Physiological responses to deficit irrigation in different apple cultivars

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DEFICIT IRRIGATION AS A PROMISING TOOL TO FACE WATER SCARCITY

WITH DROUGHT STRESS :

- Reduced Stem water potential (Ψ_{stem})
- Reduced leaf gas exchanges
- Reduced vegetative growth
- Lower yield
- Smaller fruit



WITH REGULATED DEFICIT IRRIGATION (RDI) @later stages :

- Reduced Stem water potential (Ψ_{stem})
- Leaf gas exchanges slightly reduced
- Reduced vegetative growth
- **Yield and fruit size maintained**
- **Higher fruit quality**

Reid, M. & Kalcsits, L. (2020). **Plants, 9**

Mpelasoka et al., 2022 **Horticulturae, 8**, 571

Keivanfar et al., 2019 **Agriculturae Conspectus Scientificus, 84**,

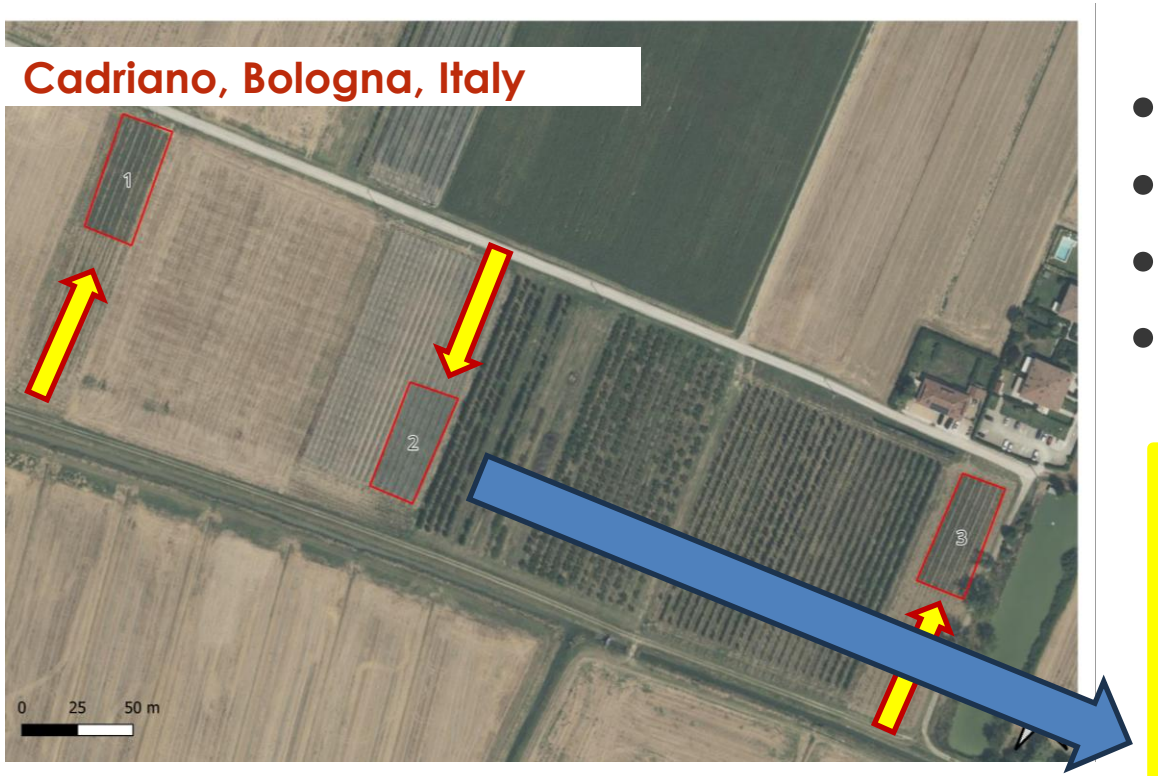
ARE THERE DIFFERENCES IN THE RESPONSE TO DEFICIT IRRIGATION AMONG VARIETIES OF THE SAME SPECIES?

Objectives

To compare the physiological responses to deficit irrigation in nine different apple cultivars



Materials and Methods: experimental trial



- 2024 and 2025 seasons
- Orchard at 2° and 3° leaf, planted in 2023;
- Three blocks; 3.5 × 1 m spacing
- Spindle trees; 20% shade anti-hail net

IRRIGATION TREATMENTS:
100%Etc vs. 50% Etc according to IRRIFRAME DSS.
DI started at 100 DAFB in 2024 and 80 DAFB in 2025

12 trees per variety
6 trees per irrigation treatment
OVER 3 BLOKS



CULTIVAR TESTED

Abbondanza
Campanino
Renetta Grigia di Torriana
Rosy glow
Gala 049
Smeralda
Red pulp Unibo
Red Unibo
Early red Unibo

Materials and Methods: measurements





Seasonal weather conditions

Soil water content

Stem water potential

1 LEAF PER TREE ON 4 TREES PER TRT

Leaf gas exchanges (Li-COR)

