Tessitura dei suoli delle diverse aree coltivate a kiwi e loro effetto sulla ritenzione idrica e la fisiologia della pianta

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ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
DIPARTIMENTO DI
SCIENZE E TECNOLOGIE AGRO-ALIMENTARI

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PROTEZIONE E SALUTE DEL SUOLO PER COMBATTERE LA CRISI AMBIENTALE

A cura del GTI SUOLO


20/09/2013

OBJECTIVES

1) assess the water retention curve of soils of the most important areas of the Italian kiwifruit industry
2) evaluate the response of Zespri Gold 3® (Zesy 002) to variation of soil moisture during the growing season as leaf gas exchange and stem Ψ_w

Treatments

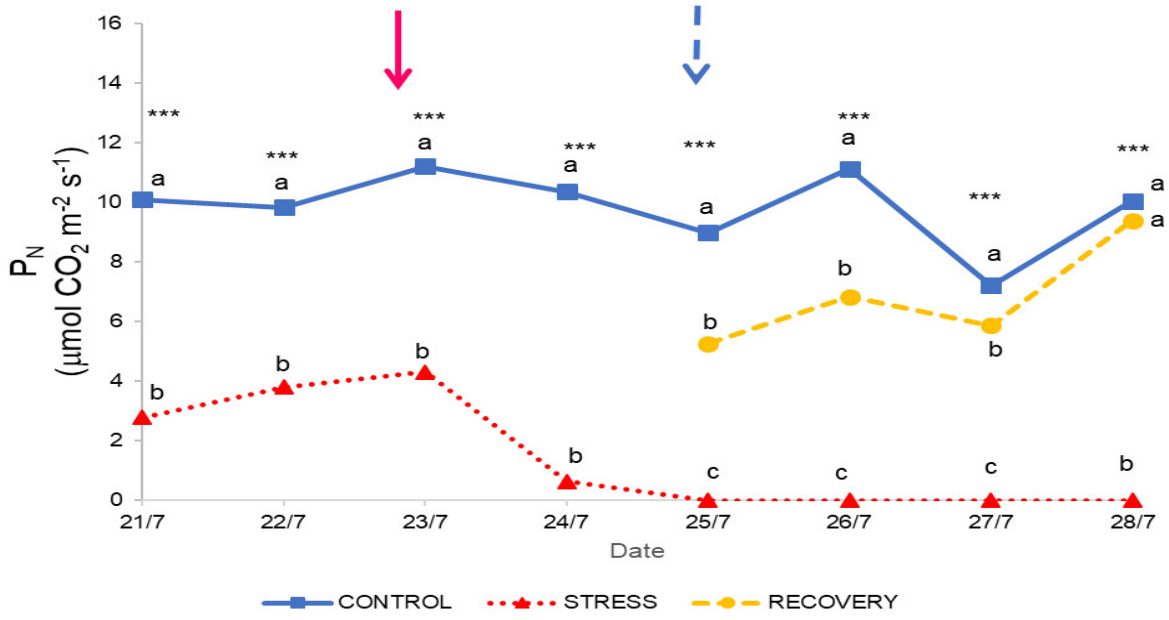
- 4-year-old, potted Gold 3® (*A*. *chinensis* var. *chinensis*), grafted onto *A*. *c.* var. *deliciosa,* trained with a 0.5-m long cordon holding 4-5 shoots
- Pots (0.1 m^3) filled with 5 different soil substrates
- In each pot a chalk potentiometric probe was installed to monitor Ψ_m and maintain soils at field capacity (Ψ_m = –30 kPa)

Soil main characteristics					
Characteristic	Calabria	Basilicata	Emilia-Romagna	Lazio 1	Lazio 2
Sand (%)	82	62	34	30	36
Loam (%)	10	12	42	28	14
Clay (%)	8	26	24	42	50
texture	Loamy sand	Loam	Loam	Clay	Clay
pH	6.5	7.7	8.2	7.0	6.4
OC (%)	2.15	1.01	2.02	2.55	1.47
Bulk density (g cm^{-3})	1.22	1.24	1.27	0.948	0.934
	Sand	Sandy-clay-loam	Loam	Clay-loam	Clay

