Water saving in arid irrigated lands
comparison of different irrigation techniques adopted under date palms in Tunisian oasis

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Presentation plan

- **Introduction**

- Tunisian oasis
- Tunisian Oasis Irrigation State
- Study Objective

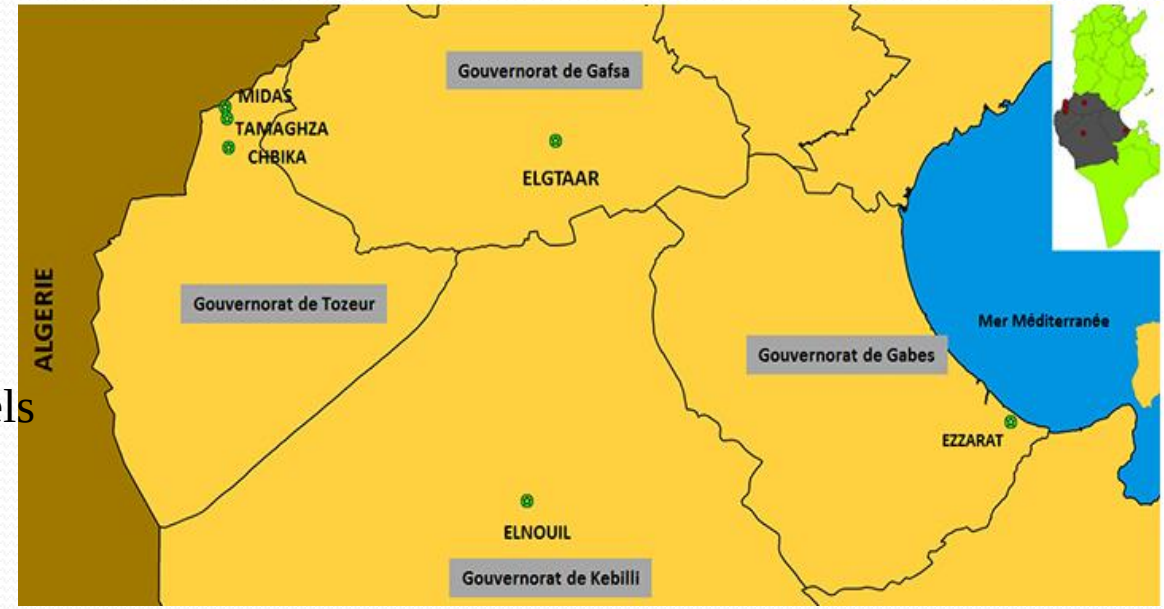
- **Study activities**
- **Results**
- **Comparison of results**
- **Conclusion**
- **Perspectives**

Tunisian Oases

Area oases: 53.9 miles Ha
60% Deglet Nour

Gafsa: 2197 Ha

Tozeur:
8444 Ha
4533 Moderns
3403 Traditionnels



Gabès:
6928 Ha

Kébili:
36000 Ha
25517 Moderns
5041 Traditionnels

Tunisian Oasis Irrigation State

Surface water 6%
Surface groundwater 15%
Deep goundwater 58%

+60% ≥ 1.5g/l → **Important but Overexploitation**

Irrigation system unsuitable for demand_ management nexus ⟷ ***Inefficient irrigation management***