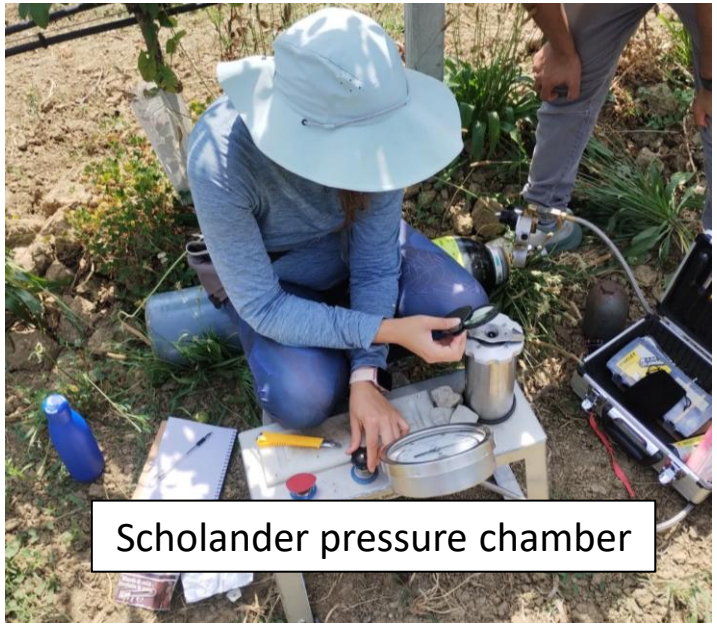
1 LEAF PER TREE ON 6 TREES PER TRT

Fruit growth (Caliper)

