Irrigated agriculture in Mediterranean areas: Conservation of natural resources & difficulties in technology transfer

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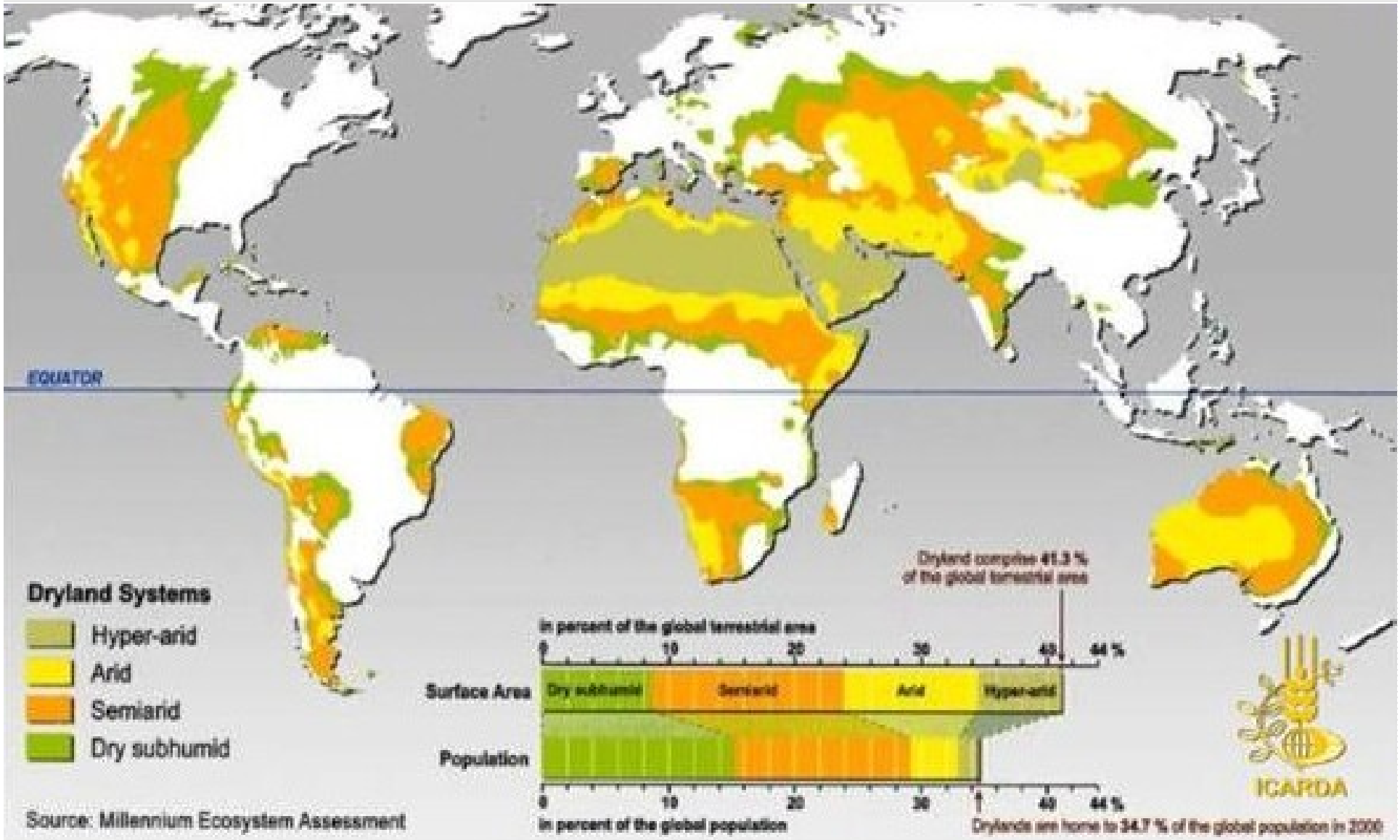
«III INTERNATIONAL WORKSHOP OF TECHNOLOGICAL INNOVATIONS IN THE IRRIGATION & II CONFERENCE ON WATER RESOURCES OF THE BRAZILIAN SEMI-ARID »
Fortaleza, 8-11 June 2010



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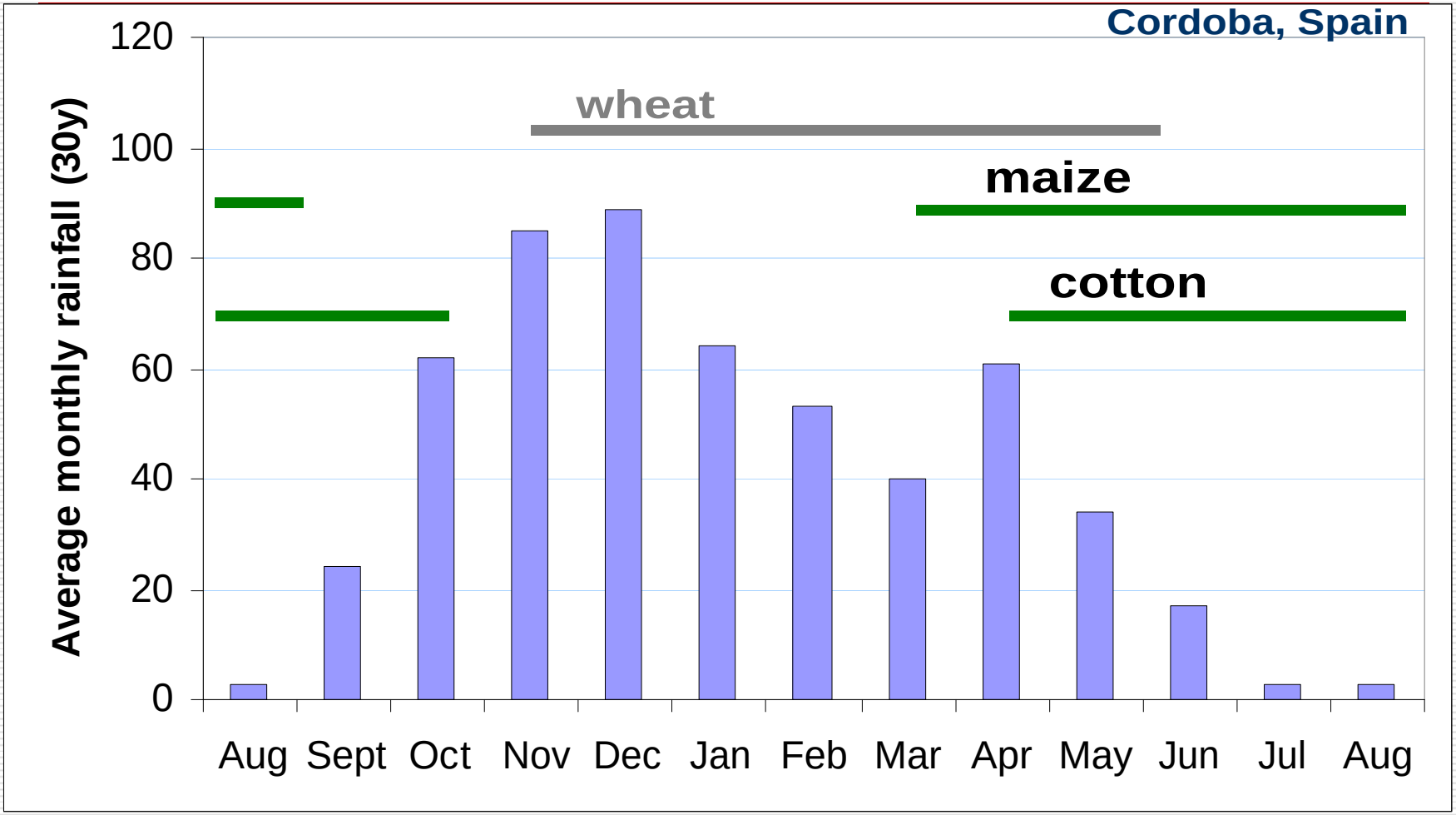
Irrigated production in semi-arid & arid environments (Mediterranean)

- Main irrigated extensive systems:
  - olive orchards and vineyards
  - cereals-based systems

    - **Southern Europe**
      irrigated maize-based systems
    - **North Africa**
      wheat (supplemental) irrigation

Southern Europe

irrigated maize-based systems



Unprotected soil during autumn and winter

Southern Europe

irrigated maize-based systems

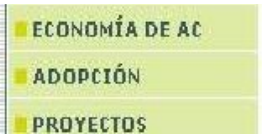
- Development of sprinkler and drip irrigation

  ⇨ irrigated crops into hilly lands

CONSERVATION AGRICULTURE

the way to go?