Ressource losses &water stress & yield losses

Poor governance




Study objective

Improvement of date palm irrigation

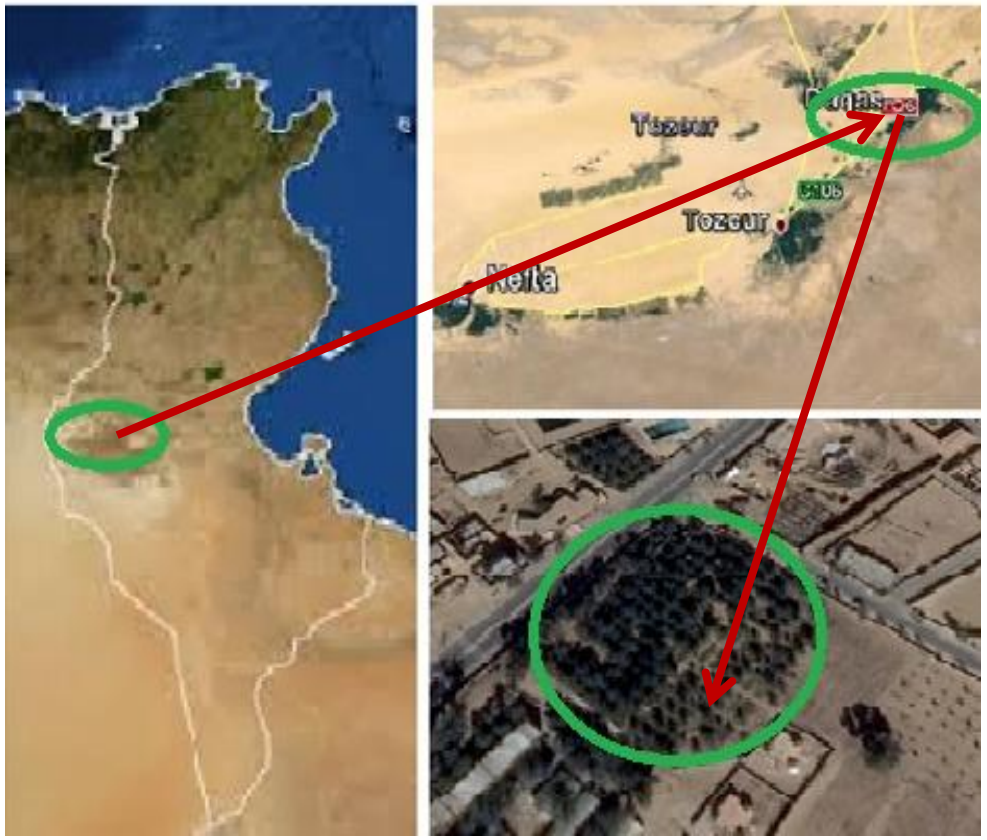
Identification of the an efficient irrigation system under date palm trees

Study activities

Soil physical & hydrodynamic properties

Assessment of different irrigation techniques under date palm

Comparison of different irrigation techniques

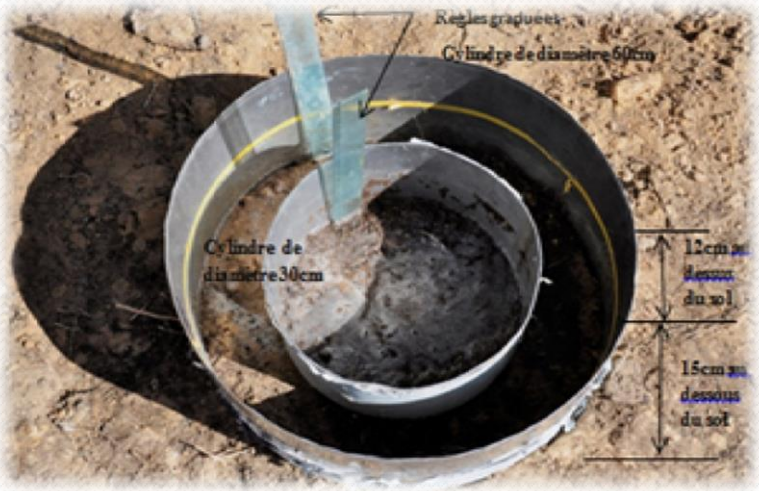


Material for soil characterization

Soil texture (Robinson-Kôhn pipette)

Measurement of Bulk density (Cylinders)

Richards Press(θ_{cc} & θ_{pf})



