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Quinoa water management in presence of shallow saline groundwater: physiological characteristics and gas exchange

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Background/Introduction

limitations for agricultural production in arid and semi-arid regions of Iran

Key challenges are:

- Water scarcity
- Water salinity

Solutions:

- Shallow groundwater contribution to crop water use
- Deficit irrigation
- Saline irrigation water
- Salt and water stress tolerant crops:
- Quinoa

Background/Introduction

Aims of the study

Investigate the influence of **saline groundwater depths** (0.3, 0.55, and 0.80 m) and **deficit irrigation** (80, 55 and 30 % of full irrigation) on growth and physiological characteristics, gas exchange of quinoa in lysimeters under greenhouse conditions.

Background/Introduction

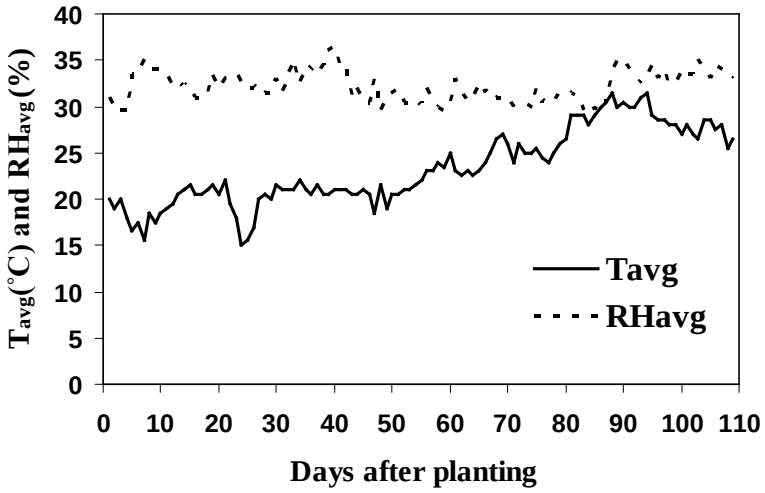
Quinoa

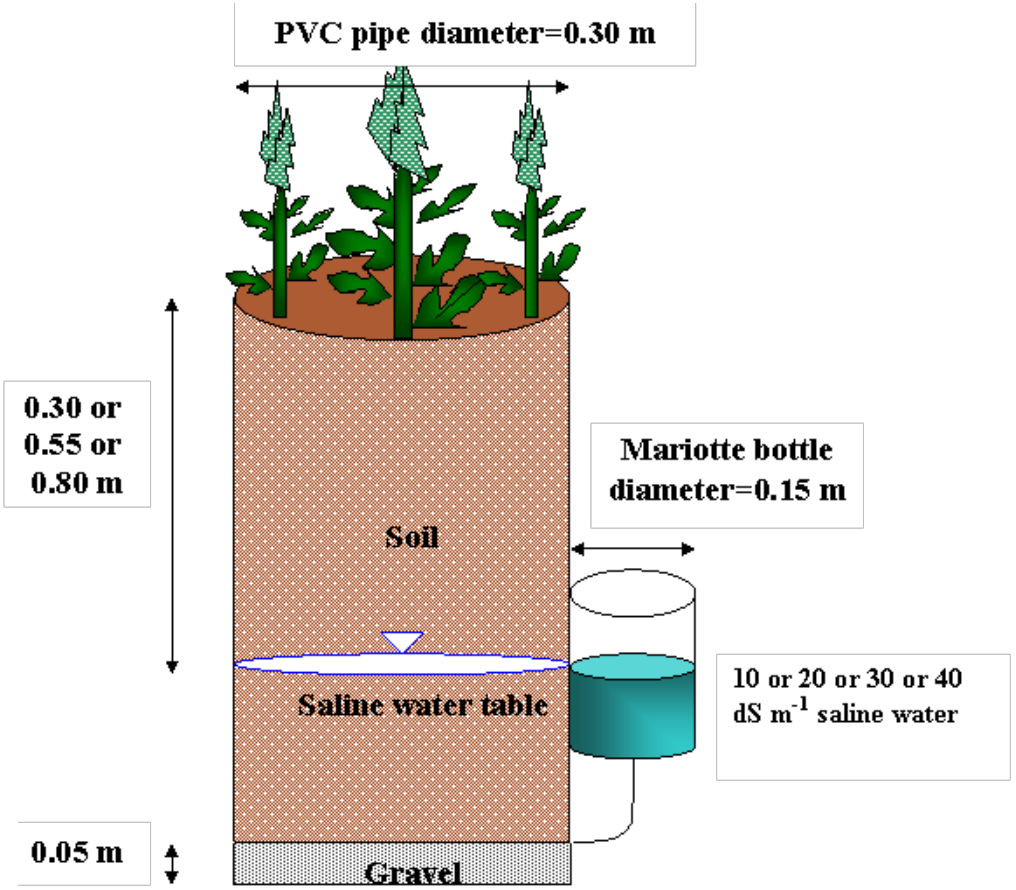
- A traditional Andean seed crop
- A food security crop
- Extraordinary tolerance to various environmental stress conditions
- Interesting nutritional properties
- Halophytic plant