- **Minimum mechanical soil disturbance**
- **Permanent soil cover**
- **Diversification of crop species grown in sequence or associations**



fincas y sistemas agro-ecológicos. Sin embargo, su adopción es más necesaria para los pequeños productores. Sobre todo aquellos que sufren una escasez aguda de mano de obra. La AC combina una producción agrícola rentable con una protección del ambiente, y la sostenibilidad; y se ha mostrado capaz de funcionar en un amplio rango de zonas ago-ecológicas y sistemas de

www.fao.org

Confederação Americana de Associações para Agricultura Sustentável
CAAPAS

CONSERVATION AGRICULTURE

- There is no single recipe
- Needs local adaptation
- Close collaboration of actors

Cultivated area under No-tillage (hectares)

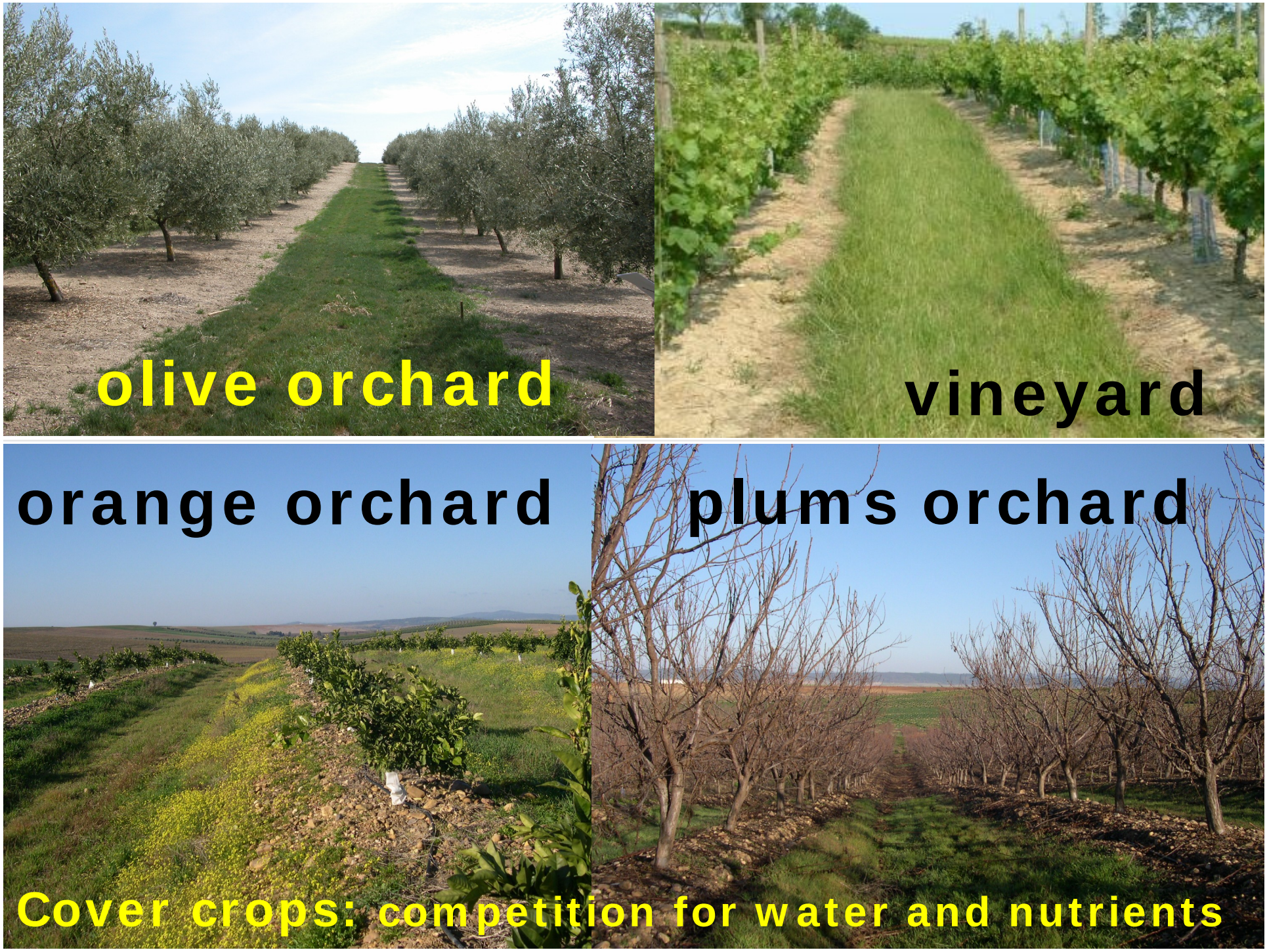
COUNTRY	1998/99	2003/07	% cultivated land
U.S.A.	19 347 000	**26 500 000**	15
Brazil	**11 200 000**	**25 502 000**	**38**
Argentina	7.270.000	**19 719 000**	59
Canada	**4.080.000**	**13 481 000**	**26**
Australia	1.000.000	9 000 000	20
Paraguay	**790.000**	**2 094 000**	**48**
Mexico	500.000	22 800	<1
Bolivia	**200.000**	**706 000**	**18**
Chile	96.000	120 000	7
Uruguay	**50.000**	**553 900**	**40**
Kazakstan	0	600 000	3
Others	**1.000.000**	**1 568 000**	
Total	**45.533.000**	**98 300 268**	

FAO AQUASTAT (2010)

Conservation Agriculture in Europe

Country	Minimum tillage (1000 ha)	No-till (1000 ha)	Cover crops jn perennial crops (1000 ha)	Total surface CA (1000 ha)	% CA / arable land	10%? Irrigated CA (1000 ha)
Belgium	140	n.d.	n.a.	140	17.2	14
Denmark	230	n.d.	n.a.	230	10.1	23
Finland	550	200	n.a.	750	34.1	75
France	3750	150	n.a.	3900	21.1	390
Germany	2300	200	n.a.	2500	21.2	250
Greece	230	100	n.a.	430	15.8	43
Ireland	10	n.d.	n.a.	10	0.9	1
Italy	480	80	n.a.	560	6.8	56
Hungary	490	10	n.a.	500	10.8	50
Portugal	300	80	30	410	20.6	41
Russia	15000	500	n.a.	15500	12.6	1550
Slovak Rep	320	130	7	457	31.9	46
Spain	1500	700	850	3050	22.2	305
Switzerland	80	12	10	102	24.9	10
UK	2500	180	n.a.	2680	46.6	268
Total	27880	2342		31220	15.7	3122

(ECAF 2006/07)


olive orchard
vineyard
orange orchard
plums orchard
Cover crops: competition for water and nutrients

