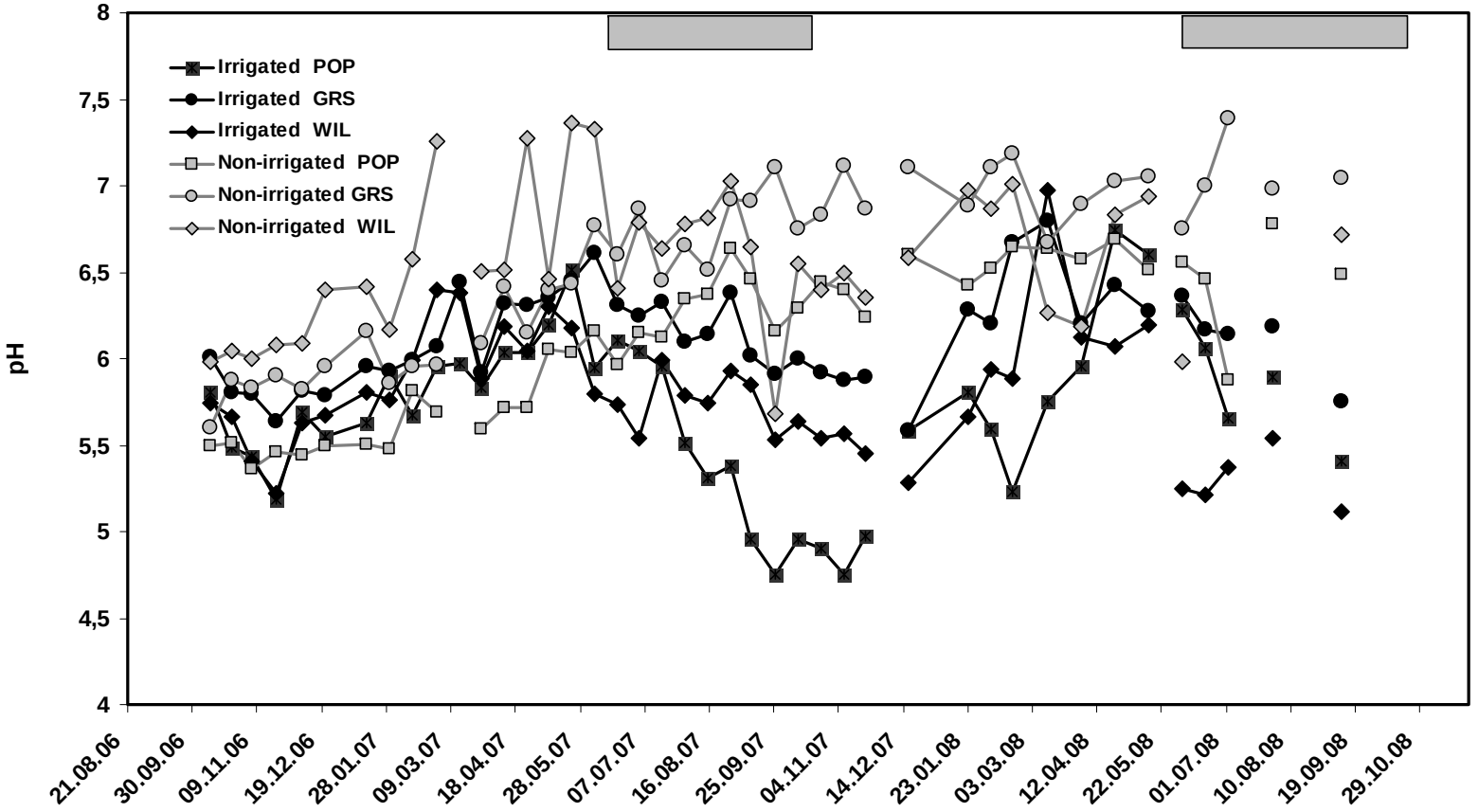
Phosphorous in groundwater



