Implementation and evaluation of the hydrological impact of green cover crops in olive orchards: a review of different experiences.

Alcala de Henares, January 29th 2014

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Objectives

1- **Review studies** on hydrologic impact of cover crops in olive groves.

2- Identify **main results**, and **practical implications**.

3- Comment on **major challenges** to improve their use and efficiency.

Layout

1- Development, approaches.

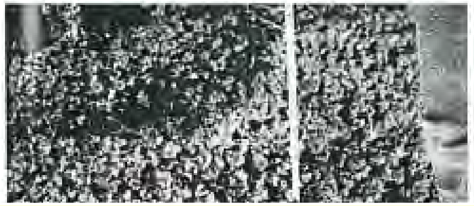
2- Experimental results: runoff, w. quality, yield, ...

3- Key fresults.

4- Challenges, potential.

Olives and cover crops I

Olives and cover crops II



Benefits	Risks
Erosion control	Competition for water with the tree
Increase of infiltration, OM and nutrient content (N).	Pest and diseases associated to c. crop.
Occasionally pasture	Wildfires
Improved water quality	
Trafficability	
Biodiversity	

aunque no faltan medianas y excelentes plantaciones, que con su pujanza enmascaran la penuria de la mayoría. Las precipitaciones son con frecuencia

lución que al mismo tiempo de proteger el suelo, ya muy erosionado, aumentara la rentabilidad, muy menoscabada, de dichos olivares.

Worthen, 1927. Farm Soils

Agricultura, March 1969.

Olives and cover crops III

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	crop	cover crop	Options	Decision

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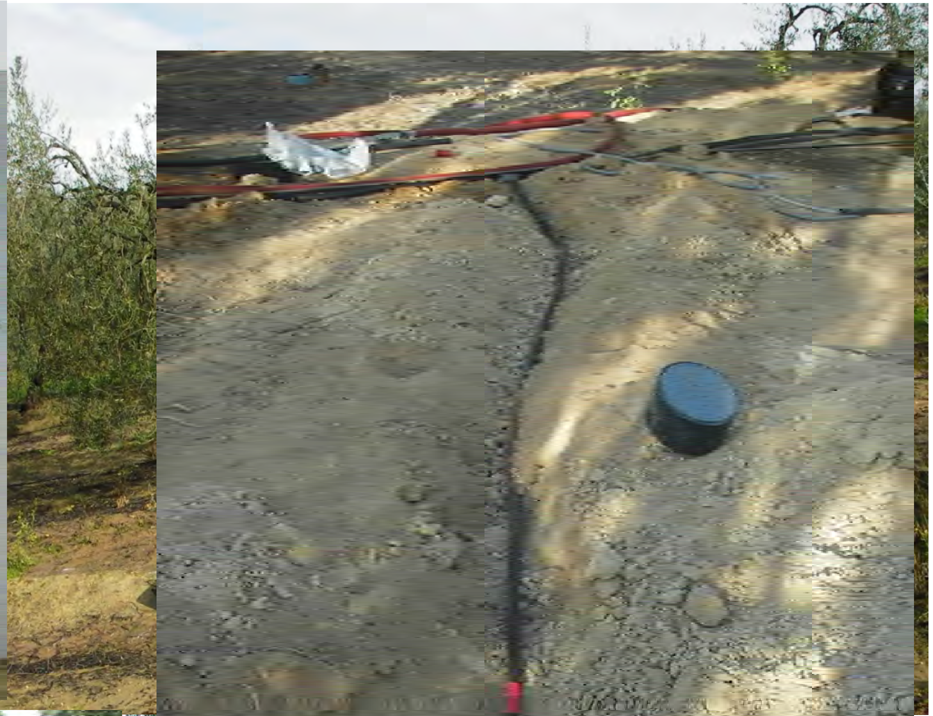
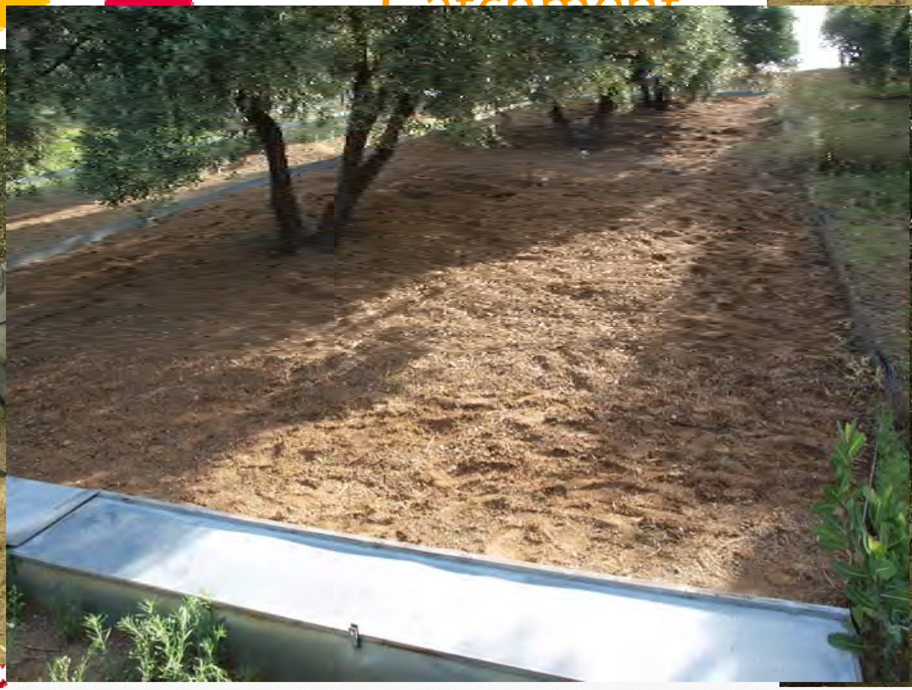
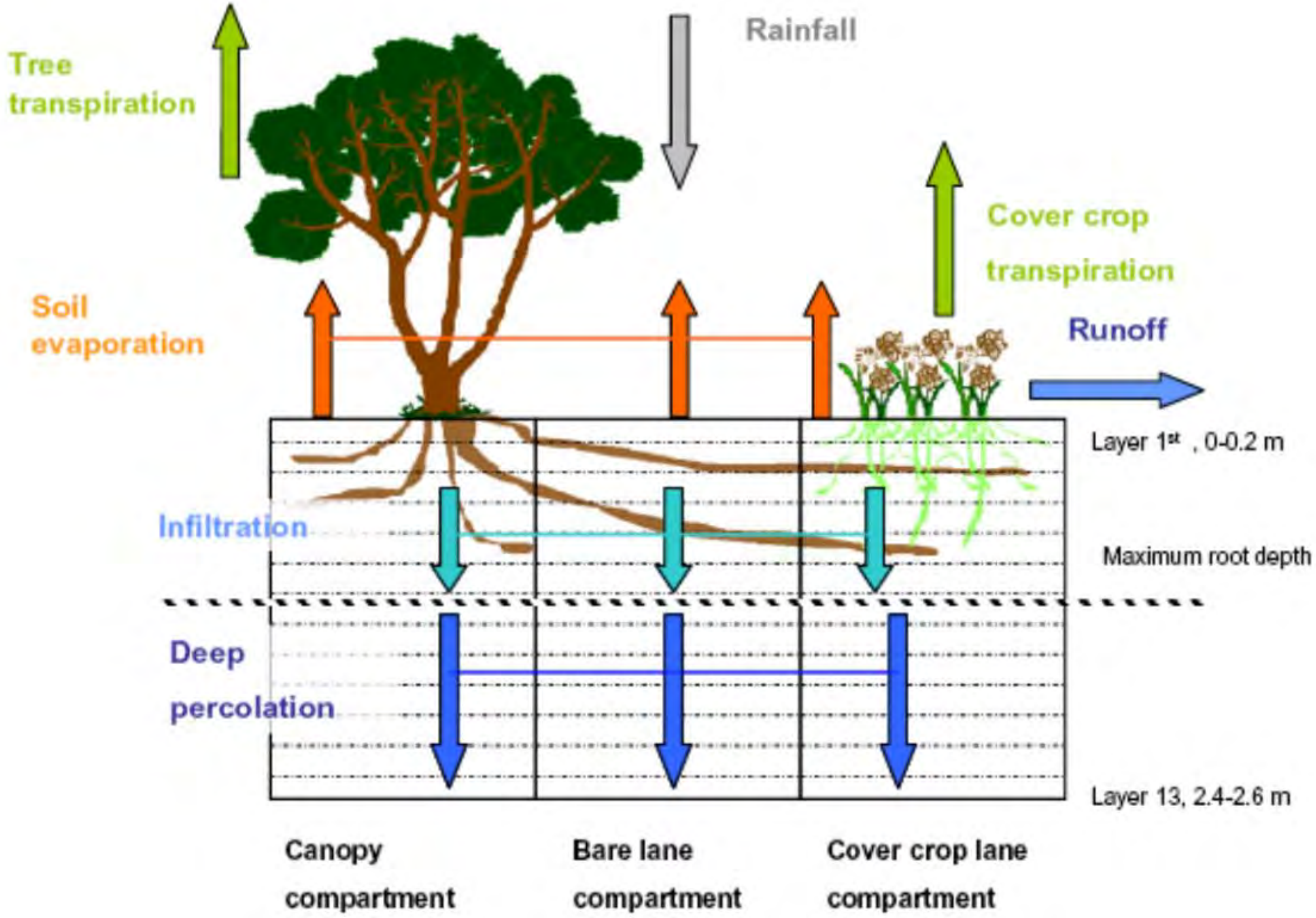