Irrigated cereal-based systems

- **Conservation agriculture in maize-based systems**
  Southern Spain
- **Looking for sustainable irrigated agriculture with small poor farmers**
  Mauritania

CA in maize-based systems

Residues covering the soil results in low Tº at sowing and slow growth

Soil compaction

R Calleja; commercial farm; Córdoba

Maize-cotton rotation
Permanent bed system

USE OF PERMAMENT BEDS

IN SPITE OF CENTRAL PIVOT

IRRIGATION

Residues management:

shoved to bottom of furrows

2 weeks before sowing

⇨ ↑ soil Tº & ↓ armadillo bugs & slugs

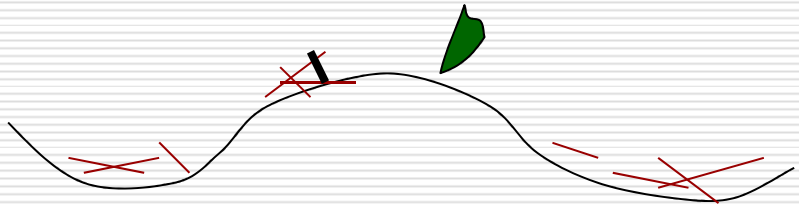
Permament bed system (Córdoba, Sp)

Permament bed system (Córdoba, Sp)

Establishment

A crop row is established 5 cm from the top centre

Following year: crop sown at the other side, 10 cm apart from preceding crop



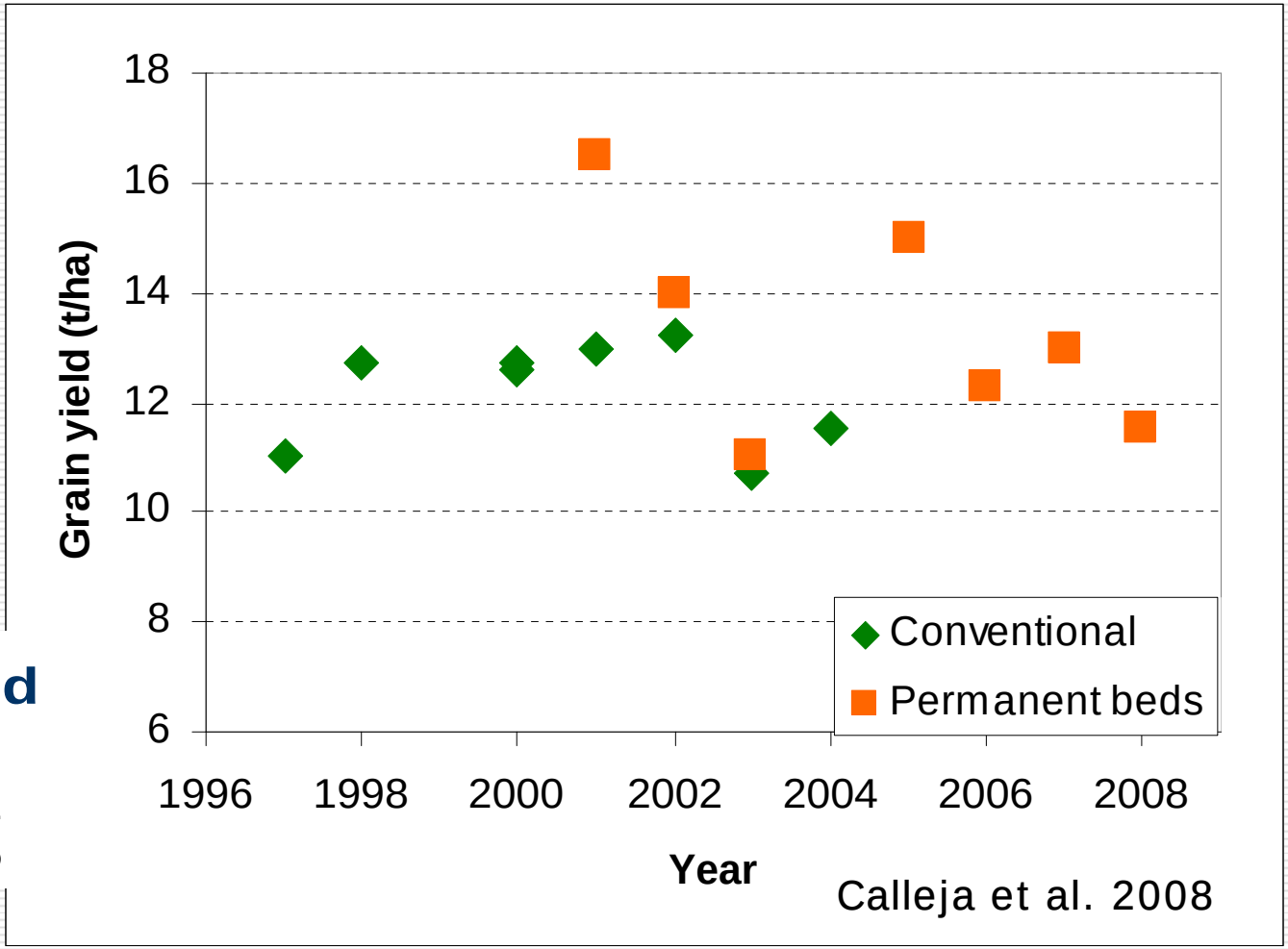
Permament bed system (Córdoba, Sp)

Permament bed system (Córdoba, Sp)

- **95 cm inter rows** ← cotton harvester
- **Controlled traffic & high flotation tires**
- **Deep ripping in trafficked furrows after cotton harvest**

Permament bed system (Córdoba, Sp)

Was maize yield affected?