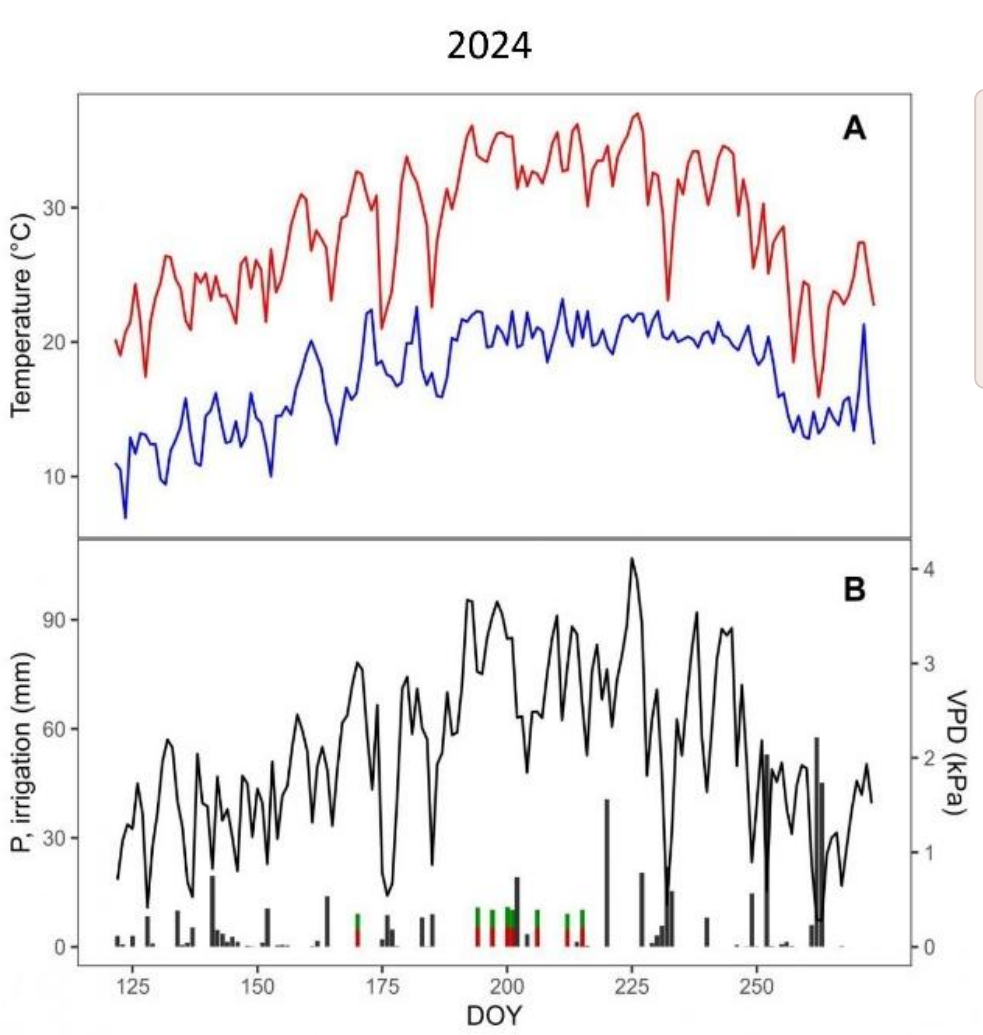
Vegetative growth

MONTHLY FREQUENCY





Two unusual rainy seasons

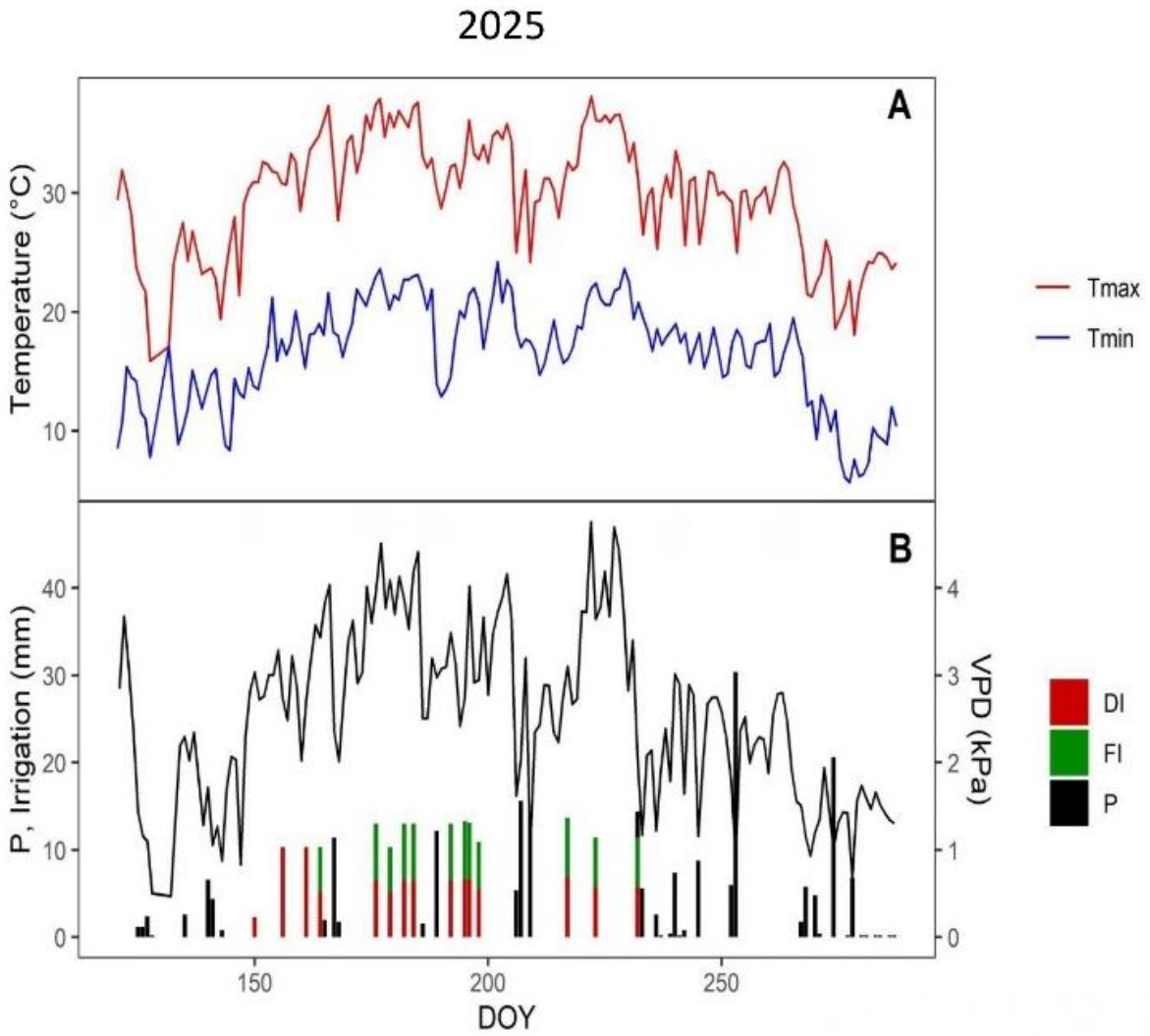


2024

FI 81.1 mm
