



Water-saving techniques in citrus fruit trees

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THE IRRIGATED AREA IN MURCIA

- 90% of region is low volume irrigation.
- High efficiency water transport.
- Subterranean water is high salinity.

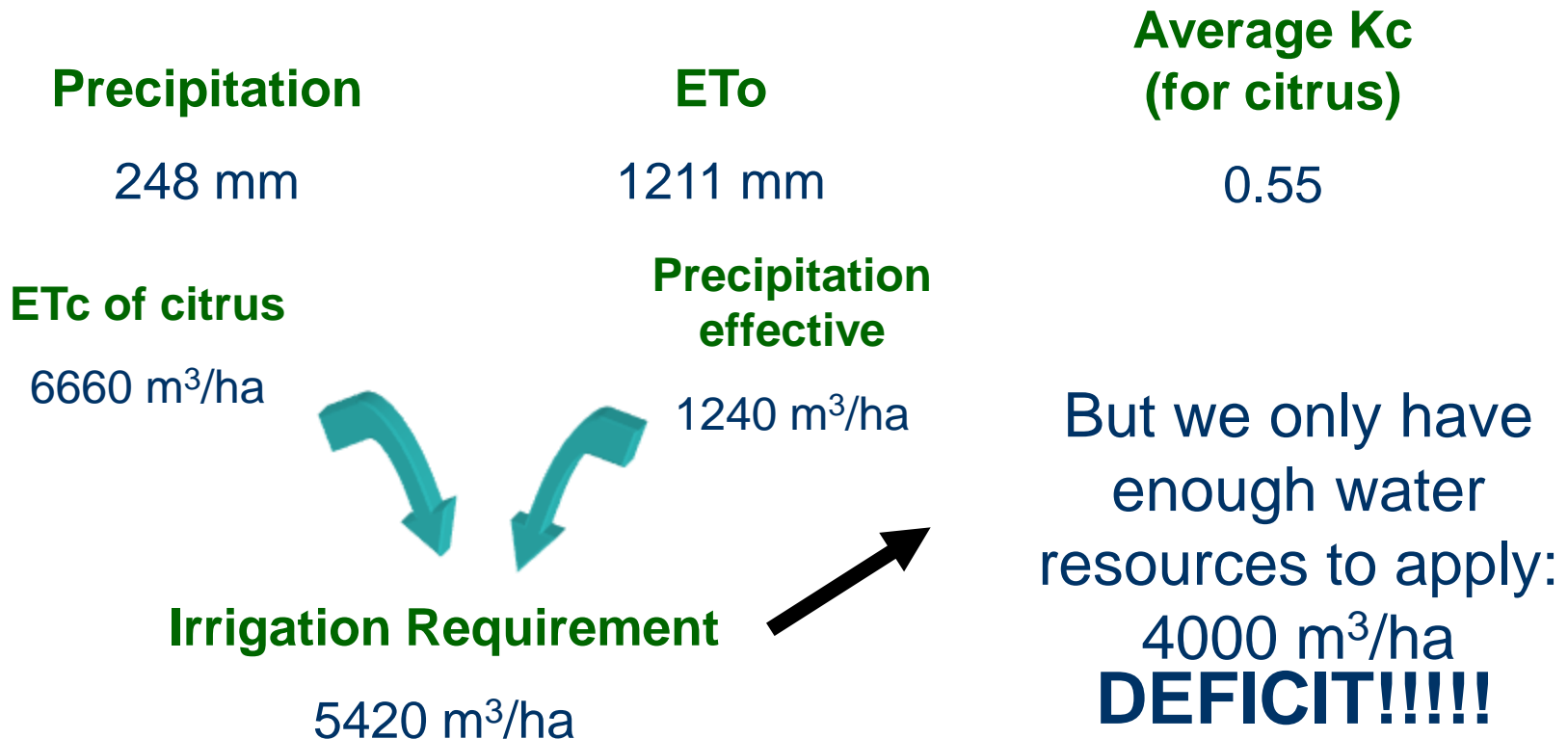


Annual Drought Stress

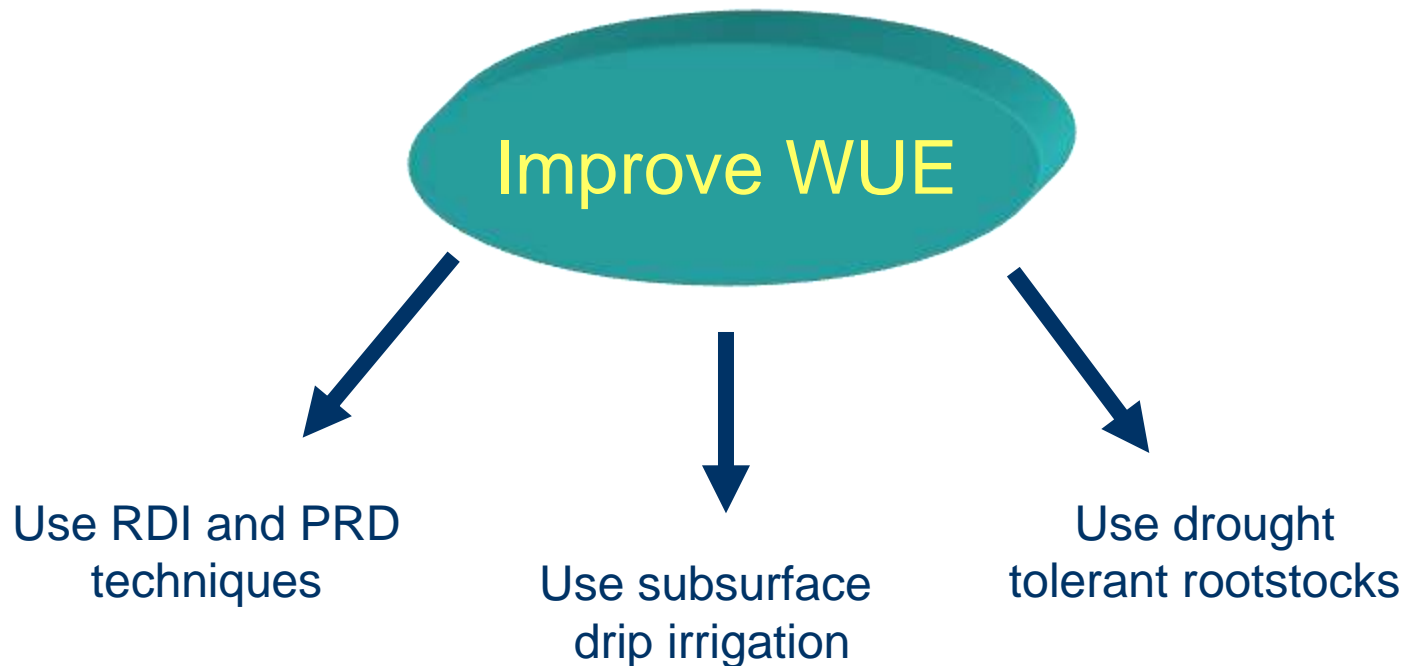
Irrigation surface	Crop Requirements	Deficit
100,626 Ha	566.2 hm ³	197.4 hm ³ /year