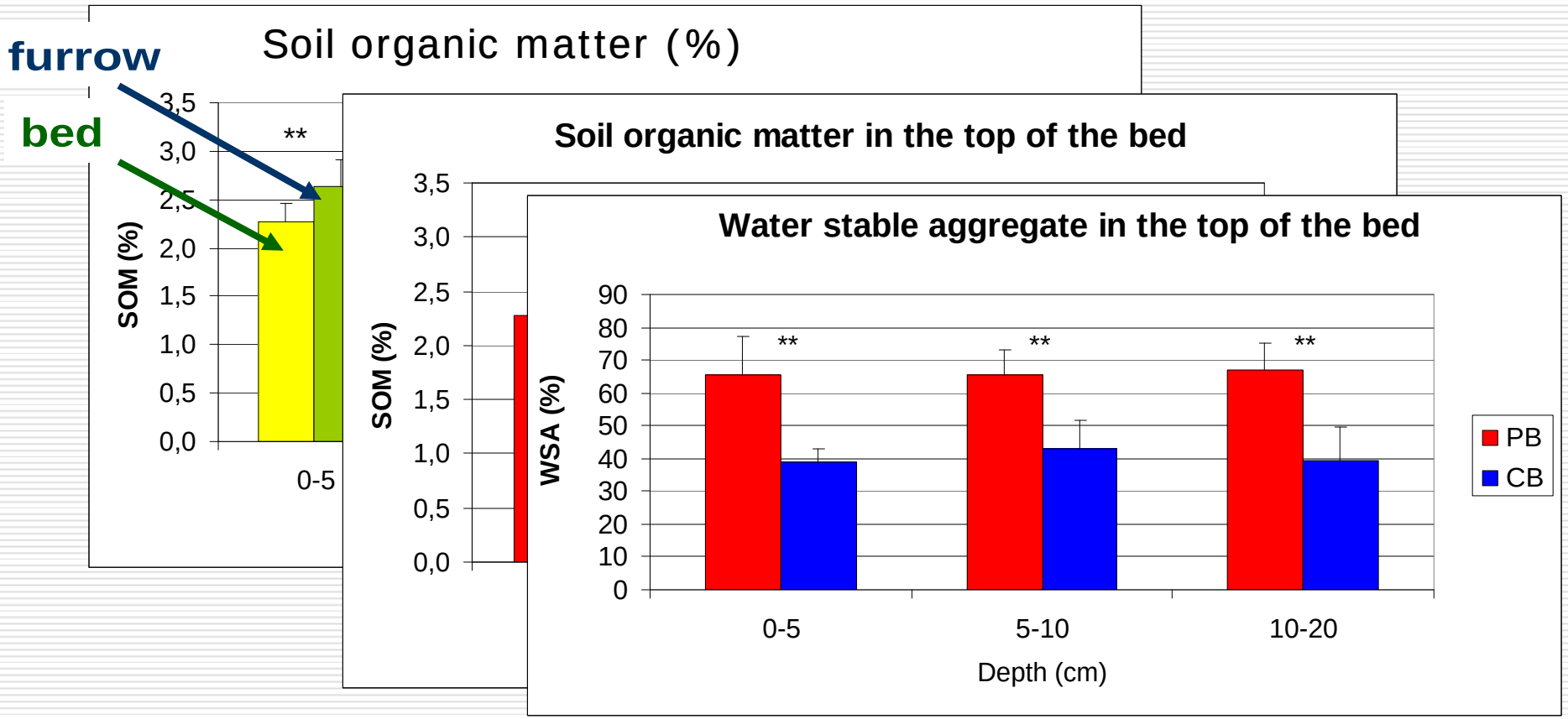


MAIZE grain yield
from 2 paddocks

1: PB introduced in 2001
2: PB introduced in 2005

Permament bed system (Córdoba, Sp)

How was soil organic matter affected with the new residues distribution?

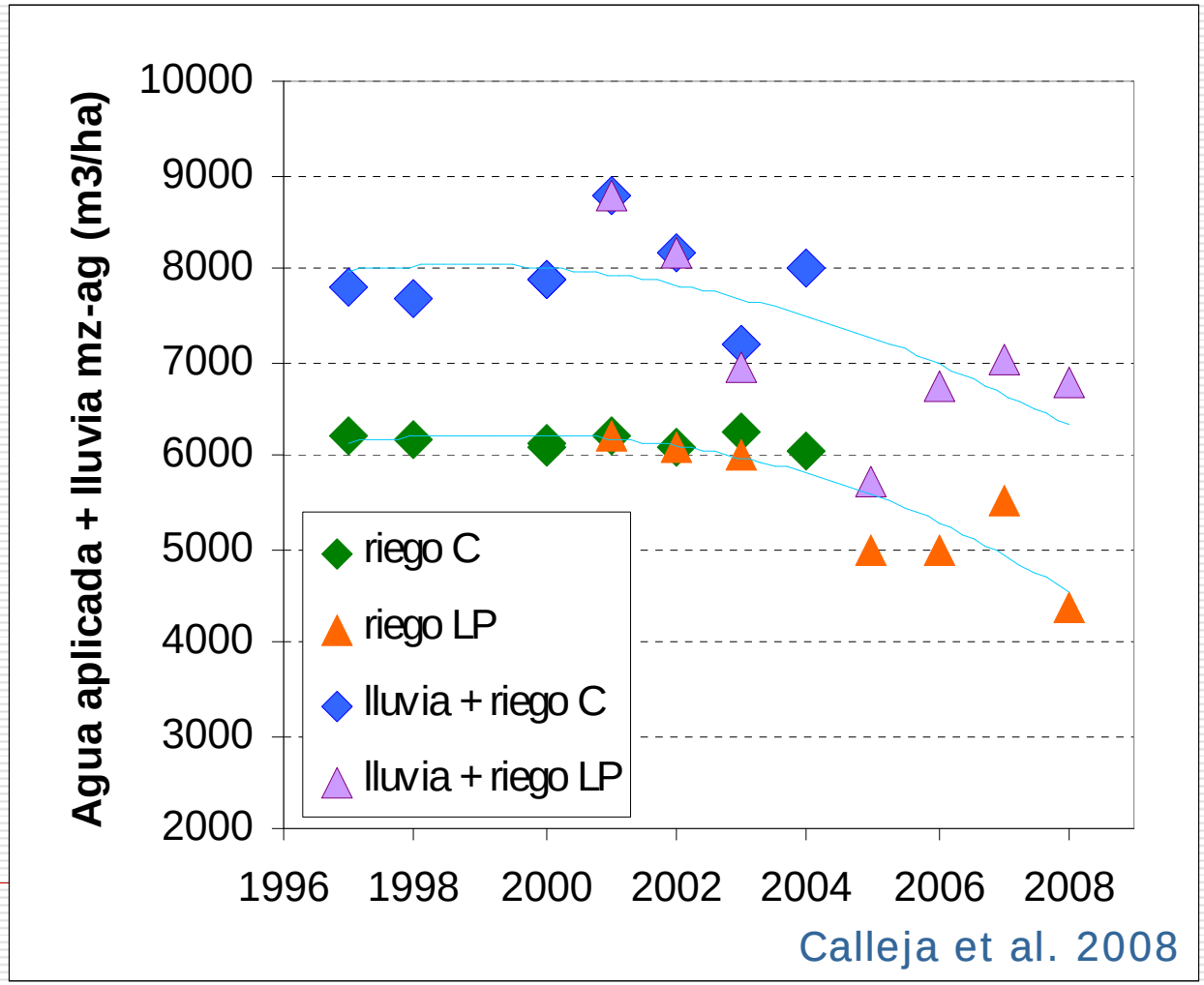


Boulal et al. 2009

Permament bed system (Córdoba, Sp)

were irrigation needs reduced?

Current applied irrigation reduced by 20%



Calleja et al. 2008

Permament bed system (Córdoba, Sp)

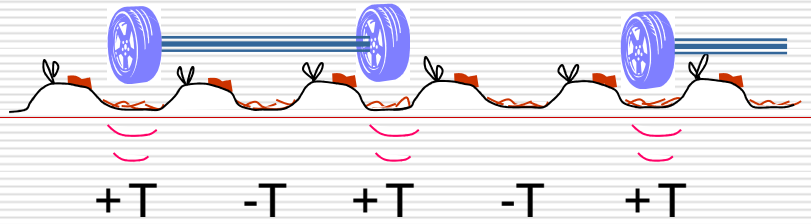
Experiment: new vs conventional

Institute of Sustainable Agriculture
CSIC, Córdoba, Spain

- **Permanent beds & mulch**
- **Conventional beds & residues incorporated with tillage**

Controlled traffic

- **Furrows +/- wheel traffic**



Irrigated cereal-based systems
PERMANENT BEDS – K. SAYRE

CIMMYT®

International Maize and Wheat Improvement Center

Permament bed system (Córdoba, Sp)

Experiment: new vs conventional

Crop growth and yield

Year 0: cotton, all conventional

Year 1: maize PB & CB

	LAI 61 dap	LAI 90 dap	AGDW t / ha	Yield t / ha
PB	**2.06 b**	**4.63 a**	**26.98 a**	**15.80 a**
CB	**2.31 a**	**4.03 b**	**24.65 b**	**14.64 b**

Permament bed system (Córdoba, Sp)

Experiment: new vs conventional

Evapotranspiration

Year 0: cotton, all conventional

Year 1: maize PB & CB

maize	ET mm	WP gy kg ha^{-1} mm^{-1}	WP by kg ha^{-1} mm^{-1}
PB	696 a	22.8 a	38.7 a
CB	689 a	20.3 a	34.5 b

Permament bed system (Córdoba, Sp)