DI 40.55 mm

2025

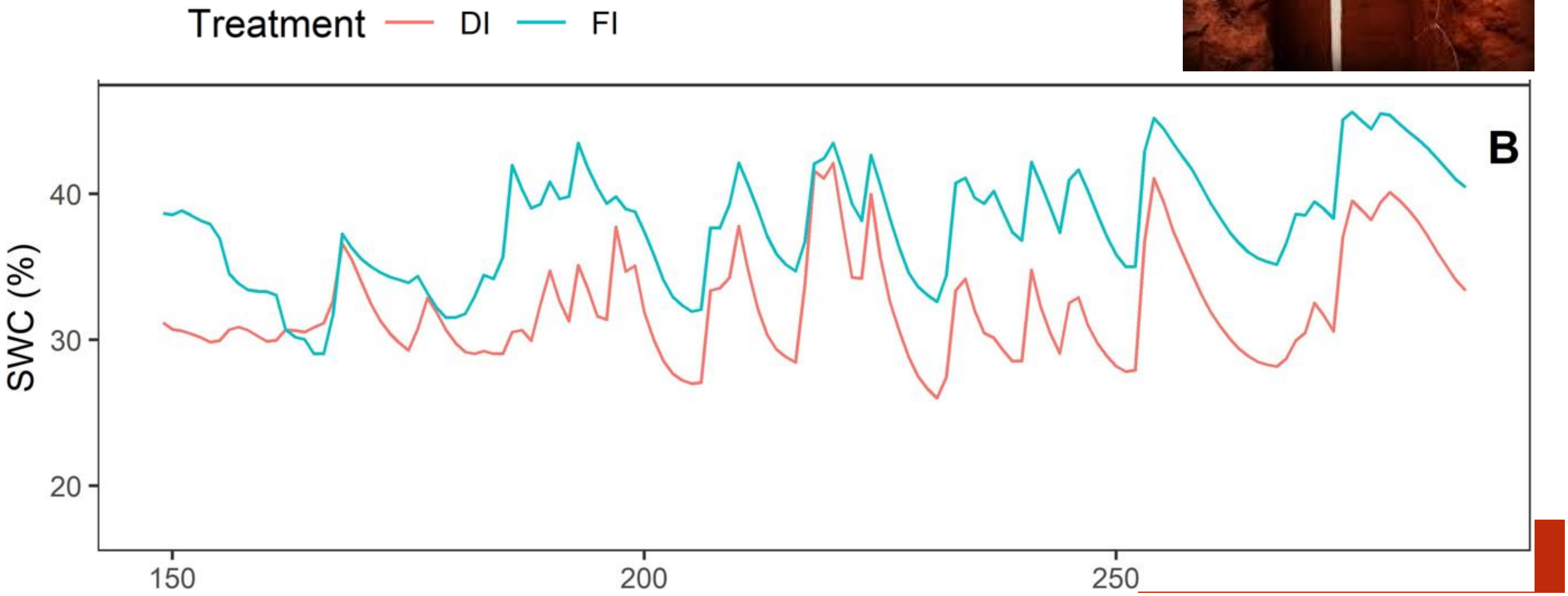
FI 169.3 mm
DI 96.1 mm



610 and 400 mm in 2024 and 2025, respectively for the period May 1°- October 31st

