



Effect of Continuous Deficit Irrigation of Soybean [Glycine max (L.) Merril] in a semi-arid environment of Argentina

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Background and justification

What is happening in the world?

Water scarcity and more population



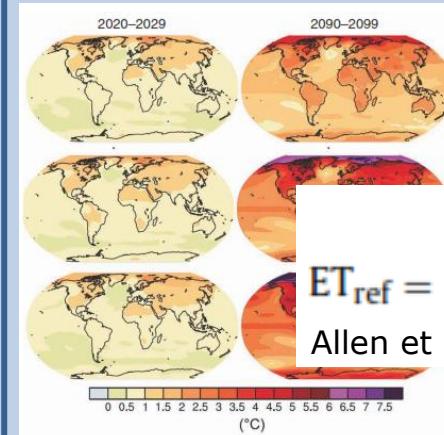
Less available
water and
more food
demand

What is happening in the world?

Water scarcity and more population



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World Climate Change

I- Increase of temperature

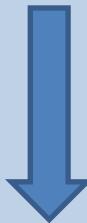
Could increase the vapor water demand of the atmosphere

II- Increase in extreme events, for example: DROUGHT

We must generate or evaluate strategies to increase "water productivity"

Irrigation strategies like **continuous deficit irrigation** (CDI) would achieves this challenge

Irrigation scheme in which the plants are exposed to a certain level of water stress throughout the growing season without causing significant decreases in performance.



In **SOYBEAN**, the major economical crop in Argentina, results are **contradictories** and we don't have antecedents in Argentina

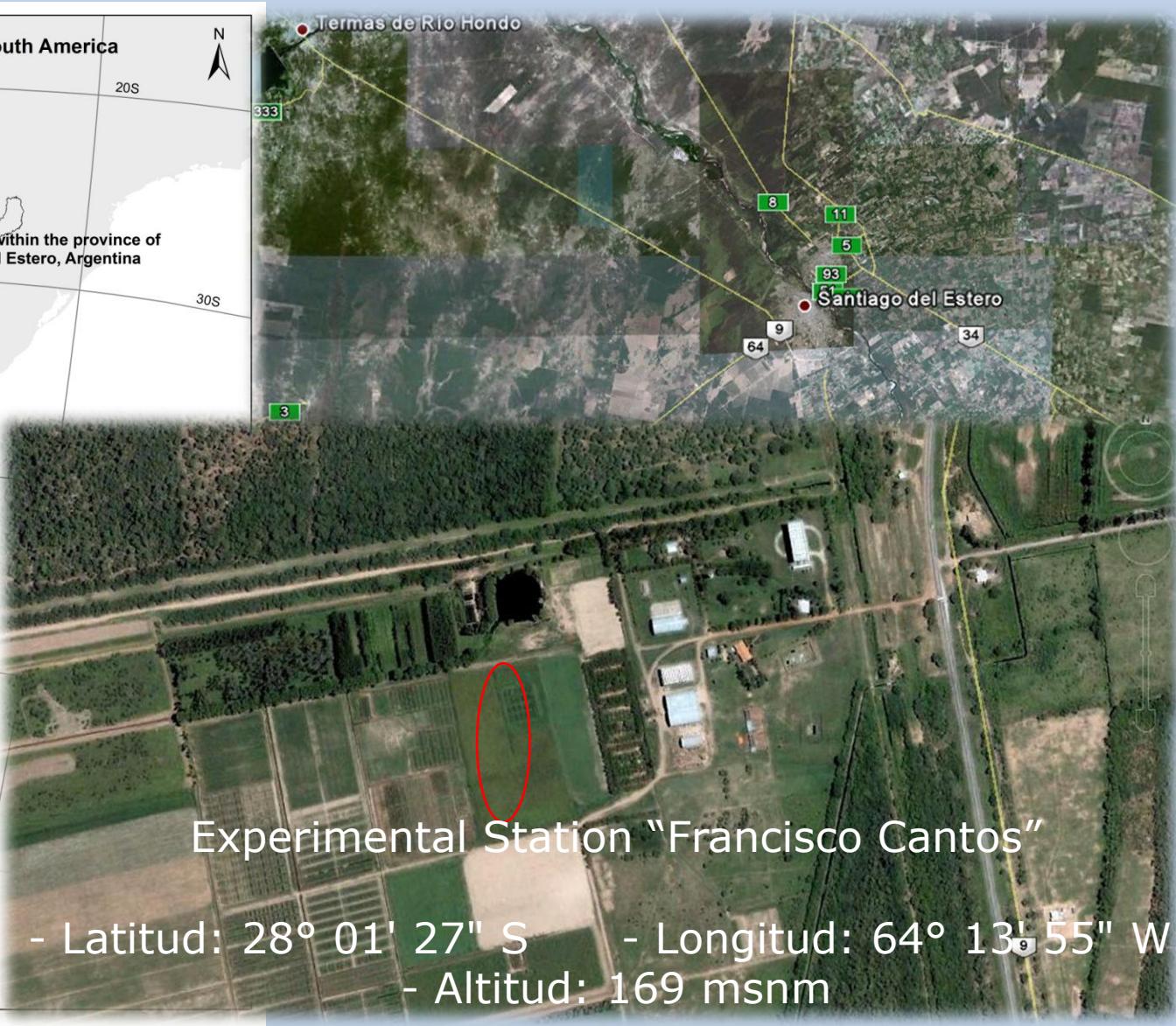
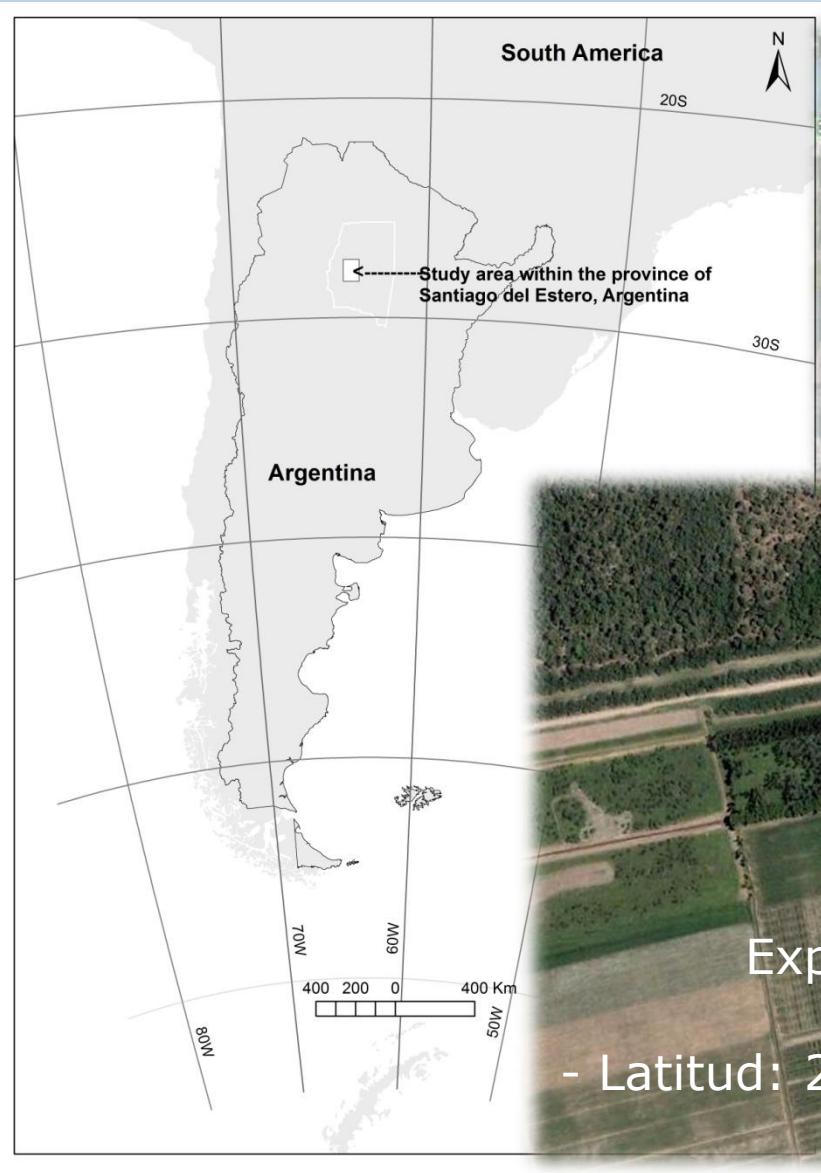
Objective

