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Uso de portainjertos en vides: una alternativa para mejorar la tolerancia a la sequía

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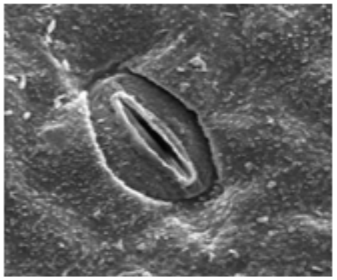
INTRODUCCIÓN

- Selección de portainjertos:
  - Resistencia filoxera,
  - Compatibilidad cultivar/injerto
  - Facilidad de propagación y enraizamiento,
  - Resistencia a nemátodos y enfermedad de Pierce,
  - Tolerancia a la caliza, sequía, salinidad y vigor

(Granett et al. 2001)

INTRODUCCIÓN

- Anatomía de la raíz
- Crecimiento y desarrollo de la raíz
  - Determinantes del desarrollo de la raíz
- Funcionamiento del sistema radical
  - Absorción de agua y transporte
  - Absorción de nutrientes



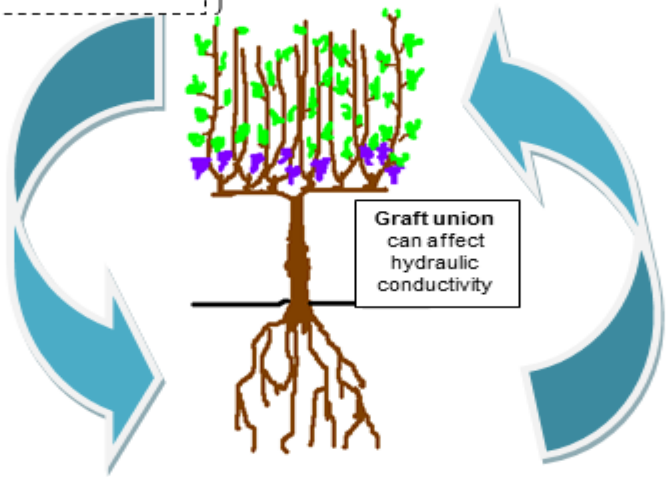
Hydraulic signalling
(aquaporin regulation)

Chemical signalling
(ABA, xylem pH, cytokinin…)

Sensitivity to cavitation and embolism

Changes in stomatal development?

Stomatal regulation → **Water loss reduction**



Rootstock vigour inducing capacity can affect leaf area and root development

Higher canopy water demand compensated by adjustments in root hydraulic conductivity?

Osmotic adjustment

Cell wall changes

Gene expression

Aquaporin expression and activity

-Root growth
-Higher hydraulic conductance
-Xylem embolism repair

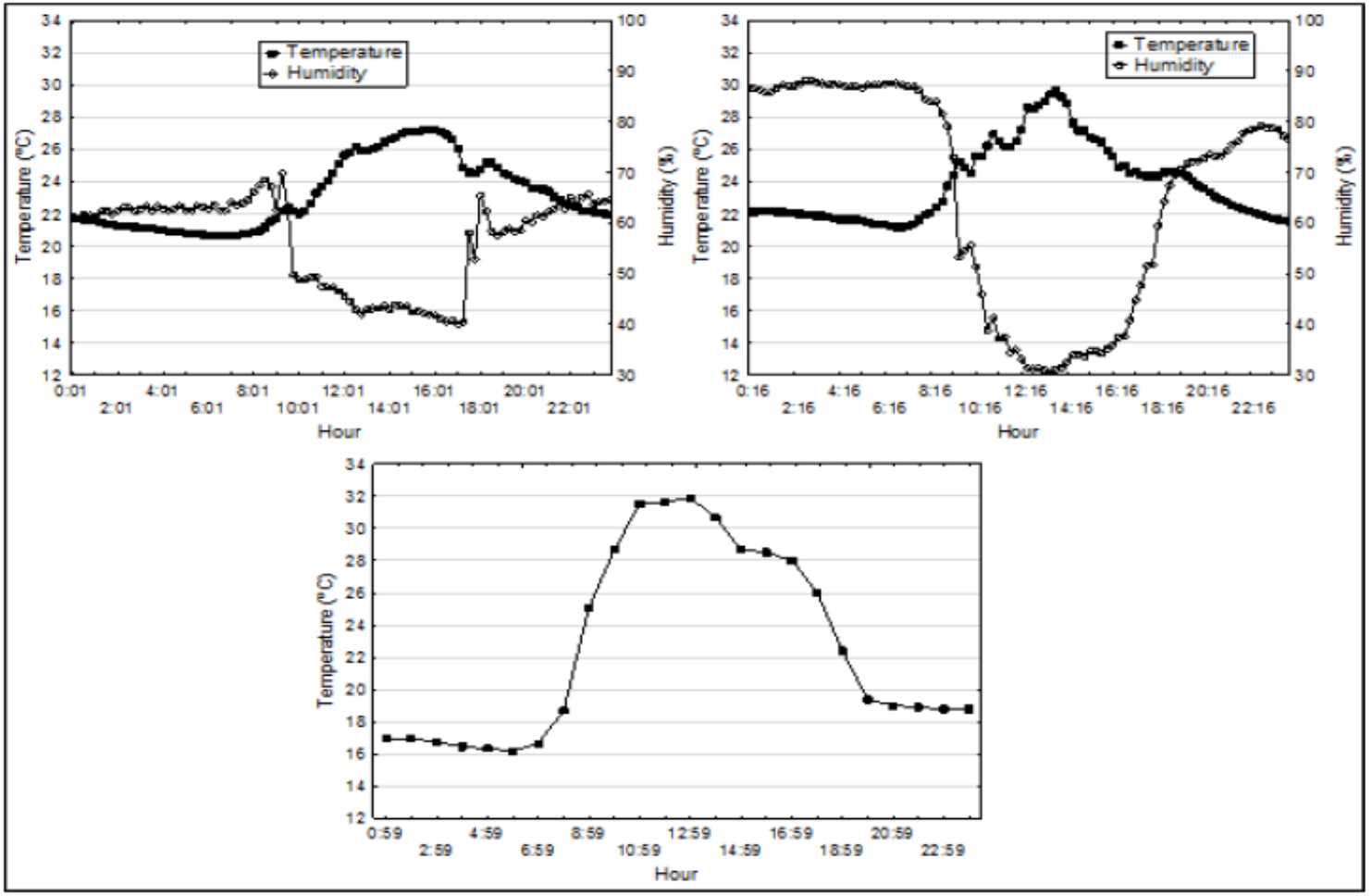
→ **Water uptake and transport improvement**

Anatomical differences of the xylem of the rootstocks affect water uptake and transport capacity

Root system is less sensitive to drought than canopy → Higher root-to-shoot ratio

Serra I., Strever A., Myburgh P., and Deloire A. 2013. A review of the interaction between rootstocks and cultivars (Vitis vinifera L.) to enhance drought tolerance in grapevine. Australian Journal of Grape and Wine Research.

