

# Quality Assessment of Meta-analyses on Soil Organic Carbon Research

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**EJP SOIL**  
European Joint Programme

## Why is this topic important for us?

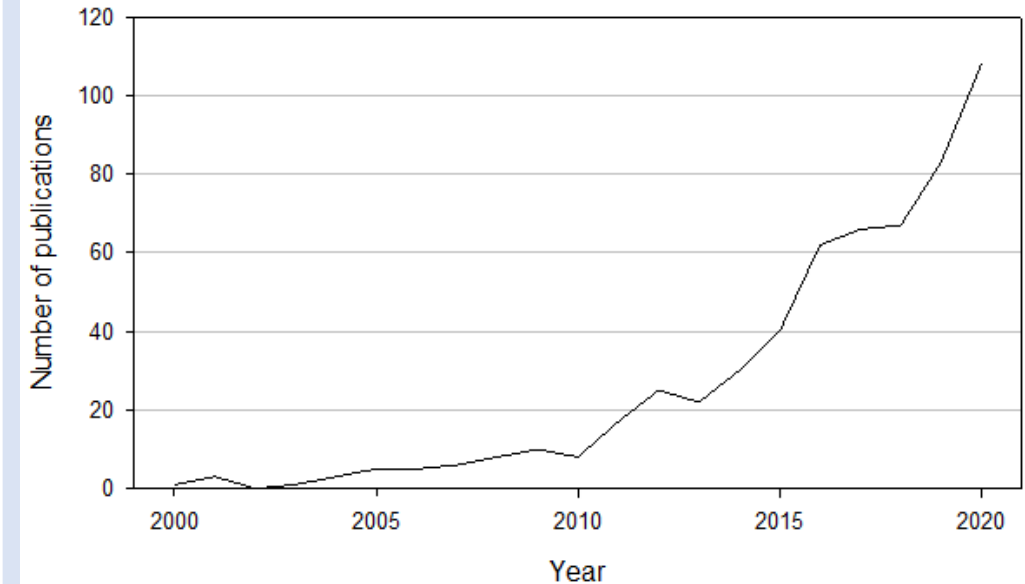
- Meta-analyses are getting more and more **popular**
- Many of them have **low quality!**

➡ Can I **trust** the results?

➡ How can I develop a **high-quality** meta-analysis?

## What is the problem?

- Researchers are missing **expertise**
- **No guidelines available** for agriculture or soil research



Number of meta-analyses in agriculture published between 2000 and 2020 (own figure).

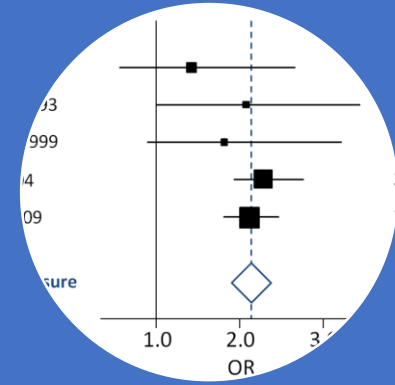
Philibert et al. (2012)  
Krupnik et al. (2019)