Double rings of Muntz
Infiltration & Ks

Irrigation assessment

Drip Subsurface irrigation

Mini diffuser

Bubbler

- Soil moisture

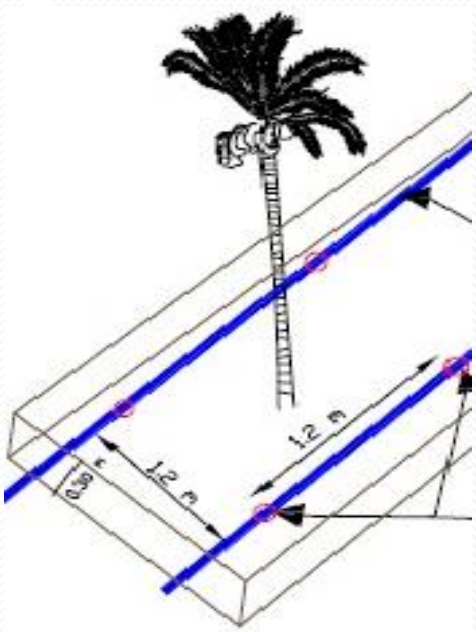
- Surface Wet radius

-Salinity

Before irrigation, just after, 24h and 48h after irrigation

Irrigation assessment

Drip subsurface irrigation

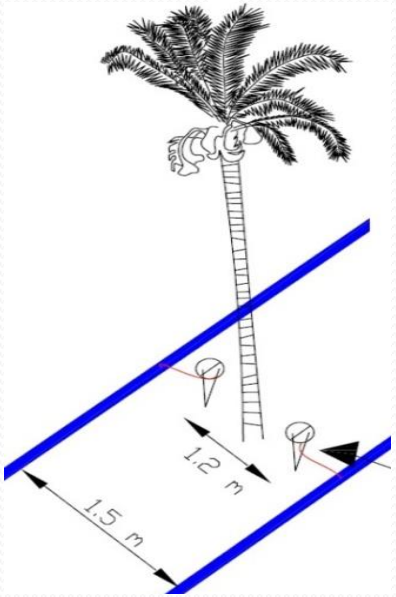


2.7h, q = 0.09 l/s

Mini diffuser

3h, q = 0.07 l/s

Bubbler



5h, q= 0.1 l/s

Irrigation assessment

Soil moisture (%) →

$$\theta = \frac{p_h - p_s}{p_s} * d * 100$$

Distribution Uniformity (%)

$$CU = 100 * [1 - (\sum|\theta i - \bar{\theta}|)/n\bar{\theta})]$$

Desalination Efficiency (%)

$$c_e = \frac{C_f - C_i}{C_f} * 100\%$$

Irrigation Water efficiency (%) →

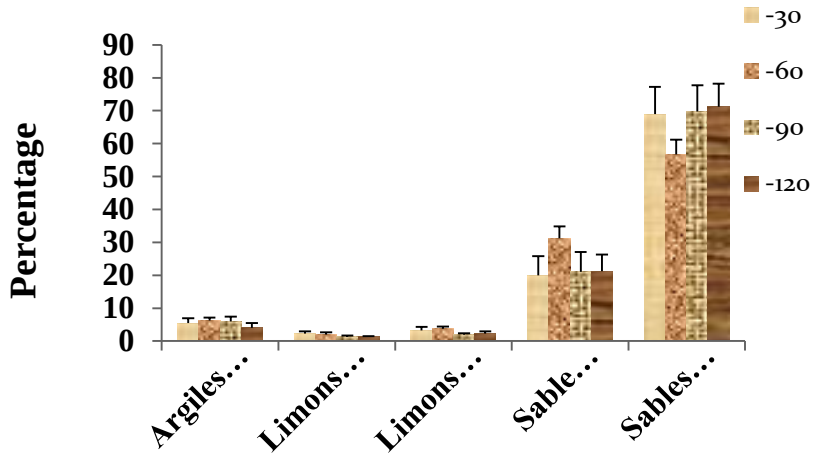
$$E_a = 100 \frac{V_{zr}}{V_T}$$

Water Use Productivity →

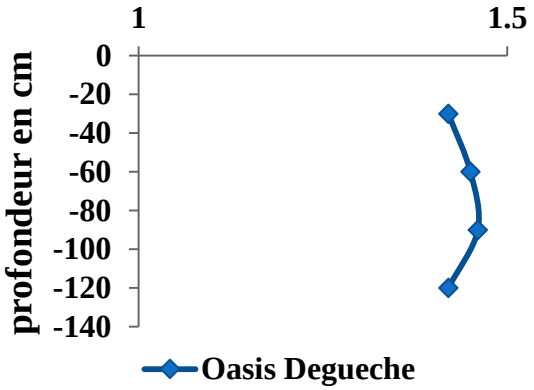
WUE
Yield kg / volume of water supplied m3