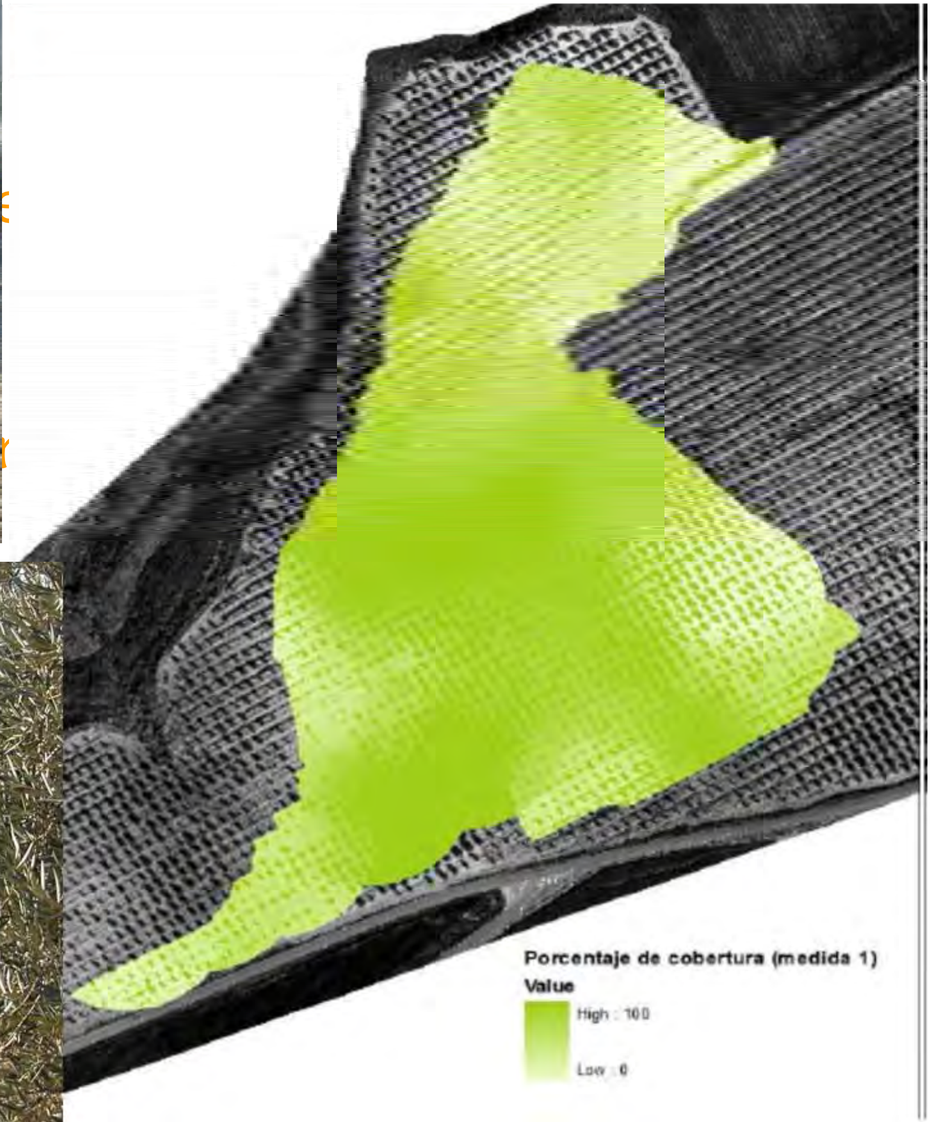



Approaches to investigate their impact III



Abazi et al. 2013 (Comp. and Elect. In Agricult.91)

Approaches to investigate their impact IV



Impact on runoff: plot scale I

Table
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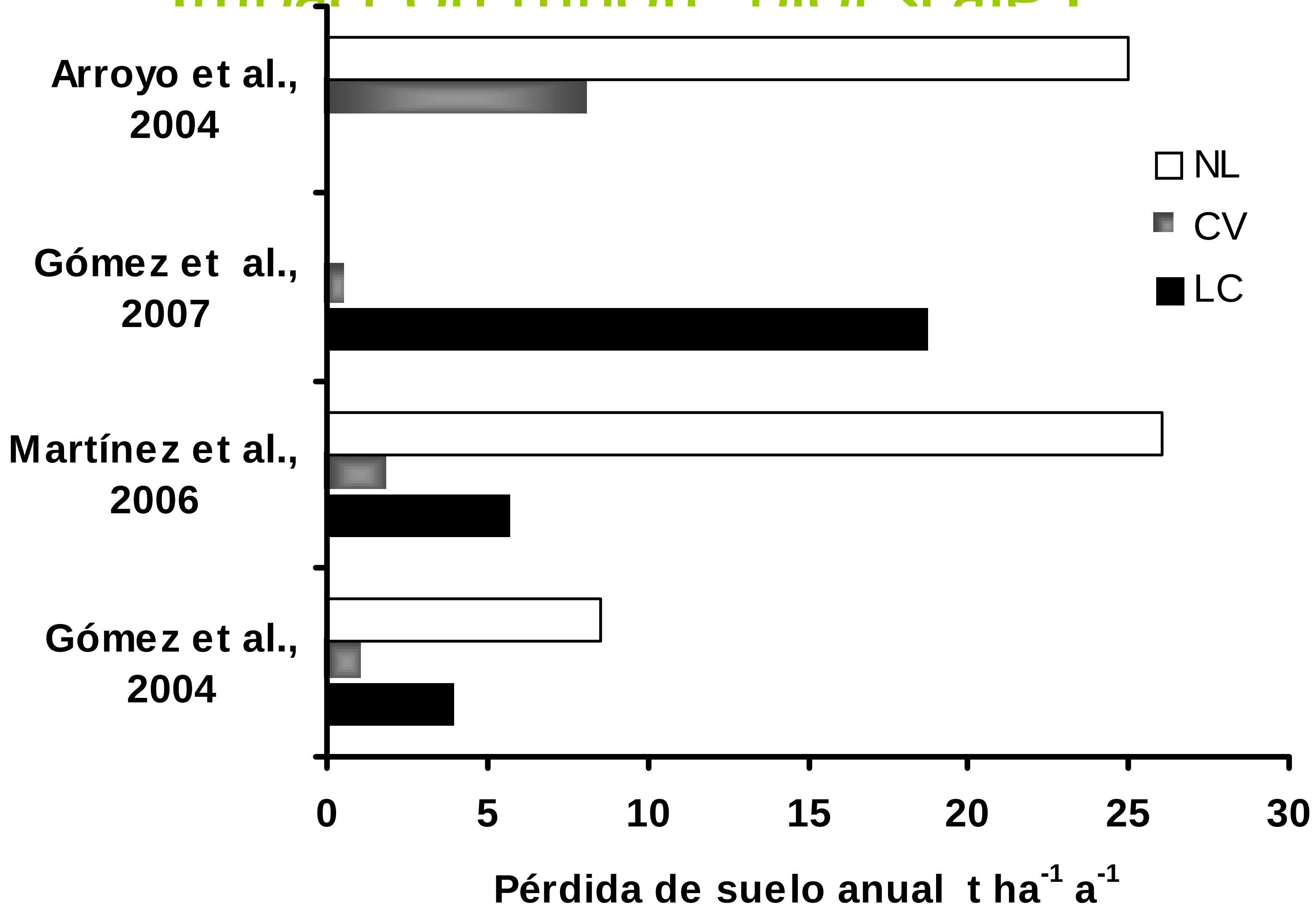