Materials and Methods

Experimental site

greenhouse at the College of Agriculture, Shiraz University, Iran (29◦56N, 52◦02E, 1810m above mean sea level) in 2013.





Details of experimental set up for constant water table

Materials and Methods

Applied treatments

Groundwater depths (0.3, 0.55, and 0.80 m)

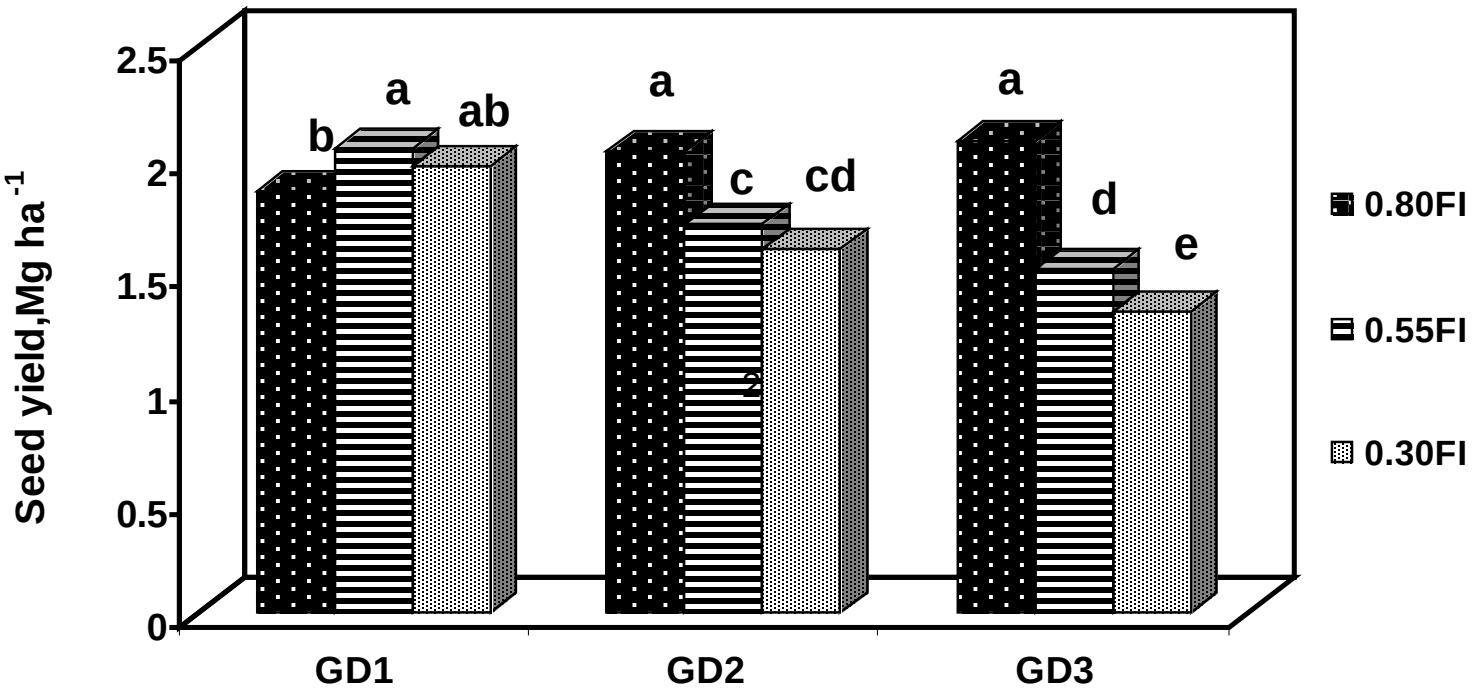
Deficit irrigation (80, 55 and 30 % of full irrigation)