Citrus area in the “Región de Murcia”

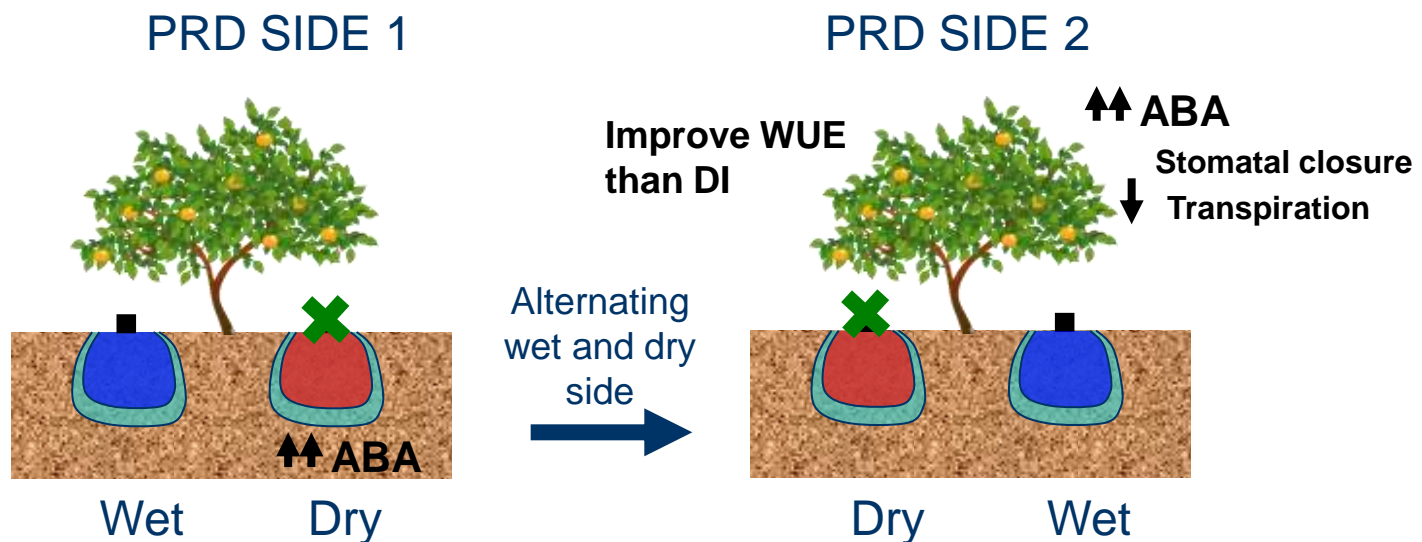
Average over the last 10 years:



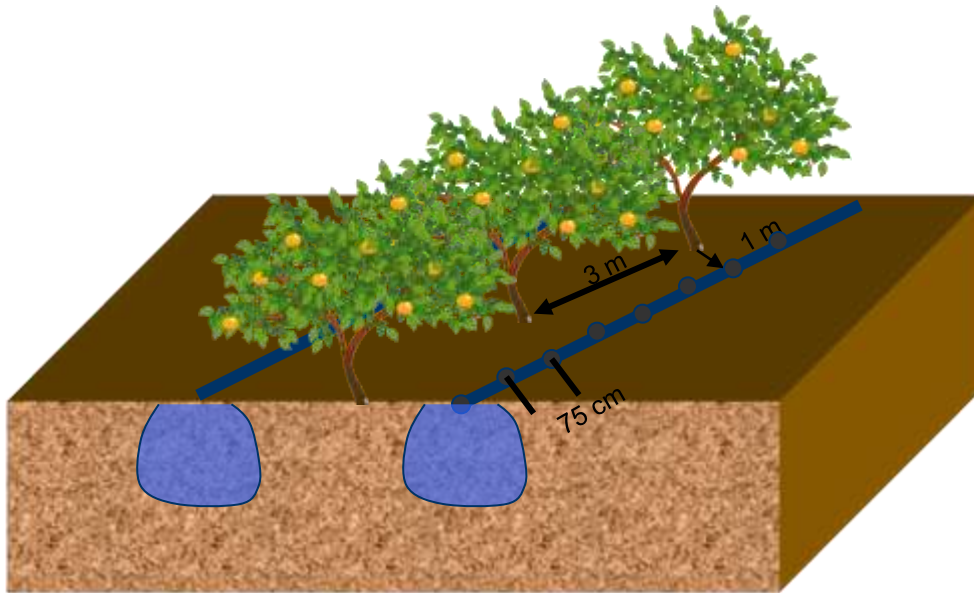
Possible ways to improve WUE in citrus



Use of partial root-zone drying to improve water use efficiency in lemon trees.



PRD vs DI



2 drip lines with
6 self-compensating drippers
(3.6 L h^{-1}) per tree, apart 0.75 m.

17 years-old 'Fino 49' lemon trees grafted on *Citrus macrophylla* with tree spacing of 8 3 m.