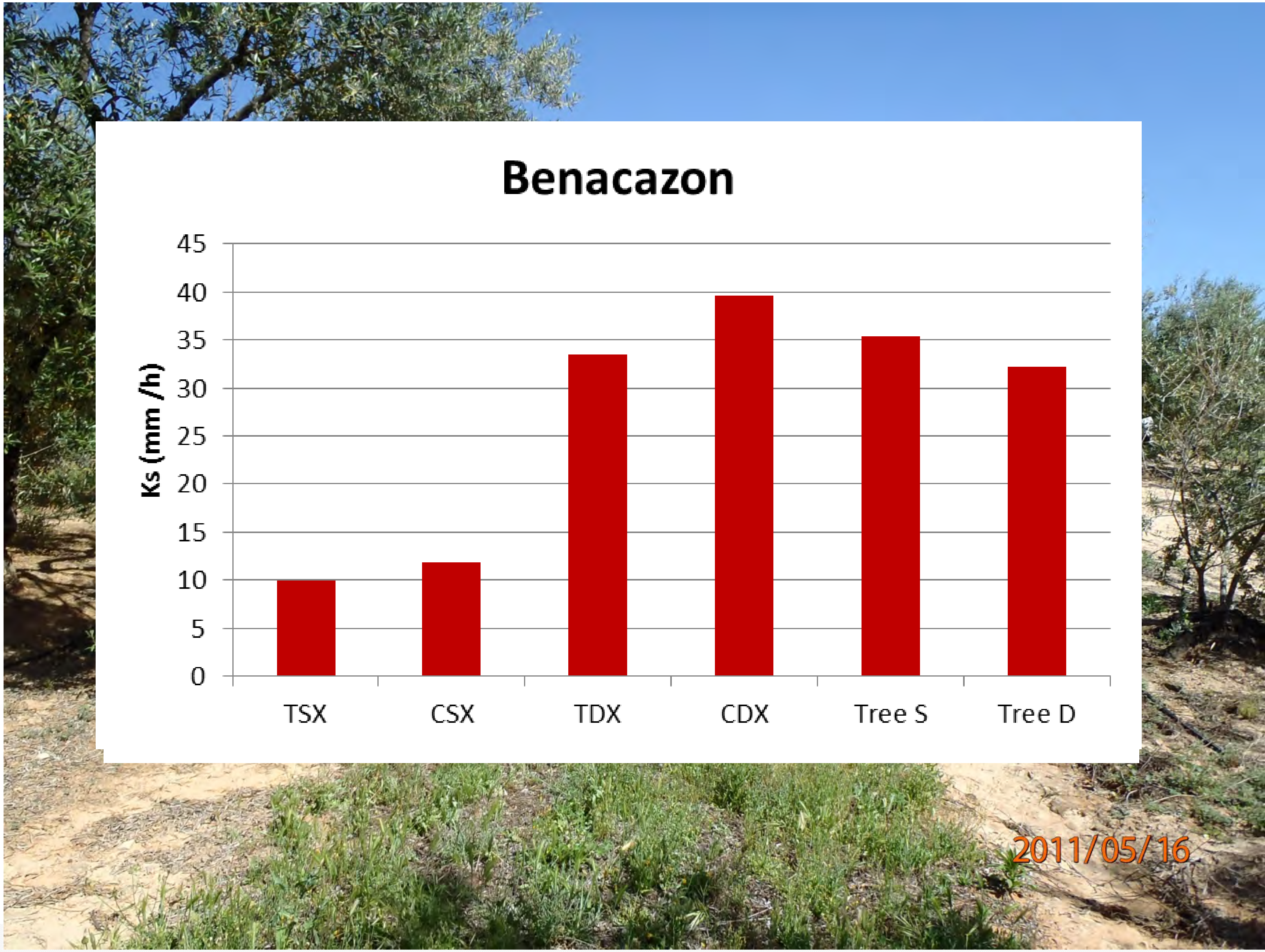
Impact on runoff: plot scale II

Table 6
Nutrient losses with runoff and eroded soil (discharge weighted) under different types of soil management

Soil management	In runoff (mg m^{-2})				In eroded soil (mg m^{-2})			
	$N–NO_3$	$N–NH_4$	$P–PO_4$	K	$N–NO_3$	$N–NH_4$	P	K
BS								
Average	22.5	5.8	1.7	5.7	0.4	2.5	0.3	4.3
Stand. dev.	25.5	7.3	2.5	7.1	0.9	2.7	0.4	5.8
Max.	74.8	24.8	7.8	22.2	2.7	7.2	1.2	14.8
Min.	0.3	0.0	0.0	0.1	0.0	0.1	0.0	0.1
Total	359.3	98.0	27.7	97.6	3.3	20.0	3.6	47.0
n	17	17	17	17	11	11	11	11
CT								
Average	100.3	7.8	2.8	9.3	39.2	8.1	2.4	19.9
Stand. dev.	211.5	5.9	2.6	6.5	87.0	12.9	4.1	29.9
Max.	658.7	17.3	8.1	19.1	194.9	30.9	9.7	72.6
Min.	0.5	1.2	0.4	1.9	0.0	0.4	0.1	1.0
Total	1003.2	77.8	28.3	92.9	196.1	40.3	12.2	99.7
n	10	10	10	10	5	5	5	5
NT								
Average	33.1	13.7	1.9	8.6	19.8	20.2	3.1	22.3
Stand. dev.	30.2	14.3	2.0	8.5	72.6	41.1	7.4	42.7
Max.	108.1	51.9	7.8	32.2	282.0	162.2	29.3	168.2
Min.	0.1	0.1	0.1	0.5	0.01	0.1	0.01	0.2
Total	595.8	246.2	33.0	155.4	297.0	303.4	46.5	333.8
n	19	19	19	19	15	15	15	15

Loamy soil, 30 % slope Francia et al. (2006).

Impact on runoff: plot scale III



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depth).

