Alfalfa to get back into planetary boundaries

2025 world alfalfa congress
FRANCE REIMS-CHÂLONS

Water management in alfalfa crops

Jézéquel S. and Arcia Ruiz I.

Parallel session 1

FROM 03 › TO 06 nov. 2025

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Soil health indicators impacted by deficit irrigation timing and severity

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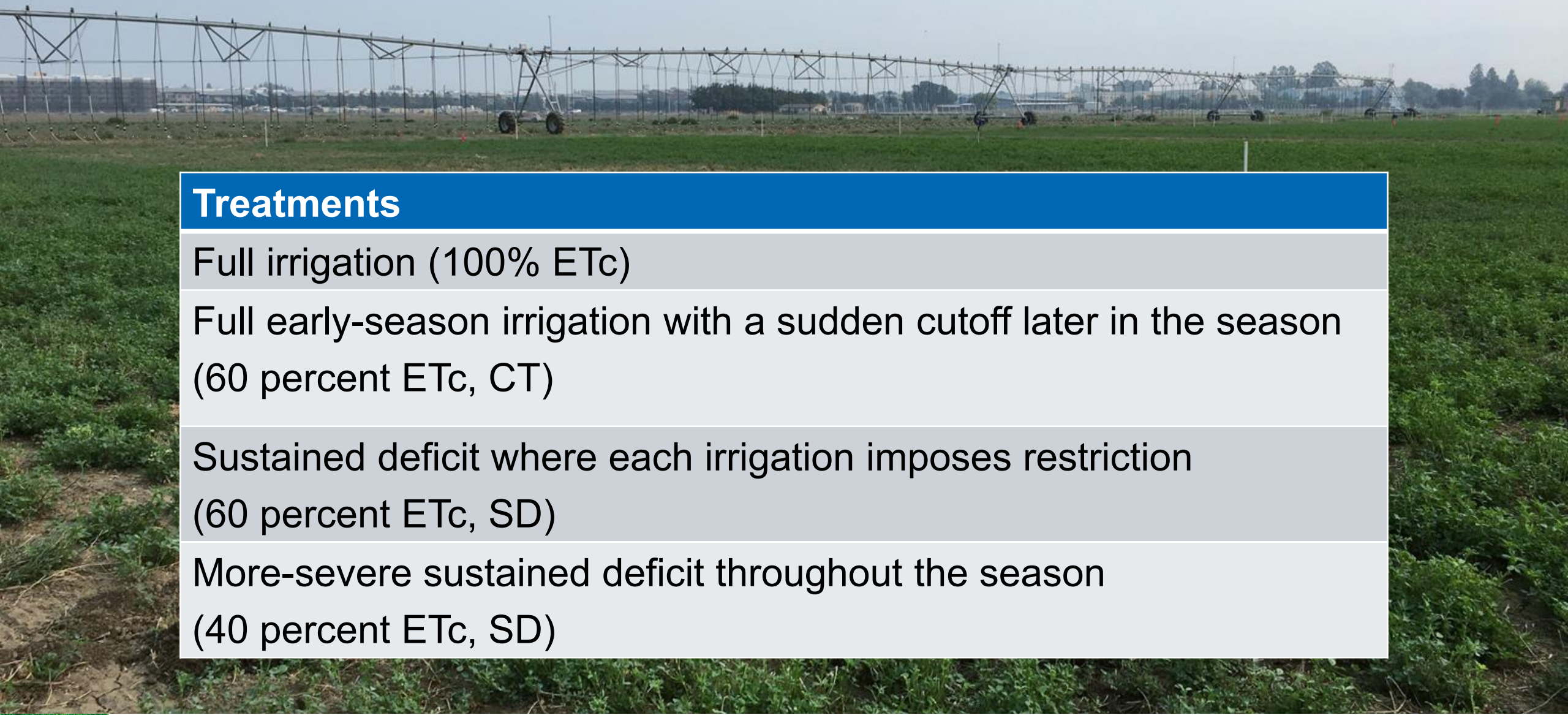
FROM 03 TO 06 nov. 2025

UC CE

Project background and objectives

- During drought, growers may have to make tough decisions on how to apply scarce water resources.
- Some growers may opt to reduce irrigation to alfalfa since it is deep-rooted and can scavenge water and nutrients from the soil profile.
- The purpose of this project was to evaluate how water shortages impact soil health outcomes.
  - Specific objectives were to determine how deficit irrigation levels and timing during the cropping season impact soil physical, chemical, and biological health properties.
  - We hypothesized the deficit irrigation would degrade soil health properties.