Results

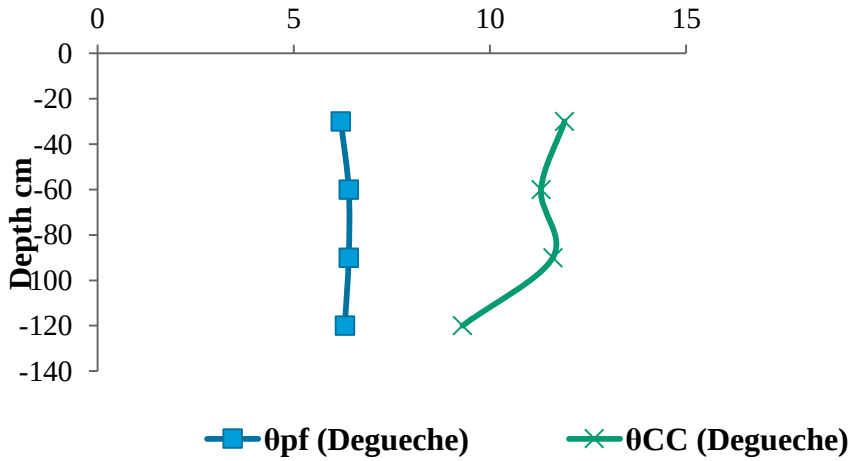
Soil Texture



Bulk Density



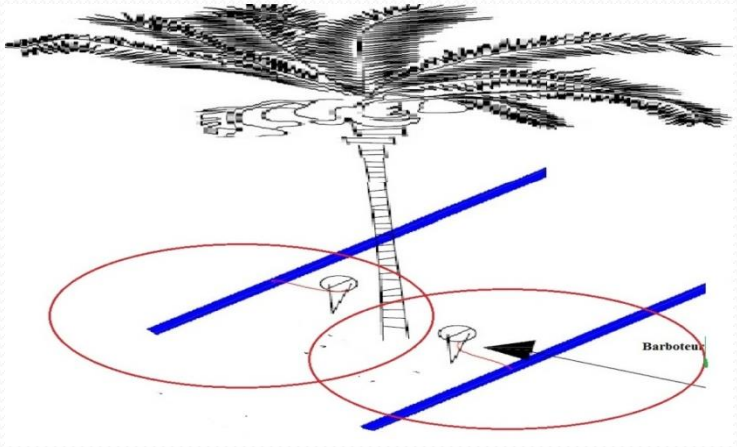
Characteristic soil water content



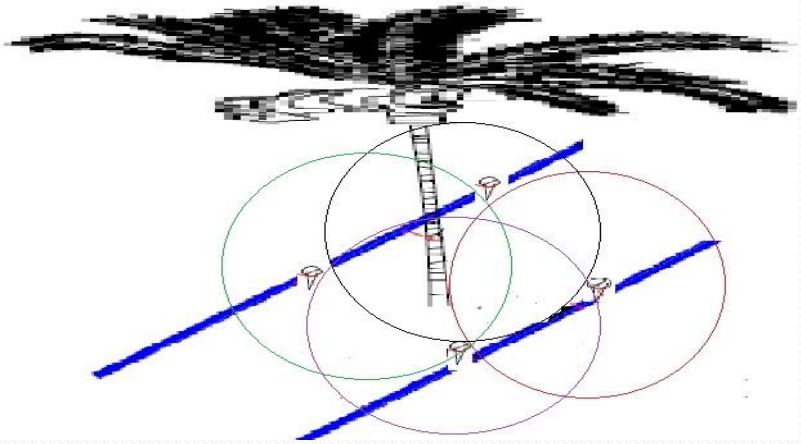
Philips Infiltration equation

$$I(t) = 2.10^{-4}t + 2.10^{-4}\sqrt{t}$$

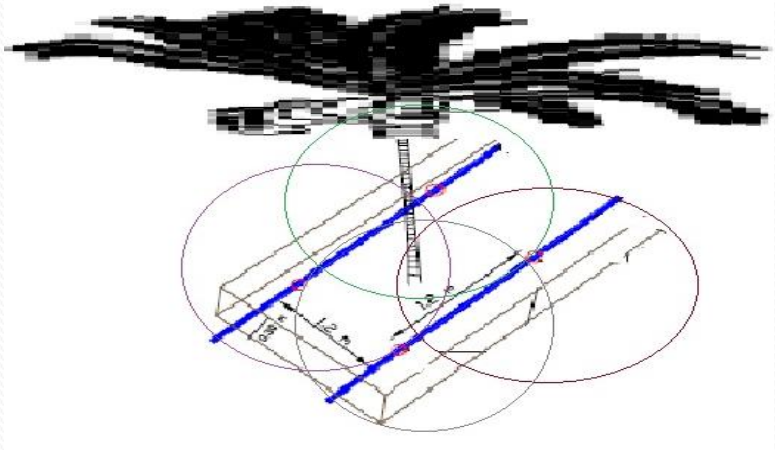
Results: Wet surface Raduis



Bubbler: 170 to180 cm

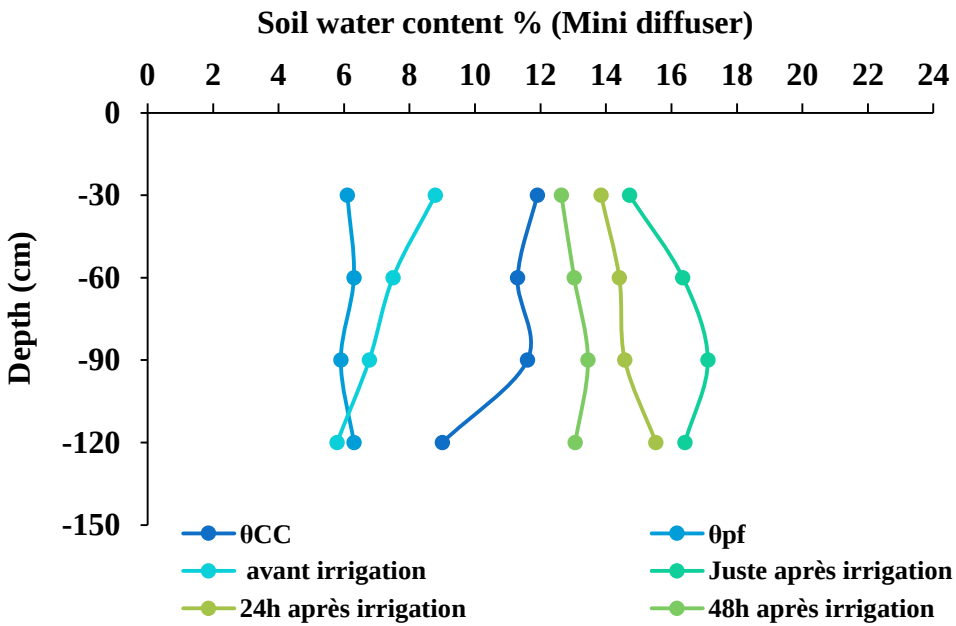


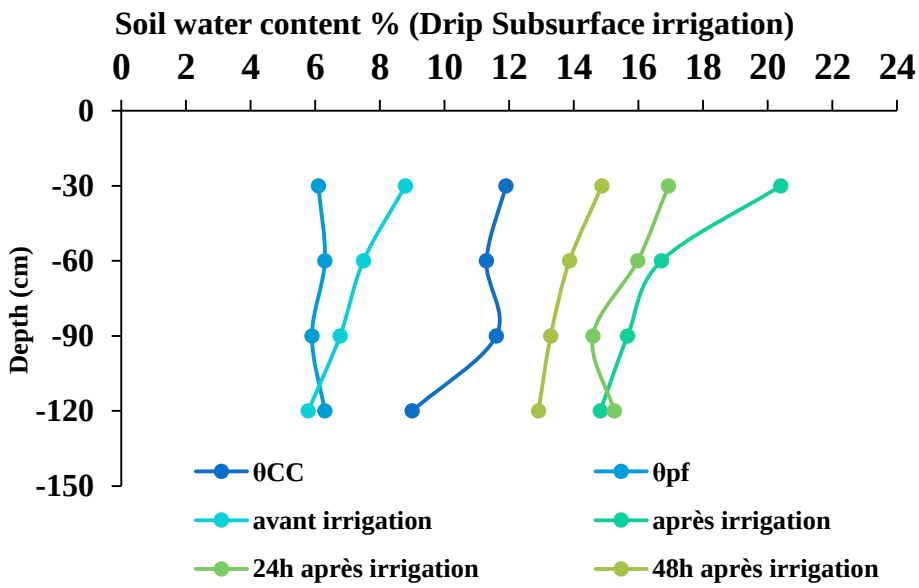
Mini diffuser 120 to130 cm