Evaluate the effect of different strategies of CDI during the cycle of soybean



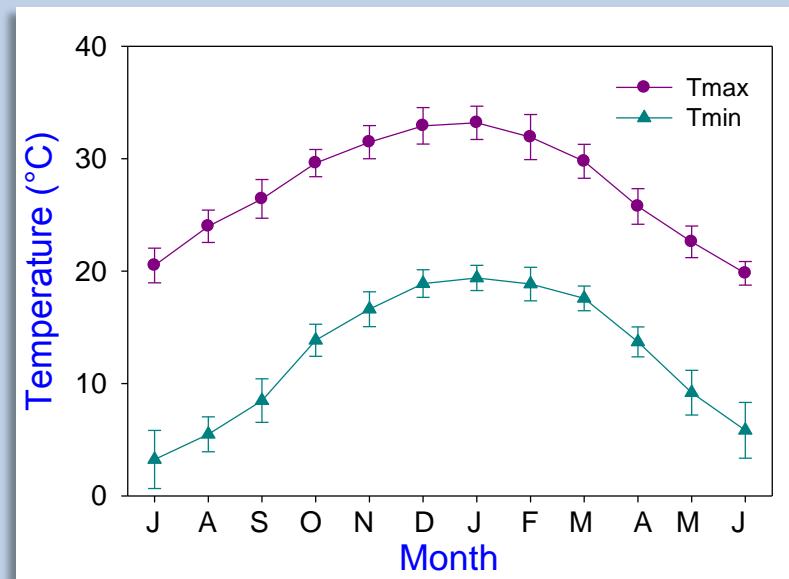
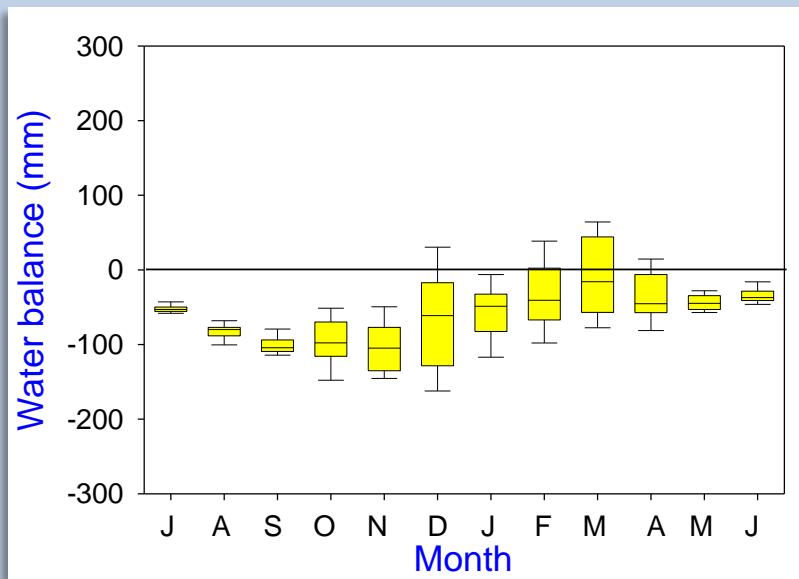
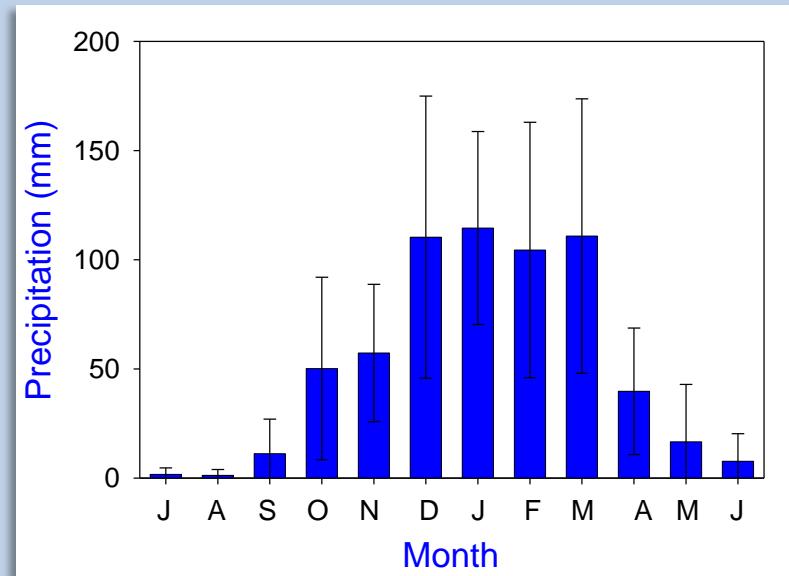
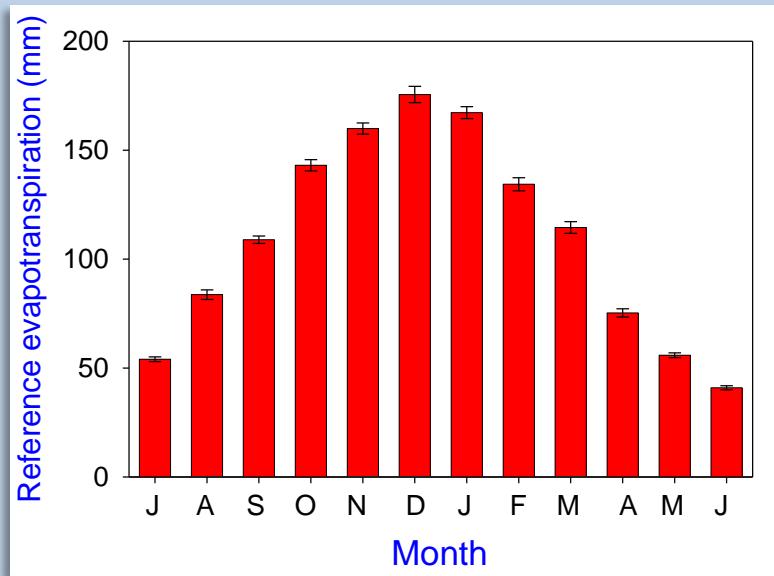
Material and Methods