Site characteristics and trial design



Treatments
Full irrigation (100% ETc)
Full early-season irrigation with a sudden cutoff later in the season (60 percent ETc, CT)
Sustained deficit where each irrigation imposes restriction (60 percent ETc, SD)
More-severe sustained deficit throughout the season (40 percent ETc, SD)

Project methods

- Soil sampling occurred in spring before irrigation began and in the fall after the last irrigation (spring and fall, 2019-2020)
- Soil sampled from 0-15, 15-30, 30-60, and 60-90 cm
- Textural analysis was performed: clay loam across the site

Physical	Chemical	Biological
Bulk density	Macro- and micronutrients	Organic matter
Compaction	Total carbon and nitrogen	Active carbon
	Electrical conductivity	Nitrogen mineralization

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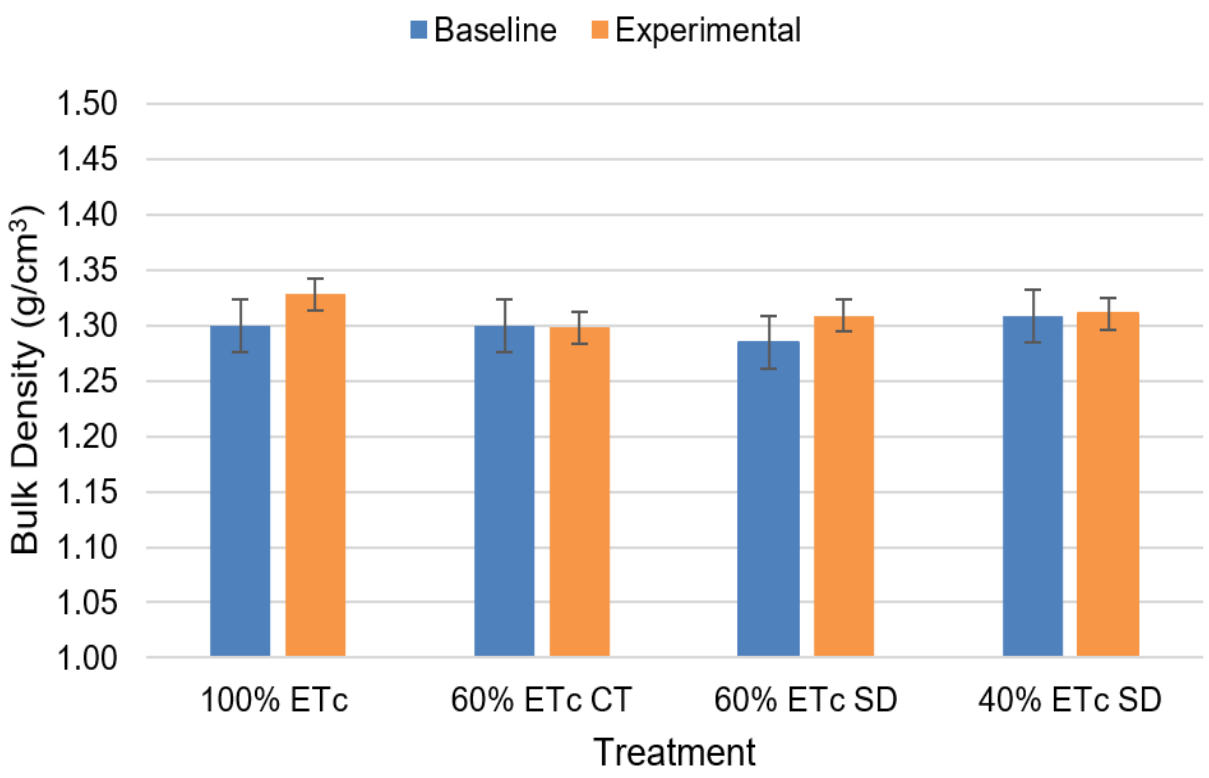
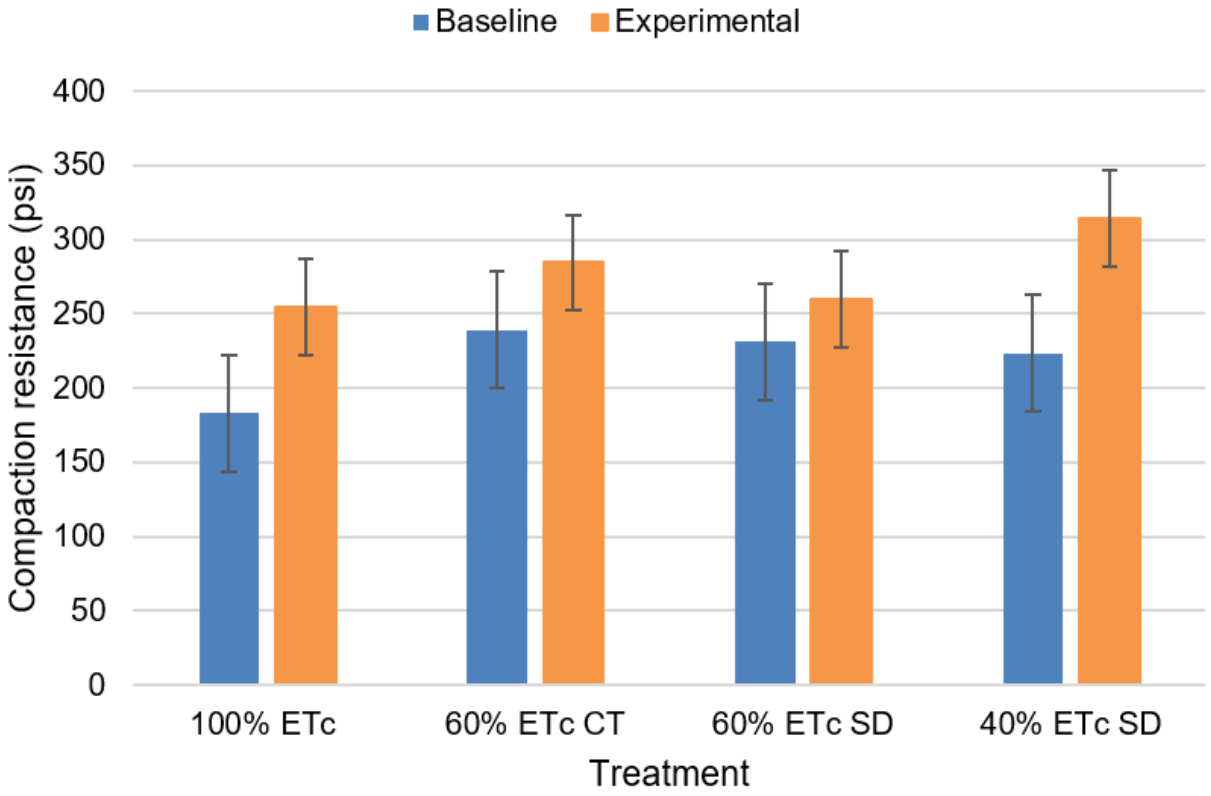
Physical properties did not differ across treatments





* P < 0.05

¥ Bulk density was evaluated for depths 0-15,15-30, 30-60, and 60-90 cm. Compaction was measured at 15-cm depth.

