

**Federal Agency for
Water Management**
Institute for Land and Water
Management Research



University of Seville
Department of Agroforestry
Sciences

**Soil erosion control measures, effectiveness and
implementation strategies –
the case of Spain and Austria**

A. Delgado and P. Strauss

Erosion – is there a problem with water pollution?

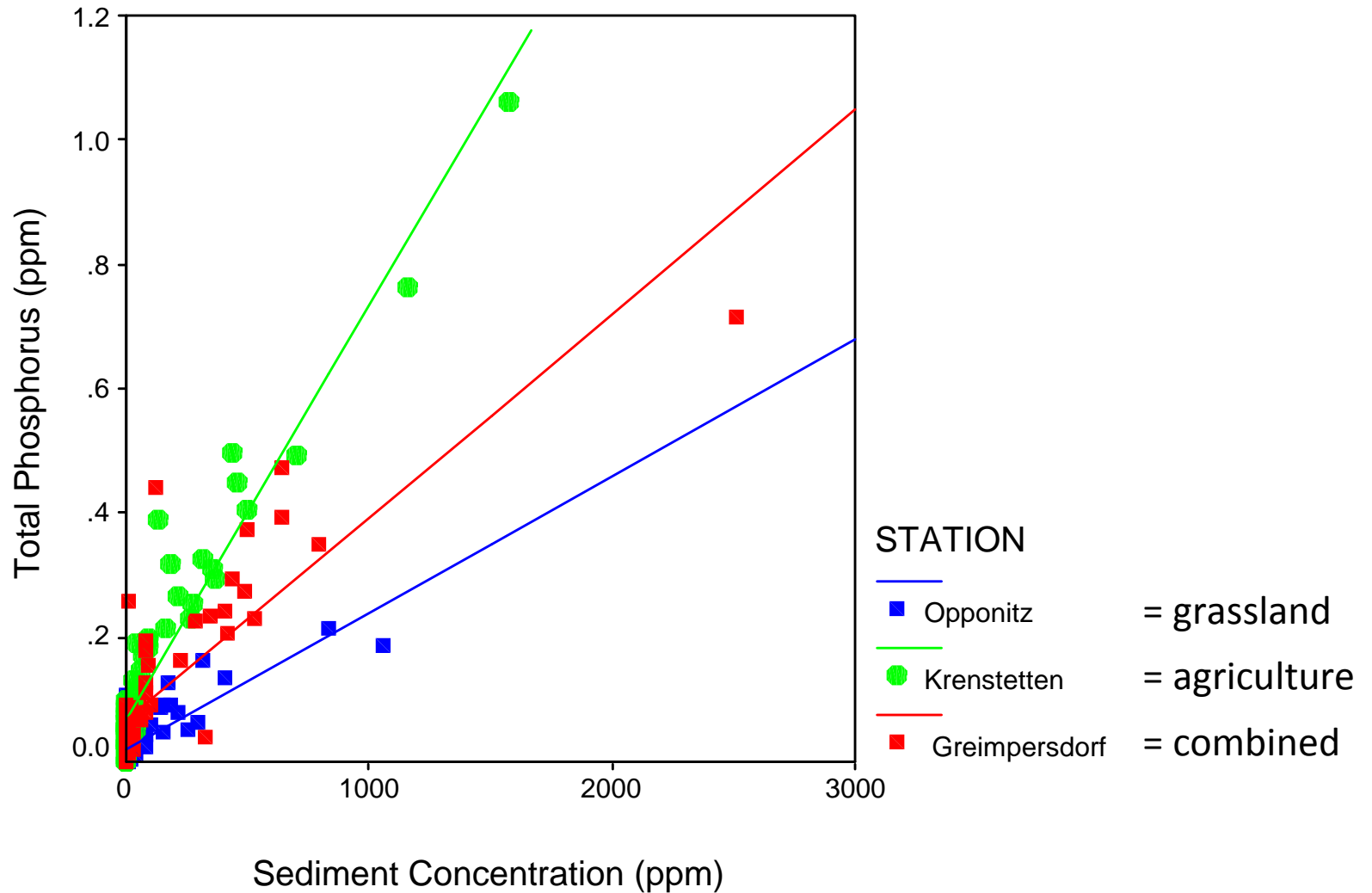


Erosion – is there a problem with water pollution?



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Relationship sediment – P_{total}

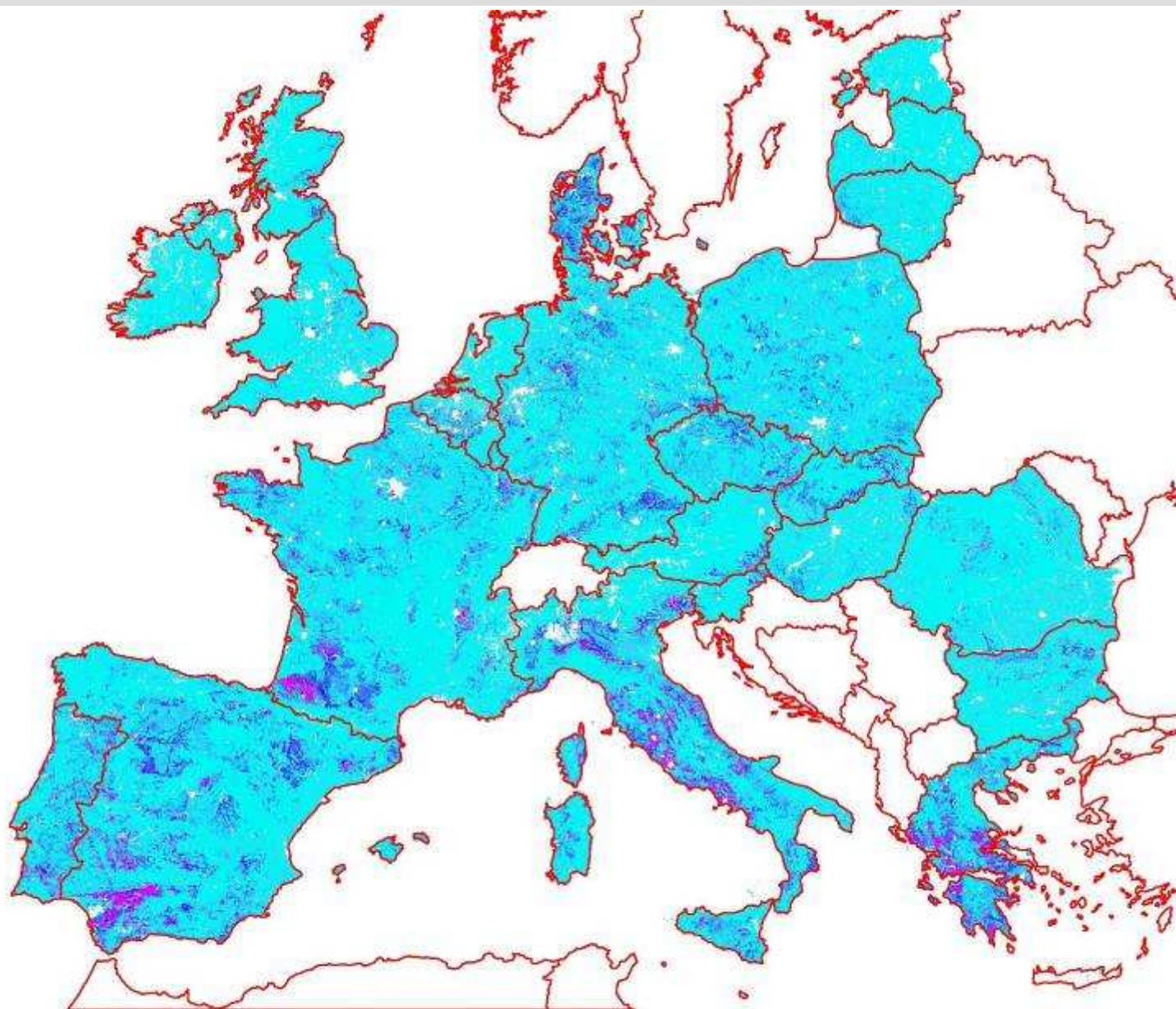


Erosion – is there a problem with water pollution?

