

Agroforestry and yield

Reference 5

Sileshi, GW. 2016 The magnitude and spatial extent of influence of *Faidherbia albida* trees on soil properties and primary productivity in drylands. *Journal of Arid Environments* 132: 1-14. doi: 10.1016/j.jaridenv.2016.03.002

Background and objective

Faidherbia albida is a leguminous (nitrogen-fixing) tree which presence in the crop fields has been widely reported to increase soil fertility and crop yields. Used to combat desertification and greening of the Sahel. *Faidherbia* has also gained prominence in climate -smart agriculture. This review provides analyses of the magnitude and spatial extent of *Faidherbia* tree impact on soil properties and cereals primary productivity. The meta-analysis aimed to answer the questions: 1) Is there any consistent increase in soil nutrient pools and crop yields due to *Faidherbia* trees and how large is the effect size?; 2) Does the tree's root system mine a particular nutrient from the soil beyond the reach of its crown?; and 3) Does the tree's root system mine the soil beyond the reach of its crown? Here, only data regarding soil organic carbon pools are reported.

Search strategy and selection criteria

Literature search in both published and unpublished sources on secondary data on plant productivity.

Study must 1) have been published in a refereed journal, book chapter or peer-reviewed proceeding or any other report; 2) have soil or crop yield measurements 'under canopy' and a corresponding measurement 'outside canopy' to be treated as a well-defined control; 3) have reported the mean as numerical or graphical data; and 4) reported soil properties for each soil depth separately.

Data and analysis

From the studies selected, pairs of observations (under canopy and corresponding values in the open area) on crop yields were extracted.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
21	<i>Faidherbia</i> trees on arable land.	Agroforestry: Scattered <i>Faidherbia albida</i> trees in crop systems	Open area or patches taken furthest from the tree trunk, in the same field as the intervention.	Logarithm of ratio (RR) of crop yields (maize, sorghum, groundnut) under the canopy to crop yields in the open area (or patches taken furthest from the tree trunk).	44%

Results

- Significant increases in yields of maize (150%) and sorghum (73%) resulted under the tree canopy, compared to the open area.
- Maize yields were 1.5–3 times higher under the canopy compared to the open area. The increase is higher under suboptimal conditions for soil fertility and other parameters, that is, where the yields in the open area are below-average.
- Groundnut yields under the canopy were lower than the open area for above-average conditions, while no significant effect was observed for groundnut yields under conditions where the open area yields are below average (<1 t ha⁻¹).
- The magnitude of tree influence on crop yields followed a common pattern of distance–decay. The influence of the tree extends beyond the drip line.
- NA

Factors influencing effect sizes

Faidherbia influences on soil properties and crops are greatest ($R \gg 1$) near the tree trunk and gradually decrease towards patches outside the influence zone of the tree approaching $RR = 1$. The magnitude of tree influence on crop yields followed a common pattern of distance–decay. Similarly, large increases in crop yields occurred in suboptimal conditions for crop productivity than in optimal conditions.

Conclusion

Faidherbia induces significant changes in soil properties and fertility under its canopy, leading to significant increases in yields for maize and sorghum under canopy. Groundnut yields were not influenced (under above-average conditions) or reduced (under below-average conditions).