20 dS m^{-1} water salinity

4 replications

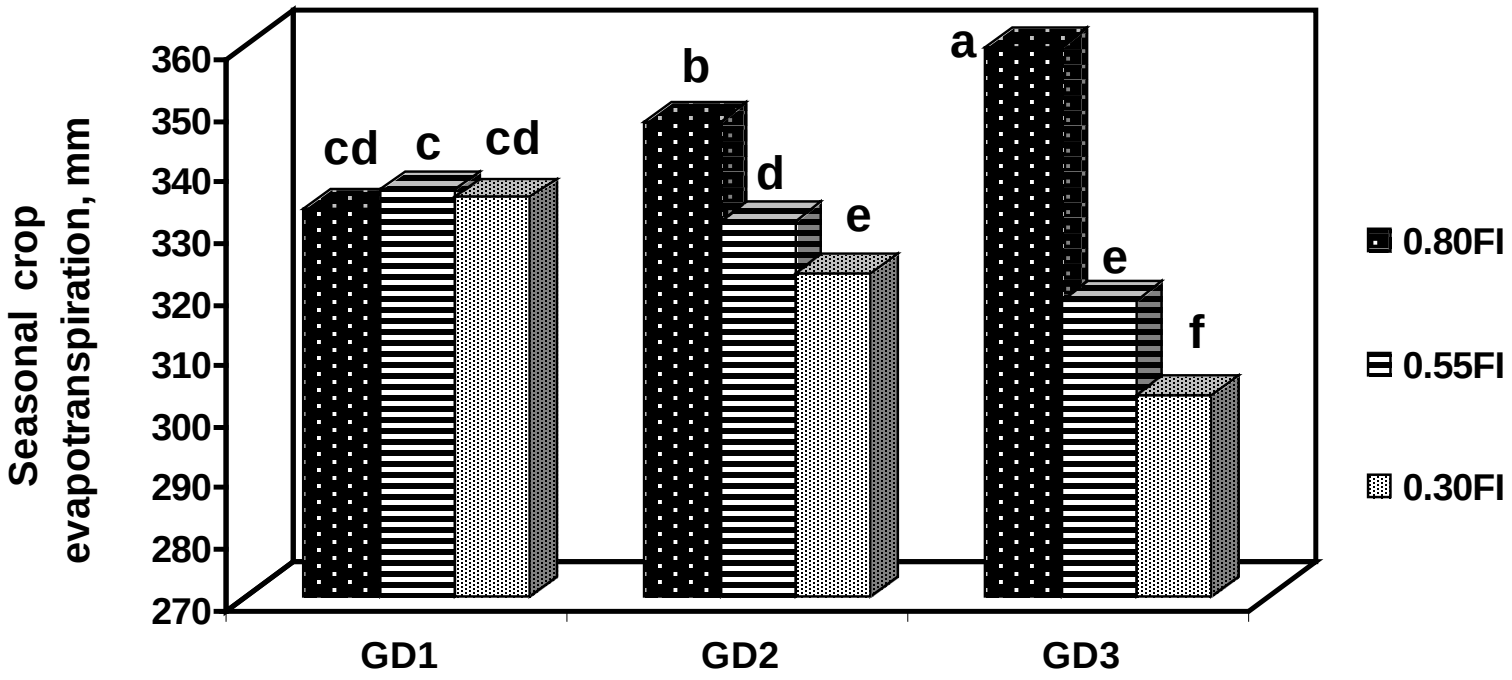
Results

Growth Parameters



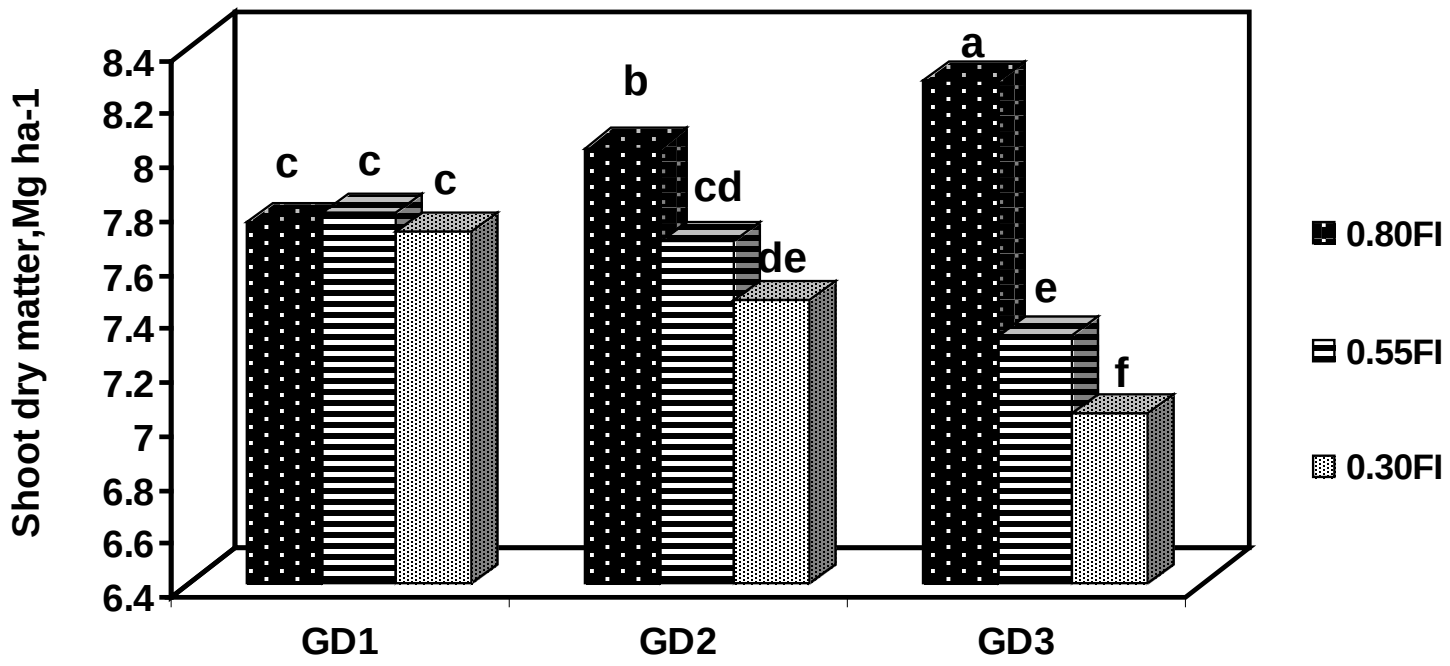
Results

Growth Parameters



Results

Growth Parameters

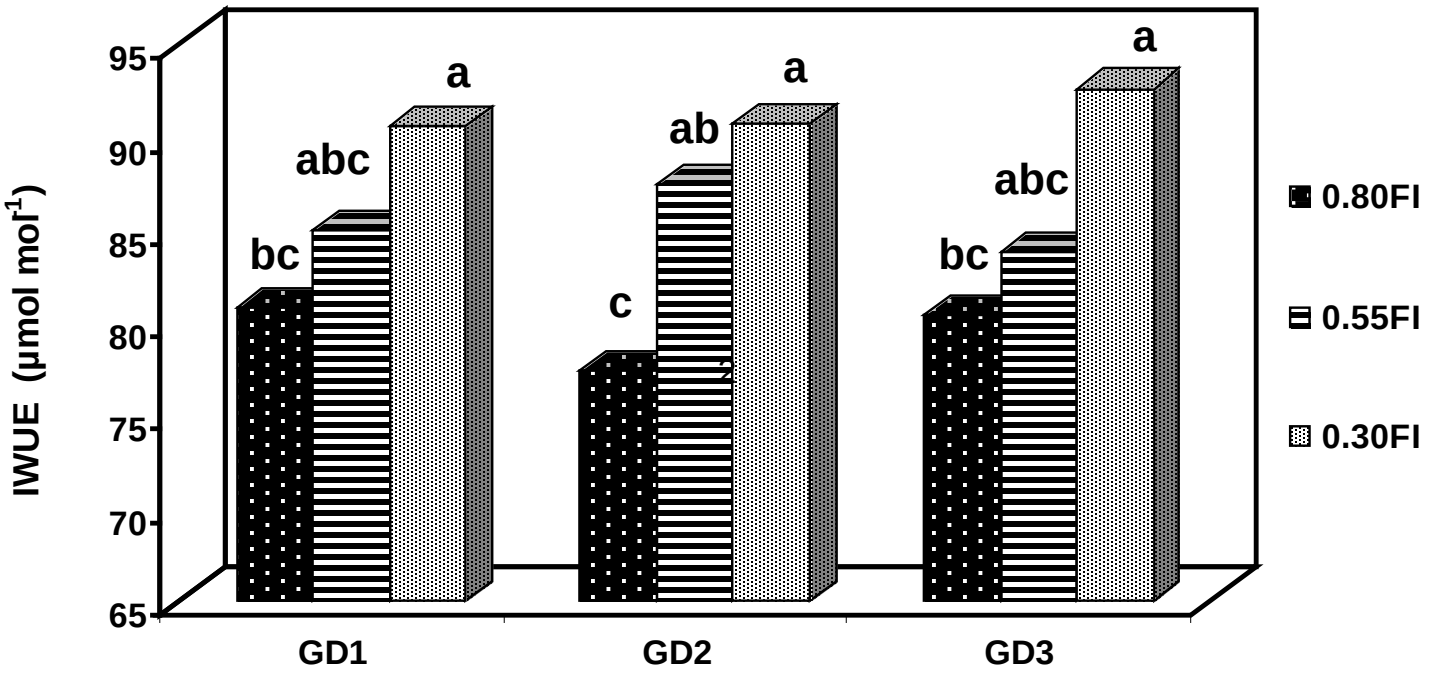