Treatments

1. From July 13, 2022: 3 plants were irrigated to maintain soil at field capacity (CONTROL); 4 plants were gradually stressed by redistributing 50% of ET
2. On July 22, in pots receiving 50% ET, irrigation was suspended (STRESS)
3. On July 25, 2 STRESS plants were re-irrigated as for the control plants (RECOVERY) to assess the recovery capacity

CONTROL (left), RECOVERY (center) and STRESS (right) plants
on July 26th, four days after water suspension


P_N (µmol CO_2 m^{-2} s^{-1})
Date
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22/7
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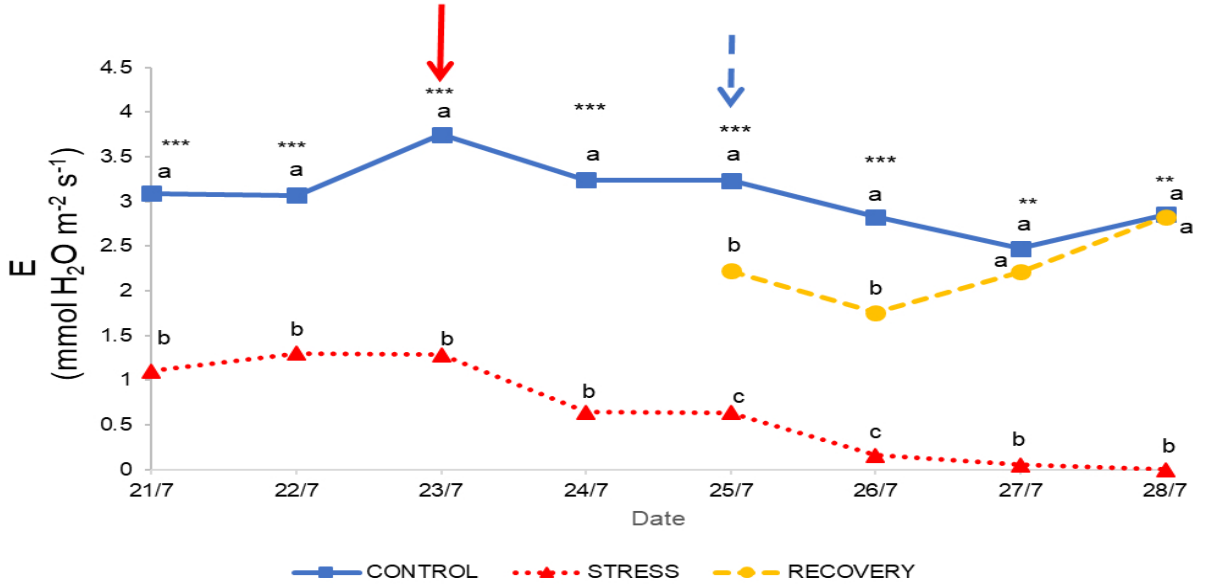
24/7
25/7
26/7
27/7
28/7
CONTROL
STRESS
RECOVERY


