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I Giornata AIGA di Approfondimento
Lo studio e la tutela delle acque sotterranee
Aula Magna del Dipartimento di Scienze della Terra e Geoambientali Università di Bari, Via Orabona 4, Bari
Martedì 25 ottobre, 2016

The water for the Mediterranean agricultural systems is a question of quantity and quality

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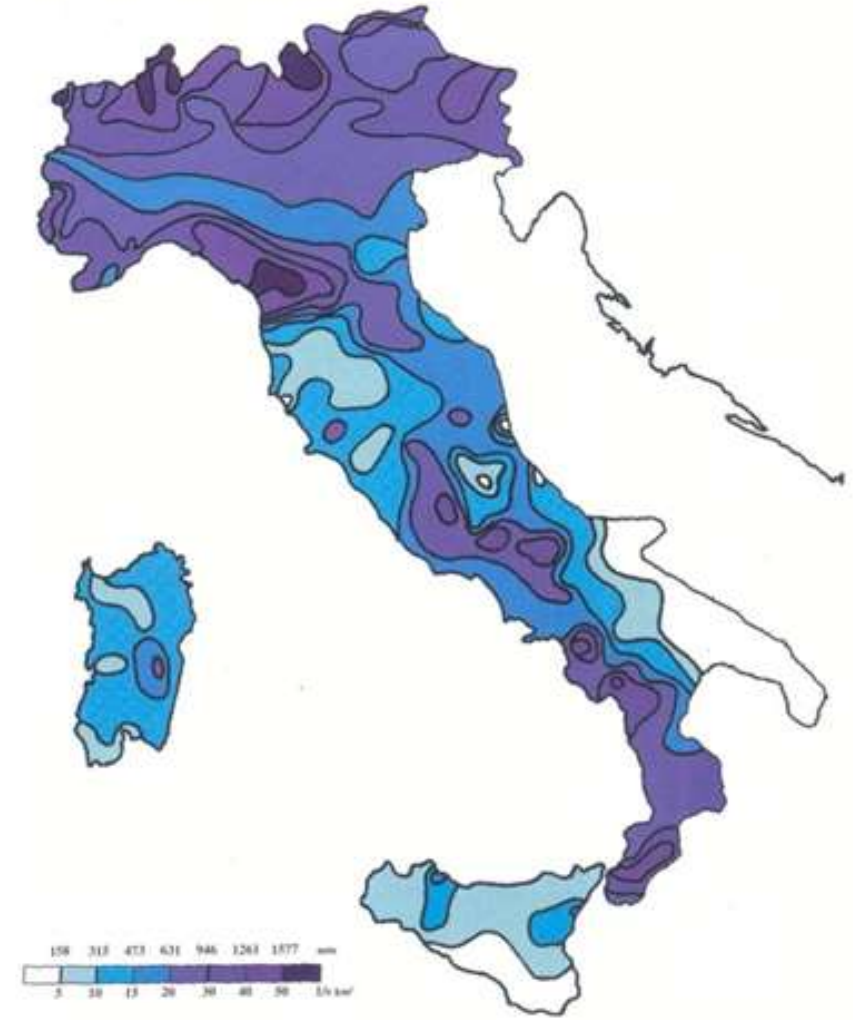
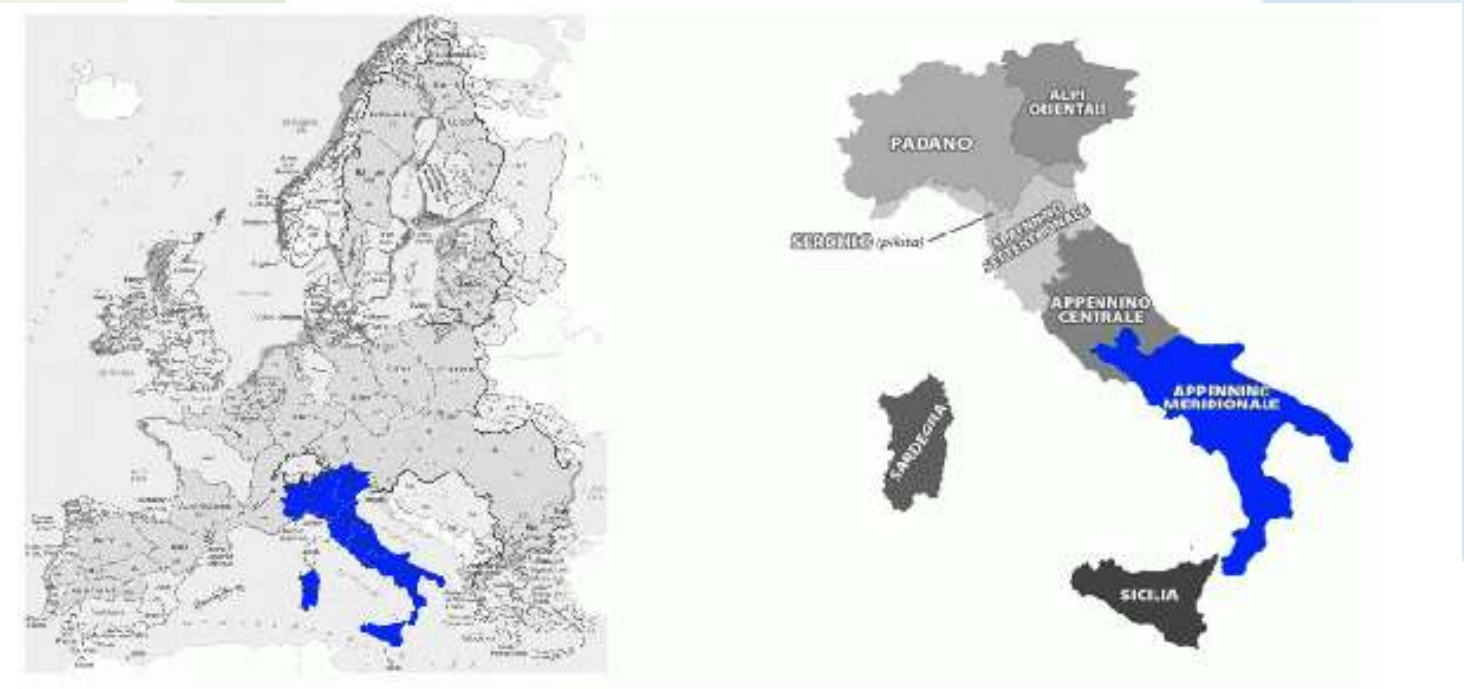


Average annual precipitation in Italy
(IRSA CNR, 1999)

