



# **Irrigation Efficiency and Water Conservation:** **Standard Sprinkler Nozzles vs High Efficiency Nozzles**

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# Background

- Residential irrigation
- Automated in-ground irrigation systems



# Background

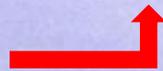
- Efficient irrigation systems:
  - Conserve water.
  - Reduce runoff and nutrient loading to waterbodies.
  - Contribute to water quality.
- Advancement of irrigation technologies (e.g., sensors, controllers, sprinkler heads, **nozzles**, etc.)
- Great opportunities to develop more efficient irrigation systems.

# Sprinkler heads

Soil level



Water inlet



# Sprinkler heads



# Sprinkle heads



# Nozzle types

Standard Nozzles



VAN

MPR and SQ

Adjustable Arc

Fixed Arc

# Nozzle types

		Low Precipitation Rate		Standard Precipitation Rate	
Standard Nozzles		High-Efficiency Rotary Nozzles		High-Efficiency Nozzles	
					
					
VAN	MPR and SQ	.. .. .		HE-VAN	U-Series
Adjustable Arc	Fixed Arc	Adjustable Arc (45° - 270°)	Full Circle (360°)	Adjustable Arc (0° - 360°)	Fixed Arc

# Objective

Compare:

Traditional nozzles

vs

High efficiency nozzles



# Materials and Methods

## Study site



## Study site



# Irrigation Timer

- Run times modified monthly



# Irrigation system

Water inlet

Pressure  
regulator

Solenoid  
valve

Flowmeter



# Nozzles tested

View from the top



View from the side



# Treatments

Nozzle brand	Nozzle model	HE	Pressure setting	
			psi	Type
Hunter	<u>12Q Pro Fixed</u>	No	60	City pressure
K-Rain	<u>FN-12Q</u>	No	60	City pressure
Rain Bird	<u>MPR 12Q</u>	No	60	City pressure
Toro	<u>570 MPR - 90°</u>	No	60	City pressure

# Treatments

Nozzle brand	Nozzle model	HE	Pressure setting	
			psi	Type
Hunter	12Q Pro Fixed	No	60	City pressure
	MP1000-90	Yes	60	City pressure
K-Rain	FN-12Q	No	60	City pressure
	RN100-ADJ-90-270	Yes	60	City pressure
Rain Bird	MPR 12Q	No	60	City pressure
	R-VAN-14	Yes	60	City pressure
Toro	570 MPR - 90°	No	60	City pressure
	PRN-A	Yes	60	City pressure

# Treatments

Nozzle brand	Nozzle model	HE	Pressure setting	
			psi	Type
Hunter	12Q Pro Fixed	No	60	City pressure
	MP1000-90	Yes	60	City pressure
		Yes	40	Optimized pressure
K-Rain	FN-12Q	No	60	City pressure
	RN100-ADJ-90-270	Yes	60	City pressure
		Yes	30	Optimized pressure
Rain Bird	MPR 12Q	No	60	City pressure
	R-VAN-14	Yes	60	City pressure
		Yes	40	Optimized pressure
Toro	570 MPR - 90°	No	60	City pressure
	PRN-A	Yes	60	City pressure
		Yes	20	Optimized pressure

# Treatment codes

Nozzle brand	Nozzle model	HE	Pressure setting	
			psi	Type
Hunter	12Q Pro Fixed	No	60	City pressure
	MP1000-90	Yes	60	City pressure
		Yes	40	Optimized pressure
K-Rain	FN-12Q	No	60	City pressure
	RN100-ADJ-90-270	Yes	60	City pressure
		Yes	30	Optimized pressure
Rain Bird	MPR 12Q	No	60	City pressure
	R-VAN-14	Yes	60	City pressure
		Yes	40	Optimized pressure
Toro	570 MPR - 90°	No	60	City pressure
	PRN-A	Yes	60	City pressure
		Yes	20	Optimized pressure

Nozzle brand	HE	Pressure Type	Treatment code
A	n	C	AnC
	y	C	AyC
	y	O	AyO
B	n	C	BnC
	y	C	ByC
	y	O	ByO
C	n	C	CnC
	y	C	CyC
	y	O	CyO
D	n	C	DnC
	y	C	DyC
	y	O	DyO