Results

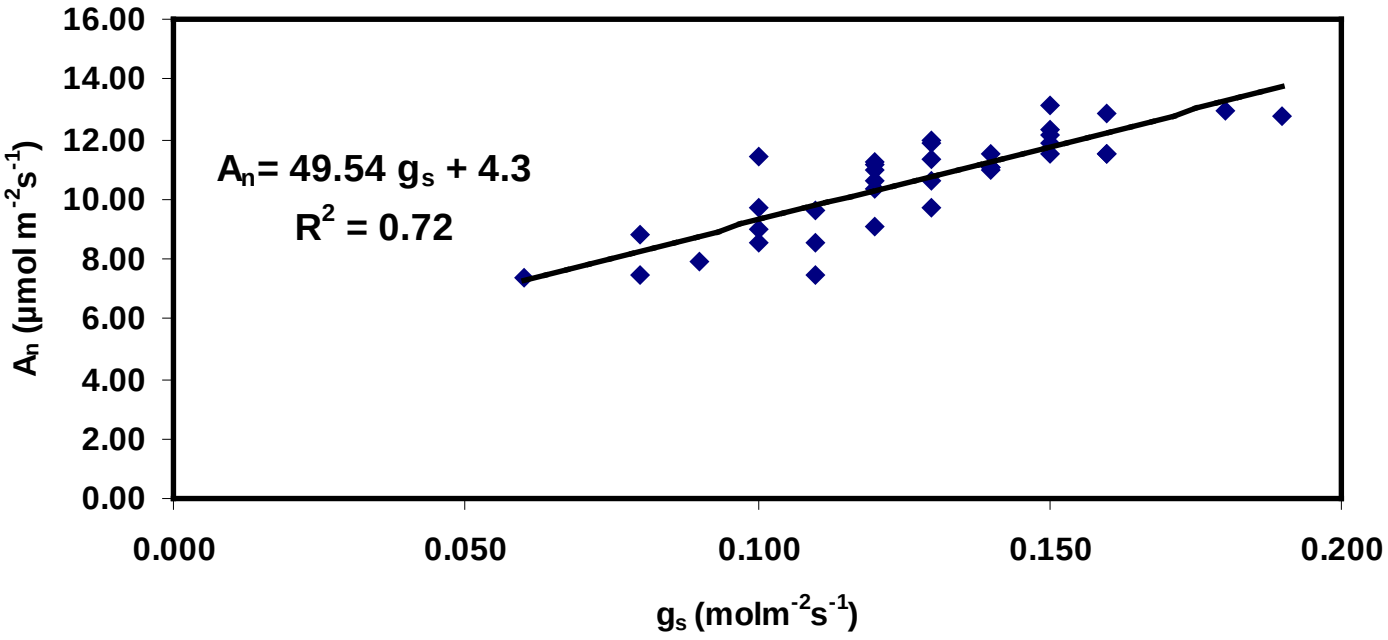
Groundwater depth (m)			Deficit irrigation
	0.80FI	0.55FI	0.30FI
Ψ (MPa)			
0.30	-2.00 bc	-1.93 cd	-2.05 bc
0.55	-1.68 de	-2.15 abc	-2.25 abc
0.80	-1.50 e	-2.30 ab	-2.47 a
A_n (μmol $m^{-2}s^{-1}$)			
0.30	11.63 bc	11.21 cd	10.90 d
0.55	12.00 b	11.10 cd	8.72 f
0.80	12.80 a	9.54 e	7.53 g
g_s (mol $m^{-2}s^{-1}$)			
0.30	0.145 c	0.133 d	0.123 f
0.55	0.158 b	0.128 e	0.098 h
0.80	0.160 a	0.115 g	0.085 i

