Economic Analysis of Maize Production and Nitrogen Use Efficiency in Rotation with *Brachiaria humidicola*

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Photo 1 CIAT-Corpoica *Brachiaria humidicola* trials in the Eastern Plains of Colombia
Source: Tropical Forages Program, CIAT

Introduction

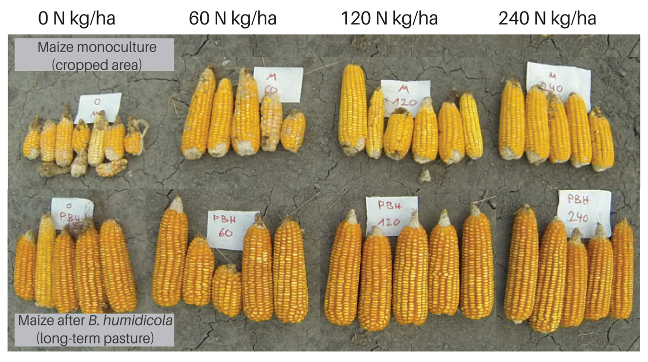
- Among the essential macro elements for maize production, nitrogen (N) is the one limiting growth and yield the most
- To maintain desired production levels, substantial amounts of N are required, mainly obtained through nitrogen fertiliser, a significant cost driver in maize production (13%-18%)
- Much of this fertilizer is lost after nitrification through leaching and denitrification processes
- Fertilizer not used by the crop produces considerable environmental damage (e.g., water pollution, emission of greenhouse gases) and generates economic loss to the producers
- The residual BNI effect in Brachiaria humidicola (Bh) (>10 years established) plots, leads to a more efficient use of N fertilizer and associated reduced costs, resulting in higher grain yields of subsequent cropped maize
- Nevertheless, real economic benefits are unknown for the producer in these rotation systems

Objectives

- To evaluate the profitability of maize production on plots previously used for Bh and compares the results to conventional maize production (M)

Materials & Methods

Figure 1 Effects of crop rotation on maize yield



Maize yield was evaluated in three plots of different previous land use systems :

- Productive *Brachiaria humidicola* (PBh)
- Degraded *Brachiaria humidicola* (DBh)
- Conventional maize (M)

On each plot, 3 doses of nitrogen (N) were applied, 60, 120, and 240 kg N ha^{-1}

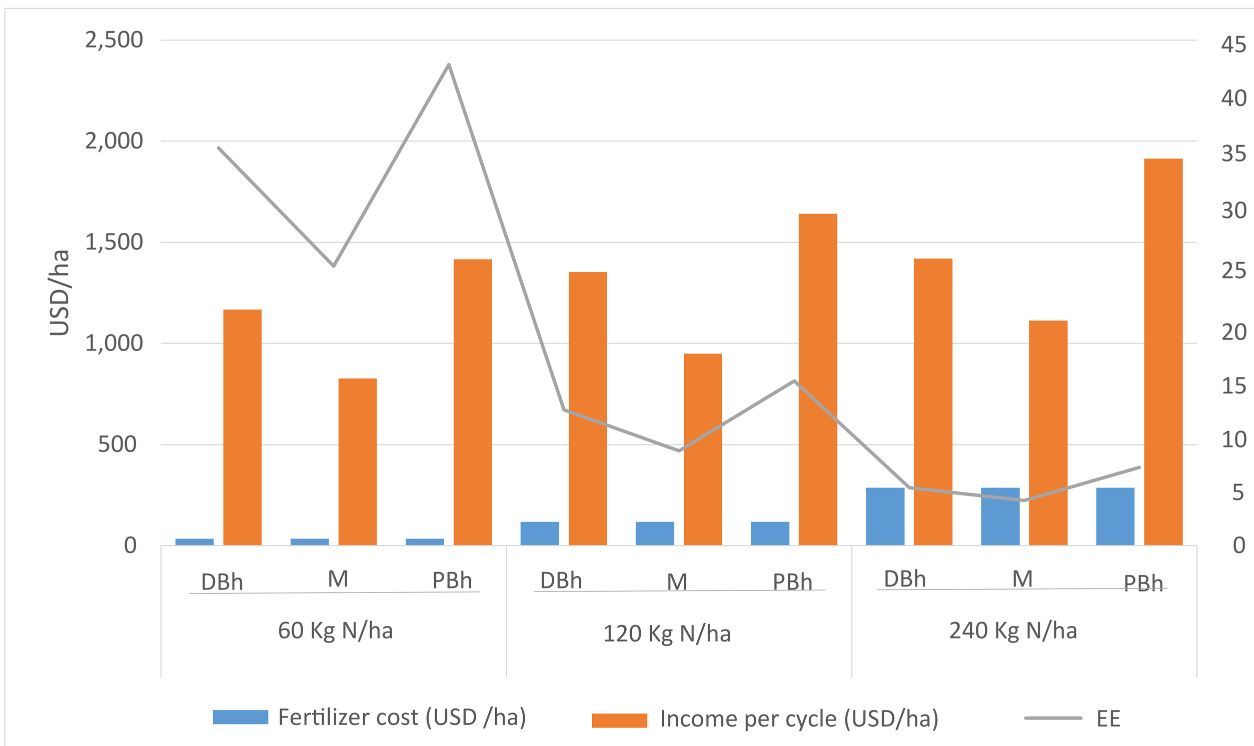
The analysis focused on measuring indicators of technical and economic efficiency with respect to Nitrogen Use Efficiency (NUE) , yields, costs associated with each plot, profitability indicators and sensitivity analysis