## Experimental Design

- Completely randomized design
- 12 treatments x 4 replications = 48 plots

## Data collection

- 15 July 2021 - 17 October 2022

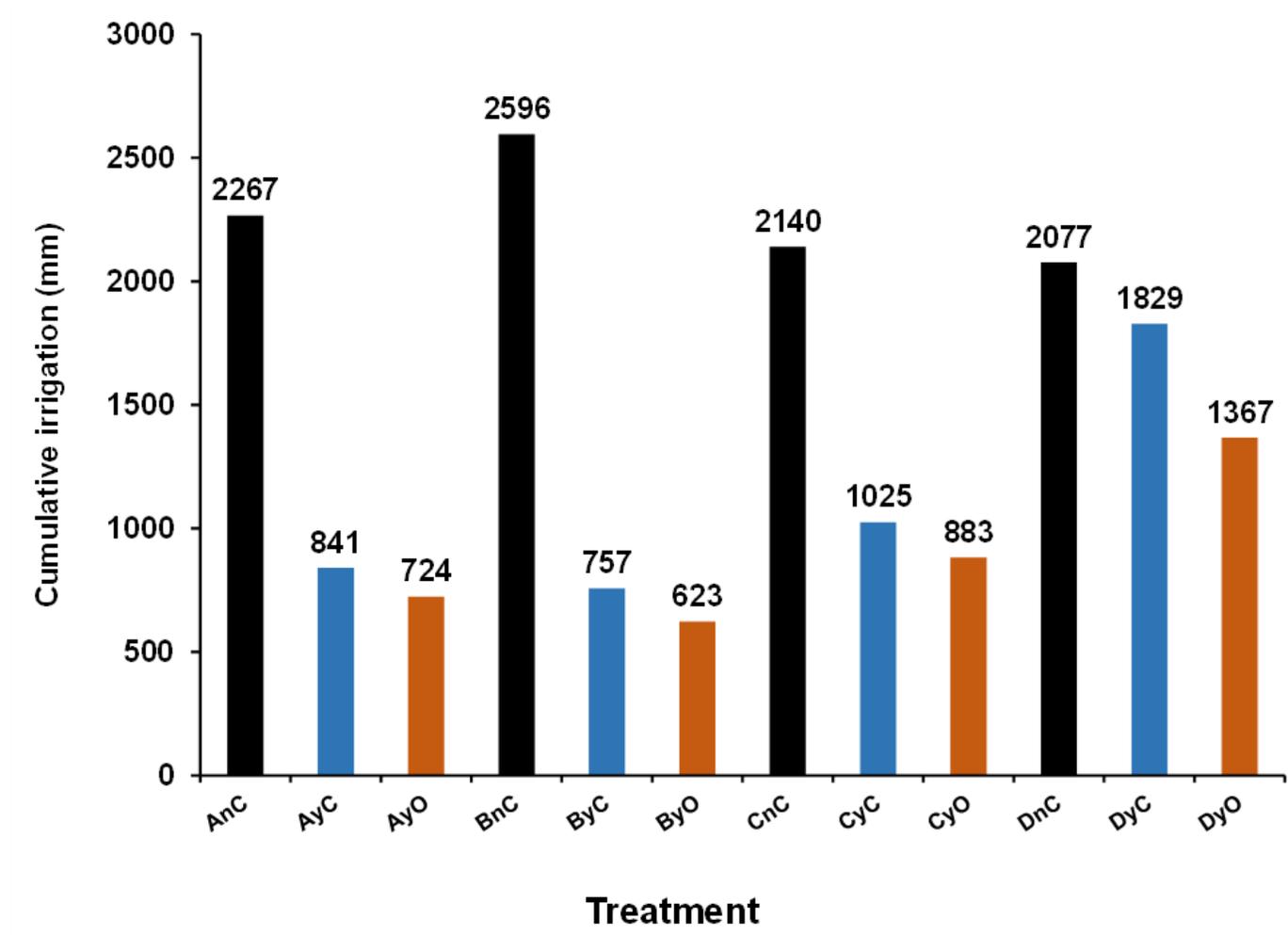
## Data analysis

- GLM procedure of SAS 9.4.
- ANOVA treatment differences.
- Duncan's multiple range test for mean differences.