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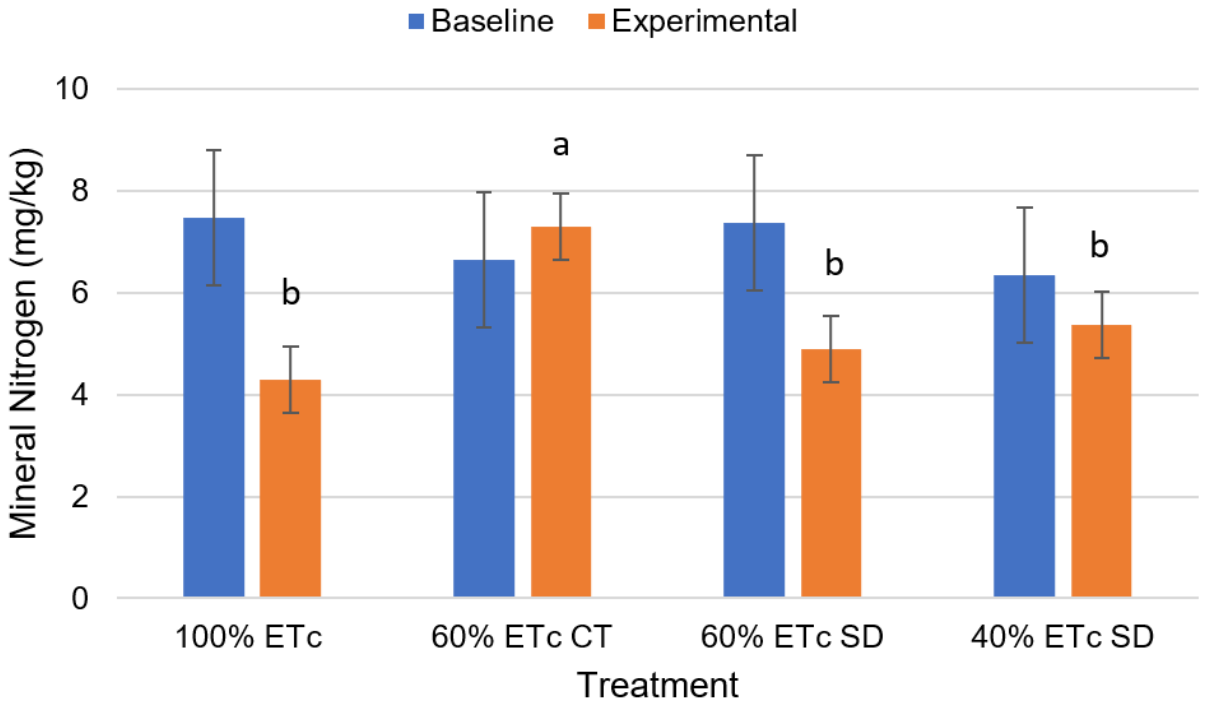
Chemical properties: deficit irrigation had some impact on soil nutrient availability

