Physiological and productive responses of the DREAM orchard: results from seasons 2025 and 2026

Brunella Morandi

DREAM Plots



3 blocks

2 management approaches

- **CNT**: natural gras in the interow
- **DREAM**: mix di cover crops + 9 different varieties

2 irrigation levels

- **FI** = 100% Etc
- **DI** = 50% Etc

4 treatments :

CNT-FI	**CNT-DI**
DREAM-FI	**DREAM-DI**

Cover crops: mix of 13 species: Lugumes Brassicas and Melliferous species

Matherials and Methods

Microclimate ⟶
- Temperature
- Relative Humidity
- Soil water content





Fruit and shoot growth ⟶
- Fruit caliper
- Shoot lenght

Physiological performance ⟶
- Stem Water Potential
- Leaf gas exchanges





Productive performance ⟶
- Yield
- Fruit quality

At regular times interval during the season

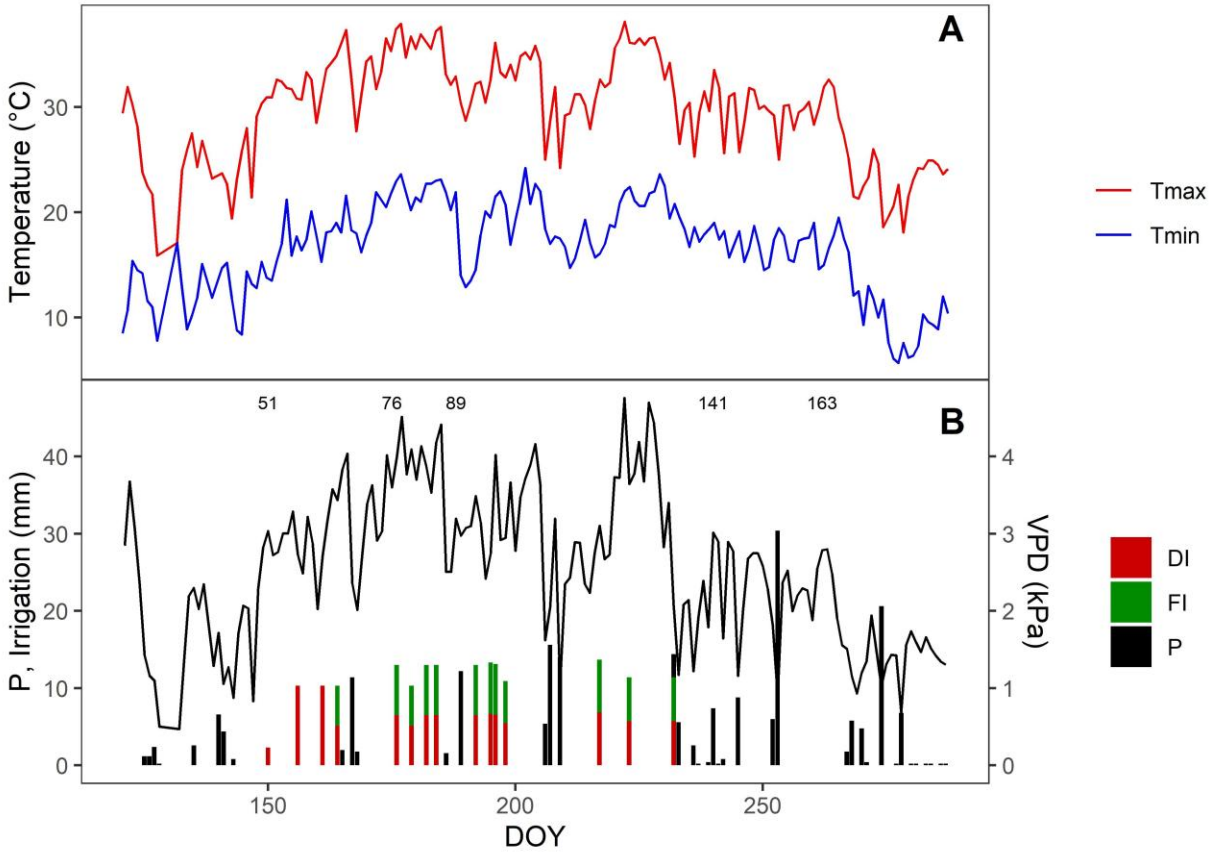

DREAM 2024


CONTROL

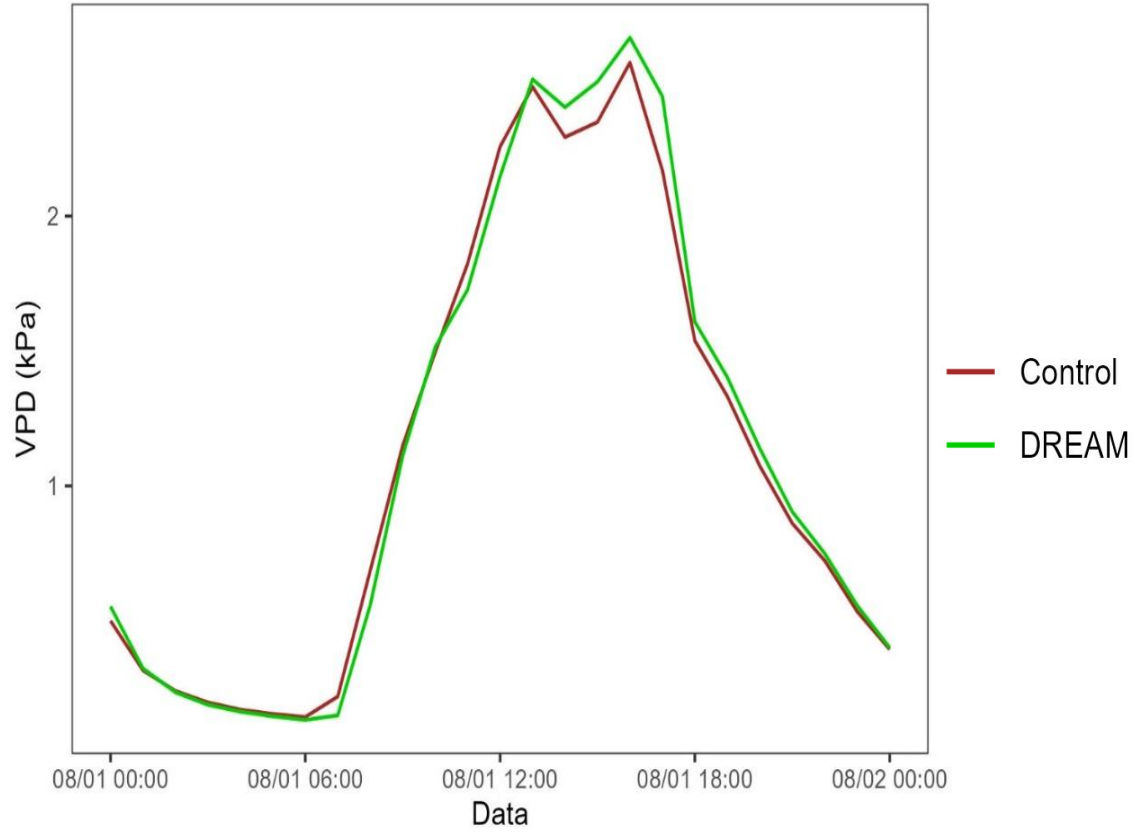
Season 2025



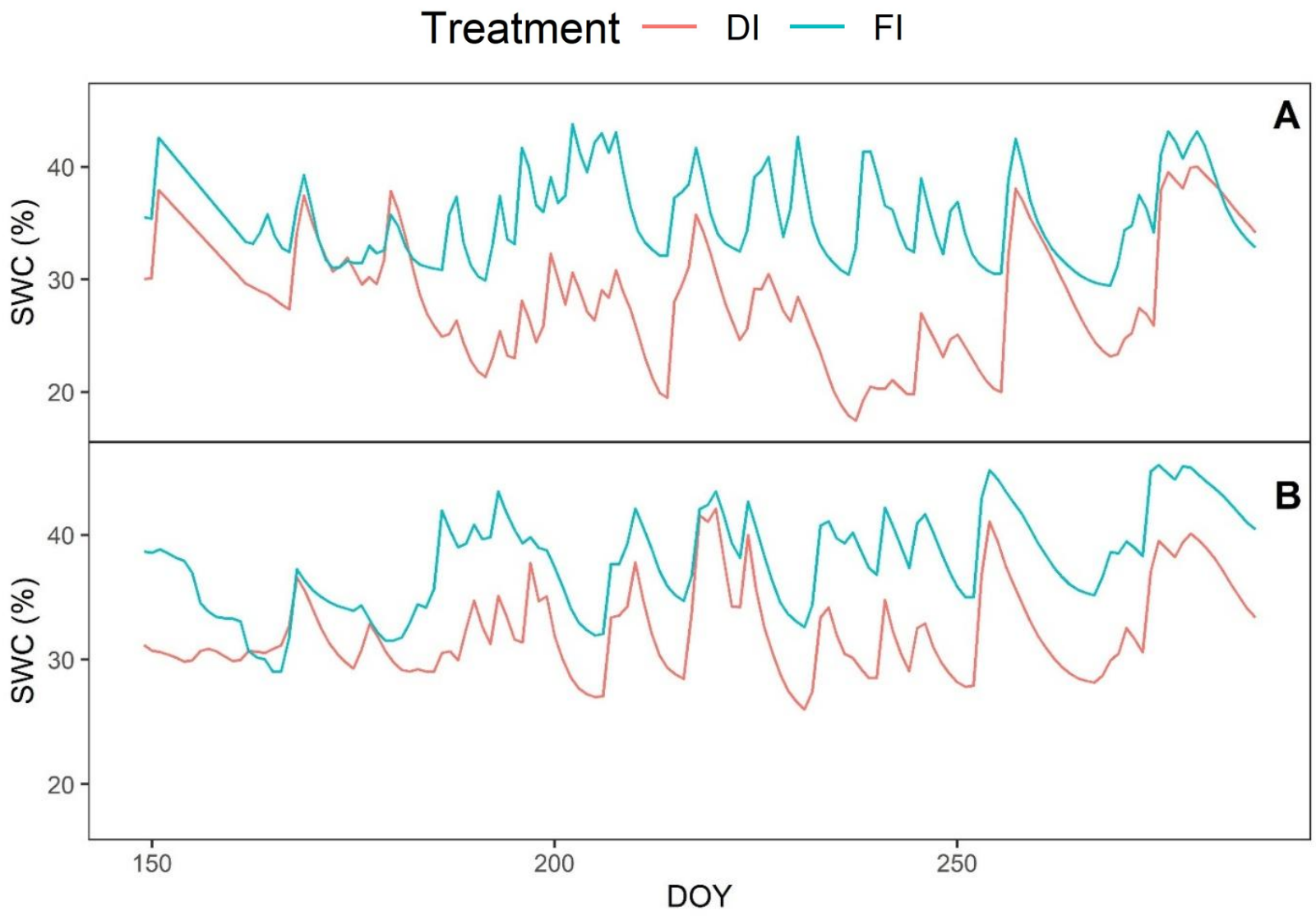
*W*eather in 2025



DREAM vs. Control: Vapour pressur deficit 2025