hydrographic districts



Distretti idrografici europei e distretti idrografici italiani

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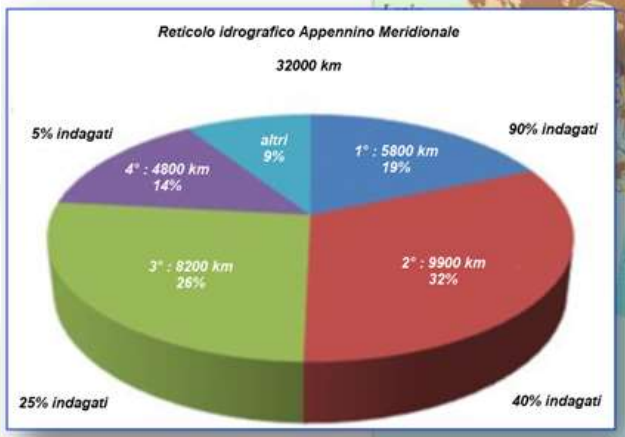
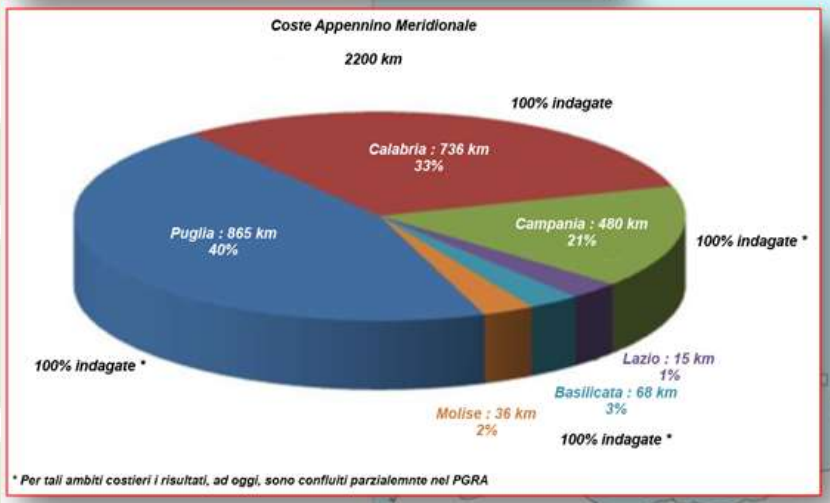
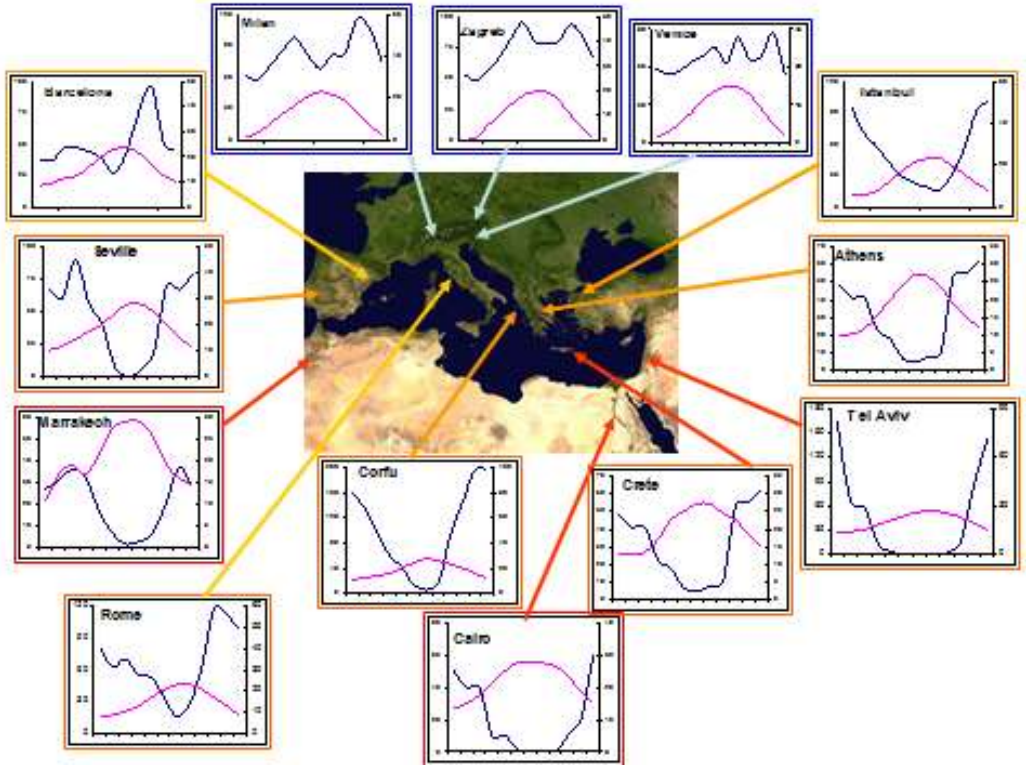
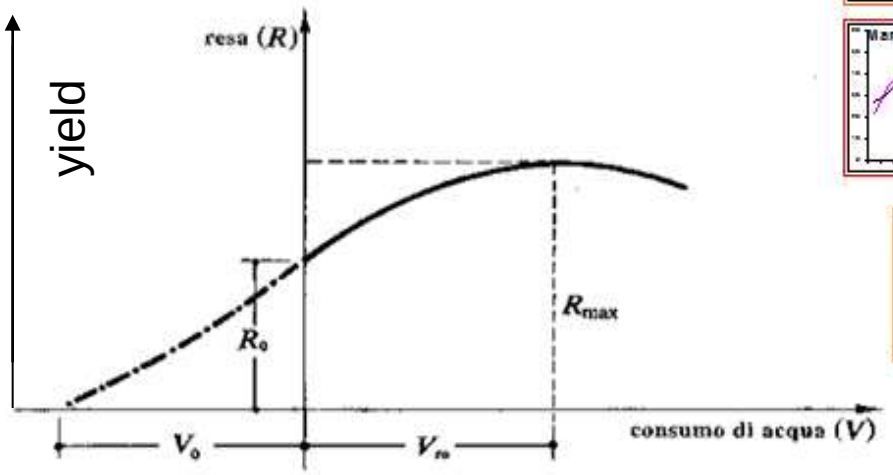




The water for the Mediterranean agricultural systems is a question of quantity and quality

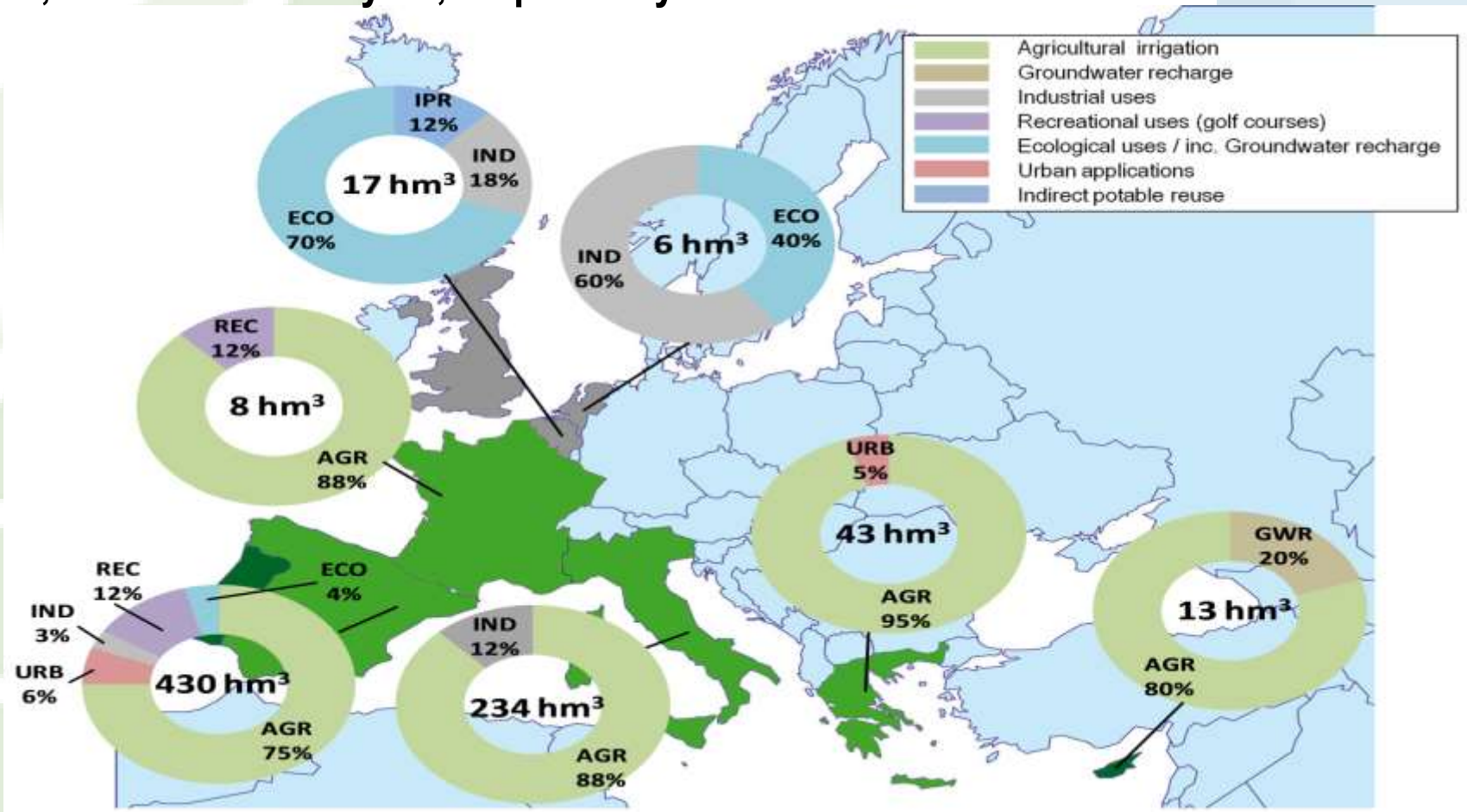
question of water balance





ET (mm) = rain + irrigation

The estimated prediction of **water reuse** volume will be of **3,222 Hm³/year in Europe by 2025**, with **Spain and Italy** showing the greatest reuse potential with **1,200 and 250 Hm³/year, respectively.**



