



# C sequestration and food security in African agroecosystems

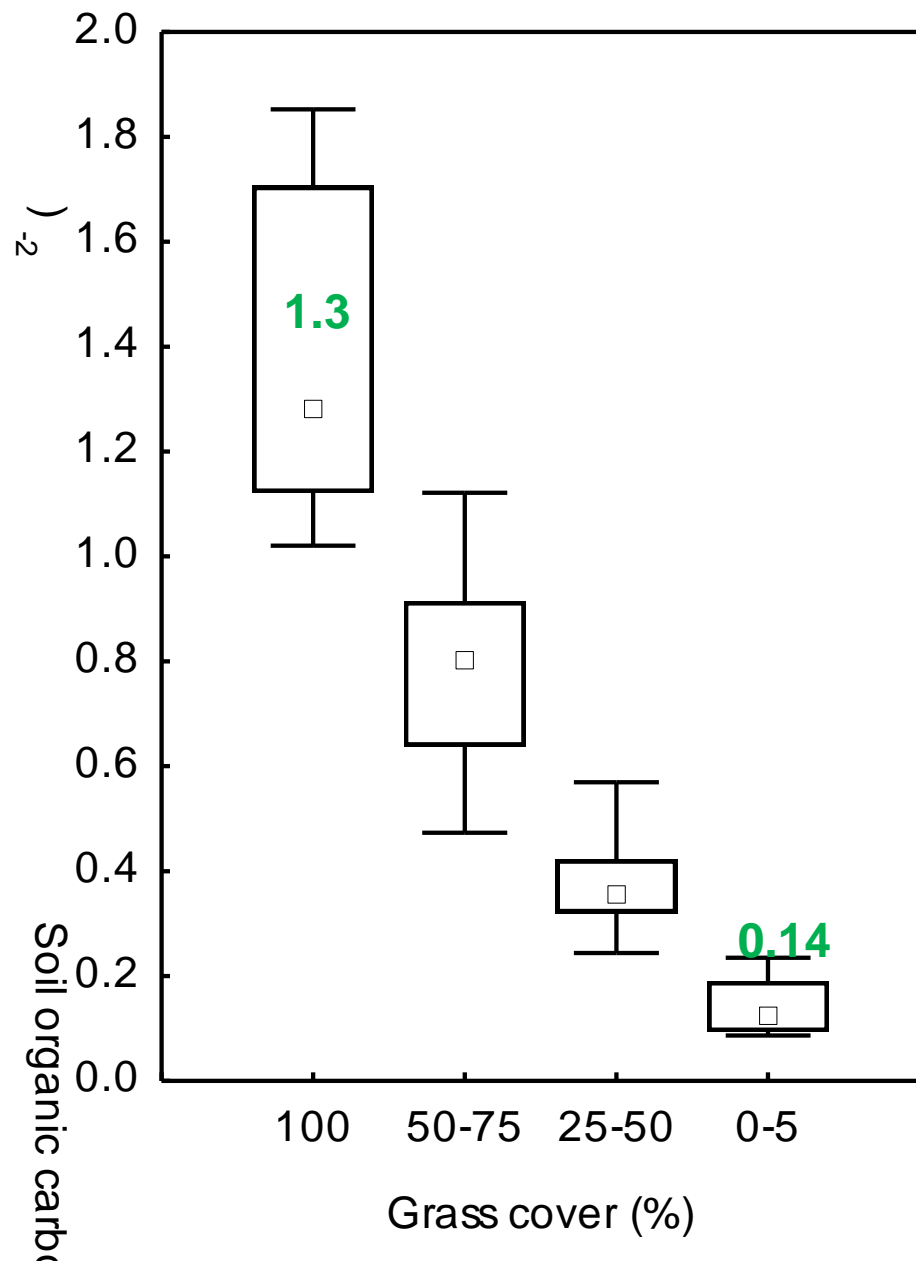
Pauline Chivenge and Shamie Zingore

# Status of Soil C in Africa

- Africa faces enormous food security challenges
- Largely attributed to low soil fertility
- Smallholder agriculture dependent on soil organic matter for crop production
- Yet, SOC in African cropping systems is generally low
  - Inherent
  - Management
- Land degradation