Develop a  
quality-criteria  
set



Search all  
available meta-  
analyses on SOC



Assess quality of  
31 SOC meta-  
analyses



# Quality createria set

## Literature search



- Inclusion/exclusion criteria
- Treatment and control
- Moderators

## Meta-analysis



- Effect size
- Standard deviation extracted
- Weighting

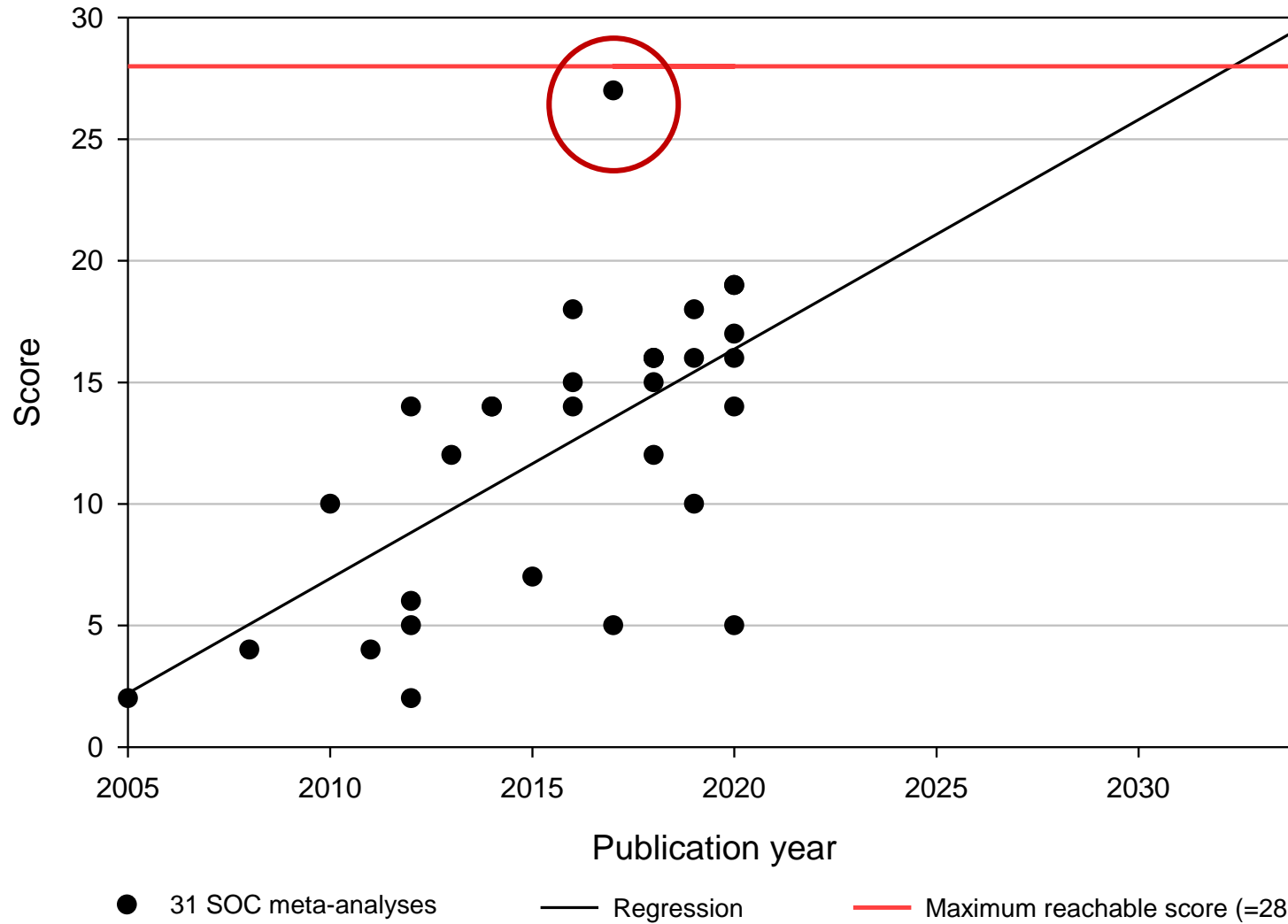
## Presentation



- Results
- Database

+ Scores .... max. 28

# A maximum score may be reached only by 2032



Haddaway et al.  
(2017)

Scores of SOC meta-analyses over time (between 2005-2020) and corresponding regression line including projection until 2035

# Importance for EU SOC research

- **New MA** on most management practises need to be done
  - On **EU scale** but also national level
- We need **EU databases**
  - Databases of all MA should be available for everybody
- We need meta-analysis **experts** for EU



# Take home message

- Number of meta-analyses **rising**
- Most of them do **not** reach **sufficient quality**
- Conducting a meta-analysis – follow strict **criteria!**
- **Critical** review existing meta-analysis
- **Engage** in trainings, use guidelines/criteria-sets
- **EU** needs a **collective database** for meta-analyses and **experts**



# References

- Krupnik, T.J., Andersson, J.A., Rusinamhodzi, L., Corbeels, M., Shennan, C., Gérard, B., 2019. Does size matter? a critical review of meta-analysis in agronomy. *Experimental Agriculture* 55, 200–229. <https://doi.org/10.1017/S0014479719000012>
- Philibert, A., Loyce, C., Makowski, D., 2012. Assessment of the quality of meta-analysis in agronomy. *Agriculture, Ecosystems and Environment* 148, 72–82. <https://doi.org/10.1016/j.agee.2011.12.003>