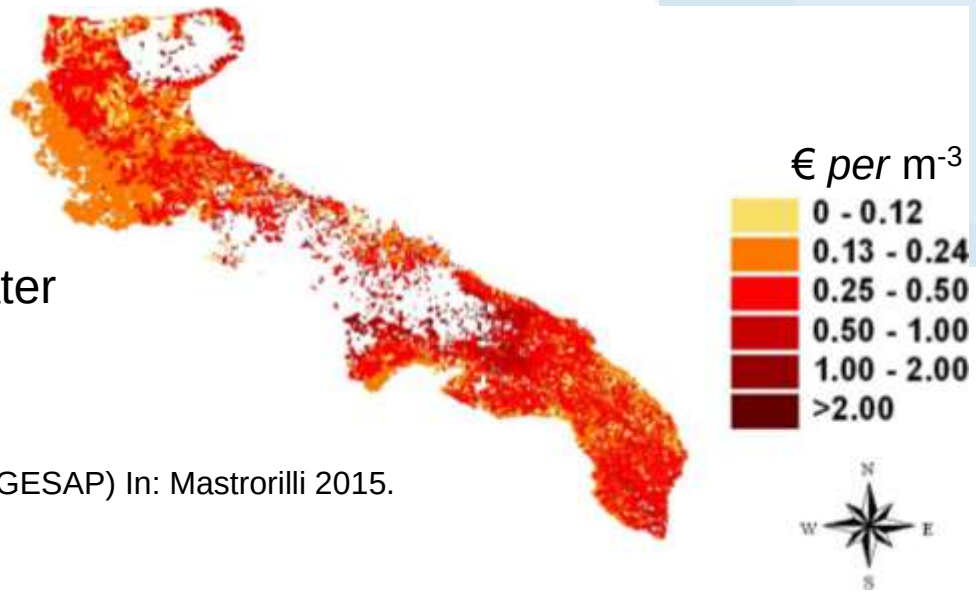
Water reuse in Europe

The water for the Mediterranean agricultural systems is a question of quantity and quality

Regioni	Acqua superficiale	Acquedotto	Acqua sotterranea	Acque reflue depurate, desalinizzate e salmastre	più di una fonte	Totale
Italia	38,3	18,6	24,0	0,1	19,0	100,0
Nord	48,6	18,8	11,6	0,1	21,0	100,0
Centro	36,2	7,9	41,2	0,1	14,6	100,0
Mezzogiorno	17,1	20,9	46,2	0,1	15,7	100,0
Puglia	6,9	12,1	67,6	0,2	13,2	100,0

is a question of money

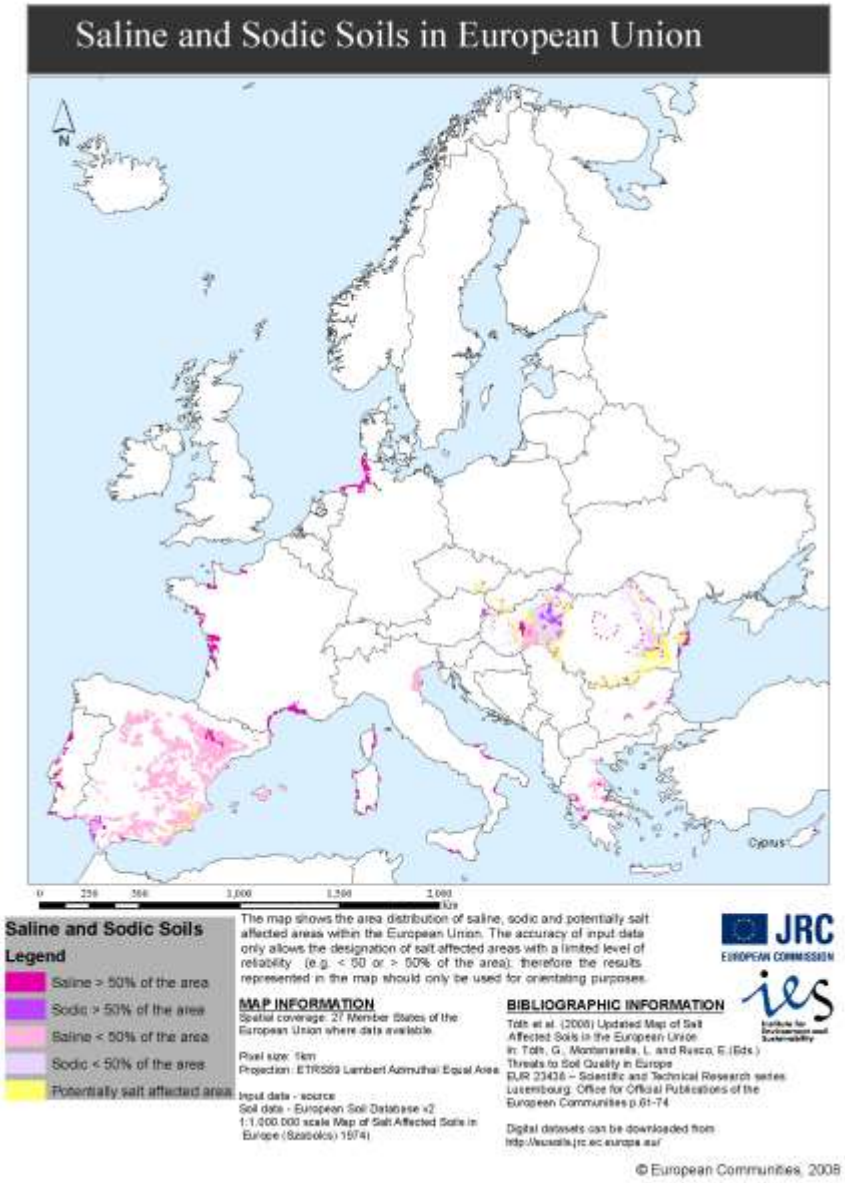
Costs for water supply from groundwater



A model of sustainable management of aquifers Puglia (GESAP) In: Mastrorilli 2015. L'acqua in Agricoltura, Edagricole, 403 pp

Soil salinization

- Worldwide: 1128 million Ha
- Europe: 20,7 millions Ha
- Natural and anthropogenic causes
- Loss of soil fertility
- Slow down or reverse through lixiviation
- Three types: saline, sodic, saline-sodic



Institute for Environment and Sustainability (2009).
Wicke et al. (2011). Energy Environ. Sci. 4:2669-2681.

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Main parameters distinguishing the soils affected by salinity and alkalinity

Tipi di suolo	EC_e (dS m^{-1})	ESP (%)	pH
Suoli salini	> 4	< 15	< 8,5
Suoli alcalini	< 4	> 15	> 8,5
Suoli salino-alcalini	> 4	> 15	> 8,5

EC = electrical conductivity of saturated paste extract; ESP = exchangeable sodium percentage.