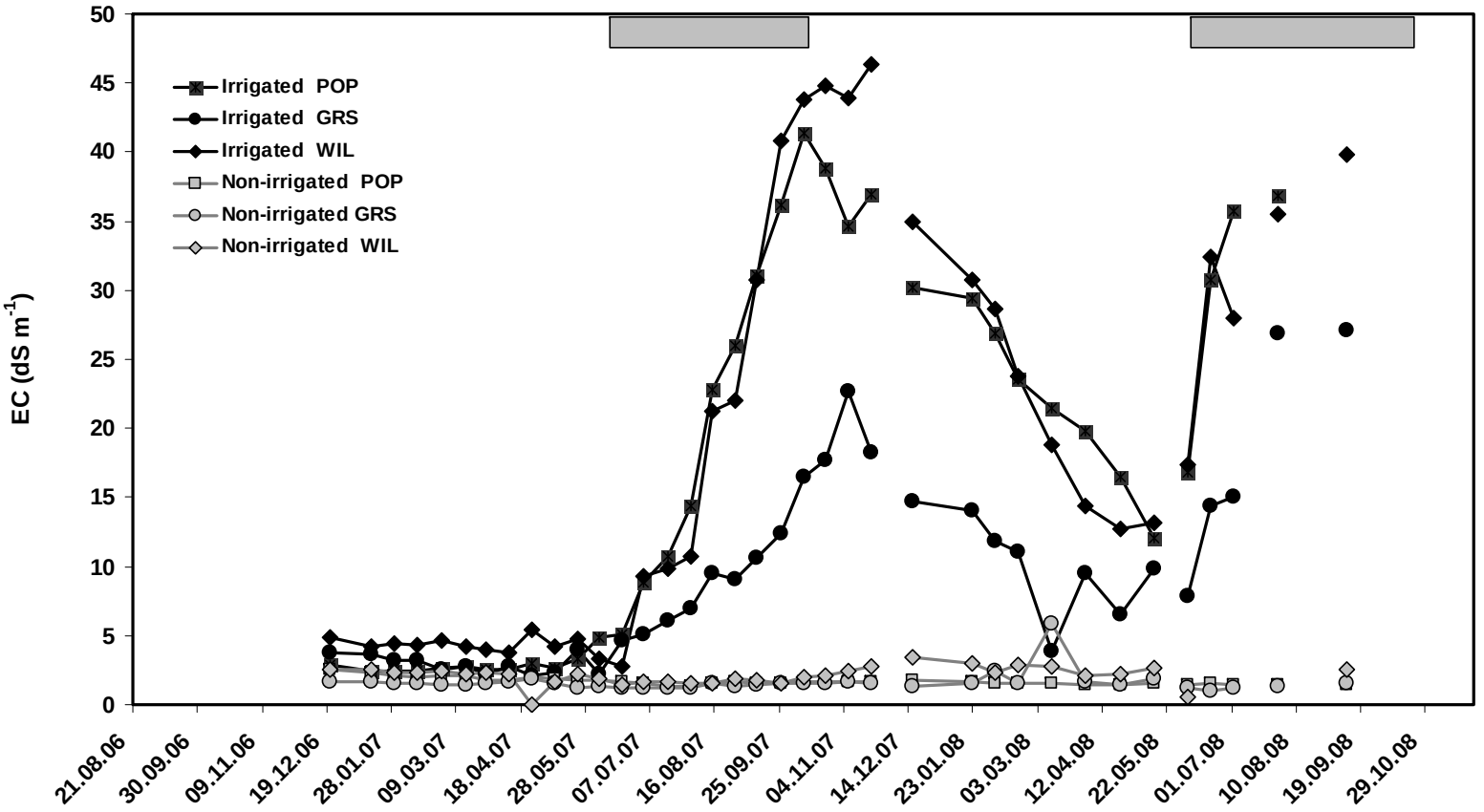
Phosphorous in soil



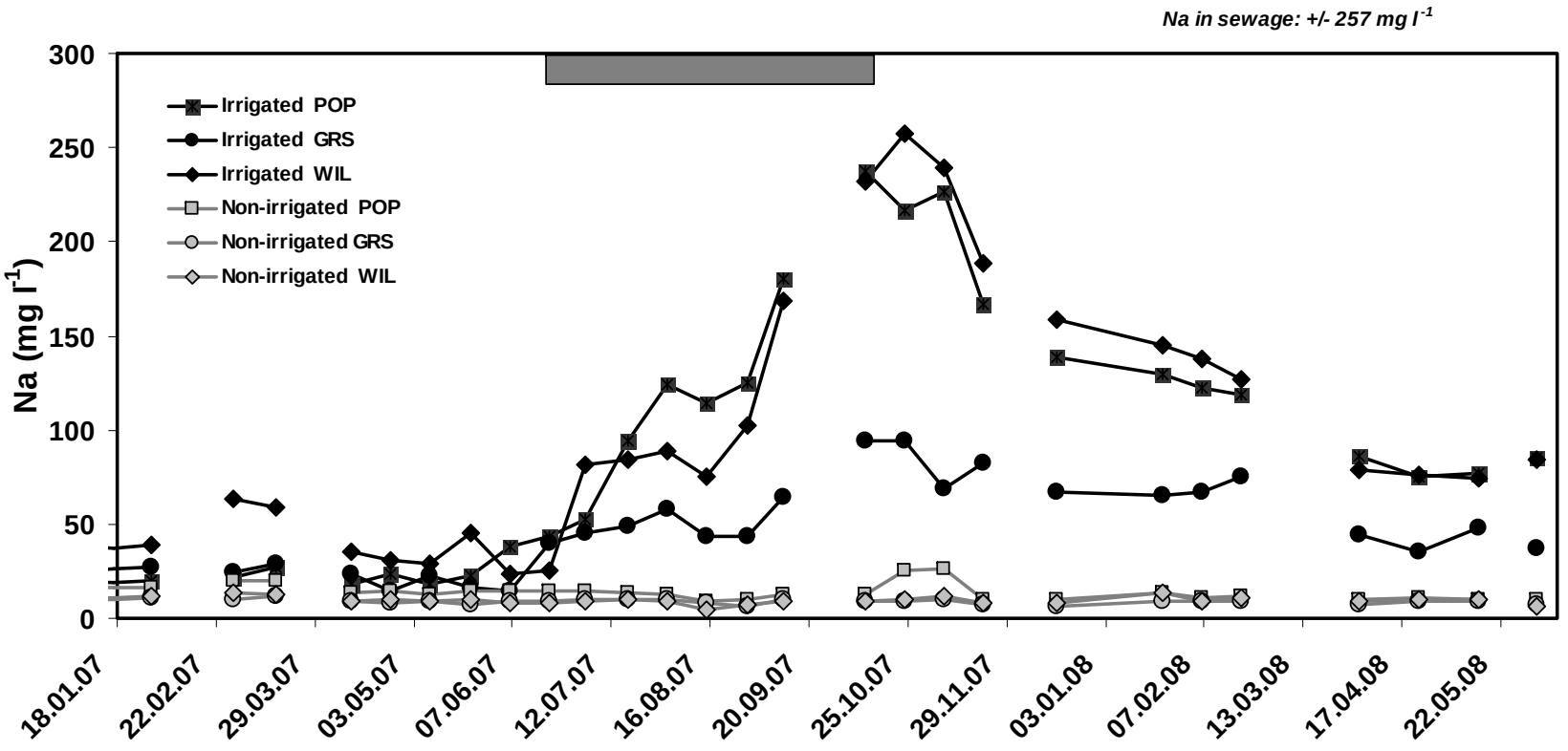