Impact on runoff: catchments

Hydrological year	P (mm)	Number of days Rainfall depth > 10 mm	EI30 (Mg mm/ha h)	Q (mm)	rc (%)	L (kg)	L (Mg/ha)	Contribution of (%) the maximum event	Month of the maximum events

Year	Annual Rainfall mm	Annual Runoff mm	Annual runoff coef. %	Annual Soil loss t ha^{-1}	Annual R S.I. units	Maximum I30 mm h^{-1}	Maximum Peak flow l s^{-1}	Maximum event R S.I. units	Ave sed. conc. g l^{-1}
2006-2007	435.2	38.4	8.8	3.99	1224.9	29.4	136.7	420.6	10.4
2007-2008	518.4	34.1	6.6	10.32	1960.4	45	112.6	1119.9	30.3
2008-2009	366.6	30.9	8.2	1.45	413.5	17.6	62.0	78.9	4.8
2009-2010	986.8	366.9	37.2	52.37	2529.9	39.2	1335.8	358.7	14.3
2010-2011	689.2	106.9	15.5	12.55	679.6	15.6	235.8	158.1	11.7
Mean	599.2	115.3	15.3	16.1	1361.5	29.4	376.6	427.1	14.3
Stdev	247.9	144.2	12.7	20.8	881.2	12.9	539.9	411.8	9.6
CV %	41.4	125.1	83.4	128.6	64.7	44.1	143.4	96.4	67.0

Table 2: Summary of annual hydrologic records at La Conchuela basin. R is rainfall erosivity, which S.I.units are MJ mm ha^{-1} h^{-1} $year^{-1}$ for annual values and MJ mm ha^{-1} h^{-1} for event values. CV means coefficient of variation; Stdev means standard deviation.

Gómez et al. (2013, submitted)

Field experiments: olive –yield

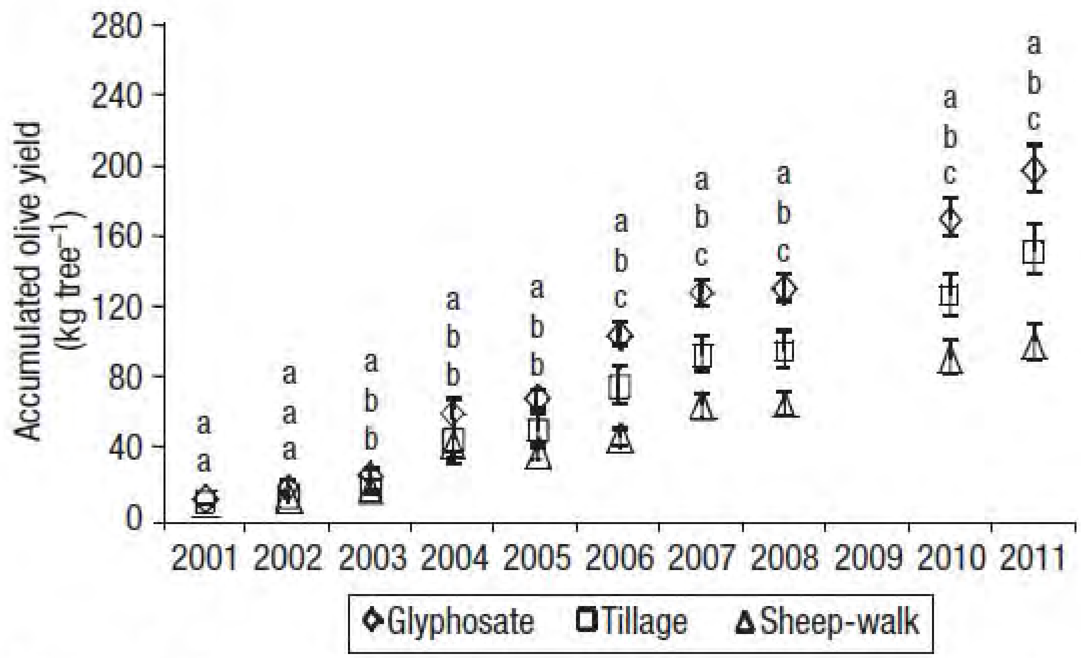


Figure 1. Accumulated olive yields from 2001 to 2011 in the plots subjected to Glyphosate, Tillage and Sheep-walk treatments. Vertical bars represent the standard deviations. Letters a, b and c are the result of the mean separation by the Tukey-HSD test ($\alpha < 0.05$) following the order Glyphosate, Tillage and Sheep-walk from top to bottom.

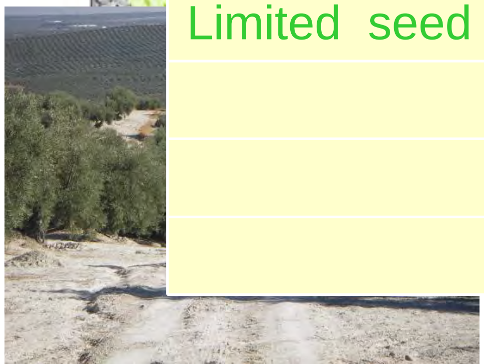
Yield CC (Kg/tree)

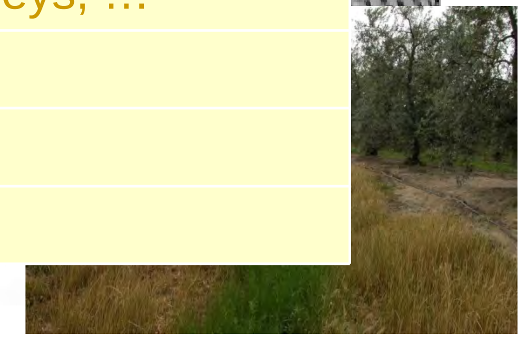
Gómez, 2005

Ferreira et al. (2013)

Field experiments: olive –yield/moist

Problems	Risks
Poor, uneven ground cover, placement	Non-seeded, or failed
Farmers reluctance	Potential risk, cost, complexity harvest/seed/control
Limited seed options	Loliums, barleys, …





Aguilera et al. (in preparation)