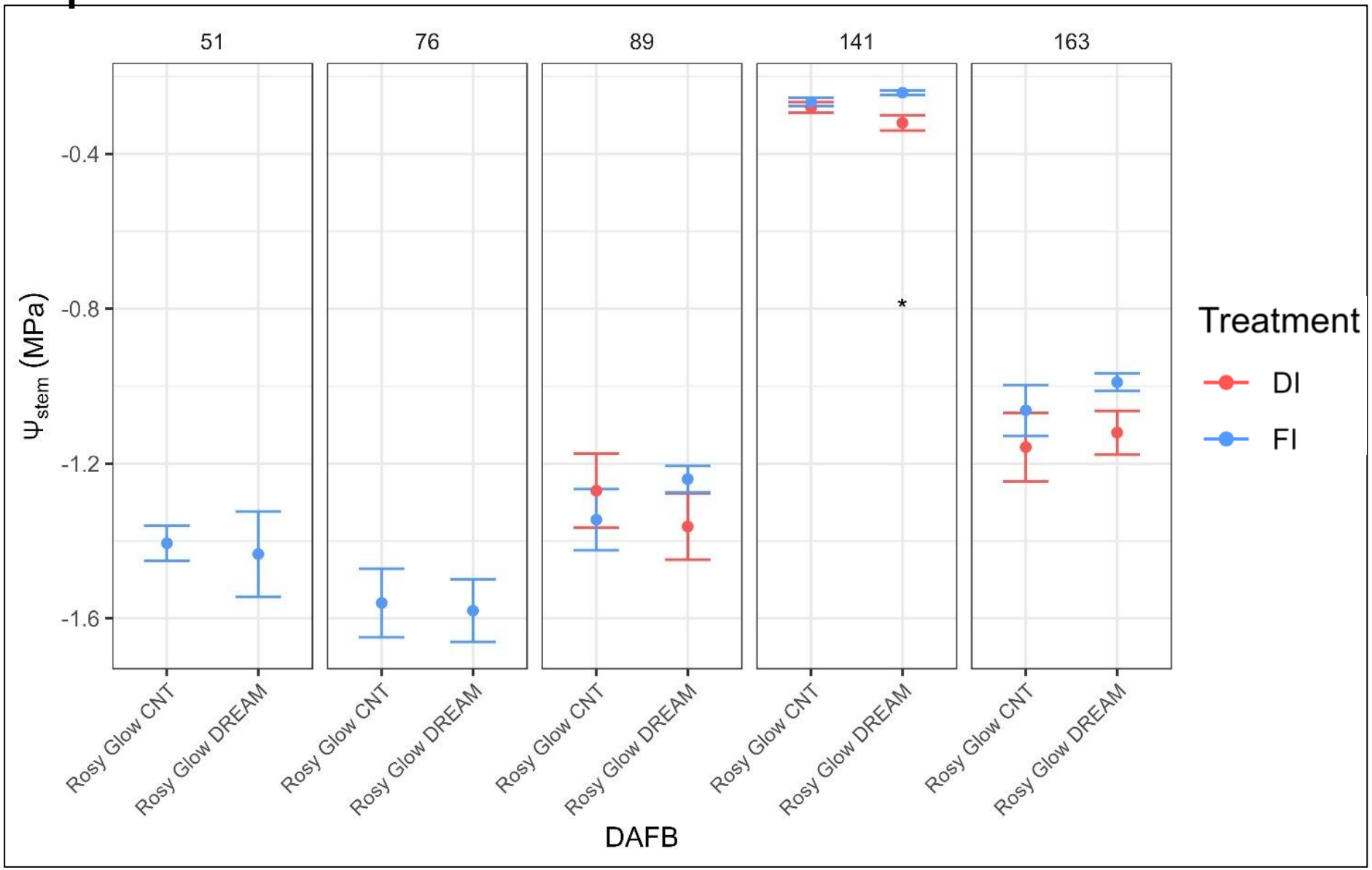


Deficit vs. Full irrigation: Soil water content 2025

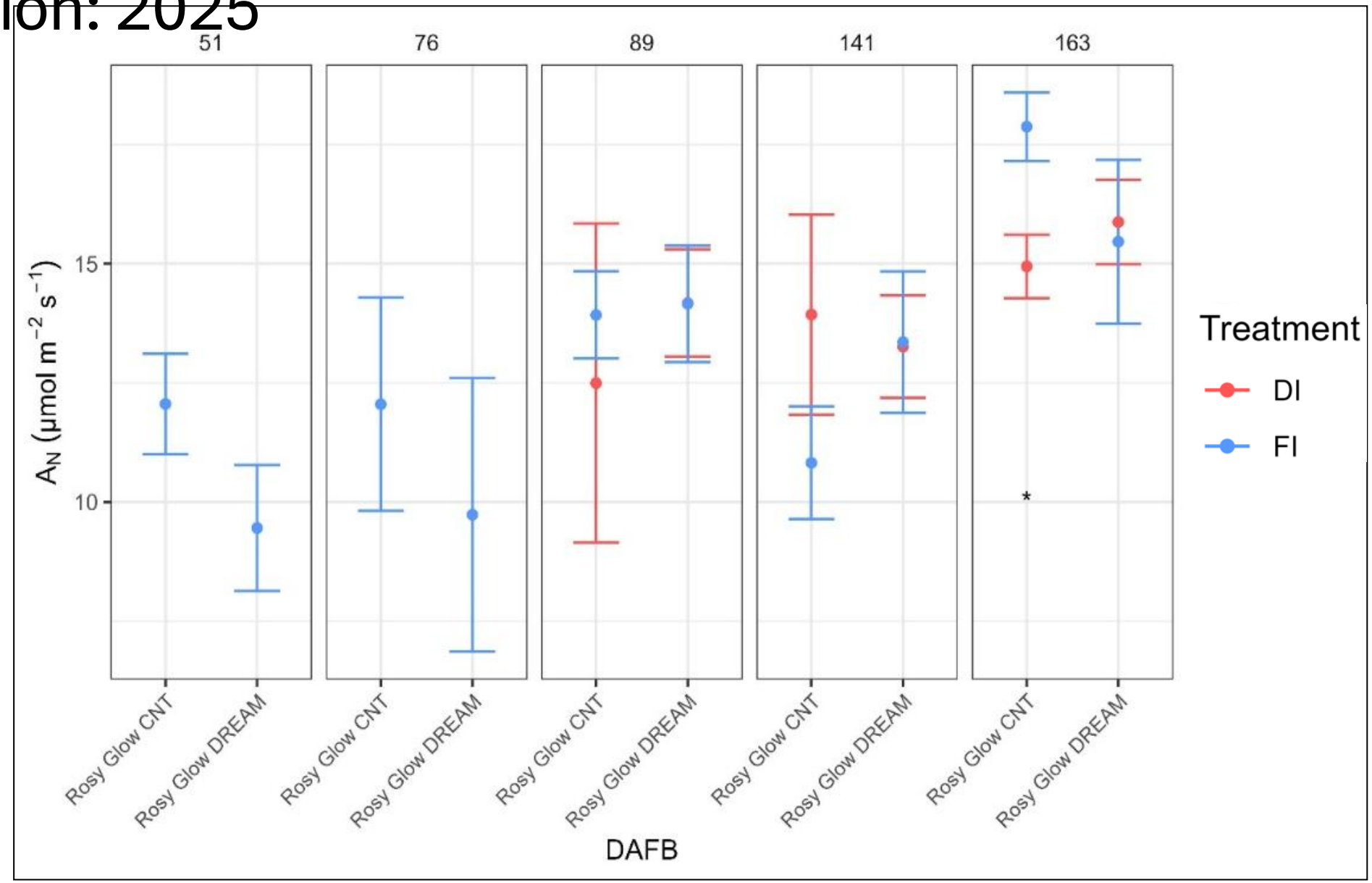


A: CNT
B: DREAM

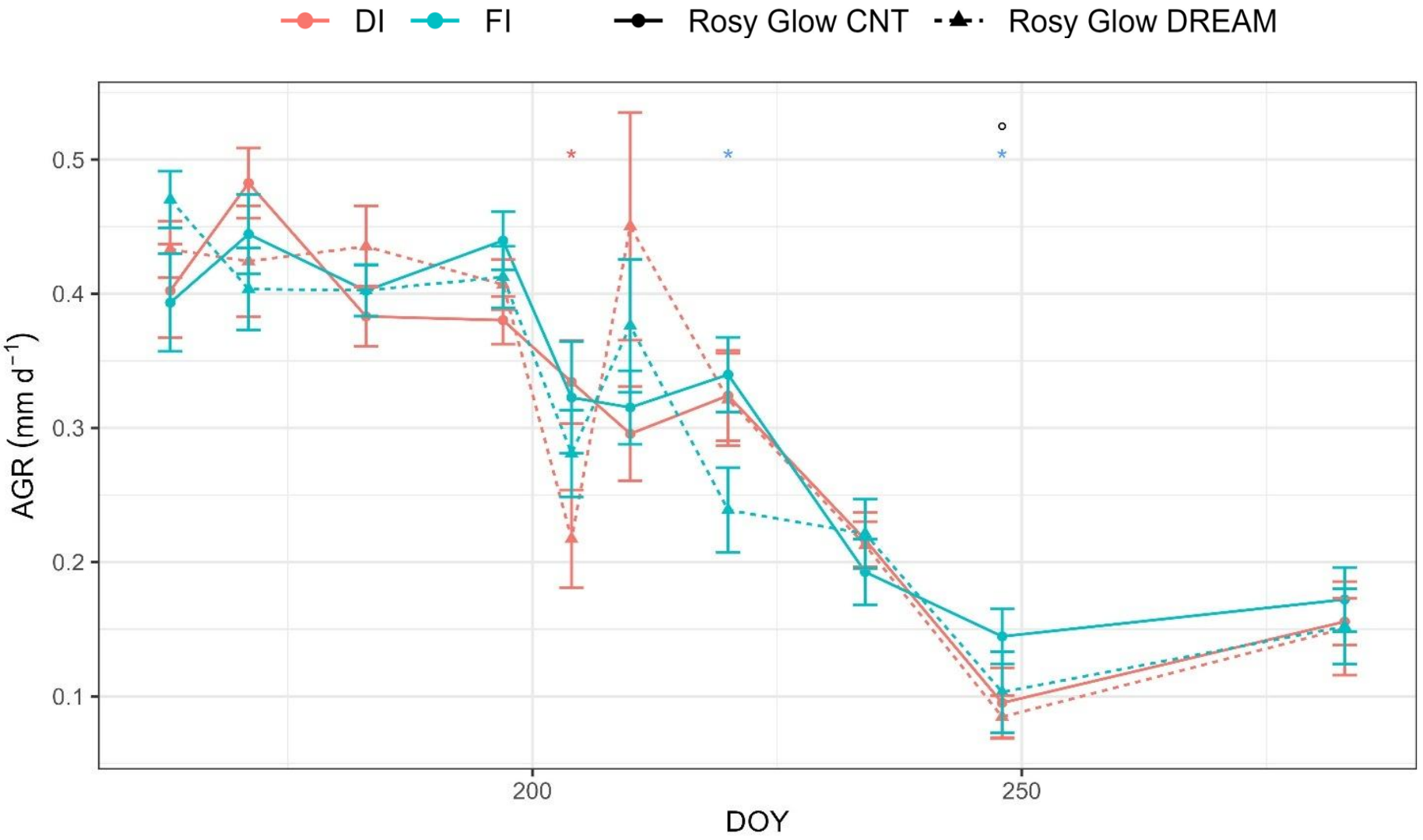
DREAM vs. Control, with full and 50% deficit irrigation: Stem water potential : 2025



DREAM vs. Control, with full and 50% deficit irrigation: Assimilation: 2025



DREAM vs. Control, with full and 50% deficit irrigation: Fruit growth rate: 2025



Production 2025: affected by a strong codling moth attack

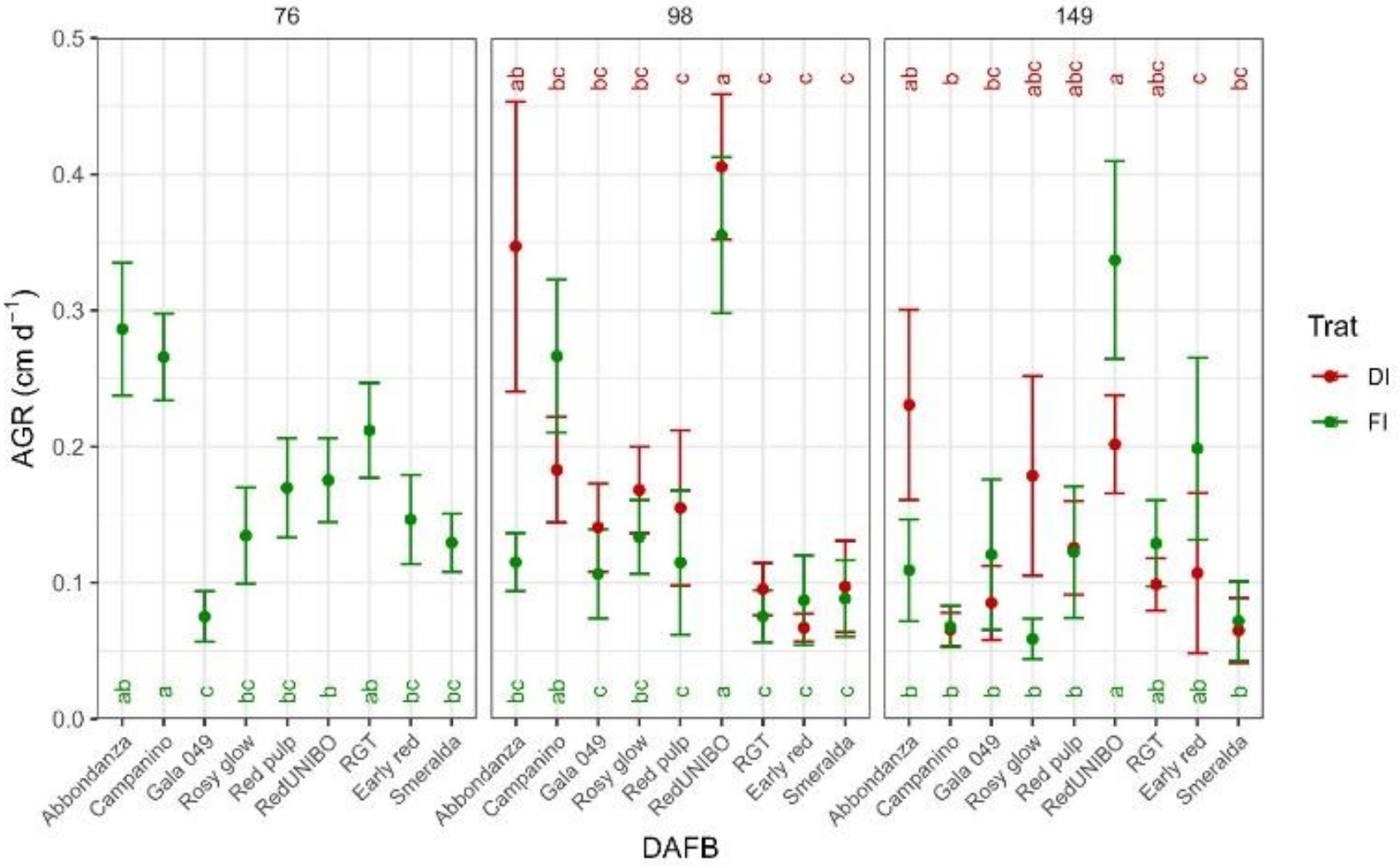
Blocco	Treatment	Crop load (kg/tree)	Ttest
CNT	FI	3.77 ± 0.304	*
DREAM	FI	1.75 ± 0.264	*
CNT	DI	4.32 ± 0.468	°
DREAM	DI	1.63 ± 0.223	°





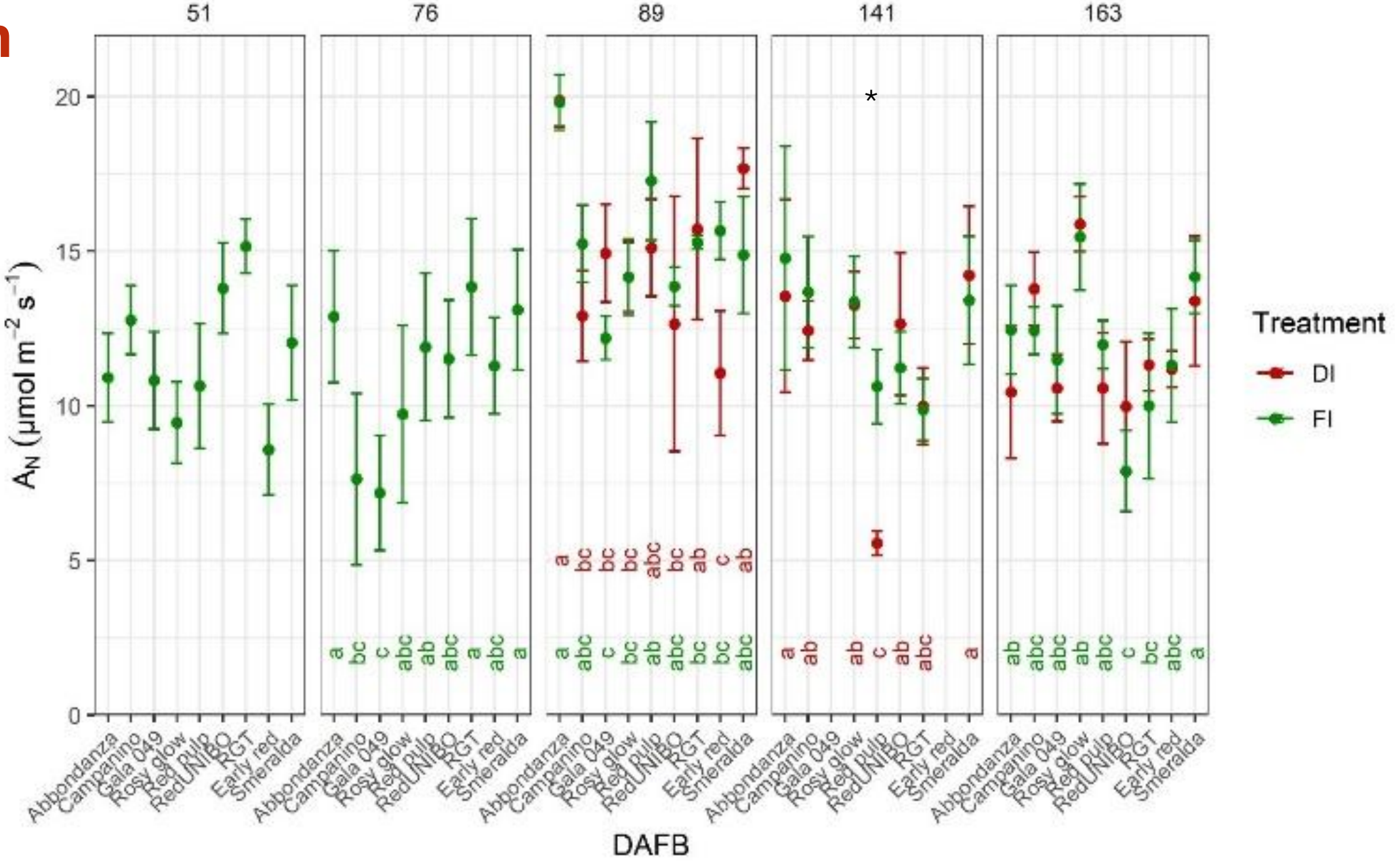
Shoot growth rate during the season (2025)

Rankings among varieties were not consistent within dates and years

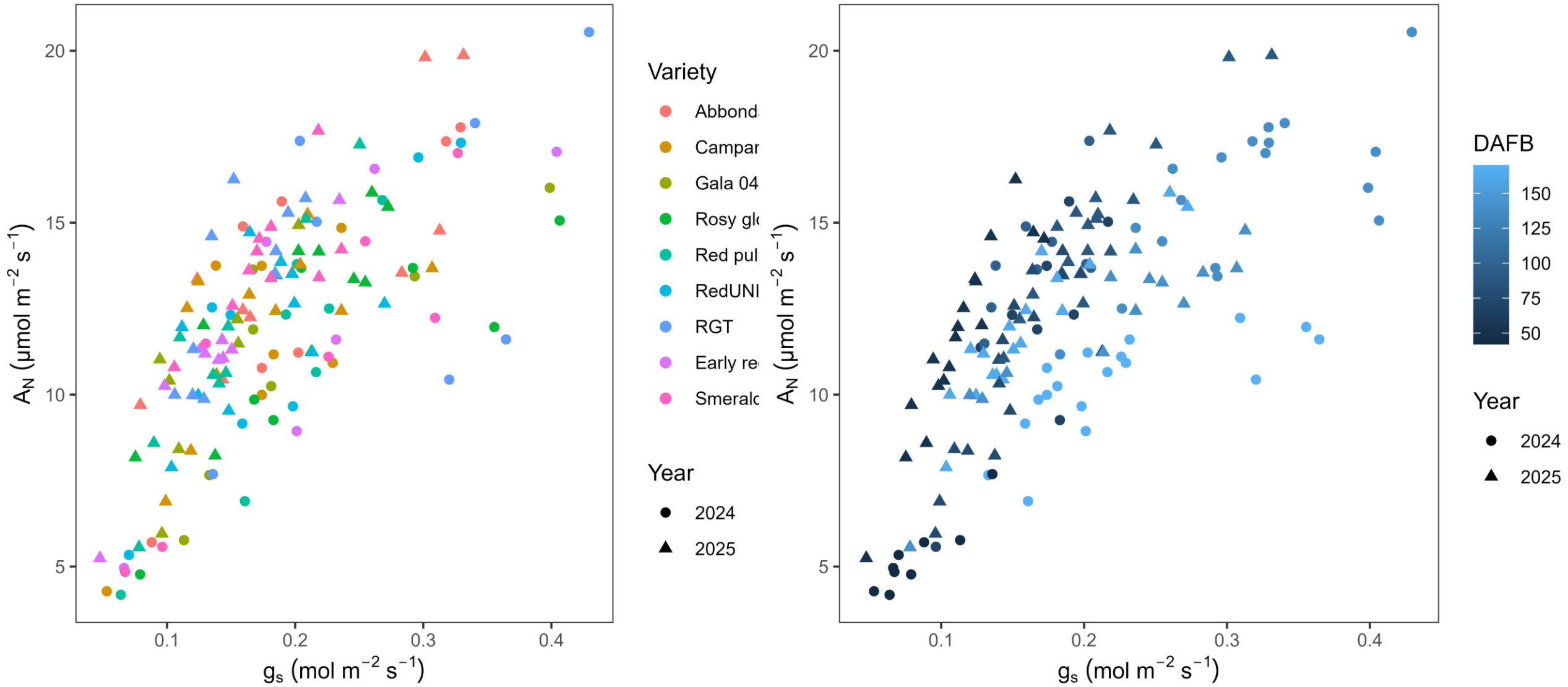


Assimilation was largely maintained under 50% irrigation

2025



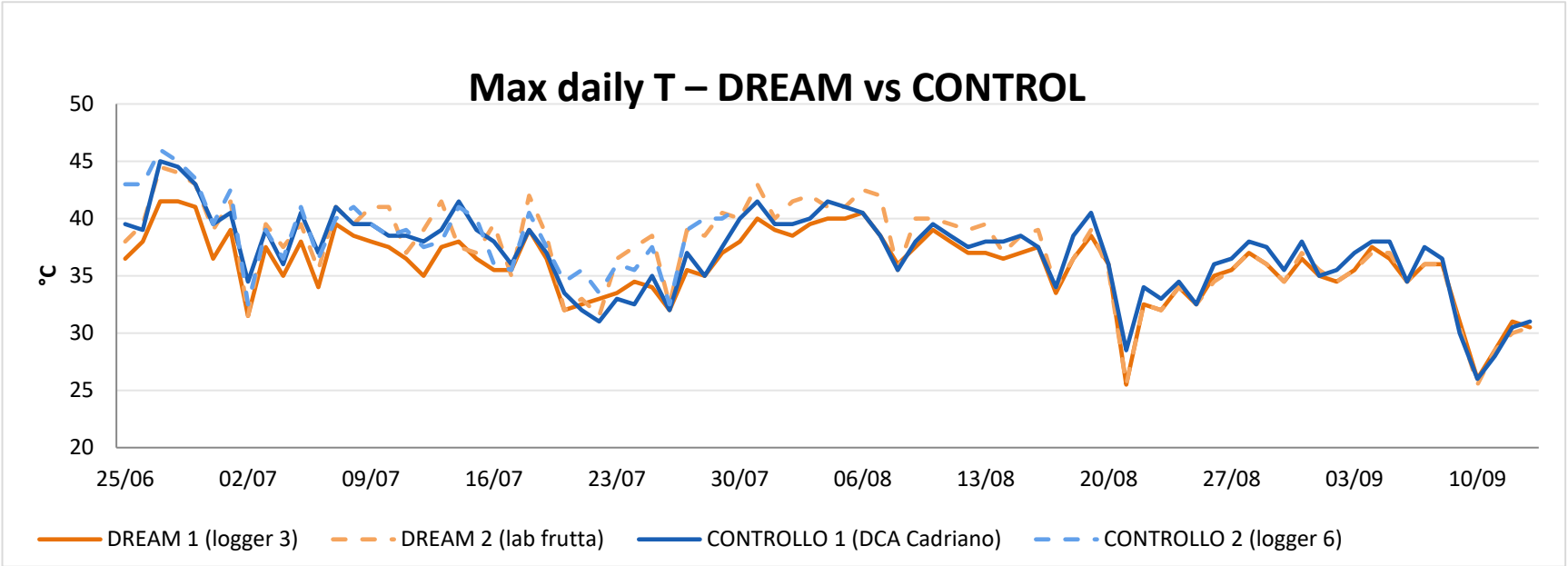
Assimilation vs. Stomatal conductance (2024 and 2025)