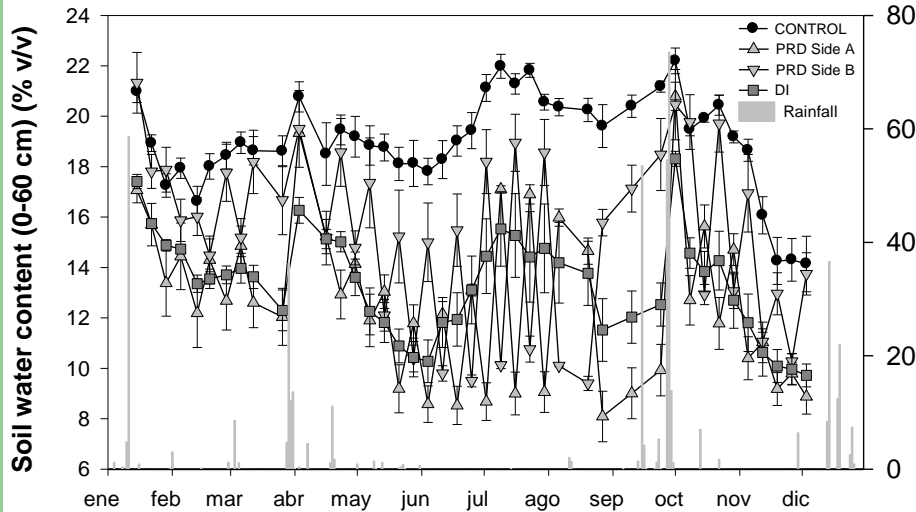
PRD vs DI

Rules for applying PRD

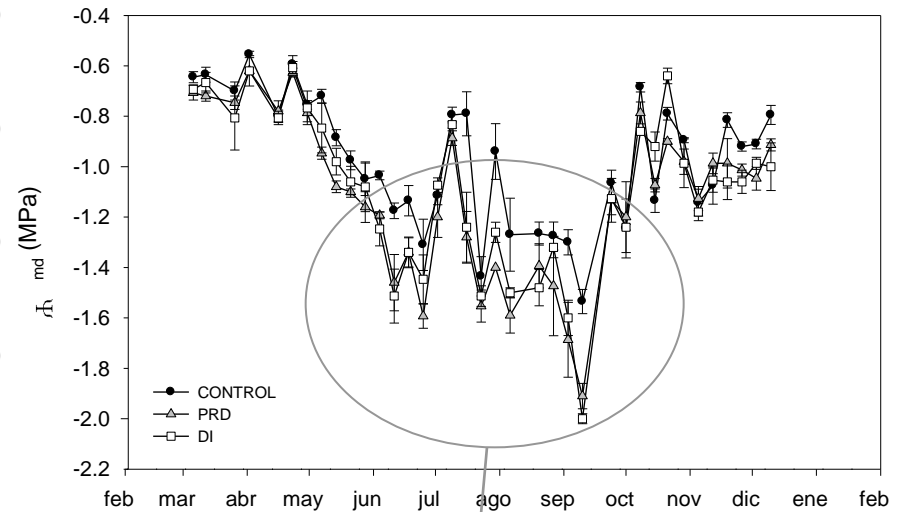
- Apply enough water to keep soil water content of the wet part higher than 18% (50-75% ET_c of Control)
- DI treatment was irrigated with the same water volume as PRD
- PRD wet-dry sides were switched every 7 days
- DI and PRD were applied all year round

PRD vs DI

Soil water content



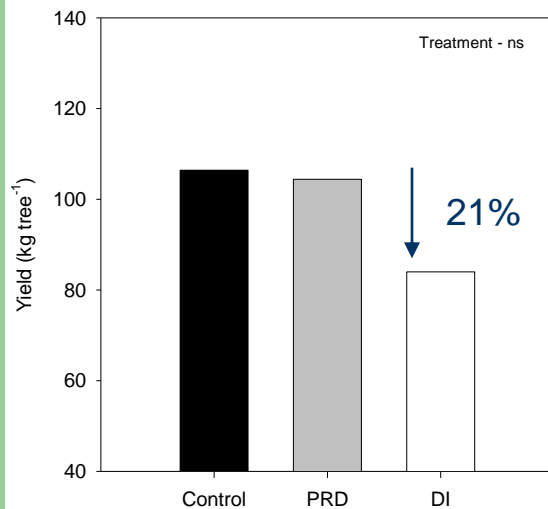
Plant water status



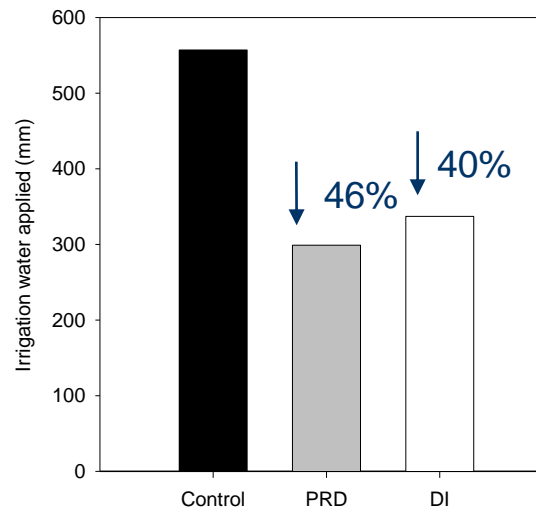
Both DI and PRD had similar values of Ψ_{md} during the high evapotranspiration period.

PRD vs DI

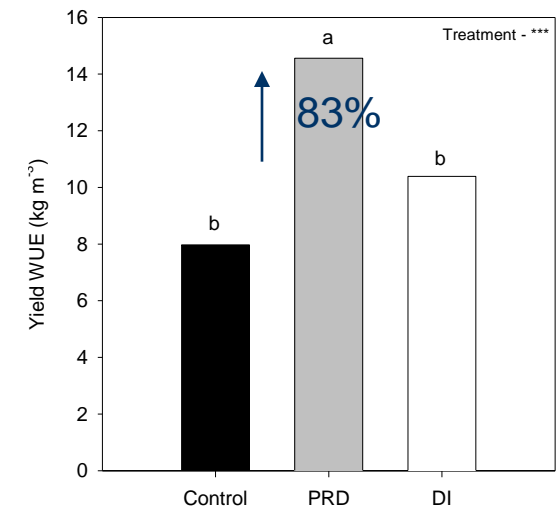
Yield



Water applied



Water Use Efficiency



There were no yield differences between treatments, thus WUE was significantly increased by PRD.

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IMPROVING CROP WATER USE EFFICIENCY OF LEMON TREES BY COMBINING PRD AND SUBSURFACE DRIP IRRIGATION

Irrigation system vs PRD

Surface



Sub-surface



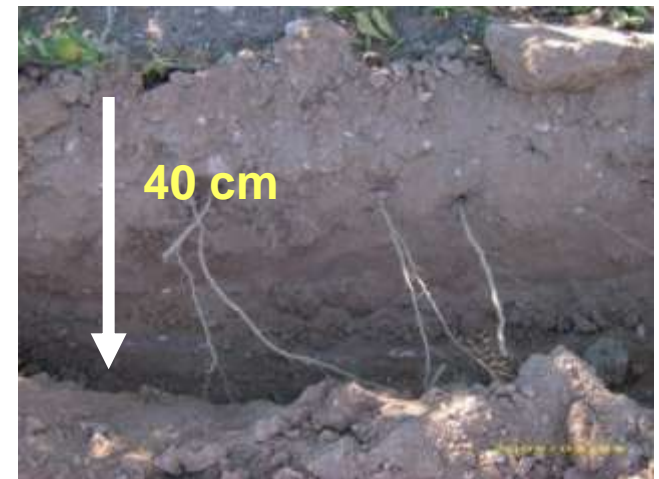
17 years-old 'Fino 49' lemon trees grafted on *Citrus macrophylla* with tree spacing of 8 3 m.

2 drip lines with 6 self-compensating drippers (3.6 L h^{-1}) per tree, apart 0.75 m.