Experimental site



Site characteristics

Climate: Semi-arid monsoon type



Soil: Aridic haplustoll with no drainage problem. Texture is silty loam throughout the profile.

Total available water is 180 mm.m^{-1} in the first 3 meters profile.

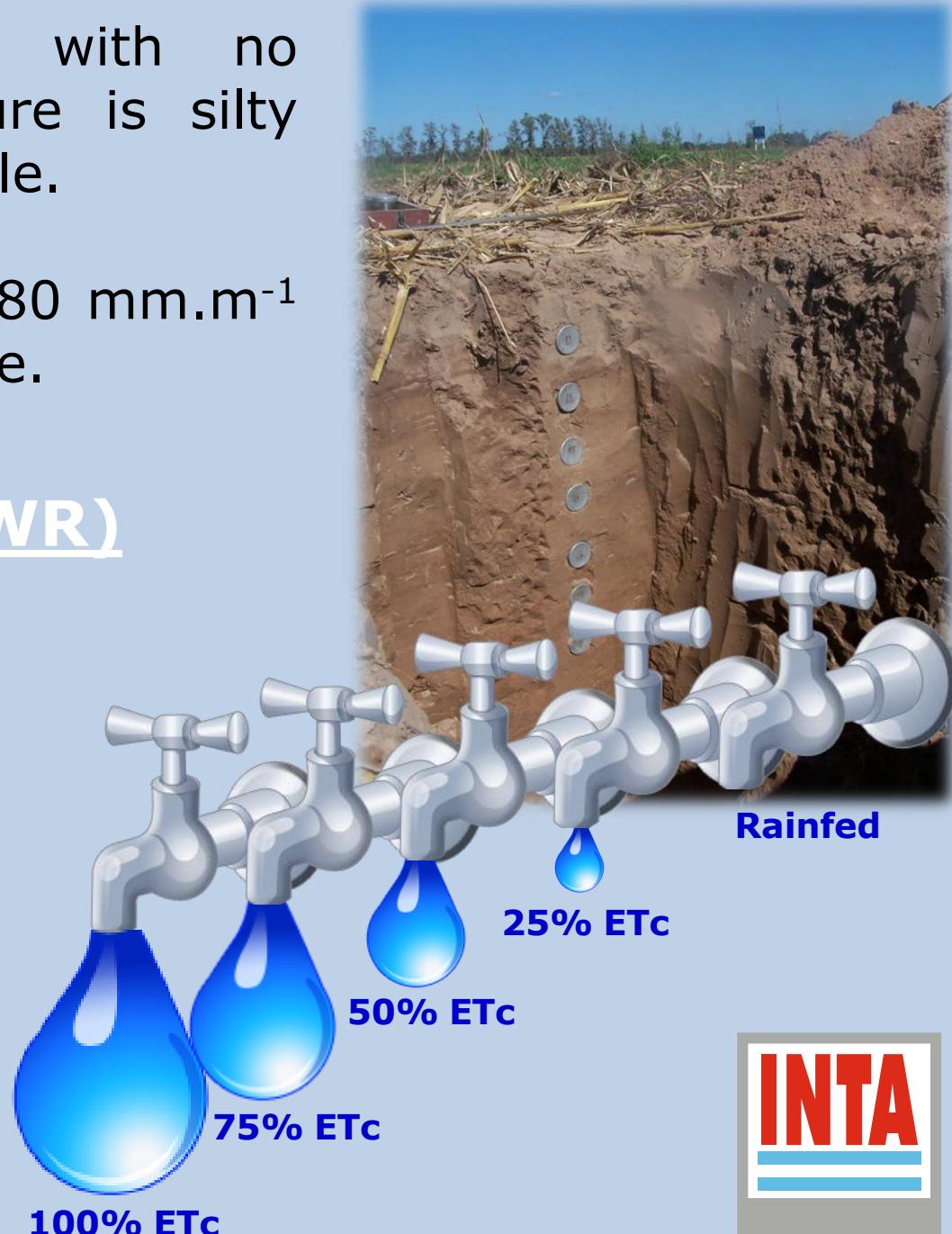
Water regimenes (WR)

Irrigation depth (mm) =

$$\text{ETc} - \text{Pef.} =$$

$$(\text{ETO} \times \text{kc}) - \text{Pef}$$

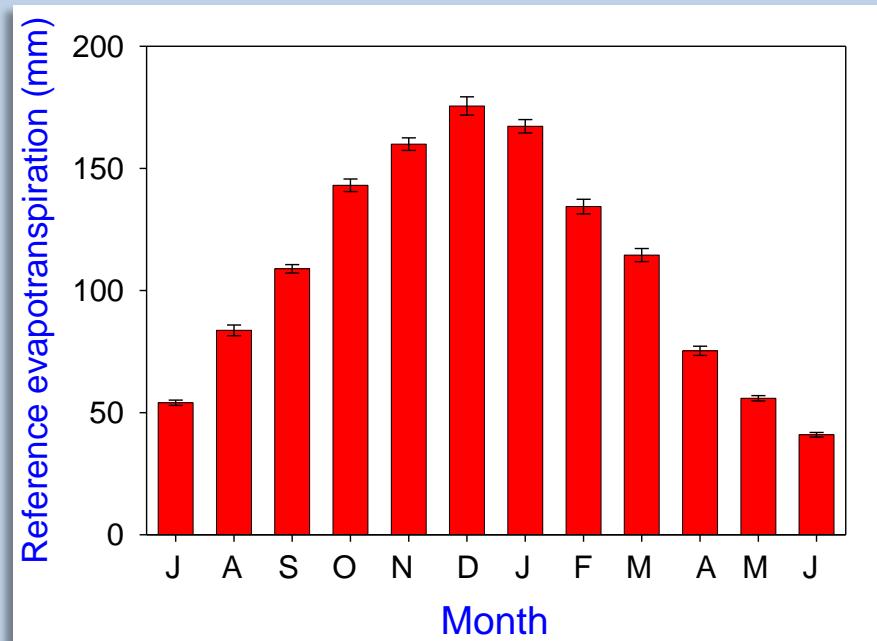
Irrigation intervals: 10 to 15 days.