# Resources

## Publications:

- Koricheva, J., Gurevitch, J., 2014. Uses and misuses of meta-analysis in plant ecology. *J. Ecol.* 102, 828–844. <https://doi.org/10.1111/1365-2745.12224>
- Gurevitch, J., Koricheva, J., Nakagawa, S., Stewart, G., 2018. Meta-analysis and the science of research synthesis. *Nature* 555, 175–182. <https://doi.org/10.1038/nature25753>

## Book:

- Koricheva, J., Gurevitch, J., Mengersen, K. (Eds.), *Handbook of Meta-Analysis in Ecology and Evolution*. Princeton University Press, Princeton

## Good meta-analysis:

- Haddaway, N.R., Hedlund, K., Jackson, L.E., Kätterer, T., Lugato, E., Thomsen, I.K., Jørgensen, H.B., Isberg, P.E., 2017. How does tillage intensity affect soil organic carbon? A systematic review, *Environmental Evidence*. BioMed Central. <https://doi.org/10.1186/s13750-017-0108-9>

## Free online trainings:

- <https://www.coursera.org/learn/systematic-review>
- About systematic reviews, which incorporate meta-analysis: <https://systematicreviewmethods.github.io/>



# Quality assessment of meta-analyses on soil organic carbon research

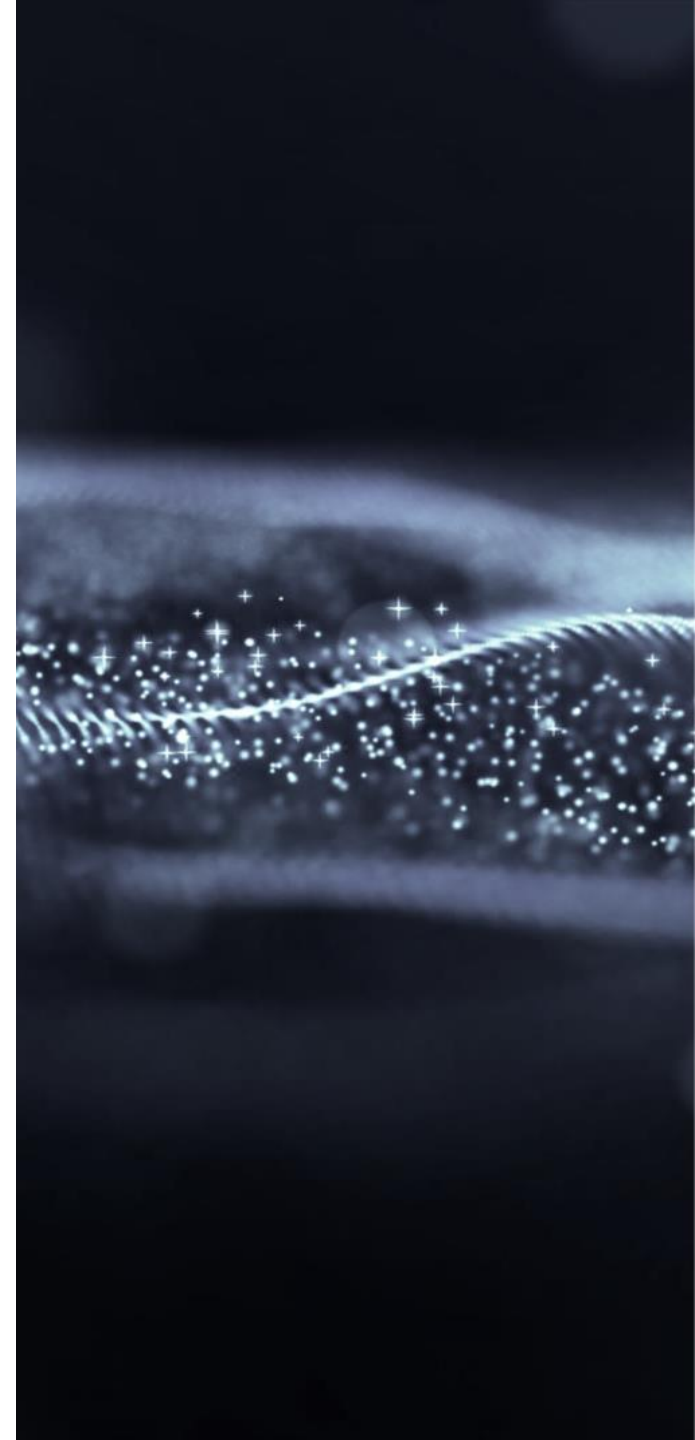
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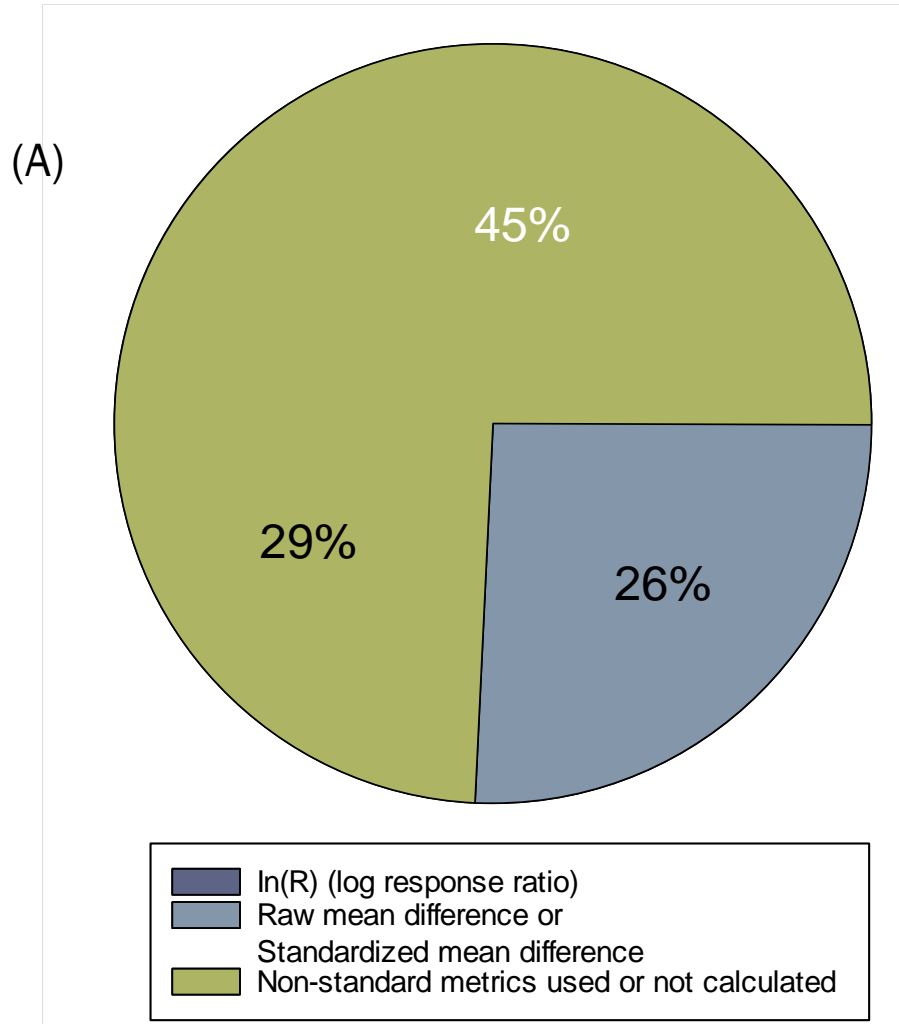
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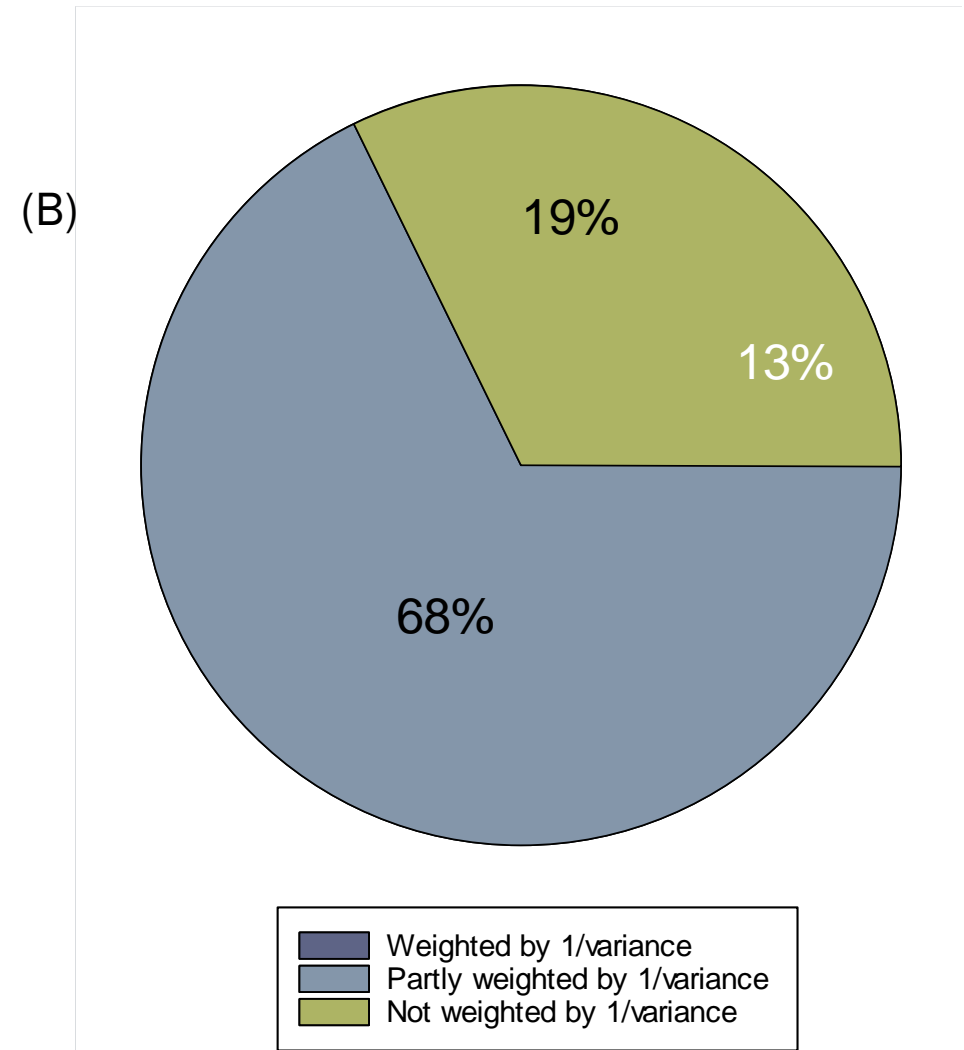
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# Key criteria: Effect size and weighting



