Nitrogen Facilitation and Competition in Timber tree - Maize Agroforestry System

World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

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Introduction

Soil erosion is a major problem limiting availability of nitrogen and other nutrients for crops on sloping lands in Southeast Asia. Integrating timber trees on croplands as contour hedgerows to control soil erosion, increase income to farmers, and improve environmental services such as biodiversity, water quality and carbon sequestration. Timber based contour hedgerow is now thought to be a viable option for smallholders.

Objective

To assess above- and below-ground nitrogen facilitation and competition in timber tree-maize hedgerow intercropping system.

Potent problem ← → Potential solutions

Materials and Methods

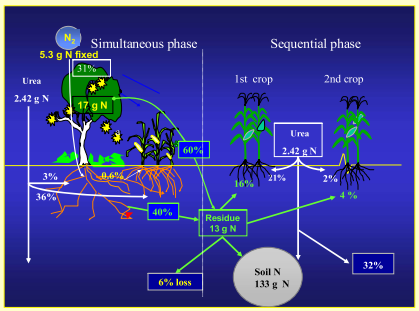
- A half-drum experiment was conducted in Claveria, Misamis Oriental, Philippines (8°38' N 124°55' E) consisting of *Acacia mangium or Gmelina arborea* in association with maize, and supplied with 0 and 80 N kg ha^{-1} during 3 cropping cycles: 1 simultaneous (tree + crop) and 2 sequential (crop) cycles.
- Tree plant parts were labeled using ^{15}N stem injection technique in order to quantify N transfer during simultaneous phase, and to partition tree above and belowground N contributions to subsequent maize crops. N fertilizer was also labeled with ^{15}N during the sequential phase. N_2 fixation of Acacia in drum and field experiments was determined using the ^{15}N natural abundance method.

Results

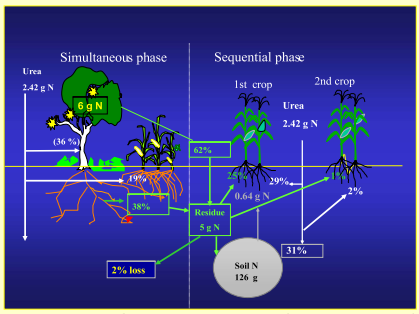
Quality of recycled plant materials

Species	Plant parts	N%	C:N	Lignin %	Polyphenols %
Acacia mangium	Old leaves	2.2	22	30	58
	Roots	1.4	35	33	25
	Young leaves	2.4	19	23	82
Gmelina arborea	Old leaves	1.8	25	23	18
	Roots	0.7	58	27	13
	Young leaves	2.1	20	24	2.7
SED		0.6	16	0.4	16

In *Acacia* low root C:N ratio promotes N release while leaf polyphenol content immobilizes N during decomposition



Nitrogen cycling in Acacia – maize AF system: 80N + roots + leaves



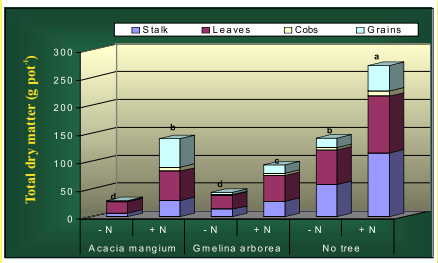
Nitrogen cycling in Gmelina – maize AF system (80 N + roots + leaves)

Maize performance during sequential phase

Species	Management	First crop	Second crop	Total
		---------N yield g pot^{-1}-----		
Acacia mangium	Root +leaves - N	1.42 b	1.53 a	2.95 b
	Roots only - N	2.37 a	1.46 a	3.83 a
Gmelina arborea	Root +leaves - N	0.73 c	1.38 a	2.11 c
	Roots only - N	0.65 c	0.84 b	1.49 d

Acacia roots strongly improve maize performance while recycled leaf material negatively affects 1st crop yield

Effect of trees and N application on maize total dry matter yield



Both trees strongly compete with the crop for native soil N. However, *Acacia* competes less for added fertilizer N.

Conclusion

Acacia mangium **is better suited for mixed agroforestry systems than the non-fixing *Gmelina aborea* due to its high N_2-fixing potential, lower N competitiveness and higher belowground N facilitation to the associated and sequential maize crops.**

Acacia mangium **N_2 fixation**

- Drum experiment with and without N
  - N + N (80 kg ha^{-1})
  - 54 % +/- 9 31 % +/- 7
- As hedgerows with 80 kg N ha^{-1} application:
  - = 38 % +/- 13
- As woodlots:
  - = 54 % +- 22
  - (n= 15 sites)

Acknowledgement and Contact

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