Crop Management

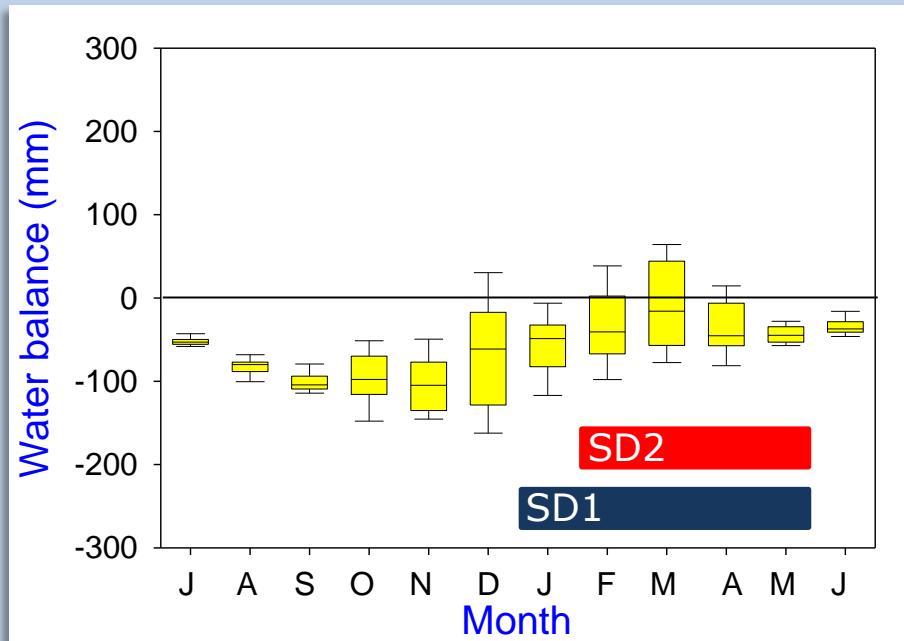
Variety: DM 8002 (MG VIII – GH determinate)

Optimal sowing date (SD1)
12/22/2011



SD2
SD1

Late sowing date (SD2)
25/01/2012



Field Measurements

- Crop phenology
- Yields and its components (number and grain weight)
- Actual evapotranspiration (ETa) using soil water balance method

$$ETa \text{ (mm)} = \Delta S + Peff$$

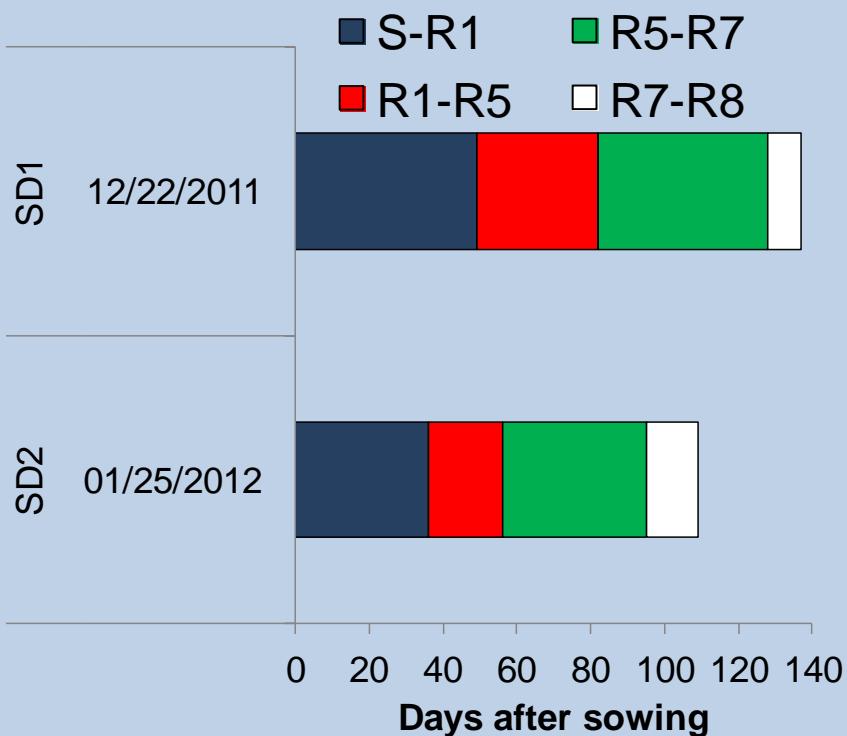
where: ΔS is the change of soil water storage considering a depth of 2 meters (gravimetric procedure), and Peff is the effective precipitation (Dardanelli et al., 1992)

- Water productivity as the ratio Y and ETa (WP_{ETa})