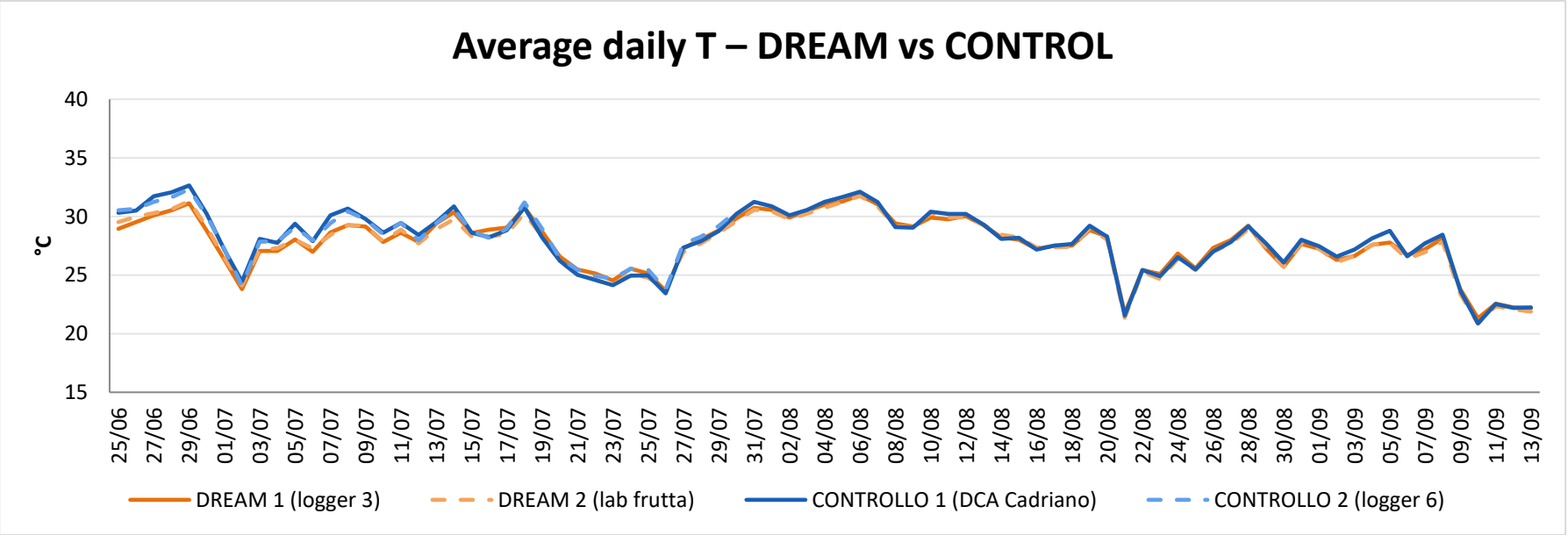




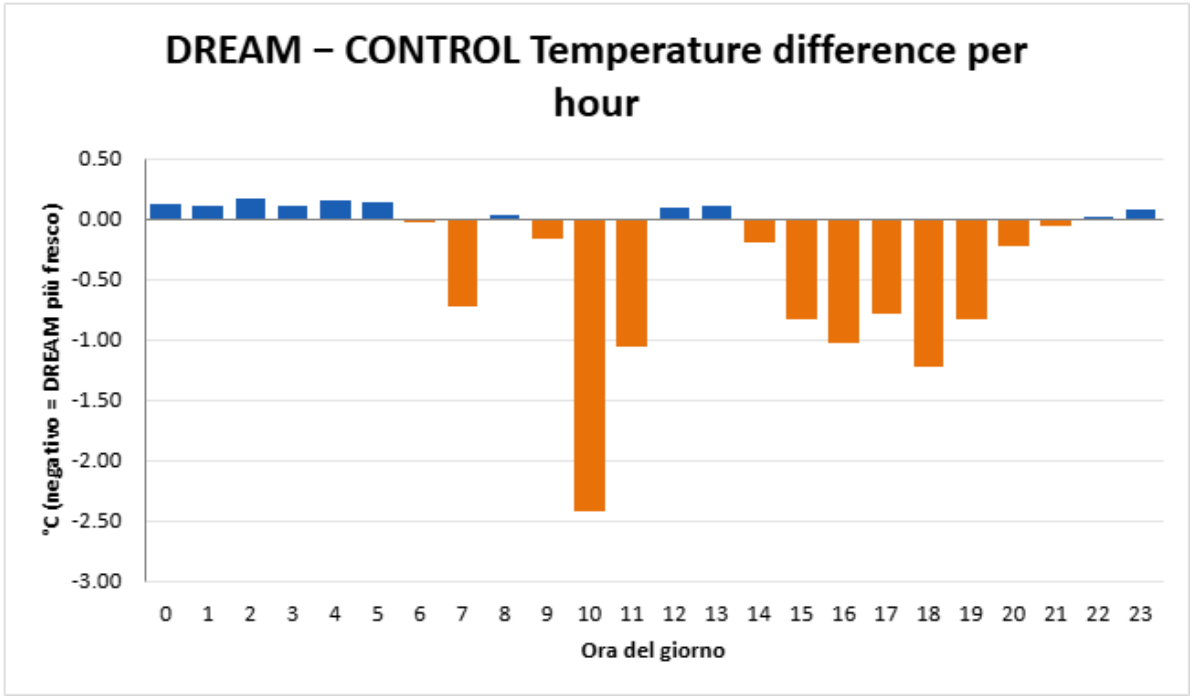
Season 2026

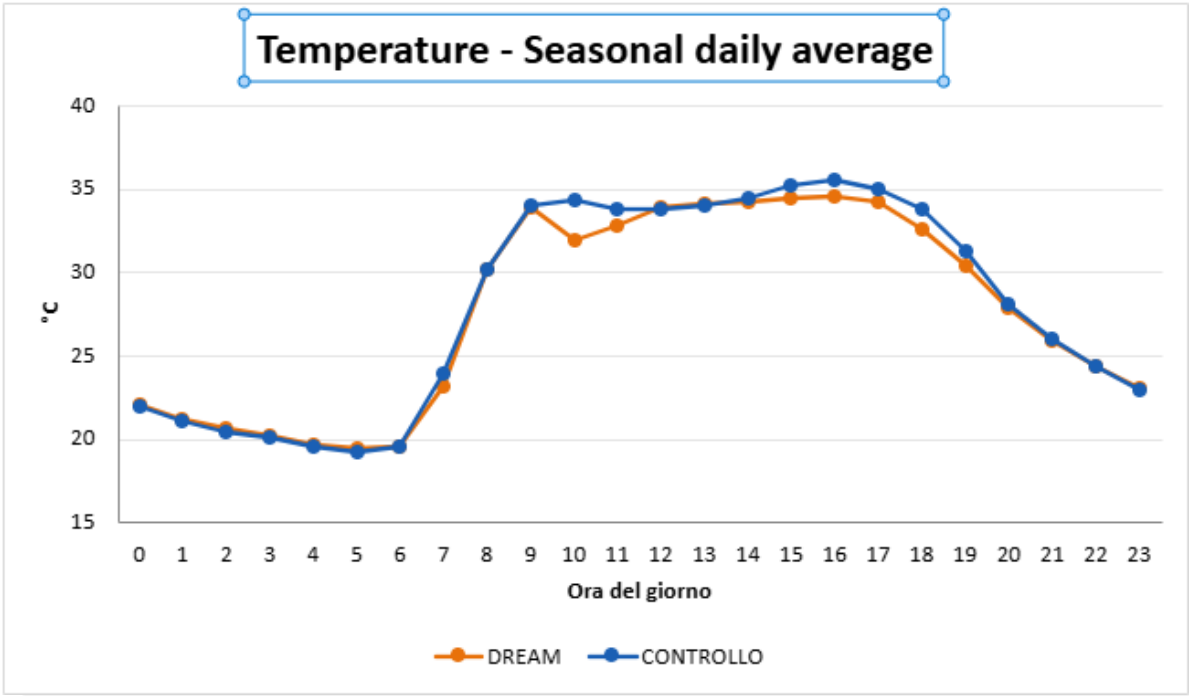
Seasonal microclimate 2026

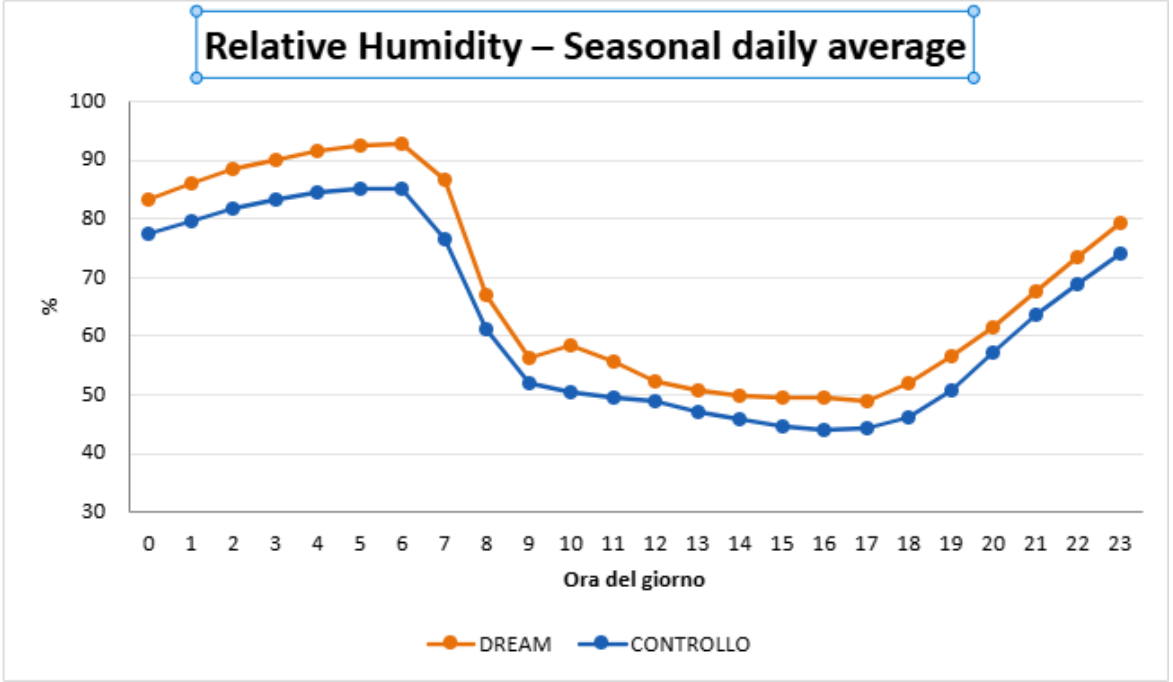




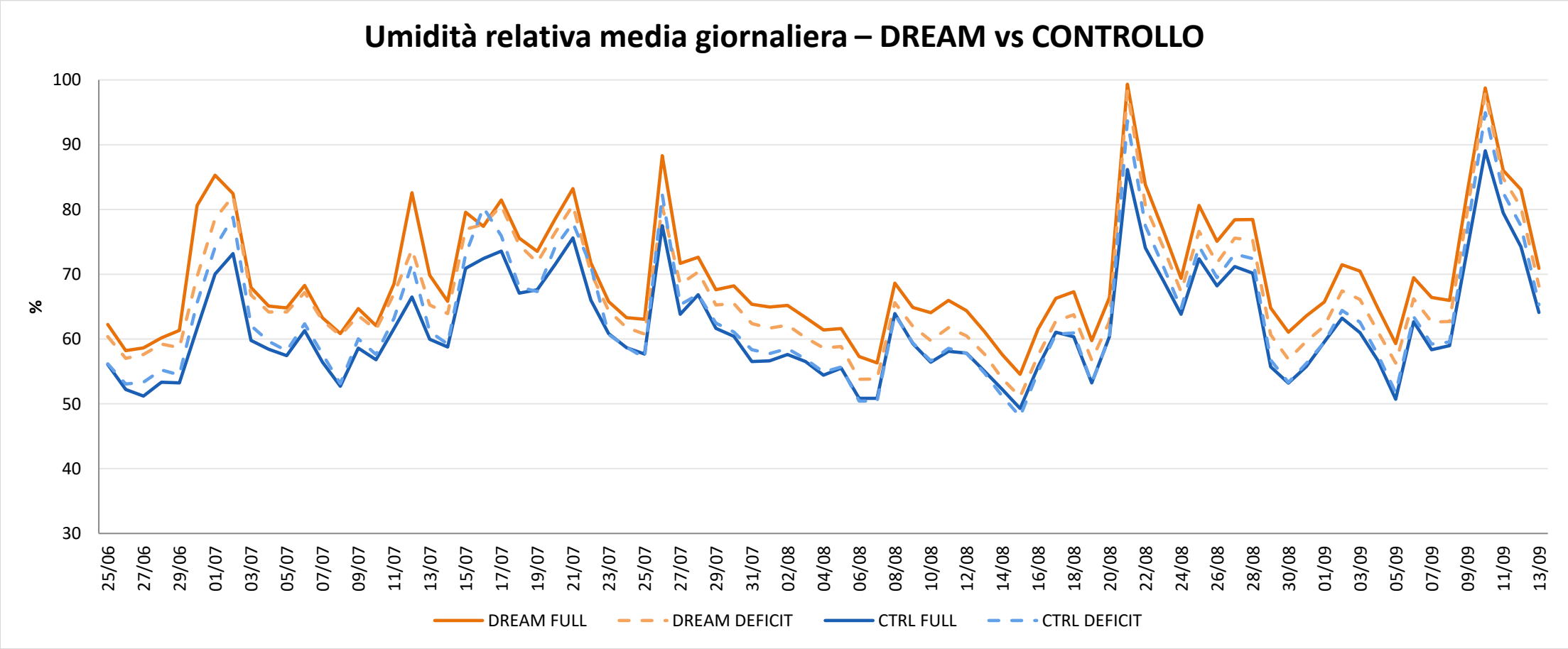
Microclimatic effect of the DREAM system