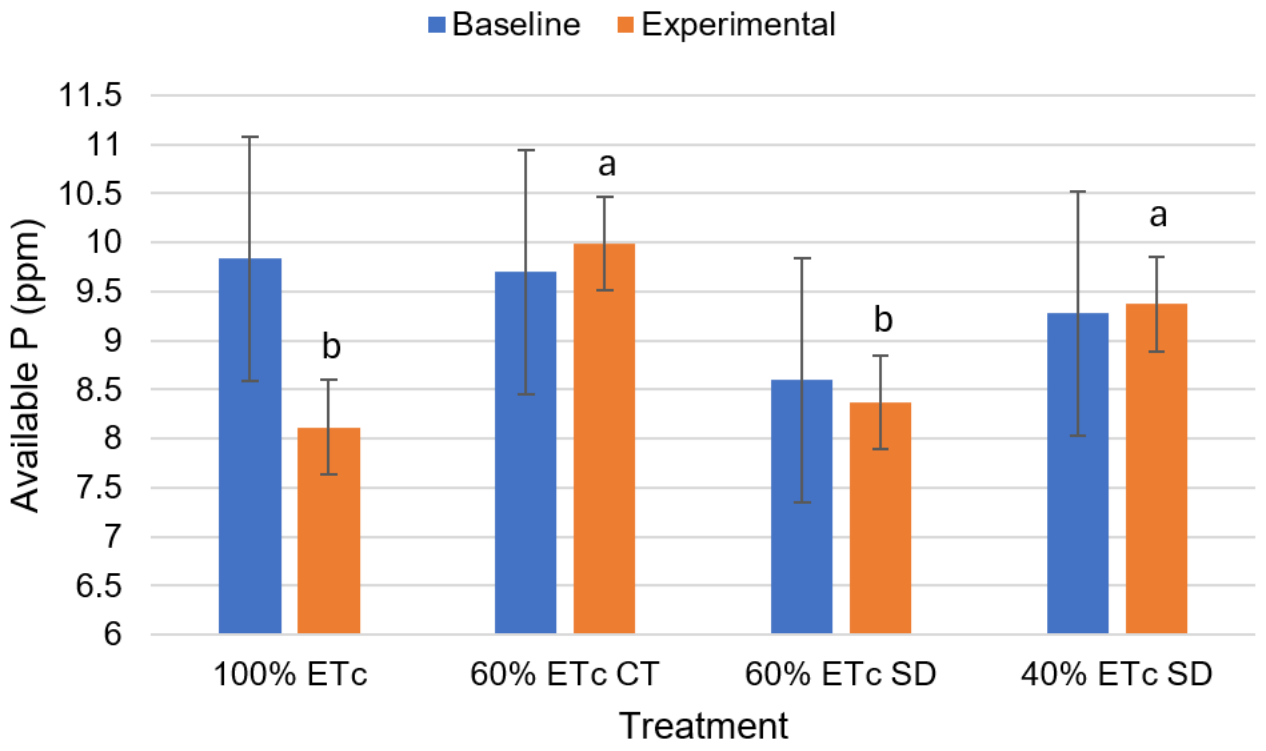
	N	P	K	SO_4-S	Ca	Mg	Na	B	CEC	Total C	OM
Baseline	NS	NS	*	NS	NS	NS	*	*	NS	NS	NS
Experi-mental	*	*	*	*	NS	NS	*	NS	NS	NS	NS

* P < 0.05

¥ Nutrient analyses were run on 0-15 and 15-30 cm depths.