Results and discussion

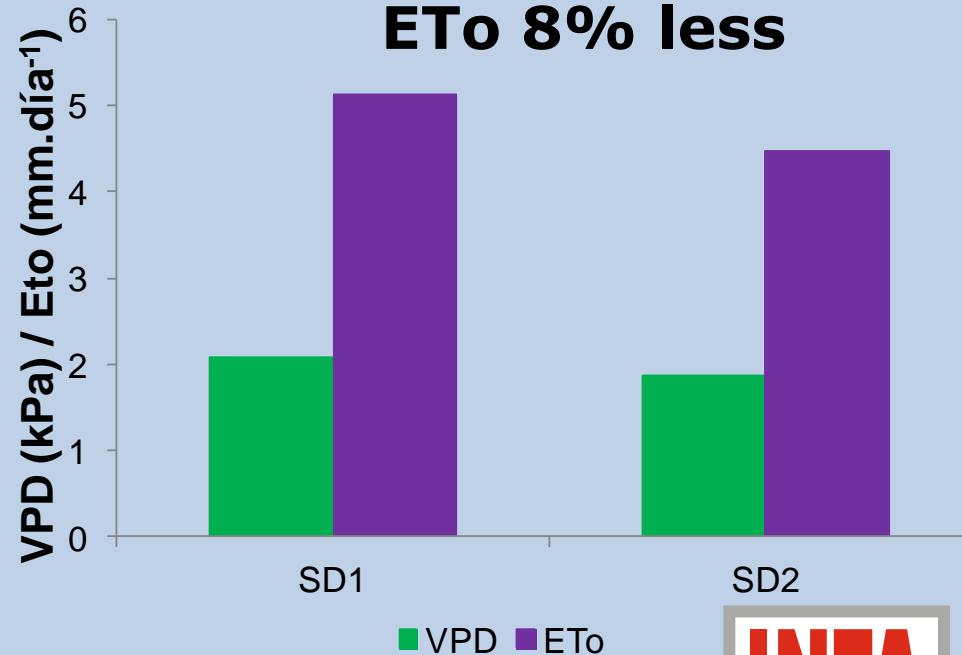
Crop development and weather conditions



SD2 cycle duration decrees 20%

Weather condition during SD2

PVD 8% less
Radiation 10% less
ETo 8% less



Actual evapotranspiration and yield

Sowing date

Source	P value Yield (kg ha^{-1})	GN.M ^{SP2}	GW (mg)
SD	<0.0001	590 1959 (56) a	158 (1)
SD ¹	3093 (91) a	500	
WR	<0.0001	1569 (81) b	157 (1)
SD ²	2473 (130) b	400	
SD*WR	ns	<0.0001	ns
SD	<0.0001	400	ns
WR	0,002	300 0,0027	ns
SD*WR	ns	300 ns	ns

■ SD1

■ SD²

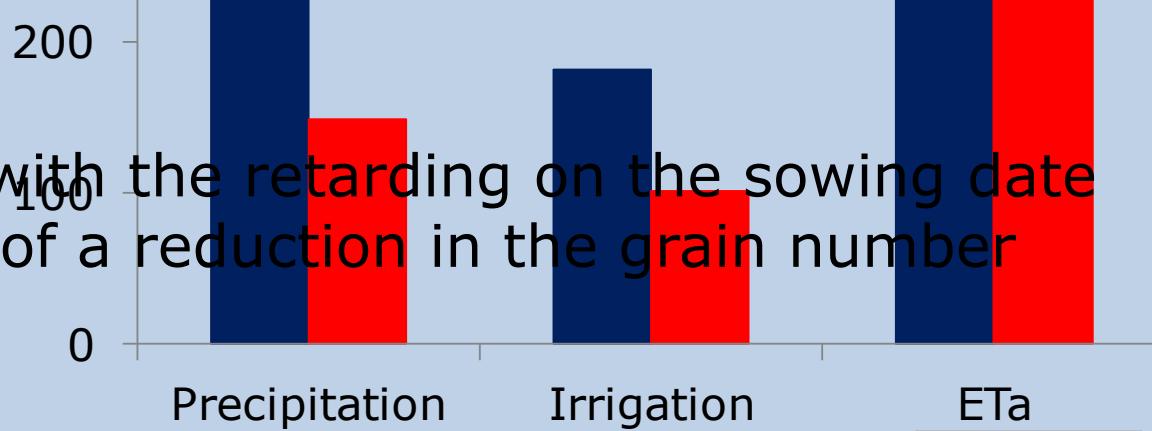
■ WR

■ SD*WR

a

b

The yield decreased with the retarding on the sowing date as a consequence of a reduction in the grain number



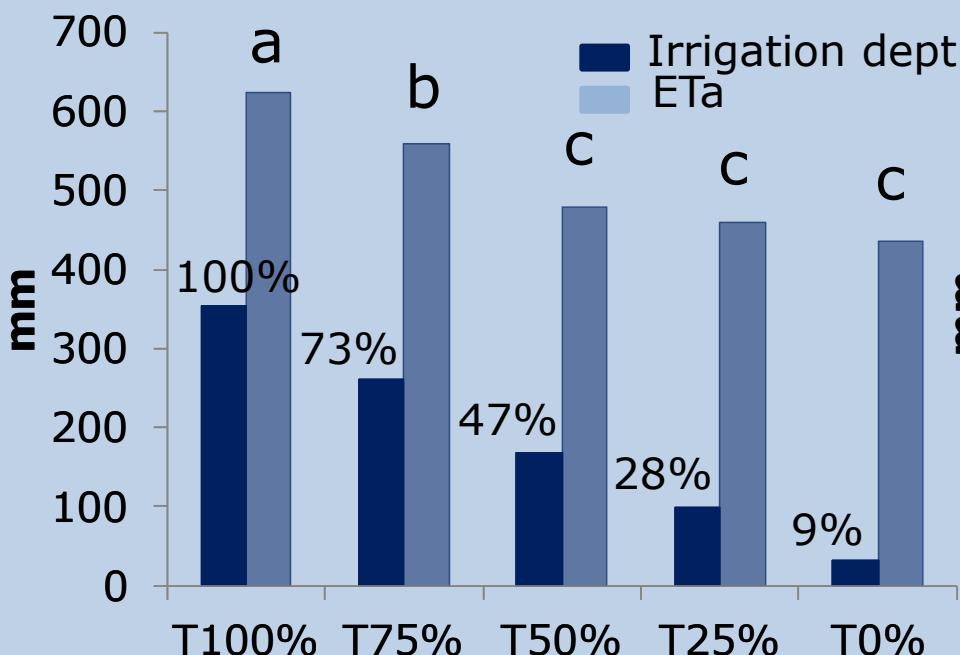
Actual evapotranspiration and yield

Water regimens

Source	p-value
SD	<0.0001
WR	<0.0001
SD*WR	ns

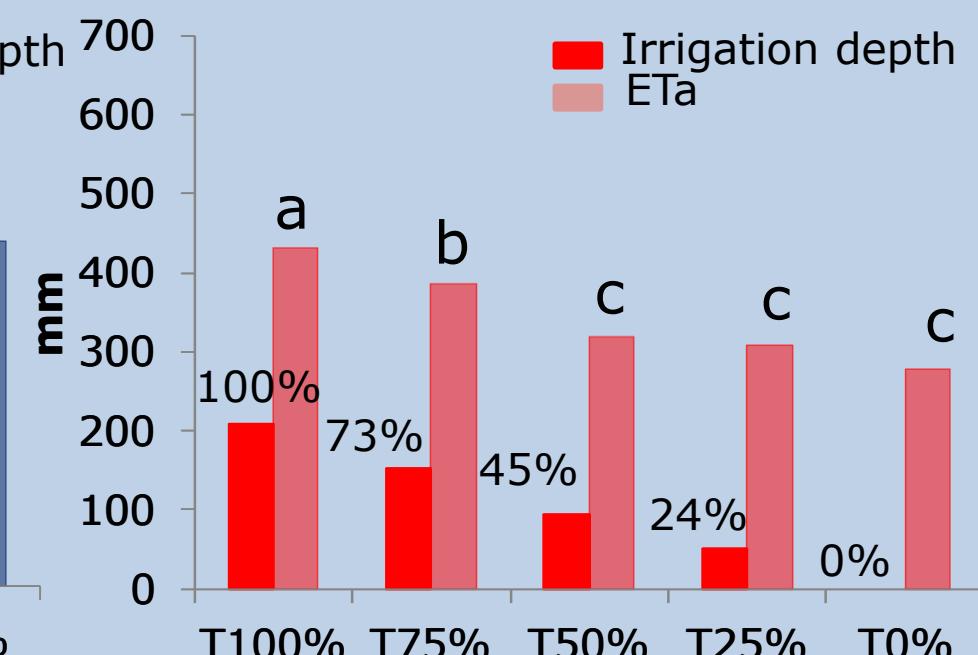
SD1

(Eff. precipitation 228 mm)