Experiment: new vs conventional

Soil water infiltration & erosion

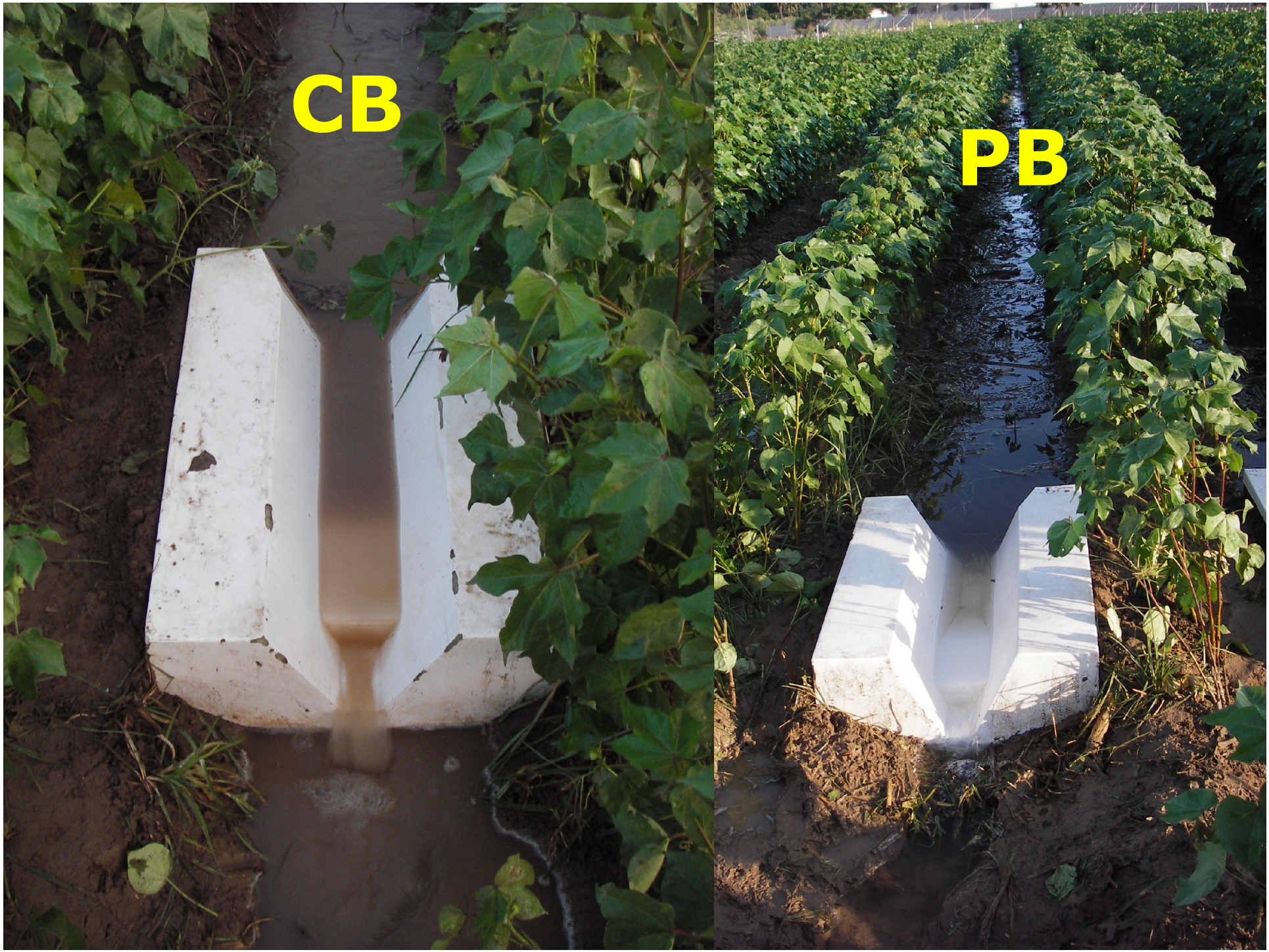
Furrow/ bed scale (140 m x 0.85 m): sprinkler irrigation simulation

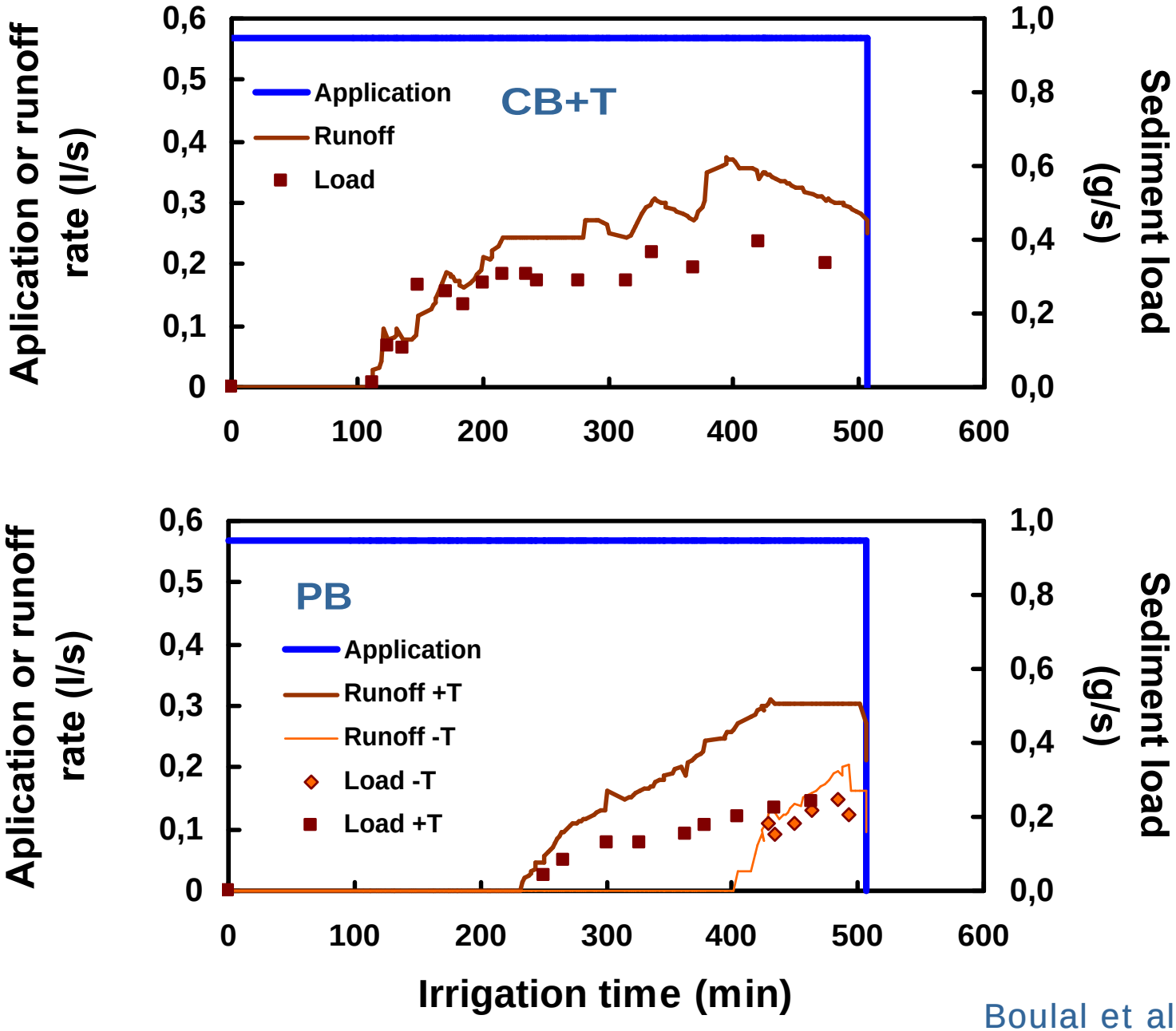
Small scale (0.9 x 0.9 m^2) Rainfall simulator *InfiAsper2*

Alves Sobrinho et al. 2007

Sprinkler irrigation simulation

Sprinkler irrigation simulation


CB
PB


Aplication or runoff rate (l/s)
Sediment load (g/s)
CB+T
Application
Runoff
Load
PB
Application
Runoff +T
Runoff -T
Load -T
Load +T
0,6
0,5
0,4
0,3
0,2
0,1
0
1,0
0,8
0,6
0,4
0,2
0,0
0
100
200
300
400
500
600
Irrigation time (min)

Boulal et al.

