

Does Mulching Increase Maize Yields in the Tropics? A Systematic Review

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Methods

Systematic review in Web of Science done in March 2020: TS =(mulch OR "green manure" OR "cover crop*" OR covercrop* OR "ground cover" OR groundcover OR "legume* cover" OR "plant residue*" OR "crop residue" OR "soil cover" OR "soil conservation" OR "climate smart" OR climate-smart) AND TS =(experiment* OR study OR studies OR trial* OR research* OR plot*) AND TS =(tropic* OR "tropical countr*" OR "tropical zone*" OR "tropical climate*" OR "tropical soil*") AND TS = (maize) NOT TI =(review*)

345 hits, 150 of which were trials on mulching maize in Tropics. 30 more papers were retrieved from sources cited in 150 papers
Inclusion criteria: in Tropics, sole maize, mulch is biomass applied on soil surface, unmulched control: 54 papers selected (Fig. 1).

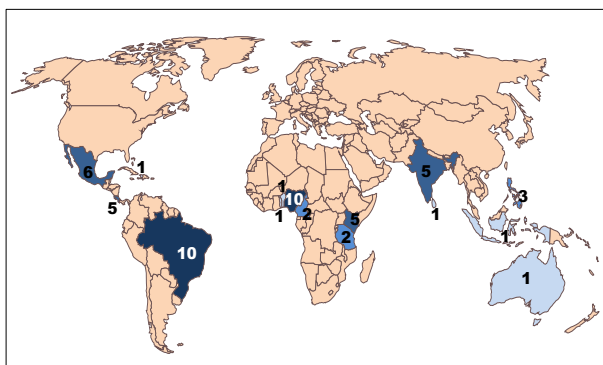


Fig. 1: Distribution of the 54 papers considered in the systematic review (numbers indicate # papers per country)

Information extracted: Rainfall, Trial length, Soil fertility level, Additional fertilizer, Soil preparation, etc., Grain yield and converted to yield ratios:

$$\text{grain yield ratio} = \frac{\text{yield of mulch treatment}}{\text{yield of control treatment}}$$

> 1: mulch with higher yield
< 1: mulch with lower yield

Data analysis

Arcsine sqrt transformation. Multiple regression in R.

Results

Mulch increases maize yield: mean ratio > 1,77 (Table 1)

Table 1 Mean, media, minimum and maximum ratio of grain yield ratio (n=148)

Mean	Median	Minimum	Maximum
1.768	1.310	0.110	7.250

17 Variables with > 70 data points (Fig. 2). Multicollinearity so some variables were removed

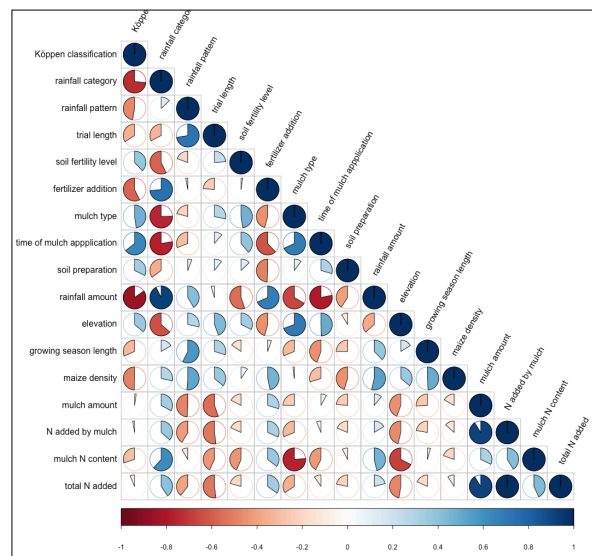


Fig. 2: Collinearity matrix of the variables of the systematic review (the closer to 1 or -1 and the darker the colour, the higher is the correlation)

Multiple regression model (n=76, R²: 0.39)

Significant factors and direction on grain yield ratio:

- Mineral fertilizer addition (+)
- Rainfall amount (-)
- Maize density (-)
- Mulch N content (-)

e.g. 1'500 mm rain, maize density of 50'000 ha⁻¹, 2.5% N in mulch
→ Without mineral fertilizer, grain yield ratio = 2.3
→ With fertilizer: grain yield ratio = 2.7

Conclusions

Mulching does increase grain yield in the tropics

Highest increases when mineral fertilizer also added, so synergistic rather than substitutional
At higher maize densities, mulching less effective, probably due to its impact on controlling weeds at low densities

Mulching recommended for intensified systems including mineral fertilizer