# Overgrazing degrades grasslands



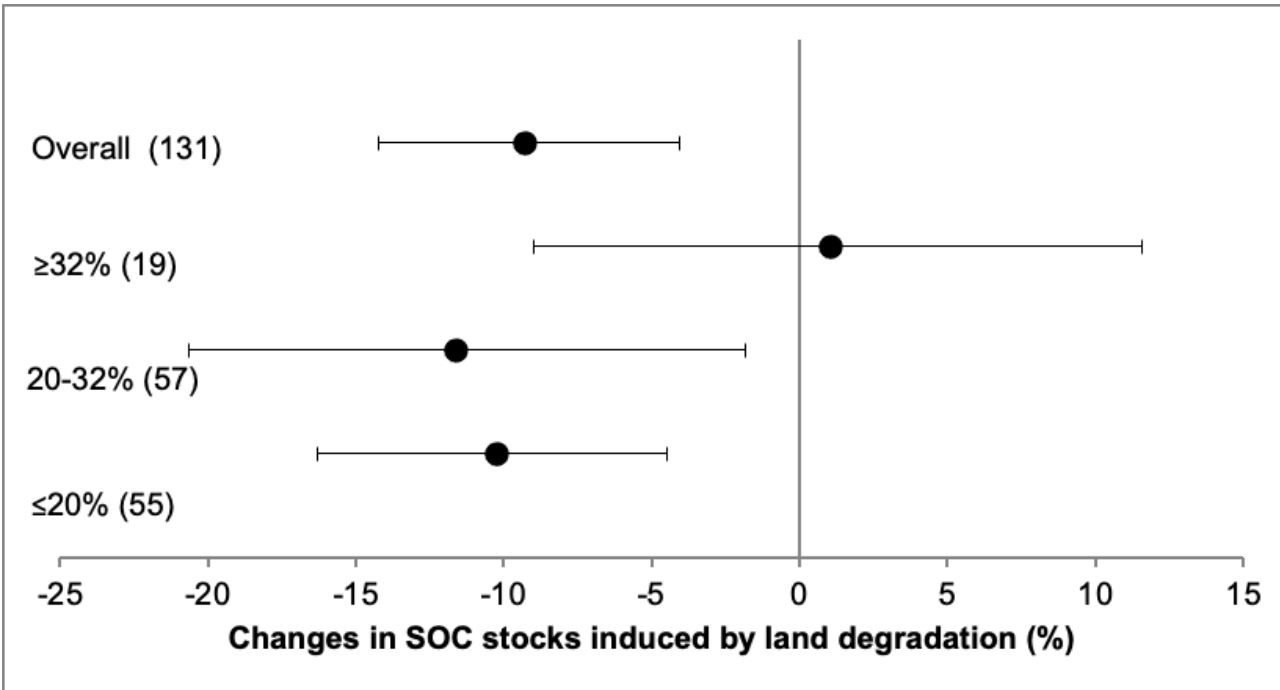
Lower biomass for livestock to graze

89%

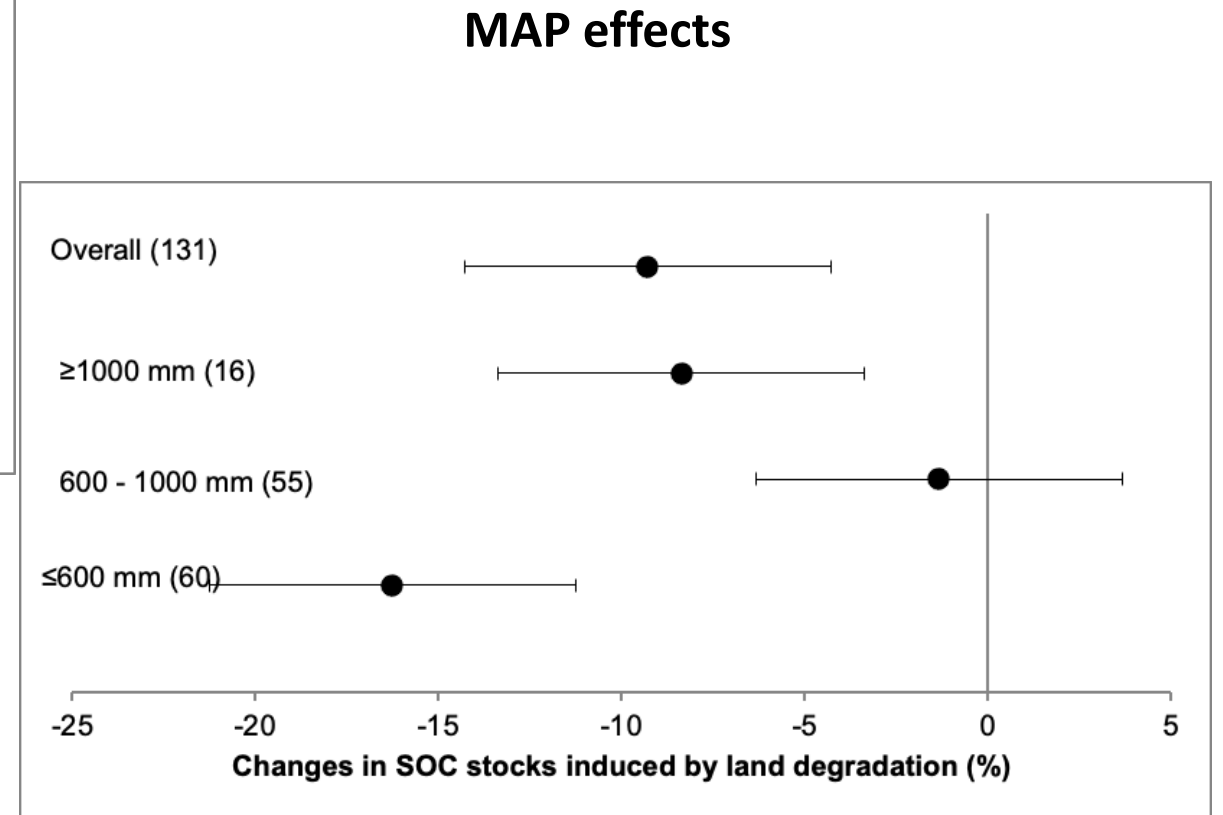


Dlamini et al., 2014  
*Geoderma* 235; 372-381

# Overgrazing degrades grasslands



Clay content effects

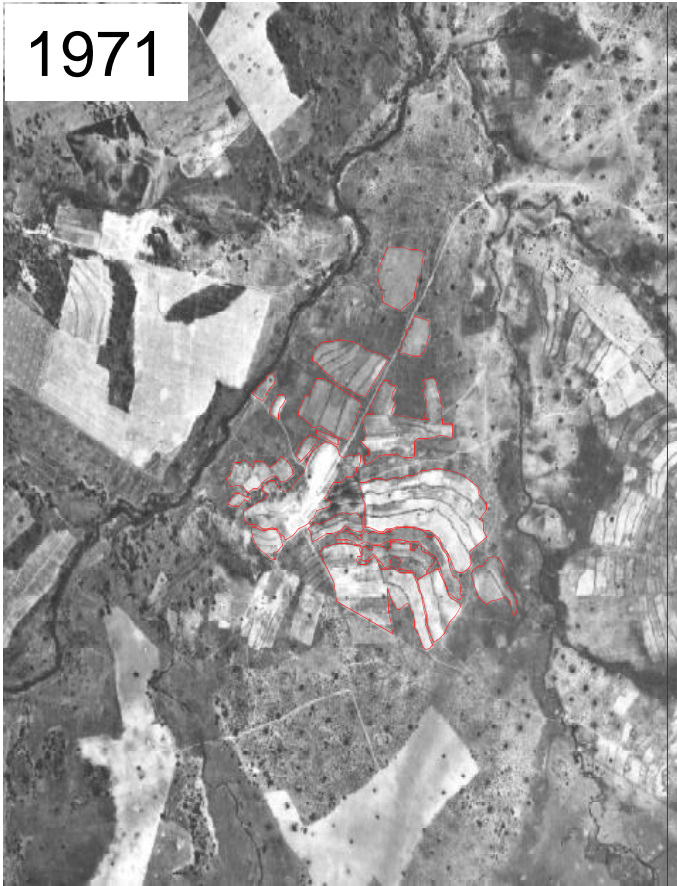




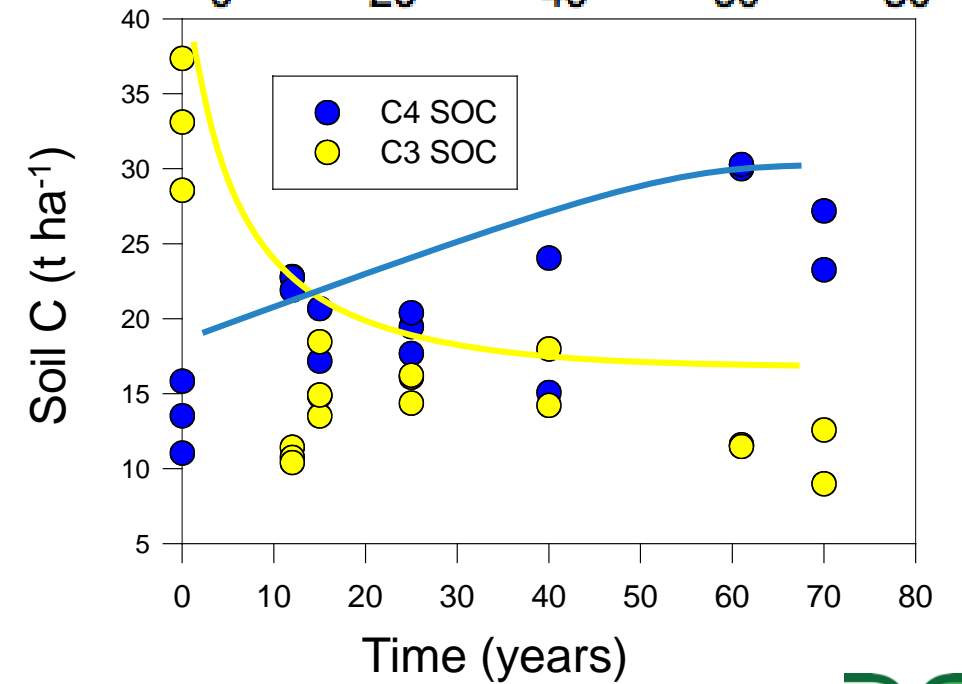
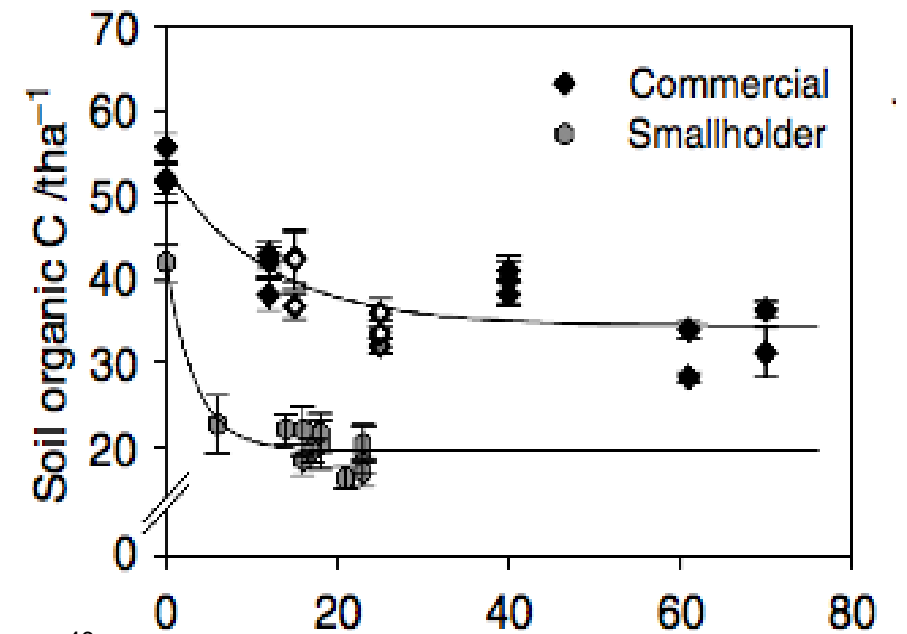
# Commercial vs smallholder