Irrigation system vs PRD



Details of subsurface system



Irrigation system vs PRD

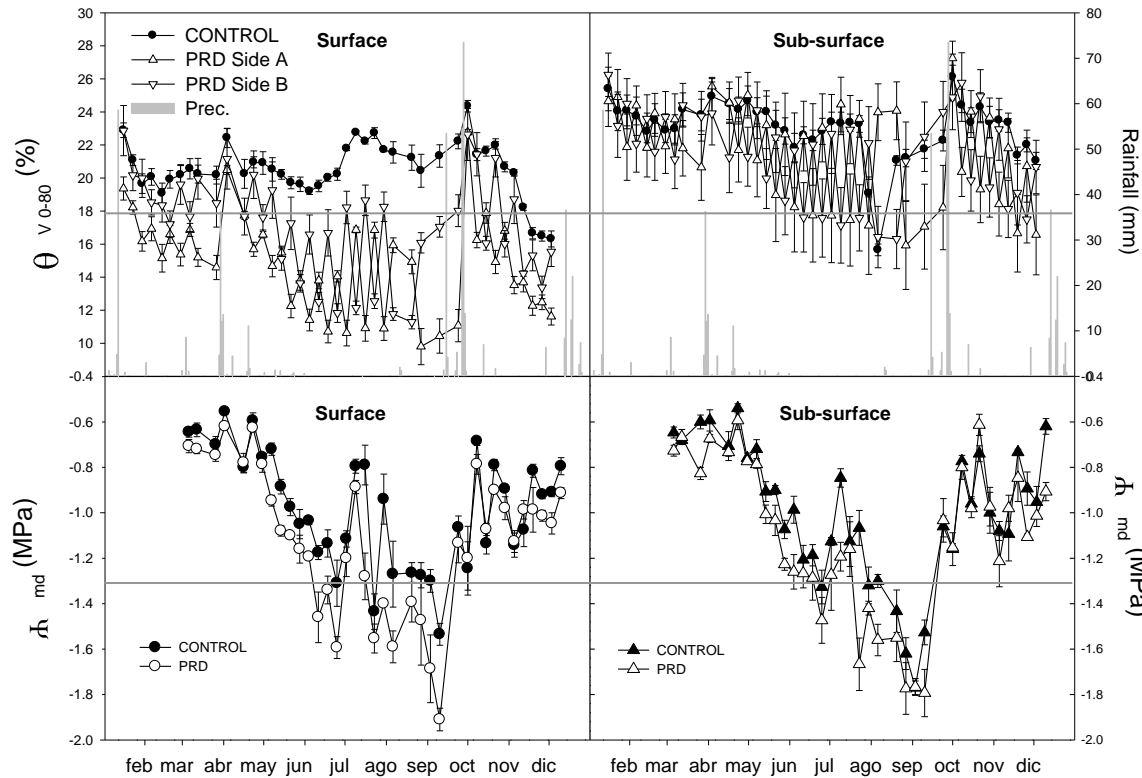
Rules for applying sub-surface irrigation:

- Keep soil water content higher than 18% and leaf water potential < -1.3 MPa (60-80% ET_c surface system).

Rules for applying PRD :

- Apply enough water to keep soil water content of the wet part higher than 18% (50-75 % ET_c control.
- PRD wet-dry sides were switched every 7 days.
- PRD was applied all year round.

Irrigation system vs PRD

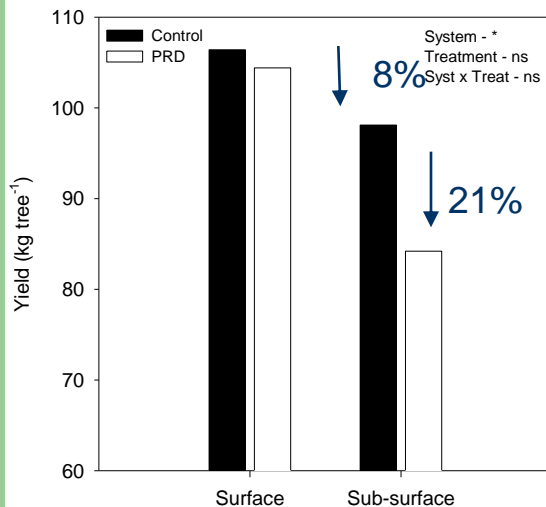


Soil and plant water status

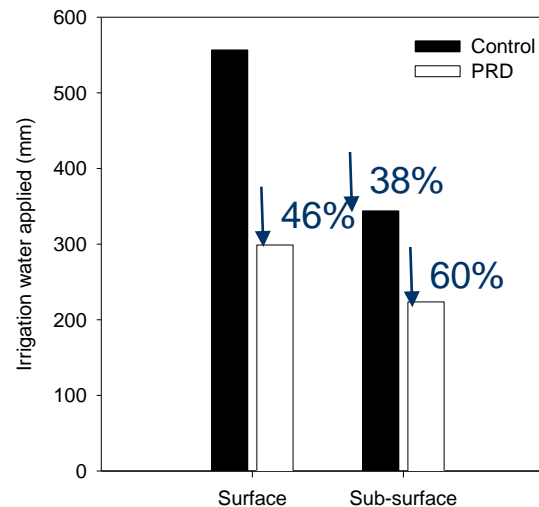
PRD reduced Ψ_{md} more in surface than in subsurface