Rainfall simulation on arable land

Site	Concentration (mg l ⁻¹)		Load (mg min ⁻¹ m ²)	
	TP	TP <0.45µm	TP	TP <0.45µm
Riva	8.8	0.23	7	0.18
Tetto Frati	7.6	0.12	5.9	0.09
Somogybabod	79	0.01	52.2	0.01
Nagyhorvati	10.8	0.14	4.3	0.06

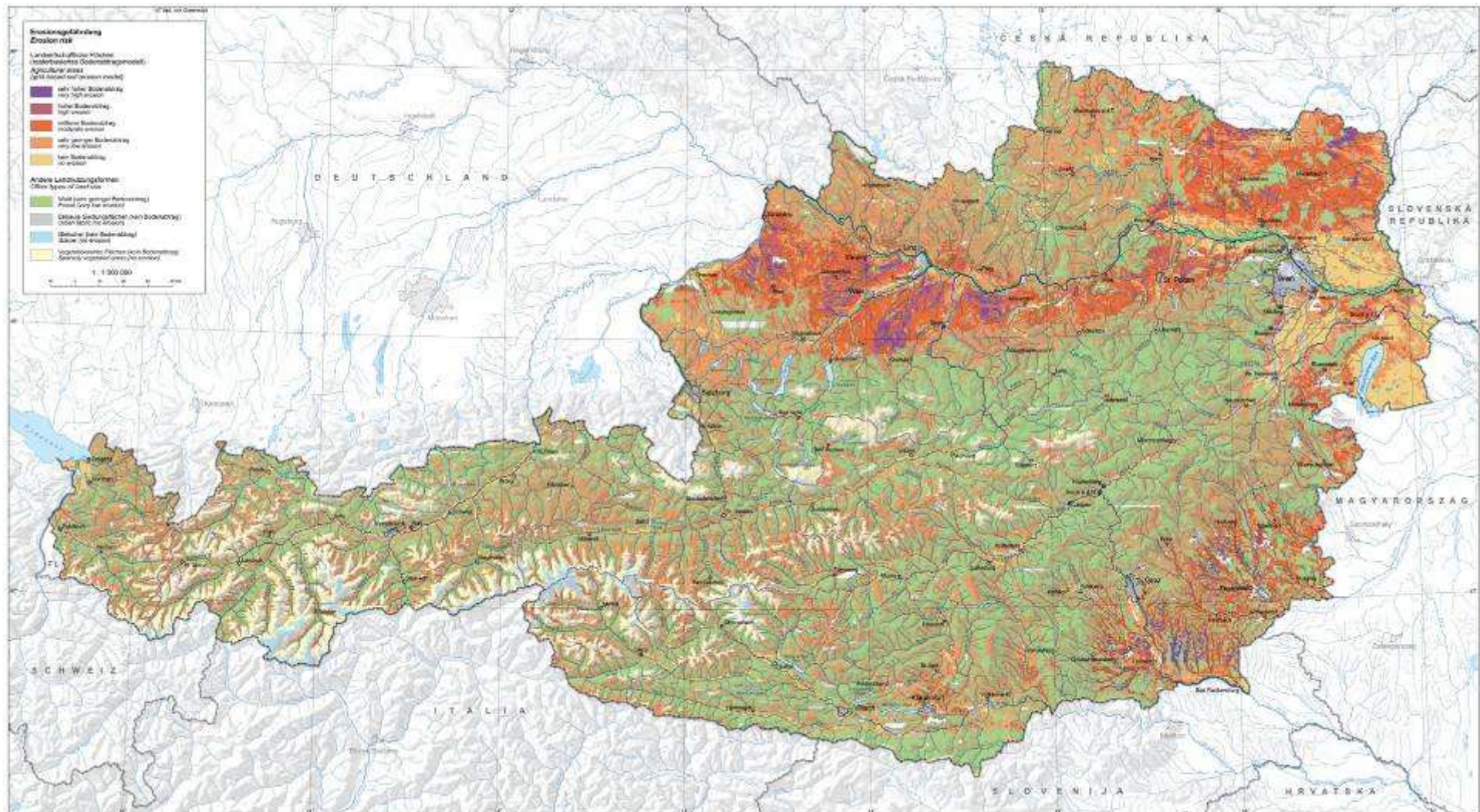
Erosion – Europe



EEA (2007)

Spatial distribution of Erosion

Austria



Strauss (2007)

Soil loss by water erosion in Austria (2004)

Amount (t ha⁻¹ a⁻¹)	Area (1000 ha)
< 6	592
6 - 11	122
11 - 22	82
22 - 33	24
> 33	20
Total	839

ÖPUL

Austrian programme for an environmentally sustainable agriculture

Set of measures to reduce negative impact of agricultural activities on environment