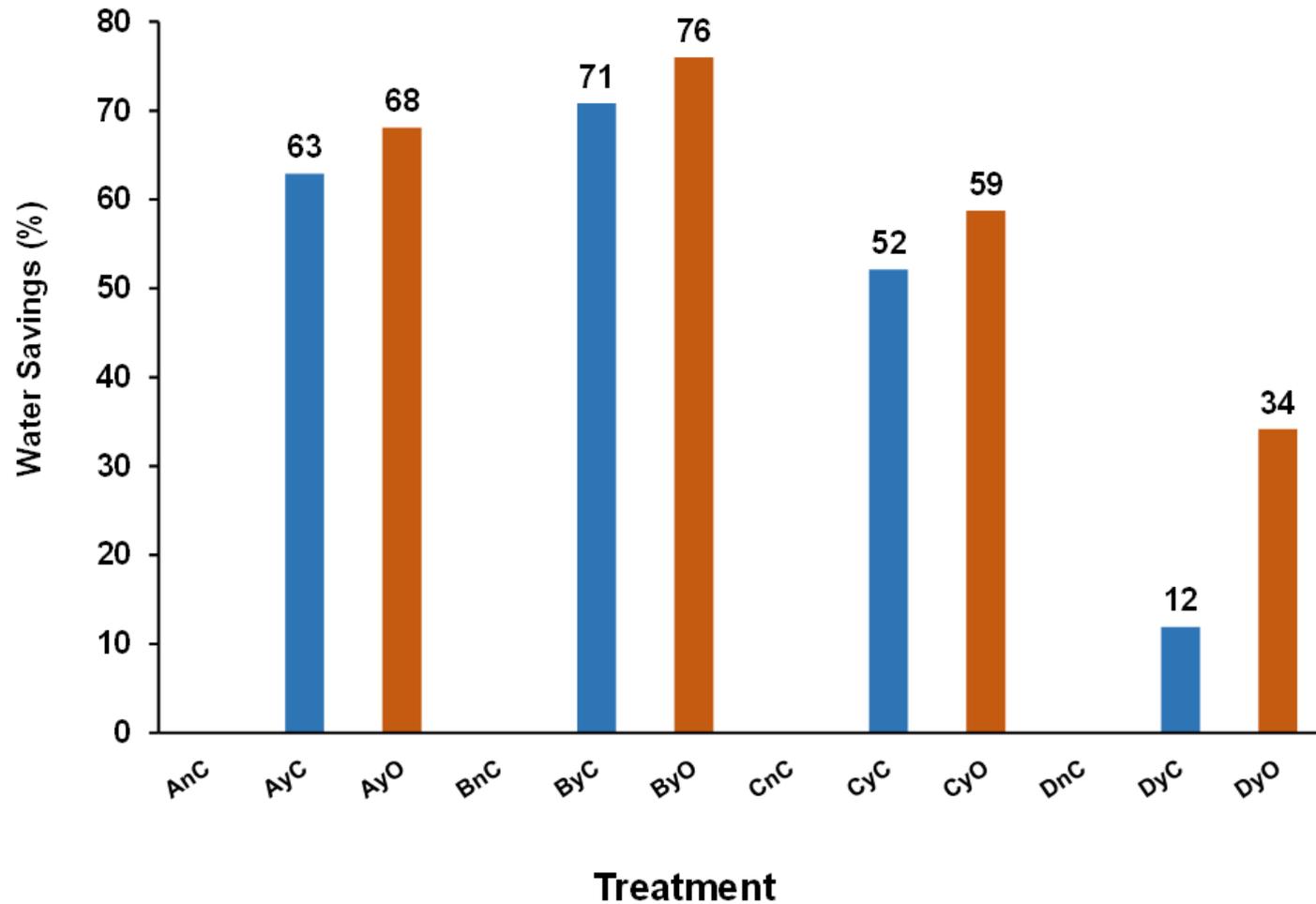
# Results and Discussion



# Irrigation applied



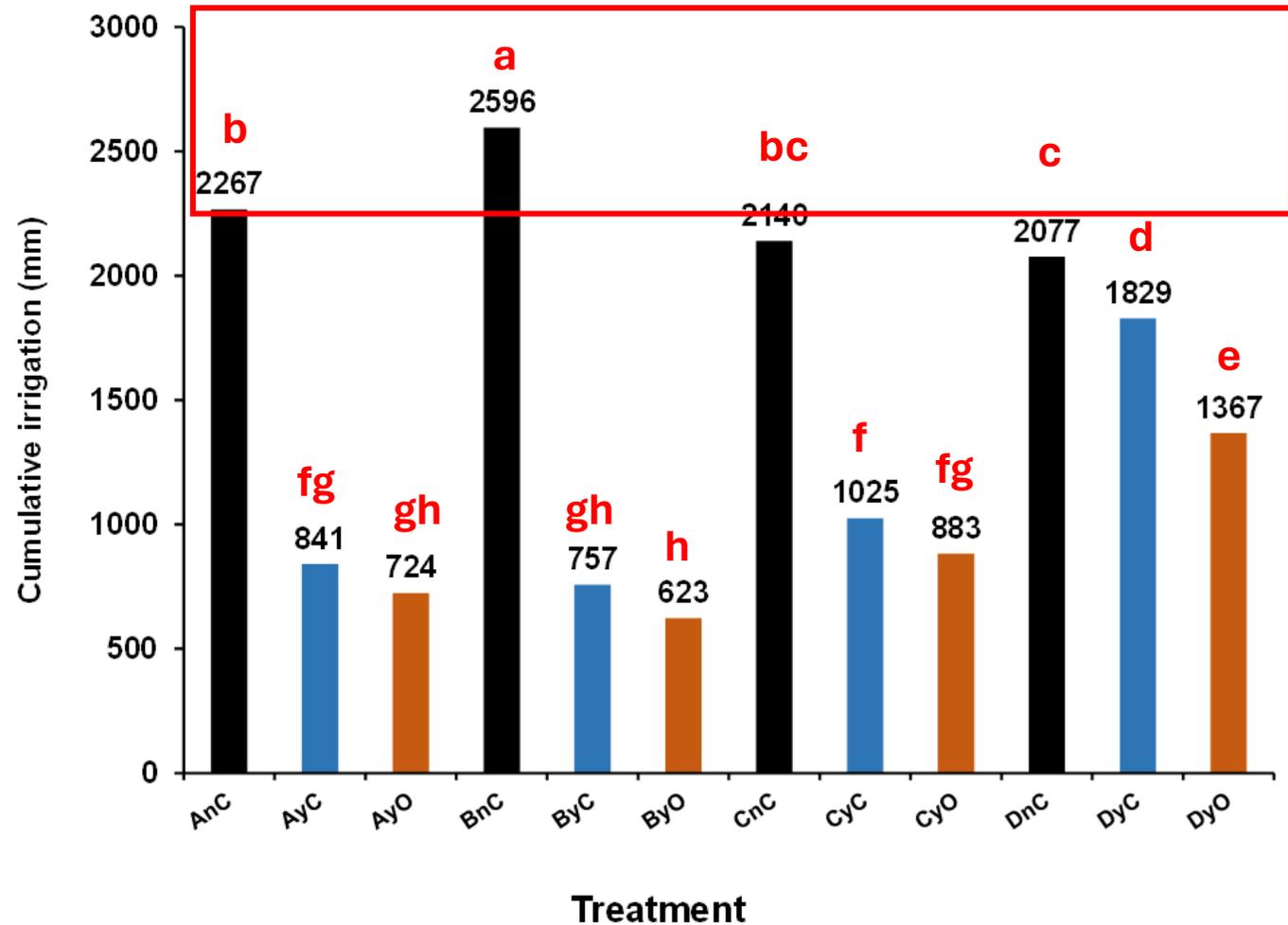