Predicting impact on runoff & water balance I

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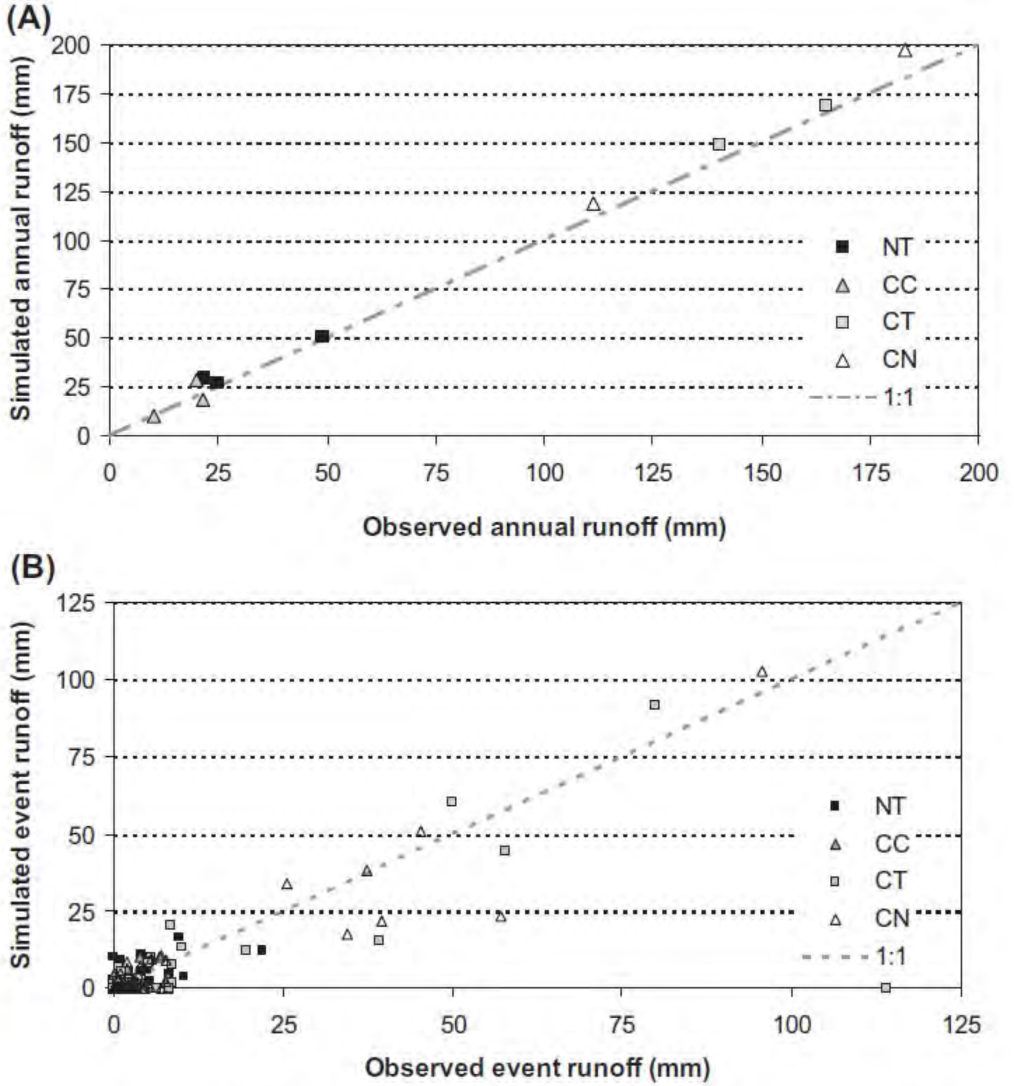
Abazi et al. (2011)



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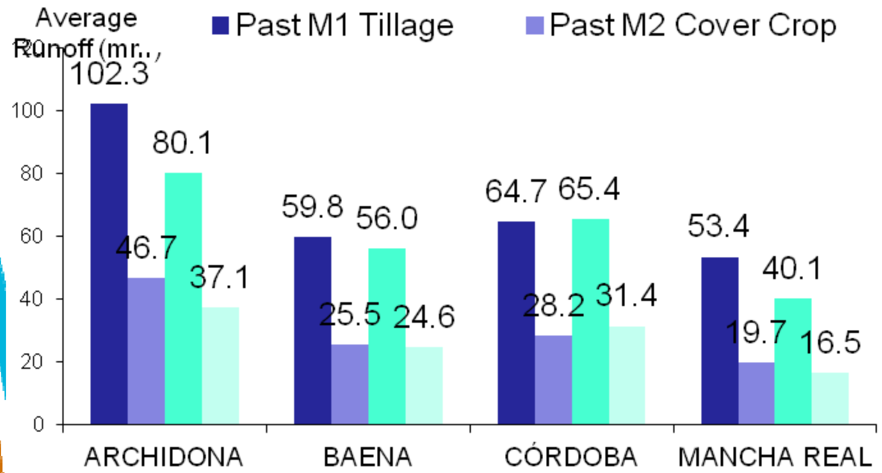
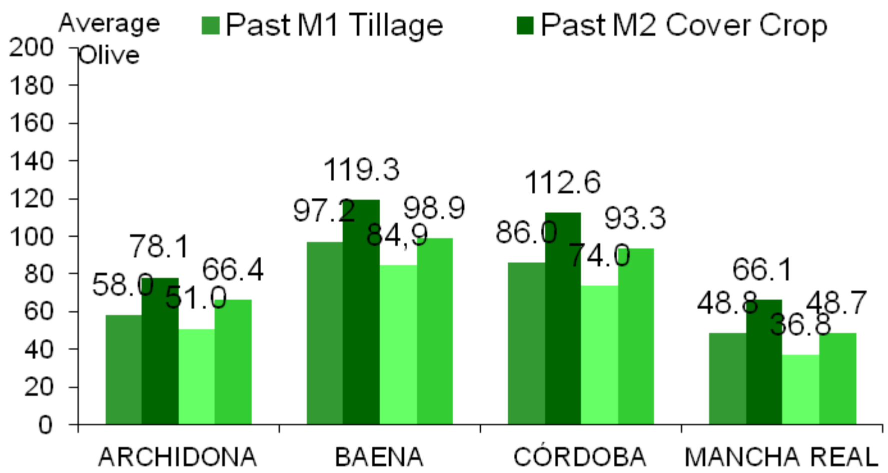
CT

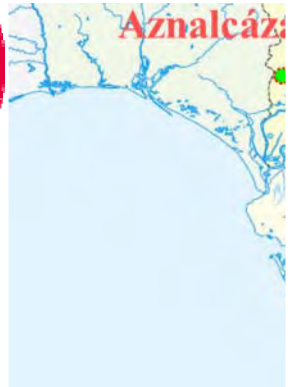
Fig. 6. Comparison between observed and simulated annual runoff (A) and event runoff (B) for the different years and treatments used in the validation of the model. NT is no tillage with bare soil, CT is conventional tillage, CC is cover crop of cereal, and CN is cover crop of natural vegetation.