Year	Type of experiment	Rootstocks	Treatments
2010/2011	Field experiment	1103 Paulsen	Well watered
			Water deficit
		110 Richter	Well watered
			Water deficit
		140 Ruggeri	Well watered
			Water deficit
2011	Greenhouse experiment (ATC)	99 Richter	Well watered
			Water deficit
		110 Richter	Well watered
			Water deficit
2012	Greenhouse experiment (NoATC)	1103 Paulsen	Well watered
			Water deficit
		110 Richter	Well watered
			Water deficit
		140 Ruggeri	Well watered
			Water deficit
		99 Richter	Water deficit
		Ramsey	Water deficit

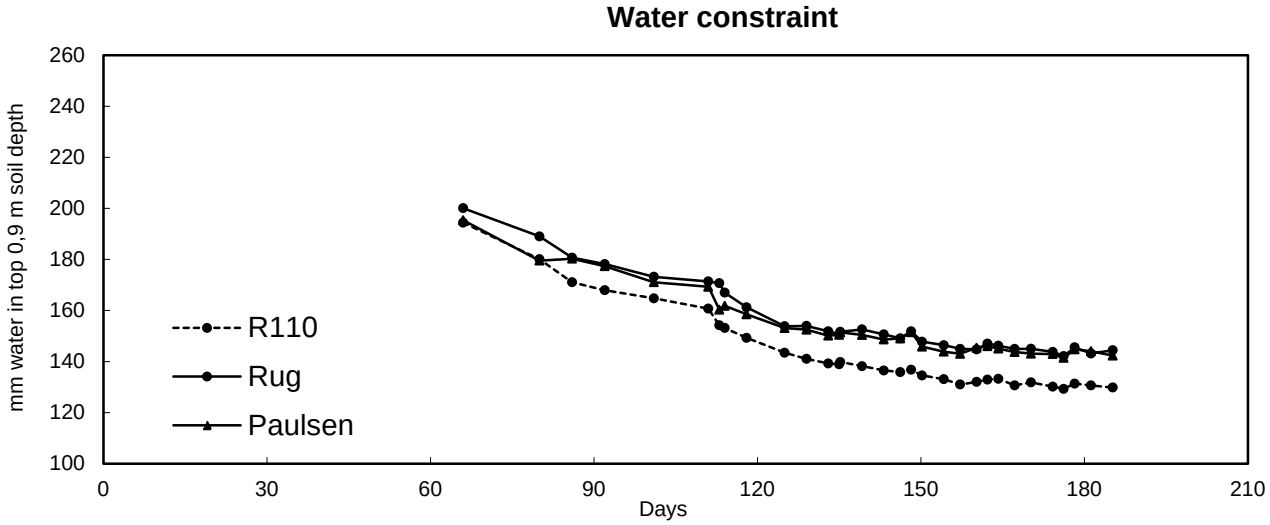


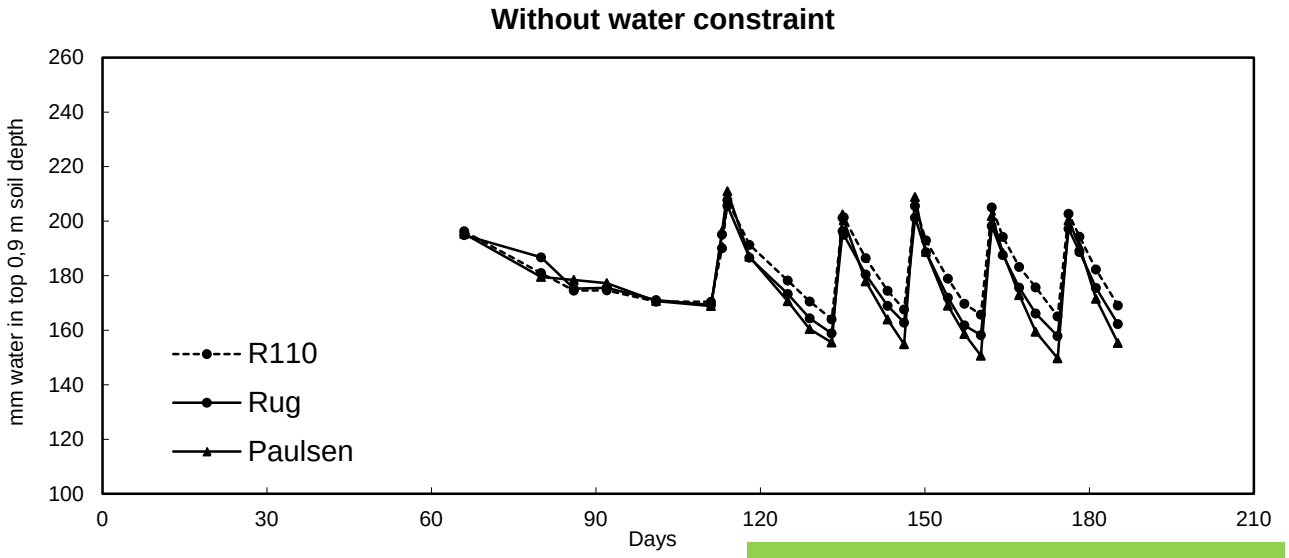
Serra et al., unpublished

Experiments	Mean temp max	Mean temp min	VPD
Greenhouse experiment (ATC)	28,1 °C ± 0,5	20,9 °C ± 0,3	1,58 ± 0,06
Greenhouse experiment (NoATC)	30,0 °C ± 1,0	19,7 °C ± 0,5	2.39 ± 0,10
Field experiment	32,1 °C ± 0,6	17,0 °C ± 0,3	ND*

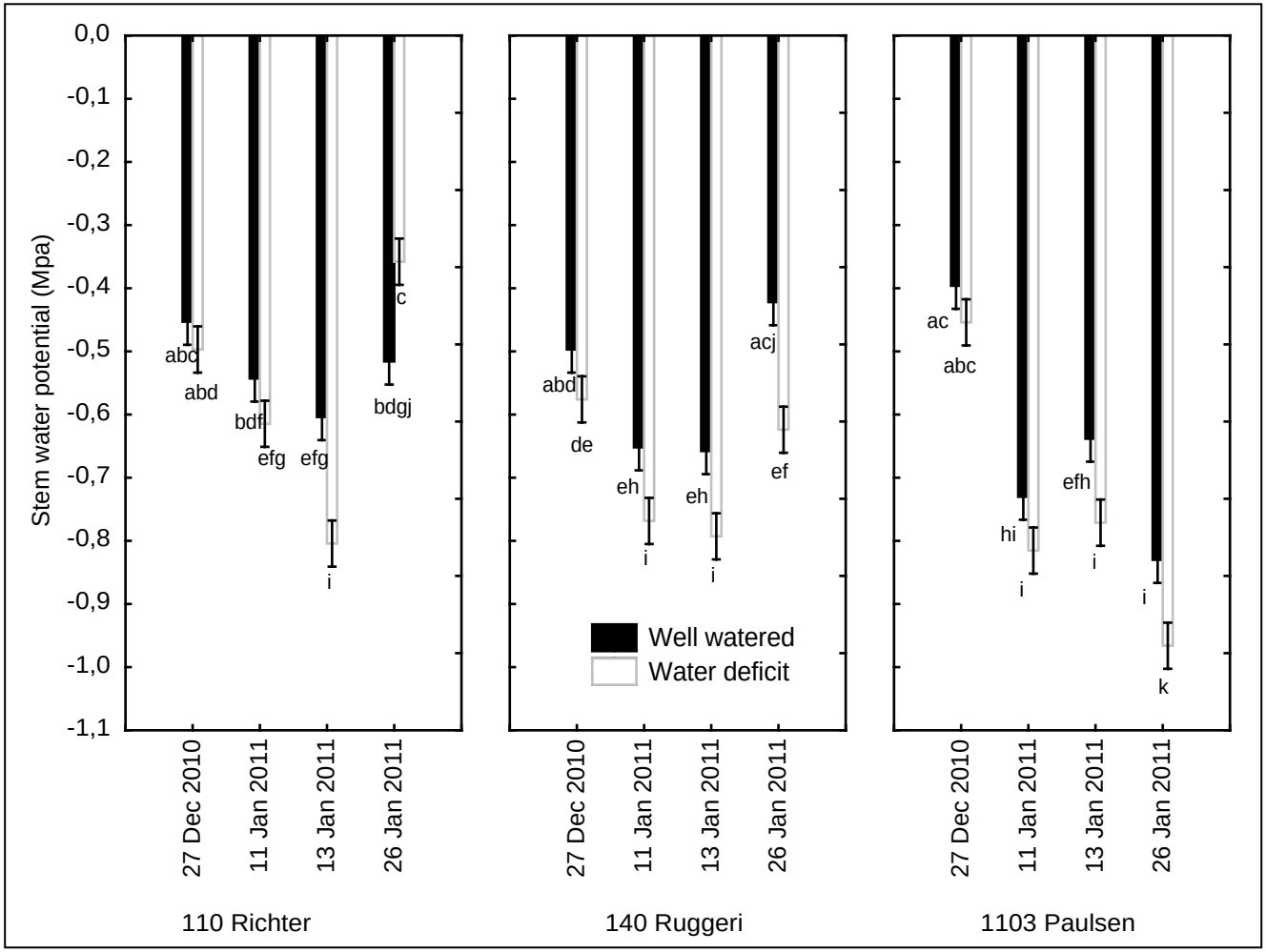
*No data.