SD2

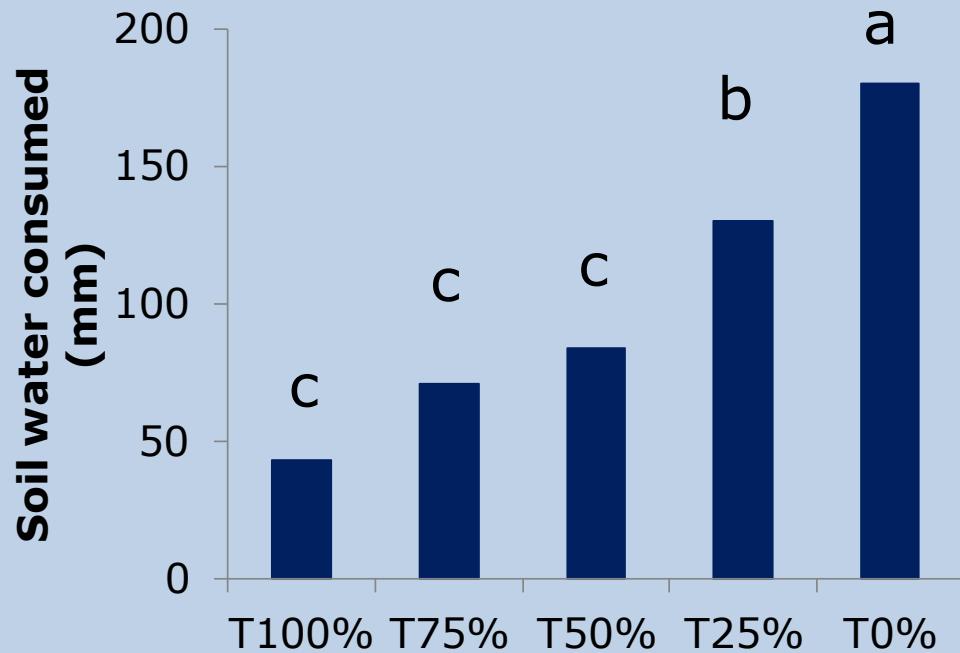
(Eff. precipitation 149mm)



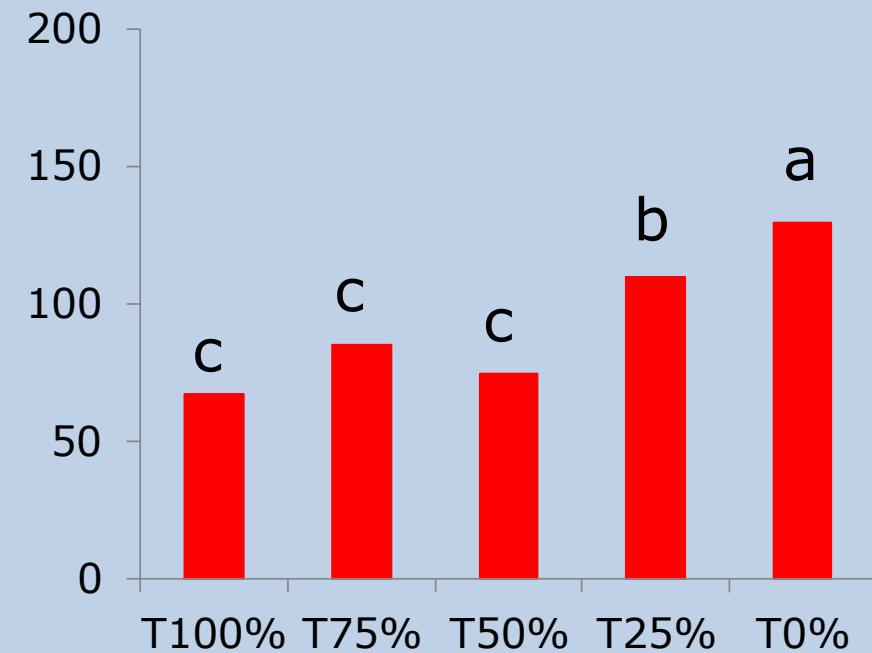
The treatments T100 and T75% were the most ET_r, being higher in T100%