Participation voluntary

Start: 1995

Coverage: ~ 90% of agriculturally used area

Annual amount: ~ 1 billion €

Direct measures

Conservation tillage on arable land

Terracing in orchards

Terracing in vineyards

Soil coverage in orchards during 10 months

Soil coverage in vineyards during winter

Undersown crops to maize

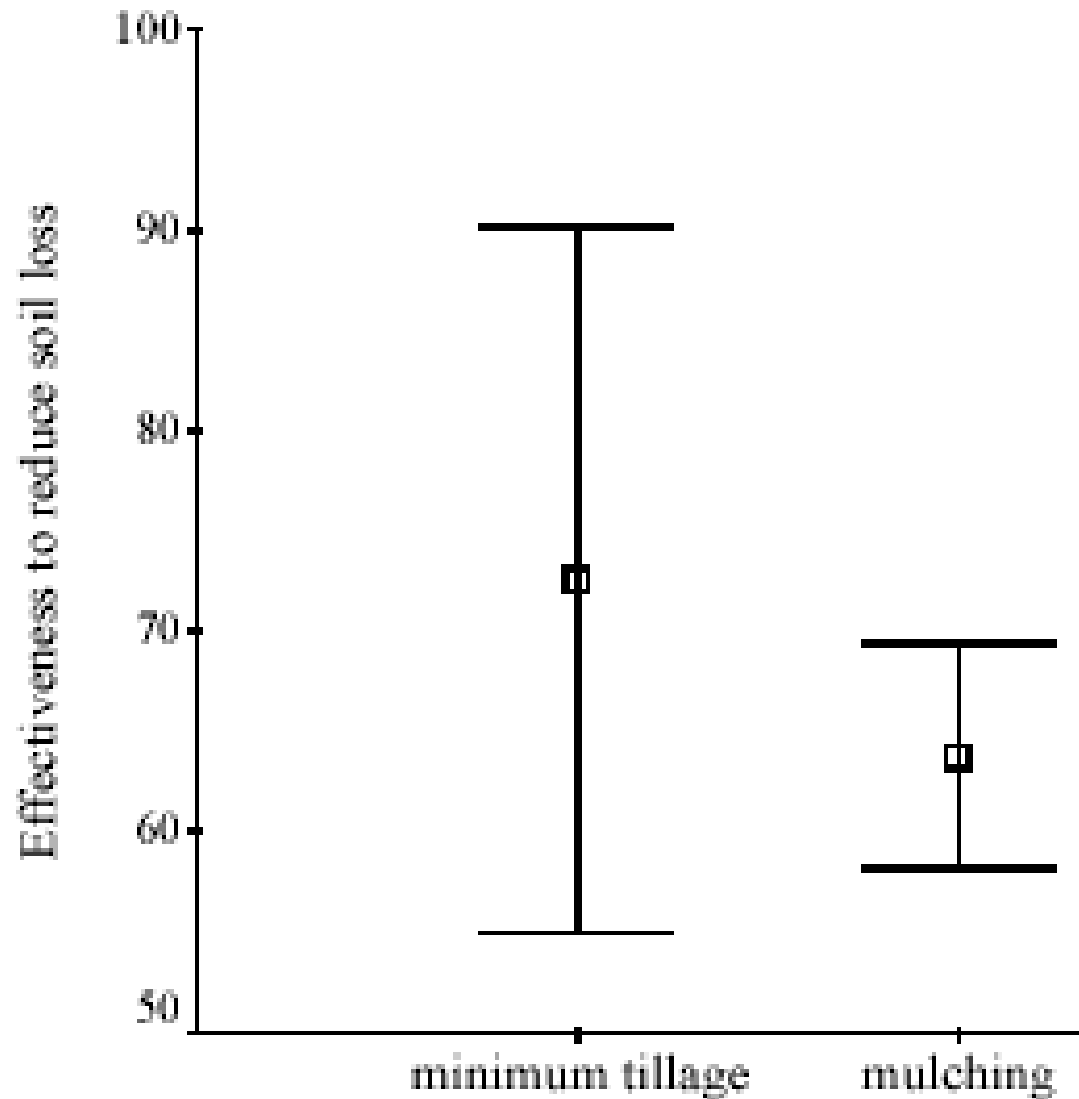
Indirect measures

Buffer strips

Organic farming

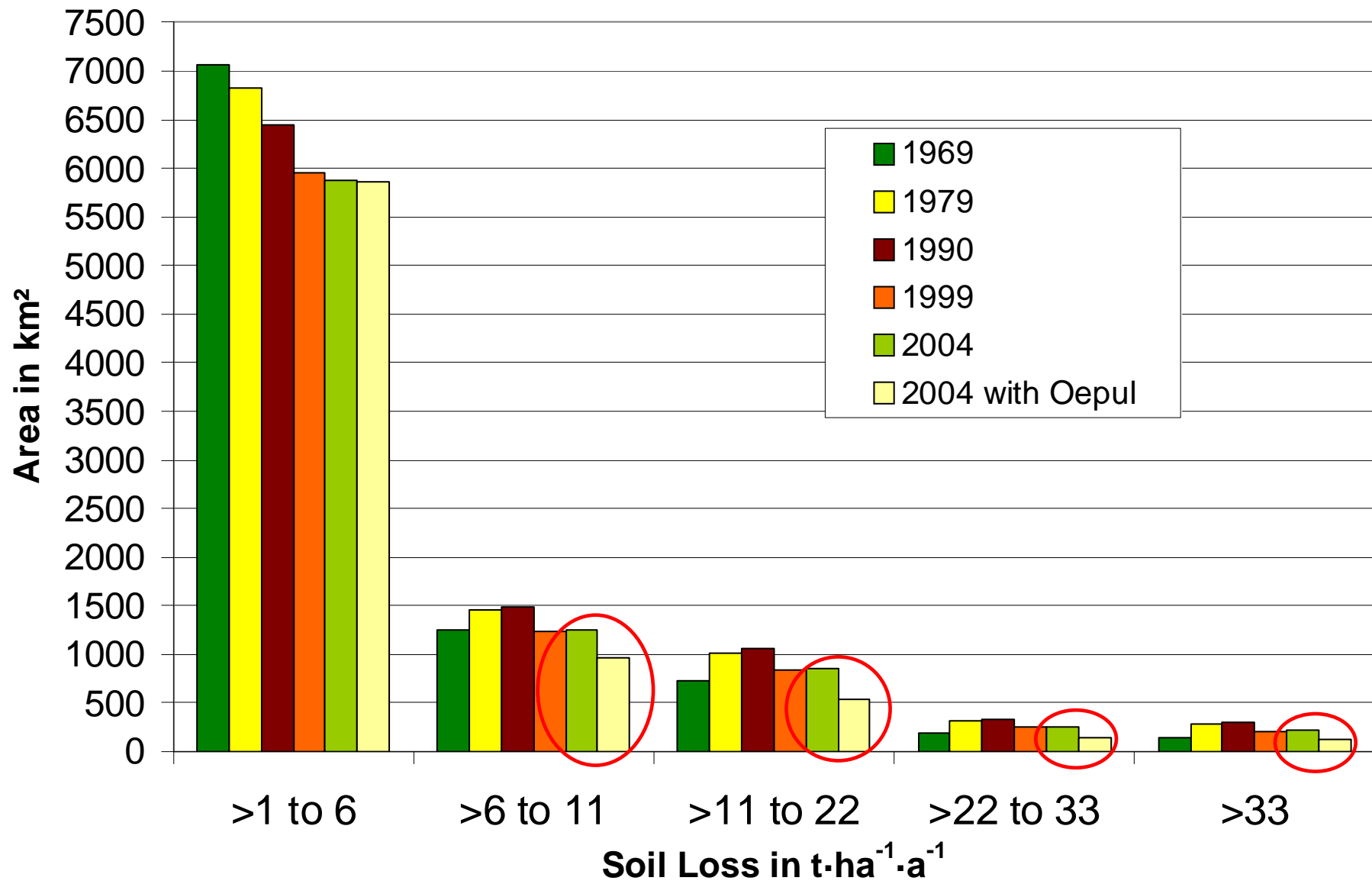
Catch crops during winter

Effectiveness of conservation tillage to reduce soil erosion – literature review for temperate climate