Serra et al., unpublished

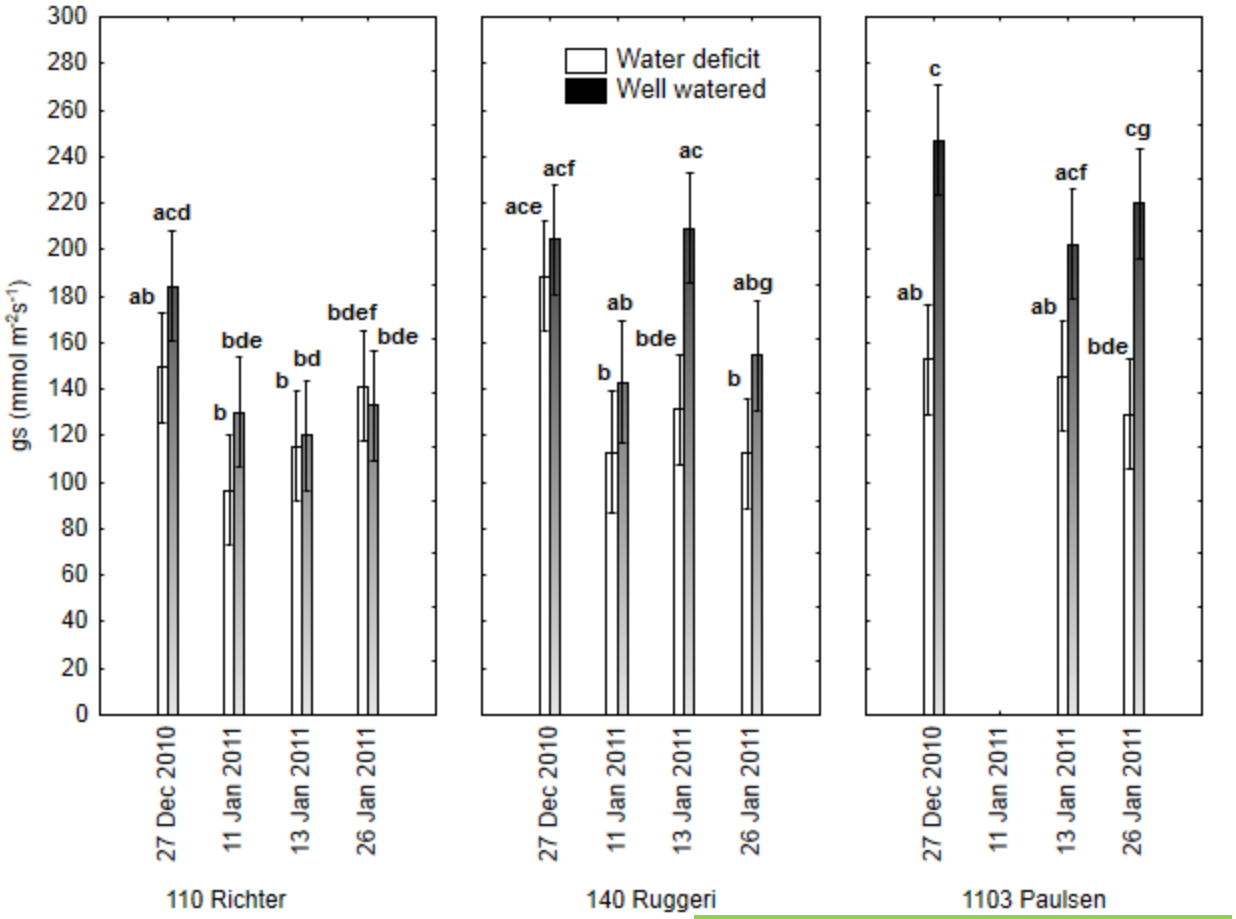




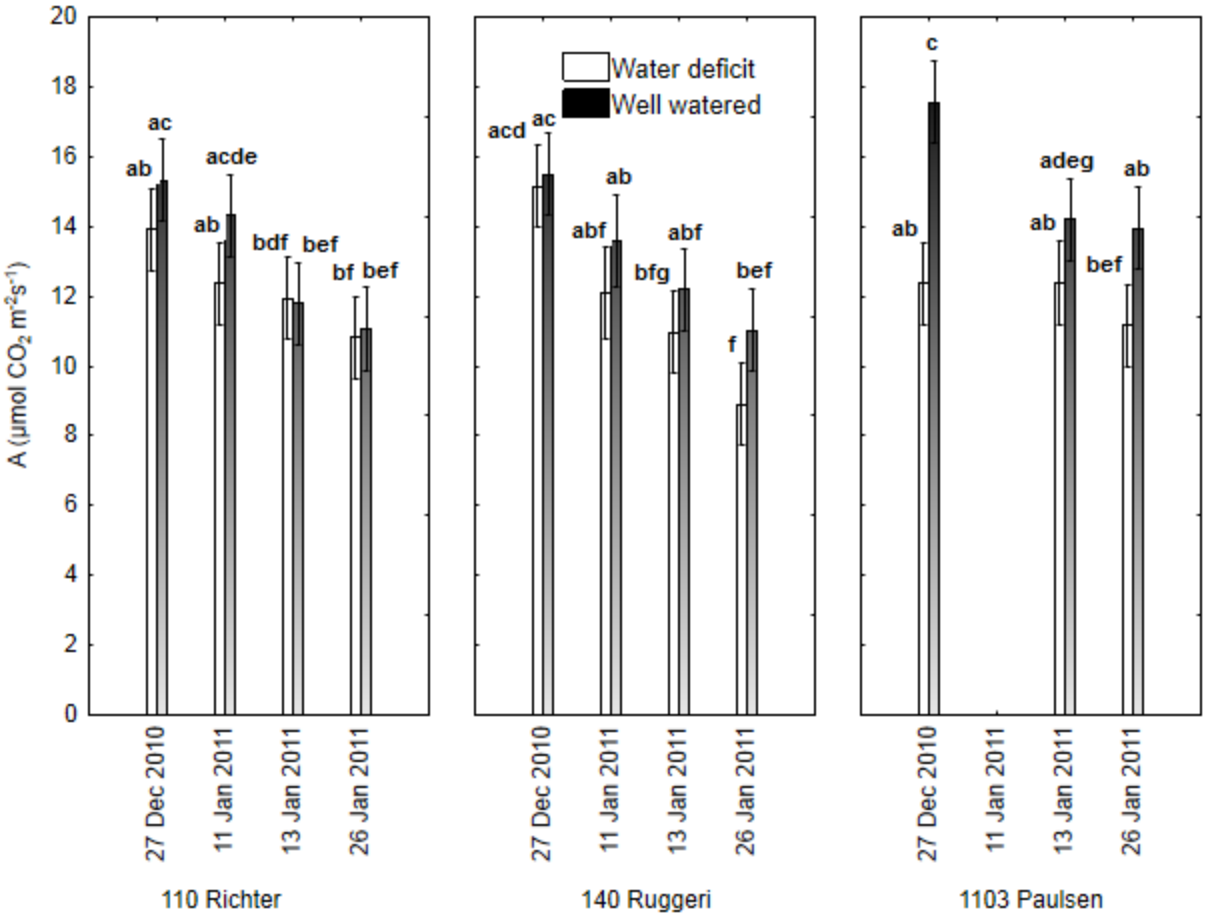
Serra et al., unpublished



Serra et al., unpublished

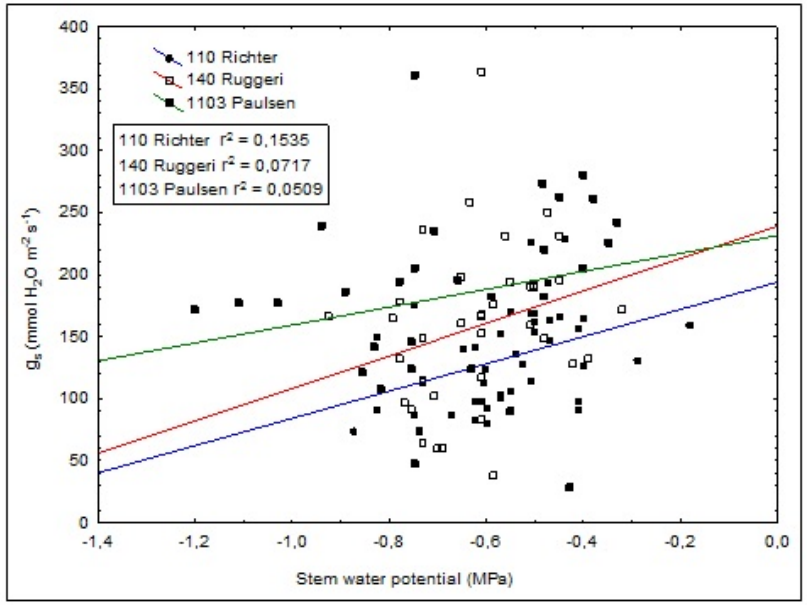


Serra et al., unpublished



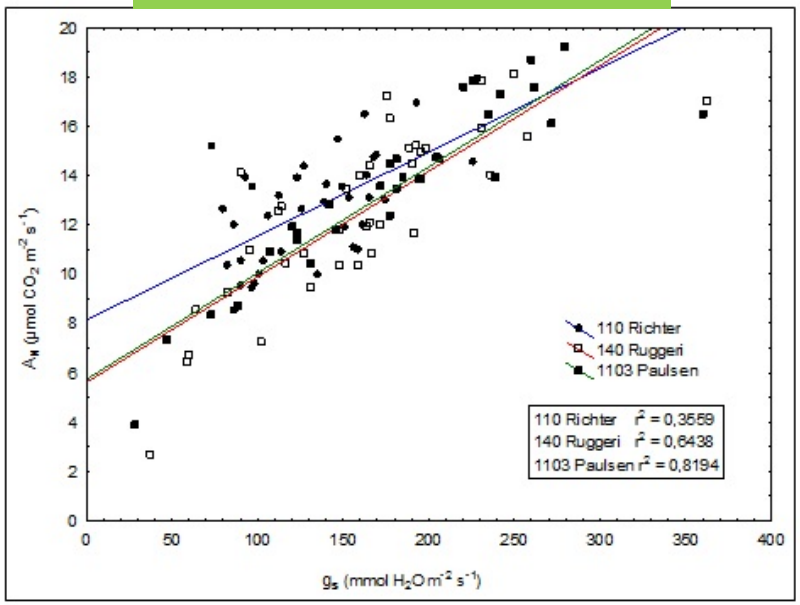
Serra et al., unpublished

