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

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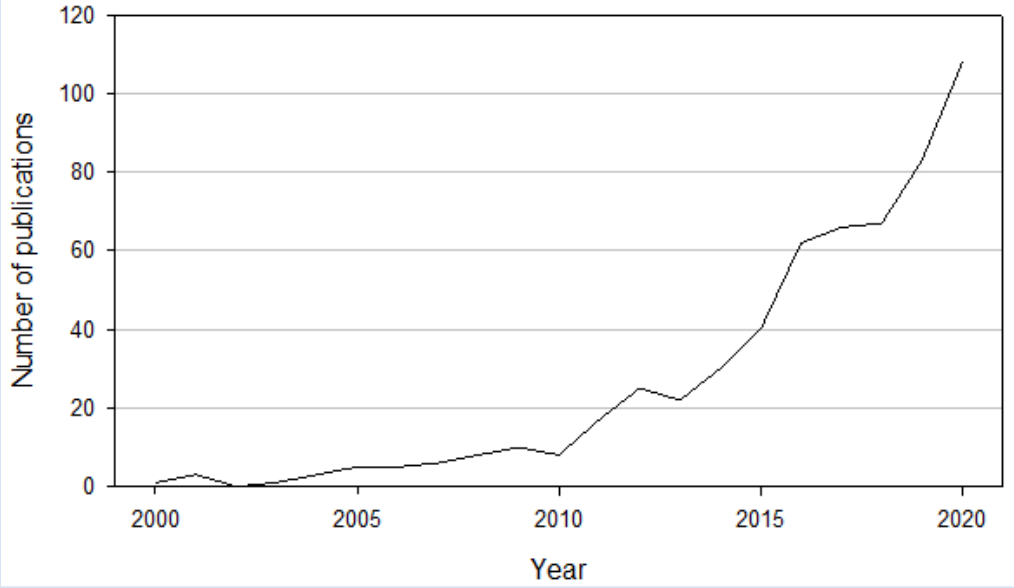
# Why is this topic important for us?

- 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?




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

# What is the problem?

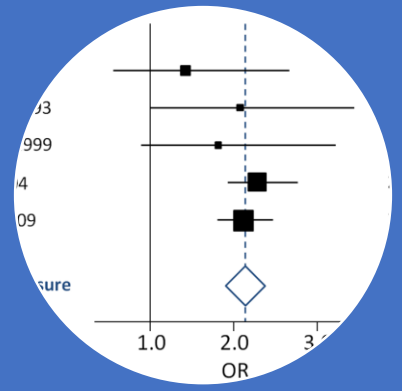
- Researchers are missing **expertise**
- **No guidelines available** for agriculture or soil research