E (mmol H_2O m^{-2} s^{-1})
Date
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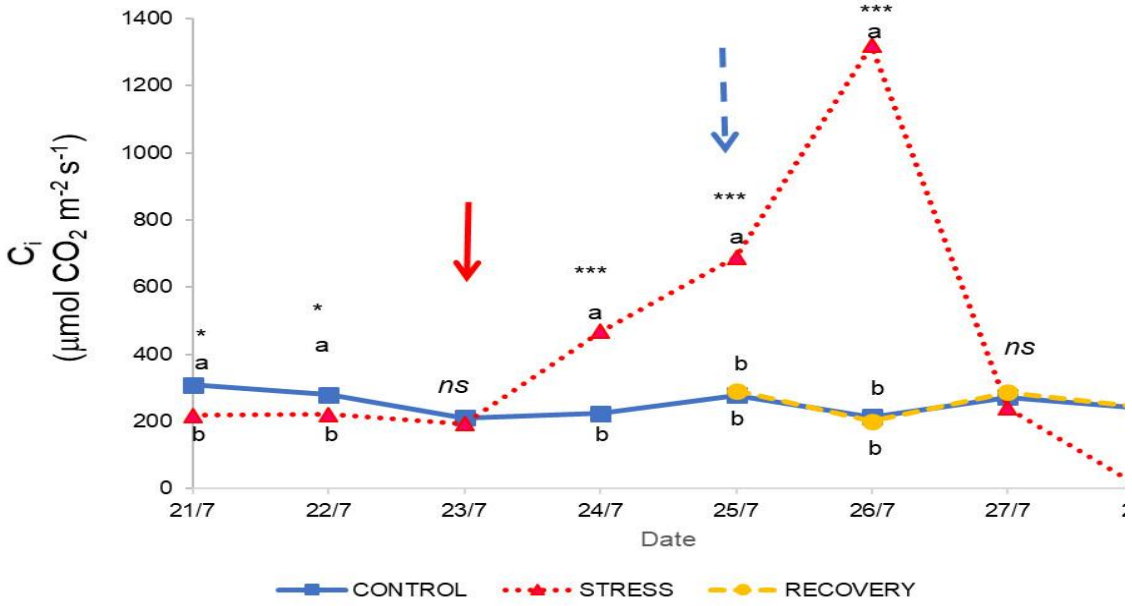
25/7
26/7
27/7
28/7
CONTROL
STRESS
RECOVERY


C_i (µmol CO_2 m^{-2} s^{-1})
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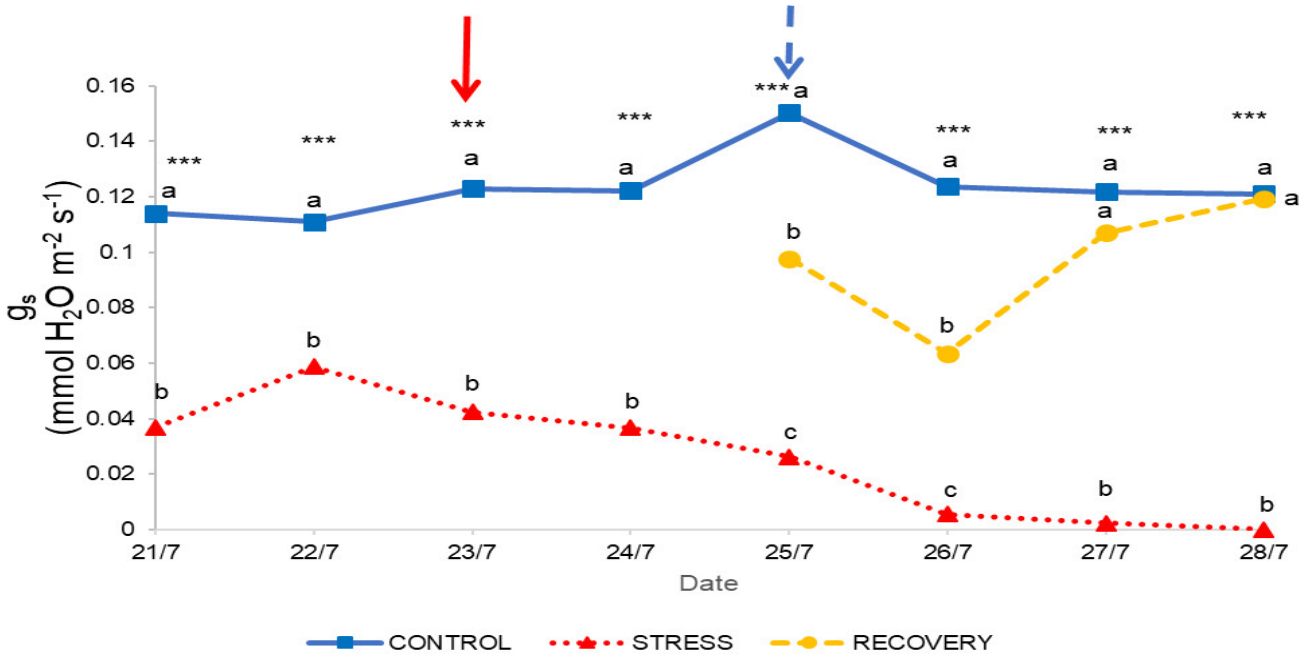
27/7
CONTROL
STRESS
RECOVERY


g_s (mmol H_2O m^{-2} s^{-1})
Date
21/7
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23/7
24/7
25/7
26/7
27/7
28/7
CONTROL
STRESS
RECOVERY