Results

Compared to the M option:

- Yields in PBh and DBh increase their levels at 32% and 62% rates, respectively
- Productive efficiency of N increases by 38% and 70% for DBh and PBh options respectively, and lower unit costs (75%) and a superior cost-benefit ratio can be observed
- Maize production in the PBh option achieved the highest economic return, associated with increases in yield as well as reductions in the per unit product cost

Figure 2 Economic Efficiency (EE)differences among three options



- The highest EE in fertilization was obtained with 60 N Kh/ha dosis in the three plots and among them the highest value was reached in the PBh plot
- The agronomic NUE and the economic efficiency indicators decrease with an increasing dose of nitrogen fertilizer
- The results are highly sensitive to variations in expected returns, and to some extent to maize sales prices and increased production costs

Table 1 Yield, costs, income and economic indicators of maize with respect to the N applied dose for each plot

Variables	M (Kg N/ha)			DBh (Kg N/ha)			PBh(Kg N/ha)		
	60	120	240	60	120	240	60	120	240
Maize yield (kg/ha)	2,592	2,993	3,564	3,575	4,134	4,533	4,366	5,168	6,009
Standard deviation of yield	428	1,141	1,249	758	1,198	1,048	981	1,878	602
Income (USD)	839	969	1,154	1,157	1,338	1,467	1,413	1,673	1,945
Total product cost (USD)[1]	1,469	1,547	1,706	1,469	1,547	1,706	1,469	1,547	1,706
Utility (USD)[2]	-630	-578	-552	-312	-209	-239	-56	126	239
Break even point (kg maize)[3]	4,590	4,834	5,331	4,590	4,834	5,331	4,590	4,834	5,331
Unit product cost (USD)[4]	0.57	0.52	0.48	0.41	0.37	0.38	0.34	0.30	0.28

Average data of three years of evaluation (2013-2015), with three repetitions for each dose of nitrogen fertilizer. Prices were converted to dollars by using the average Representative Market Exchange Rate (RMER) for each year, respectively
[1]Total product cost: the result of fixed costs (include costs of soil preparation, planting, control of pests and diseases) plus variable costs (include costs of N fertilizer); [2]Utility: the total income (sale price (0.32 USD) x yield) minus total costs; [3]Break even point: represents the minimum yield level to cover total production costs; [4]Unit product cost: obtained by dividing total product cost by total production.

Conclusions

- Crop rotation of *Brachiaria humidicola* and maize is an alternative to improve production efficiency and profitability, resulting from the residual effects of BNI related to Bh
- Knowing about the economic benefits of such a rotation system serves as a decision making tool to livestock producers and can help in promoting the adoption of *Brachiaria humidicola* in livestock production systems

References

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