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

# Aim

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

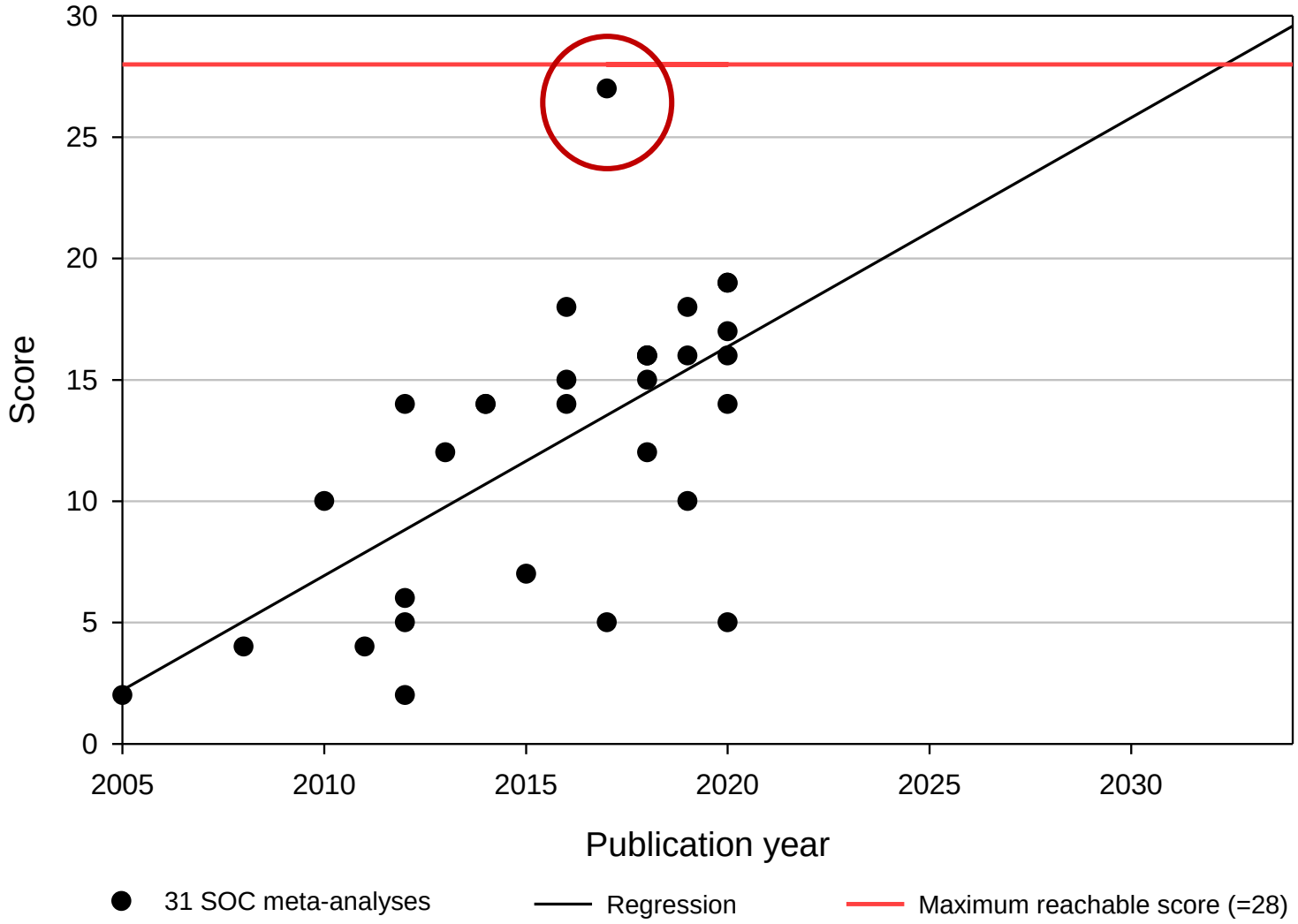
- Effect size
- Standard deviation extracted
- Weighting