Effects of irrigation on soil water pH



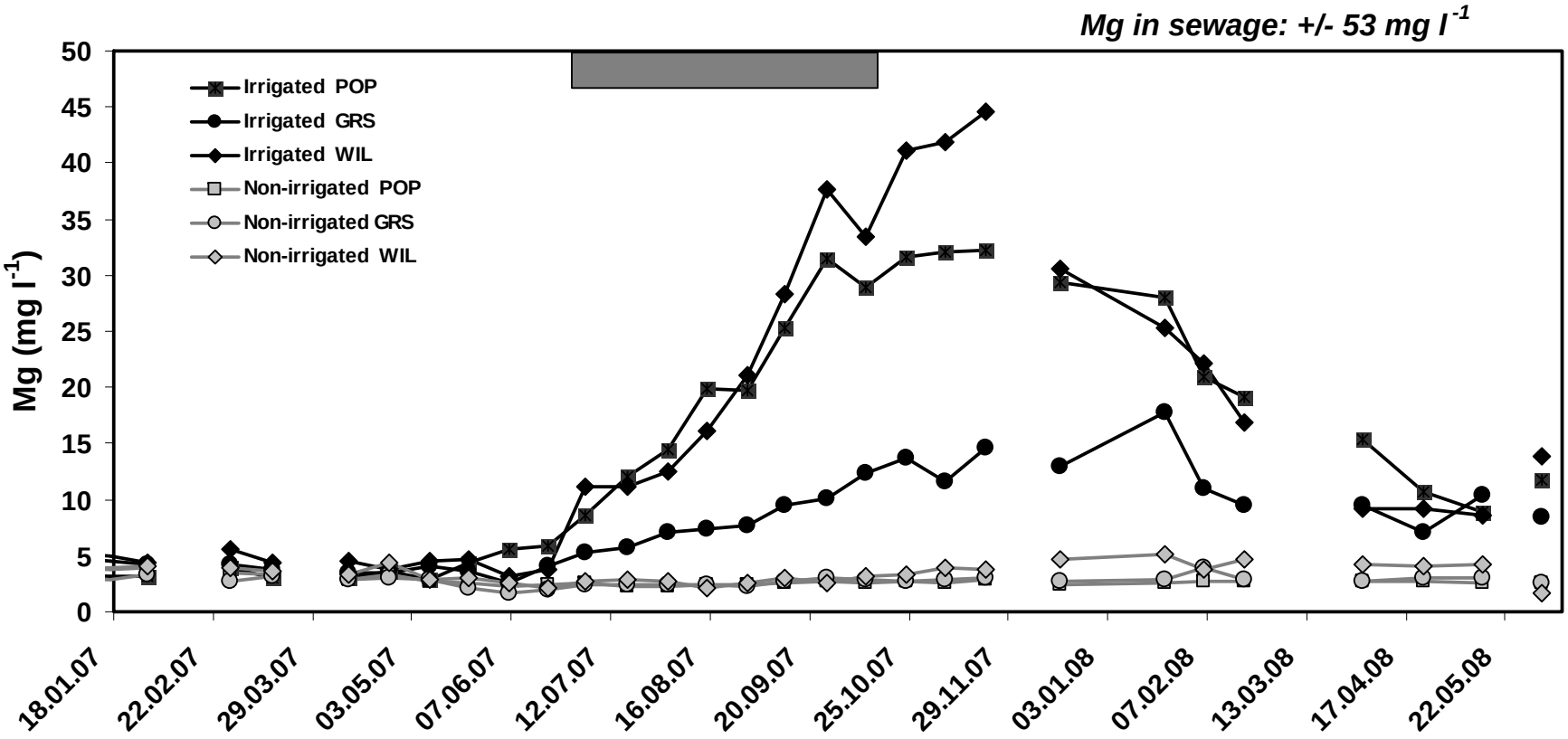
Effect of irrigation on electrical conductivity of soil water