Soil water % at field capacity (FWC), wilting point (WP), plant death, water available (WA)					
SOIL	FWC	Pre-stress ET 50% July 22	WP July 24*	Plant death July 26*	WA (FWC-WP)
Sand	13.7 ± 2.1	11.9 ± 2.4	4.7 ± 0.1	3.0 ± 0.7	9.0
Sandy-clay-loam	17.5 ± 1.5	14.2 ± 4.2	7.2 ± 1.8	5.4 ± 0.5	10.3
Loam	21.1 ± 3.2	18.5 ± 4.0	14.0 ± 3.3	13.8 ± 2.9	7.1
Clay-loam	27.6 ± 0.1	25.6 ± 4.9	18.0 ± 1.9	13.2 ± 1.7	9.6
Clay	33.2 ± 2.8	31.4 ± 3.6	22.4 ± 1.1	17.8 ± 1.1	10.8
Replicates	n=7	n=4	n=4	n=2	-

*** Loam soil: WP July 25 and plant death July 27**

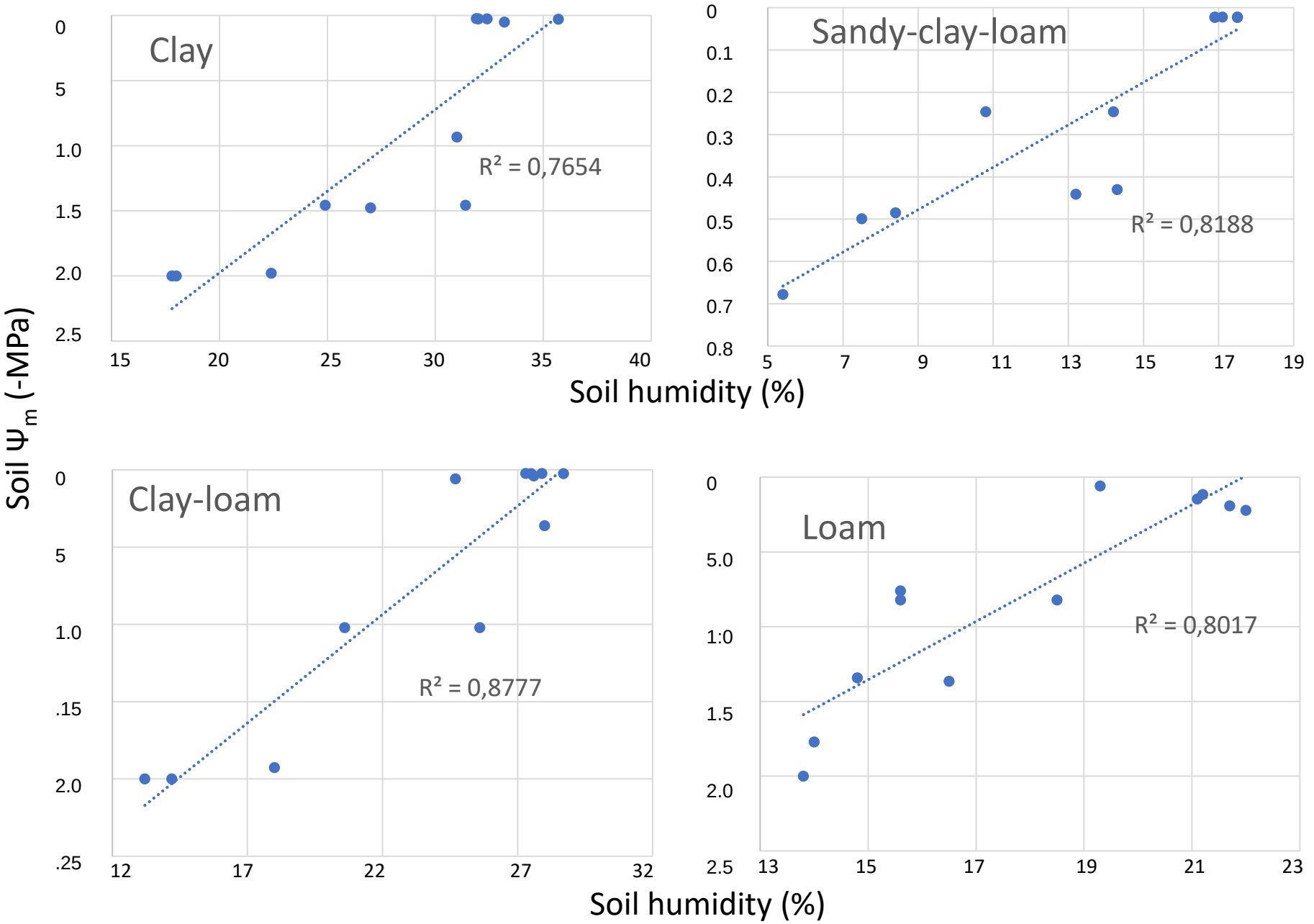
Soil matric potential (Ψ_m) at field capacity (FWC), wilting point (WP), and at plant death			
SOIL	FWC (-bar)	WP (-bar)	Plant death (-bar)
Sand	0.37	18.7 ± 0.14	20
Sandy-clay-loam	0.23	4.9 ± 0.37	6.8
Loam	1.45	17.7 ± 0.25	20
Clay-loam	0.50	19.8 ± 0.04	20
Clay	0.39	19.3± 0.15	20
Replicates	n=56*	n=4	n=2
***: number of observations 7 by 8 dates = 56**			