## 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. Princton 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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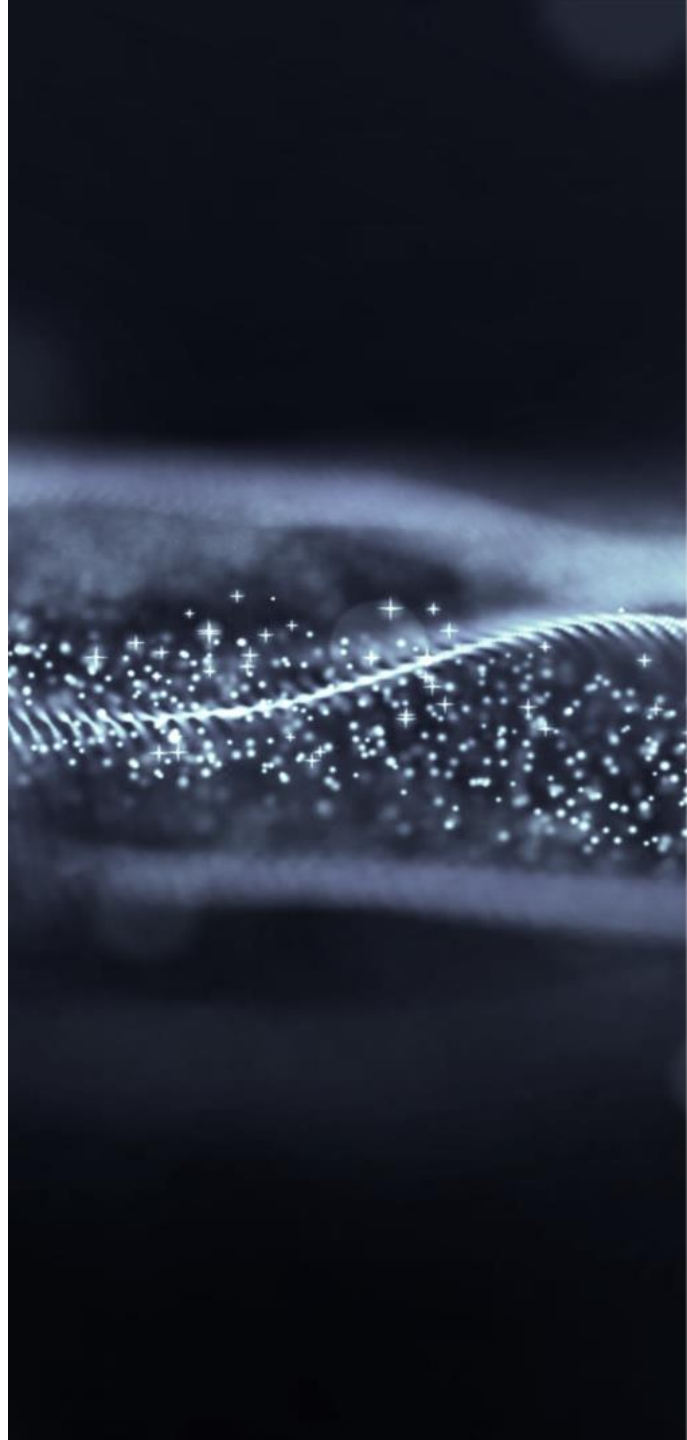
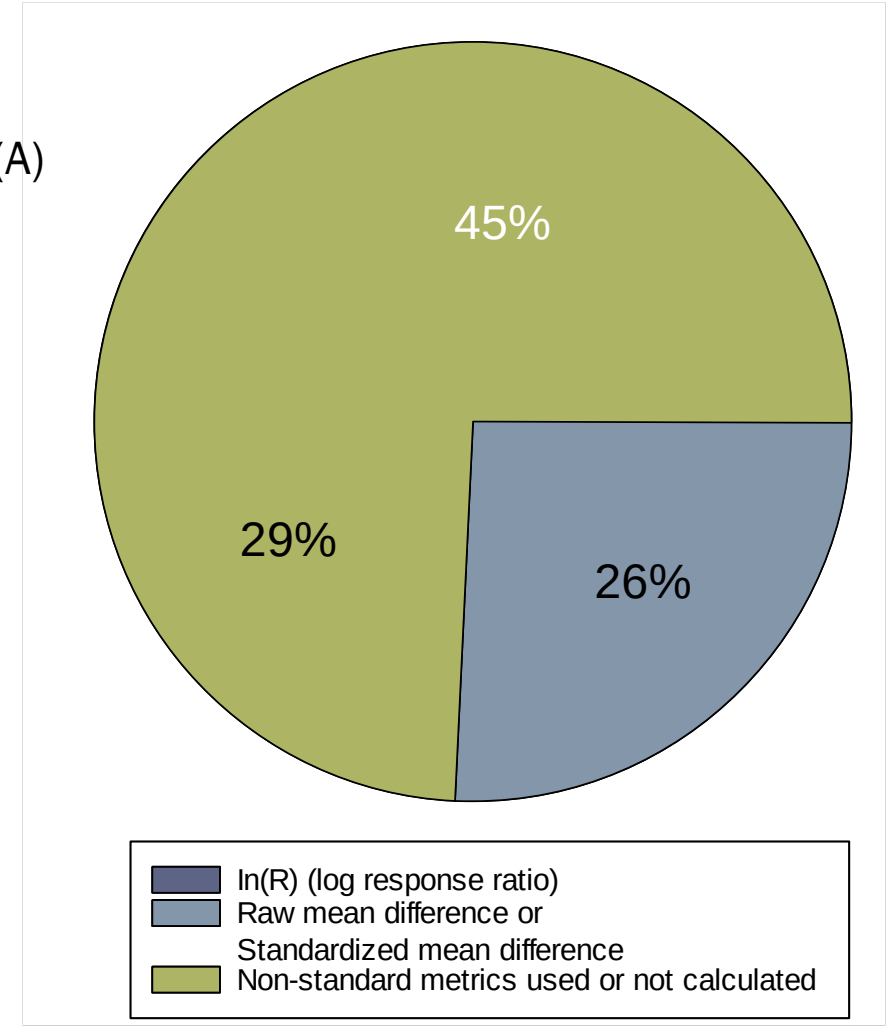
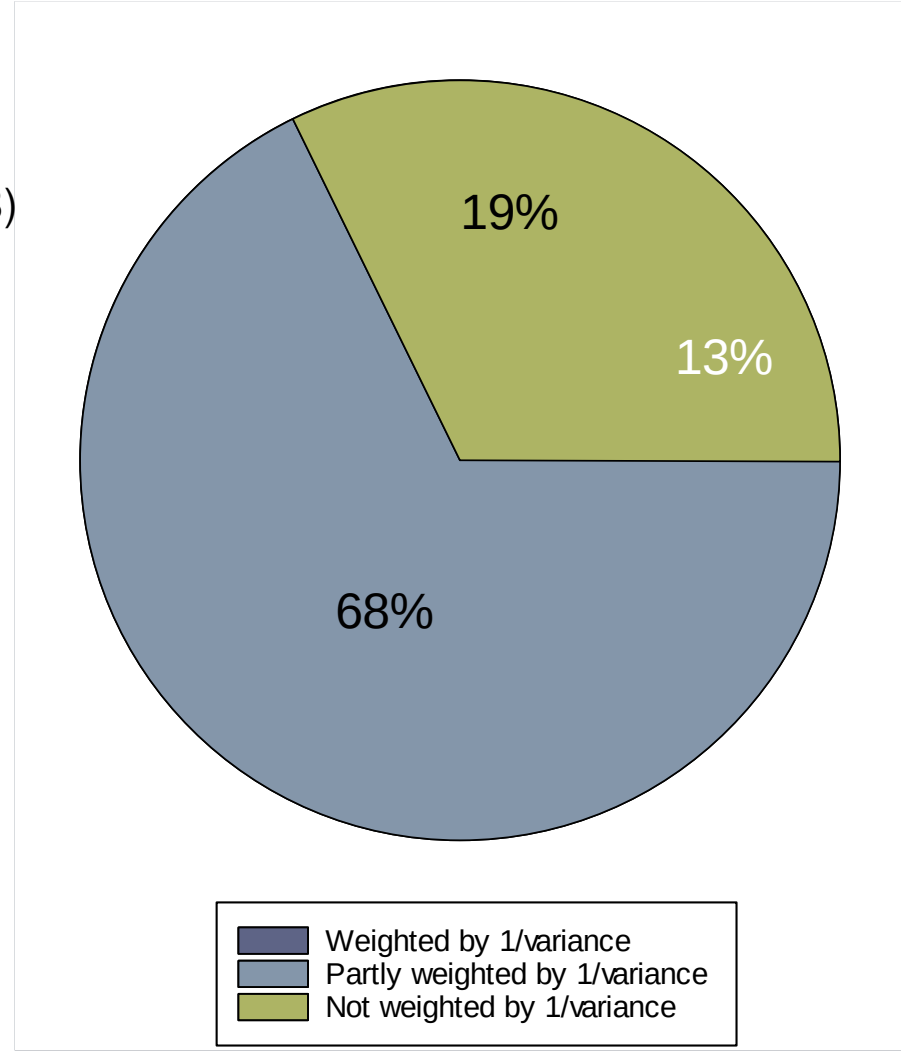


# Key criteria: Effect size and weighting




(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”

- Tillage
- Cover crops
- Residue
- Amendments

## Not ”true”

- 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 | Reviewers / editors | Meta-analysis expert group |
| --- | --- | --- |
| • At University<br>• Trainings | • Be critical<br>• Minimum standards | • Critical evaluation of published meta-analysis<br>• Reliable database creation<br>• Carry out high-quality meta-analyses |