$$\mathrm{ESP} = \frac{[Na^+]}{[Na^+ + K^+ + Ca^{2+} + Mg^{2+}]}$$

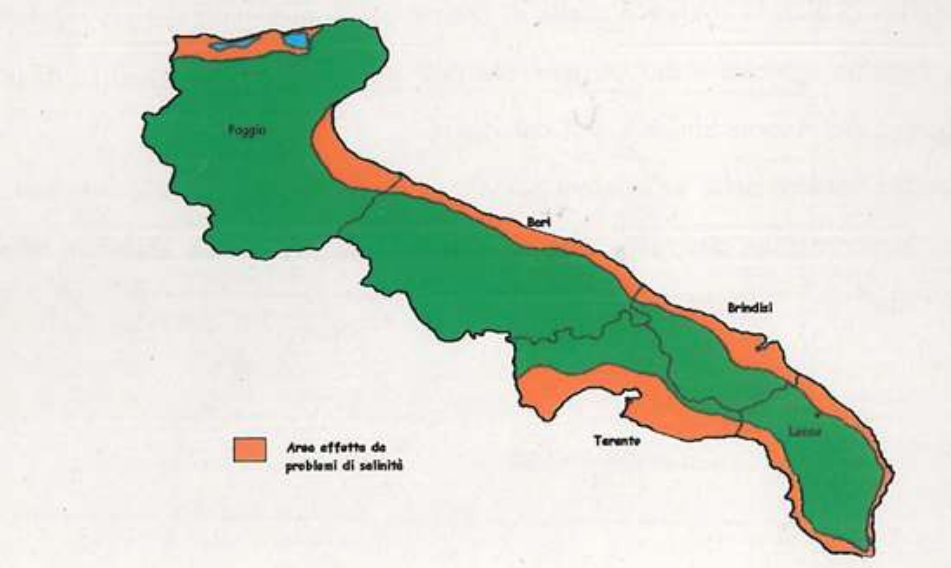
Salinity problem

0.25-1.5 million irrigated hectares per year are lost because of salinization

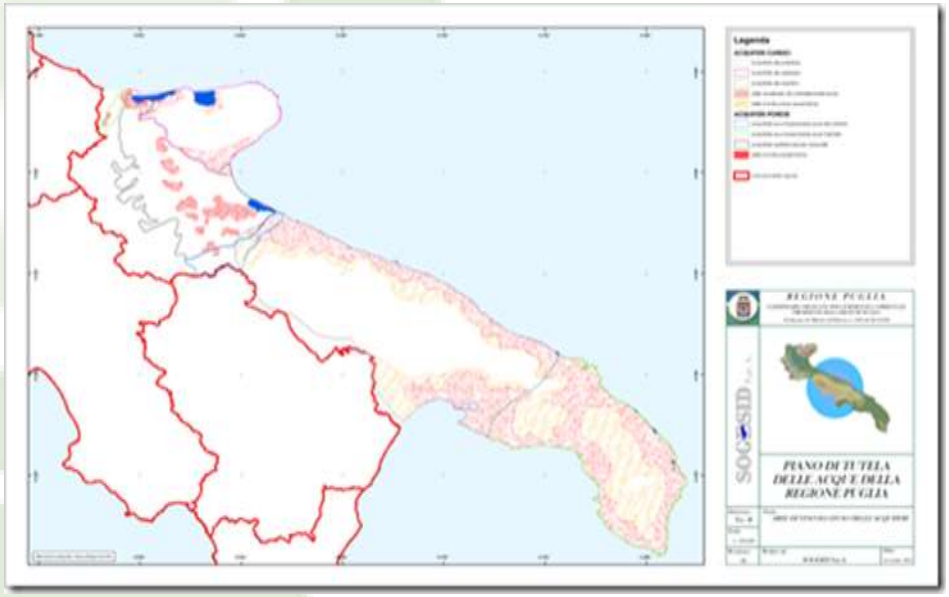
Soil secondary salinization in the semi-arid regions seriously affects the productivity of at least **20-30 million ha**

11% of the total irrigated surface

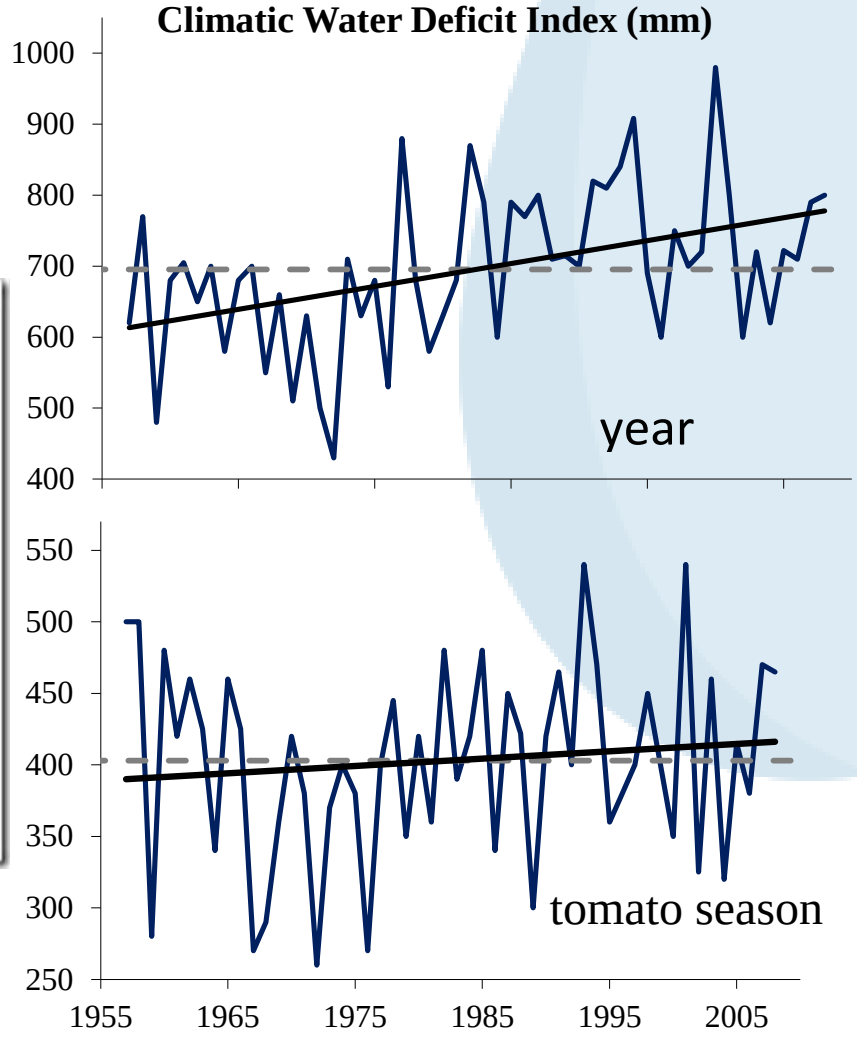
An estimated **100,000** hectares are irrigated with water from aquifers, of which 85% have a very high level of salts



Salinity problem

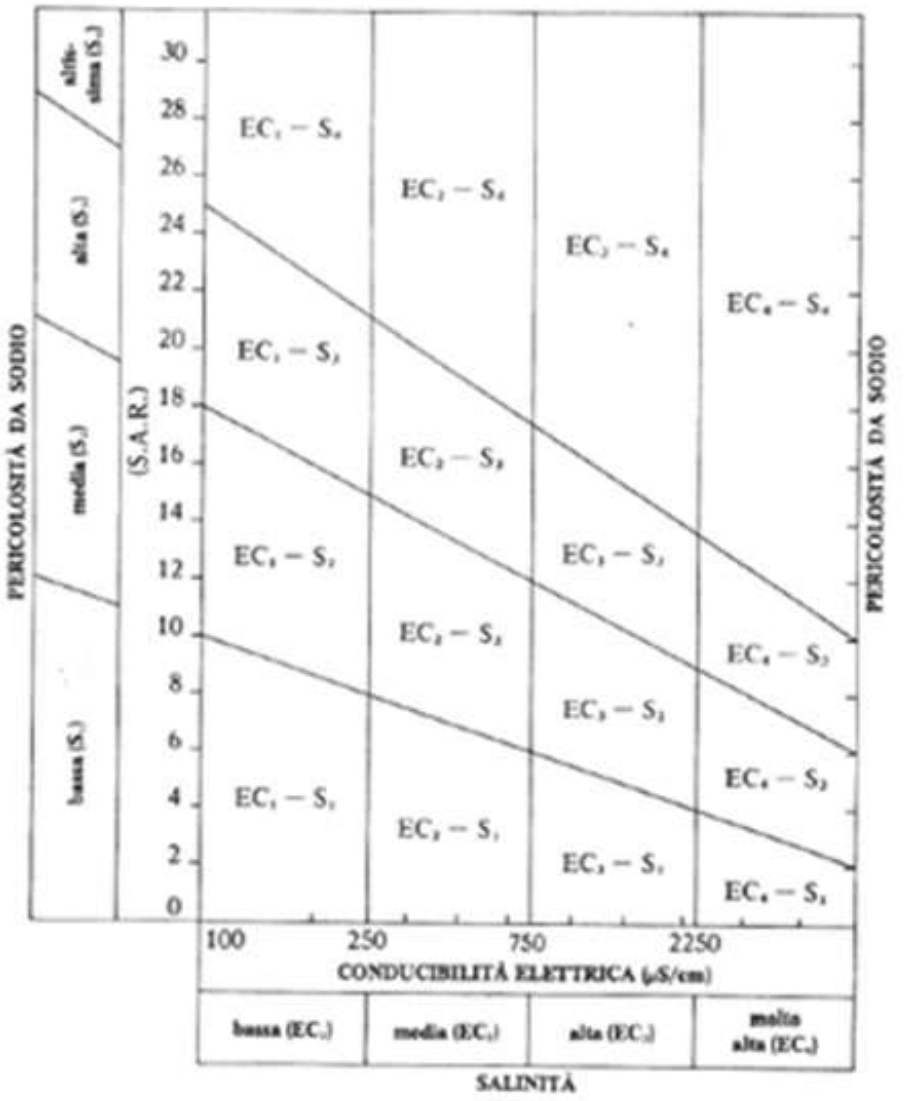


"Aree di vincolo d'uso degli acquiferi" (Tav. B della Relazione del PTA) 2006



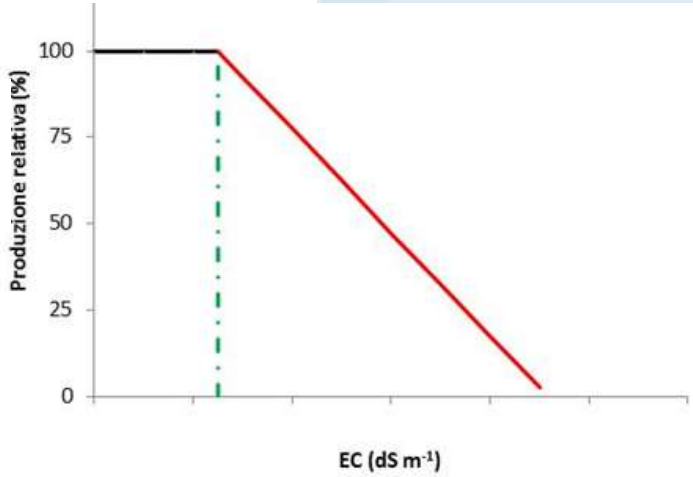
Guidelines for assessing water quality for irrigation (Ayers and Westcot, 1994)