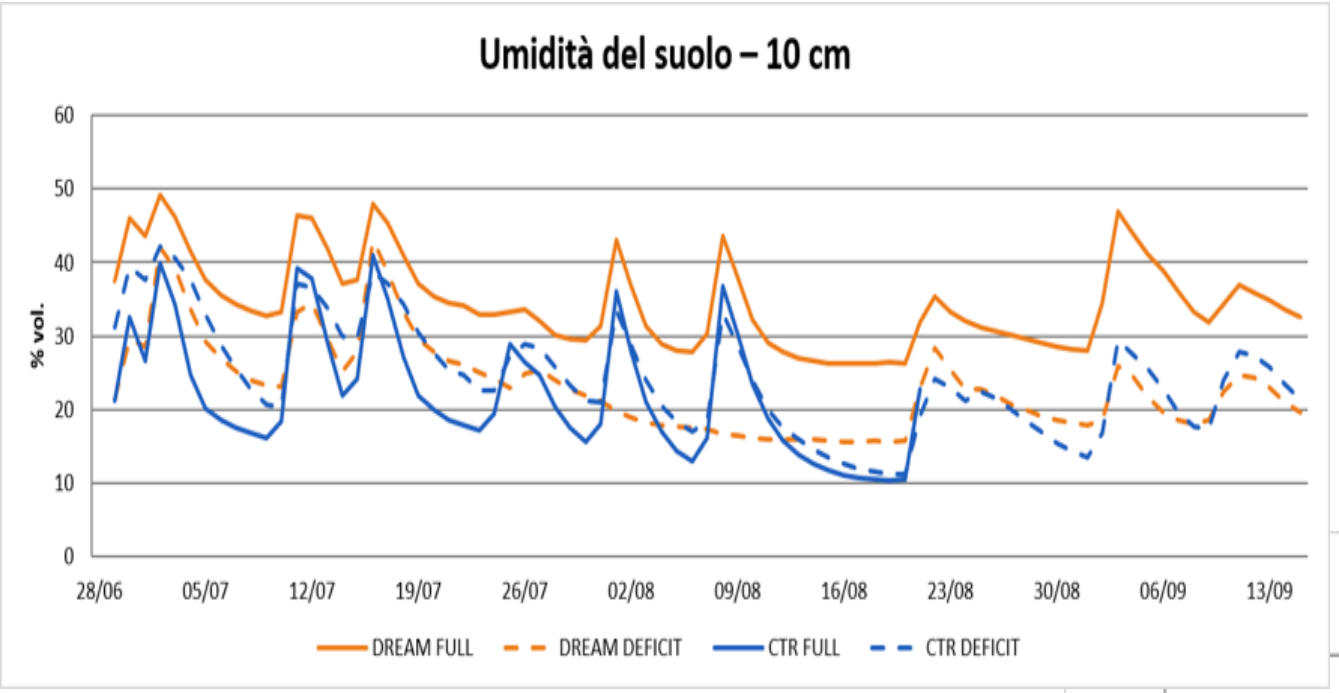


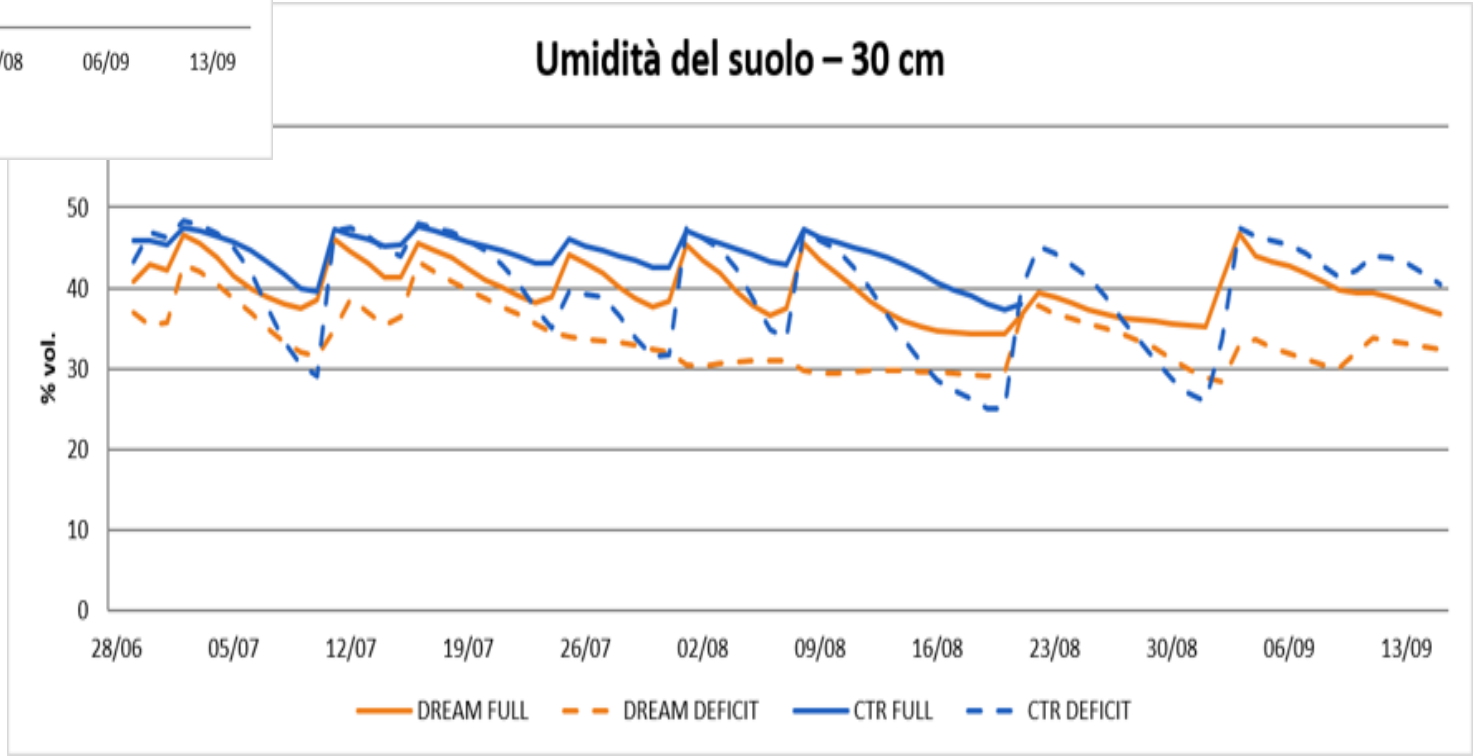


Max daily relative humidity

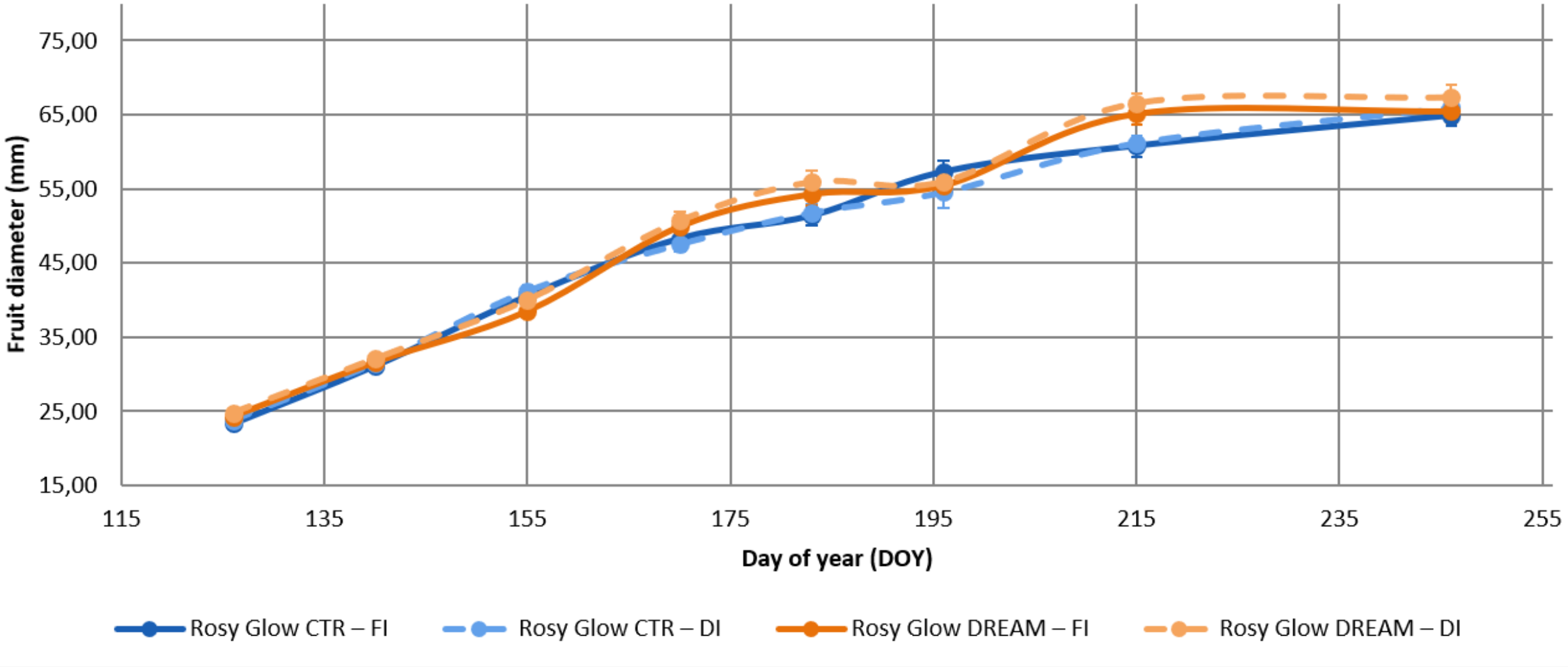


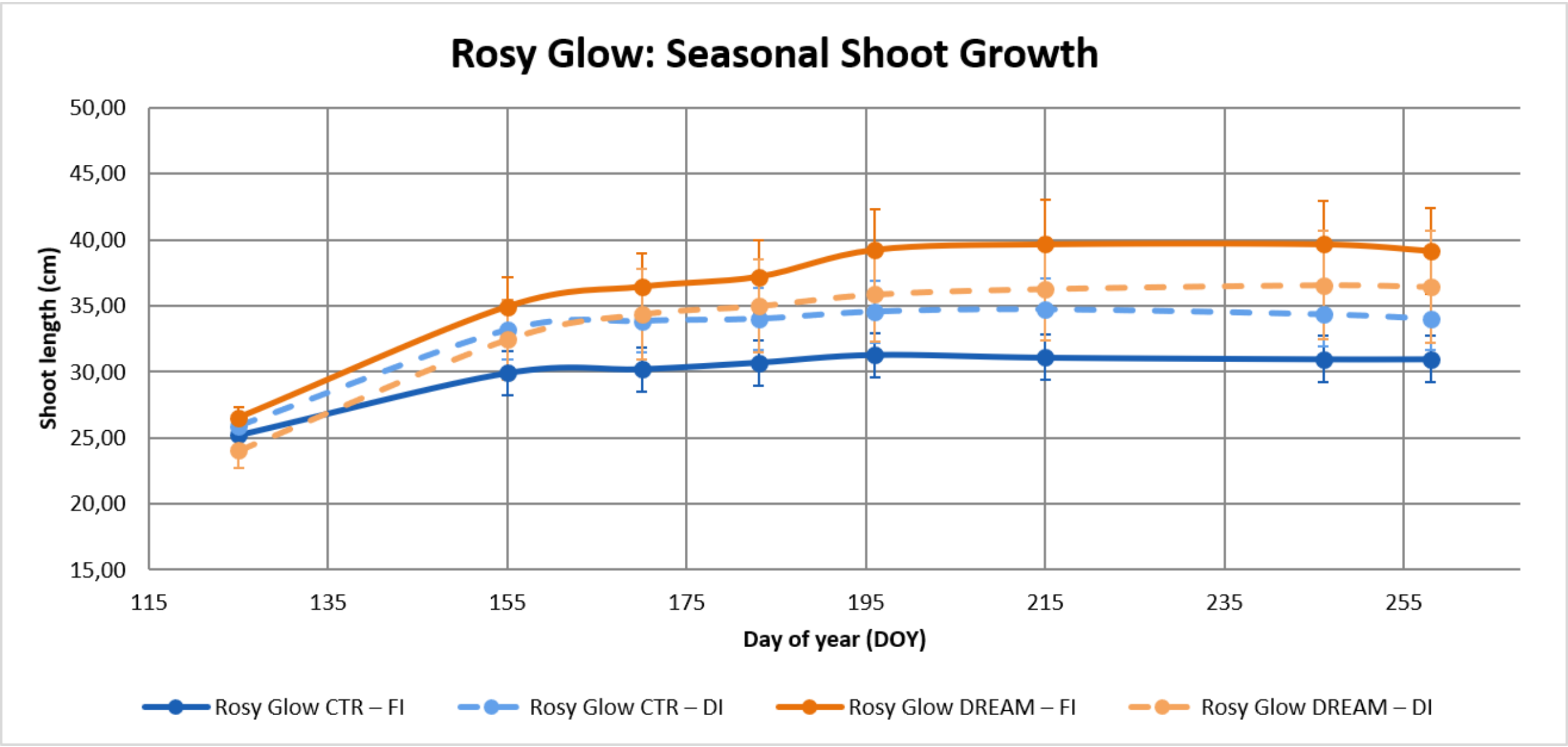
SOIL WATER CONTENT 2026



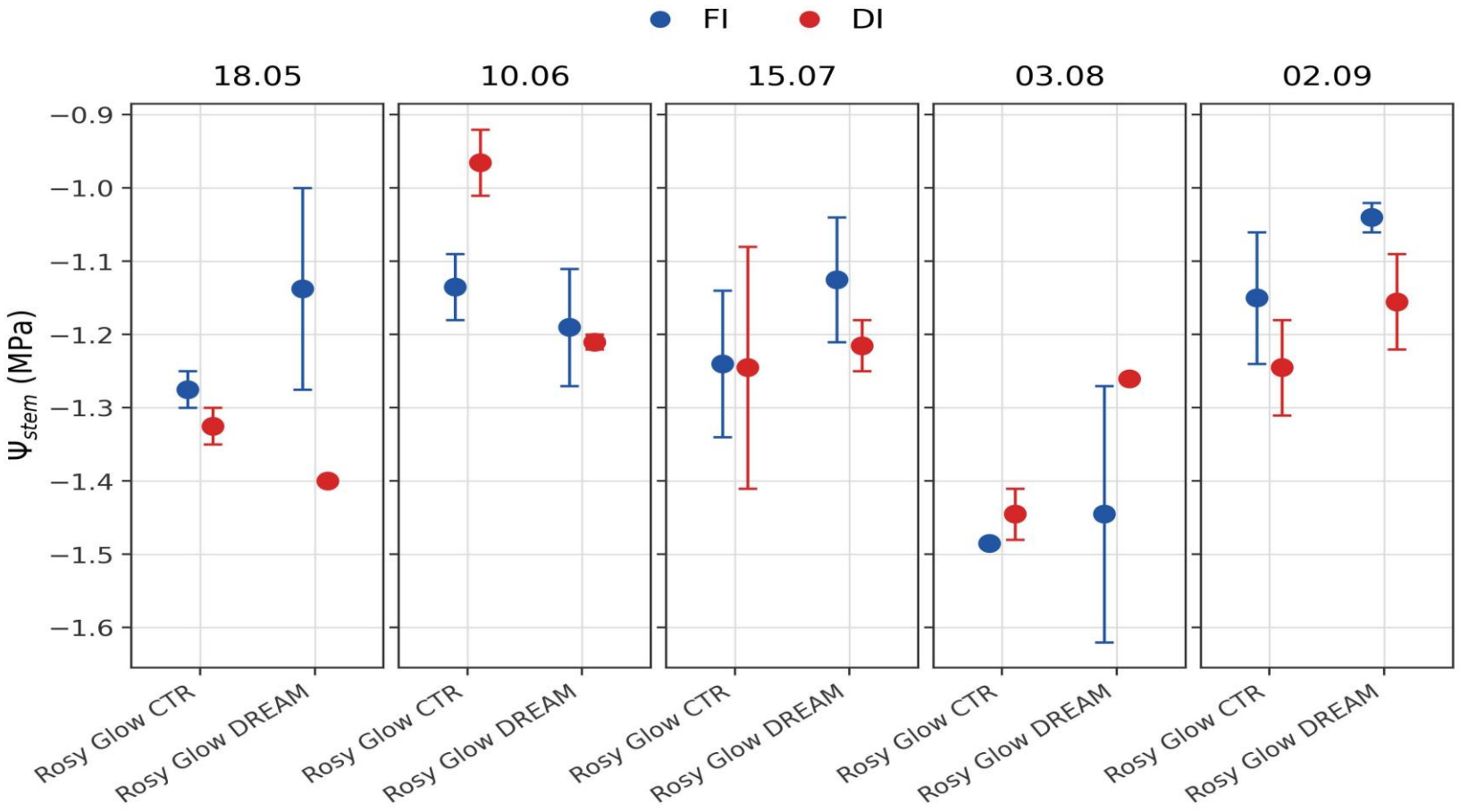


Rosy Glow: Seasonal Fruit Growth

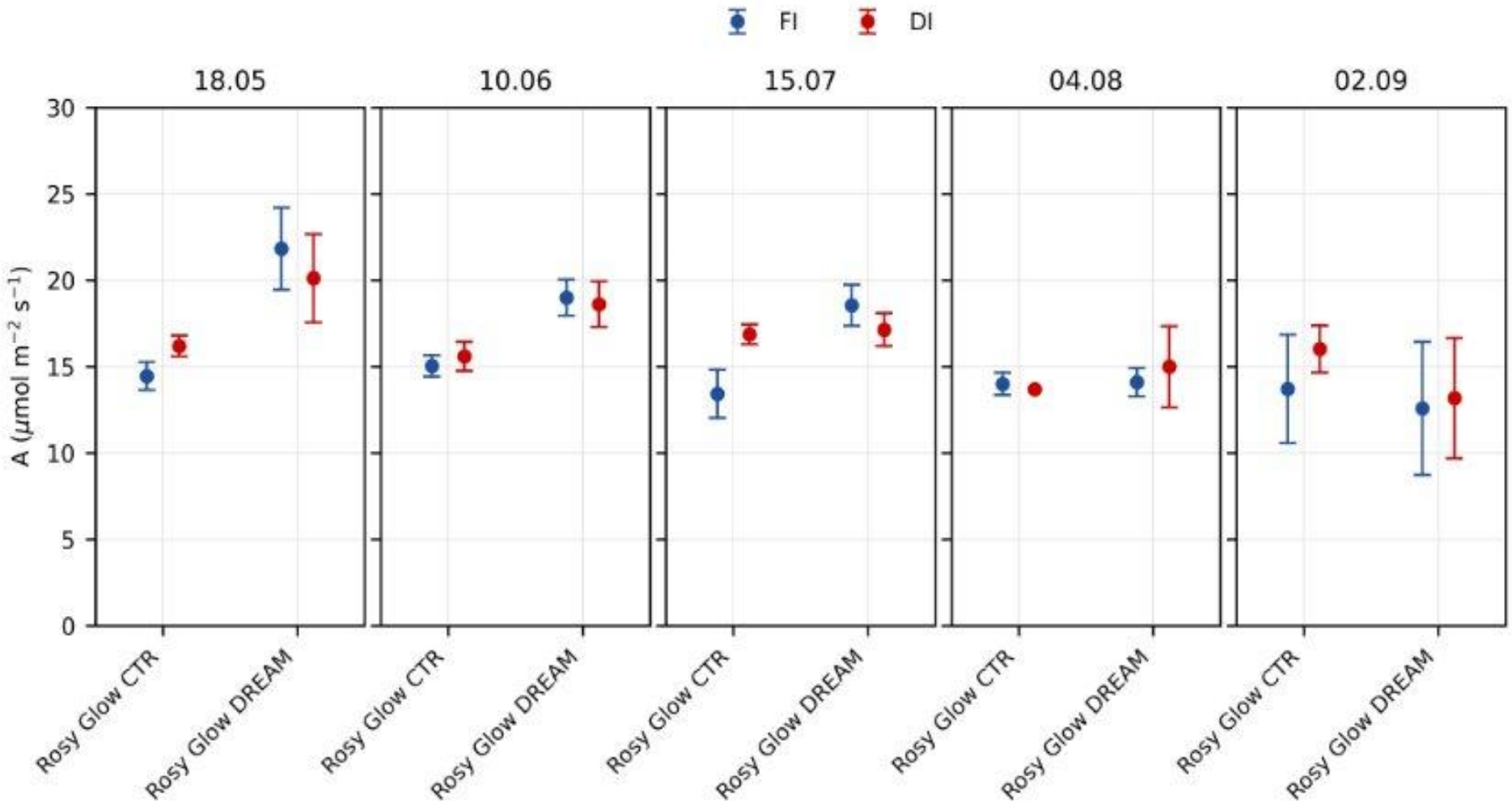



Rosy Glow: Seasonal Shoot Growth
50,00
45,00
40,00
35,00
30,00
25,00
20,00
15,00
Shoot length (cm)
115
135
155
175
195
215
235
255
Day of year (DOY)
Rosy Glow CTR – FI
Rosy Glow CTR – DI
Rosy Glow DREAM – FI
Rosy Glow DREAM – DI

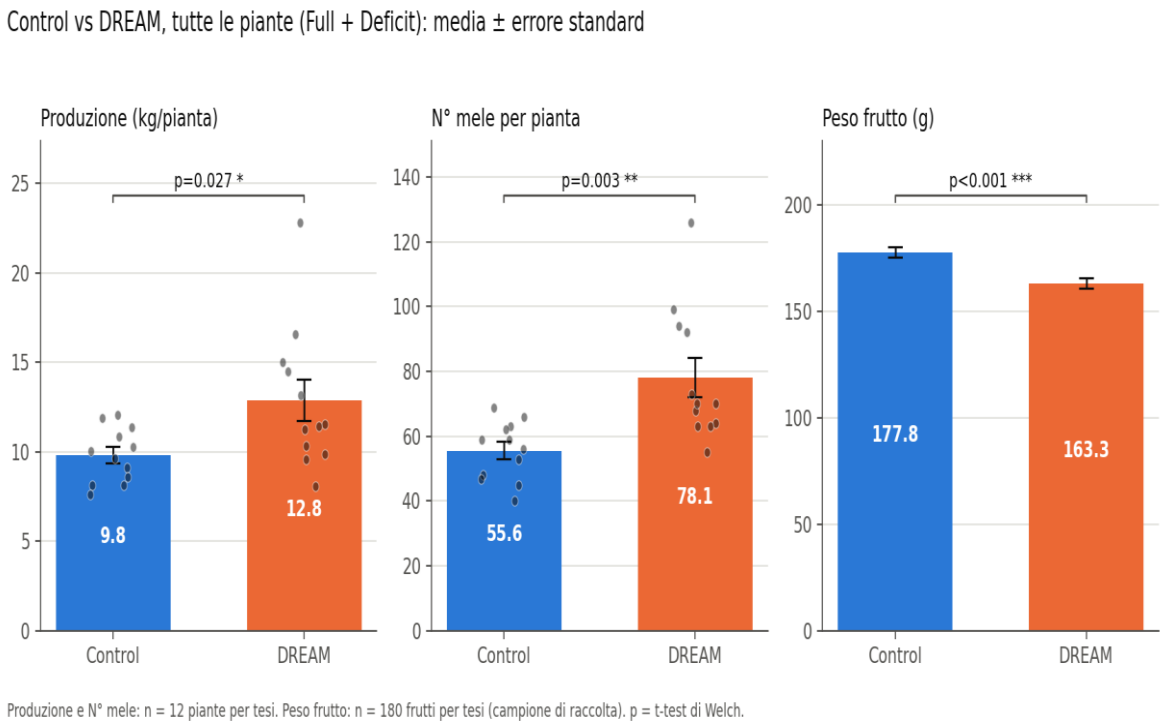
DREAM vs. Control, with full and 50% deficit irrigation. Stem water potential