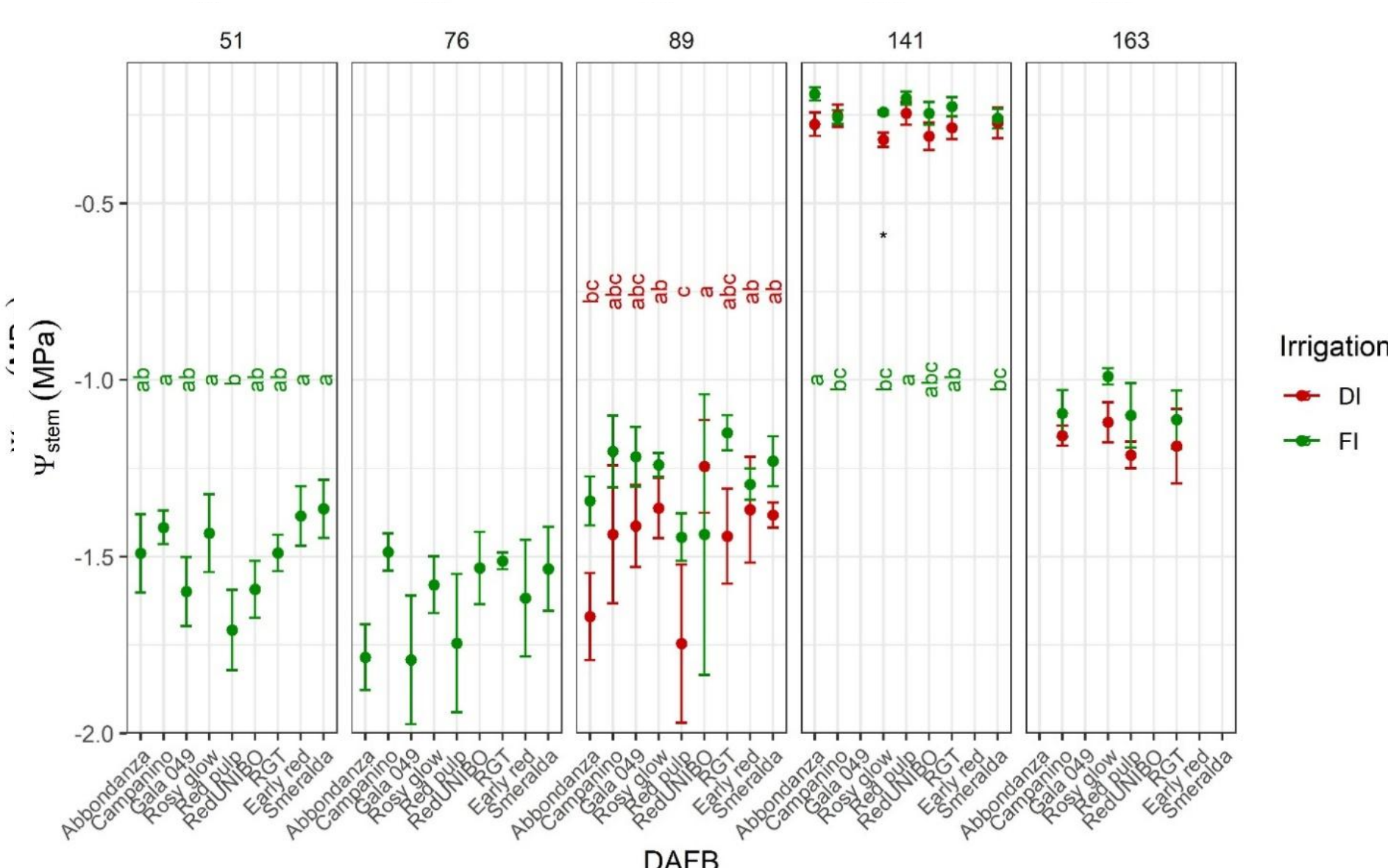
Soil water content (2025)