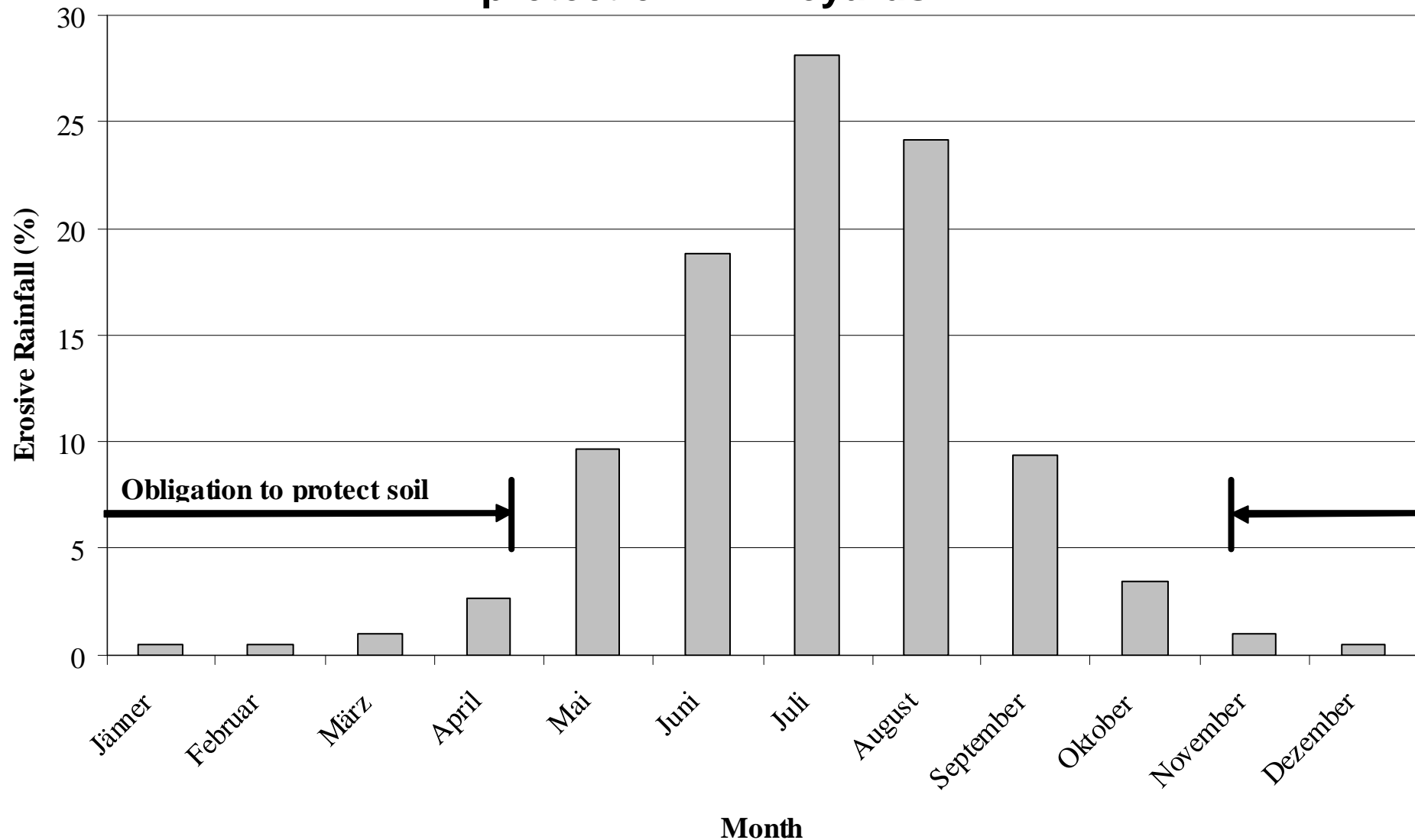


Temporal evolution of erosion

Austria

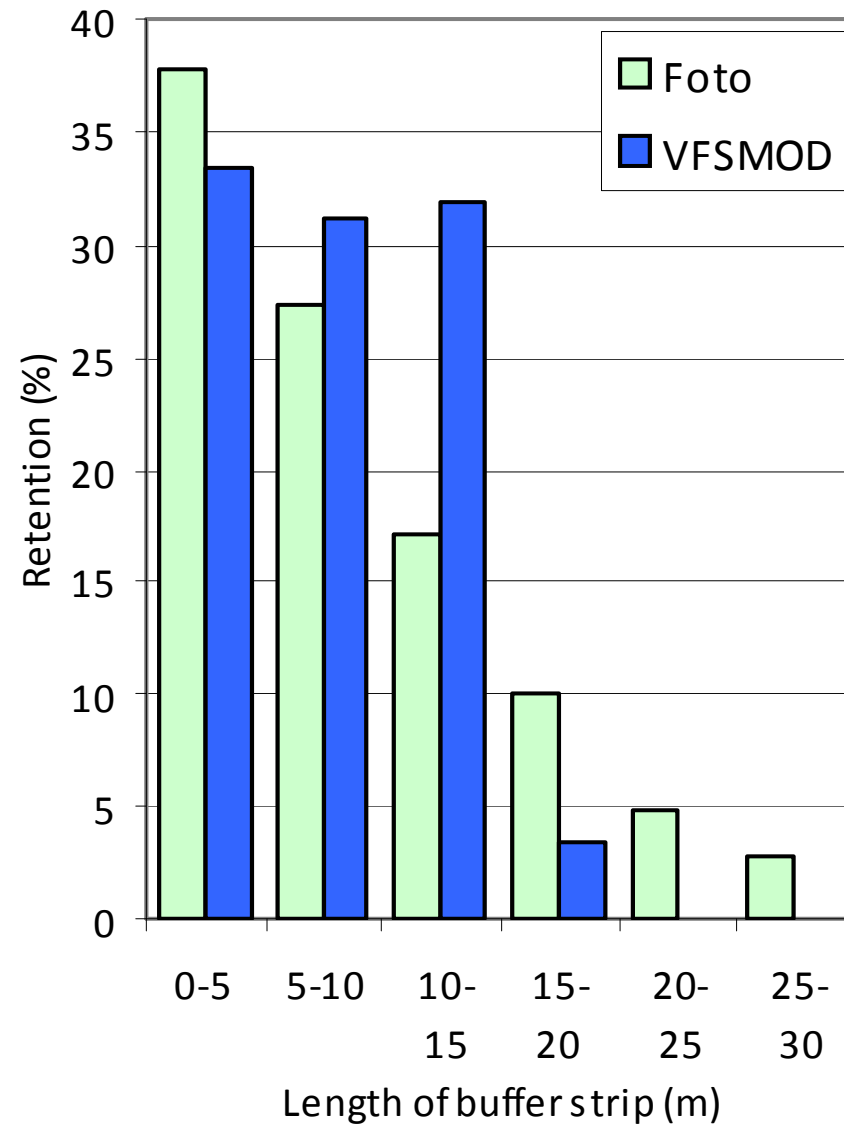
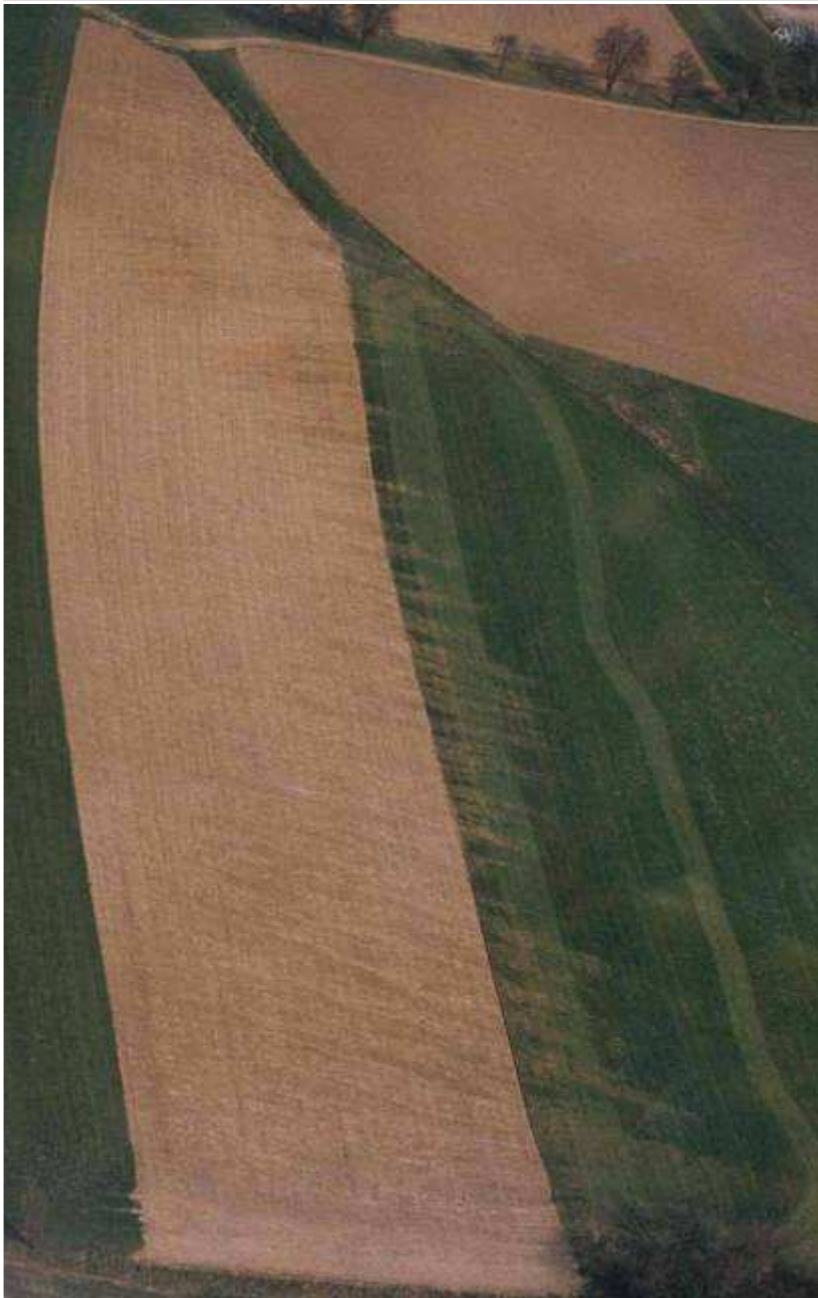