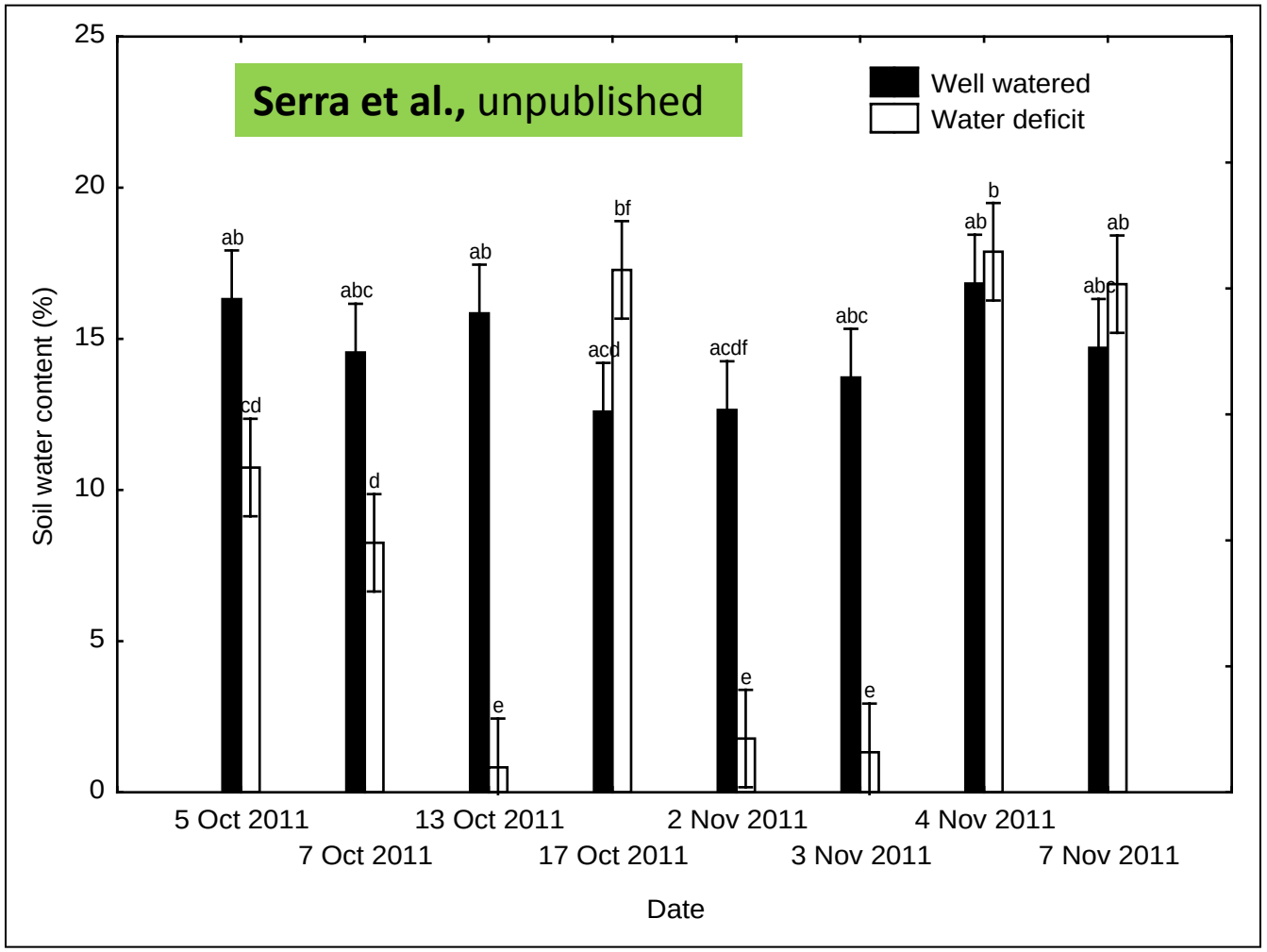
A



Serra et al., unpublished

B




Serra et al., unpublished
Well watered
Water deficit
Soil water content (%)
25
20
15
10
5
0
ab
cd
abc
d
ab
e
acd
bf
acdf
e
abc
e
ab
b
abc
ab
5 Oct 2011
7 Oct 2011
13 Oct 2011
17 Oct 2011
2 Nov 2011
3 Nov 2011
4 Nov 2011
7 Nov 2011
Date