Irrigation system vs PRD

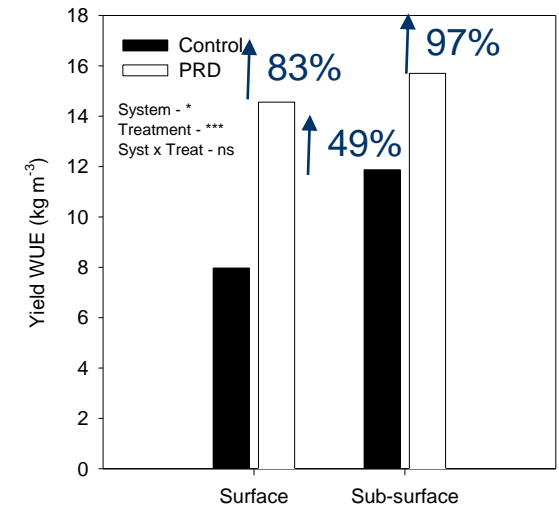
Yield



Water applied



Water Use Efficiency



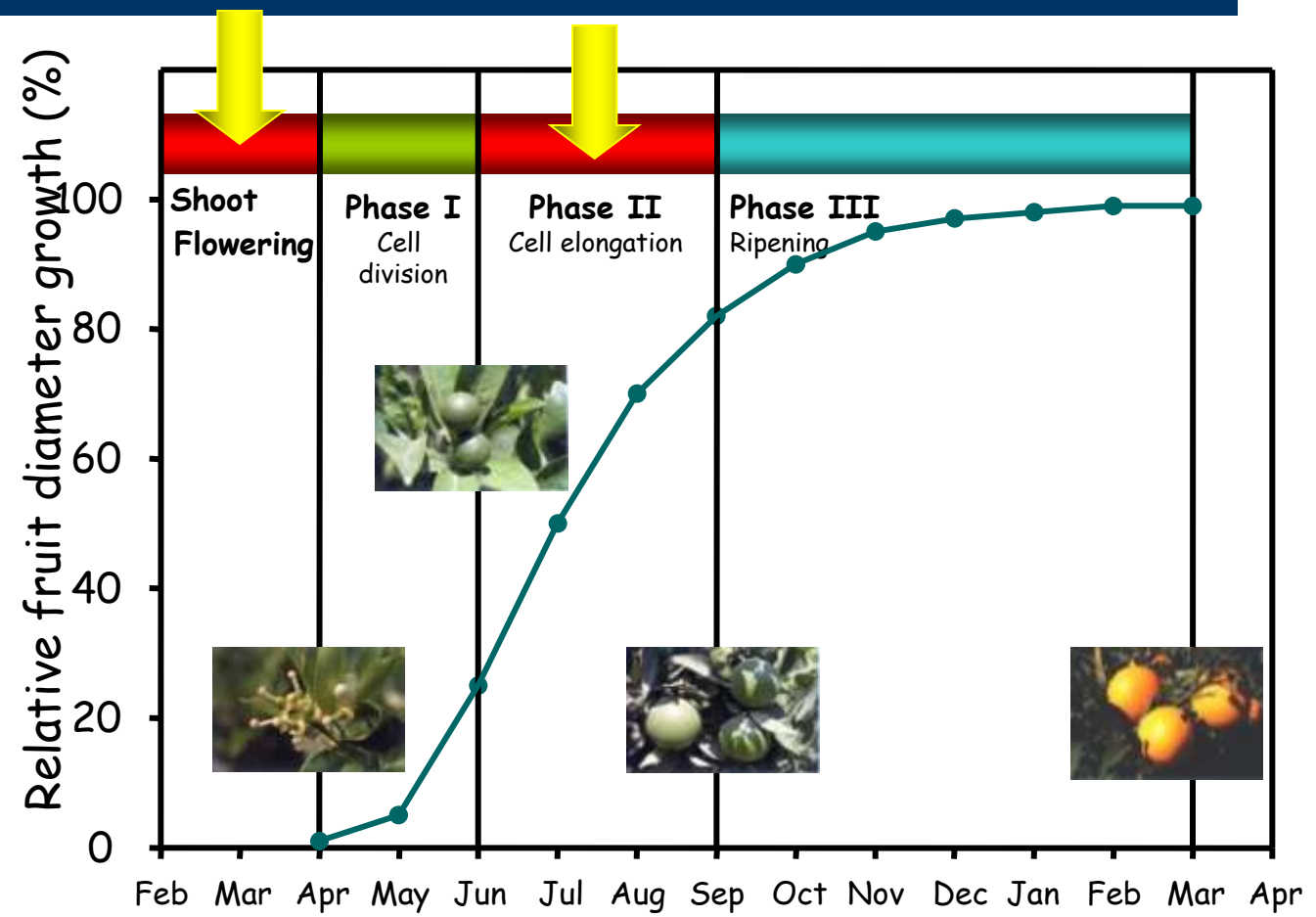
Sub-surface - ↑ WUE
PRD - ↑ WUE

Applying sub-surface PRD reduced yield slightly but increased significantly WUE.

Water stress sensitivity

- Low
- Medium
- High

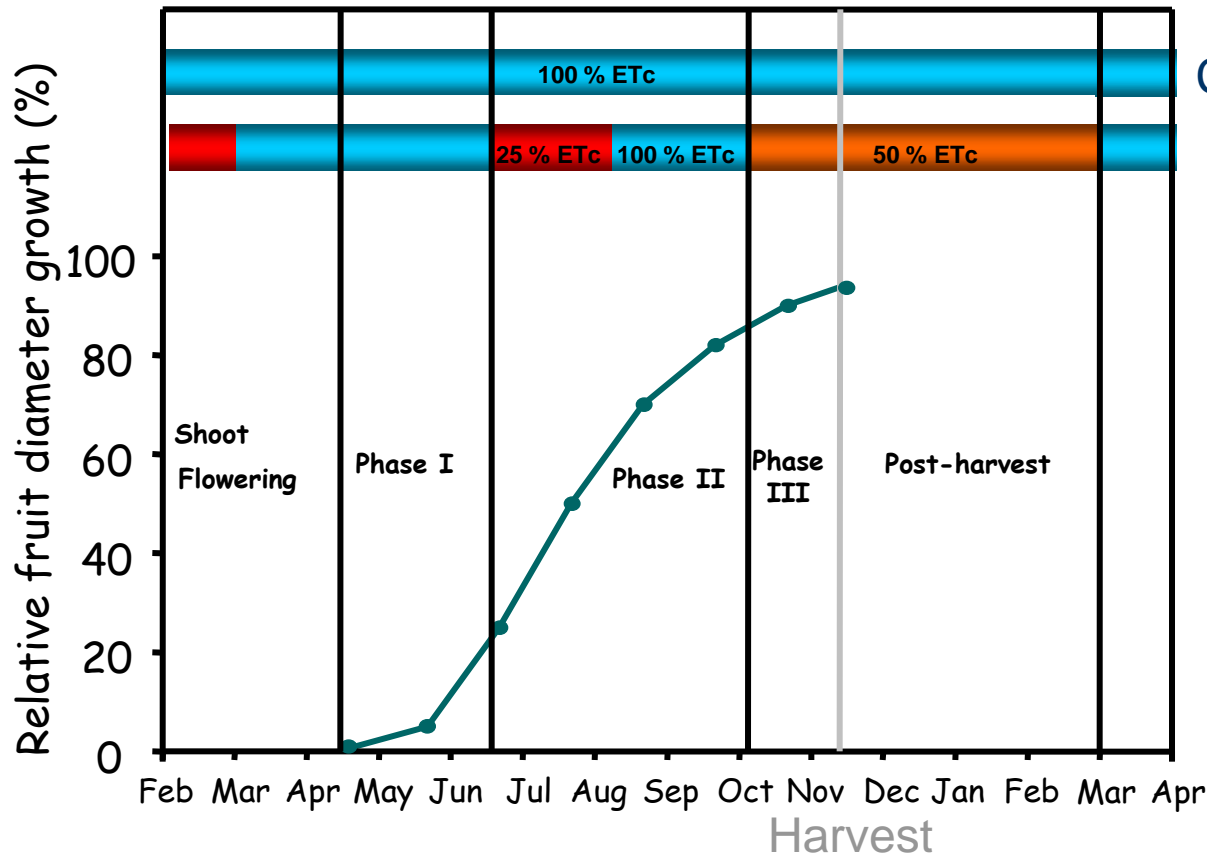
Critical periods in citrus



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Use of Optimised RDI strategy in mandarin trees.

Optimised RDI strategy in mandarin



Control

RDI

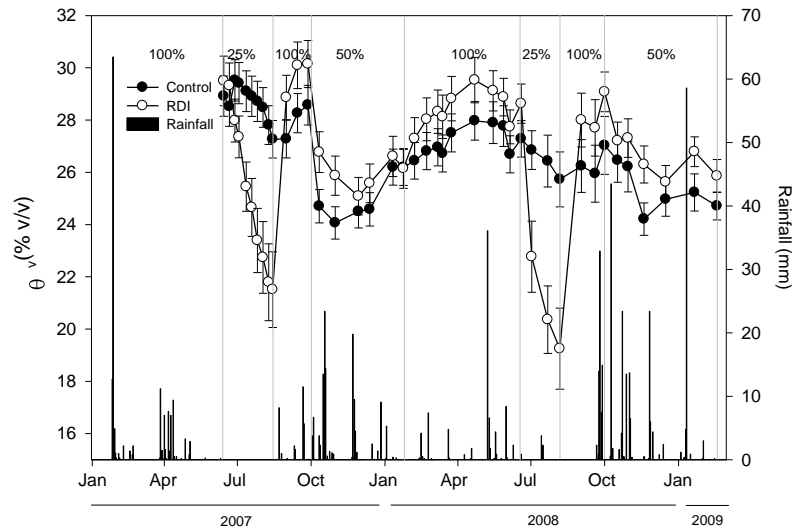
Optimized RDI strategy based in previous studies:

Gonzalez-Altozano and Castel, 1999 J. Am. Soc. Hort. Sci. 74: 706-713

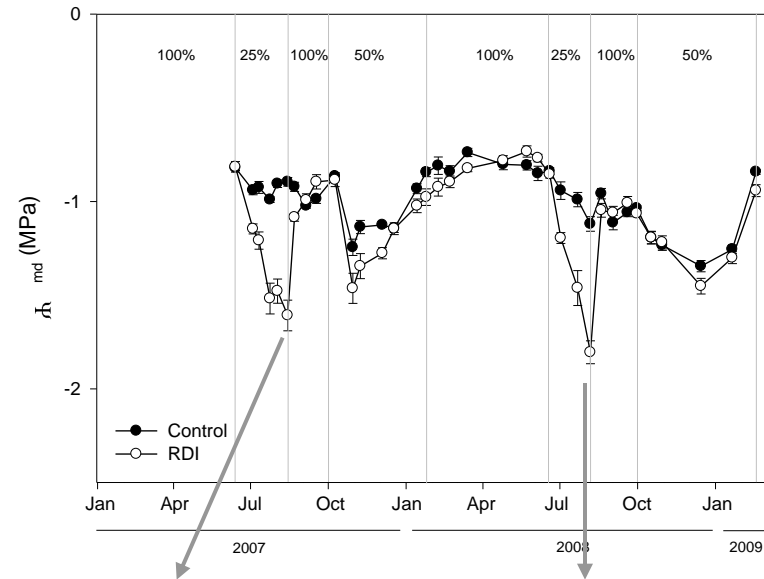
Romero et al., 2006, Tree physiol 26(12):1537-1548

Optimised RDI strategy in mandarin

Soil water content

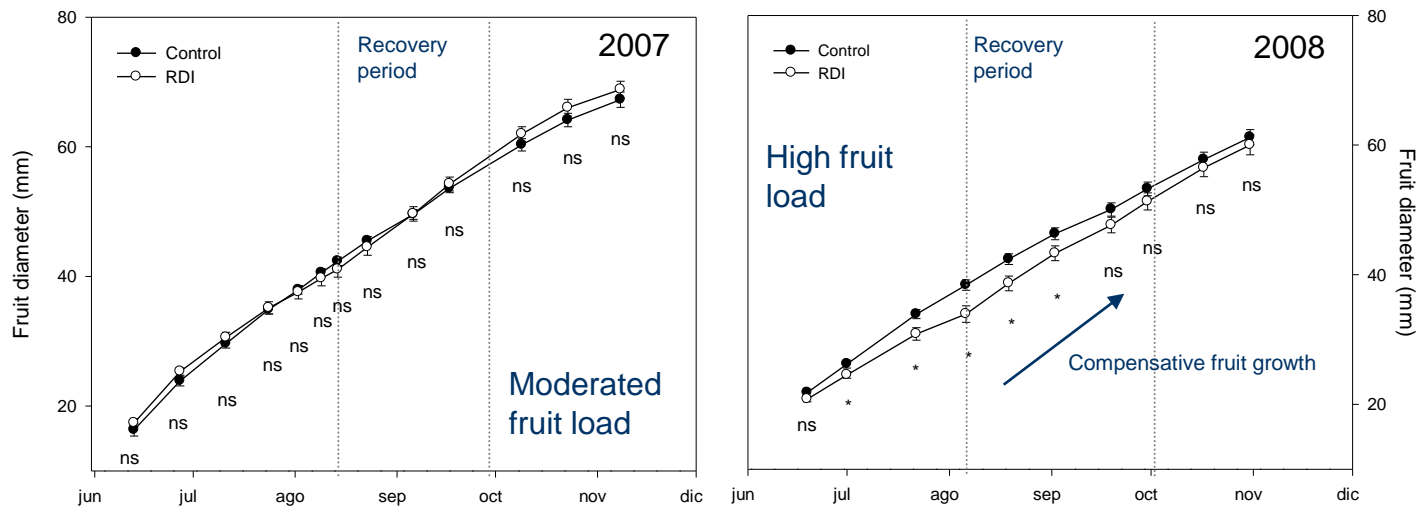


Plant water status



RDI affected plant water status mainly during period I in both years.

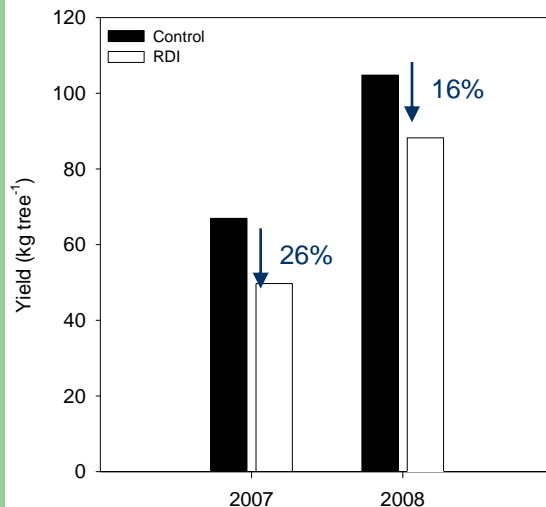
Optimised RDI strategy in mandarin



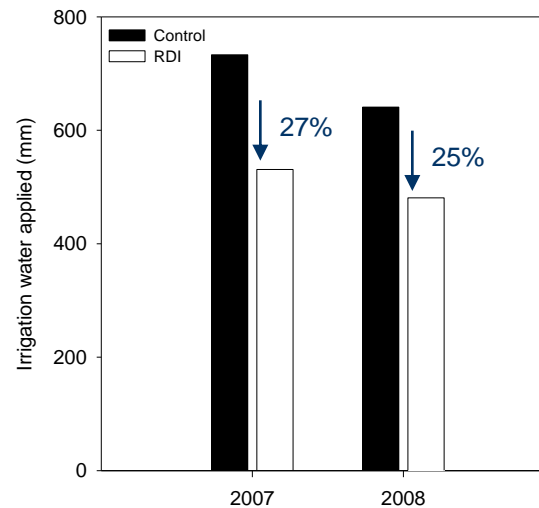
In 2008, RDI reduced fruit growth during period I, but this was compensated by increased growth during the recovery period.

Optimised RDI strategy in mandarin

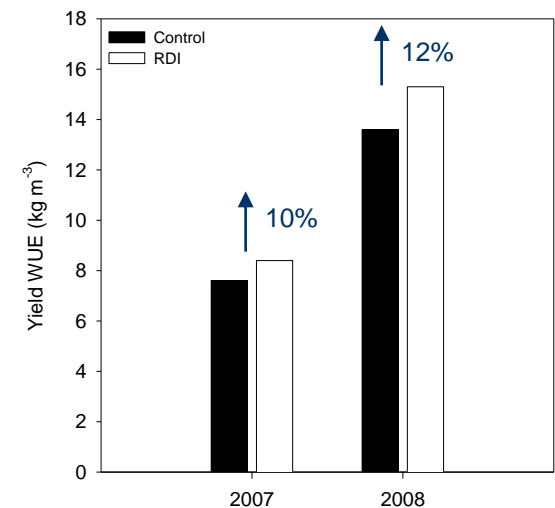
Yield



Water applied



Water Use Efficiency



RDI decreased yield due to a reduction of fruit load but the water saved increased WUE