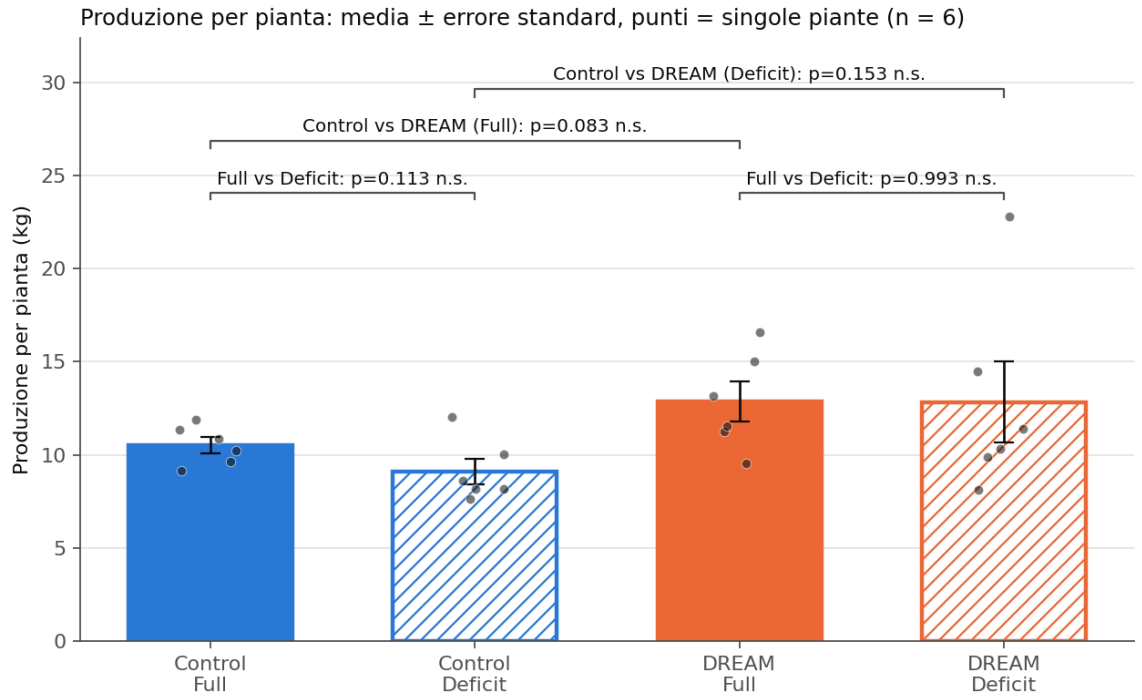
DREAM vs. Control, with full and 50% deficit irrigation: Assimilation



DREAM vs. Control, with full and 50% deficit irrigation. Forecasted productivity 2026

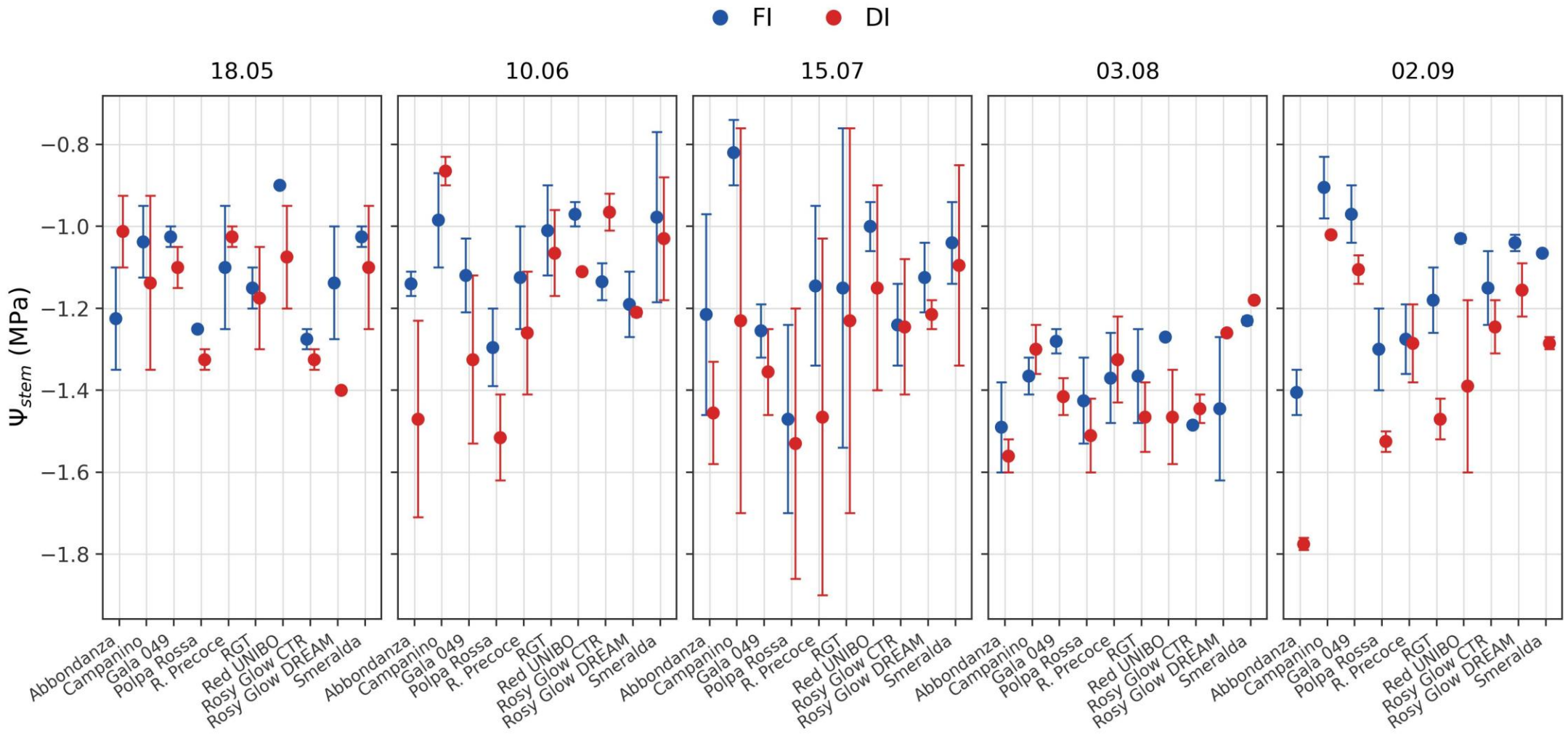


Produzione e N° mele: n = 12 piante per tesi. Peso frutto: n = 180 frutti per tesi (campione di raccolta). p = t-test di Welch.

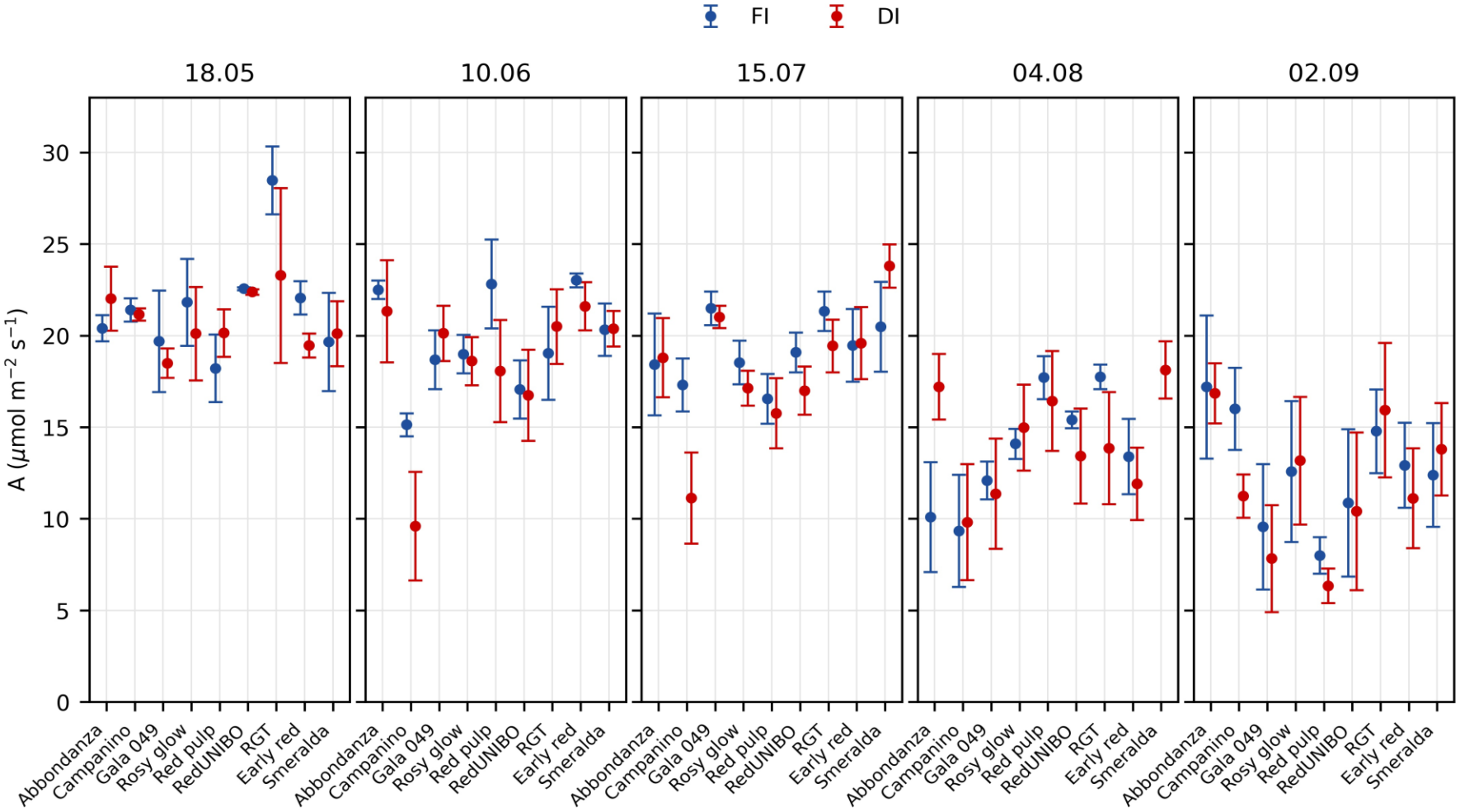


p = t-test di Welch. Barre piene = irrigazione Full, tratteggiate = Deficit.

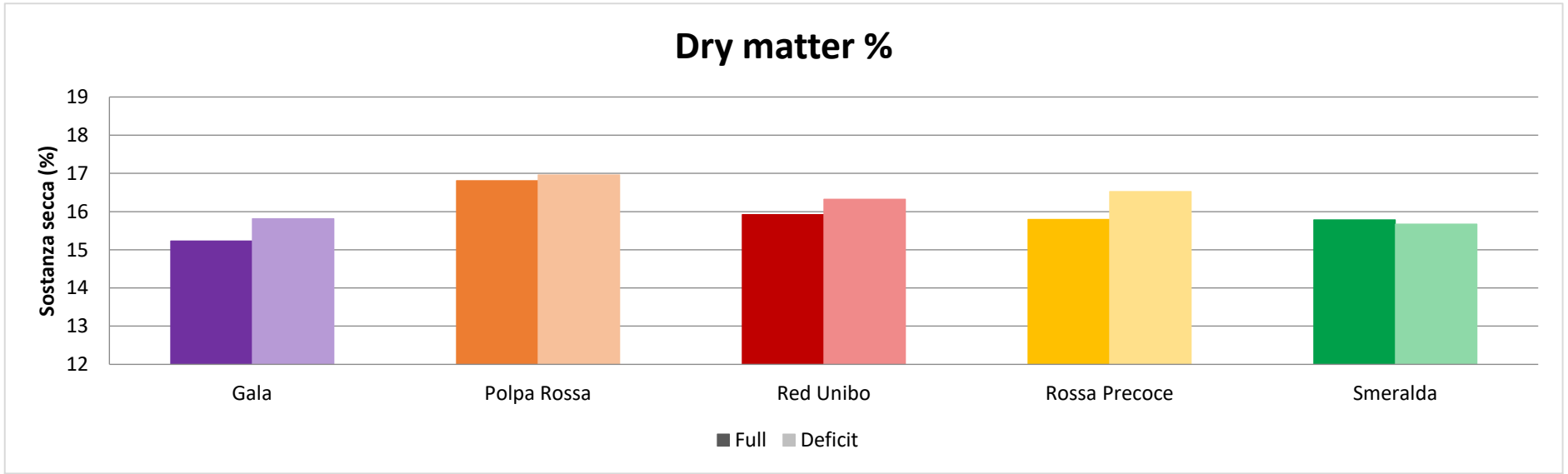
Other DREAM varieties in full and 50% deficit irrigation: stem water potential

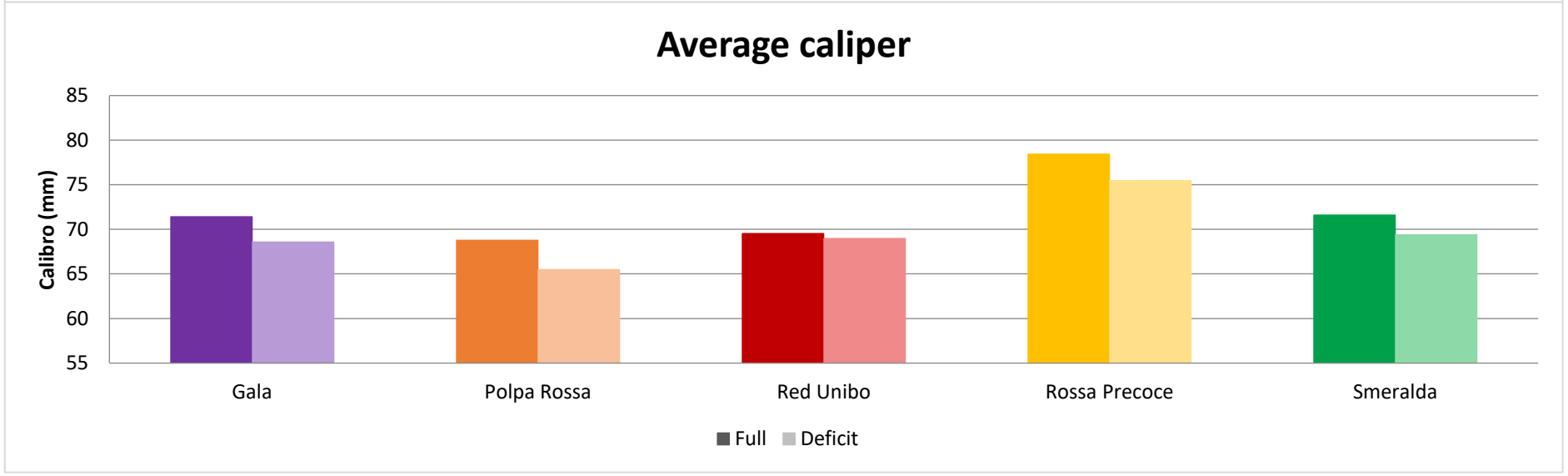


Other DREAM varieties in full and 50% deficit irrigation: stem water potential



Effect of deficit irrigation on fruit size and dry matter % (varieties already harvested)





Pro & Cons of the DREAM agroecosystem

- Cover crops consociation does not reduce tree physiological and productive performance
- Cover crops reduce canopy temperatures and improve their relative humidity thus reducing the VPD.
- Deficit irrigation is well tolerated even in very warm and dry years.

- Defence is more difficult to manage in multi-variety orchards
- Cover crops should be self sowed….otherwise too dfficult to manage sowing.



Cover crops in DREAM orchard – effect on plant biodiversity

Federica Zanetti, Elena Ferro, Luca Martelli

DISTAL - UNIBO



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Materials & Methods

- Each growing season the DREAM orchard has been interseeded with an annual cover crop mix named «Apistico annual».
- The mix is composed of 8 different plant species including Fabaceae, Brassicaceae, and Apiaceae species

- Only half of the orchard has been interseeded with cover crops, while the other part has been managed as «business as usual» (= conventional orchard).



APISTICO
annuale



COMPOSIZIONE	
Trifoglio incarnato precoce	20%
Meliloto giallo	20%
Trifoglio incarnato tardivo	15%
Trifoglio resupinato	15%
Sulla sgusciata	10%
Camelina	10%
Aneto	5%
Colza foraggera	5%

DOSE DI SEMINA / EPOCA	
25 - 30 Kg/ha	Autunnale (primaverile)

CICLO	Annuale

Miscuglio con otto essenze appartenenti a tre diverse famiglie botaniche con fioritura scalare per garantire un pabulum prolungato ad api ed insetti utili. Le specie introdotte sono ammesse sia dal protocollo **dell'ECOSCHEMA 5 che dalla CARTA DEL MULINO**.
Lo sfalcio del miscuglio dopo la fioritura e la fruttificazione permette la disseminazione con conseguente rinascita nell'anno successivo.