Occurrence of erosive rainfall in Austria compared to obligation for soil protection in vineyards



Buffer strips

Austria



Strauss (unpubl)

Ploughing in autumn

Management across slope

Grassed water ways

„Wheat“ instead of „maize“

Strip cropping

Double seeding density

Twin tyres

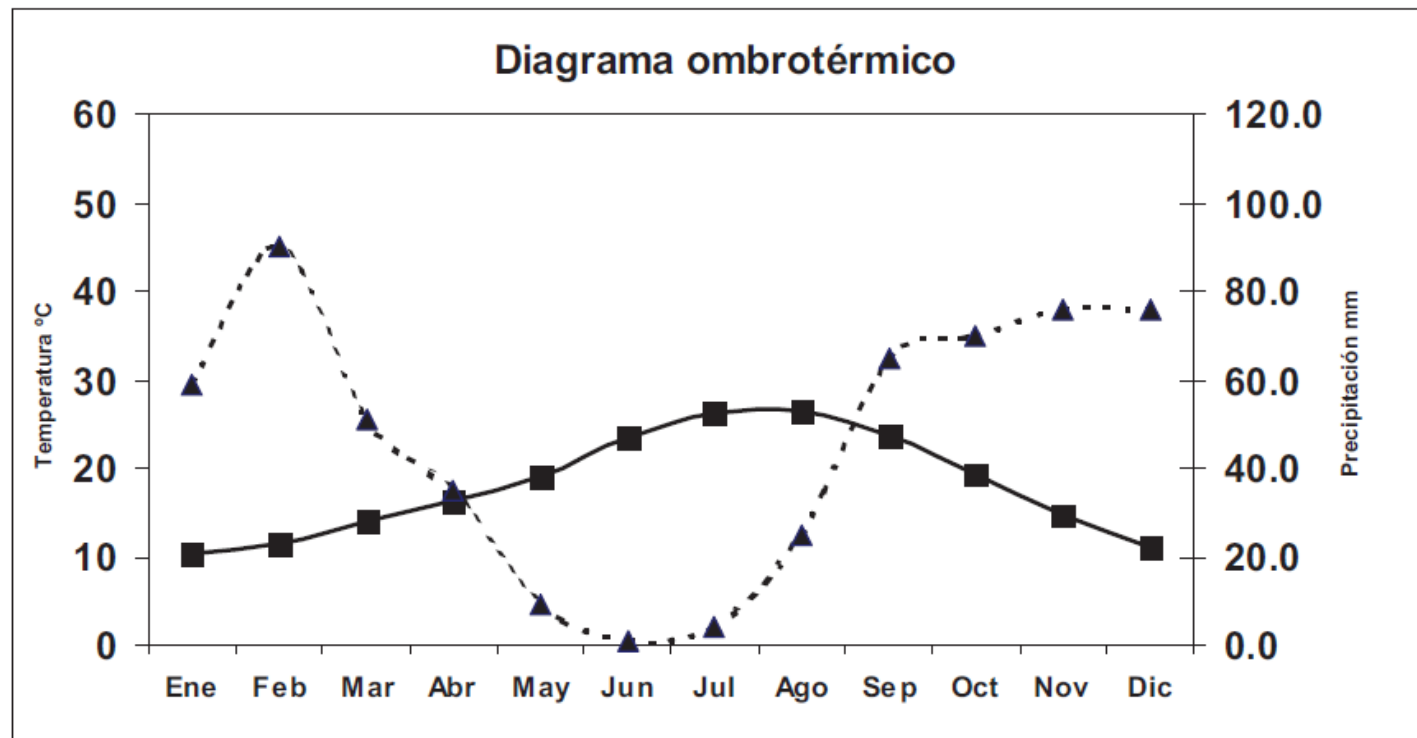
Seeding of winter barley together with maize

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The mediterranean climate

Spain

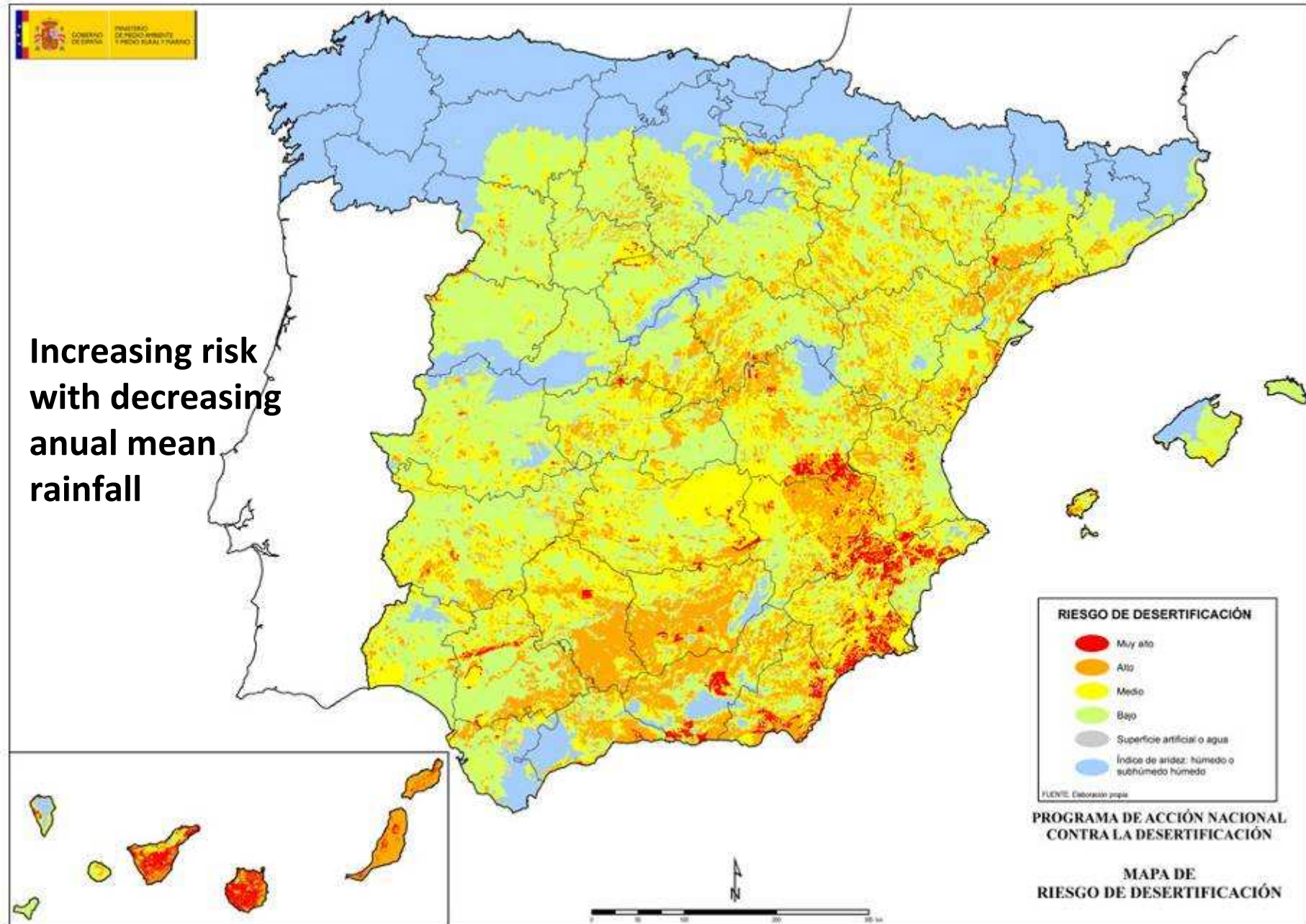
	<i>Ene</i>	<i>Feb</i>	<i>Mar</i>	<i>Abr</i>	<i>May</i>	<i>Jun</i>	<i>Jul</i>	<i>Ago</i>	<i>Sep</i>	<i>Oct</i>	<i>Nov</i>	<i>Dic</i>
tm °C	10.3	11.6	14.1	16.4	19.1	23.4	26.3	26.4	23.7	19.2	14.6	11.0
P(mm)	59.0	90.0	51.0	35.0	9.0	1.0	4.0	25.0	65.0	70.0	76.0	76.0