Problemi potenziali dell'irrigazione	Parametro		Nessuna
Salinità (influenza la disponibilità di acqua per la coltura)	EC_w (dS m^{-1})		< 0,7
	TDS (mg L^{-1})		< 450
Infiltrazione (influenza la velocità di infiltrazione dell'acqua nel terreno tenendo conto, contemporaneamente, di EC_w e SAR)	SAR = 0-3	con EC_w	> 0,7
	SAR = 3-6	con EC_w	> 1,2
	SAR = 6-12	con EC_w	> 1,9
	SAR = 12-20	con EC_w	> 2,9
	SAR = 20-40	con EC_w	> 5,0
Tossicità (effetti da ioni specifici su specie vegetali sensibili)			
Sodio (Na)			
Irrigazione superficiale	SAR		< 3
Irrigazione a pioggia	meq L^{-1}		< 3
Cloro (Cl)			
Irrigazione superficiale	meq L^{-1}		< 4
Irrigazione a pioggia	meq L^{-1}		< 3
Boro (B)	mg L^{-1}		< 0,7



Salinity and agronomic options

general model: yield vs. salinity
(Maas and Hoffman, 1977)



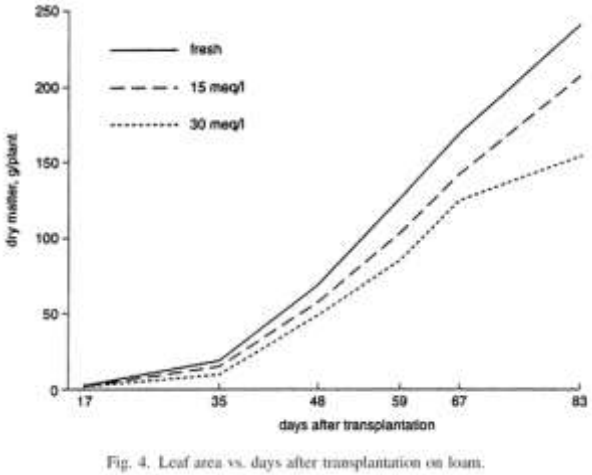
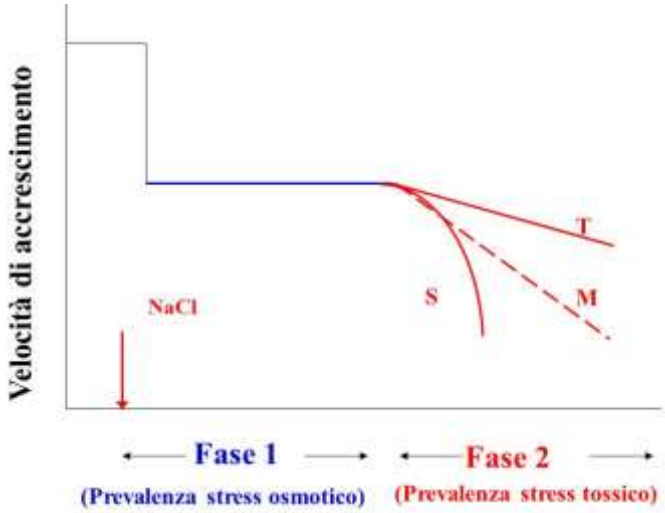


Fig. 4. Leaf area vs. days after transplantation on loam.

biphasic growth response to salt stress of 3 genotypes:

1. sensitive (S)
2. moderately tolerant (M)
3. tolerant (T)

(adapted by Munns, 1993)



agro-techniques prescriptions

- choice of crops to be irrigated
- leaching of solutes supplied through irrigation water
- drainage network
- breaking and / or removal impervious soil layers (and superficial crusts)
- crop rotation (irrigated – rainfed crops)
- vertical tillage
- scheduling crop fertilization at different rates
- organic amendment supply
- blending saline and fresh waters
- irrigation methods which do not favor the accumulation of solutes in the soil volume where the roots of the crop are more active
- short irrigation intervals
- irrigation volumes in excess, higher than those required to bring to the field capacity the soil layer colonized by the roots (leaching requirement)

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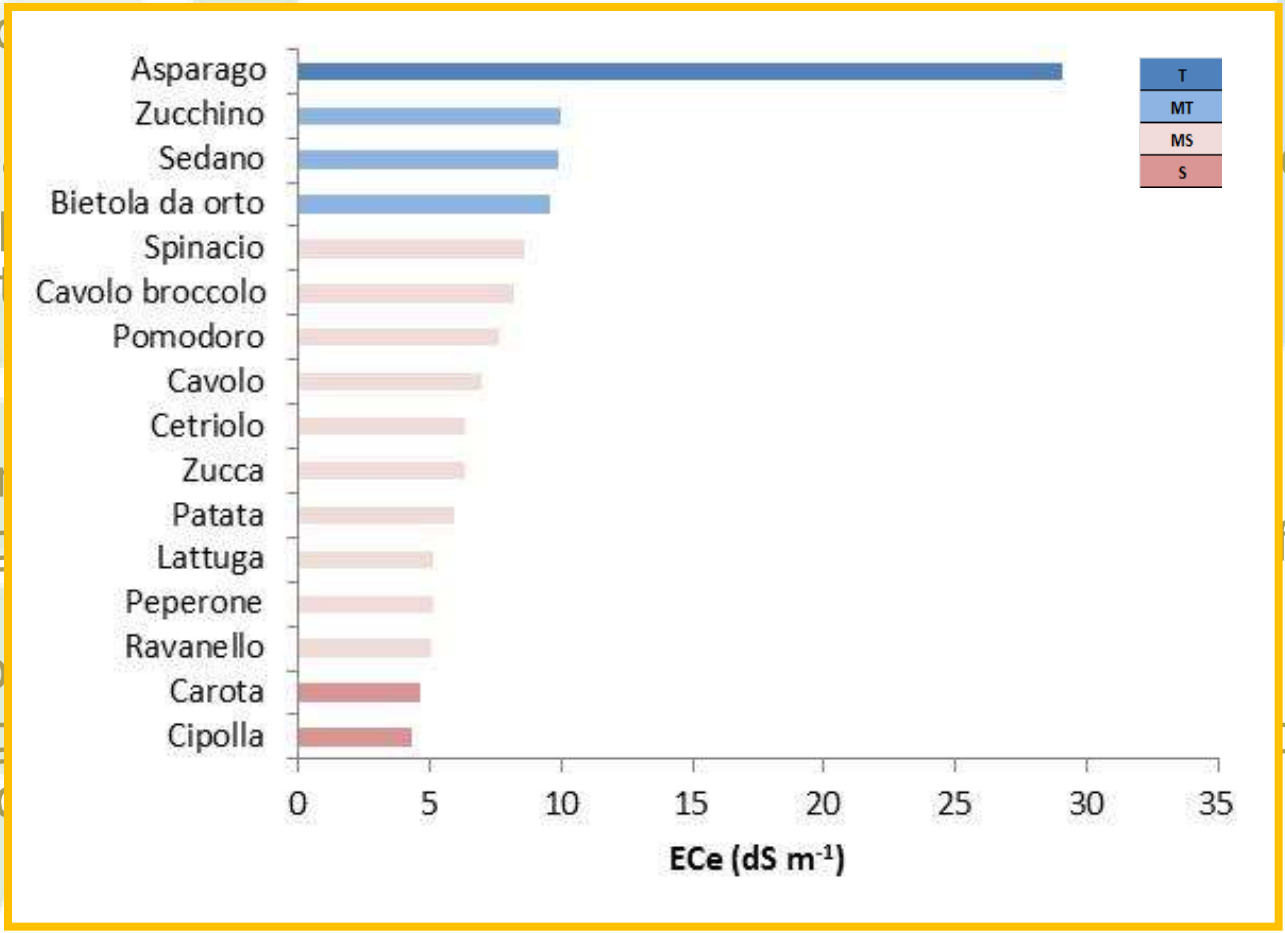