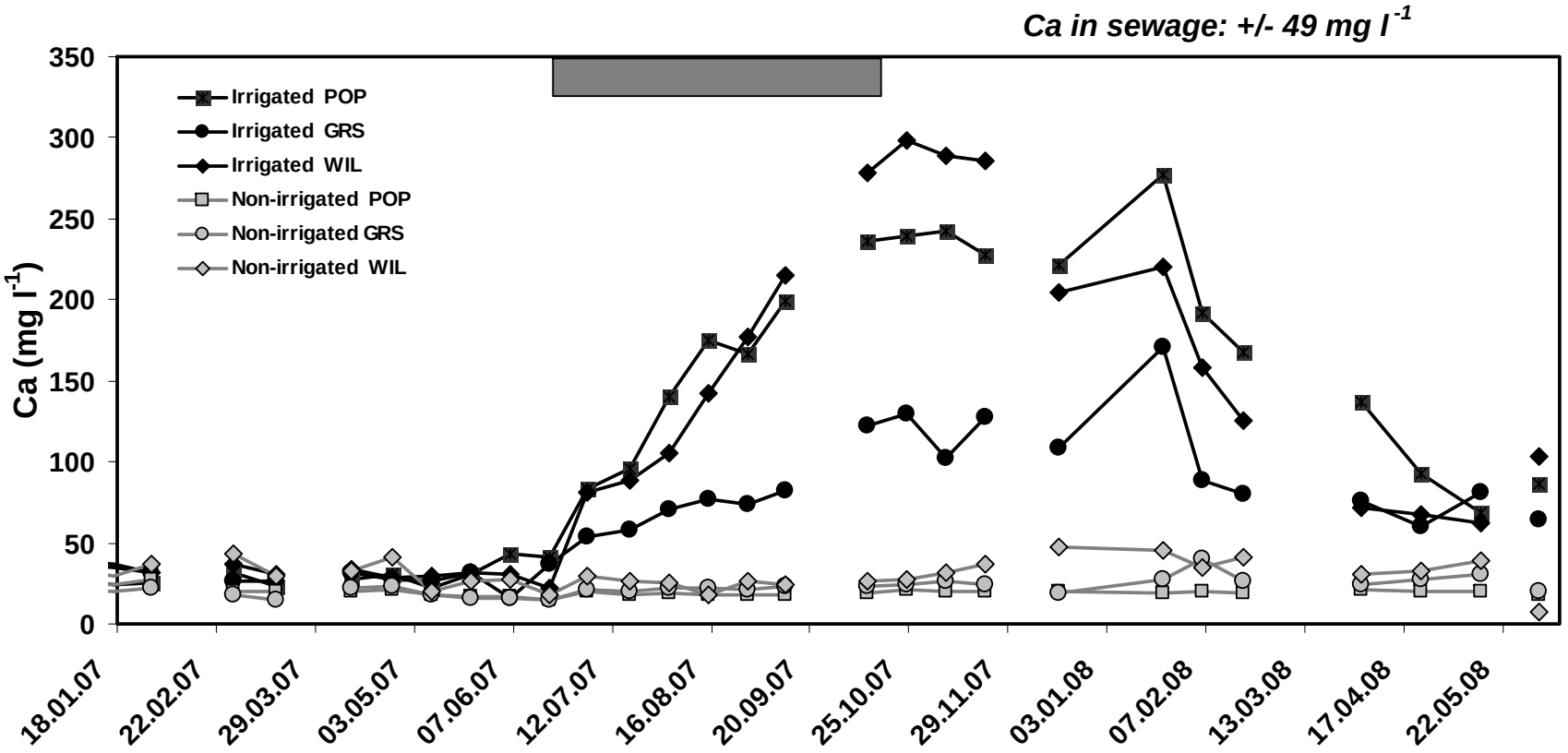
Sodium in soil water



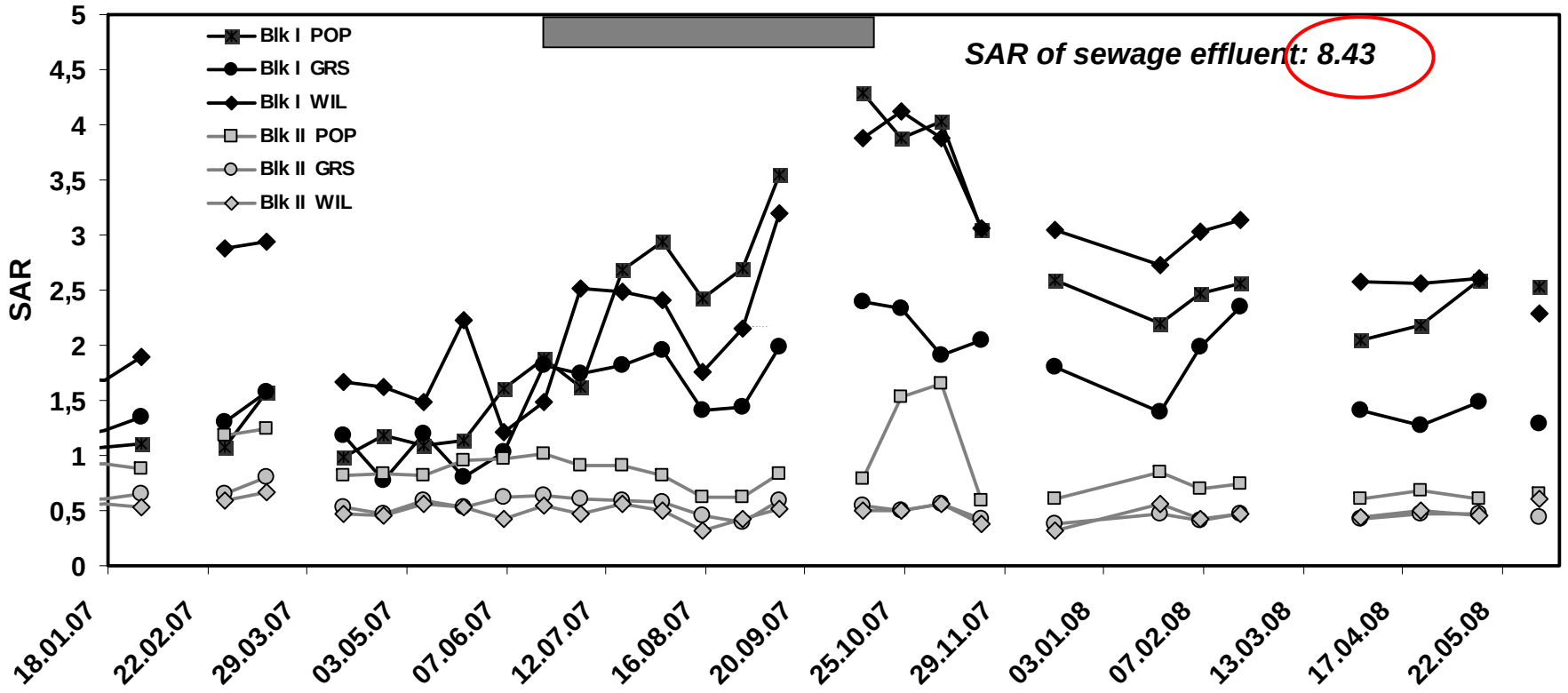
Magnesium in soil water



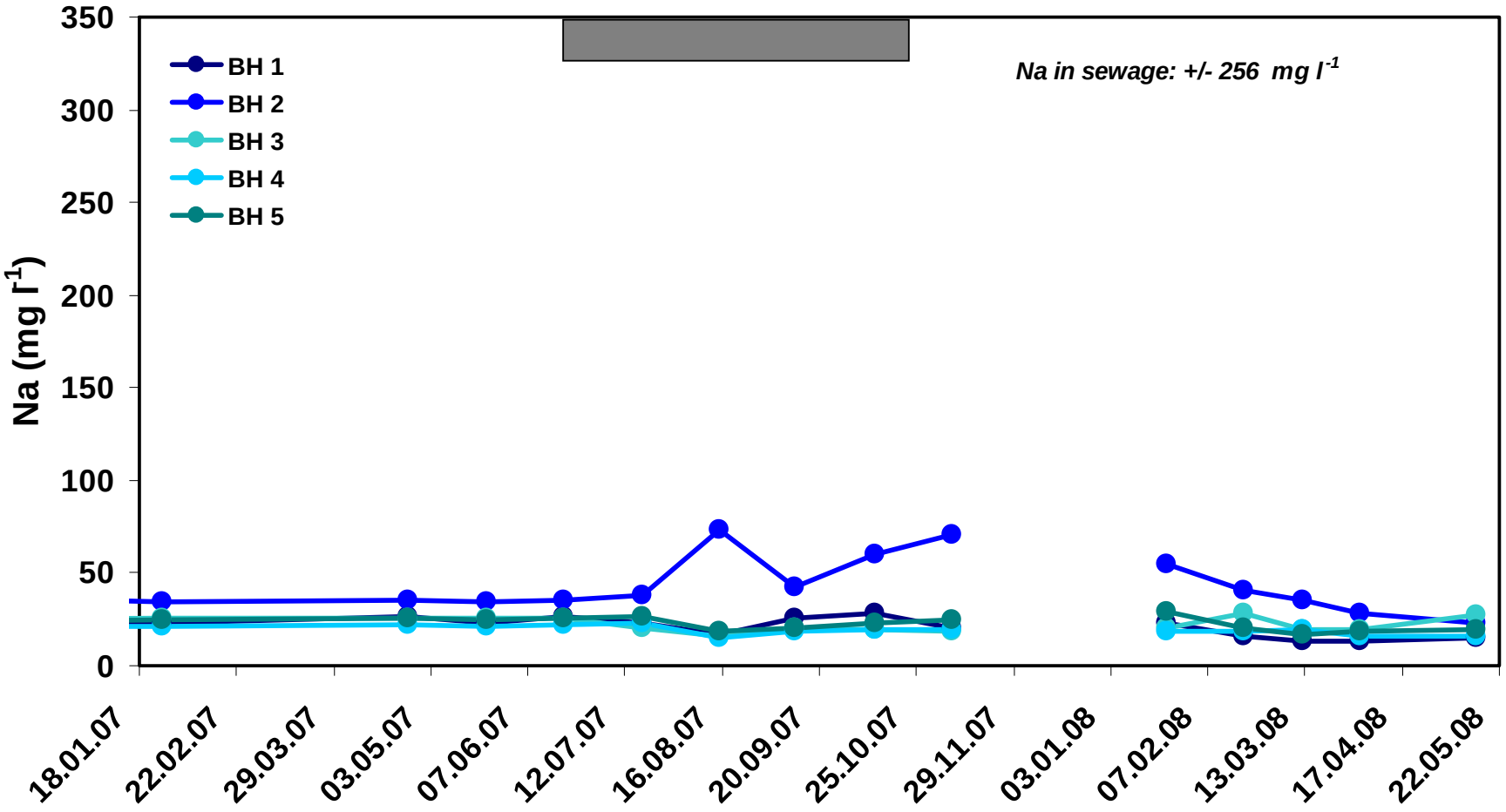
Calcium in soil water



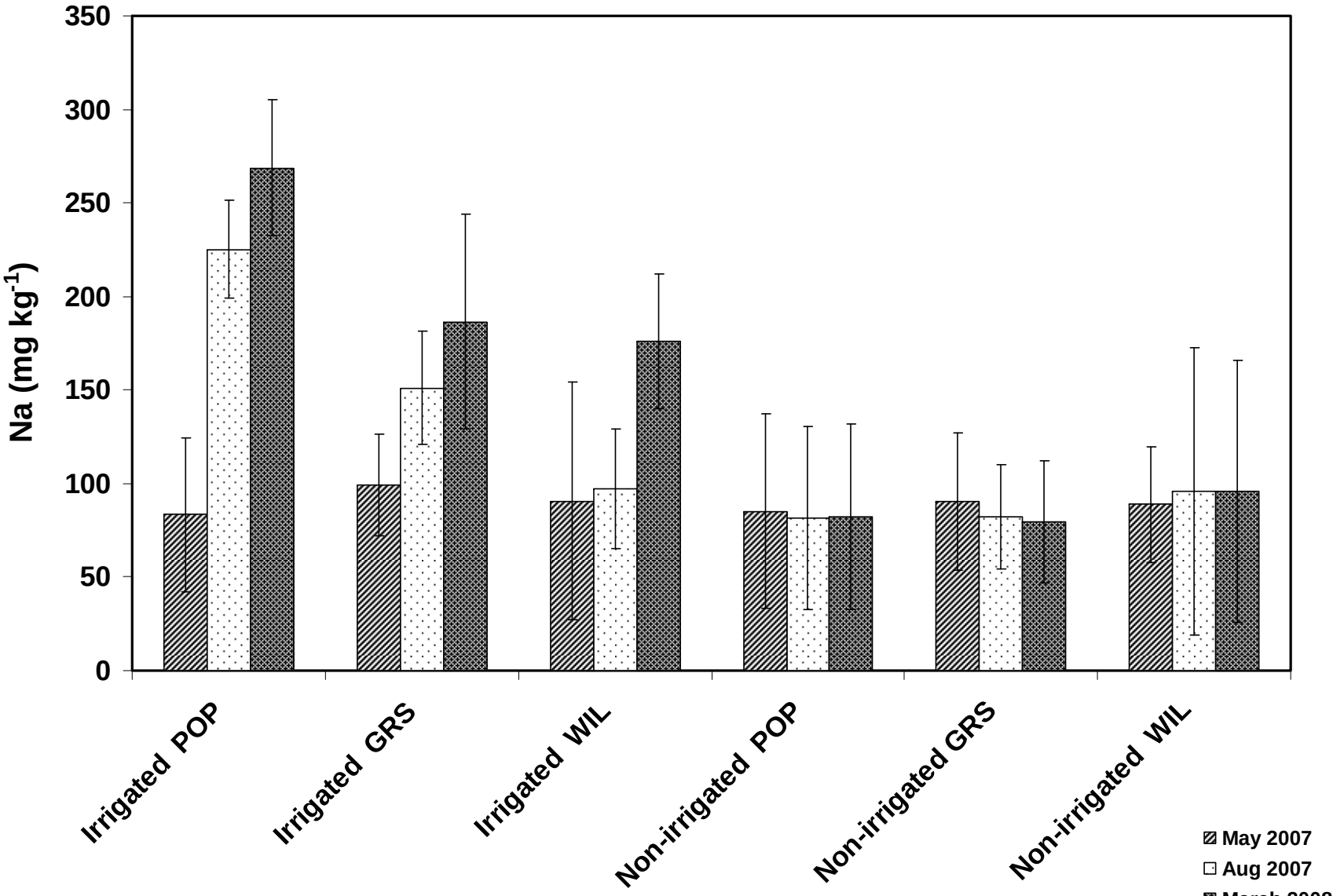
Sodium adsorption rate of soil water



Sodium in groundwater

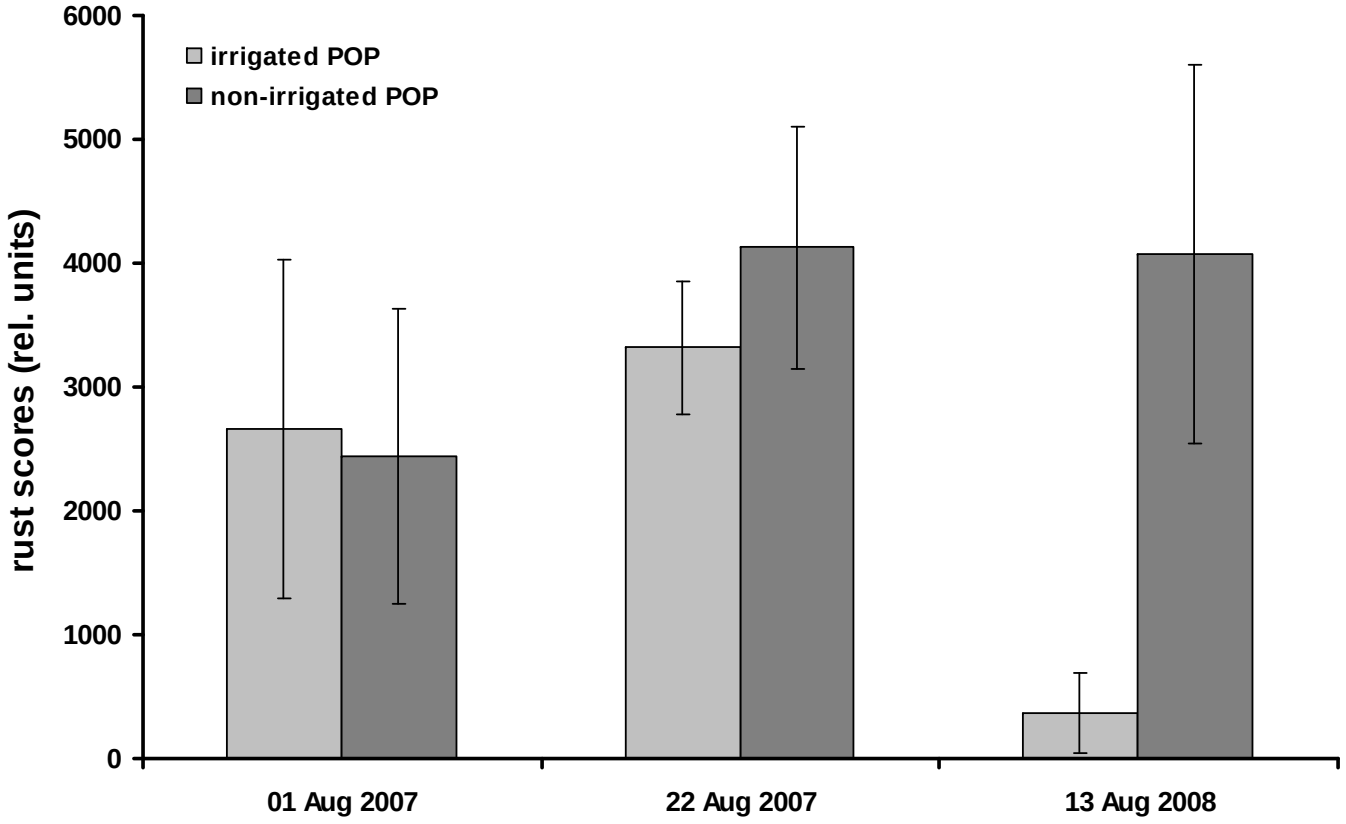


Sodium in soil




Leaf rust *Melampsora* spp.
in polpar

Rust in poplar



Effects of rust on pop

- Severe die-back of branche
- Effects on the root system
- Delayed leaf development
- Additional negative impacts caused by
  - Water logging
  - High salt concentrations

Conclusions I

- All species showed similar patterns in nutrient removal
- Efficient removal of N from the applied municipal sewage effluent
- No leaching of N into groundwater
- Slight increase of P in soil water during irrigation period
- No leaching of P into the groundwater
- No evidence of accumulation of P in soil

Conclusion II

- Transient changes of other parameters in soil water, but not in groundwater and soil
- Potential risk of sodium accumulation in soils
- Selection of genotype important for health and good performance

For NI climate and soil conditions willow would be the better energy crop.

Willow and poplar would need different irrigation treatment for optimal performance.

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Thank you for your attention!

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