- **Soil is usually covered by herbaceous crops during shorter periods of time when compared with humid climates**
- **Limited water availability for plants determine that winter cover crops are not usual (except in irrigated lands)**
- **Climate exhibit a more irregular distribution of rain with frequent localized extreme rainfall events.**
- **Particularly relevant erosion in olive (2.5 million ha) and vineyards (1.1 million ha)**

Spatial distribution of erosion

Spain

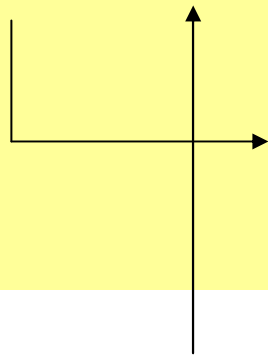


Area and erosive levels in Murcia

Nivel erosivo (t·ha ⁻¹ ·año ⁻¹)		Superficie geográfica		Pérdidas de suelo		Pérdidas medias (t·ha ⁻¹ ·año ⁻¹)
		ha	%	t·año ⁻¹	%	
1	0-5	513.232,68	45,37	1.136.231,62	5,86	2,21
2	5-10	217.849,16	19,26	1.555.694,52	8,02	7,14
3	10-25	199.535,88	17,64	3.124.984,87	16,11	15,66
4	25-50	82.834,03	7,32	2.884.926,03	14,88	34,83
5	50-100	49.029,35	4,33	3.444.607,85	17,76	70,26
6	100-200	27.432,47	2,42	3.770.662,05	19,44	137,45
7	>200	10.923,46	0,97	3.476.519,10	17,93	318,26
SUPERFICIE EROSIONABLE		1.100.837,03	97,31	19.393.626,04	100,00	17,62
8	Láminas de agua superficiales y humedales	5.799,53	0,51			
9	Superficies artificiales	24.623,73	2,18			
TOTAL		1.131.260,29	100,00			

National inventory of soil erosion (2002-2012)

Implementation of the AEM (Spanish law 2352/2004)



One of the objectives is to reduce soil erosion

The control corresponds to regional governments

Implementation of AEM in Spain (“Guía de condicionalidad” – conditionality guide)

Subsidies are conditioned to conservation of environment

Three objectives:

- **Soil conservation: reduce soil erosion**
- **Preservation of agricultural areas**
- **Habitat conservation: soil structure, optimal irrigation, manure store**

No mention to soil pollution: in “nitrate law” conditionality is restricted to “vulnerable areas”

Measures to achieve soil conservation included in “conditionality guide”

1. Reduction of soil erosion:

- Optimal tillage depending on the soil slope
- Soil cover
- Terracing

2. Soil organic matter management

- Incorporation of crop residues

3. Preservation of soil structure:

- Accurate use of machinery

a) Tillage adapted to slope

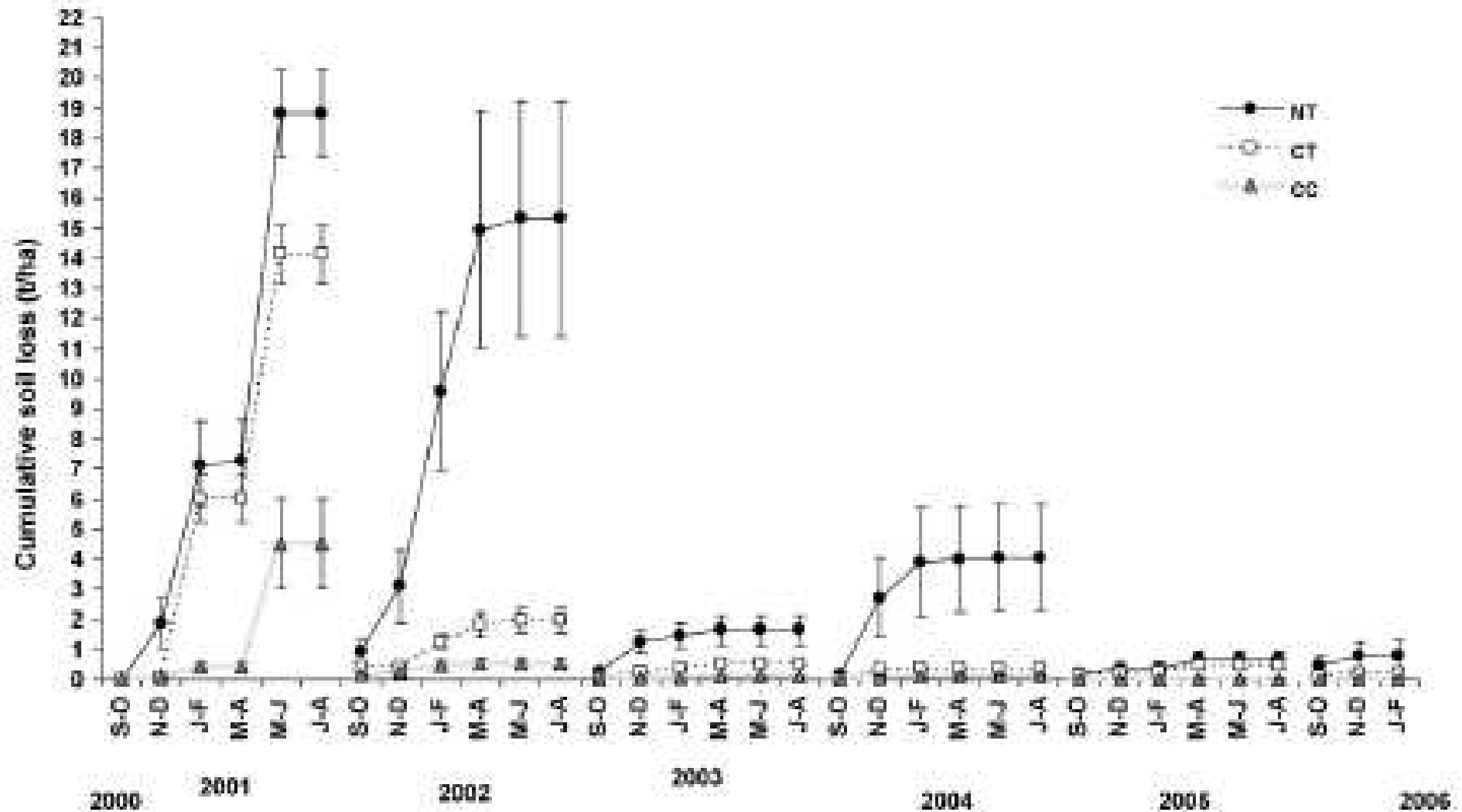
- In field crops, tillage across slope if it is $> 10 \%$
- In olive and vineyards no tillage when slope $> 15 \%$
- Tillage must not affect bench stability
- Seeding must be done as soon as possible to cover the soil

b) Soil cover

- **In winter field crops, tillage is forbidden between harvest and 1st September**
- **Cover crops in tree plantations**
- **Cover crops and restrictions in crop rotations in areas with high erosion risk**
- **Management of uncultivated/fallow land: soil cover, minimum tillage**