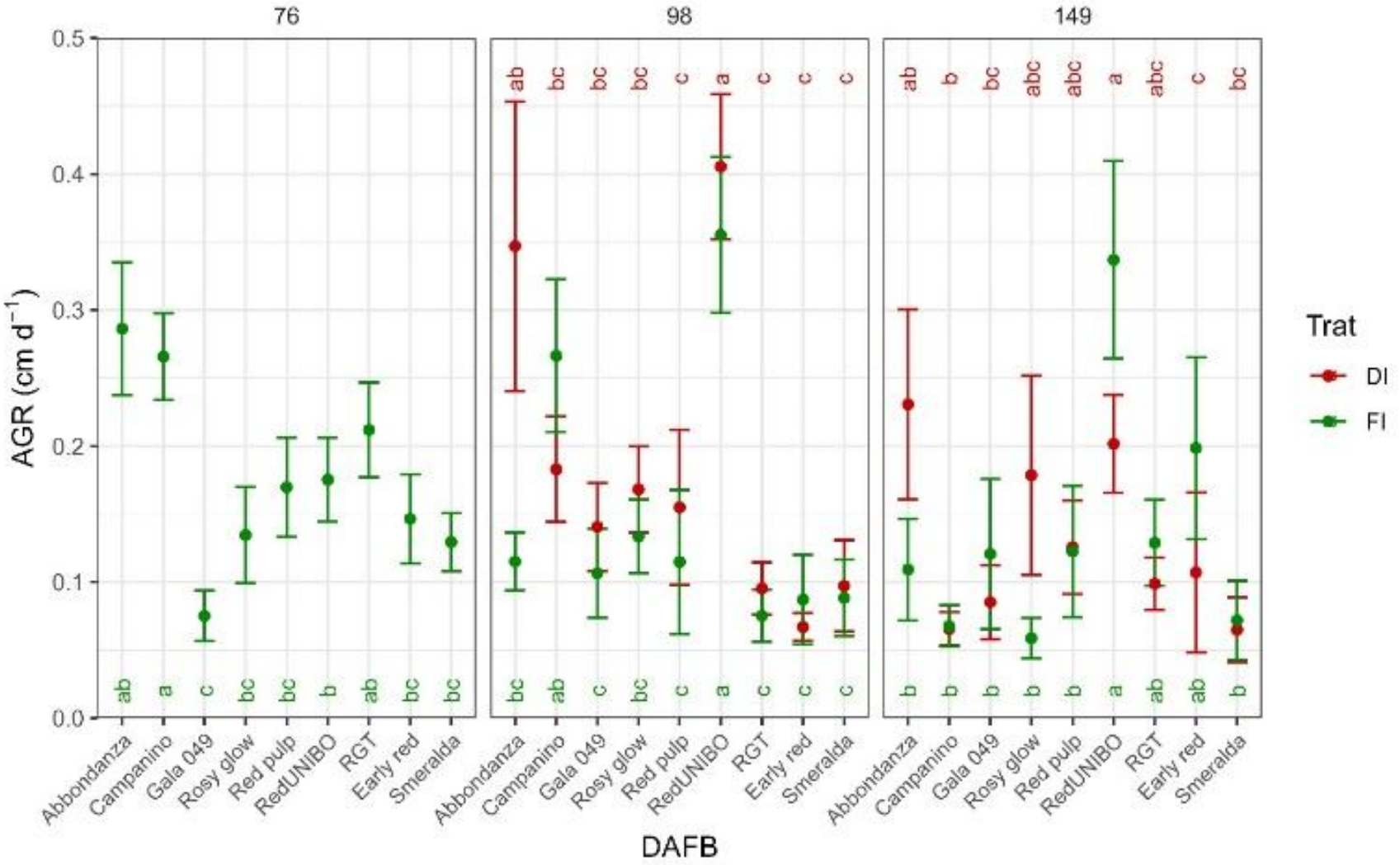
Stem water potential responded to 50% RDI but few significant differences were recorded





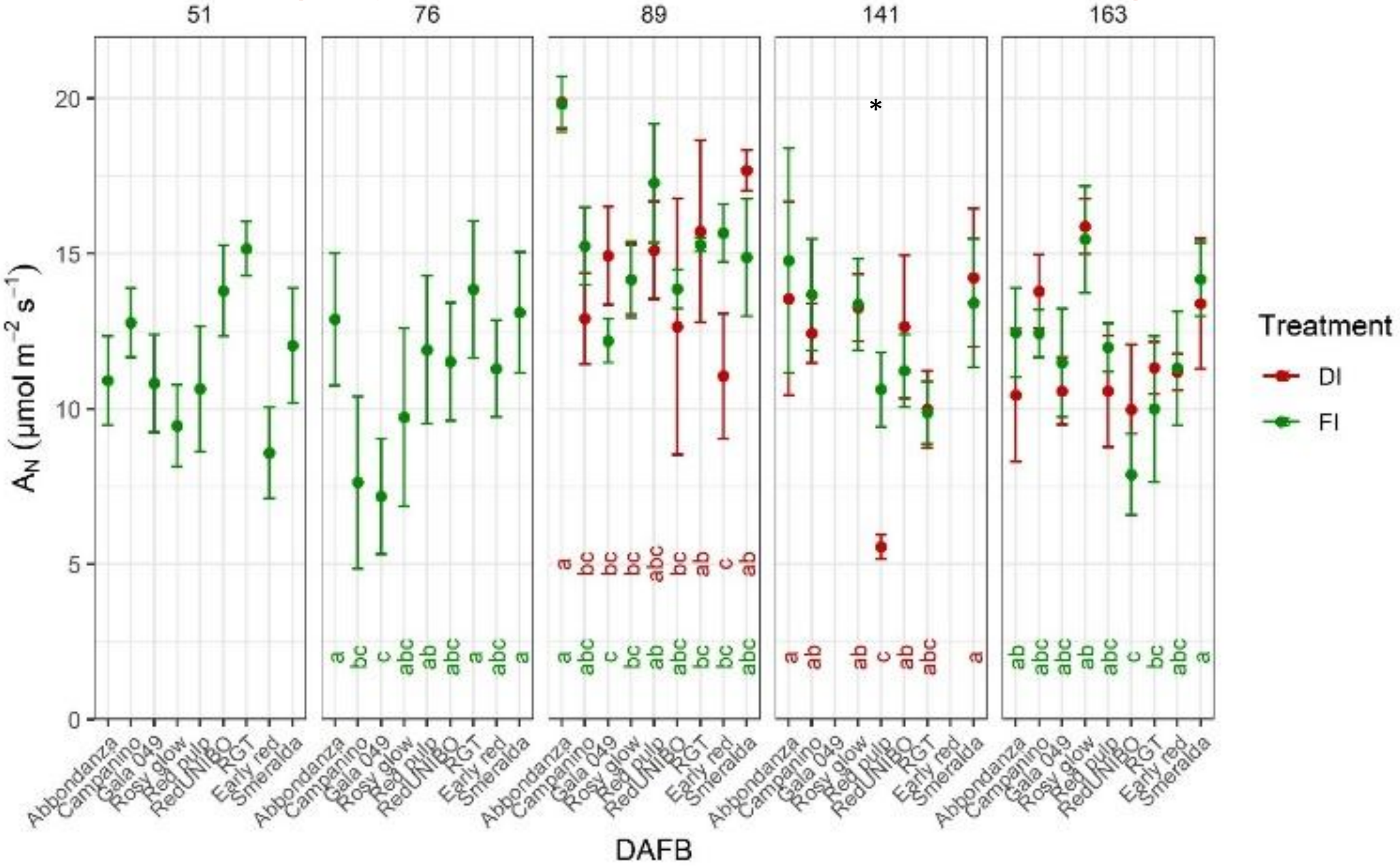
Shoot growth rate during the season (2025)