# Water savings



# Irrigation applied

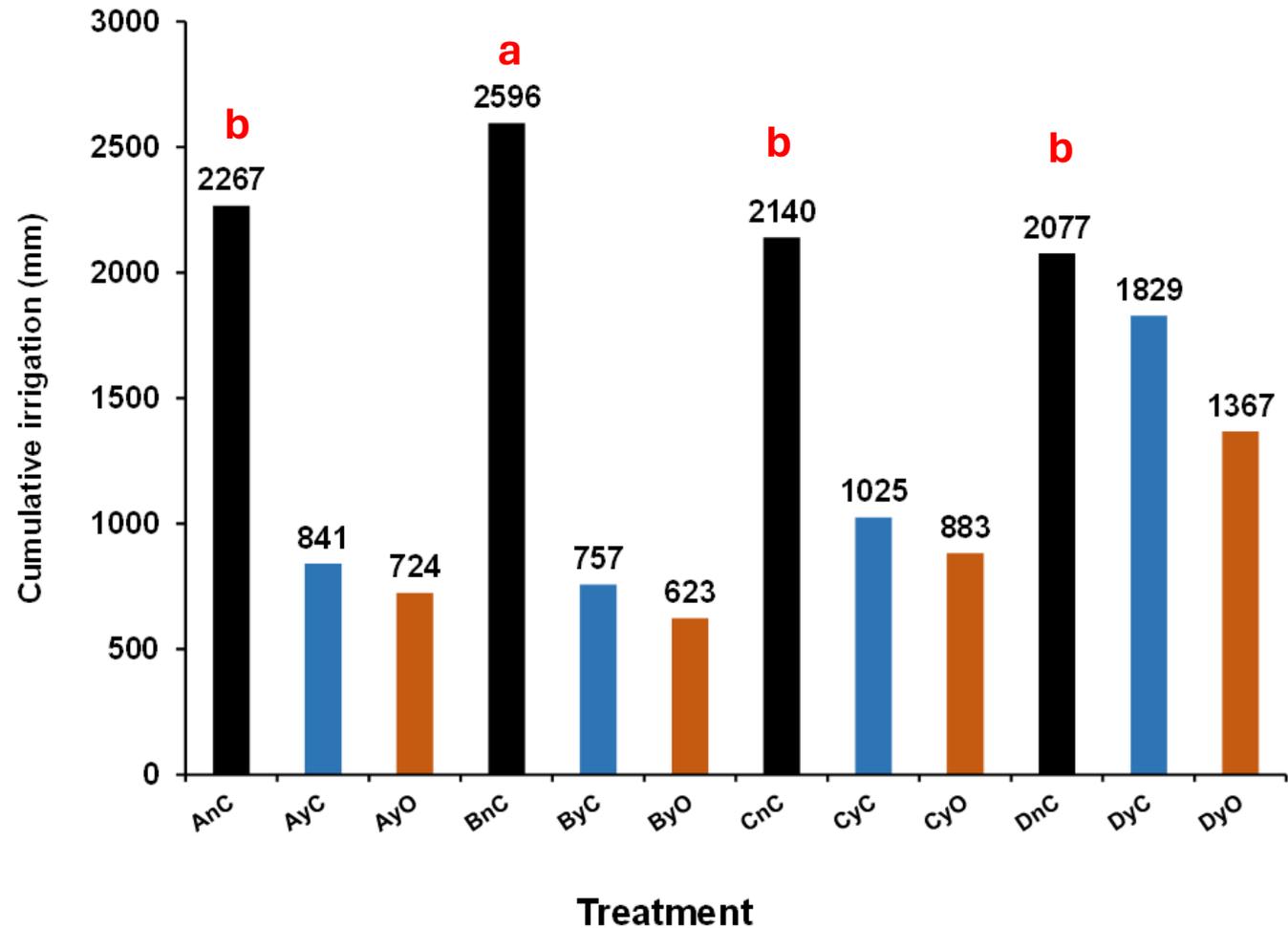
Statistical comparisons:

Between all treatments