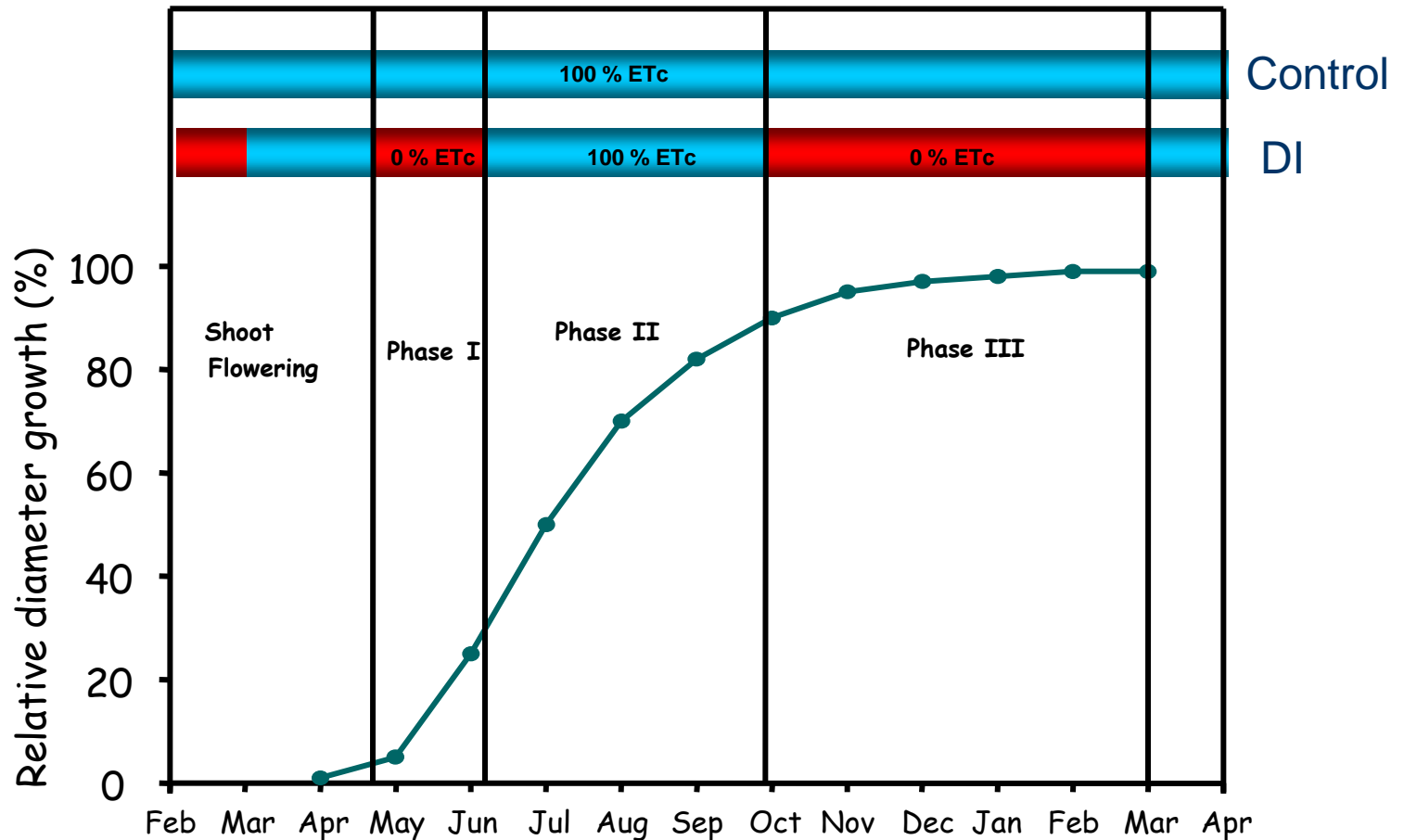
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Interaction Drought tolerant rootstock x Deficit Irrigation

Interaction Rootstock vs DI

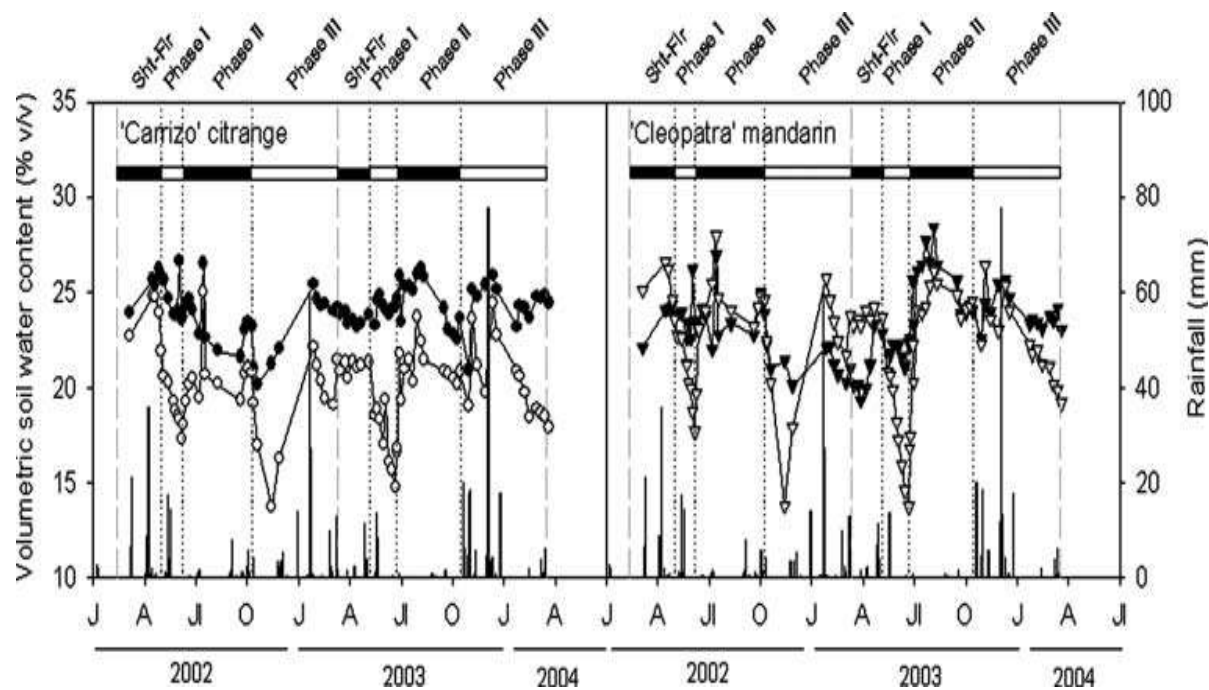
- Adult trees of 'Lane late' navel orange grafted on:
 - Carrizo 'Citrange' (Drought sensitive)
 - Cleopatra 'Mandarin' (Drought tolerant)
- Two irrigation treatments:
 - Control (100% ET_c)
 - DI