Permament bed system (Córdoba, Sp)

Experiment: new vs conventional

Soil water infiltration & erosion

Irrigation management practices identified for homogeneous soil management

need to be revised in PB CTrf

Permament bed system (Córdoba, Sp)

Experiment: new vs conventional

Soil water infiltration & erosion

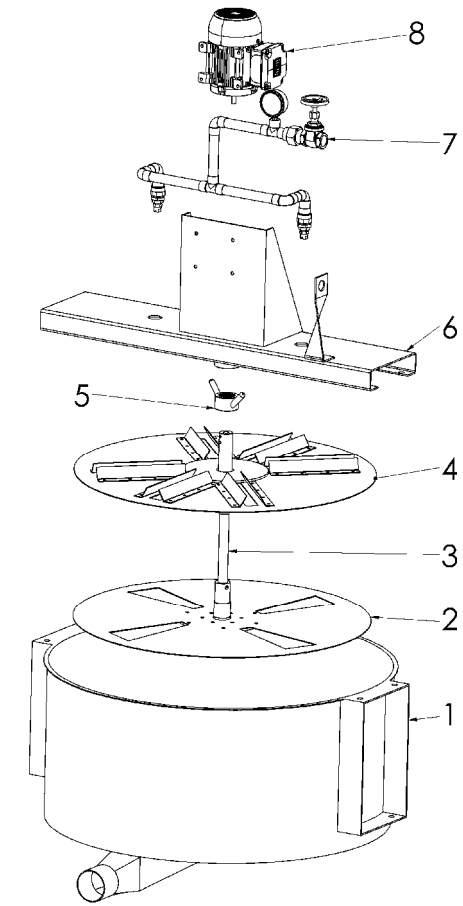
Model: sprinkler water application & soil infiltration and runoff

simulate irrigation performance

5 irrigation performers

operation diagrams ⇨guidelines

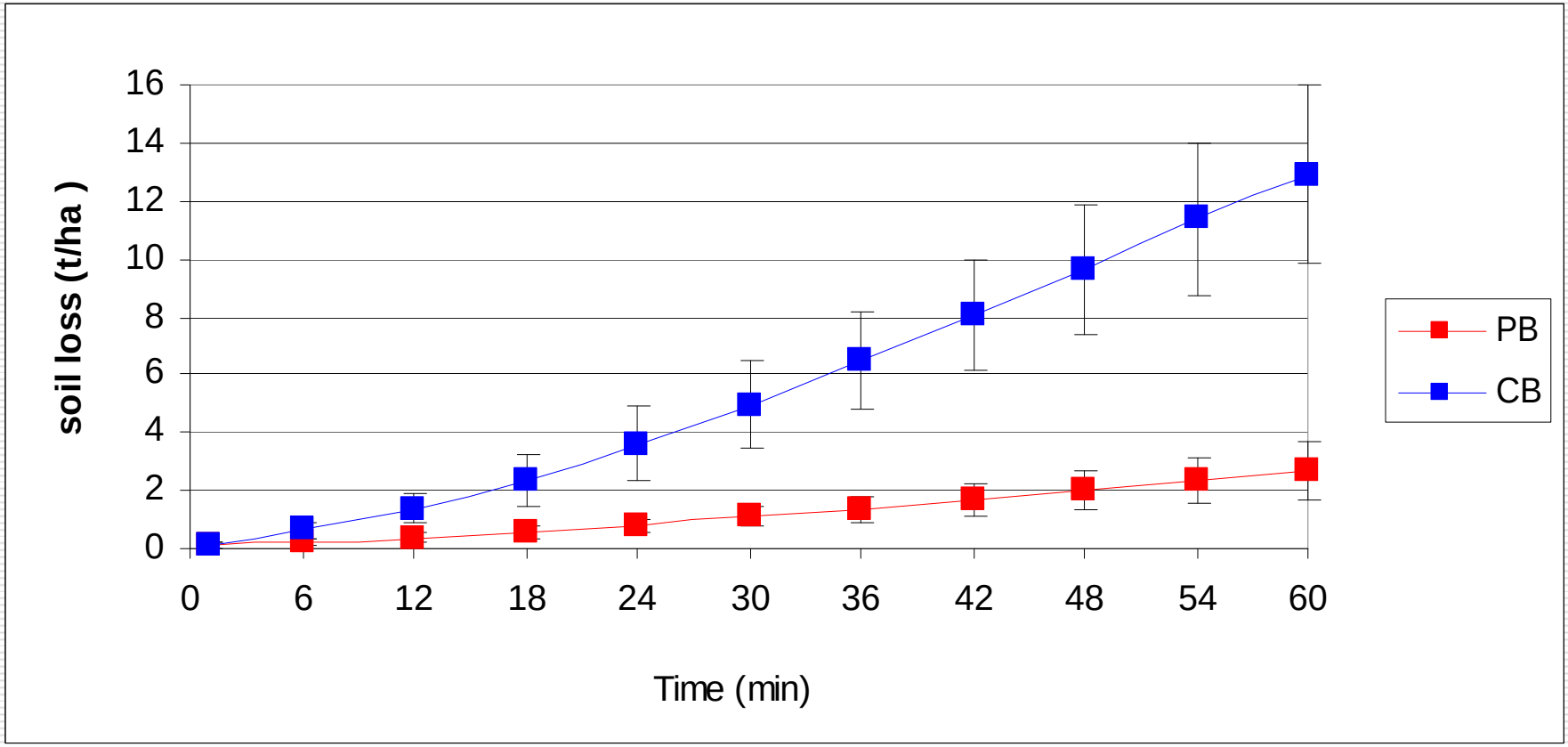
Rainfall intensities 30-150 l $m^{-2}h^{-1}$
Overland flow intensities 94-573 l $m^{-2}h^{-1}$



Alves Sobrinho et al., 2007

Permament bed system (Córdoba, Sp)