# Irrigation applied

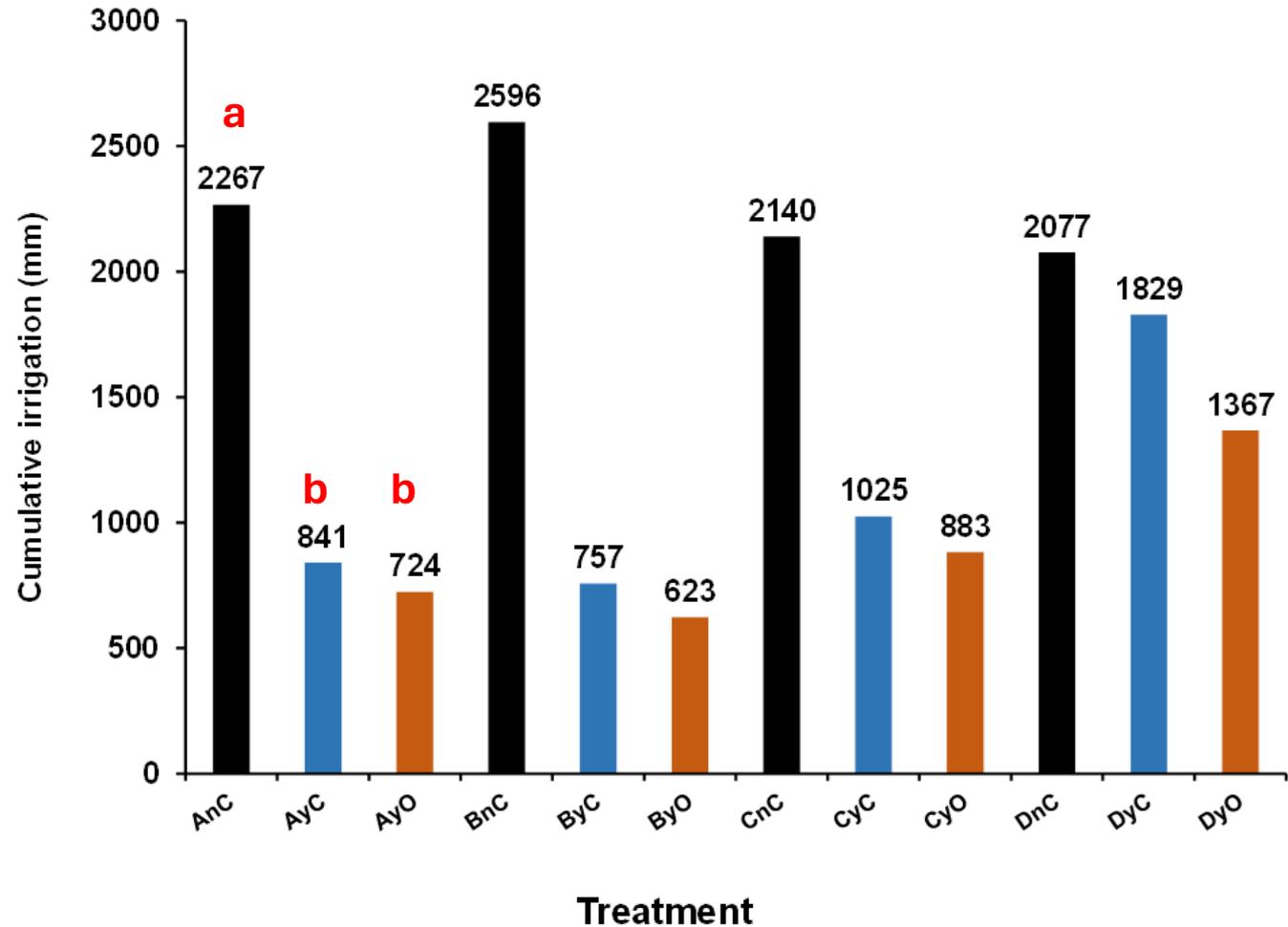
Statistical comparisons:  
Between traditional nozzles