Interaction Rootstock vs DI



Interaction Rootstock vs DI

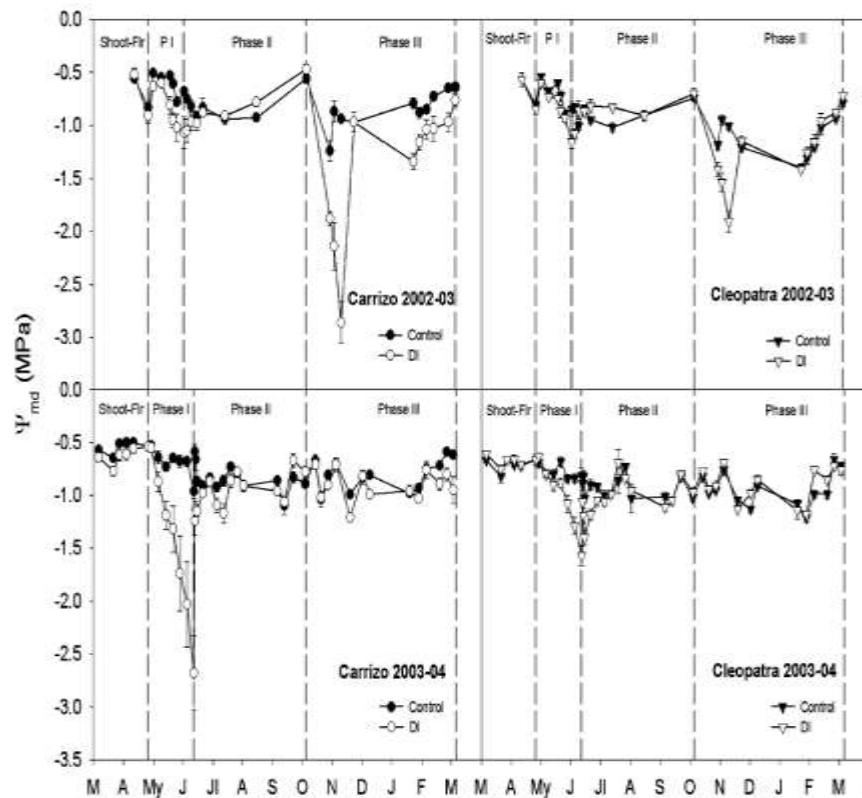
SOIL WATER CONTENT



Cleopatra had higher soil moisture values than Carrizo

Interaction Rootstock vs DI

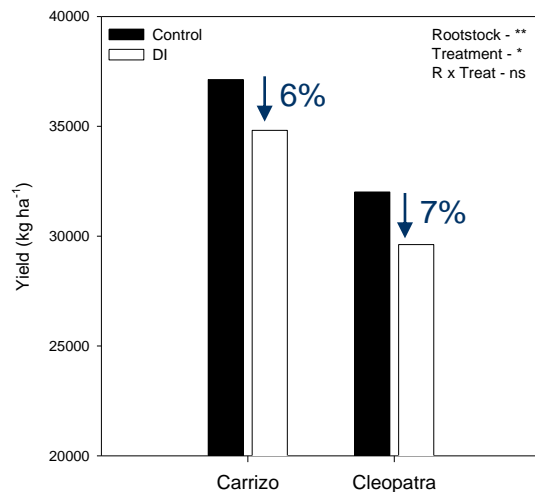
PLANT WATER STATUS



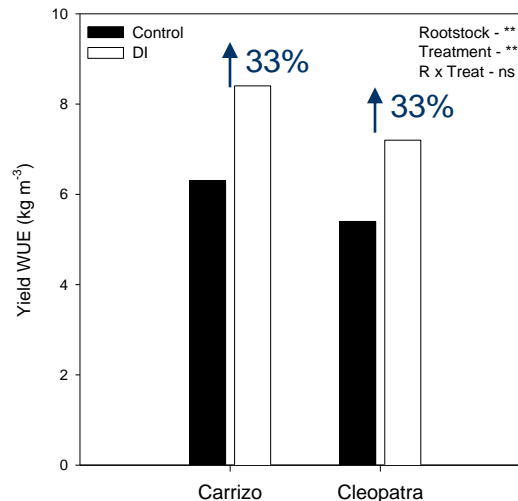
Cleopatra kept better plant water status than Carrizo under DI conditions.

Interaction Rootstock vs DI

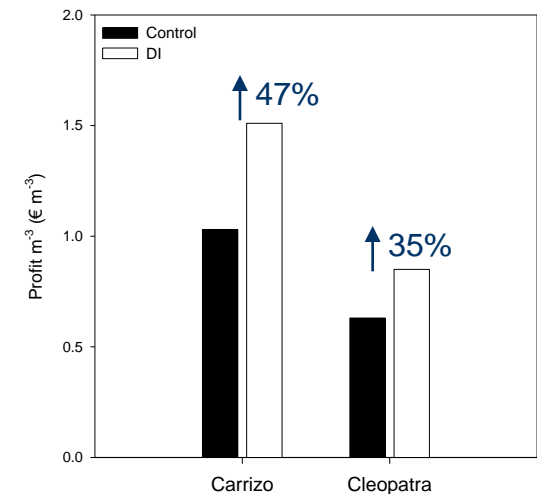
Yield



Water Use Efficiency

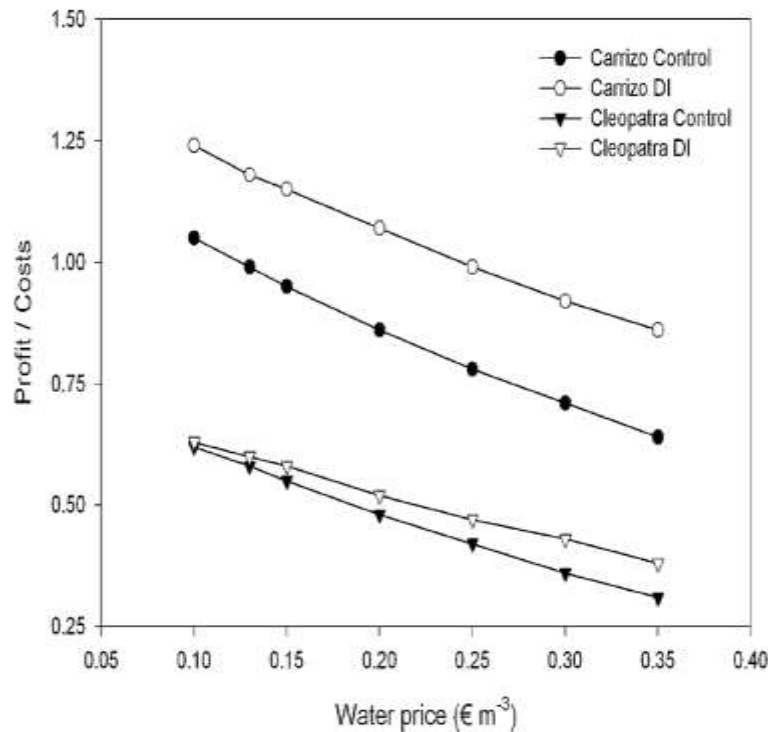


Profit



DI reduced yield, but increased WUE and profit in both rootstocks

Interaction Rootstock vs DI



An increase in water price reduced the final profit, but the water saved by DI increased the profitability when the price of water is high.

Fig. 2. Profit/costs (total costs) as a function of water price for each treatment and rootstock.

In conclusion...

The use of the different ways to improve WUE can be an important tool for citrus growers to save water and increase their profits when water is scarce or its price is high





**Instituto Murciano de Investigación y
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**THANK YOU FOR YOUR
ATTENTION**