Experiment: new vs conventional



PB 80% less soil loss than CB

Boulal et al. 2007

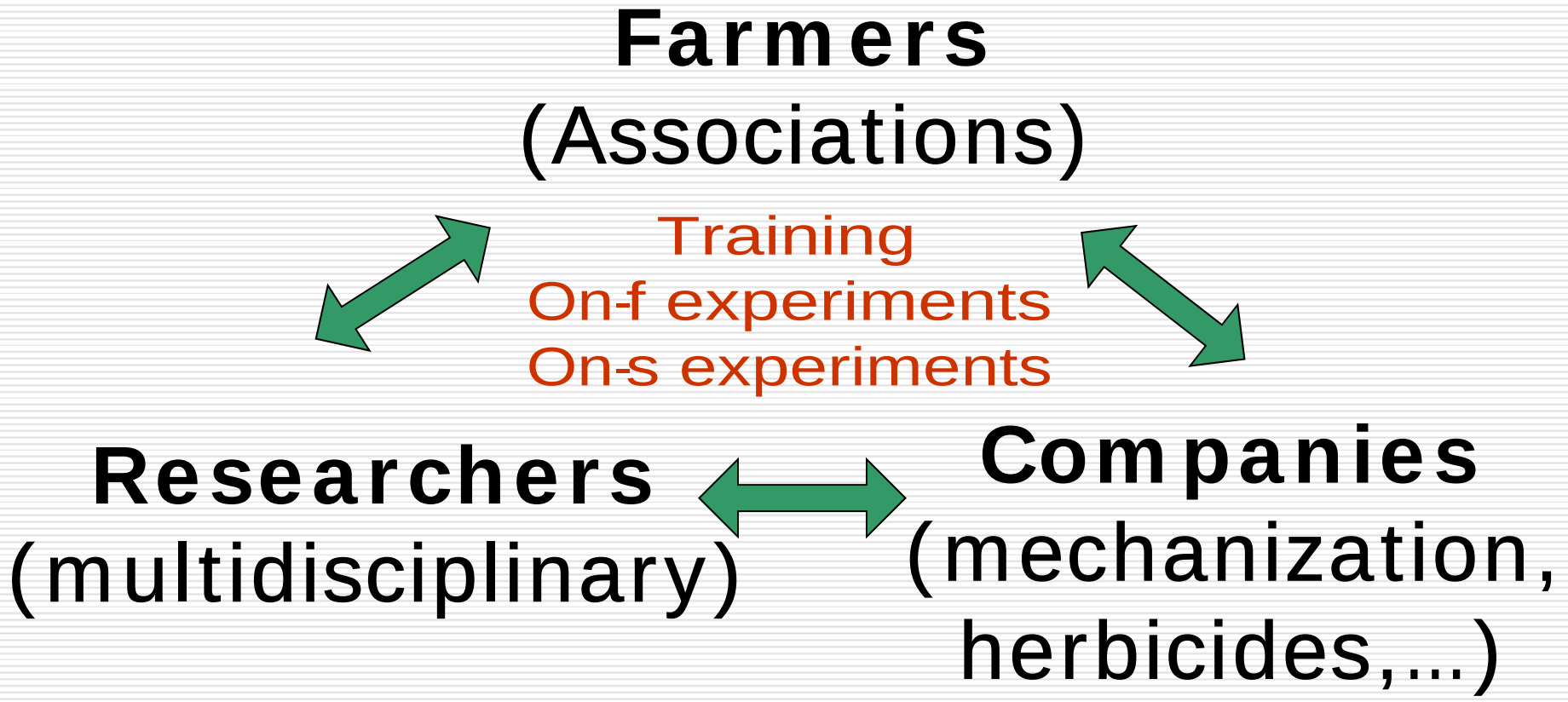
Permament bed system (Córdoba, Sp)

FUTURE on-farm / on-station

- **Revise irrigation management practices**
- **Evaluate water and soil saving** time, space
- **Study off-site movement of herbicides & sediments**
- **Evaluate controlled traffic & sporadic tillage to avoid or relieve soil compaction**
- **Evaluation of genotypes for permanent bed systems and direct seeding**

Permament bed system (Córdoba, Sp)

FUTURE



Participatory research in agronomy

- ... refers to applied research specifically designed to answer questions in close collaboration with farmers.
- Particularly important when weak extension (and research)