Chikwaka

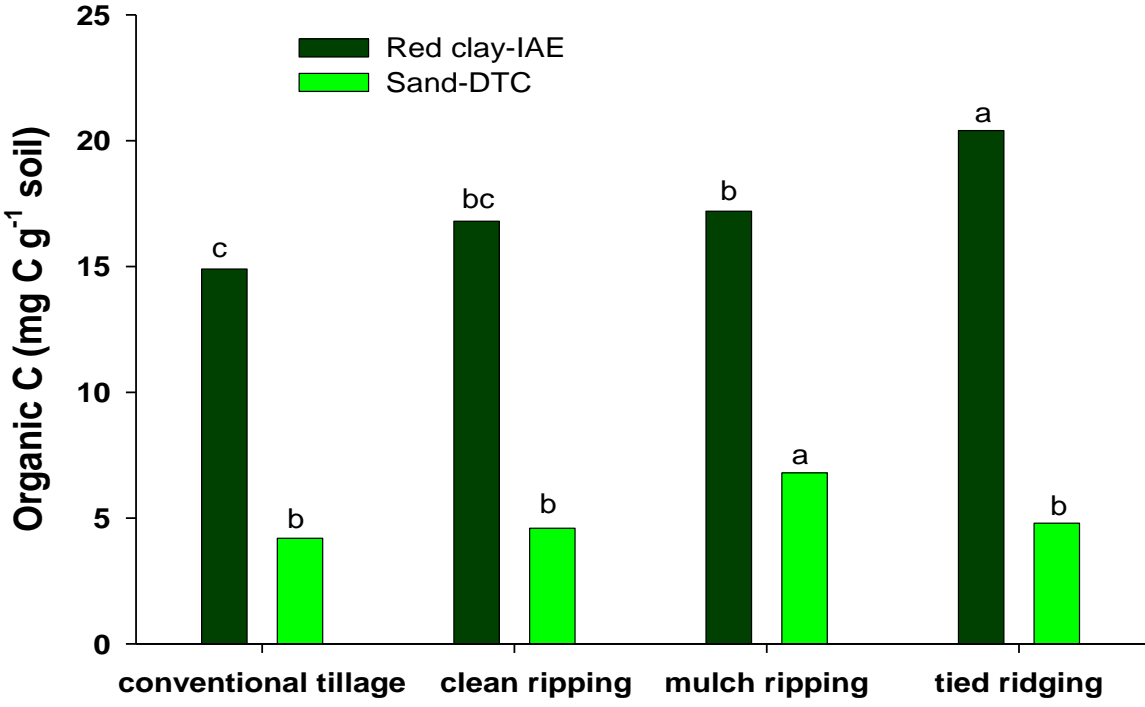
1971



1996



# Tillage and mulch effects on SOC

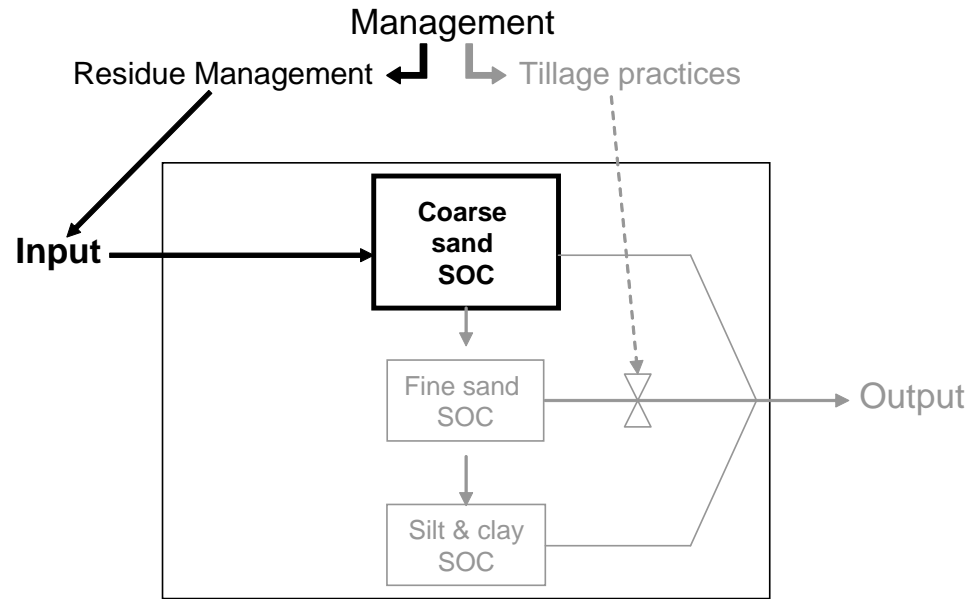


Tied ridging had 80% lower soil erosion than conventional tillage

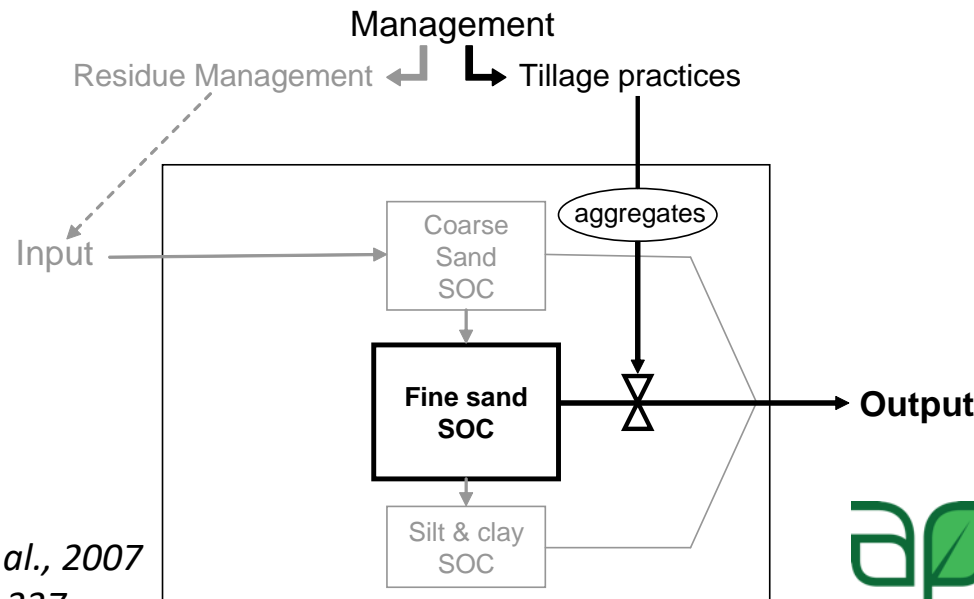