Soil water use

Water regimenes



Source	p-value
SD	ns
WR	<0.0001
SD*WR	ns

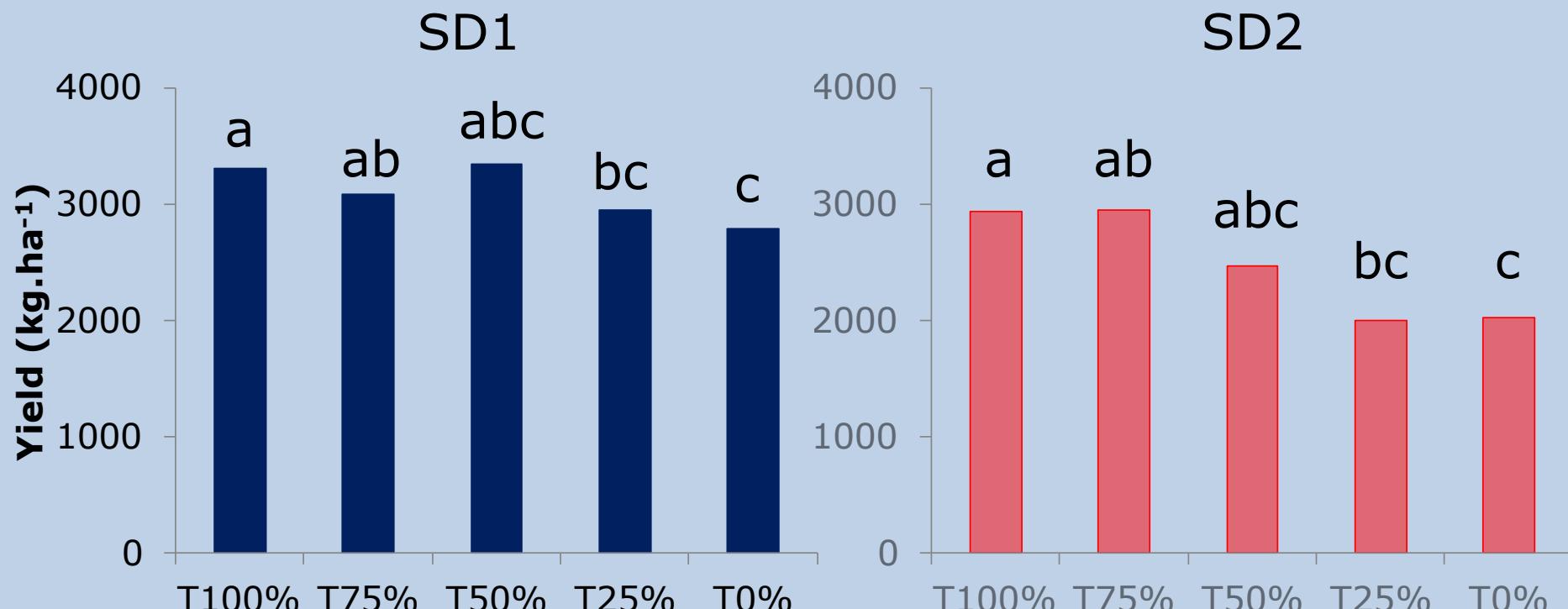


Although water consumption in T75% and T50% was higher compared to T100%, the differences were only statistically significant in T25% and T0%

Yield and components

Water regimens

SD	Yield ($\text{kg} \cdot \text{ha}^{-1}$)	$\text{GN} \cdot \text{m}^{-2}$	GW (mg)
SD	<0.0001	<0.0001	ns
WR	0,002	0,0027	ns
SD*WR	ns	ns	ns

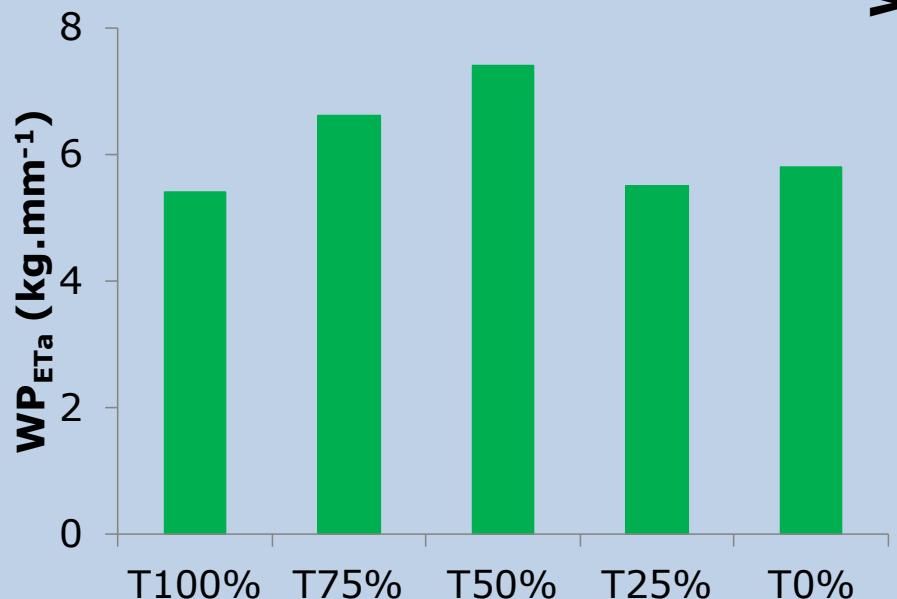


Yield did not decrease in the treatments
CDI 75% and T50% in relation with
T100%

Water productivity

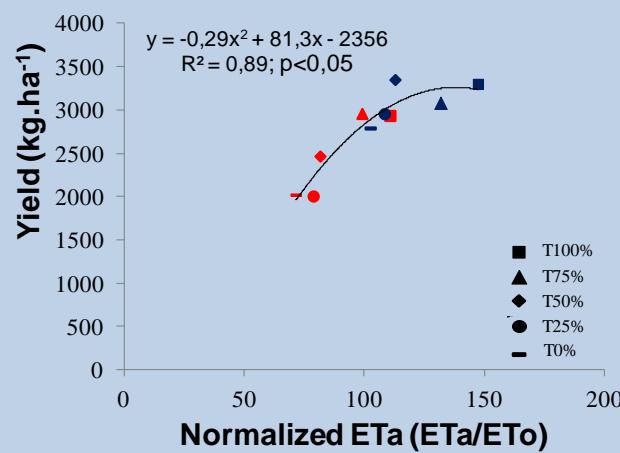
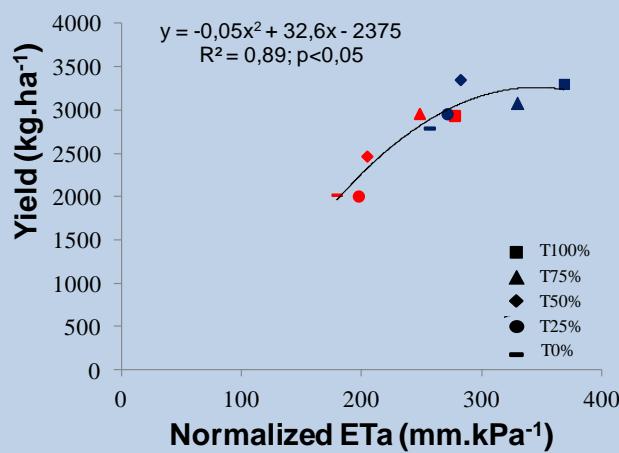
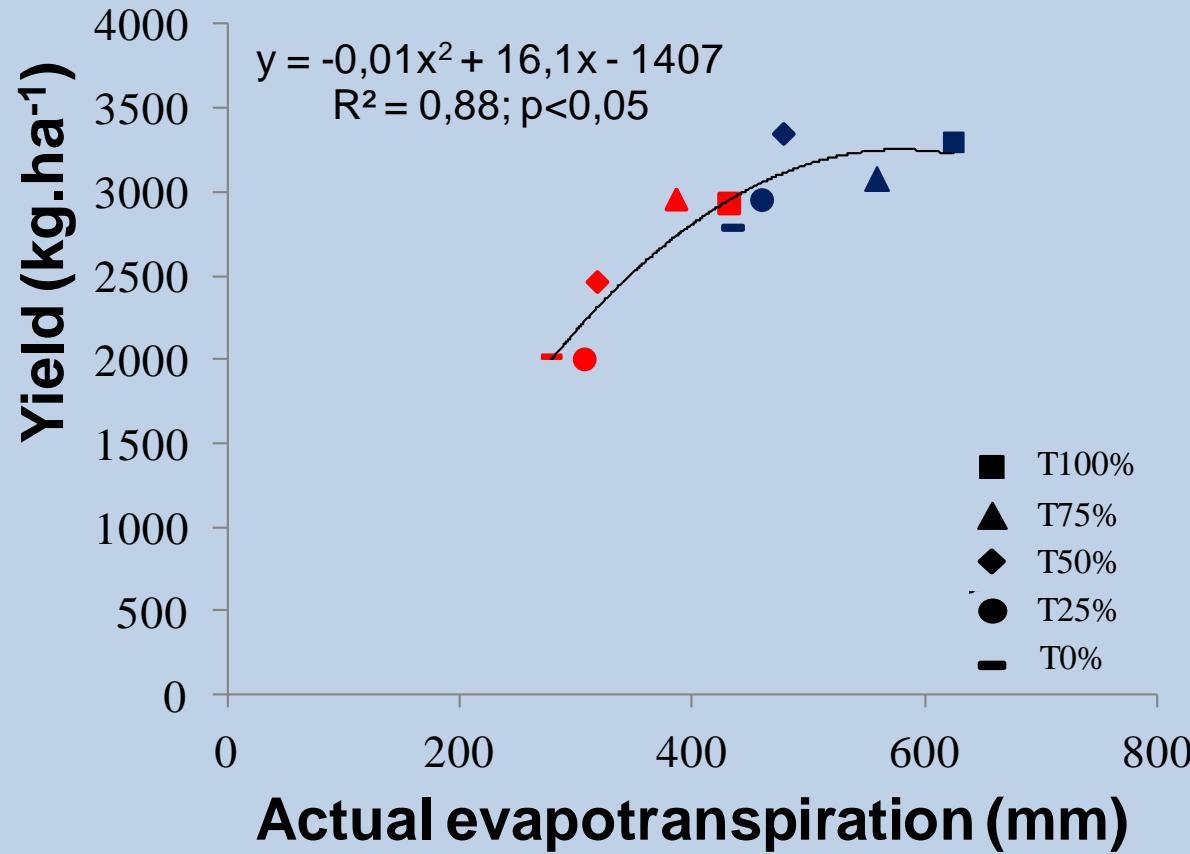
Sowing date