Deficit irrigation impacted plant available N and P

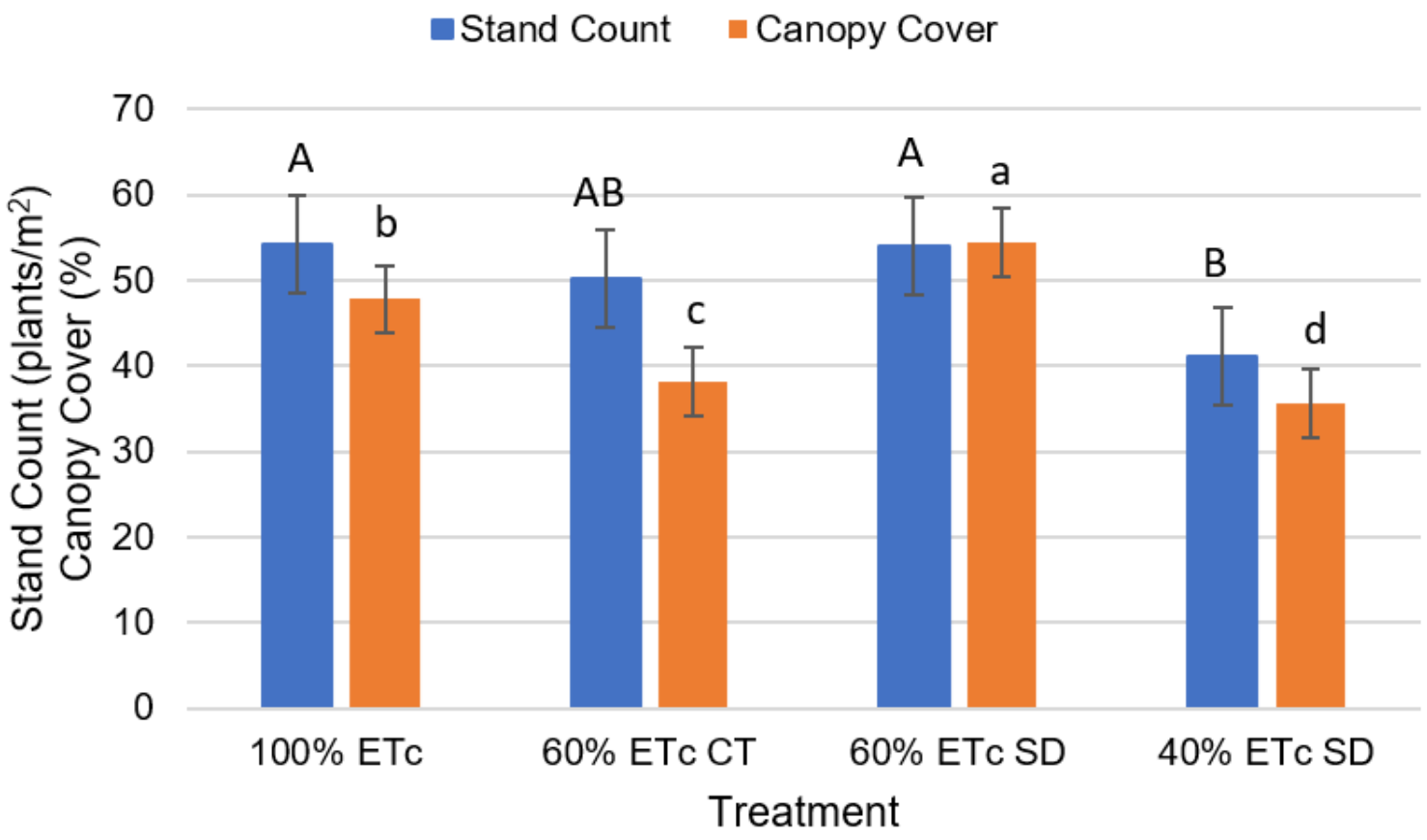




* P < 0.05