Rankings among varieties were not consistent within dates and years

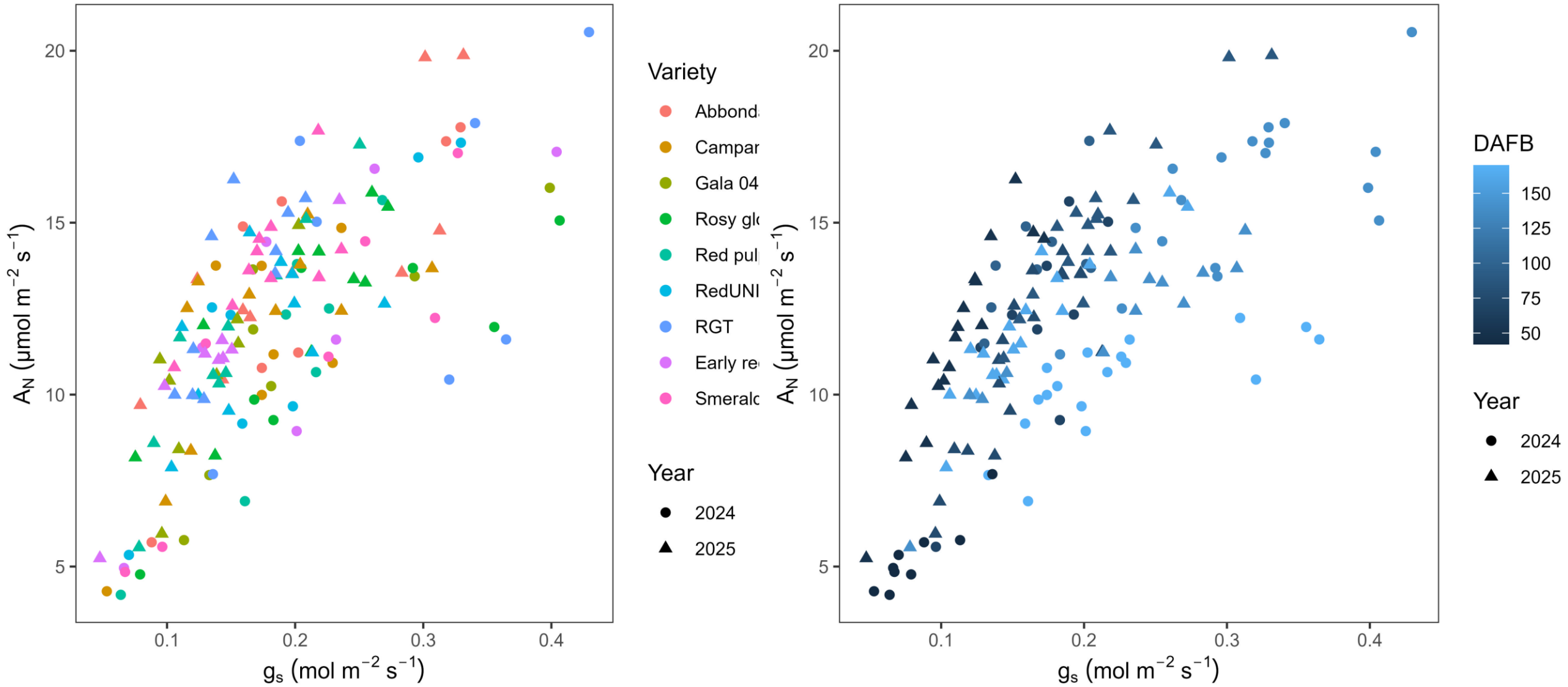


Assimilation was largely maintained under 50% irrigation

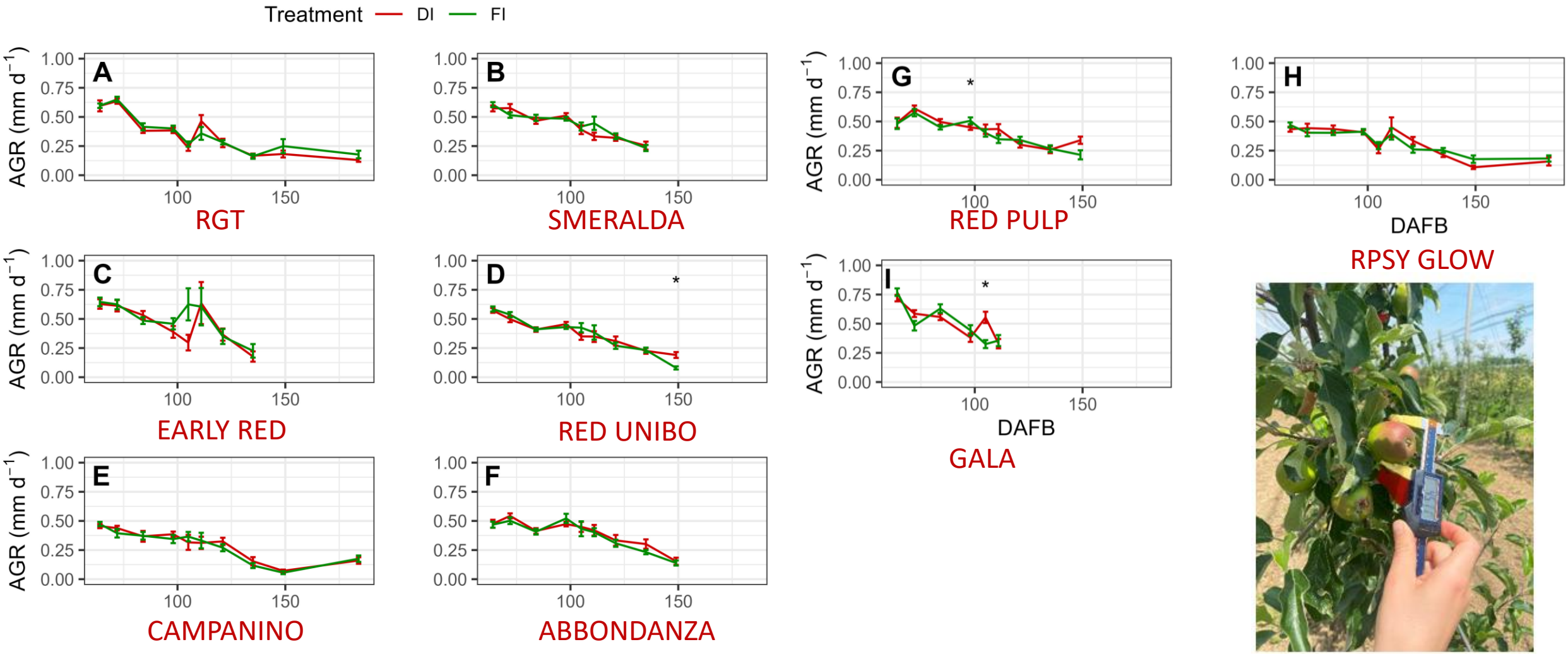
2025



Assimilation vs. Stomatal conductance (2024 and 2025)