NS differences in maize yield



## Sandy Soil



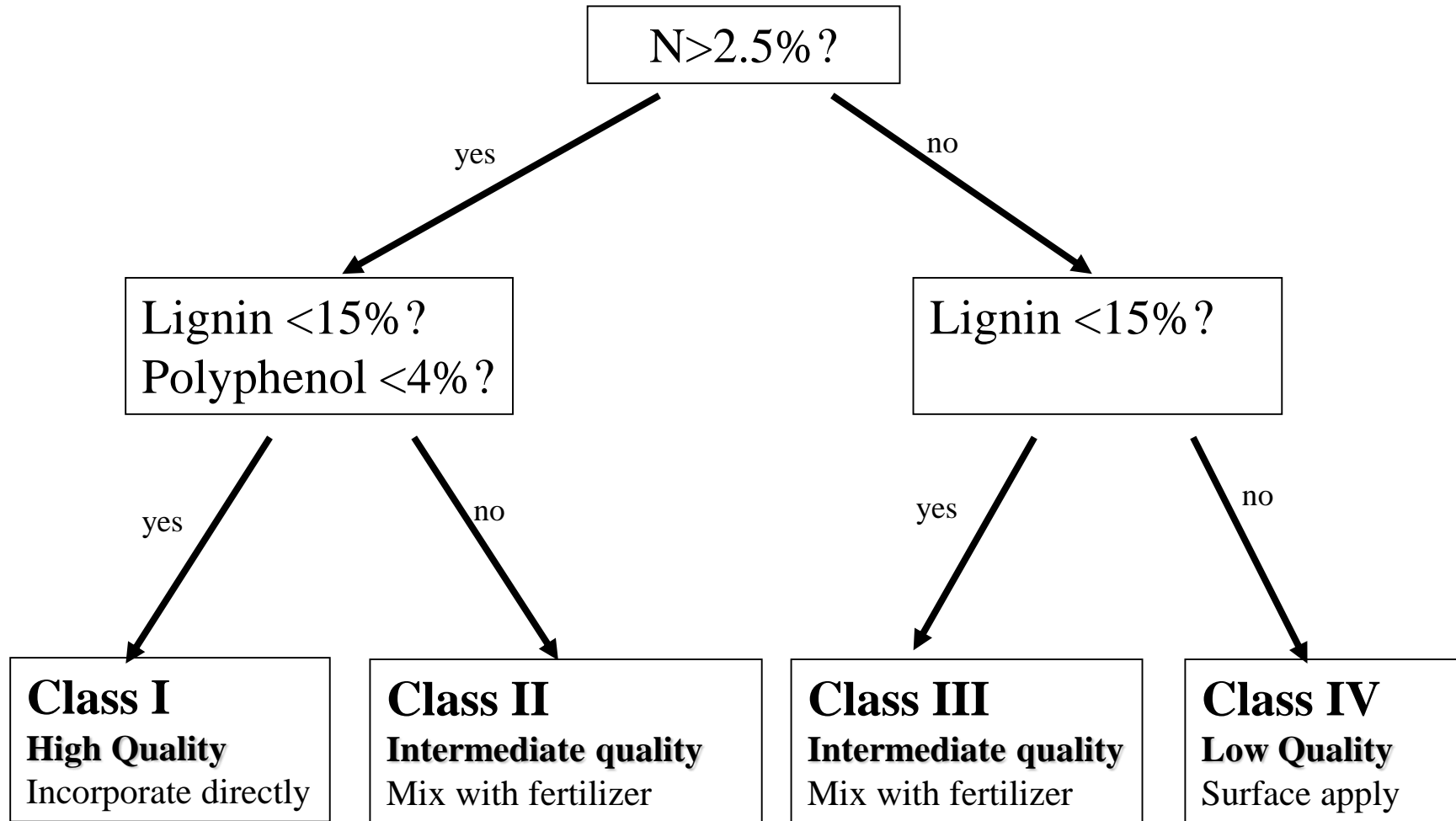
## Clay Soil



Chivenge et al., 2007  
STR 94: 328-337

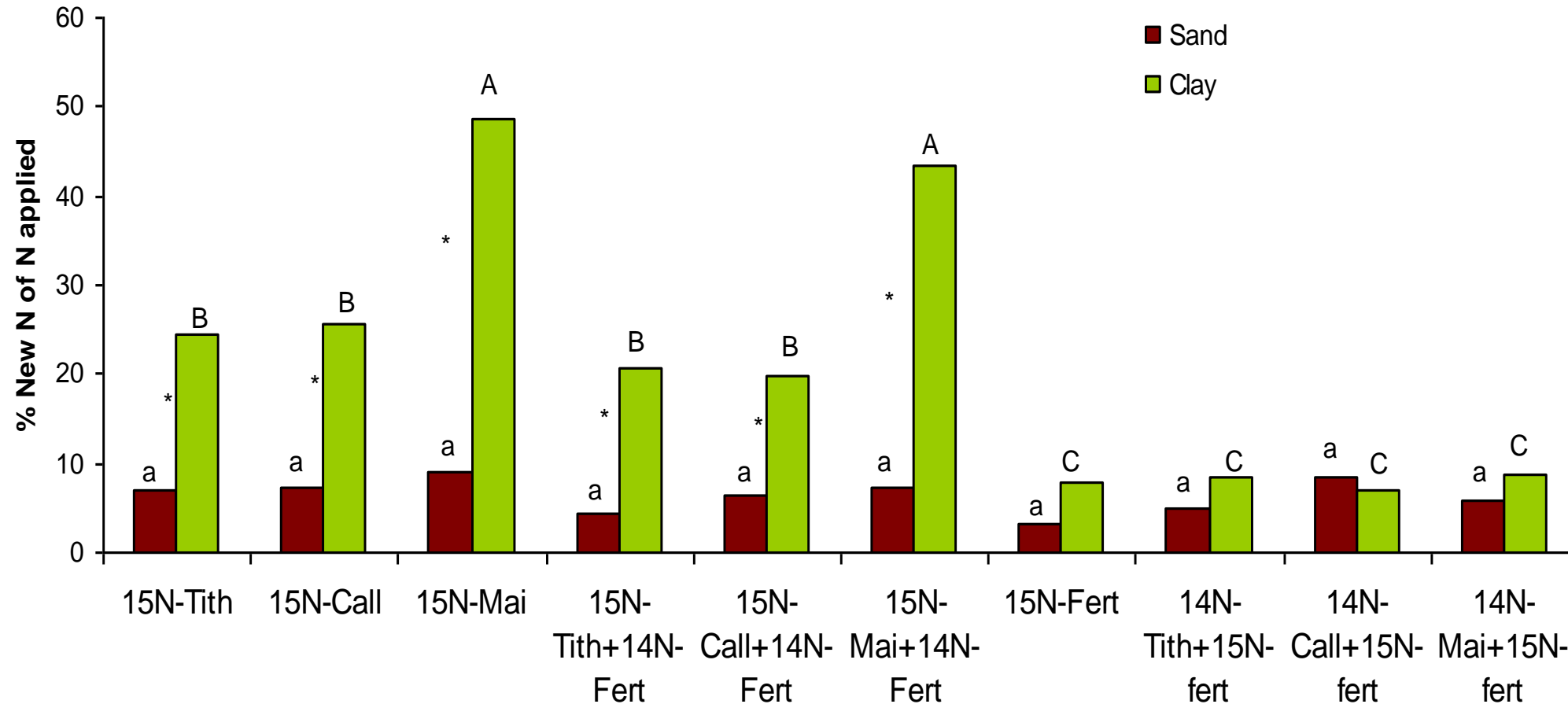


# Organic matter addition is important, especially for sandy soils. Does quality matter?