Serra et al., unpublished

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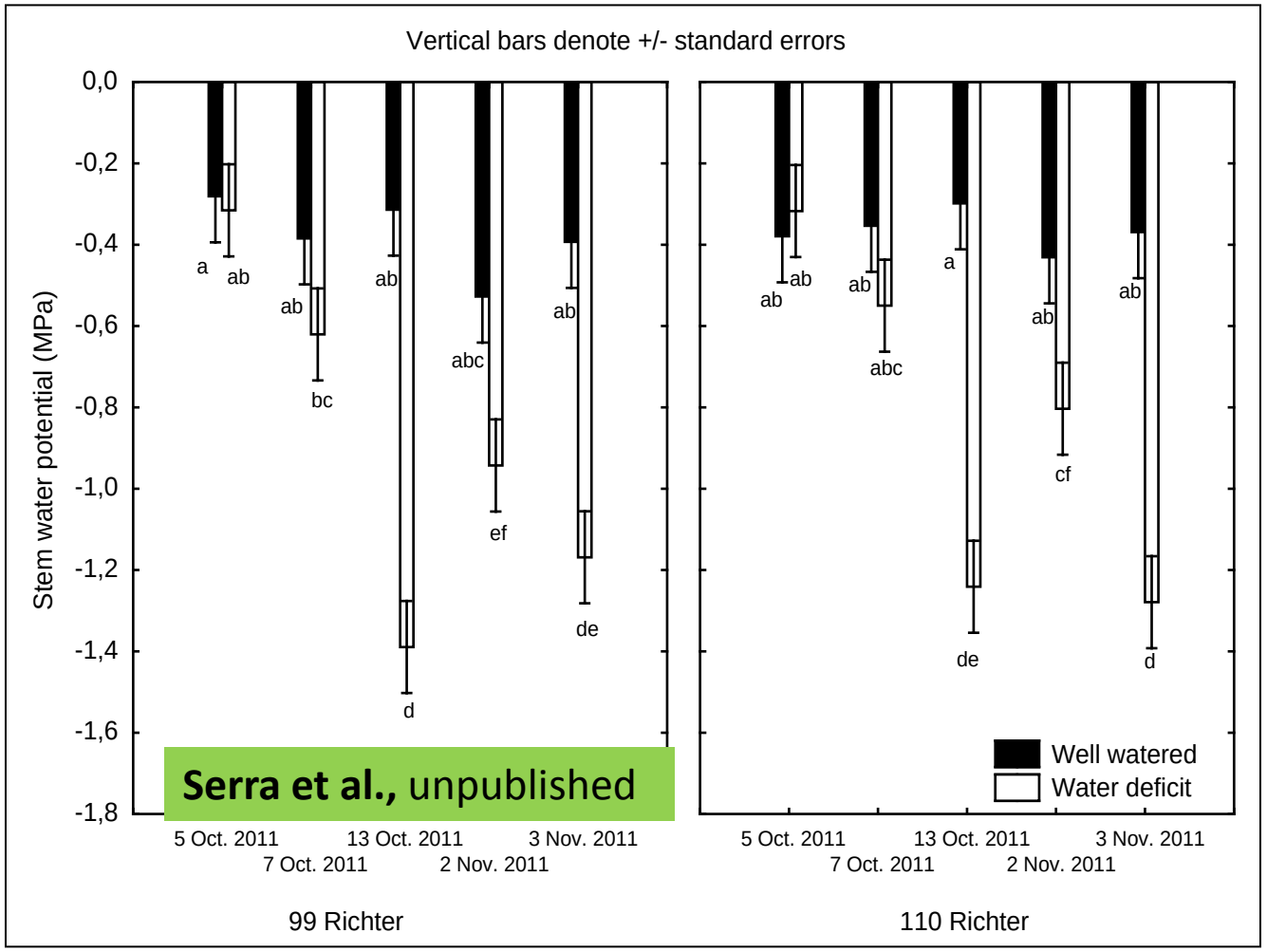