Sustainability of irrigated agriculture in Mauritania

CSIC

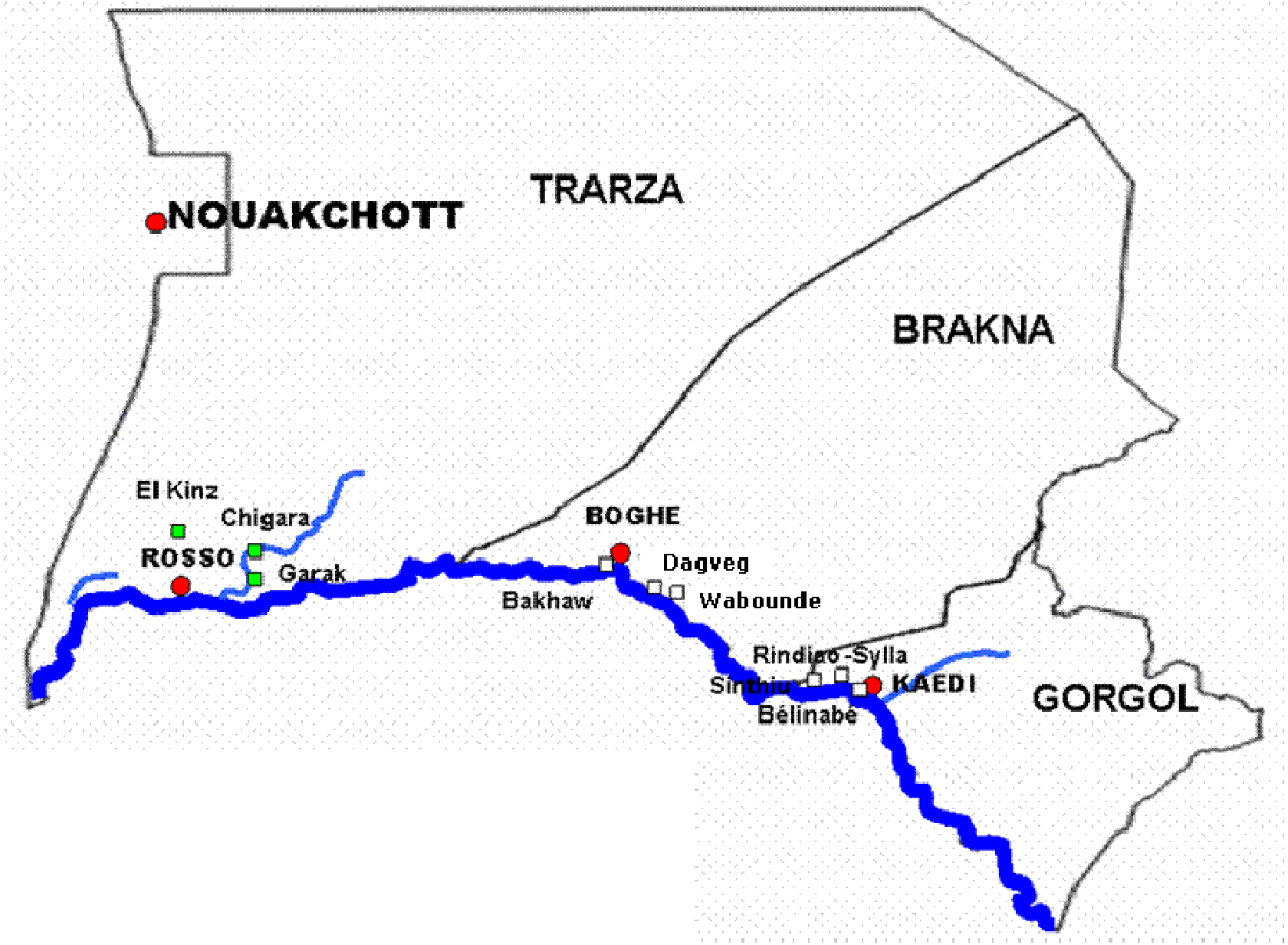
Coopératives du producteurs du riz

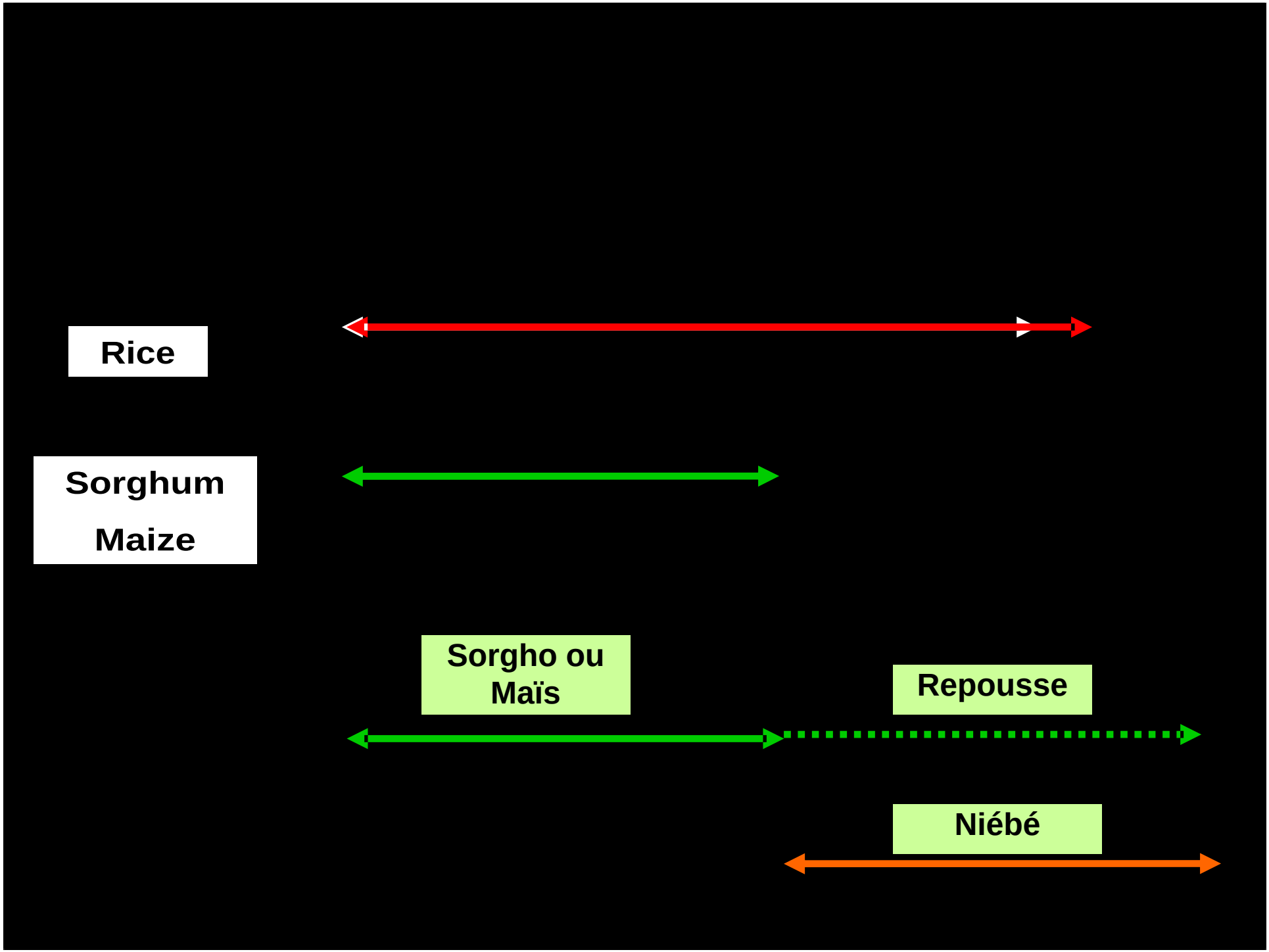
UPC UNIVERSITAT POLITÈCNICA DE CATALUNYA

AECI

OBJECTIVES:

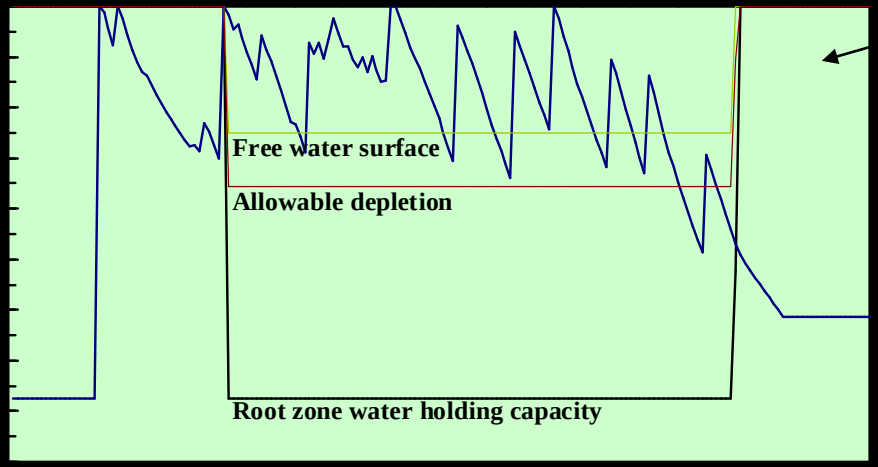
Examine irrigation perimeters
Look for alternatives to rice when needed
Set sound basis for rehabilitation


NOUAKCHOTT
TRARZA
BRAKNA
El Kinz
Chigara
ROSSO
Garak
BOGHE
Dagveg
Bakhaw
Wabounde
Rindigo-Sylla
Sinthiu
KAEDI
Bélinabé
GORGOL

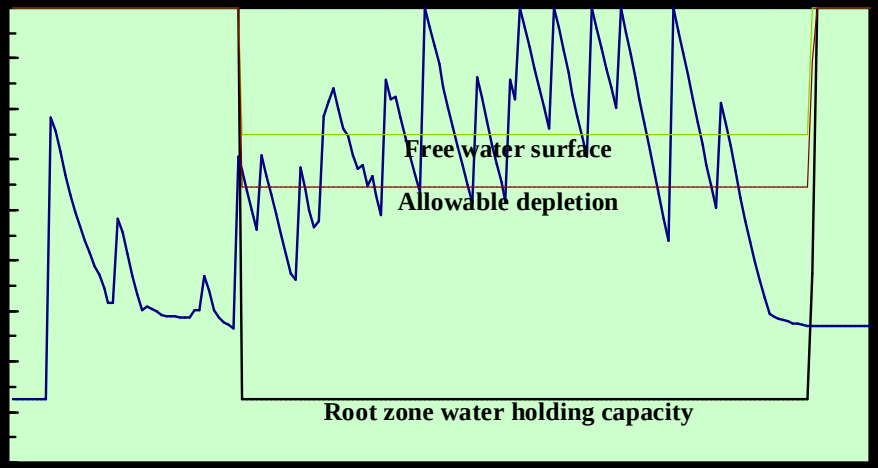

Rice
Sorghum
Maize
Sorgho ou
Maïs
Repousse
Niébé

Mauritania – 106 farmers 2009 each farmer one treatment

	sorgho	**maïs**	**riz**	**sorgho**	**maïs**	**riz**
	6	4	5	444	430	529
	4	3	7	311	320	603
	4	4	5	210	268	501
MOY	**4**	**4**	**6**	**306**	**347**	**557**



Heavy soils



Mixed soils

Adoption of sorghum

Sustainability of irrigated agriculture in Mauritania FUTURE

- Improve agronomy of sorghum & maize with limited resources:
  - Evaluate localized fertilization
  - Conservation agriculture & residues conflict
- Improve double cropping (cowpea) system

5th World Congress of Conservation Agriculture

26-29 September 2011

http://www.wcca2011.org/

Obrigada!

AFRICA DO SUL 2010
Desculpe-me Brasil,
mas é a vez da Espanha!!