Effectiveness - conservation tillage

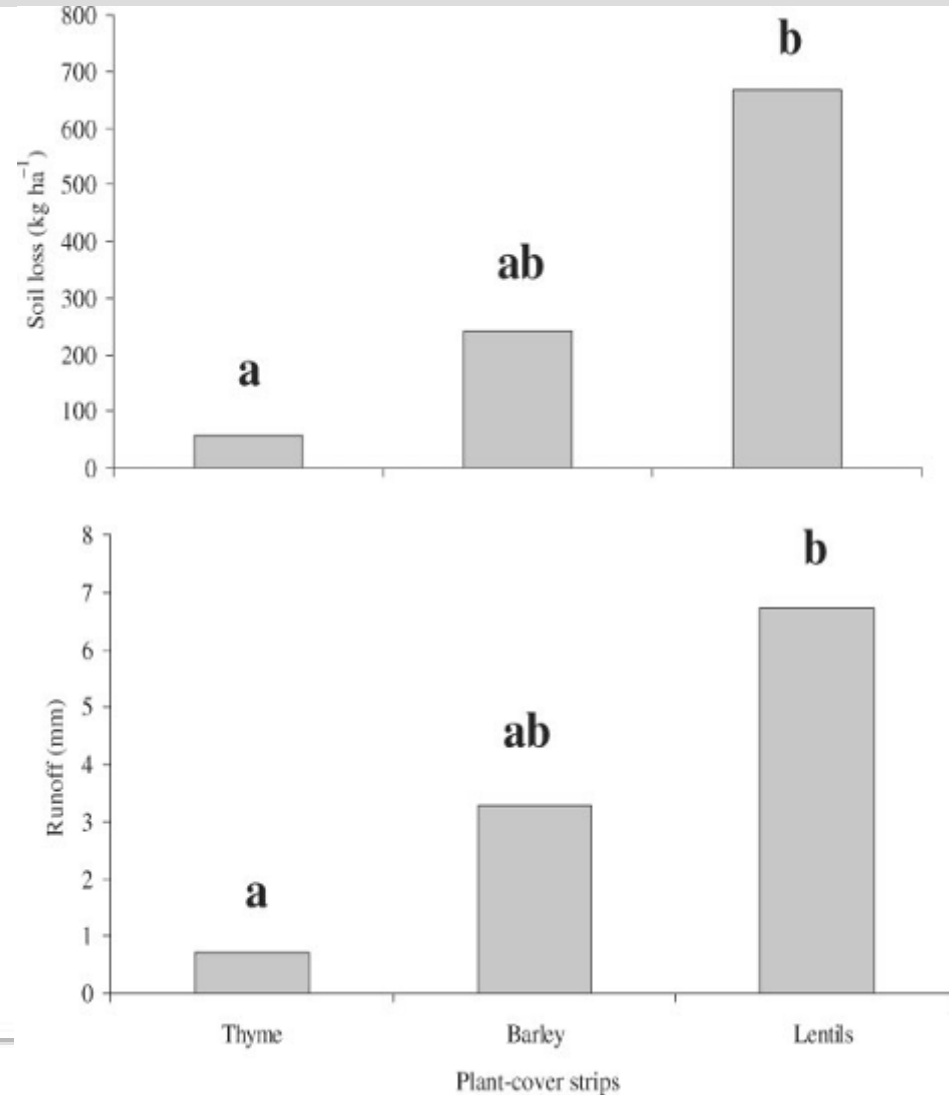
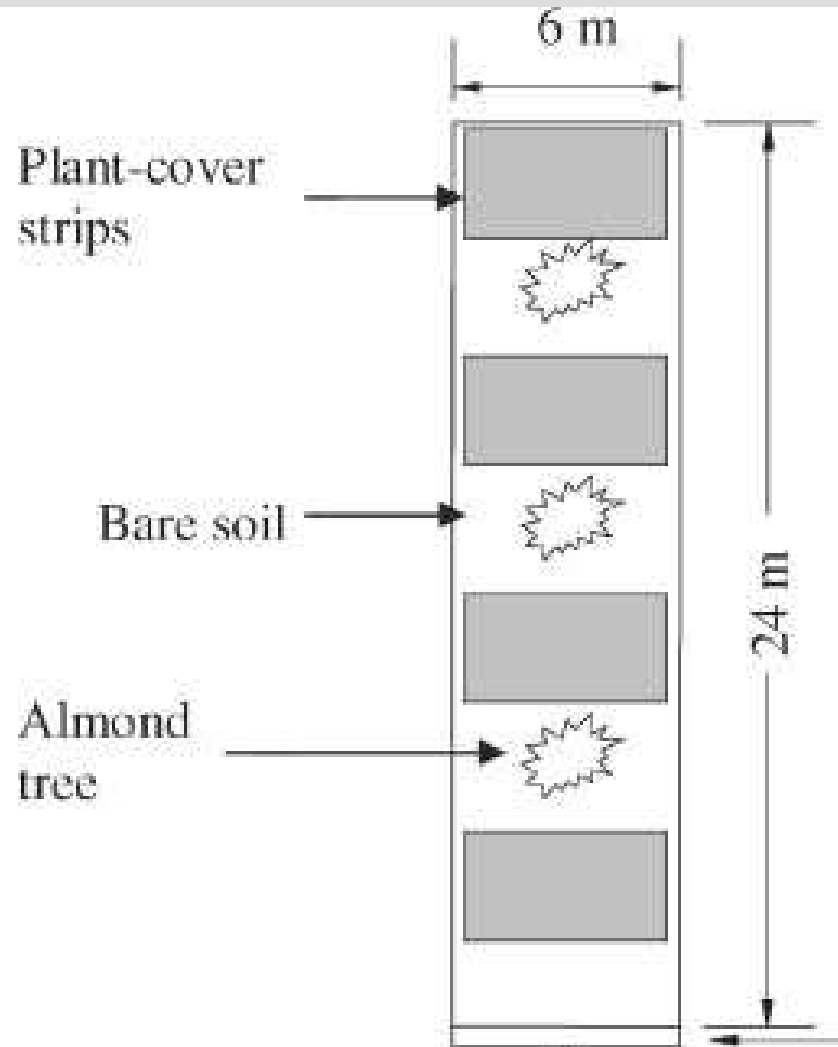
Spain



Soil loss in olive groves under no tillage (NT), conventional tillage (CT) and cover crop (CC) in SE Spain (Gómez et al., 2009)