Materials & Methods

Measurements

Cover crops were planted from Feb to Apr depending on meteorological conditions.
Cover crops have been usually terminated in June/July in order to allow the typical operations for treatment applications






Biodiversity assessment
In ach growing season, the number of species in the DREAM orchard and in the business as usual one has been monitored in 54 randomly positioned 20 x 20 cm squares, installed in the interrow




Conventional orchard



DREAM orchard



Results

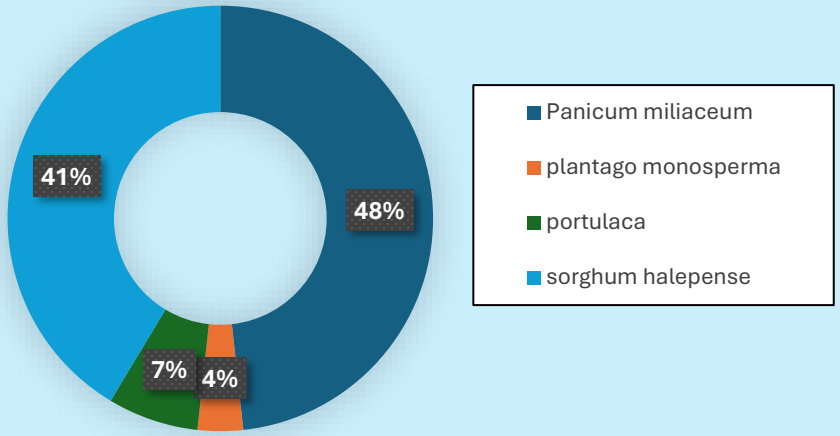
- Meteorological conditions highly impacted not only the sowing date of the cover crops, but also their development and diversity

	2023			2024			2025			2026		
Month	**T min**	**Tmax**	**Prec**	**T min**	**Tmax**	**Prec**	**T min**	**Tmax**	**Prec**	**T min**	**Tmax**	**Prec**
Feb	-0.49	12.35	14.2	3.17	14.91	**34.4**	3.38	10.36	49.5	3.75	12.98	**40.3**
Mar	3.83	17.25	29.0	6.65	17.41	**37.0**	5.82	16.12	51.2	4.67	15.58	**55.0**
Apr	5.95	18.55	31.4	8.38	20.58	**32.2**	8.75	20.49	46.6	8.62	21.25	**44.4**
May	12.52	22.14	**276.2**	12.36	23.85	**15.4**	11.84	24.60	25.6	11.63	25.25	**87.0**
Jun	16.56	29.39	55.6	16.86	29.20	**42.8**	18.82	33.08	0.0	17.48	33.09	**25.4**

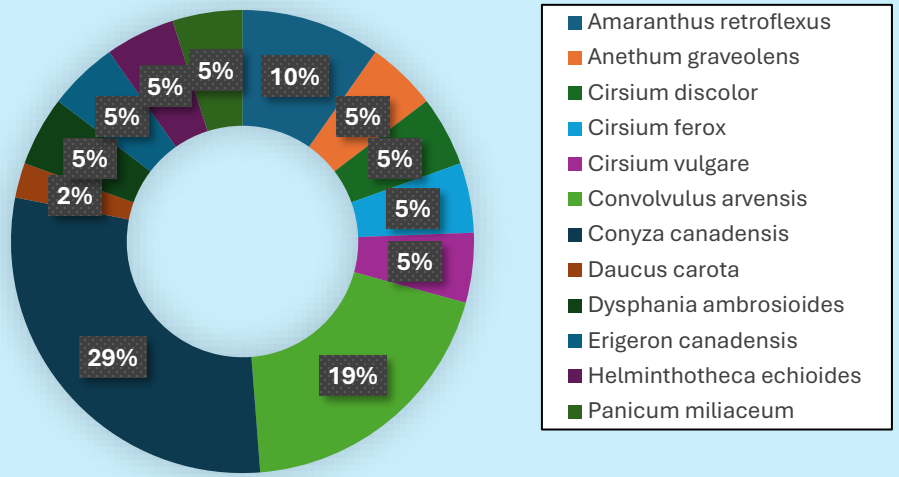
Results 2023 & 2024

Biodiversity

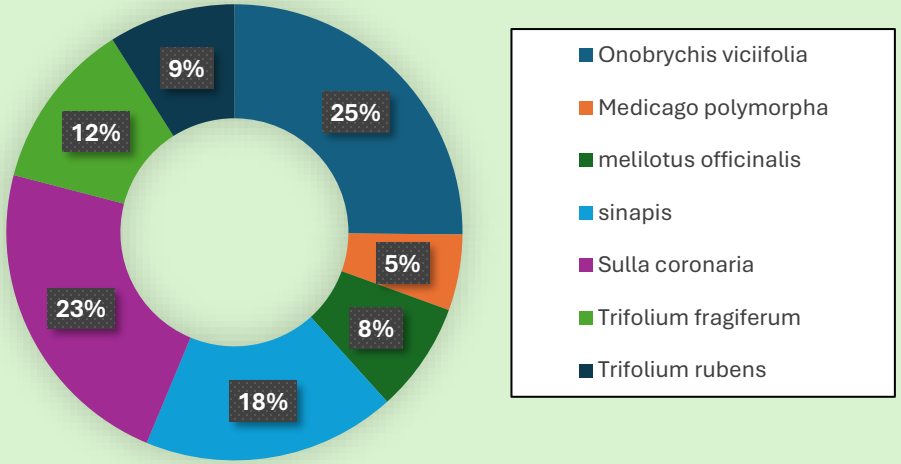
Conventional system 2023



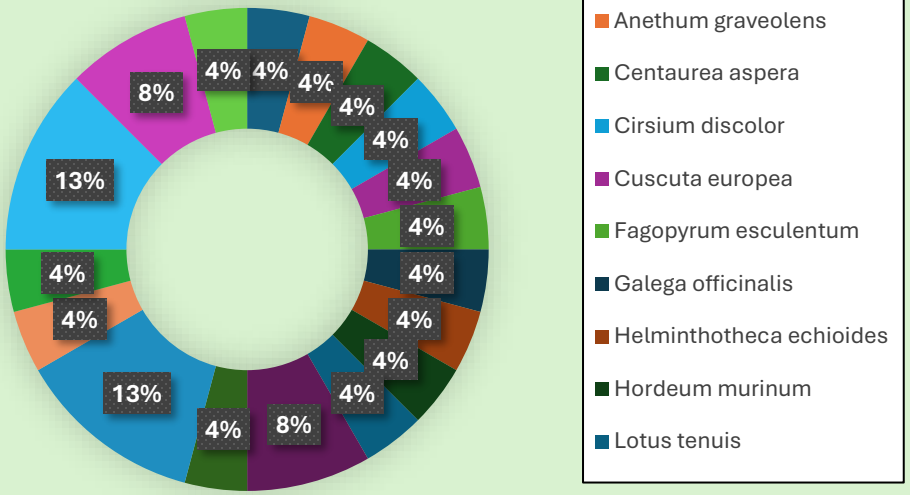
Conventional system 2024



Dream system 2023

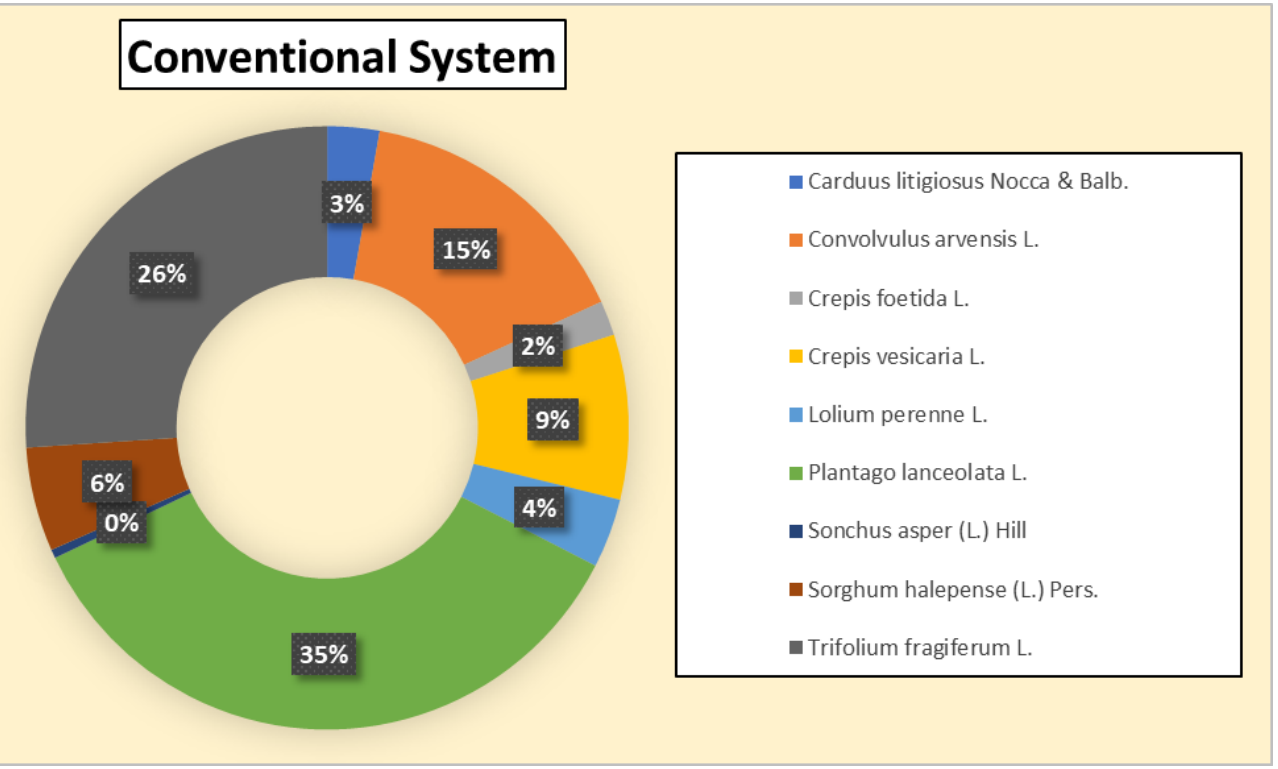


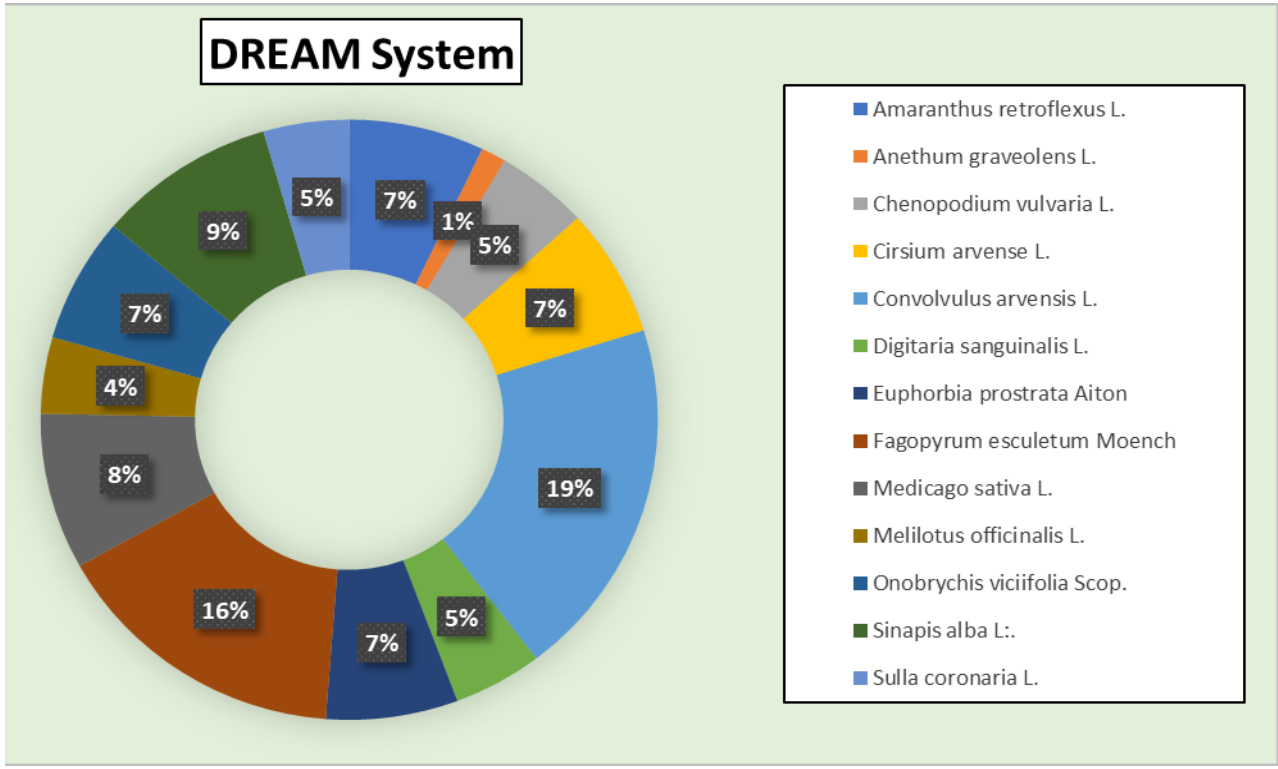
Dream system 2024



Results 2025

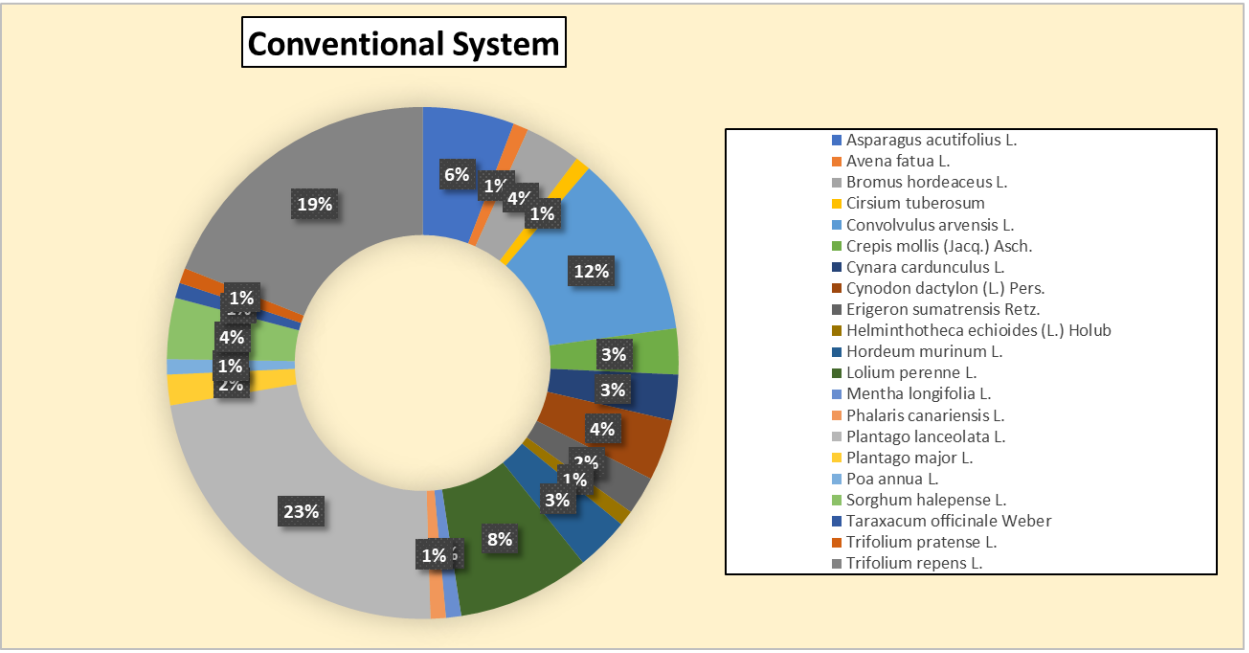
Biodiversity

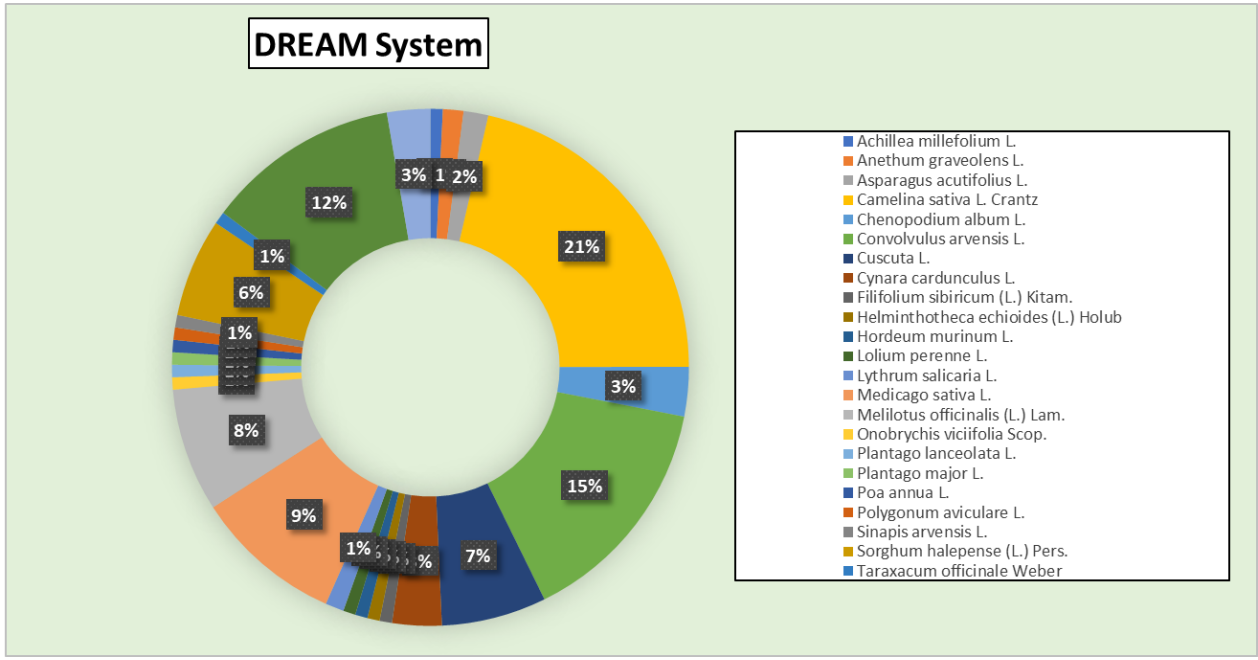




Results 2026

Biodiversity





- 2024 & 2026 have been characterized by larger species diversity in both types of orchard
- Those springs have been characterized by a more even distribution of precipitation

Diversity indexes

Orchard	Shannon diversity index				Evenness index			
	2023	2024	2025	**2026**	2023	2024	2025	**2026**
Conventional	1.26	2.17	1.70	**2.47**	0.78	0.88	0.77	**0.88**
DREAM	2.39	2.79	2.48	**2.45**	0.91	0.97	0.94	**0.88**

- DREAM orchard has been characterized by higher species diversity than BAU
- 2026 spring allowed also Conventional to have a greater diversity than in the previous years, with comparable results than DREAM

Lesson learnt

- The use of CC allowed an increased plant biodiversity in the orchard
- DREAM interrows were characterized by higher presence of Fabaceae and Brassicaceae, possibly allowing an increase of nutrients availability of apples (to be confirmed by soil analysis and soil biodiversity assessment



Thanks for the attention

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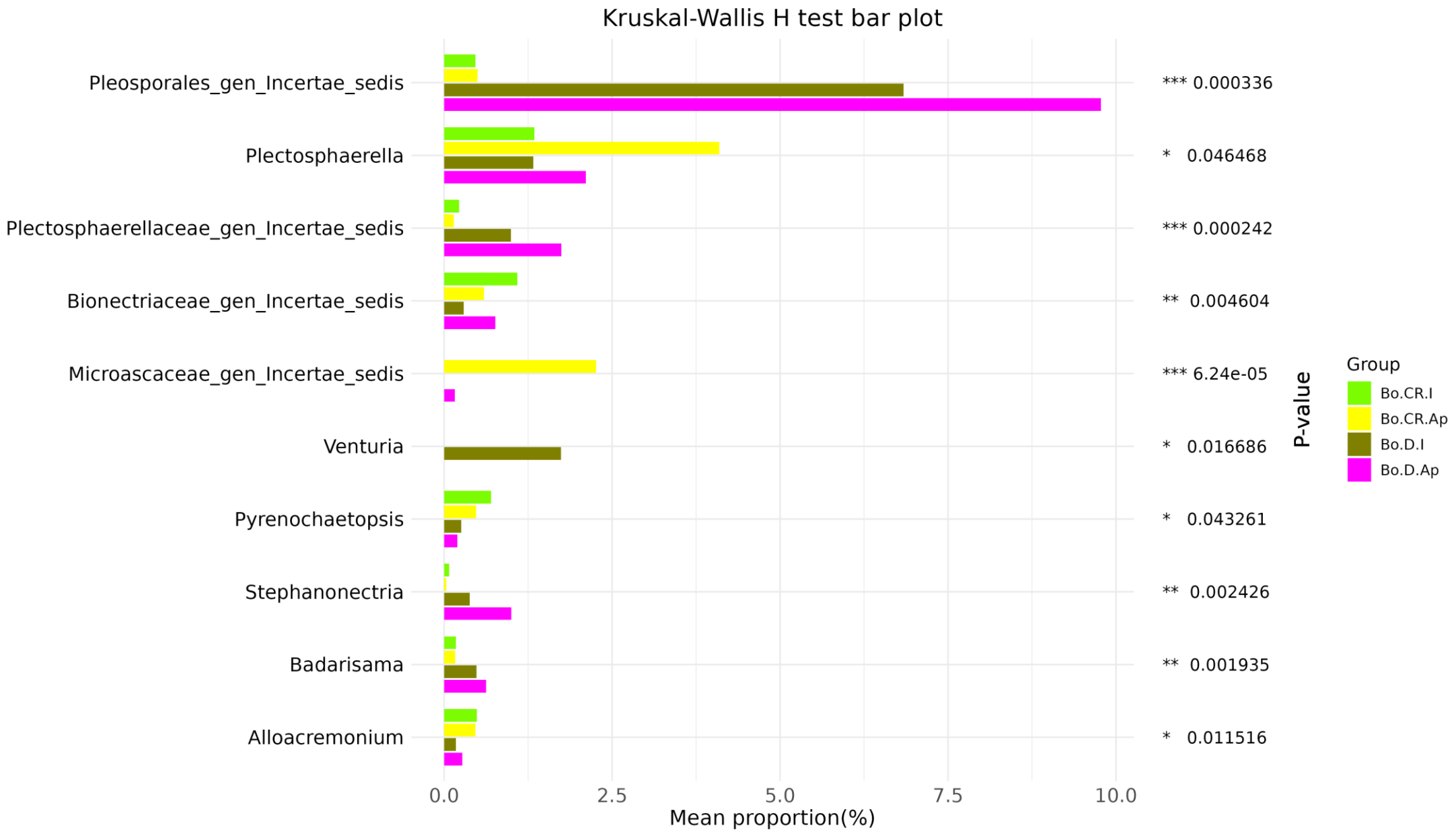
SOIL FUNGI SPECIES ABUNDANCE