# Quality affects short-term C dynamics

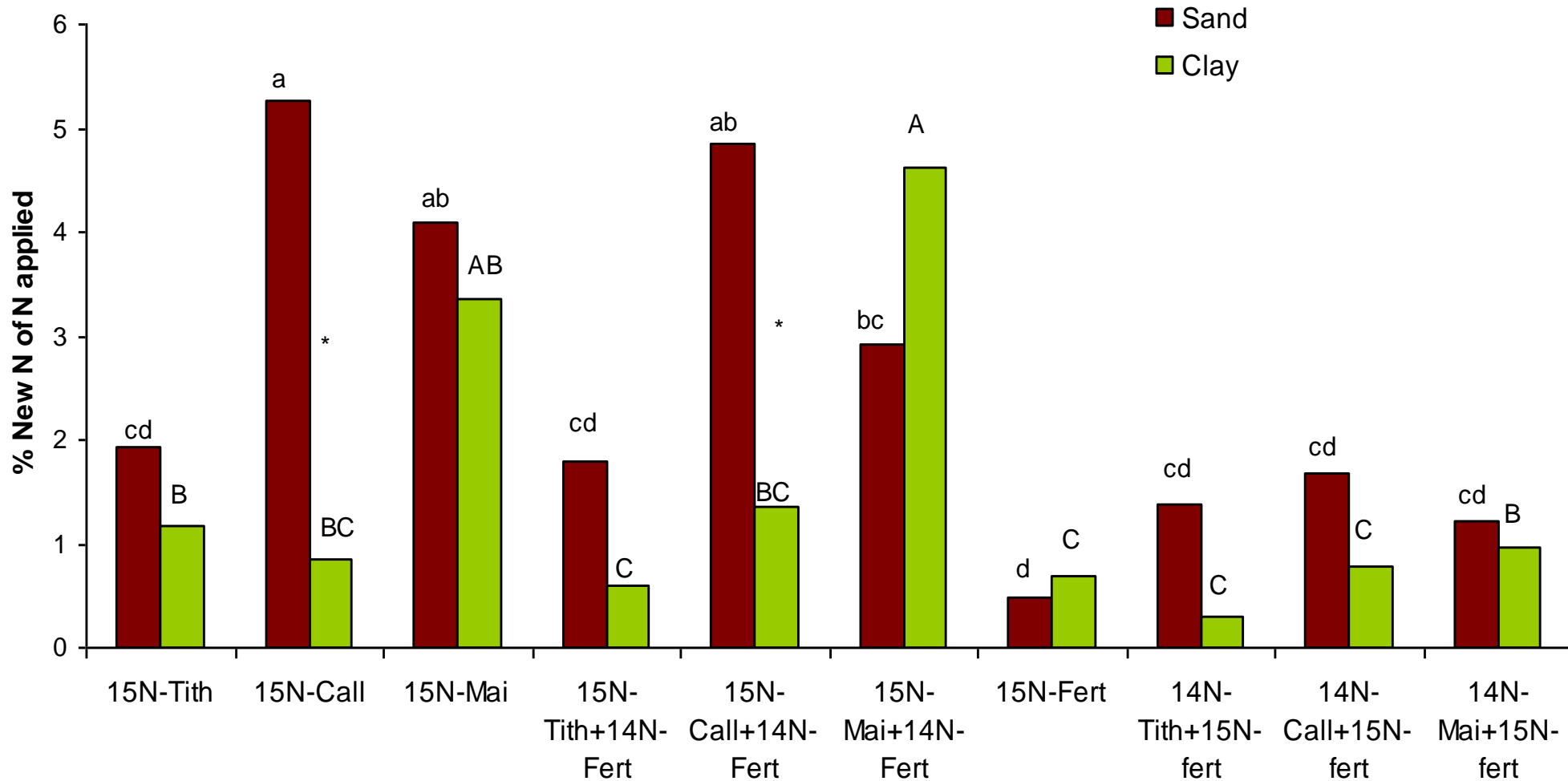
Macroaggregate % new N





# Quality affects short-term C dynamics

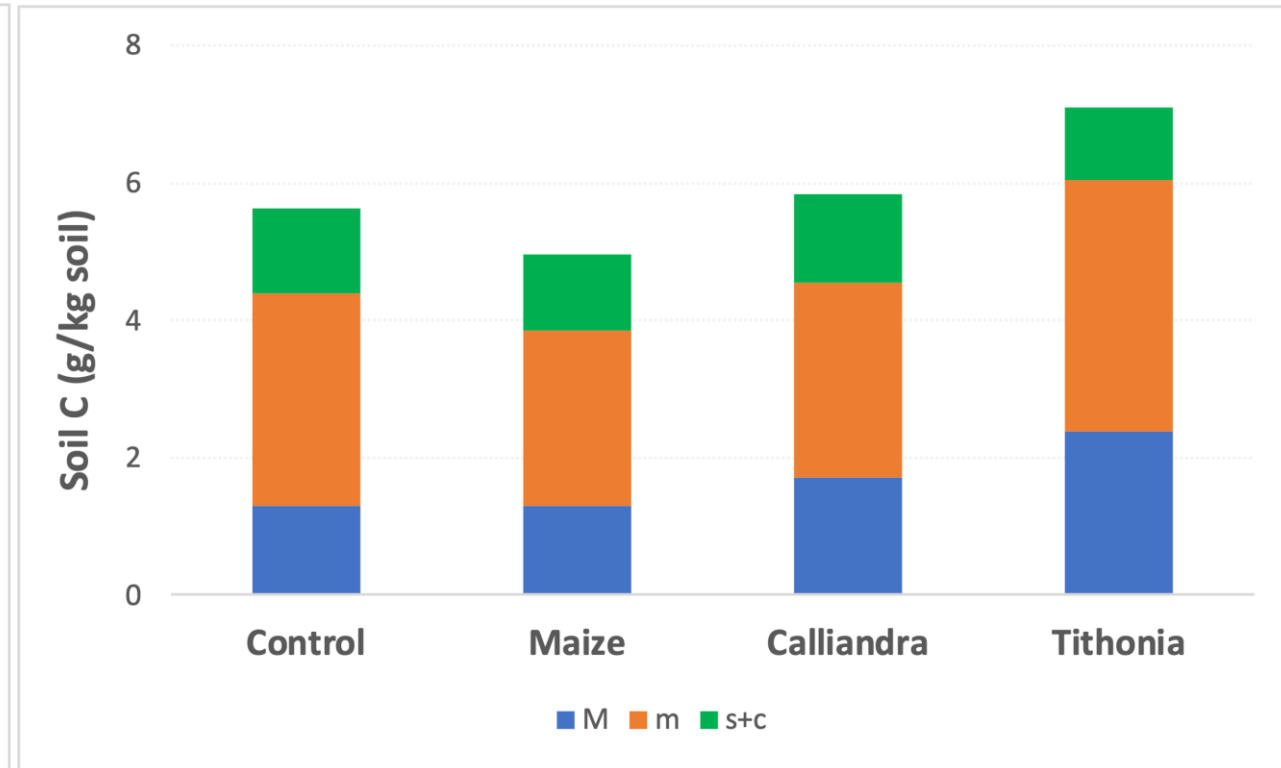
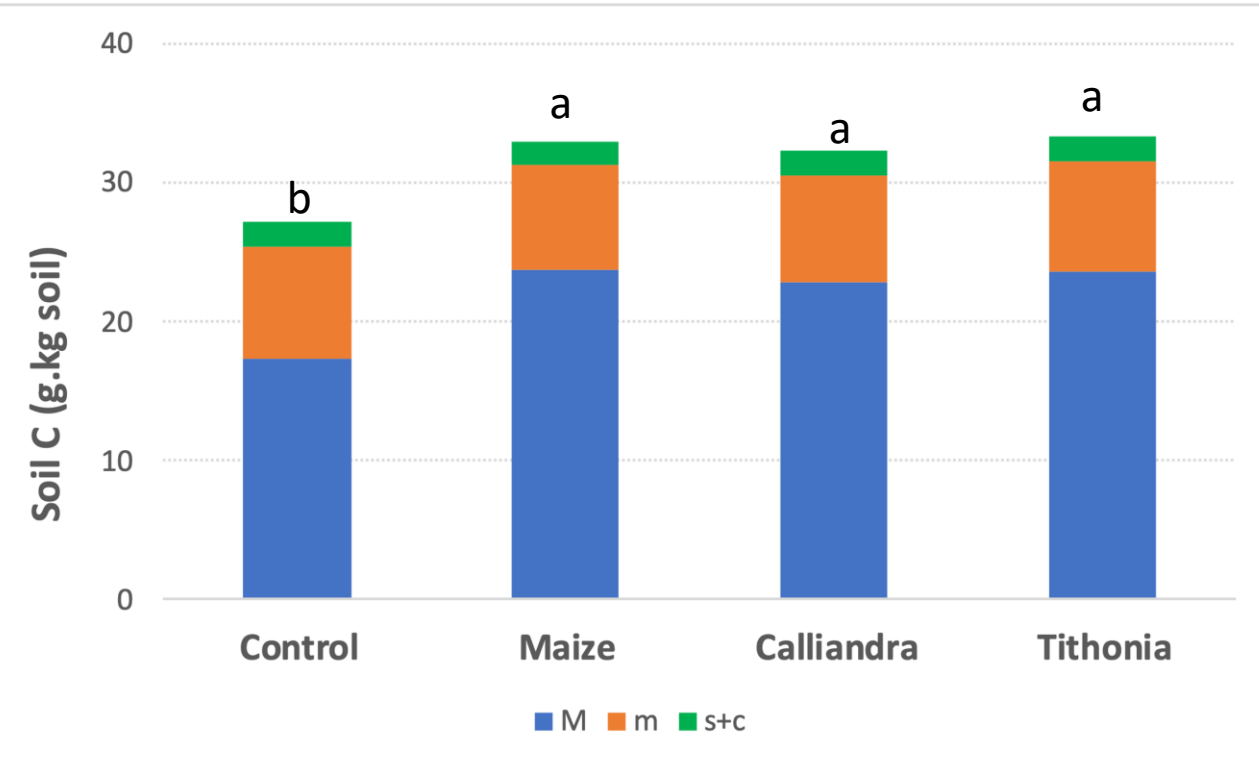
Coarse POM % new N