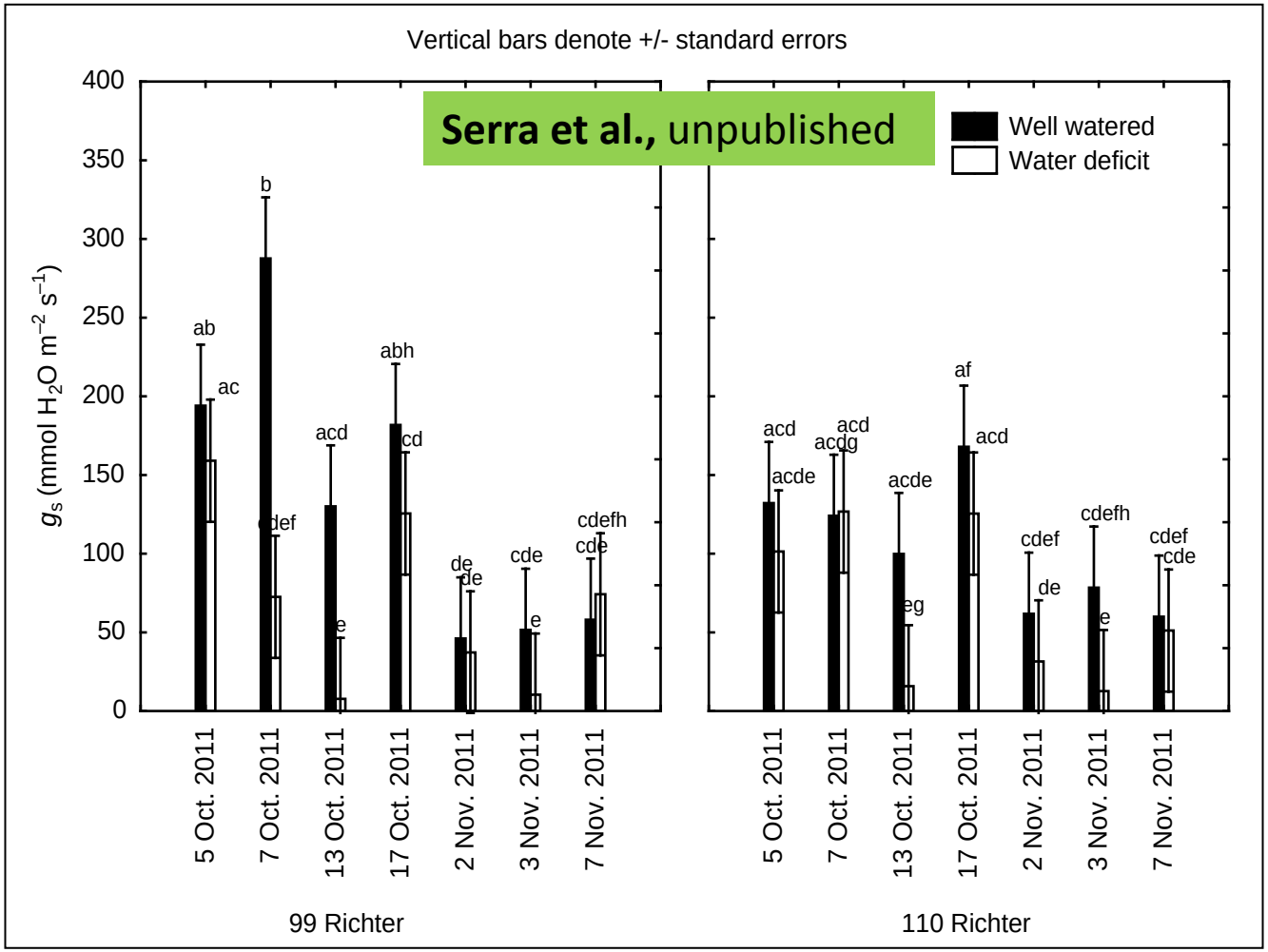
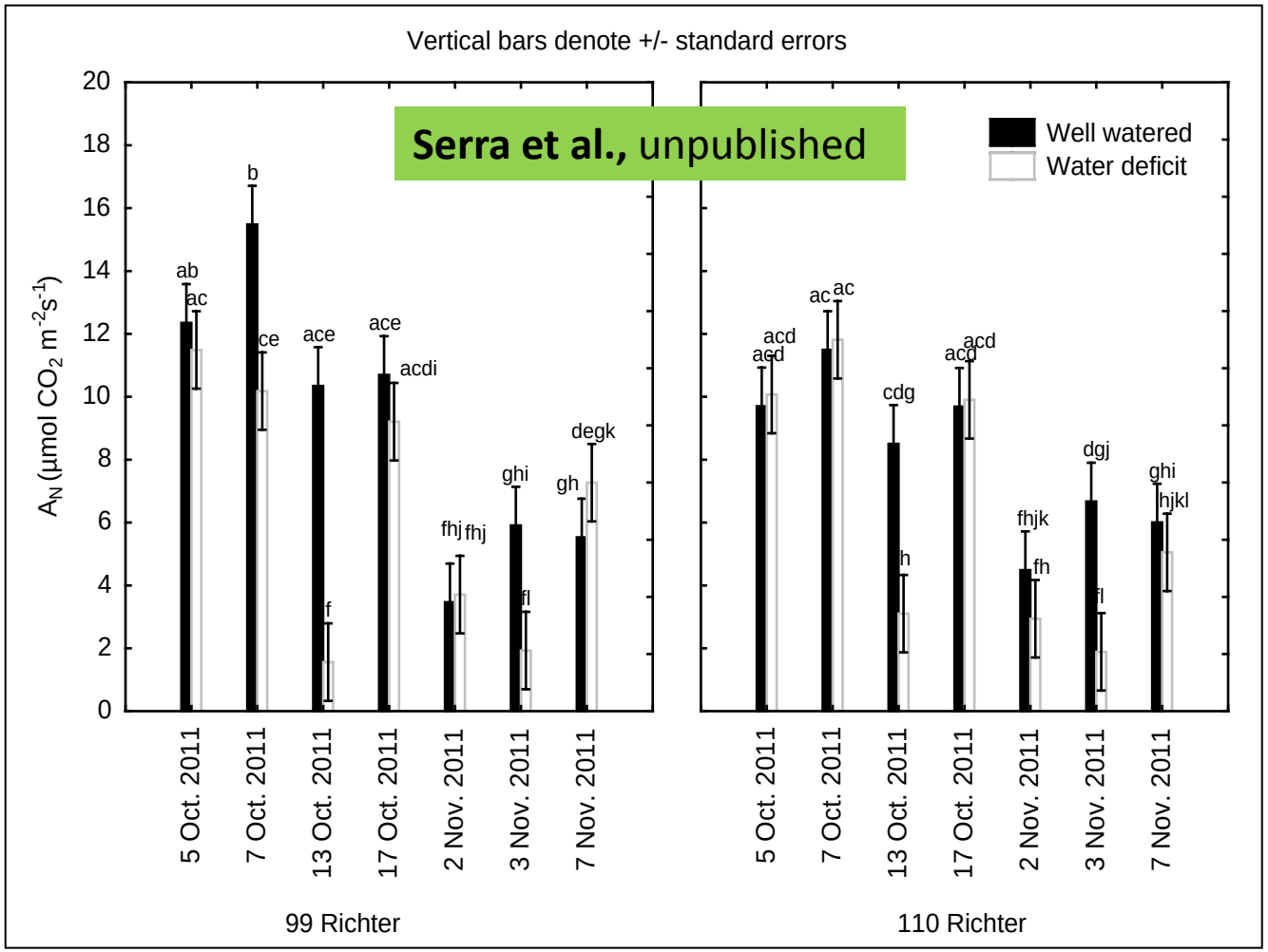
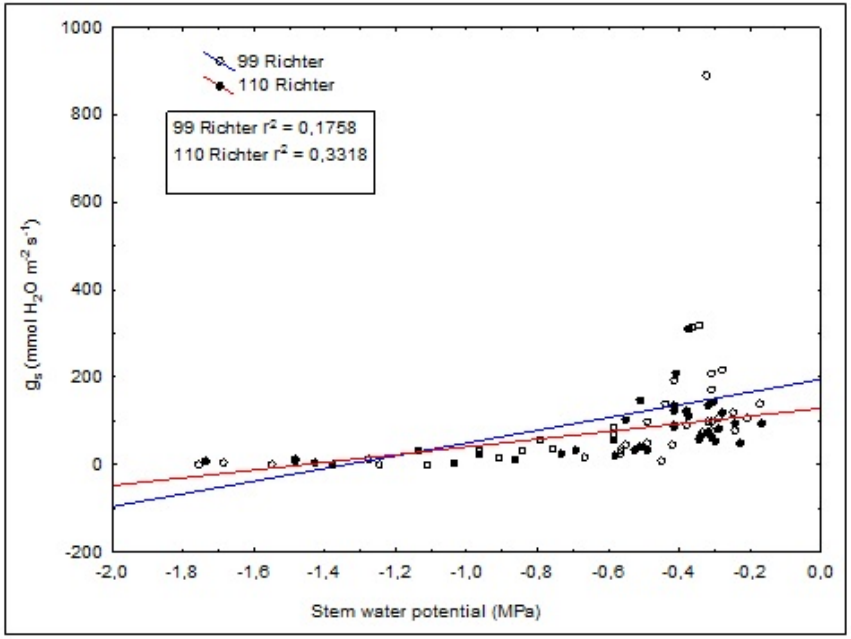


