

EFFECT OF MINIMUM TILLAGE AND NO-TILLAGE ON CARBON STOCKS IN SPANISH AGRICULTURAL SOILS

BACKGROUND

Soil tillage practices are of particular importance in relation to soil carbon, because they affect carbon dynamics directly and indirectly. Long-term tillage can reduce the carbon stock up to 20-50% (Lopez-Fando & Pardo, 2011). Also, continuous and intense or excessive tillage can cause a loss of soil organic carbon, leading to an increase in erosion and degradation of the soil structure. Causing damage to the soil biota, compaction of the structure, crusting and loss of fertility (Soldevilla-Martinez et al., 2013).

On the other hand, conservation agriculture, "no-tillage", reduces the negative effect of the impact of tillage and has been confirmed to have a great potential to convert carbon-emitting soils into Be able to determine if the agricultural practice of no tillage or reduced tillage has a positive or negative influence on carbon stocks in Spanish soils.

OBJECTIVES

How do other variables affect carbon stocks in Spanish soils such as the average annual precipitation, the average annual temperature, the percentage of clay in the soil, the years of implementation and the climate?

What role do Spanish soils play in this carbon sequestration in the context of climate

sink soils, capturing atmospheric carbon.

Soil organic carbon is considered an indicator of soil quality due to its agronomic and ecological functions. (Carbonell-Bojollo et al., 2015).

METHODOLOGY



change.