The role of cultivar interactions with arthropods in Integrated Pest and Pollinator Management strategies for apple orchards

Francesco Lami*, Melissa Venturi, Lisa Cabiddu, Lucia Lenzi, Mariana Paola Mazzei, Diletta Missere, Brunella Morandi, Fabio Sgolastra



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Integrated Pest and Pollinator Management (IPPM)

Insecticide reduction/elimination



Floral resource diversification

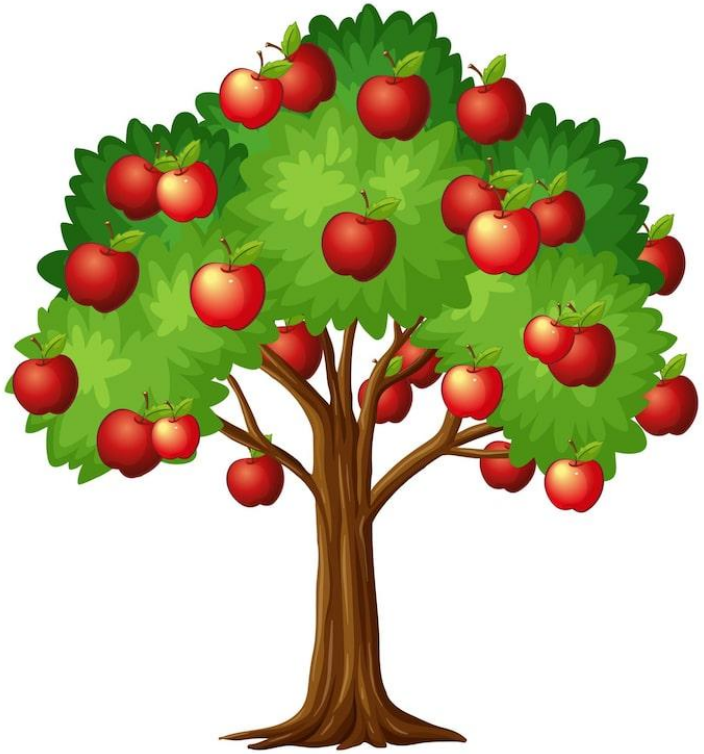




Wild vegetation, flower strips, cover crops…

…even crop/cultivar diversification

Cultivar selection







The «perfect» IPPM cultivar

The DREAM project

3 pairs of experimental orchards: IPPM vs. conventional

9 different apple cultivars



Flowering period lasts longer

POLLINATION



Beneficial arthropod abundance



Pink Lady

Flowering cover crops (14 species



Additional, diversified resources

PEST RESISTANCE

Field work: Ecosystem functions

Pest resistance

2025

Pollination contribution

Herbivore damage on fruits



Cydia pomonella

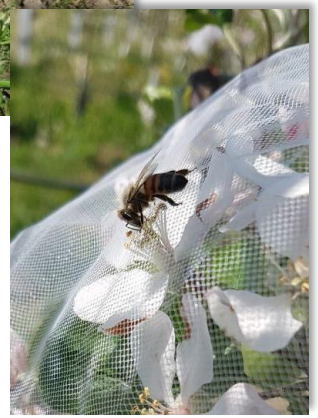


Halyomorpha halys



10 trees per cultivar/plot,
10 fruits per tree





3 trees per cultivar/plot,
90 trees in total

Exclusion
Vs.
Control

Fruitlet set
Fruit set
Seed set
Weight/Size
Sugar content

Flower visits
5 min. per tree



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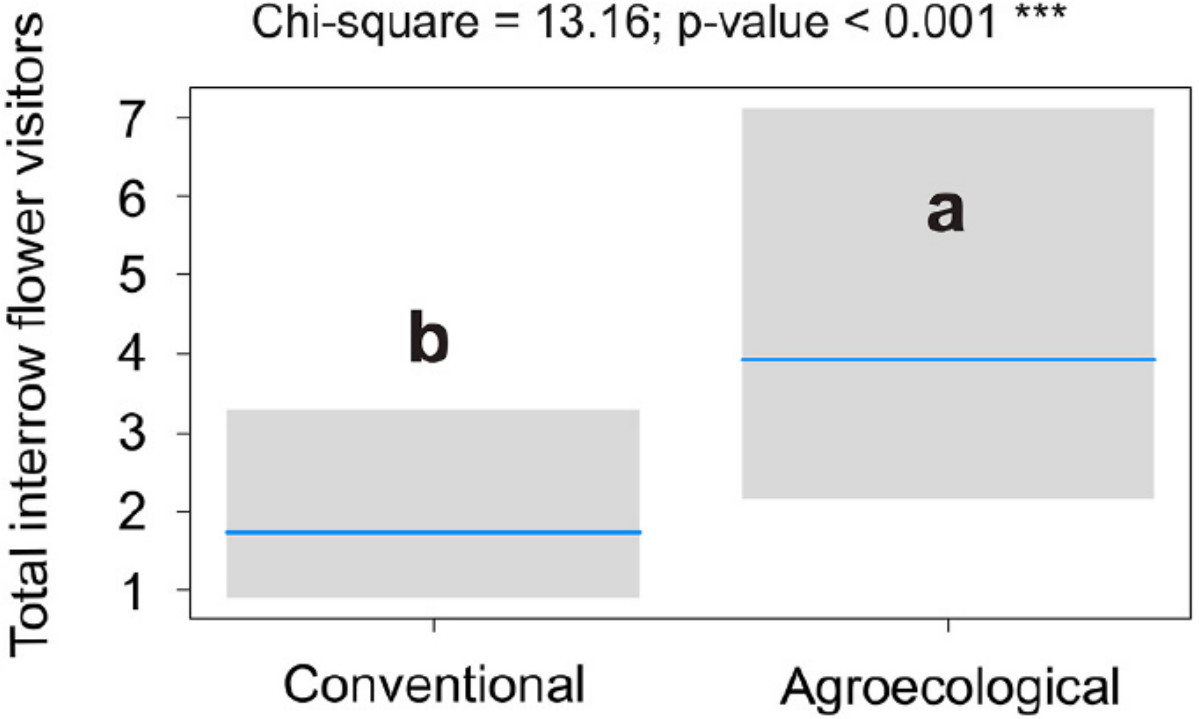
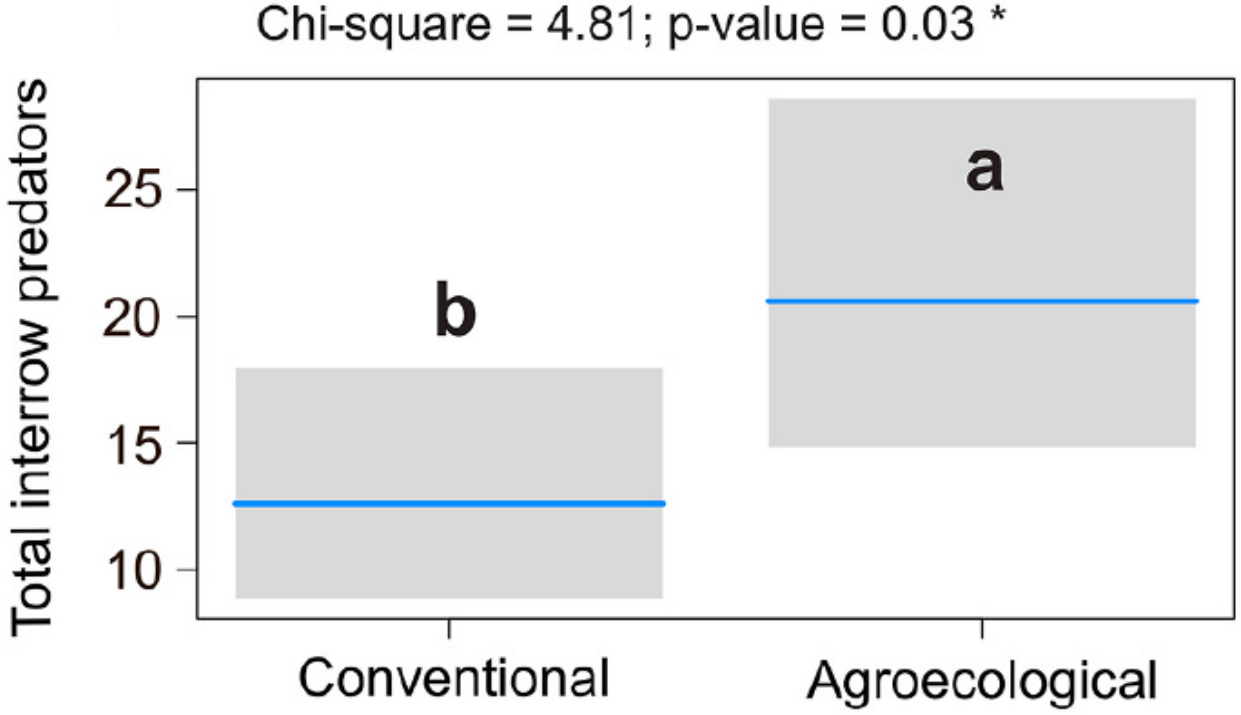
Cover crops are great for beneficials











The cultivar dilemma: Trade-offs and synergies

	Flower_visits	Fruitlet_contrib	Fruit_contrib	Weight_contrib	Diameter_contrib	Height_contrib	Seed_contrib	Sugar_contrib	CM_res_tree	BMSB_res_tree	CM_res_fruit	BMSB_res_fruit
N_flowers												
Flower_visits									-0.43	-0.40	-0.41	-0.40
Fruitlet_contrib		0.60								-0.51		-0.39
Fruit_contrib			-0.43	-0.54					-0.45	-0.42	-0.40	
Weight_contrib				0.95	0.79	0.61						
Diameter_contrib					0.71	0.59	-0.45					
Height_contrib						0.47				-0.48		
Seed_contrib												
Sugar_contrib												
CM_res_tree										0.56	0.98	0.51
BMSB_res_tree											0.51	0.93
CM_res_fruit												0.46

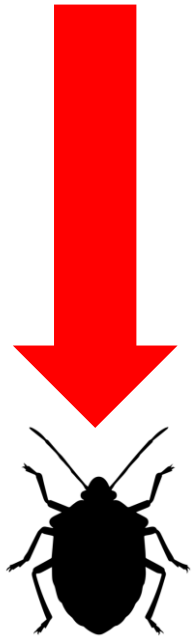
Pollinators

Pests



+ Pollinator contribution/attractiveness





- Pest resistance

N_flowers = Number of flowers per tree
Flower_visits = Visits per flower
Fruitlet_contrib = Fruitlet set contribution
Fruit_contrib = Fruit set contribution
Weight_contrib = Fruit weight contribution
Diameter_contrib = Fruit diameter contribution
Height_contrib = Fruit height contribution
Seed_contrib = Seed set contribution
Sugar_contrib = Sugar content contribution
CM_res_tree = Codling moth resistance (fruits per tree)
BMSB_res_tree = BMSB resistance (fruits per tree)
CM_res_fruit = Codling moth resistance (damages per fruit)
BMSB_res_fruit = BMSB resistance (damages per fruit)

Conclusions

All cultivars, in different ways, **benefit from pollination** for yield and/or quality





Considering the trade-offs, **pest resistance should be prioritized** in IPPM apple orchards



Pink Lady:
Can be IPPM only for part of the season



Less used varieties:
More promising!

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Pest note

The role of cultivar interactions with arthropods in integrated pest and pollinator management strategies for apple orchards

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More info here!

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Thank you for your attention!

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Consumer acceptance of sustainable apple production

Brunella Morandi



Objectives of the consumer study

Can sustainable orchard management preserve consumer acceptance and market potential?

01 **Compare Pink Lady apples from conventional and DREAM agroecological orchards**

02 Assess 50% deficit irrigation across four DREAM cultivars

03 Measure sensory quality, purchase intention and perceived value

Decision focus

Market acceptance

Water-saving viability

Communication and pricing

Experimental comparisons



Two blind-sample comparisons

A / B

Conventional control vs DREAM management

50%

Deficit irrigation vs full irrigation

Cultivars: Pink Lady, Abbondanza, Smeralda and Red Unibo

Consumer test protocol

Public events, autumn 2025

30–52 consumers per comparison. Apples were harvested in 2025 and cold-stored for no more than one month.

1 **Blind tasting**

Two coded samples offered to each participant

2 **7-point hedonic scale**

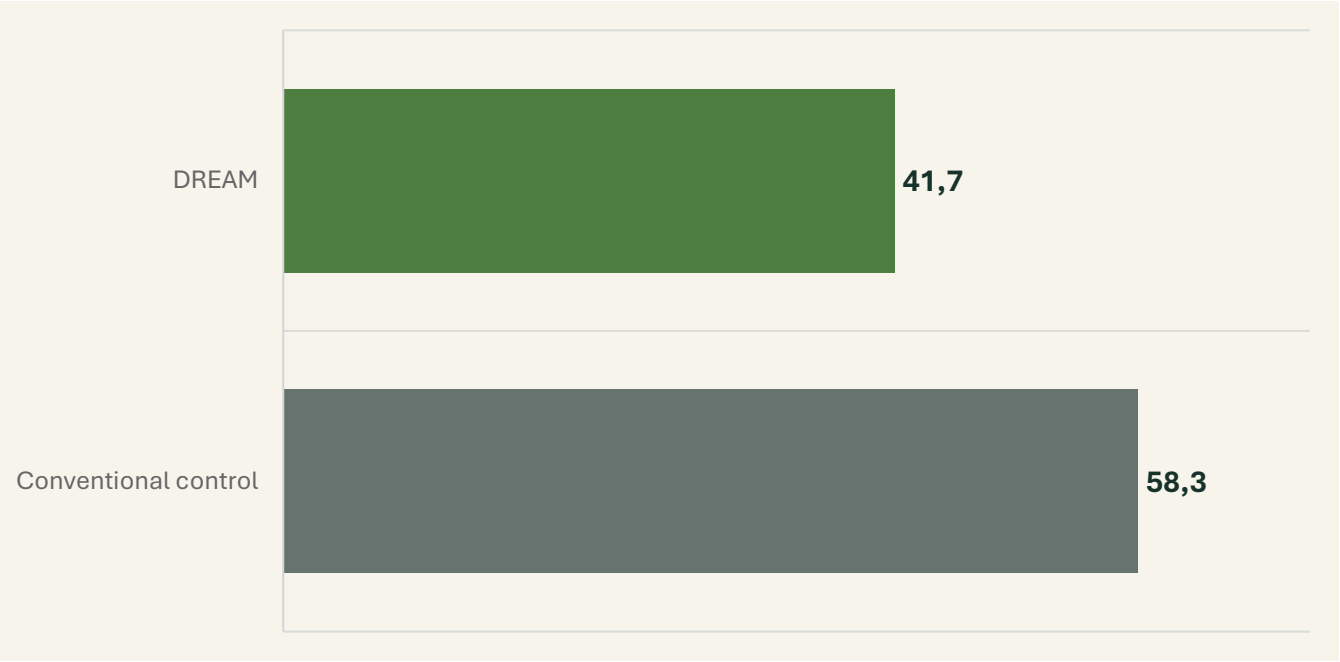
Nine attributes: texture, taste, freshness and appearance

3 **Market questions**

Purchase intention, premium price, intended use, preference and naturalness



DREAM retained market acceptance



77.8%

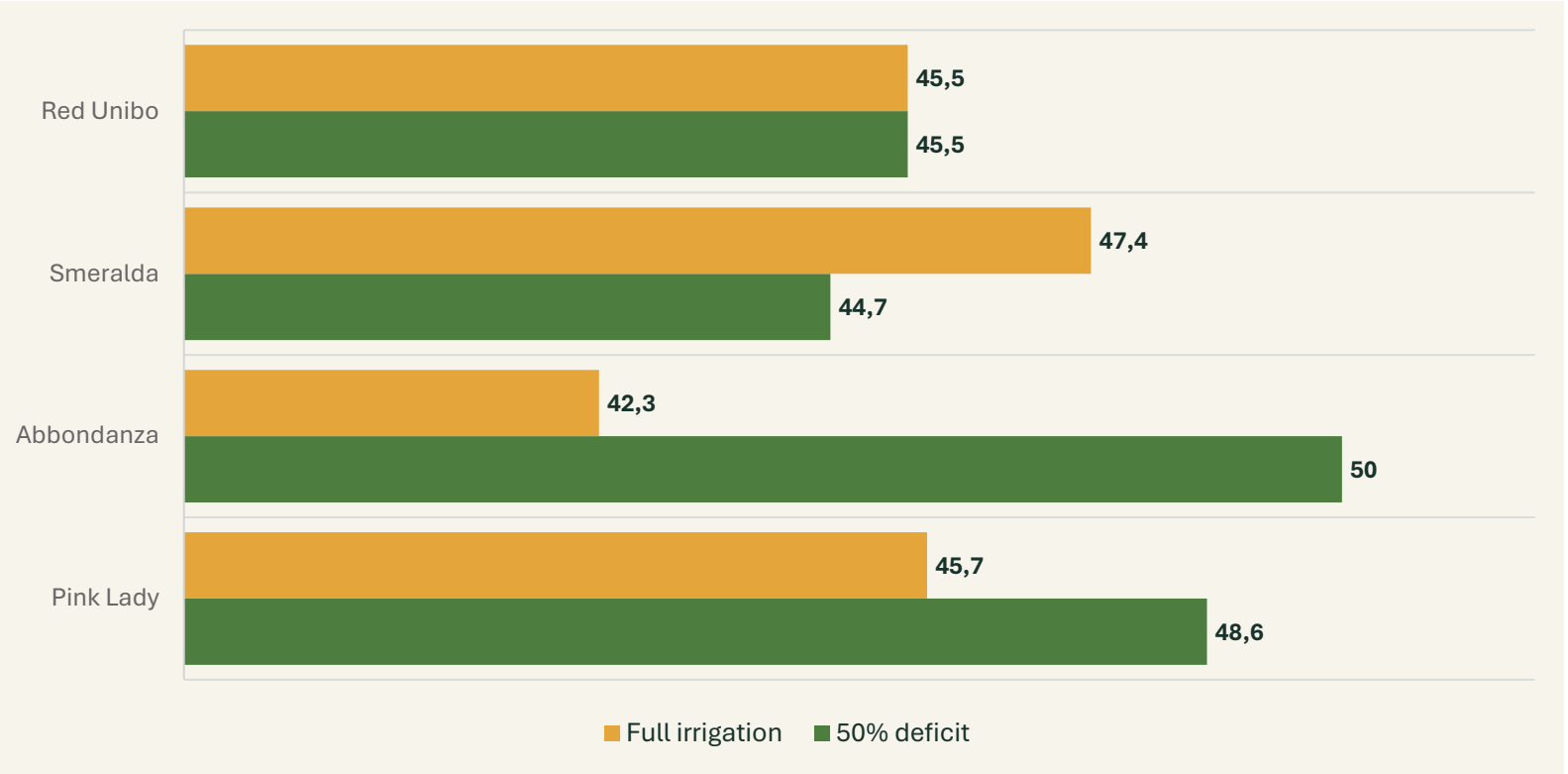
would purchase DREAM fruit

What the comparison shows

- Sensory quality remained high
- Preference shifted modestly toward the control
- Sustainability was not identifiable by taste alone

Premium pricing remained limited: 47.2% preferred the regular market price.