Serra et al., unpublished


Vertical bars denote +/- standard errors
Serra et al., unpublished
Well watered
Water deficit
g_s (mmol H_2O m^{-2} s^{-1})
400
350
300
250
200
150
100
50
0
ab
ac
b
def
acd
e
abh
cd
de
de
cde
e
cdefh
cde
acd
acde
acd
acdg
acde
eg
af
acd
cdef
de
cdefh
e
cdef
cde
5 Oct. 2011
7 Oct. 2011
13 Oct. 2011
17 Oct. 2011
2 Nov. 2011
3 Nov. 2011
7 Nov. 2011
99 Richter
110 Richter

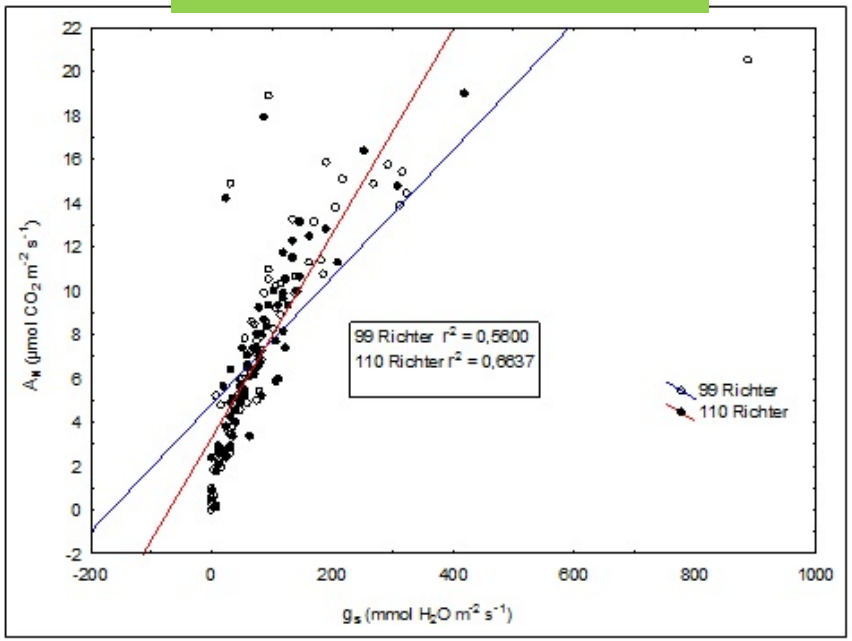

Vertical bars denote +/- standard errors
Serra et al., unpublished
Well watered
Water deficit
A_N (µmol CO_2 $m^{-2}s^{-1}$)
0
2
4
6
8
10
12
14
16
18
20
ab
ac
b
ce
ace
f
ace
acdi
fhj
fhj
ghi
fl
gh
degk
ac
ac
acd
acd
cdg
h
acd
acd
fhjk
fh
dgj
fl
ghi
hjkl
5 Oct. 2011
7 Oct. 2011
13 Oct. 2011
17 Oct. 2011
2 Nov. 2011
3 Nov. 2011
7 Nov. 2011
99 Richter
110 Richter