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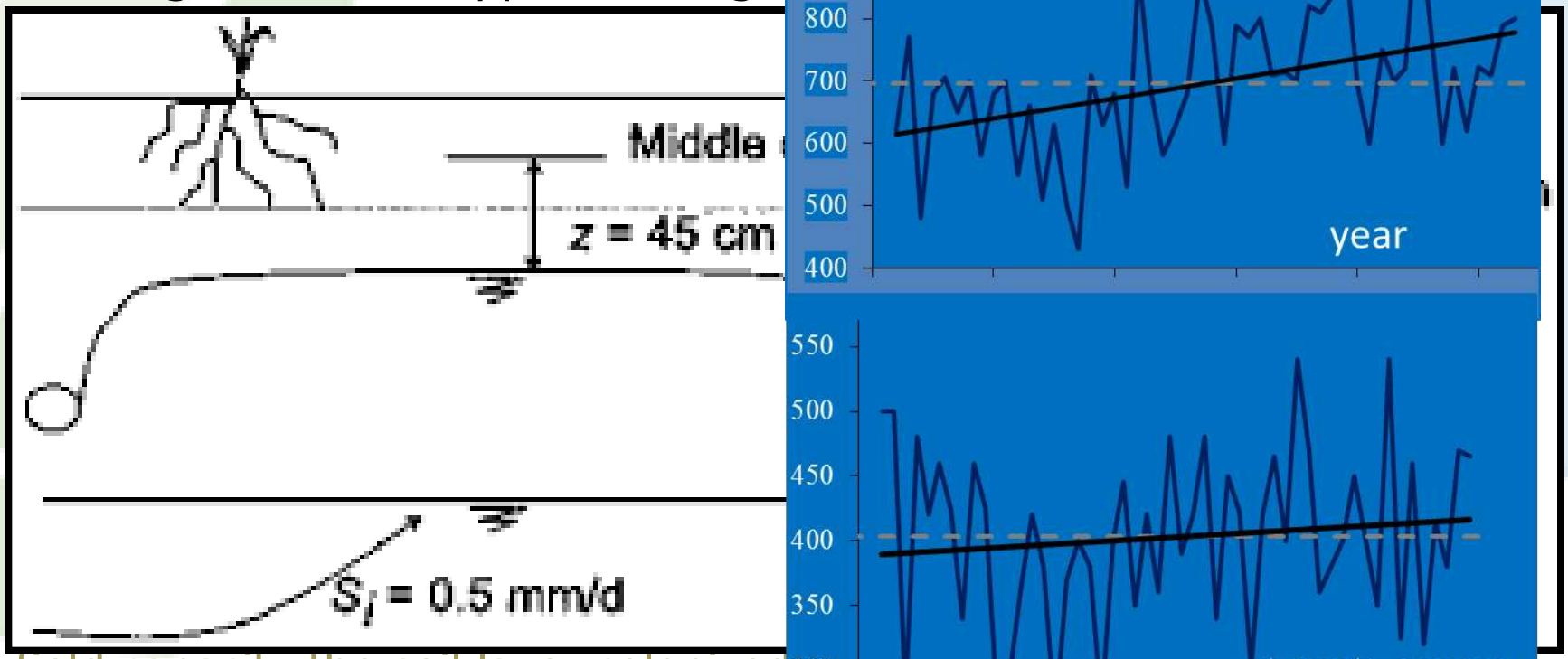

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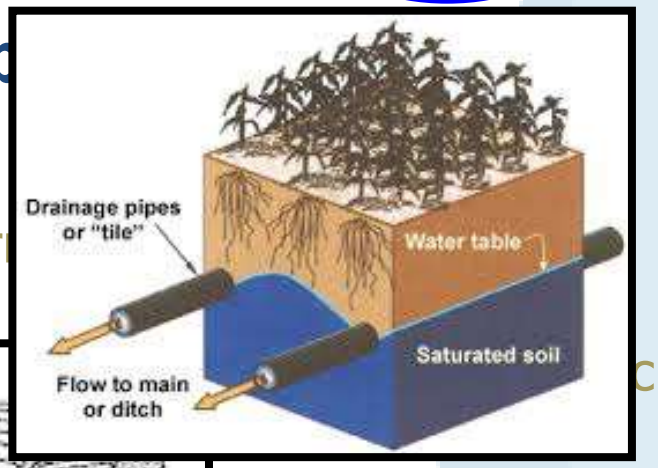

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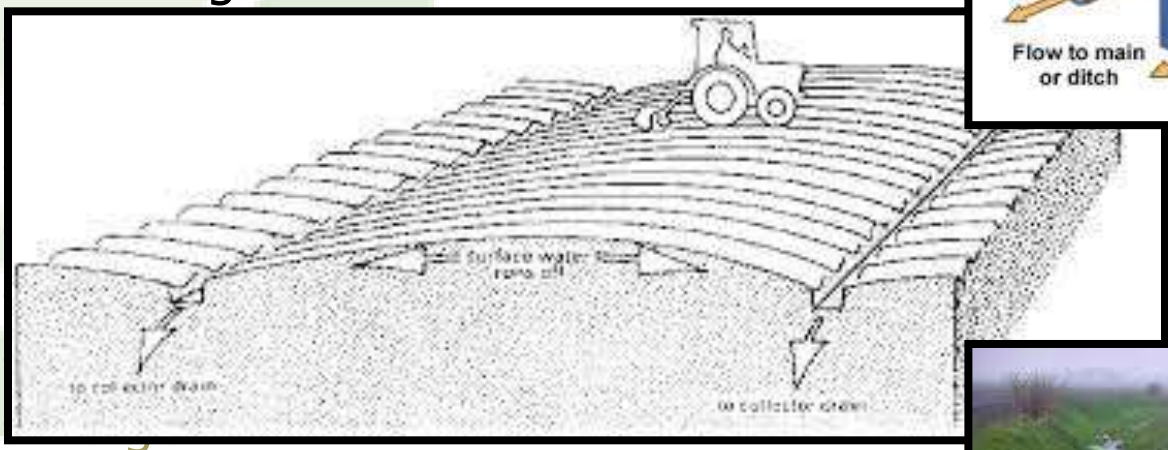

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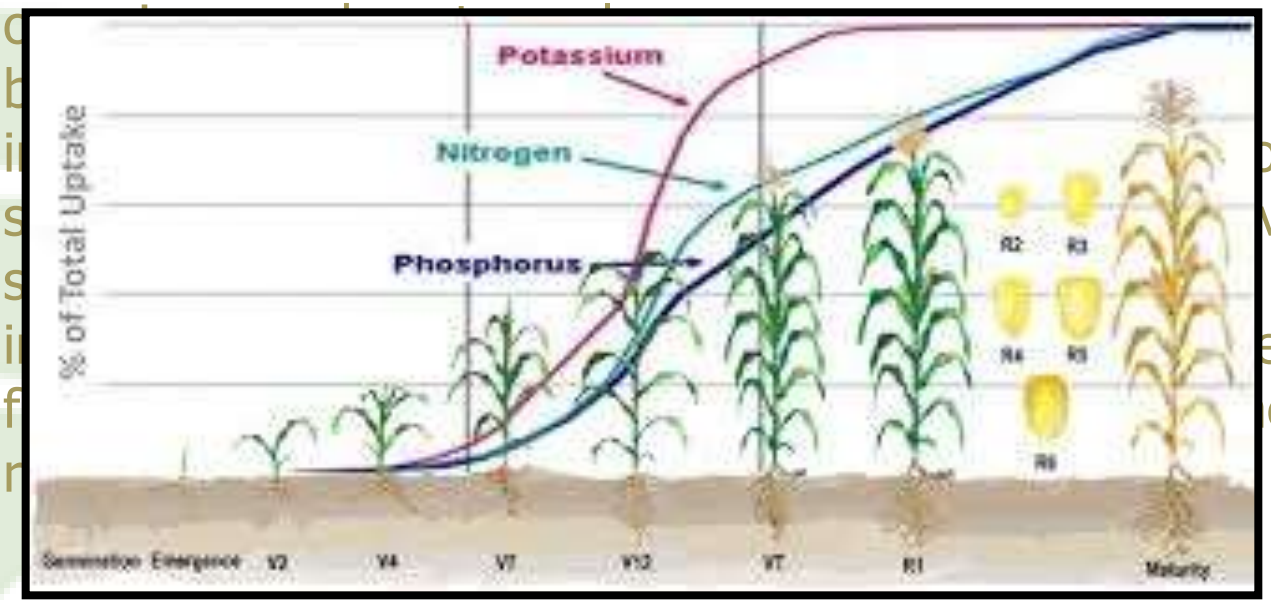