Deficit irrigation matched full irrigation

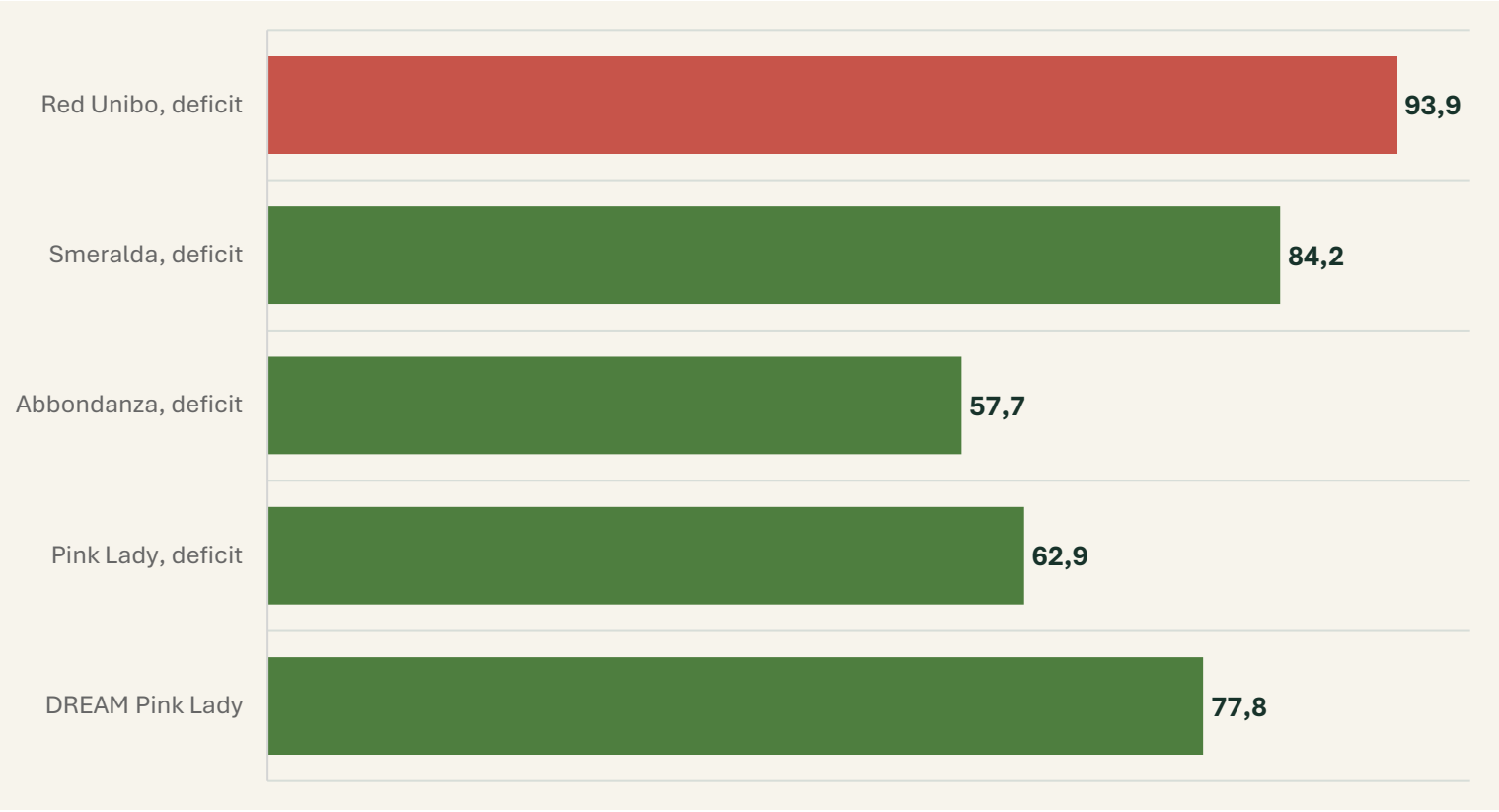


Purchase intention: deficit

Pink Lady	62.9%
Abbondanza	57.7%
Smeralda	84.2%
Red Unibo	93.9%

Cultivar differences were larger than irrigation-treatment differences.

Consumers showed strong purchase intention



Highest purchase intention

93.9%

Red Unibo under deficit irrigation

Across the tests, sustainable fruit achieved favourable commercial acceptance.

Comparisons used different consumer groups and sample sizes, so cultivar rankings should be interpreted cautiously.

RESULTS

Limited willingness to pay a premium

A large share of consumers preferred the standard market price even when they liked the fruit.

47.2%

DREAM Pink Lady

preferred the regular price

57.1%

Pink Lady, deficit

preferred the regular price

16.7–17.1%

Conditional premium

depending on perceived quality and benefits

The same overall pattern emerged for Abbondanza, Smeralda and Red Unibo: most consumers selected the standard price or made a premium conditional on clear benefits. Only a minority would certainly pay more.

SUMMARY

Key conclusions and market implications

Quality

DREAM management and 50% deficit irrigation maintained positive sensory ratings.

Variety

Red Unibo showed the strongest immediate market potential, followed by Smeralda.

Value

High acceptance did not translate into broad willingness to pay a premium.

Communication

Labels and clear evidence of environmental benefits are needed to make sustainability visible.

Bottom line: water savings and agroecological management can be pursued without materially compromising consumer acceptance.



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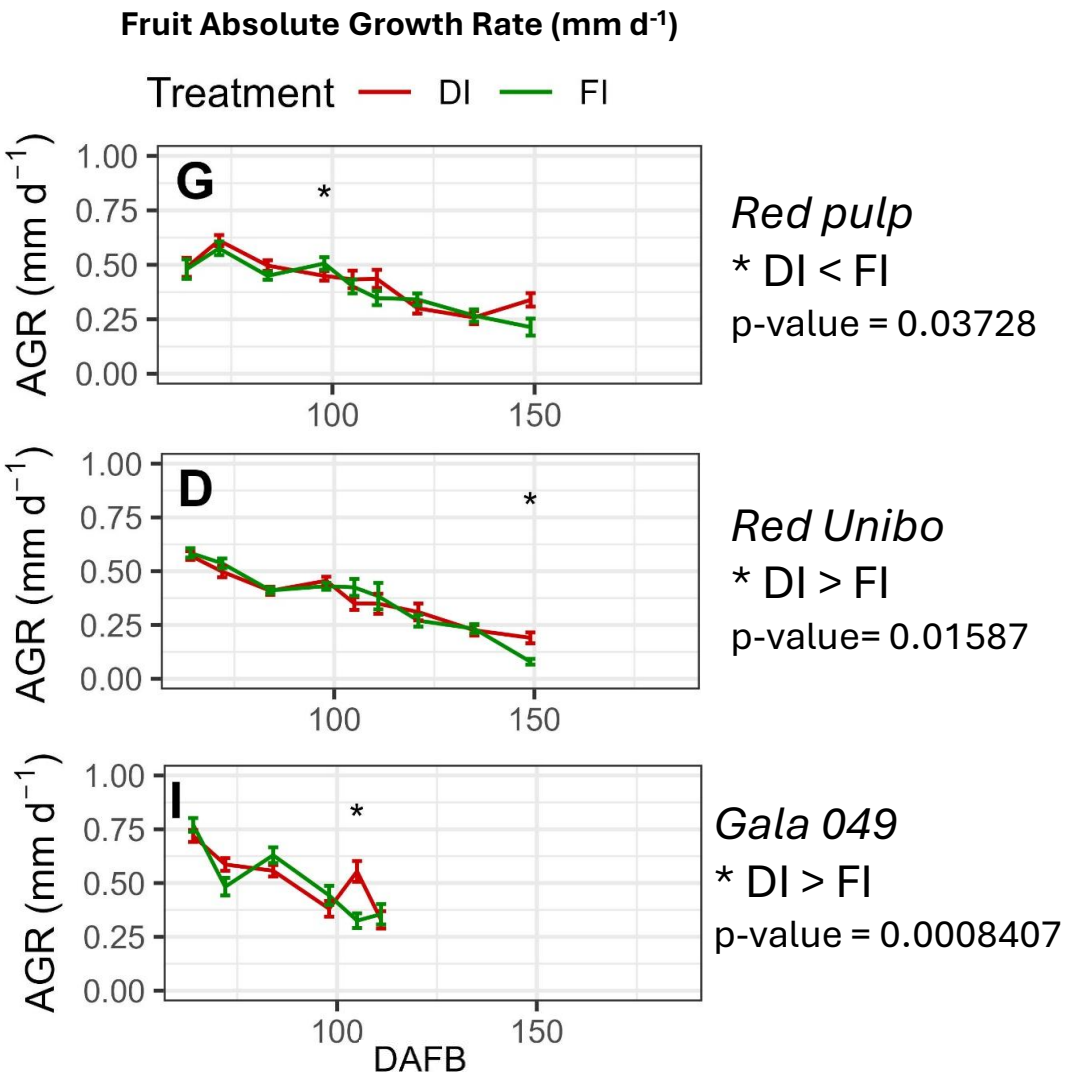
PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

Funded by the European Union

Results – responses of fruit and shoot growth

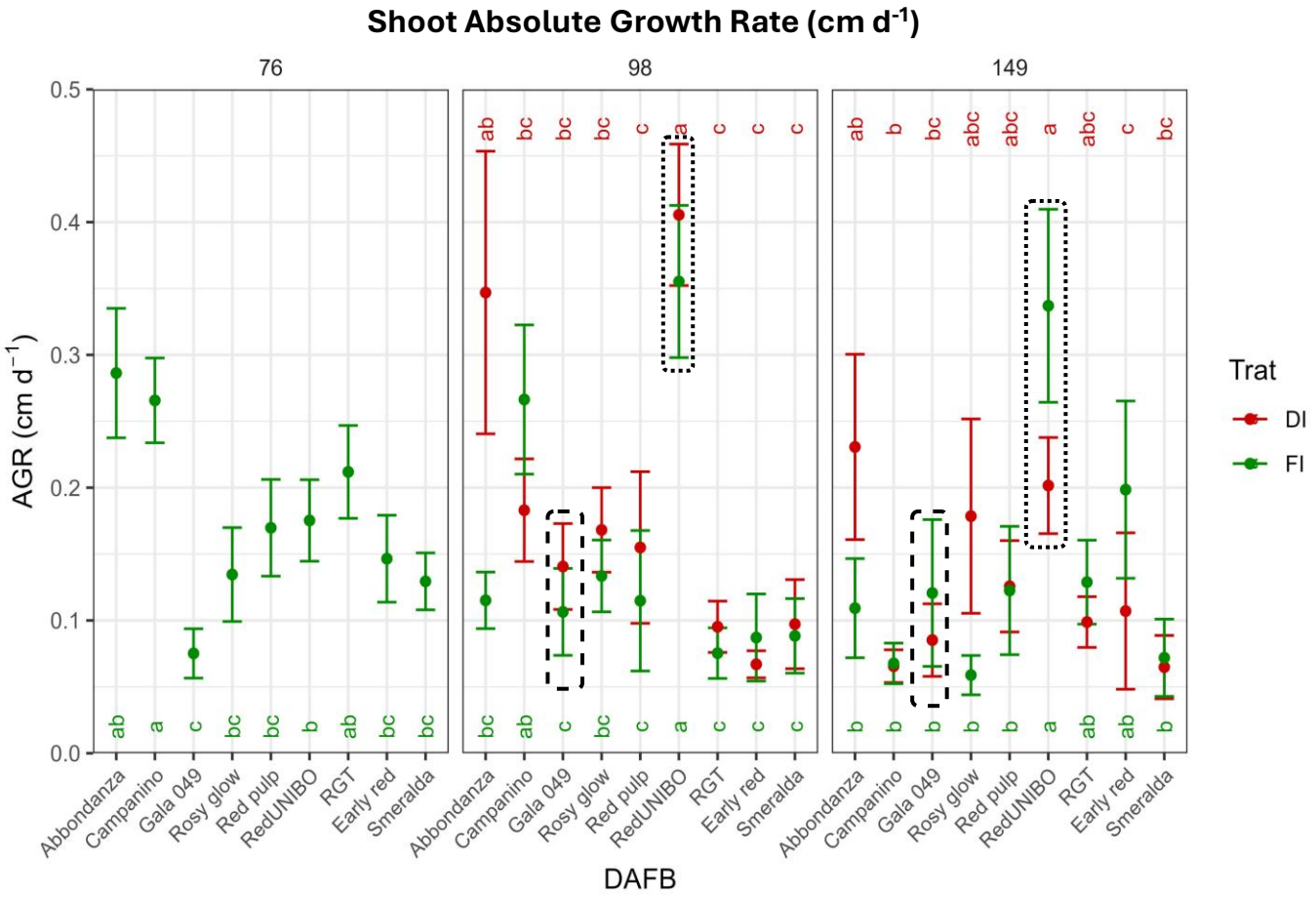


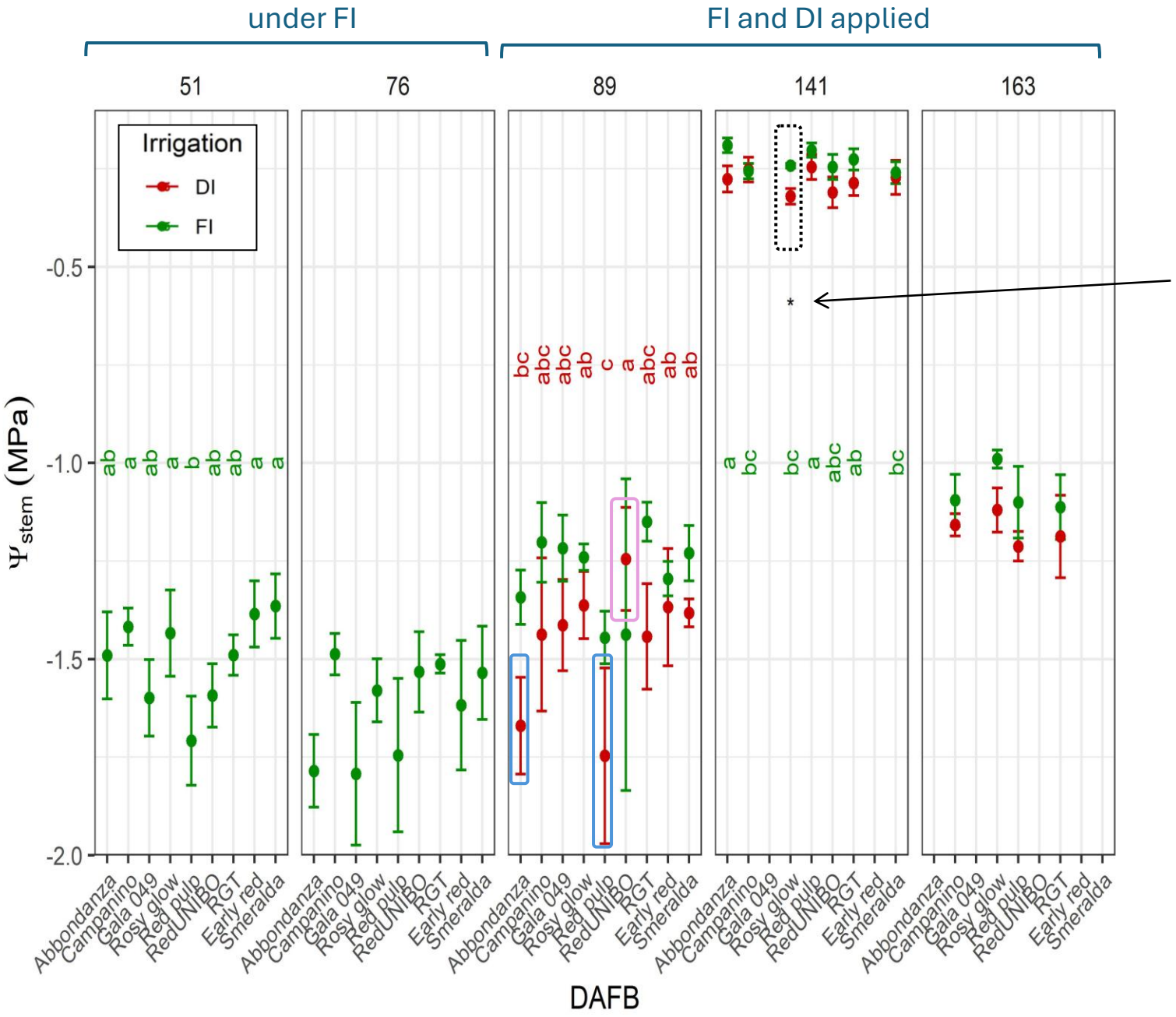
Red pulp
* DI < FI
p-value = 0.03728

Red Unibo
* DI > FI
p-value= 0.01587

Gala 049
* DI > FI
p-value = 0.0008407

- AGR_{FRUIT} : significant differences in three cultivars (*according to Wilcoxon test)
- AGR_{SHOOT} : no signficant differences





Results – physiological responses

Stem water potential (Ψ_{stem})

- Irrigation treatments

Significant difference in '<u>Rosy glow</u>' (*according to Wilcoxon test, p-value = 0.02186)

- Differences among cultivars

'Abbondanza' and 'Red pulp'

'Red Unibo'

(according to Mixed effects models)