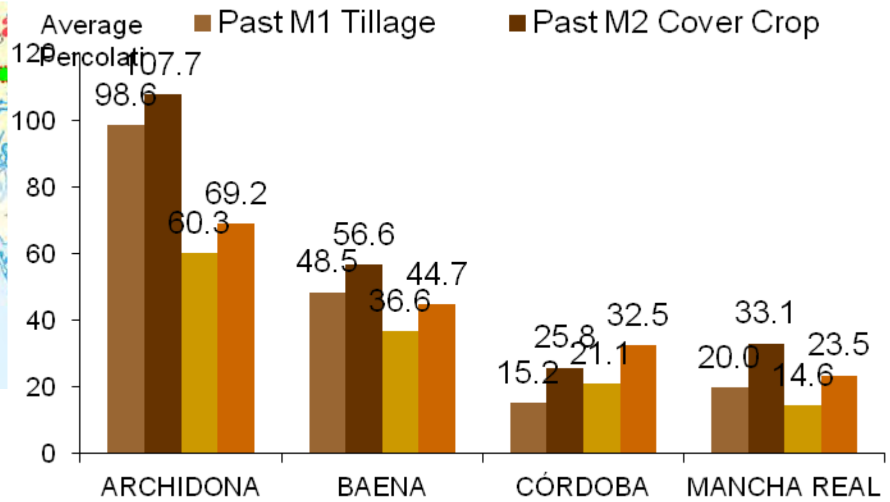
Abazl et al. 2013 (Comp. and Elect. In Agricult.91)

Predicting impact on runoff & water balance II





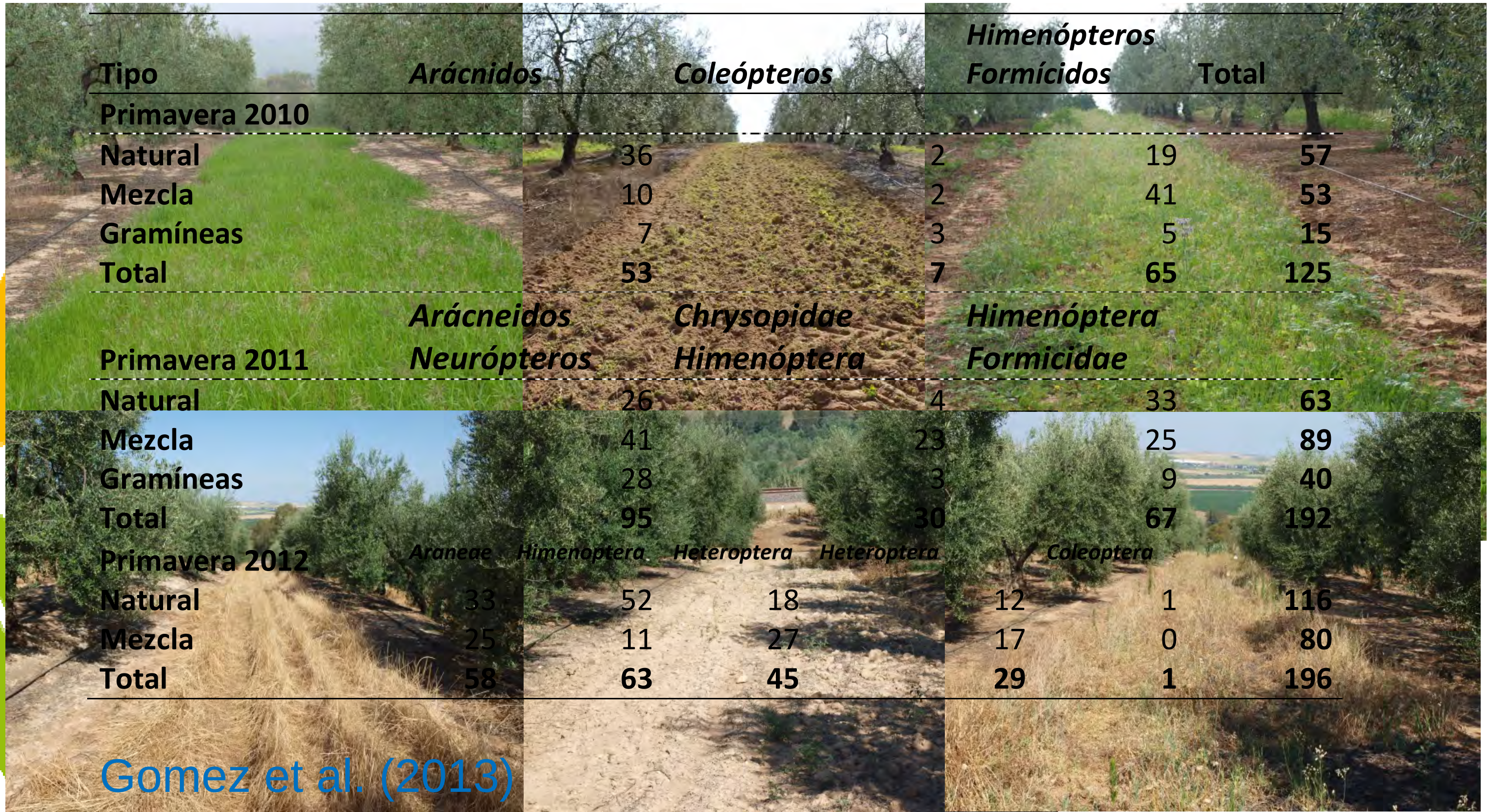




Rodríguez Carretero et al. (2013)