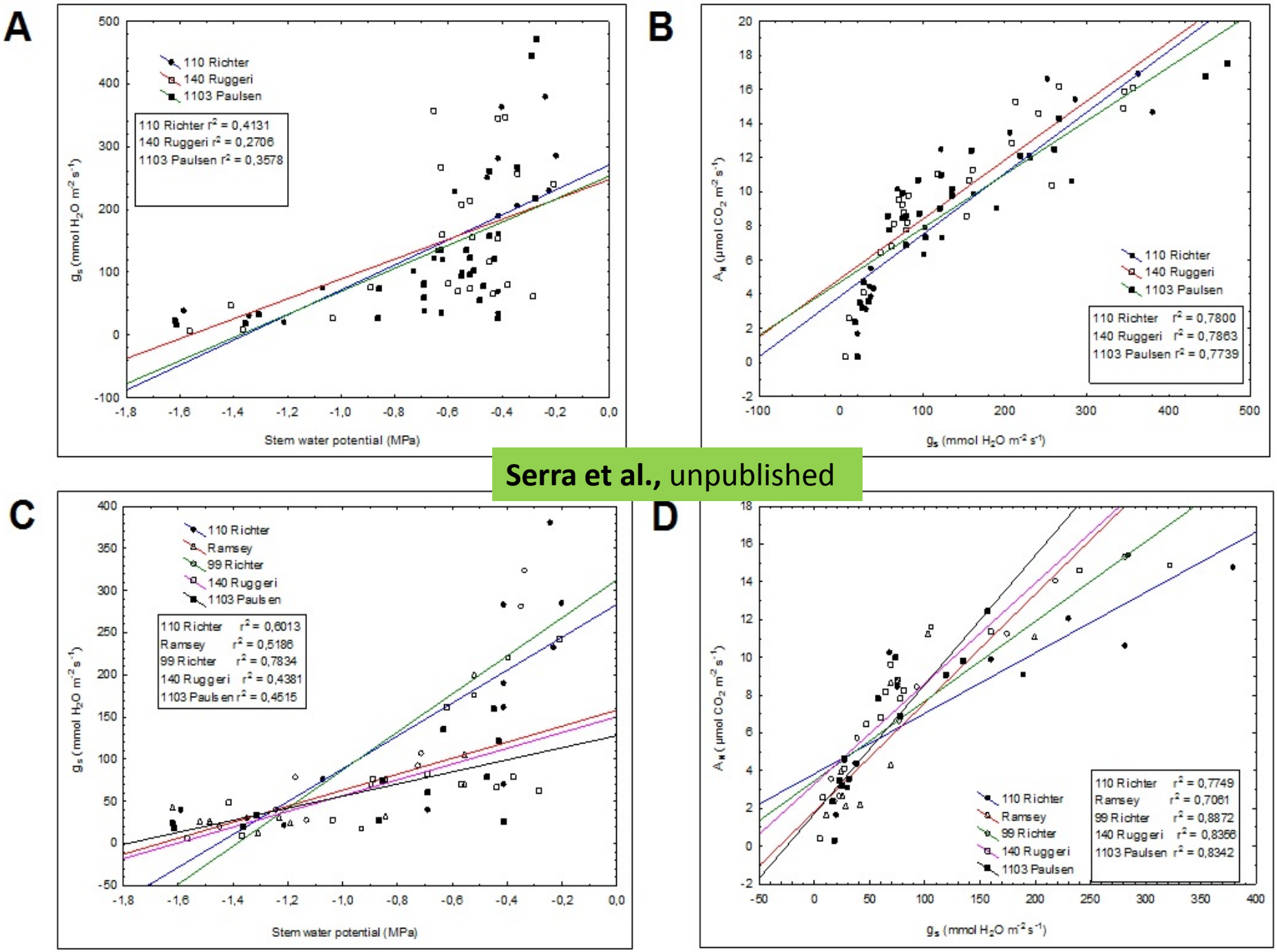
A



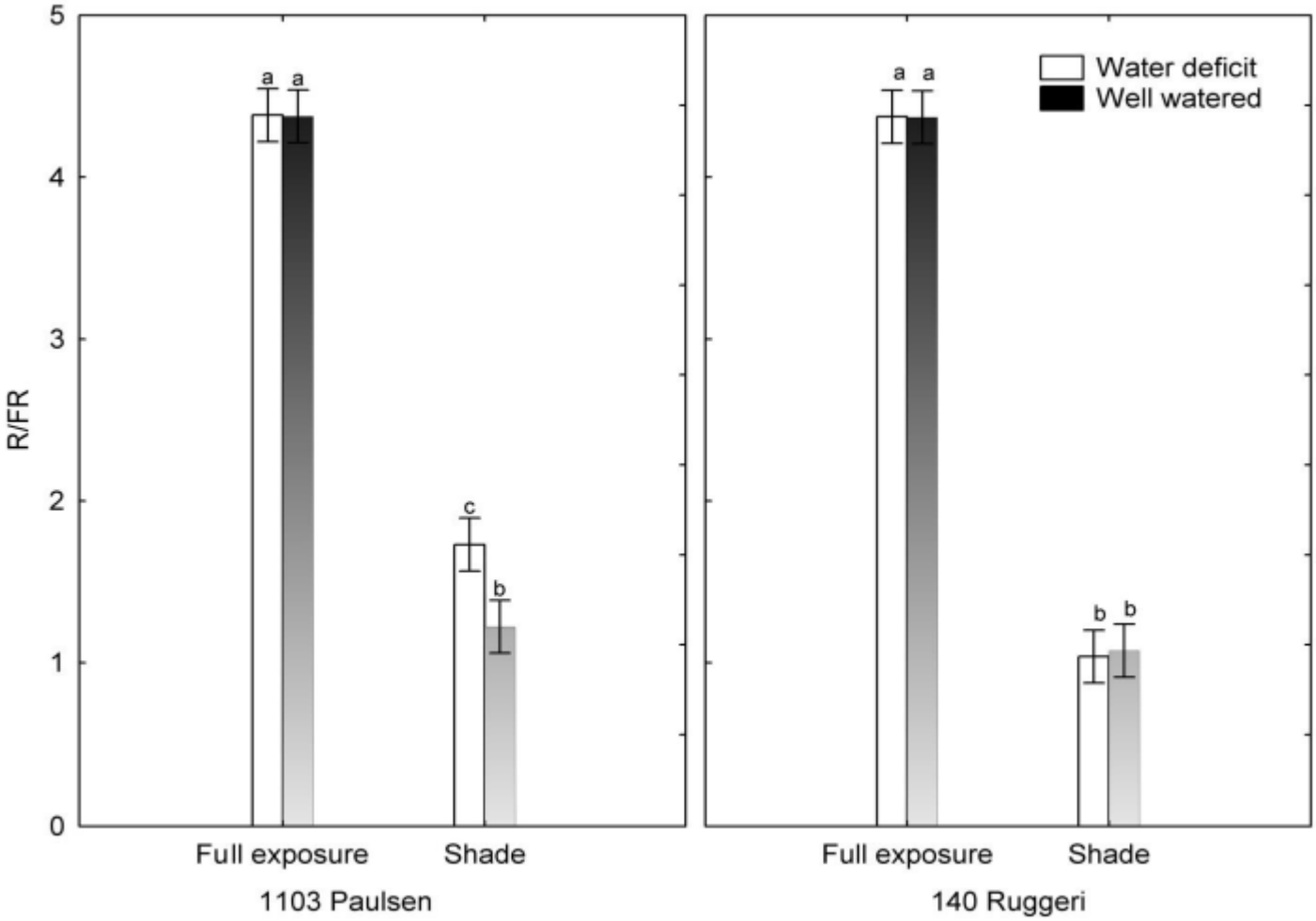
Serra et al., unpublished

B




A
110 Richter
140 Ruggeri
1103 Paulsen
110 Richter r² = 0,4131
140 Ruggeri r² = 0,2706
1103 Paulsen r² = 0,3578
gs (mmol H2O m-2 s-1)
Stem water potential (MPa)
B
110 Richter
140 Ruggeri
1103 Paulsen
110 Richter r² = 0,7800
140 Ruggeri r² = 0,7863
1103 Paulsen r² = 0,7739
AN (µmol CO2 m-2 s-1)
gs (mmol H2O m-2 s-1)
Serra et al., unpublished
C
110 Richter
Ramsey
99 Richter
140 Ruggeri
1103 Paulsen
110 Richter r² = 0,6013
Ramsey r² = 0,5186
99 Richter r² = 0,7834
140 Ruggeri r² = 0,4381
1103 Paulsen r² = 0,4515
gs (mmol H2O m-2 s-1)
Stem water potential (MPa)
D
110 Richter
Ramsey
99 Richter
140 Ruggeri
1103 Paulsen
110 Richter r² = 0,7749
Ramsey r² = 0,7061
99 Richter r² = 0,8872
140 Ruggeri r² = 0,8356
1103 Paulsen r² = 0,8342
AN (µmol CO2 m-2 s-1)
gs (mmol H2O m-2 s-1)

Year	Type of experiment	Rootstocks used in the experiments	Treatments	
2010/2011	Field experiment	110 Richter	Well watered	
			Water deficit	
2011	Greenhouse experiment (controlled ambient)	99 Richter	Well watered	
			Water deficit	
		110 Richter	Well watered	
			Water deficit	
2011/2012	Field experiment	1103 Paulsen	Well watered	leaves full sun exposure
				Leaves in the shade
			Water deficit	leaves full sun exposure
				leaves in the shade
		140 Ruggeri	Well watered	leaves full sun exposure
				leaves in the shade
			Water deficit	leaves full sun exposure
				leaves in the shade
2012	Greenhouse experiment (semi controlled ambient)	1103 Paulsen	Well watered	
			Water deficit	
		110 Richter	Well watered	
			Water deficit	
		140 Ruggeri	Well watered	
			Water deficit	
		99 Richter	Water deficit	
		Ramsey	Water deficit	



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Treatments	Stomatal size (µm)	Stomatal density (pores mm^{-2})
FIELD		
Rootstock		
110 Richter	13.5	111.2
Water status		
No water constraint (ψ_{stem}= -0.5 MPa)	13.2 a	94.0 b
Moderate water constraint (ψ_{stem}= -0.8 MPa)	13.8 a	128.5 a
GREENHOUSE		
Rootstocks		
99 Richter	13.0 a	102.6 a
110 Richter	12.8 a	99.2 a
Water status		
No water constraint (ψ_{stem}= -0.4 MPa)	13.4 a	95.6 a
Severe water constraint (ψ_{stem}= -1.4 MPa)	12.4 b	106.1 a
Interaction[1]		
Rootstock X water status	ns	ns
FIELD		
Rootstocks		
1103 Paulsen	13.1 b	124.6 a
140 Ruggeri	20.5 a	90.4 b
Water status		
No water constraint (ψ_{stem}= -0.5 MPa)	17.0 a	109.9 a
Moderate water constraint (ψ_{stem}= -0.8 MPa)	16.6 a	105.1 a
Light exposure		
Full sun exposure	15.8 b	114.8 a
Shade	17.8 a	100.1 b
Interaction[1]		
Rootstock X water status	*	ns
Rootstock X light exposure	***	ns
Water status X light exposure	*	ns

[1]ns, *, **, ***, not significant and significant at $p \leq 0.05$, 0.01, and 0.001, respectively. Numbers with different letters differ significantly at the 0.05 level by Fisher's significant difference.

Serra et al., unpublished

CONCLUSIONES

- Nuestro estudio confirma la influencia del portainjerto en el estado hídrico de la vid y el intercambio gaseoso del cultivar lo que implica una influencia en la absorción de agua y su transporte y una regulación de la conductancia estomática.
- Nuestros datos respaldan la hipótesis que la influencia del portainjerto pareciera ser mayor bajo un incremento de déficit hídrico hasta un punto donde el estado hídrico es el principal determinante de la conductancia estomática y por lo tanto de la fotosíntesis.
- Adicionalmente se muestra que el desarrollo de los estomas se ven afectados por la luz, déficit hídrico y probablemente por los portainjertos. Los resultados confirman que los portainjertos regulan el tamaño del estoma y su funcionamiento.