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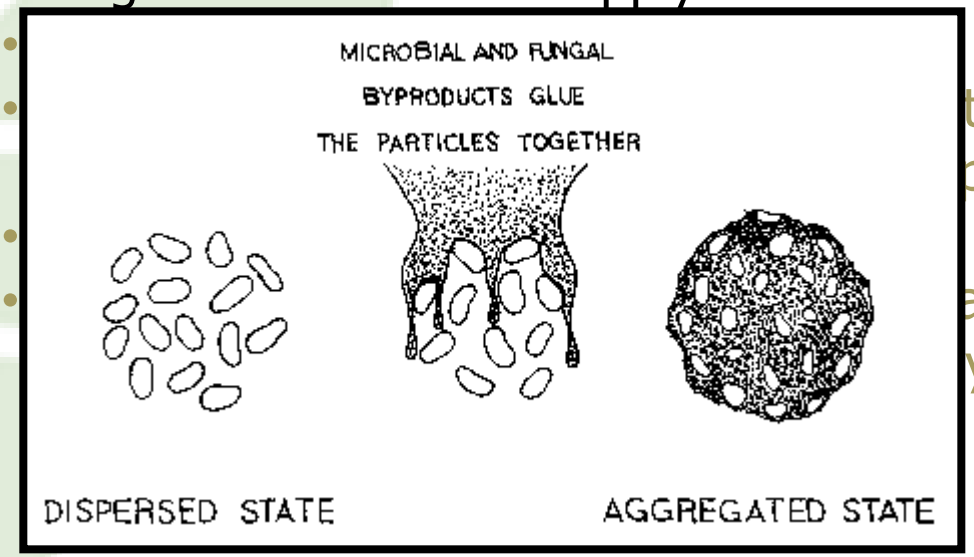

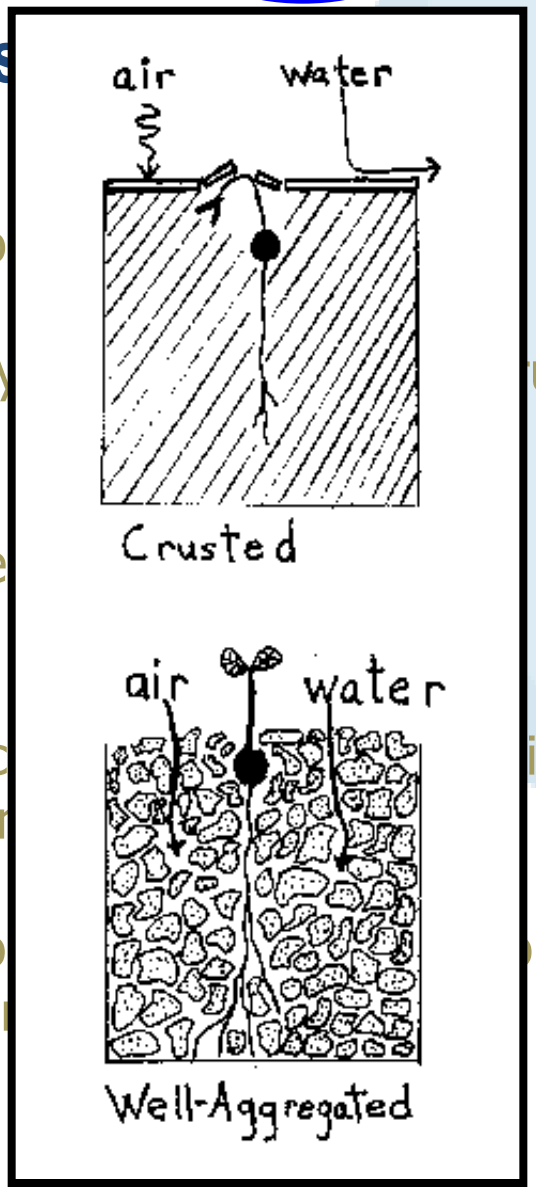

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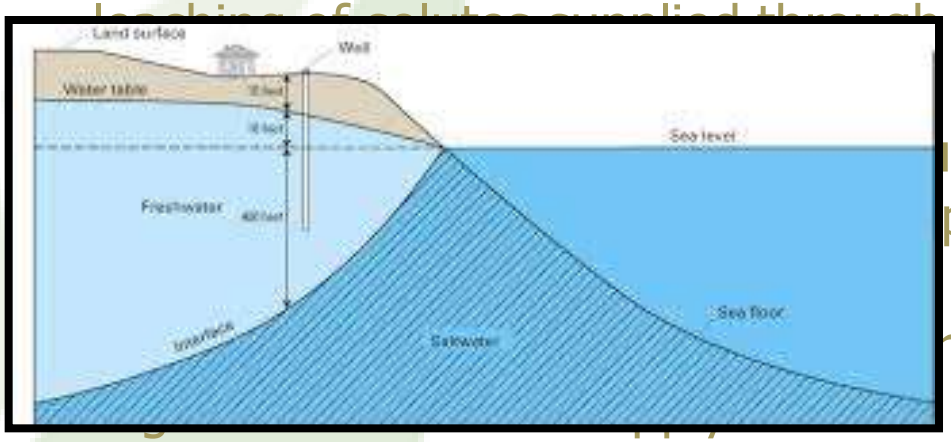

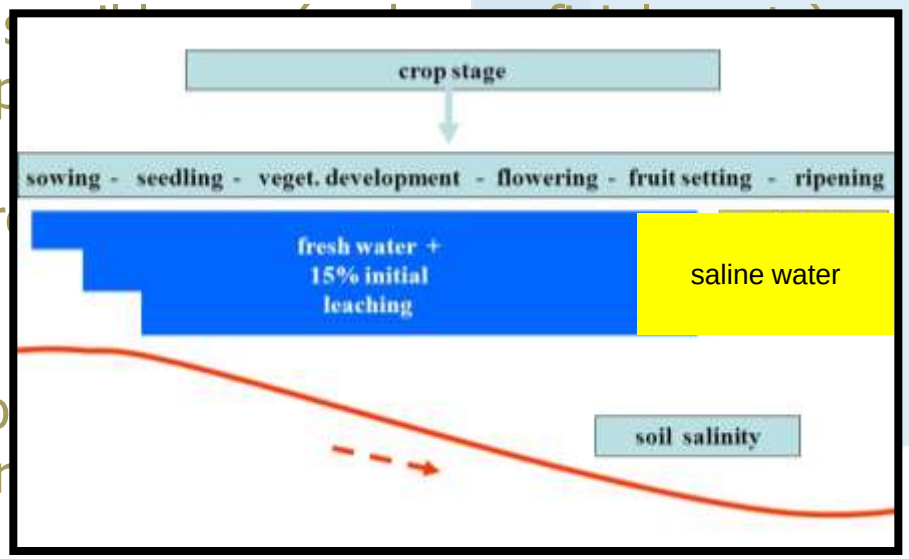

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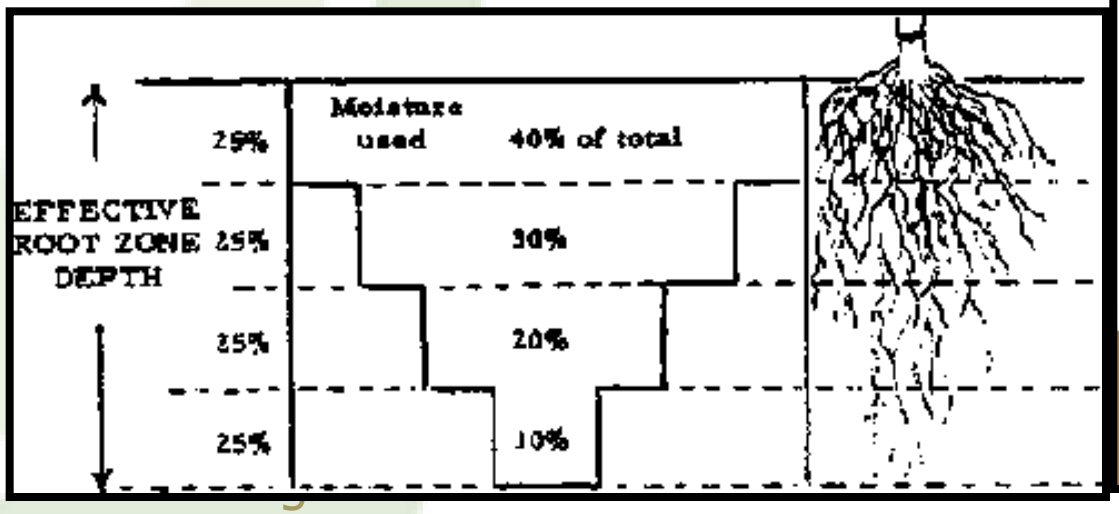