Improving use of cover crops I

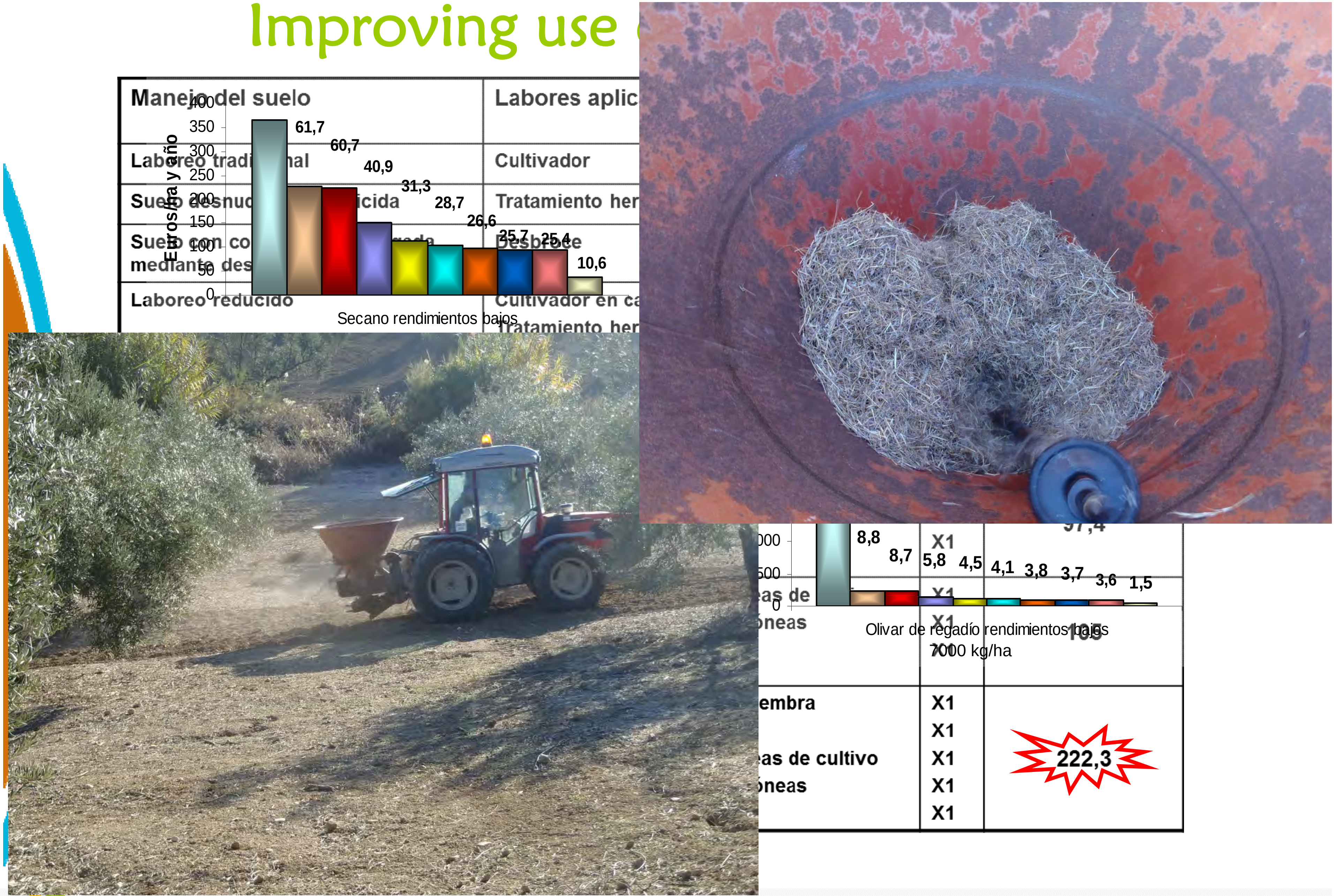
Improving use of cover crops II



Tipo		Arácnidos		Coleópteros	Himenópteros Formícidos	Total
Primavera 2010						
Natural		36		2	19	**57**
Mezcla		10		2	41	**53**
Gramíneas		7		3	5	**15**
Total		**53**		**7**	**65**	**125**
Primavera 2011		*Arácneidos Neurópteros*		*Chrysopidae Himenóptera*	*Himenóptera Formicidae*	
Natural		26		4	33	**63**
Mezcla		41		23	25	**89**
Gramíneas		28		3	9	**40**
Total		**95**		**30**	**67**	**192**
Primavera 2012	*Araneae*	*Himenoptera*	*Heteroptera*	*Heteroptera*	*Coleoptera*	
Natural	33	52	18	12	1	**116**
Mezcla	25	11	27	17	0	**80**
Total	58	**63**	**45**	**29**	**1**	**196**

Gomez et al. (2013)

Improving use



Comments

1- Use of cover crops is already a reality in olive orchards.

2- There are empirical evidences about its impact on runoff , soil properties and soil water balance.

3- We can quantify, with a measure of uncertainty, that impact.

4- Their use still been far from optimum: management, difficulties associated to yield risk and cost.

Avenues for improving

1- Management(seeding,-traffic killing, rainfed vs. irrigated location-connectivity) improvement for enhancing impact . Cooperative research.

2- Better adapted varieties, mixes. Cost limited. Cooperation with farmers, Coops., SME. Not necessarily a market for most companies.

3- Positive externalities: biodiversity, soil water quality,


Thank you
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