# Irrigation applied

Statistical comparisons:

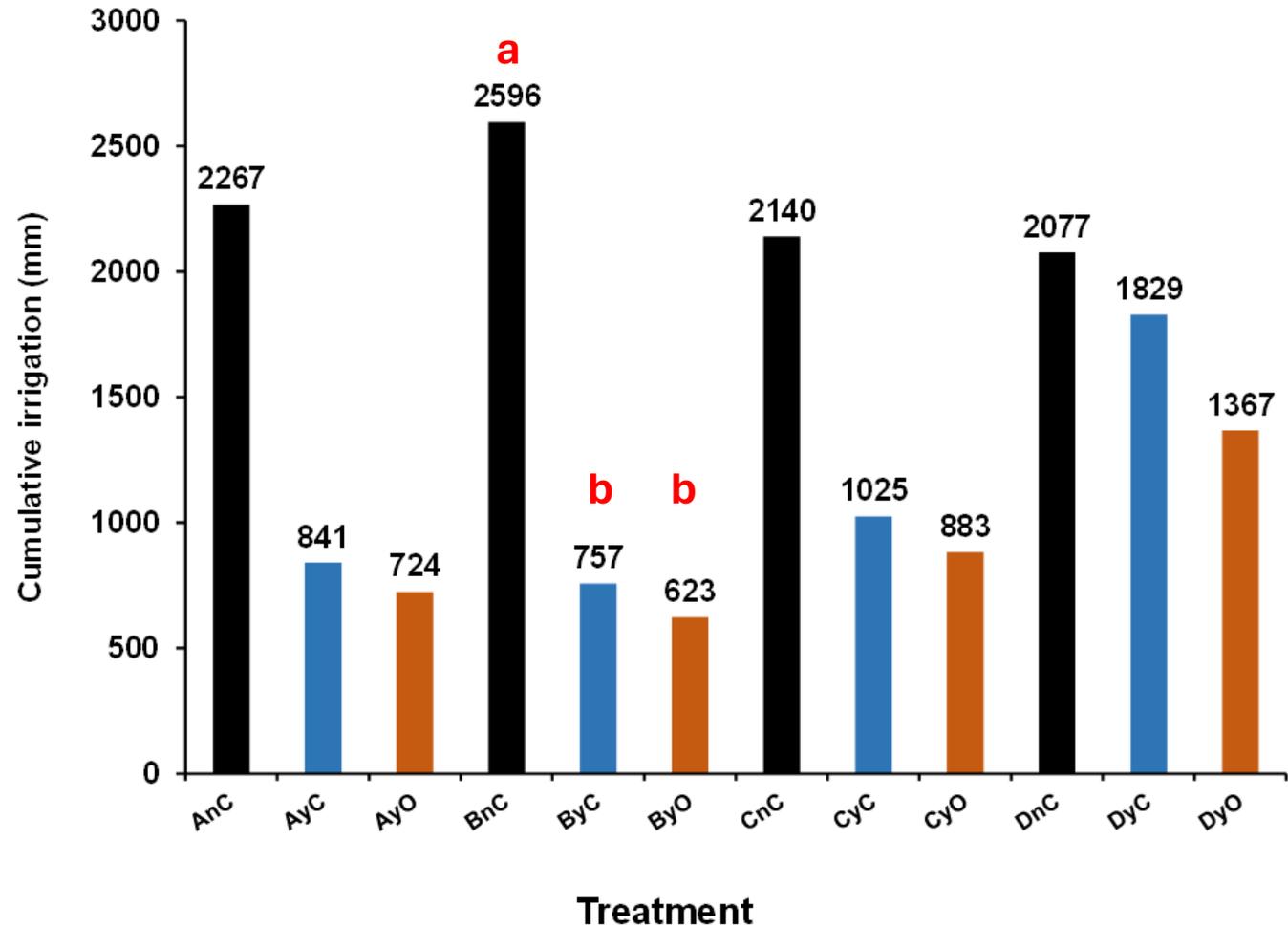
Between nozzles: brand A



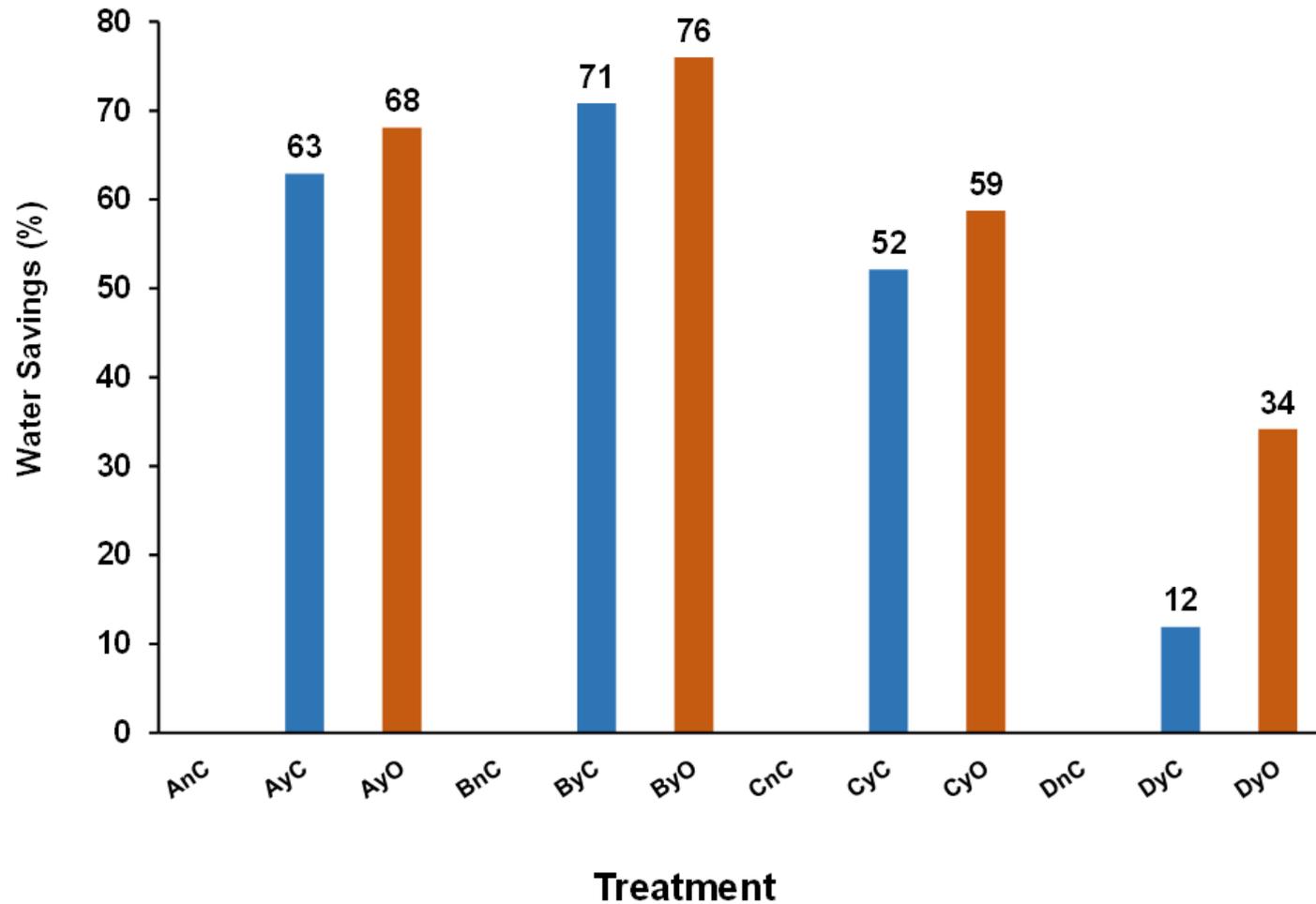
# Irrigation applied

Statistical comparisons:

Between nozzles: brand B



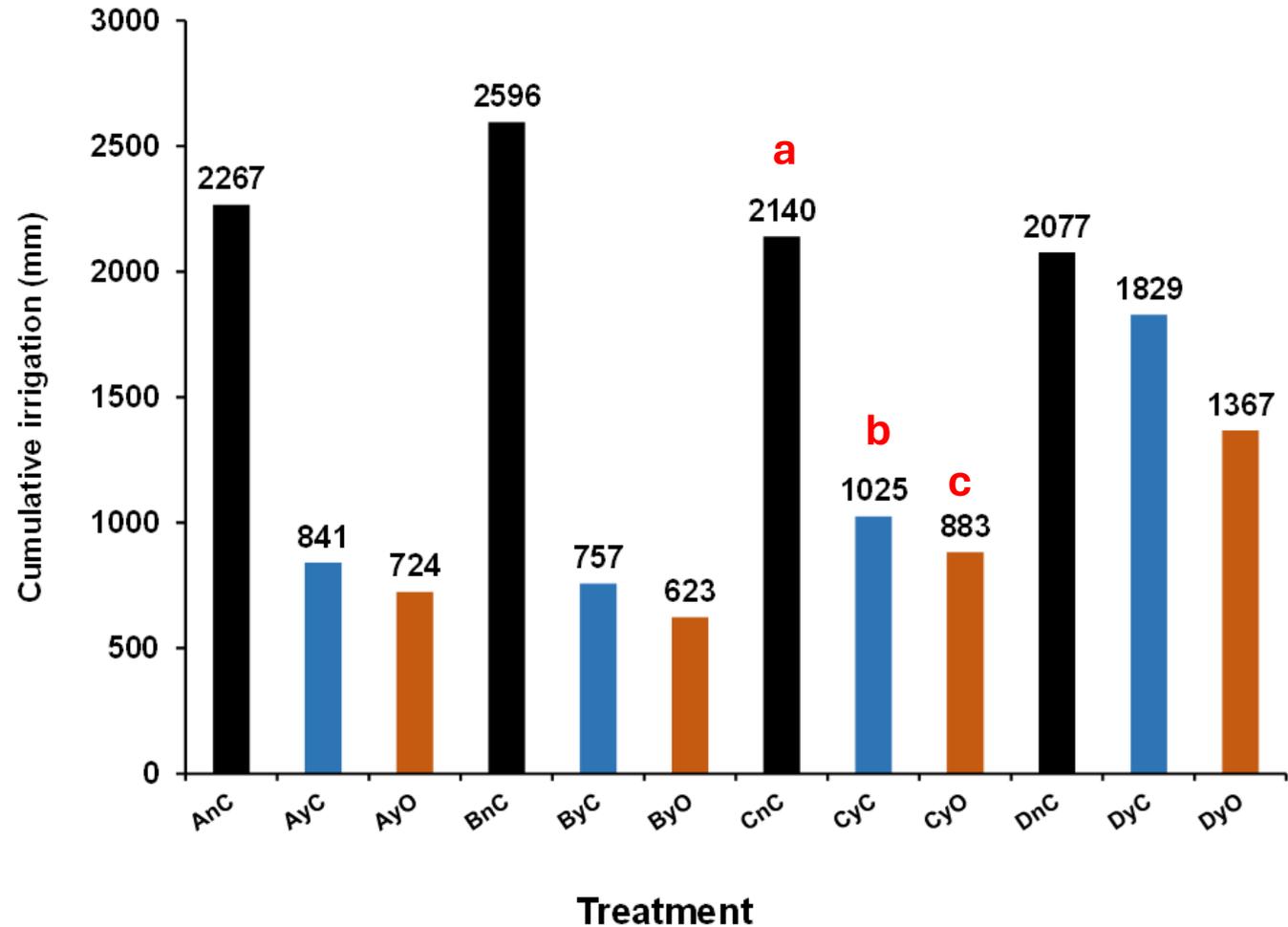
# Water savings



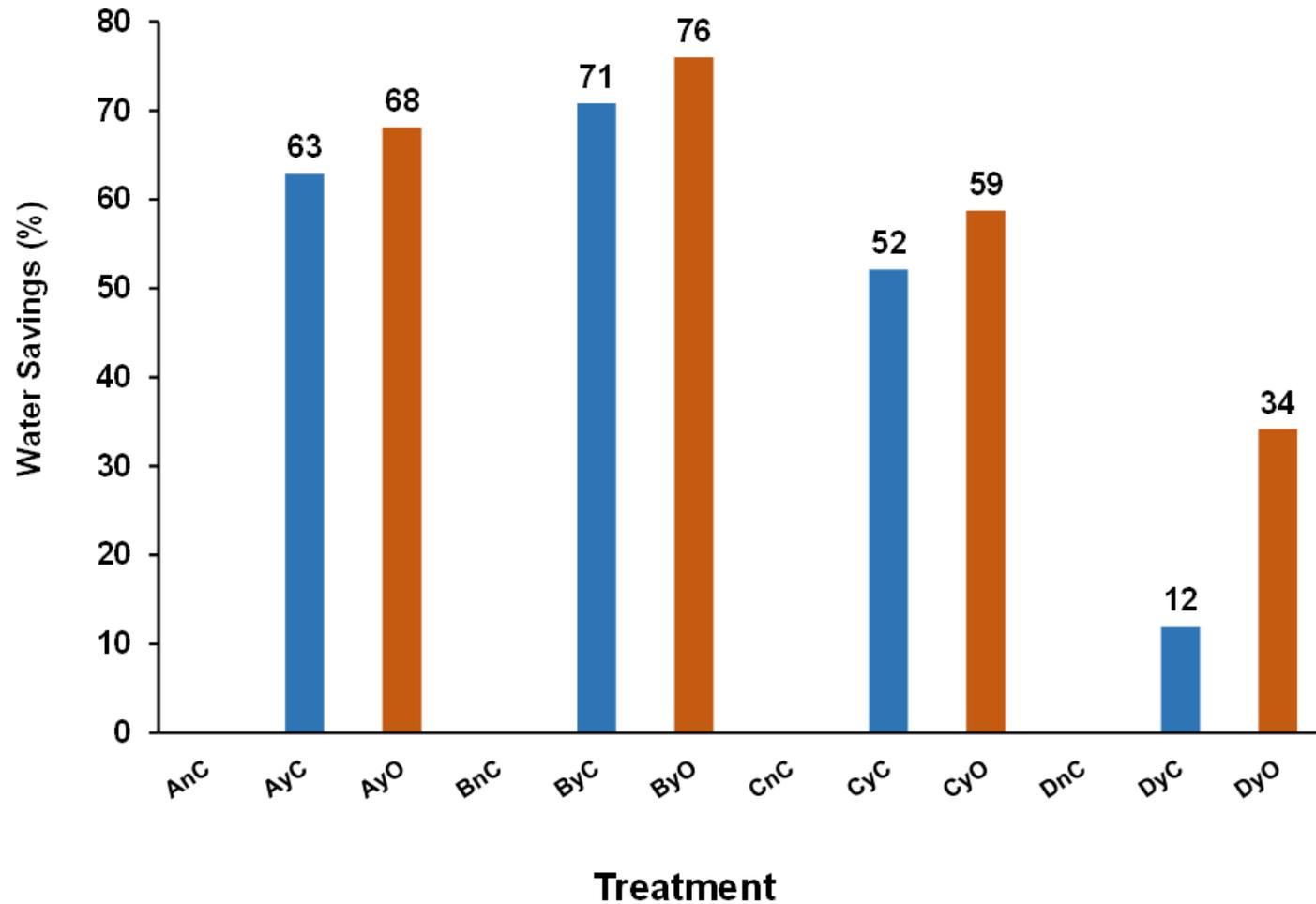
# Irrigation applied

Statistical comparisons:

Between nozzles: brand C



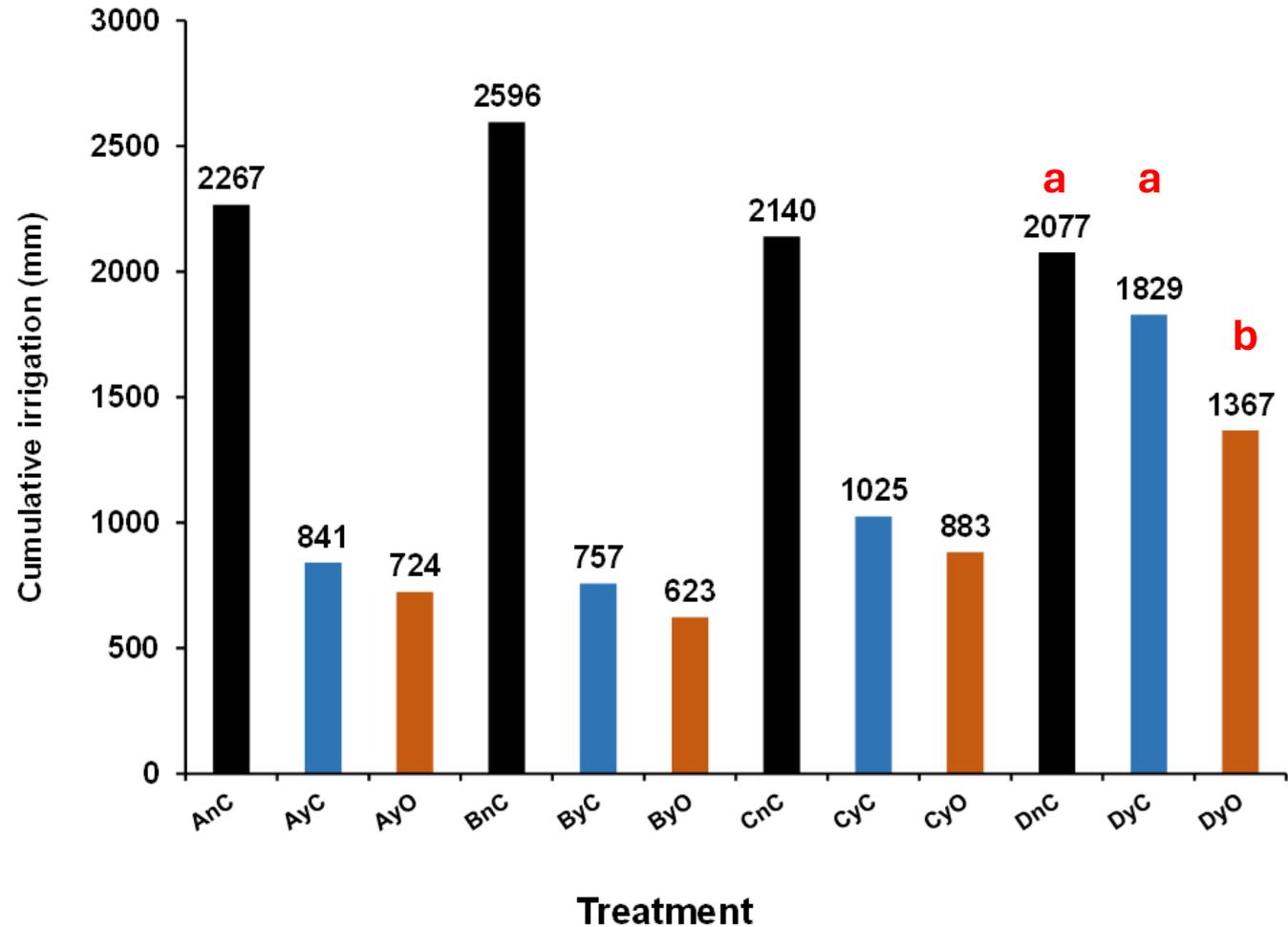
# Water savings



# Irrigation applied

Statistical comparisons:

Between nozzles: brand D



# CONCLUSIONS

## Brands A & B:

- HE nozzles achieved larger water savings vs their respective traditional nozzles (between 63 and 76%).
- Without the need of additional pressure regulation.
- Exchanged w/o extra cost or pressure regulation.

# CONCLUSIONS

- **Brand C:**

- HE vs traditional nozzles saved less water than brands A & B
- Need optimized pressure regulation to achieve higher water savings
- Need higher maintenance → less attractive

- **Brand D:**

- Their HE nozzles saved the least water
- Would need pressure regulation to save a significant amount of water

## LIMITATIONS OF THE STUDY

- TQ and DU were not evaluated.
- Water saving effects not known on the turf quality.

# Acknowledgment

- We want to thank Tampa Bay Water for funding this study.



Questions?