HYPOTHESES

 $C0^2$

Apesteguía et al., 2017 b	: 🔳	2.83% 3.40 [2.96, 3.84]					
Arias et al., 2017	· · · · · · · · · · · · · · · · · · ·	1.78% 12.73 [4.05, 21.41]	Apesteguia et al., 2017 a				% 7.60 [6.54, 8.66]
Bienes et al., 2021 a	┝──┼■──┥	1.40% 3.50 [-7.96, 14.96]	Apesteguía et al., 2017 b			5.31	% 5.80 [4.18, 7.42]
Bienes et al., 2021 b	⊢	1.05% 3.50 [-11.22, 18.22]	Bienes et al., 2021 a			5.20	% 1.90 [0.06, 3.74]
Carbonell-Bojollo et al., 2015		2.81% 2.53 [1.61, 3.44]	Bienes et al., 2021 b			4.47	% 1.50 [-1.53, 4.53]
Corral-Fernández et al., 2013 a		2.34% 0.51 [-4.67, 5.69]	Do 2013			4 739	6 9 60 [6 98 12 22]
Corral-Fernández et al., 2013 b	⊢	1.58% -1.81 [-11.89, 8.27]	Carcia Eranco et al. 2021			5.21	% 560 [3 70 7 41]
De Leijster et al., 2019	⊢ ∎∺-1	2.36% -2.00 [-7.04, 3.04]	Garcia-Franco et al., 2021			J.ZI 5.10	$70 0.00 0.79, \ 7.41$
Fernández et al., 2020 a		2.83% -1.00 [-1.27, -0.73]	Hemanz et al., 2009 a		H	5.10	% U.ZU[-1.81, Z.ZI]
Fernández et al., 2020 b		2.80% 11.20 [10.06, 12.34]	Hernanz et al., 2009 b		►	4.39	% -0.80[-3.94, 2.34]
Fernández et al., 2020 c		2.82% 4.00 [3.18, 4.82]	Hernanz et al., 2009 c		⊢ ∎+	3.91	% -0.20 [-4.08, 3.68]
Fernández et al., 2020 d		2.82% 1.80 [1.18, 2.42]	Hernanz et al., 2	009 d	⊢	4.35	% 0.20 [-3.00, 3.40]
Fernández-Ugalde et al., 2009	:=	2.82% 2.69 [2.19, 3.19]	Hernanz et al., 20	009 e	→ —	3.68	% -0.20[-4.44, 4.04]
Garcia-Franco et al., 2021	· · · · · · · · · · · · · · · · · · ·	1.81% 37.20 [28.72, 45.68]	Hernanz et al. 2	009 f		4.06	% 0.30[-3.34 3.94]
González-Rosado et al., 2020a		1.46% 0.72 [-10.22, 11.66]	Hornanz et al., 20	000 a		2.40	$\frac{76}{2}$ 0.00 [0.04, 0.04]
Gonzalez-Rosado et al., 2020b		1.18% -2.95 [-16.30, 10.40]	Hernanz et al., 2009 g			3.40	$\frac{1}{10}$ -0.10[-4.07, 4.47]
Gonzalez-Hosado et al., 20200		1.18% -5.13 [-18.48, 8.22]	Hernanz et al., 2009 h			4.25	⁷⁶ 0.00 [-3.36, 3.36]
Hernanz et al., 2009 a		2.63% 0.70 [-2.44, 3.84]	López-Fando & Pardo, 2009			5.67	% 2.24 [1.57, 2.92]
Hernanz et al., 2009 b		2.49% 0.40 [-3.76, 4.56]	Lopez-Fando & Pardo, 2011			4.85	% 0.31 [-2.12, 2.74]
Hernanz et al., 2009 d		2.30% 1.30[-3.02, 0.02]	M. Panettieri et al., 2013			5.23	% 1.86 [0.08, 3.64]
Hernanz et al. 2009 e		2.03% 1.10[-5.98.8.18]	Martínez-Mena et al., 2020 a			5.28	% 5.20 [3.51, 6.89]
Hernauz et al., 2009 f		2.12% 2.00 [-4.56, 8.56]	Martínez-Mena et al., 2020 b			2.349	8.80 [1.99, 15.61]
Hernanz et al., 2009 g		1.90% 1.50 [-6.42, 9.42]	Panettieri 2013			1.569	6 0 93 [-8 32 10 18]
Hernanz et al., 2009 h	·	2.10% 1.80 [-4.90, 8.50]	Sombrero & de Benito 2010			5.25	% 665[/01 830]
Hondebrink et al., 2017 a	HEH	2.65% 5.54 [2.57, 8.51]	Sombrero & de Benito, 2010			J.2J	// 0.05 [4.51, 0.55]
Hondebrink et al., 2017 b		2.81% 4.98 [3.98, 5.98]				4.0.0	
López-Fando & Pardo, 2009		2.80% 9.91 [8.79, '1.03]	RE Model			100	% 2.77[1.41, 4.12]
Lopez-Fando & Pardo, 2011		2.80% 6.80 [5.54, d.06]					
Lozano-García & Parras-Alcántara, 2013a		2.82% -6.00 [-6.79, -5.2					
Lozano-García & Parras-Alcántara, 2013b		2.82% 3.90 [3.15, 1				~ ~ ~	
M. Panettieri et al., 2013		2.79% 5.66 [4.27,	-20 -10 0 10 20 30 40				
Novara et al., 2019	⊢	1.74% 0.74 [-8.24,	Graph 2: Meta-analysis of the effect of reduced tillage				
Panettieri, 2013		2.01% 2.83 [-4.39,	practices in carbon stocks in spanish agriculture soils Mean Difference				
Parras-Alcántara et al., 2014a	H	0.63% 9.43 [-11.68, 30.54]	Source: own elaboration				
Par Alcantara et al., 2014b		1.46% -12.66 [-23.64 68]					
Parra cantara et al., 2015		1.50% 3.79[-6.84, 4.42]					
Sanchez-Li la et al., 2016 a		2.81% 13.24 [12.36 2]		No tillage	Reduced tillage	Conventional tillage	
Soldeville Mertinez et al., 2010 D		2.03% -0.00[7.51 7.35]					
Sombrero & de Benito, 2010		2 78% 10 12 [8 55] 69]		p-value	p-value	p-value	Anova
Vázquez et al. 2020		2.62% 8.50 [5.29 1.71]	Duration	0.04	0.00	0.00	
			Precipitation	0,84	0,86	0,98	no significance
RE Model		100% 4.03 [2.13, 5.93]	Temperature	0,26	0,35	0,14	no significance
<u>Graph 1:</u> Meta-analysis of the effect of no			% Clay	0,9	0,11	0,74	no significance
tillage practices in carbon stocks in spanish			Years	0,08	0,37	0,09	no significance



Mean Difference

Table 1: p-values of simple regression and anova test between climatic variables and carbon stocks in spanish agriculture soils. Source: own elaboration



No-tillage or minimal tillage agricultural practices have been linked to soil Focus on climate role and include more types of it to have greater carbon content with significant results. scientific rigor.

Also, we can see the need to include more factors in the model, since the Hypothetical scenario, in which no-till is applied to all spanish crop results show heterogeneity. It is a process where more factors are fields (50 million hectares). 201.5 million Tonnes of Carbon would be captured from the atmosphere. In 2020, in Spain 274.7429 involved than just the type of tillage. million Tonnes of CO2 were emitted. Therefore, the potential of

As we saw in other factors; no significant results have been extracted. Probably because agricultural management practices interfere a lot, for example the addition of organic matter periodically or not (López et al.,

2012).

DISCUSSION

Graph 3: Bar diagram showing the carbon stock of the soil in each type of tillage according to the climate. Source: own elaboration

Csa

No tillag Reduce No tillage Ventional Ventional Reduced Reduced

CLIMATE

35



GRAPHICS



Spanish agricultural land is vital for reducing emissions.