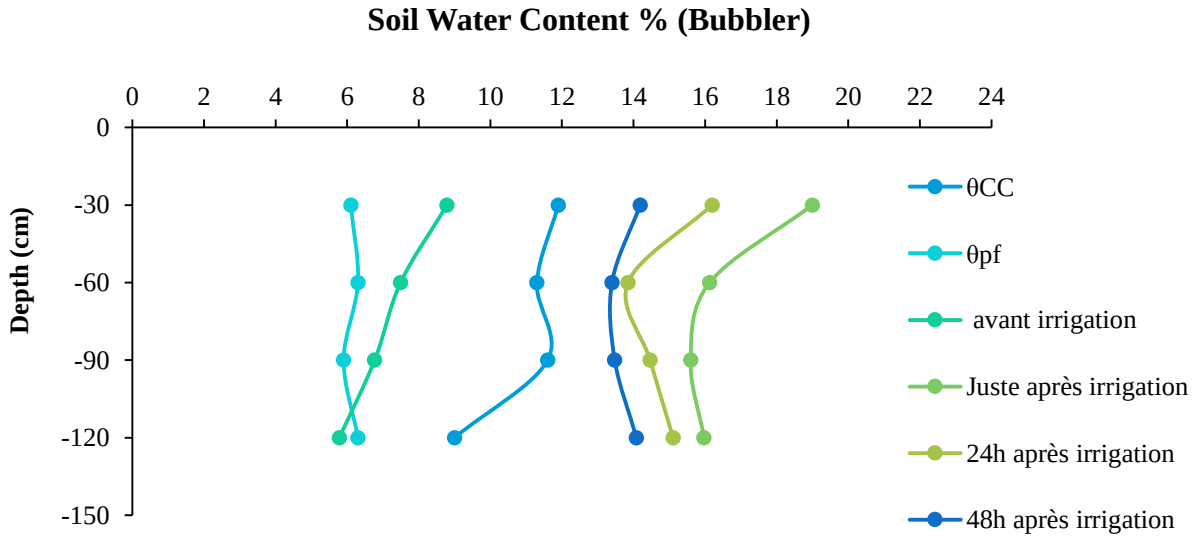


Drip subsurface irrigation 120 to 150 cm

Results: soil Moisture







Comparison of Results

	Drip subsurface irrigation (2.7h)	Mini diffuser (3h)	Bubbler (5h)
Soil water content (after irrigation) %	17	16	16
Wet surface Radius (cm)	120	110	170
Water losses (mm)	71	63	57
CU % (After irrigation)	90	95	96
Ea % (0-1.2m)	30	45	62
C_e (%)	**36**	**11**	**67**

Comparison of Results

	Mini diffuser	Drip surface irrigation	Bubbler
2013	43±0,33	42±0,88	42±0,56
2014	57±0,88	54±0,33	60±0,66
2015	63±0,66	59±0,57	66±0,55

Conclusion

Best Efficiency of irrigation water application by bubbler (62-78%)

Good homogeneity distribution of irrigation water (5h) ≥ 90%

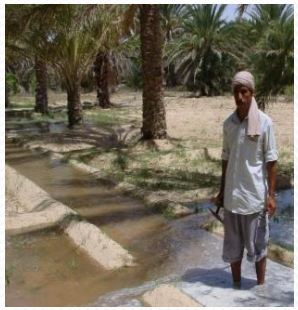
Productivity of irrigation water 2013-2015 (36%)

Best wet surface Radius bubbler (170 to 180 cm)

The best desalination efficiency (67%)

Perspective?

Adapt all oasis stakeholders to climate change conditions through introducing Bubbler system



Thank you for your attention