# But in the long-term quality does not matter

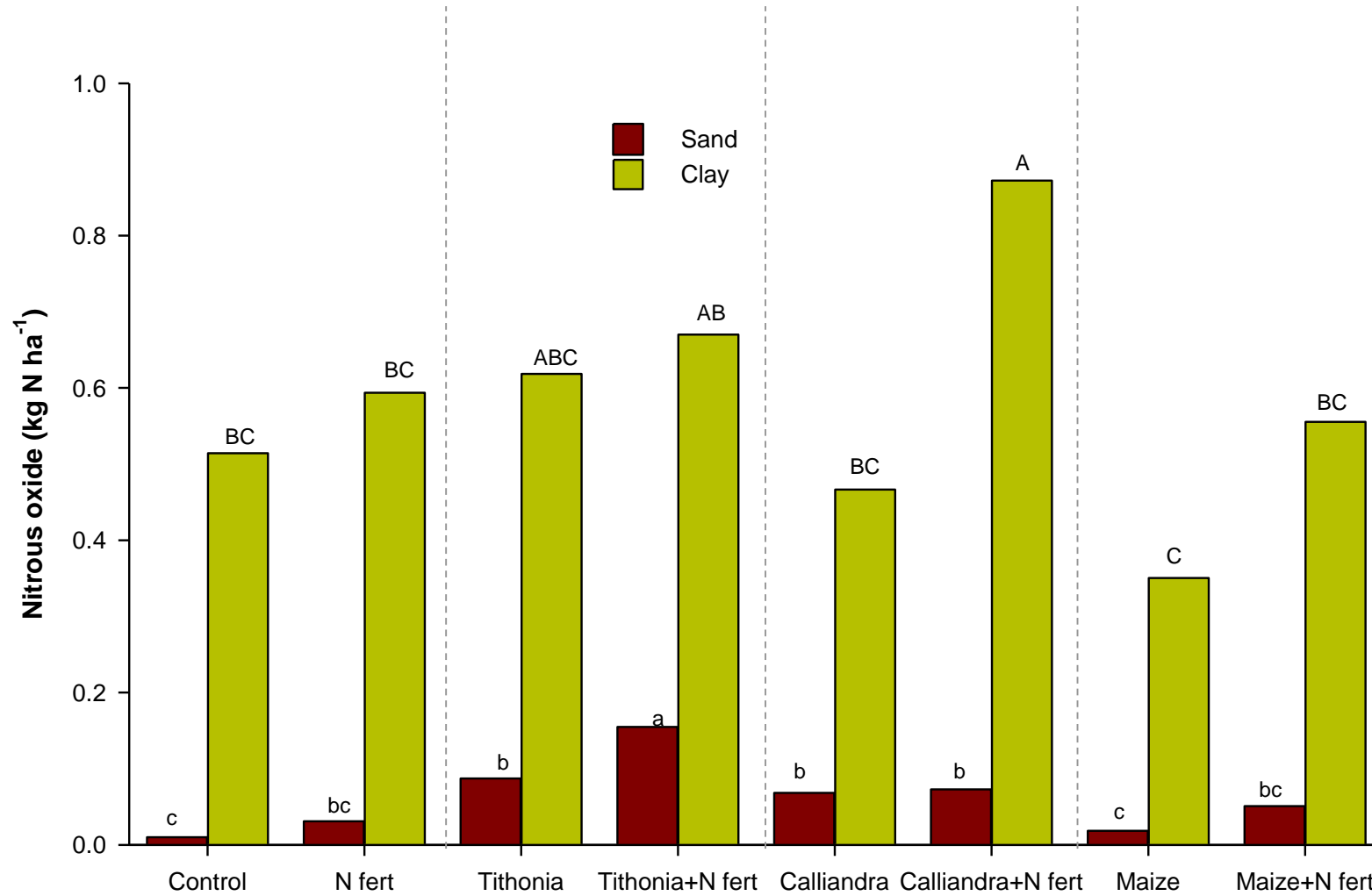
Embu – Clay soil

Machanga – Sandy soil



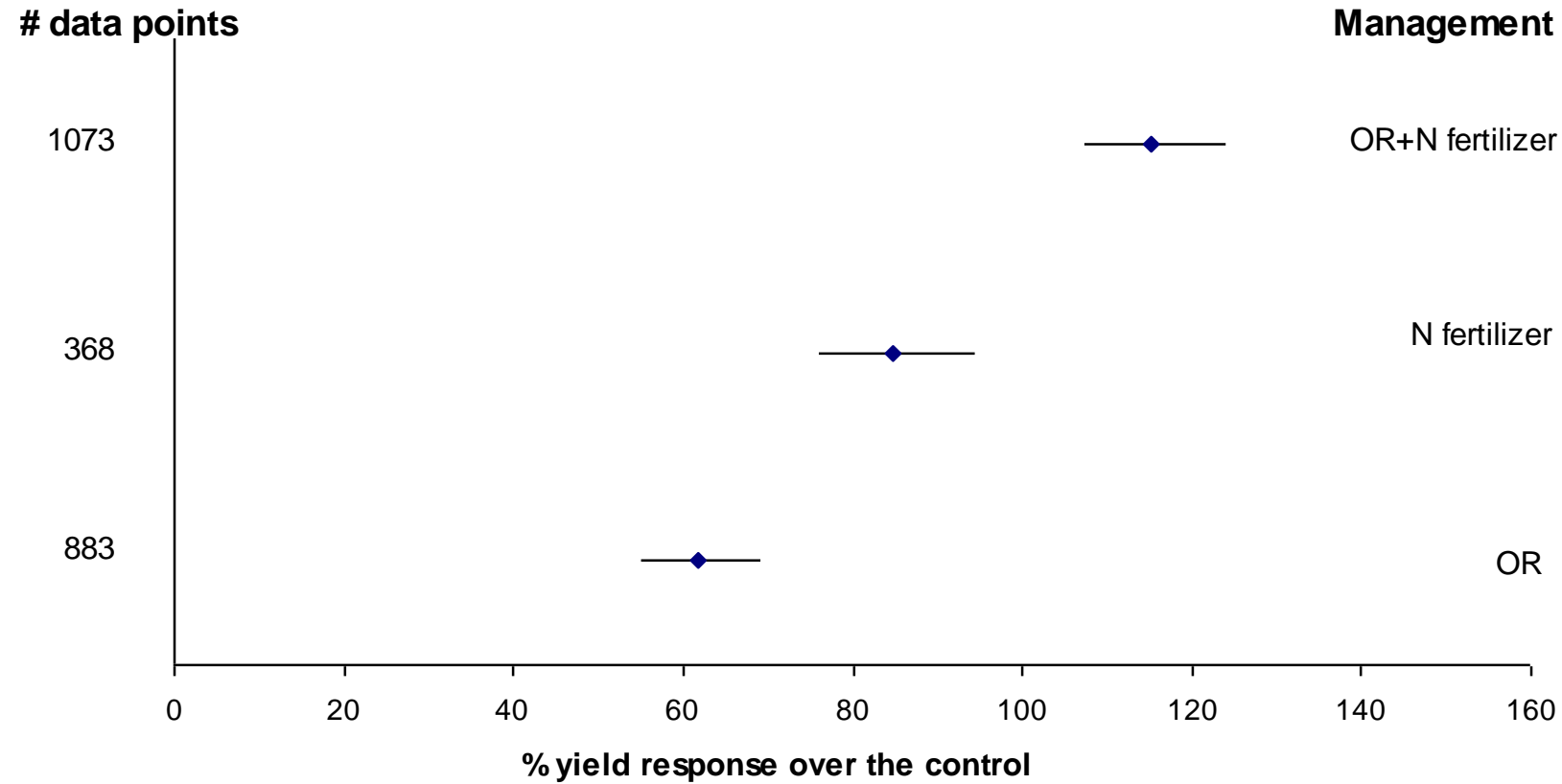
Gentile et. al, 2010  
Nut Cycling, 88: 121-131