SD	WPETa ($\text{kg} \cdot \text{mm}^{-1}$)
SD	0,0014
WR	0,0912
SD*WR	ns



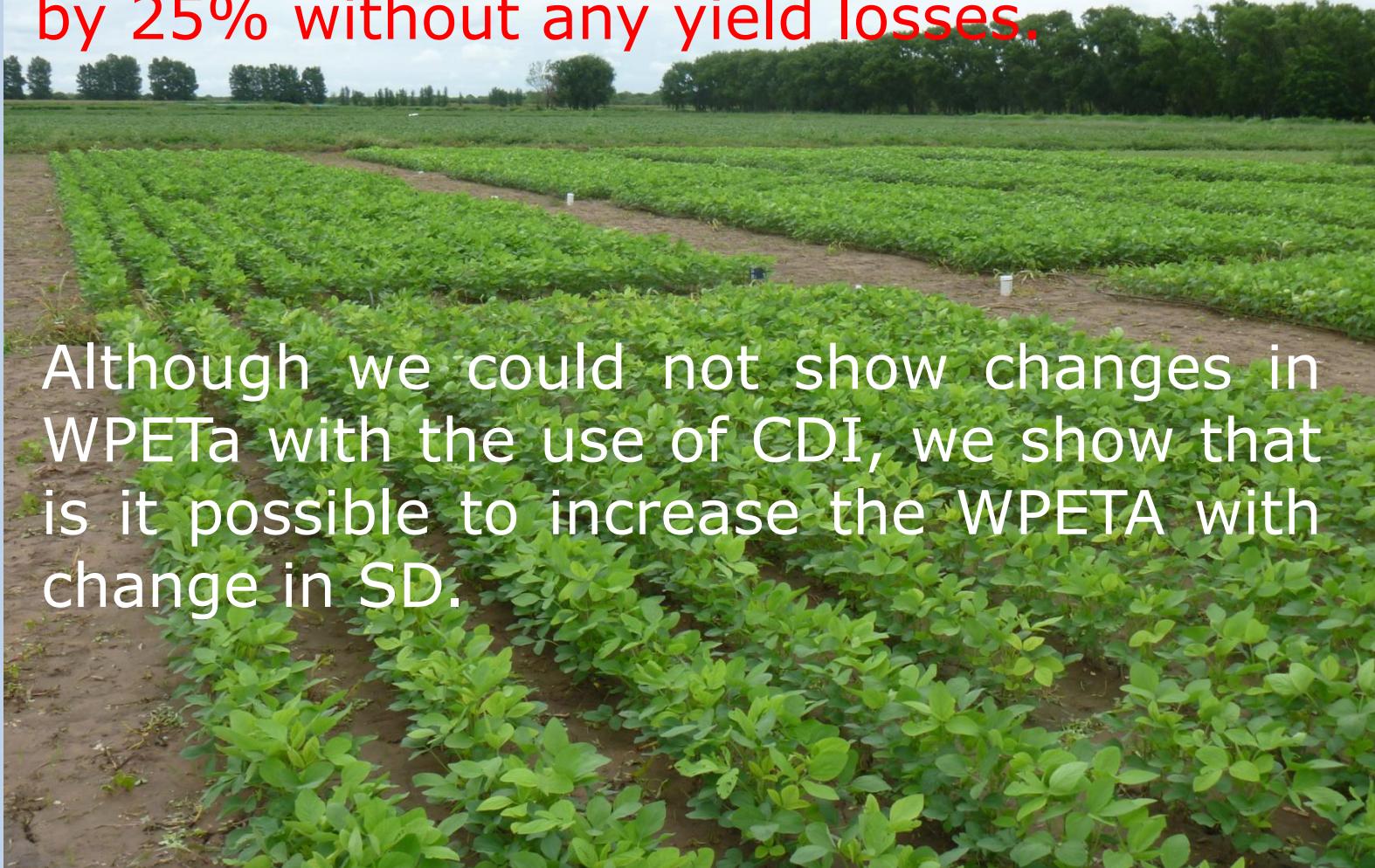
Only difference was found in water productivity between planting dates, being higher in the FS2. This could be associated with lower average vapor pressure deficit (VPD) during the second sowing date

Yield production function



Conclusions

In soybean and in Santiago del Estero, irrigation water depth could be reduced by 25% without any yield losses.



Although we could not show changes in WPETa with the use of CDI, we show that is it possible to increase the WPETA with change in SD.

Acknowledgements



**Water National
Program**



**Project:
Evaluation of changes
in water productivity
against different
climate scenarios in
various regions of the
Southern Cone**

iMany thanks!