(A) Ratio of effect size metrics used by the meta-analyses



(B) Ratio of meta-analyses which weighted by the inverse of variance

# Only 4 out of 31 SOC meta-analyses classified as “true” meta-analyses

“True”

Not “true”



- Tillage
- Cover crops
- Residue
- Amendments

- Fertilization
- Organic
- Biochar
- Diversification
- Combined
- High input
- Set-aside

Nr.	First author and year	Management categories studied
1	Aguilera (2013)	tillage, amendments, organic, cover crop, combined and fertilization
2	Angers (2008)	tillage
3	Bai (2019)	conservation agriculture: tillage, cover crop and biochar
4	Chen (2018)	amendments and fertilizer
5	Cooper (2016)	tillage, organic system
6	Feng (2020)	tillage
7	García-Palacios (2018)	organic system
8	Gattinger (2012)	organic system
9	González-Sánchez (2012)	tillage and cover crop
10	Haddaway (2017)	tillage
11	Han (2016)	residue and fertilizer
12	Jian (2020)	cover crop
13	King (2018)	diversification
14	Kopittke (2017)	tillage, organic system and amendments
15	Ladha (2011)	fertilization
16	Li (2020)	tillage and residue
17	Liu (2016)	biochar
18	Luo (2010)	tillage
19	Maillard (2014)	amendments
20	Majumder (2019)	biochar
21	Mathew (2020)	diversification
22	McDaniel (2014)	diversification
23	Meurer (2018)	tillage
24	Mondal (2020)	tillage
25	Ogle (2005)	tillage, high input systems and set-aside
26	Poeplau (2015)	cover crop
27	Sun (2020)	conservation agriculture: tillage, cover crop and residue
28	Tuomisto (2012)	organic system
29	Virto (2012)	tillage
30	Xia (2018)	residue and fertilization
31	Xu (2019)	residue

# How to solve the problem

## Education

- At University
- Trainings

## Reviewers / editors

- Be critical
- Minimum standards

## Meta-analysis expert group

- Critical evaluation of published meta-analysis
- Reliable database creation
- Carry out high-quality meta-analyses