# N<sub>2</sub>O emissions



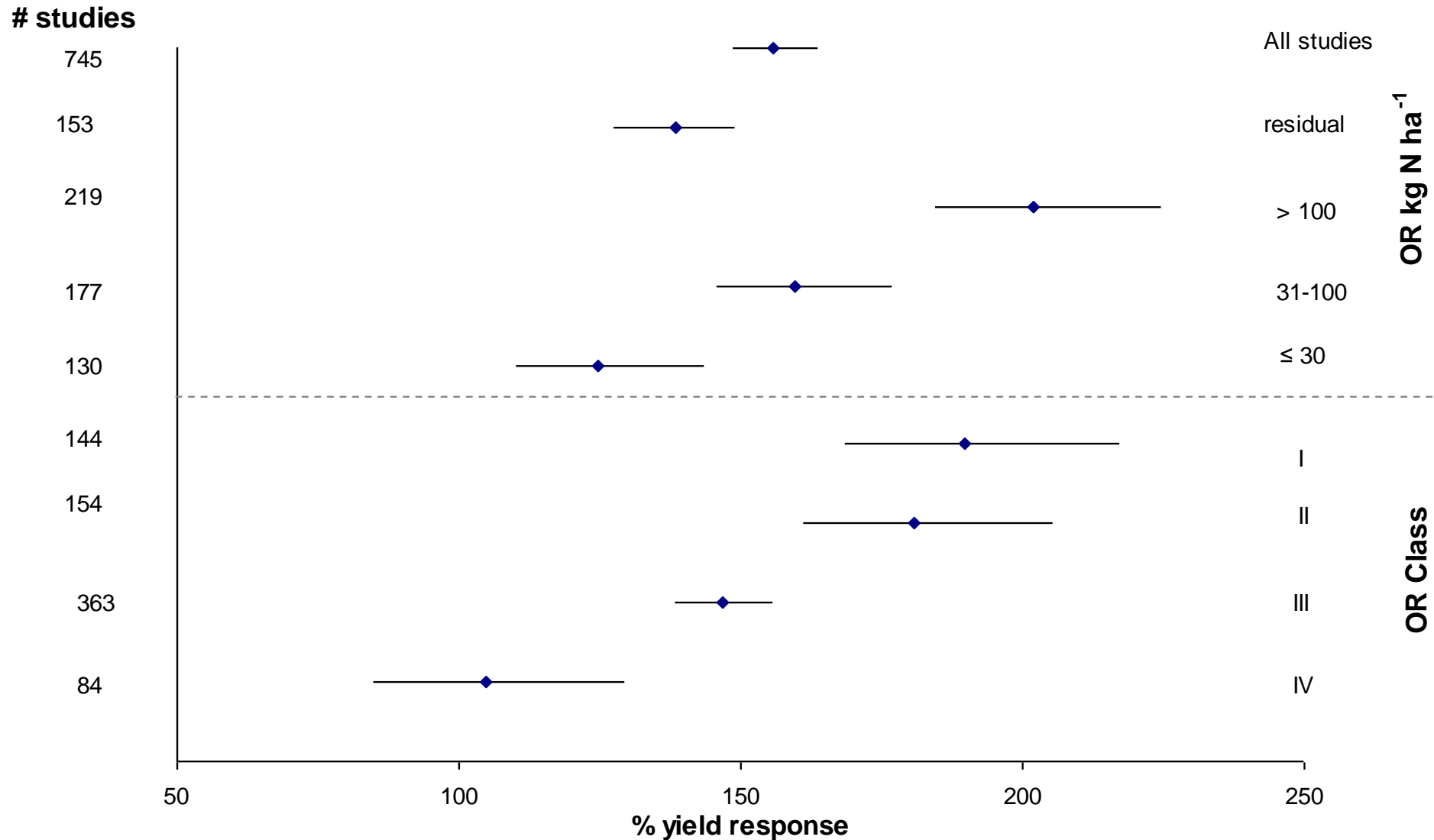
# Combined organic matter and fertilizer influence yield

## Overall responses vs control



Chivenge et al., 2011  
*Plant & Soil*, 342: 1-30

# OR quality influences maize yield

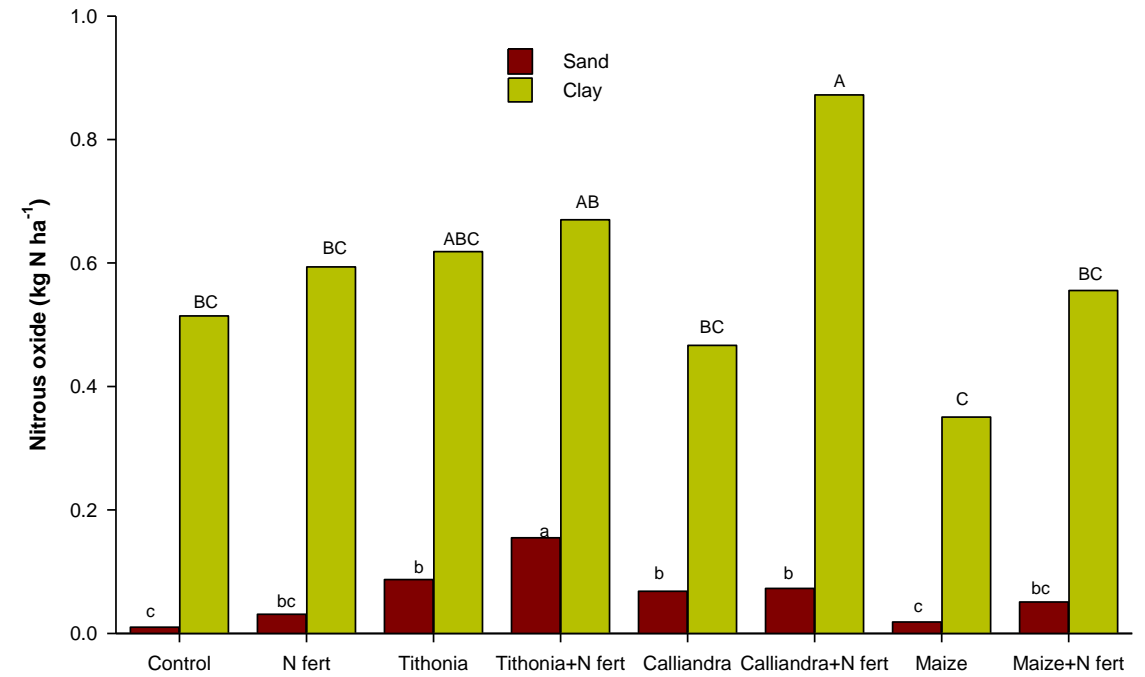
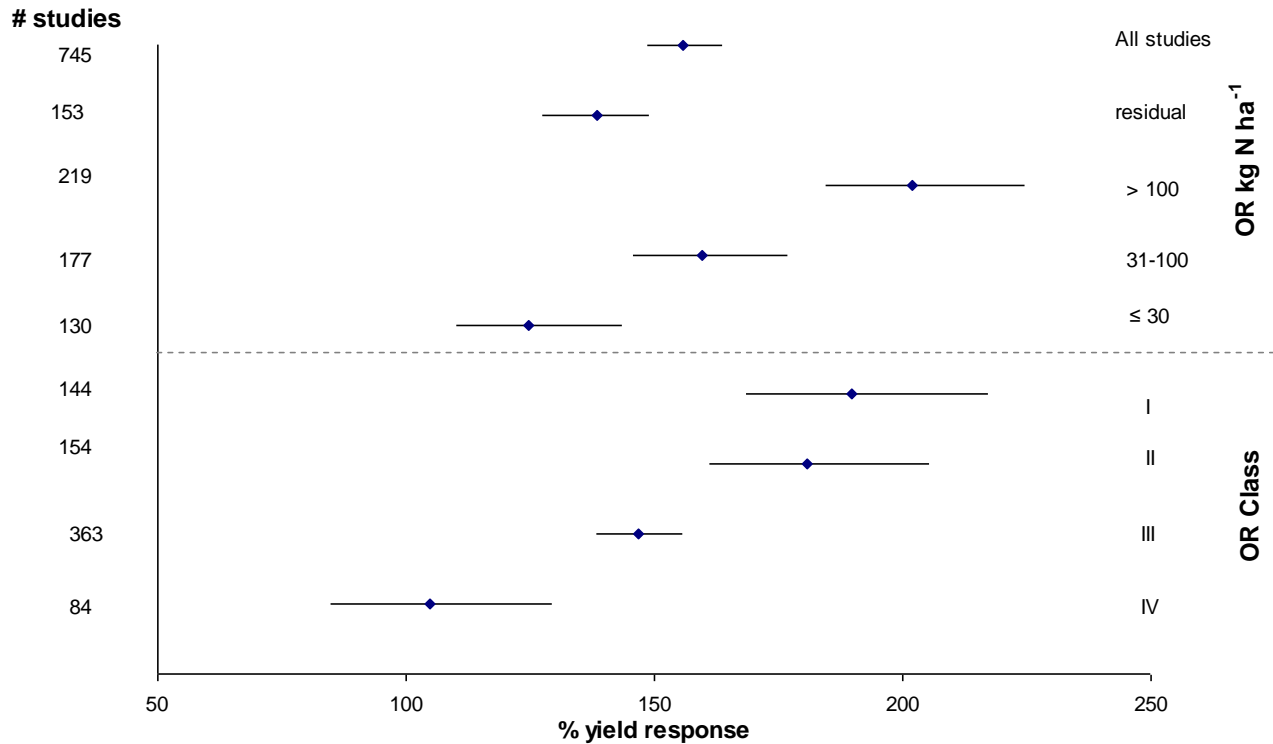