Results

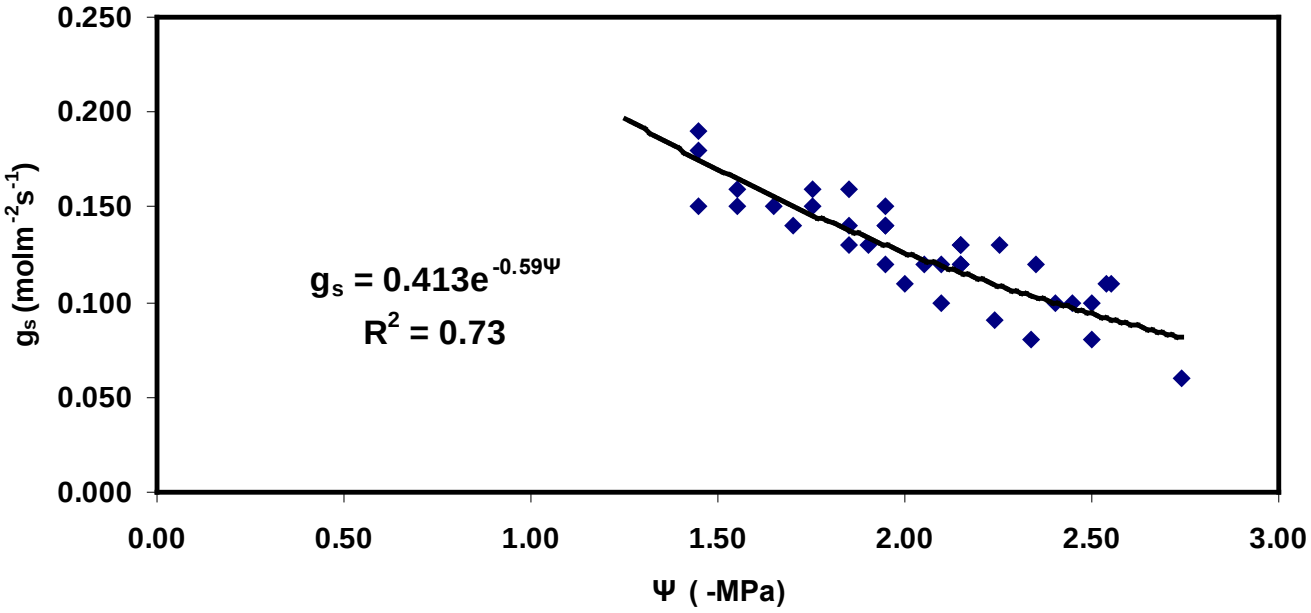
IWUE



Results


16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0.000
0.050
0.100
0.150
0.200
A_n (µmol $m^{-2}s^{-1}$)
g_s (mol$m^{-2}s^{-1}$)
A_n= 49.54 g_s + 4.3
R^2 = 0.72

Results


0.250
0.200
0.150
0.100
0.050
0.000
gs (molm-2s-1)
gs = 0.413e-0.59Ψ
R2 = 0.73
0.00
0.50
1.00
1.50
2.00
2.50
3.00
Ψ (-MPa)

Conclusions

- Results showed that mean value of leaf water potential (Ψ) dropped from -1.7 to -2.25 MPa by reducing the irrigation regime from 0.80FI to 0.30FI.
- Deficit irrigation significantly affected the leaf stomatal conductance (gs) and leaf photosynthesis rate (An).
- 70% reduction of the irrigation water resulted in only 41% reduction in An as compared with maximum An (12.8 µmol m-2 s-1 at 0.80 m GD with 0.80FI)
- Intrinsic water use efficiency (IWUE) determined as An/gs increased 15%.