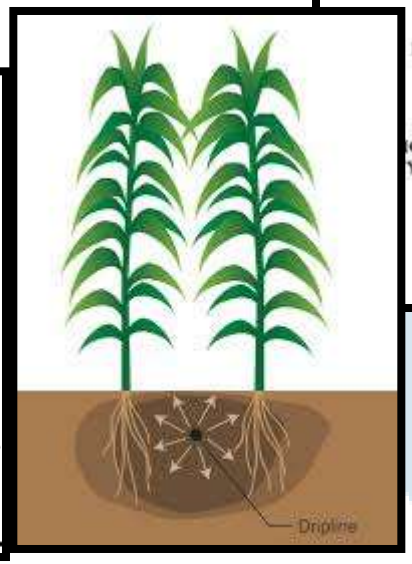

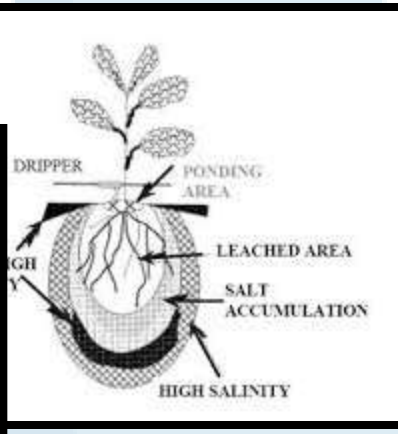

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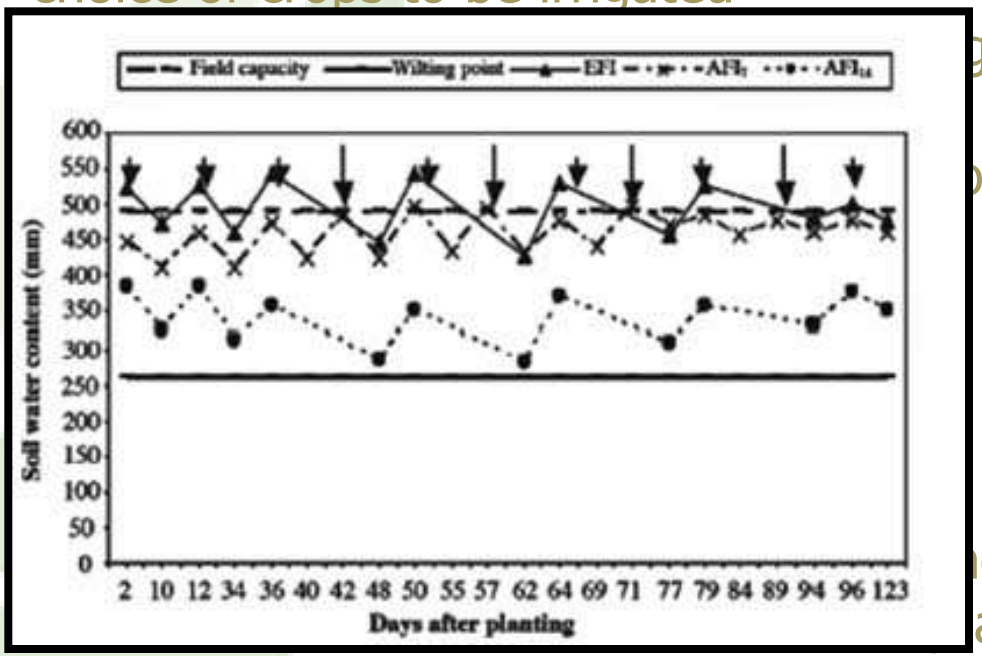

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- leaching of solutes supplied through irrigation water
- drainage network
- breaking and / or removal impervious soil layers (and superficial crusts)

$$LR = ECw / ECdw = Ddw / Dw$$

LR = leaching requirement, in percento del volume di adacquamento;
ECw = conducibilità elettrica (dS m^{-1}) dell'acqua d'irrigazione;
ECdw = conducibilità elettrica (dS m^{-1}) dell'acqua di drenaggio dallo strato radicale, massima compatibile con la produzione ipotizzata della coltura;
Ddw = quantità di acqua di drenaggio espressa in altezza (mm);
Dw = quantità di acqua irrigua espressa in altezza (mm).

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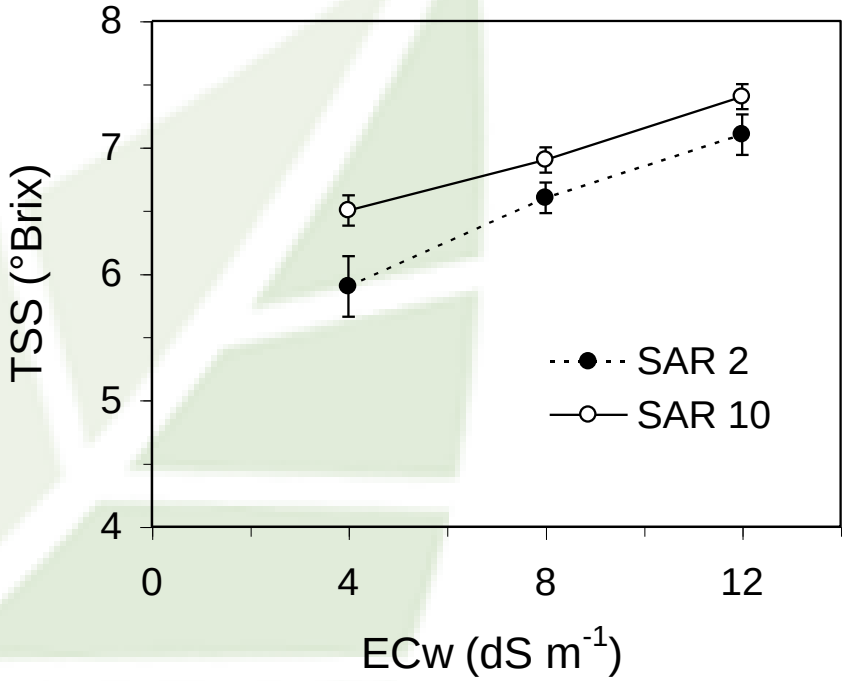
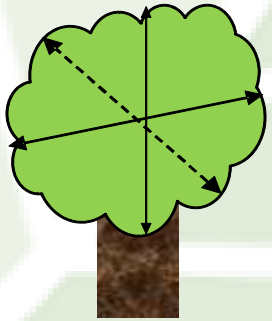

8
7
6
5
4
TSS (°Brix)
0
4
8
12
ECw (dS m-1)
SAR 2
SAR 10

Periodic plant measurements

Tree Canopy



Leaf Analysis

Fruit Diameter, fruit set

Stem water potential

Leaf gas exchange

Harvest

Yield assessment

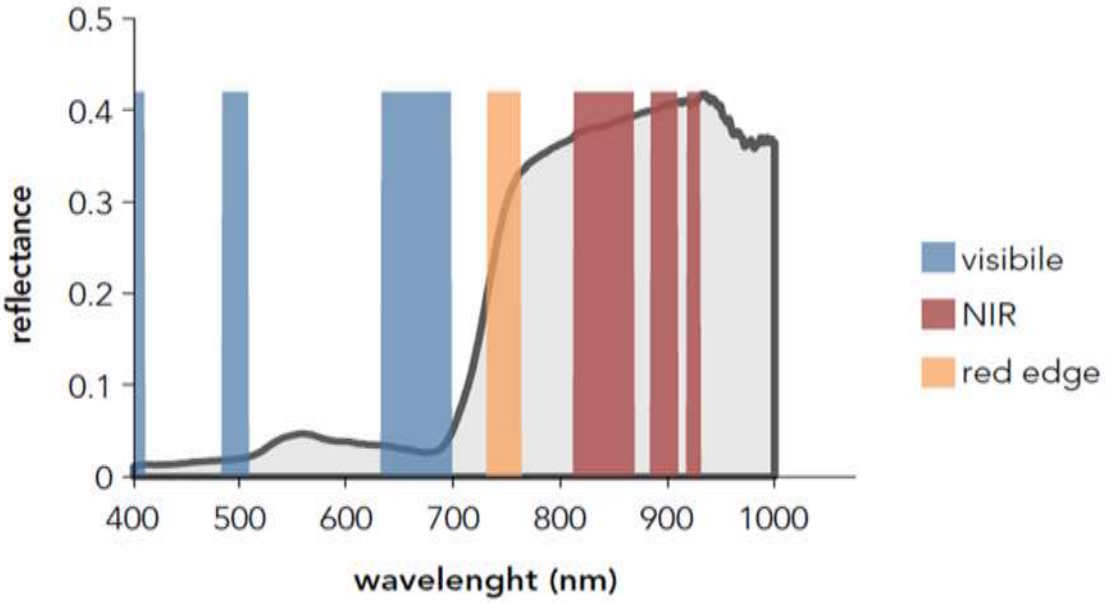
Production (kg.tree $^{-1}$)

Diameter distribution

Quality indexes

- ❑ TA
- ❑ SSC
- ❑ pH
- ❑ Vitamin C

Fruit safety


0.5
0.4
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0
reflectance
400
500
600
700
800
900
1000
wavelenght (nm)
visibile
NIR
red edge

Soil measurements

Soil water content

- Matric soil water potential
- Soil solution water quality

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Martedì 25 ottobre, 2016

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grazie