¥ Nutrient analyses were run on 0-15 and 15-30 cm depths.

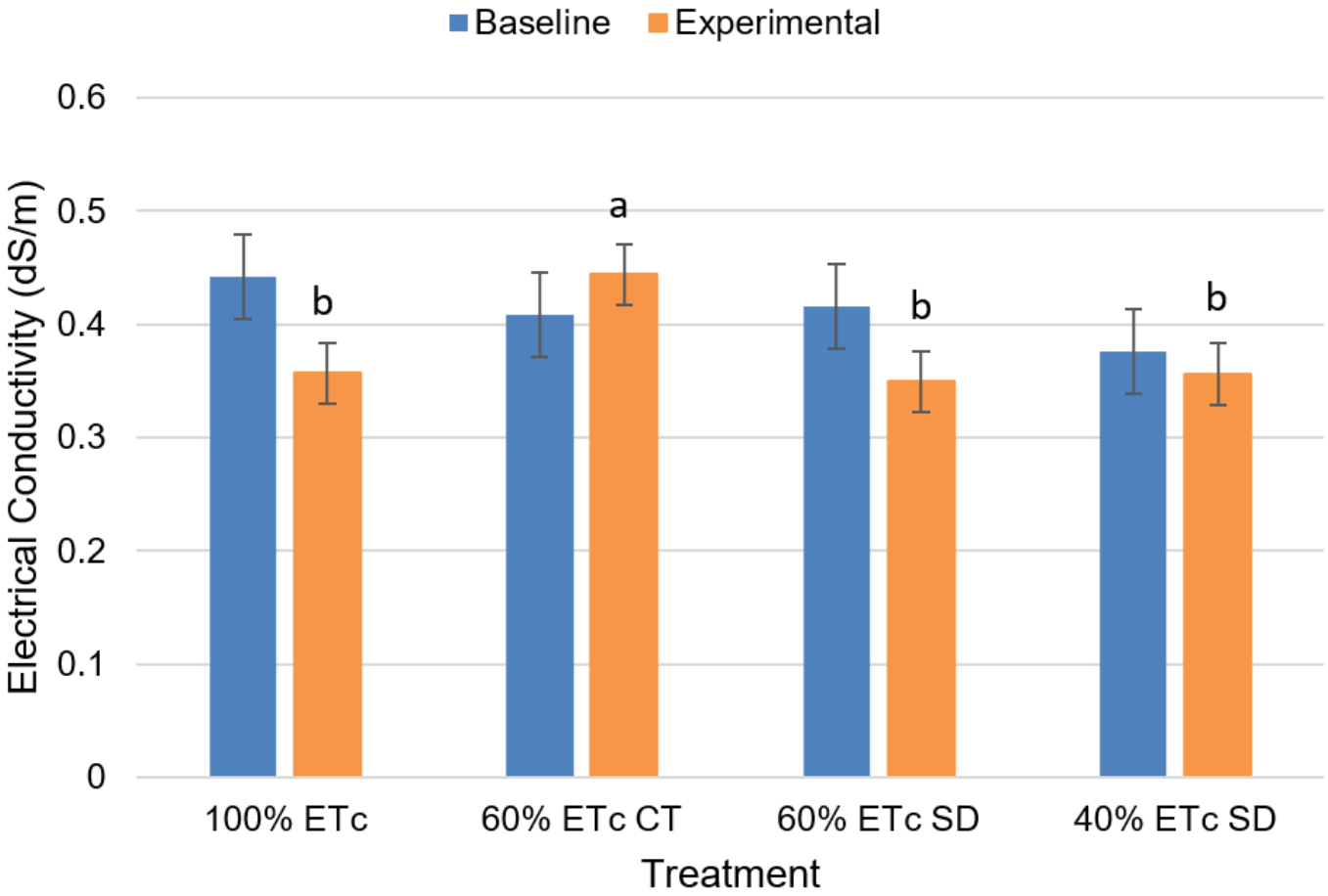
Deficit irrigation impacted alfalfa stand