Effectiveness – plant cover strips

Spain

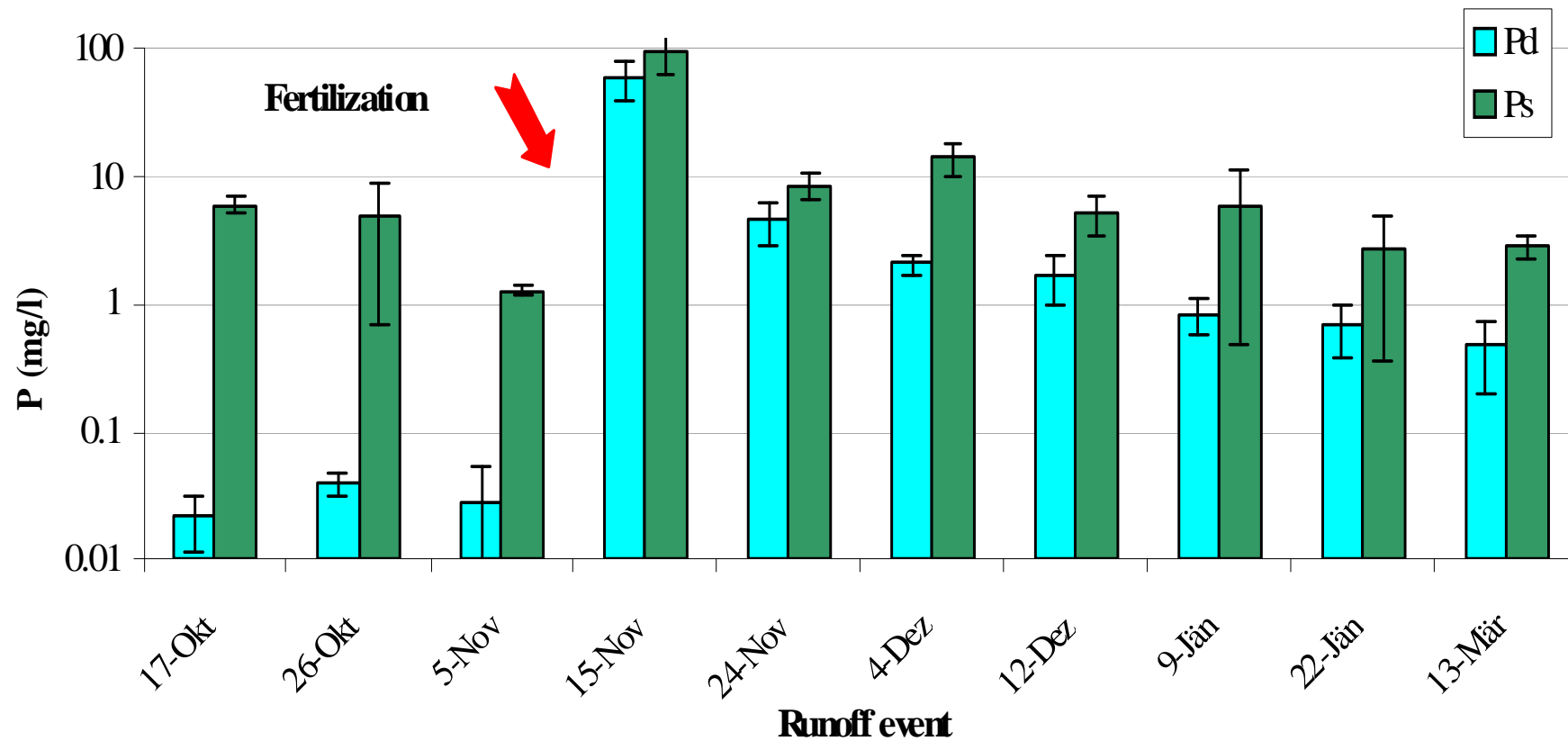


Effectiveness of plant cover strips in olive tree in Spain (Martínez Raya et al., 2006)

- Effectiveness of no-tillage should be accurately evaluated depending on crops, soil types and slopes
- Cover crops is the most effective mitigation option, but effects on water and economic balance should be evaluated
- Erosion control measures could increase pollution if accurate nutrient management is not considered (e.g. accurate incorporation of fertilizers under no-tillage)

P loss under NT

Spain

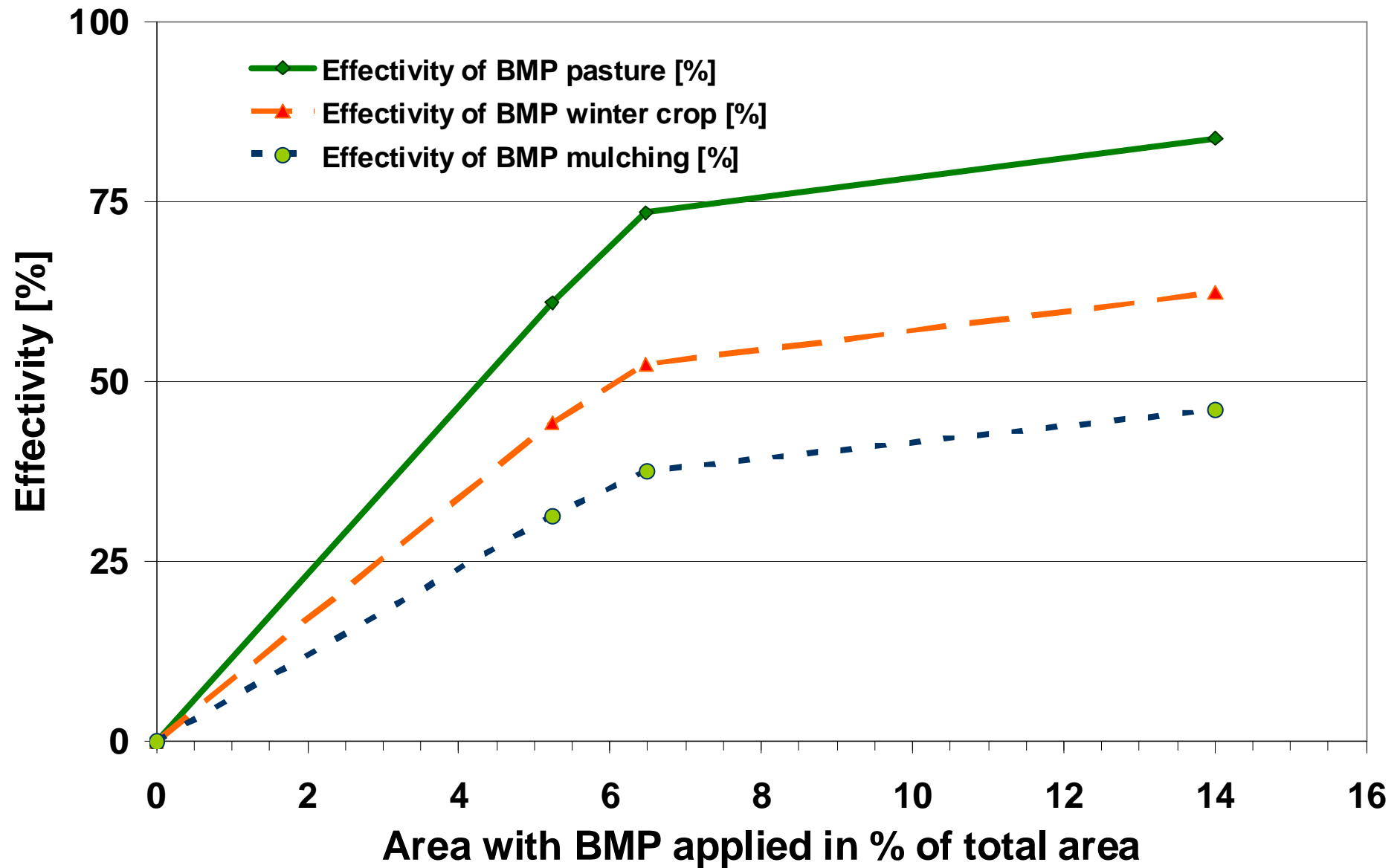


Incidental losses of P fertilizer under no-tillage in a Vertisol from SW Spain (Delgado et al., unpublished)

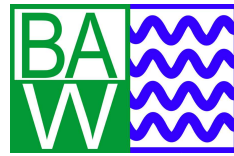
- How can we obtain a better participation of farmers to erosion control measures?
- How can we obtain a better localisation of sensitive areas – money?
- Are there counter effects of erosion control measures and how can we evaluate them?

Localisation of sensitive areas

Austria



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Thank you for your attention!

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