Fruit growth rate in DI and FI irrigated trees - 2025



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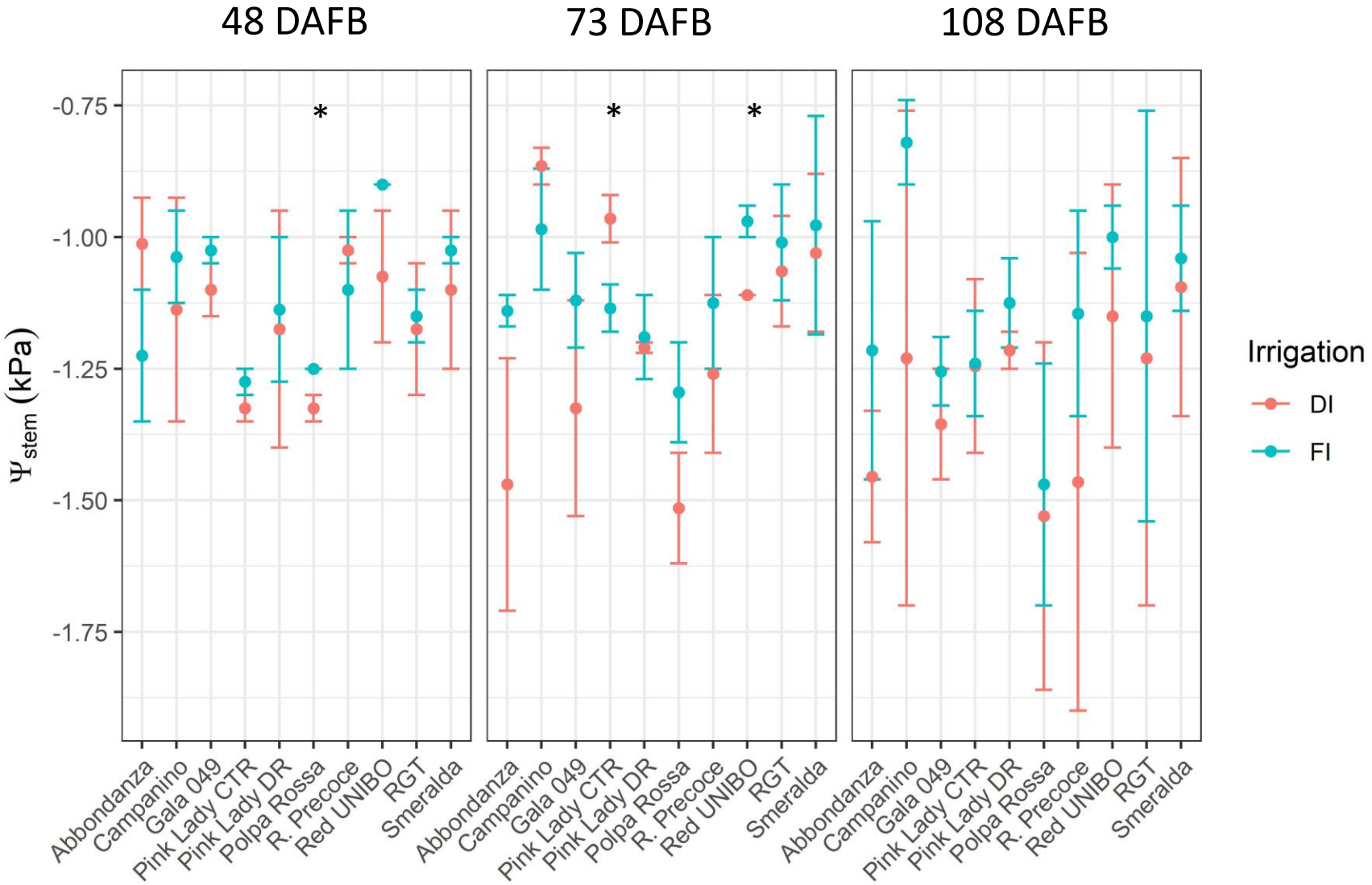
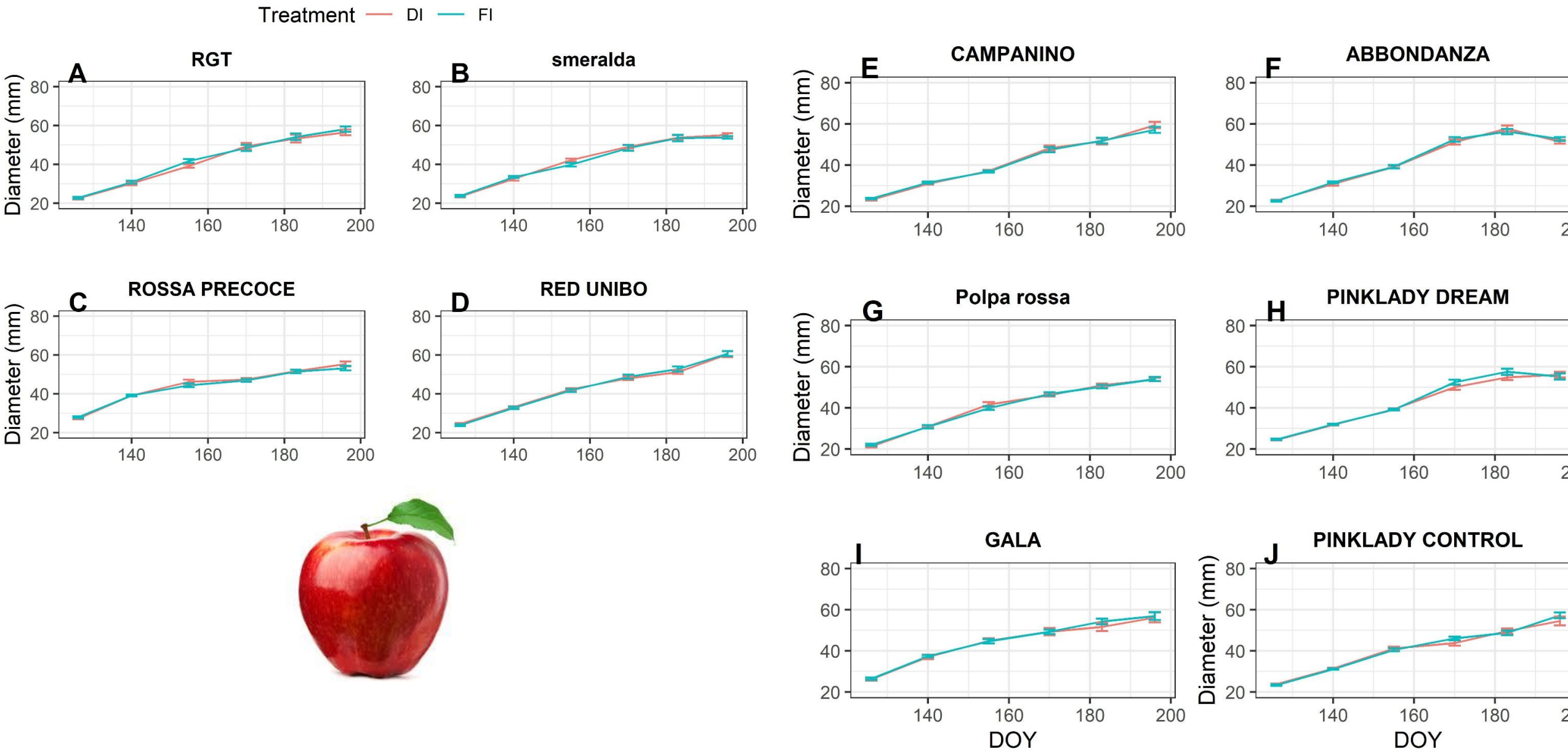
What about 2026?

Still no differences in Ψstem and leaf gas exchanges…at least until July 15th





Nor in fruit growth, so far….



Conclusions

- In our conditions, deficit irrigation did not significantly affect tree physiological and productive performance in any of the 9 cv. tested
- This might be due to the relative high summer precipitations of the two years tested (2024-2025)
- Some differences in the absolute values of several parameters were recorded among varieties, but they were not consistent over phenological stage and years.
- Could lack of responses in the second (and third) year be due to «adaptation» effects?
- Based on these results we assume different apple varieties can be irigated following the same RDI approach (e.g. 30-50% from second stage, according to literature)

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