Chivenge et al., 2011  
Plant & Soil, 342: 1-30



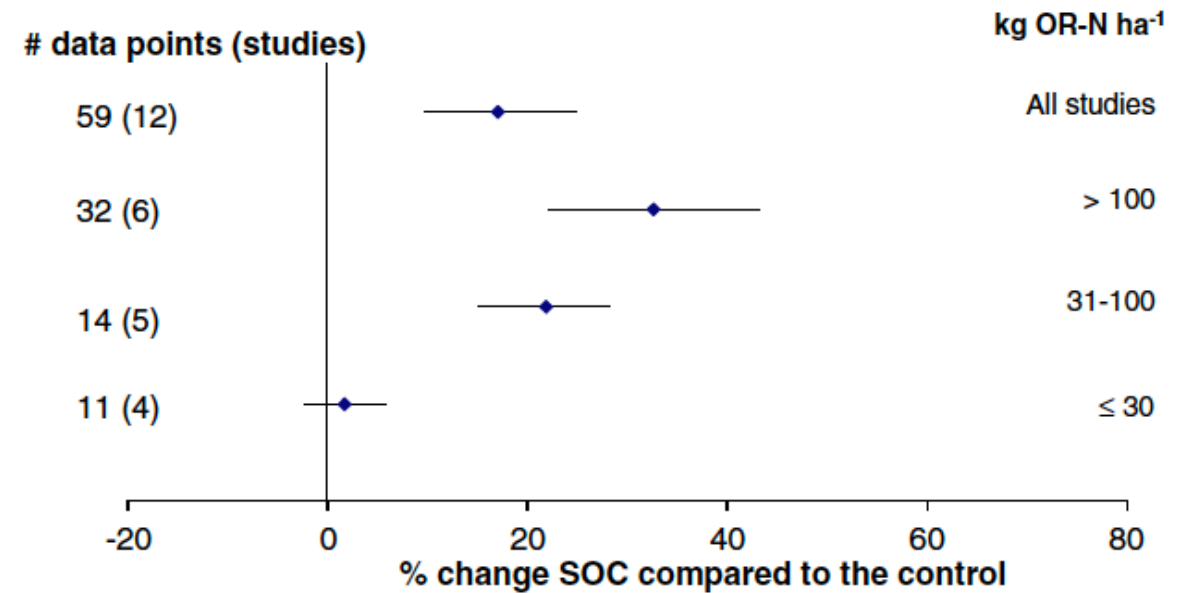
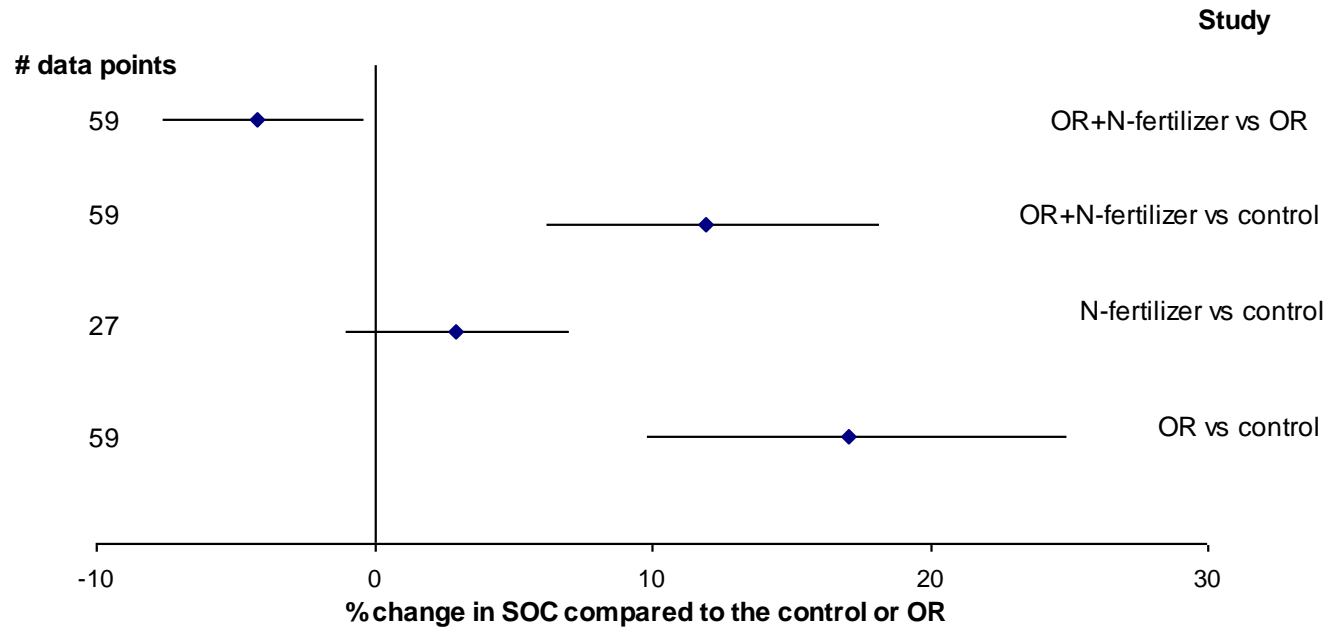


# OR quality influences maize yield



Chivenge et al., 2011  
 Plant & Soil, 342: 1-30

# Combined organic matter and fertilizer influence SOC



*Chivenge et al., 2011*  
*Plant & Soil, 342: 1-30*

# Summary

- Soil texture influences SOC
- Short-term preservation of OR derived N is affected by;
  - Chemical recalcitrance in sandy soil
  - Macroaggregate protection in clayey soil
- Organic matter quality influences yields
  - And short-term GHG emissions
  - But does not affect SOC
- Challenge:
  - Competing uses for crop residues



Thank you



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PLANT NUTRITION  
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