* P < 0.05

¥ Evaluated about one week after cutting in Sept 2020.

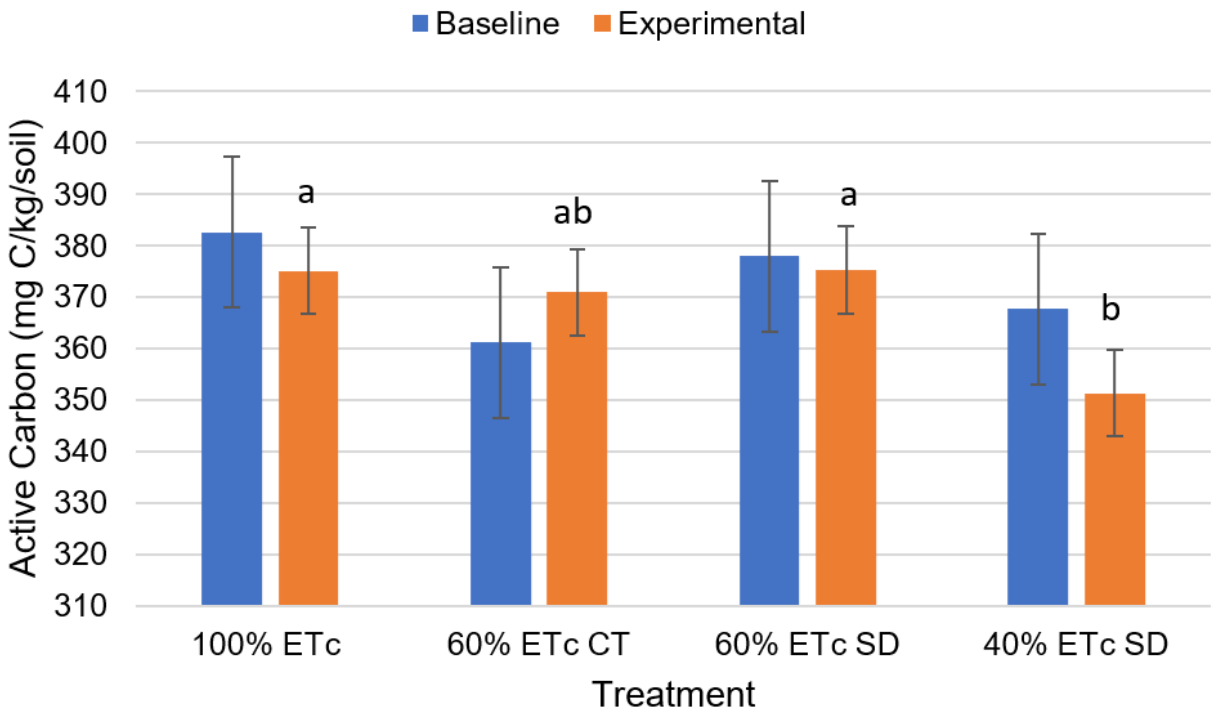
Deficit irrigation timing impacted salinity