Estimated (mean ± std dev) daily water lost (l 100 kg^{-1} of soil DW) and leaf area (last irrigation July 22nd, irrigation was suspended on July 23						
SOIL	July 16	July 23	July 24	July 25	July 26	**Leaf area (m^2 $tree^{-1}$)**
Sand	6.05 ± 0.6	2.56 ± 0.1	1.50 ± 0.1	1.34 ± 0.1	0.91 ± 0.1	**1.69**
Sandy-clay-loam	5.26 ± 0.3	3.52 ± 0.7	1.91 ± 0.0	1.46 ± 0.1	1.18 ± 0.1	**1.58**
Loam	4.75 ± 0.3	2.79 ± 0.2	2.46 ± 0.5	1.54 ± 0.2	1.22 ± 0.2	**1.31**
Clay-loam	7.16 ± 0.7	3.67 ± 1.1	2.34 ± 0.2	1.64 ± 0.2	1.26 ± 0.1	**1.51**
Clay	7.32 ± 0.5	4.72 ± 0.6	2.74 ± 0.6	1.58 ± 0.3	1.41 ± 0.1	**1.34**
Replicates	n=7	n=4	n=2	n=2	n=2	**n=7**

Fruit drop (g DW plant^{-1}) in stress plants

SOIL	July 25th	July 26th	July 27th	July 29th
Sand	0 b	0 c	39.8 a	0 b
Sandy-clay-loam	0 b	5.51 b	29.1 b	0 b
Loam	0 b	0 c	0 b	27.4 a
Clay-loam	0 b	27.9 a	36.1 a	0 b
Clay	3.59 a	0 c	44.3 a	0 b
Significance	***	***	*	***

Relationship between soil moisture and soil matric potential



CONCLUSIONS

- Our plants were in pots and the trial was performed during hot weeks (average temperature 31°C, with peak of 46°C) that exacerbated plant responses

- Although, the rapidity of drought stress symptoms and recovery observed in this trial may not be observed in field, however it gives an idea on the promptness of yellow kiwifruit plants to respond to variation of soil moisture

- From our data, it appears that soil water availability must be kept at optimal level, since it is strictly related with plant C fixation

CONCLUSIONS

- Among the few differences observed in soil behaviors, loam soil from Emilia-Romagna region, lost and gained humidity more slowly showing to be more resilient to drought stress than the others

- Potentiometric chalk probes can be carefully used in sandy coarse soils considering their lower accuracy

- Soil texture alone cannot explain the soil water retention and water availability

ACKNOWLEDGEMENTS

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