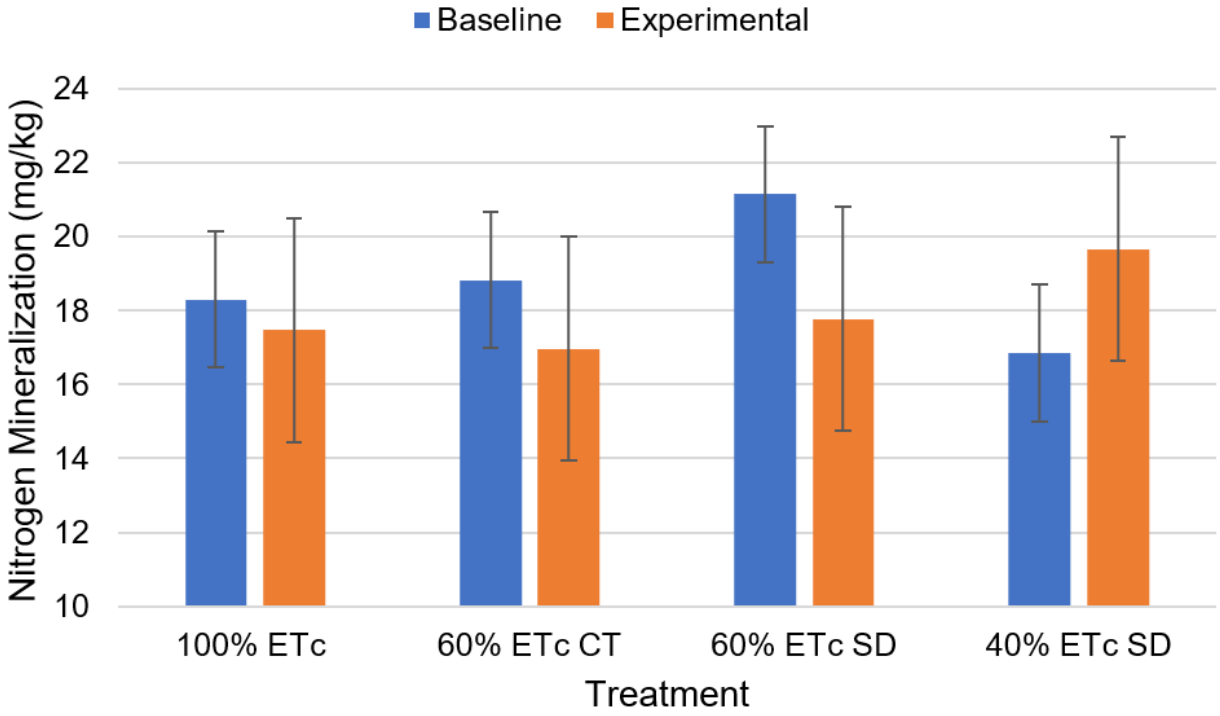


* P < 0.05

¥ EC was analyzed for depths 0-15, 15-30, 30-60, and 60-90 cm.

Deficit irrigation had mixed results on biological properties





* P < 0.05

¥ Active carbon and N mineralization were analyzed for 0-15 and 15-30 cm depths.

Summary

- Deficit irrigation may be an important water management strategy during drought.
- This project demonstrated that some soil health properties are impacted by deficit irrigation timing and severity.
- Many factors will influence grower decision-making.
  - Alfalfa yield, quality, and pricing will likely be more influential than short-term changes in soil health.
  - Longer term studies are needed.
- Policy decisions during drought around water use prioritization may have implications for soil health.

Thank you!

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