Estimation of the optimal nitrogen dose in a *Brachiaria humidicola*-corn rotation system in the Colombian Eastern Plains

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Introduction

» Among the essential macro elements, nitrogen (N) is critical for crop growth and yield.

» To maintain desired production levels, significant amounts of N, obtained primarily through nitrogen fertilizers, are required.

» However, high amounts of the applied N are lost due to nitrification in the soil, causing an increase in greenhouse gas (GHG) emissions (nitrous oxide), pollution of water bodies and increased fertilizer application.

» It is key to improve efficiency in the use of N fertilizer through the optimization of application rates. This contributes to reducing GHG emissions, especially in crops with high N demands such as corn.

» CIAT, in collaboration with other institutions, have carried out a study in the Colombian Eastern Plains in order to determine the Biological Nitrification Inhibition (BNI) potential in permanent lots of *Brachiaria humidicola* (*Bh*), which allows for increasing nitrogen use efficiency (NUE) in a *Bh*-corn rotation system.

Objective

» To determine both the optimal economic dose (OED) and the optimal technical dose (OTD) of N in a *Bh*-corn rotation system using three response models.

» To identify the most appropriate response model for obtaining OED and OTD estimates.

Methodology

» Data was obtained from field trials in the Colombian Eastern Plains between 2013 and 2017, where corn production in a *Bh*-corn rotation system (with residual BNI effect) was compared with conventional corn production (without residual BNI effect).

» For determining the OED and OTD of N, three response models were be applied: a quadratic (QM), pseudo-quadratic (PQM) and discontinuous rectilinear (DRM) model. The comparison of these models allows to identify the most suitable model for obtaining the best OED and OTD estimates of N.

Results

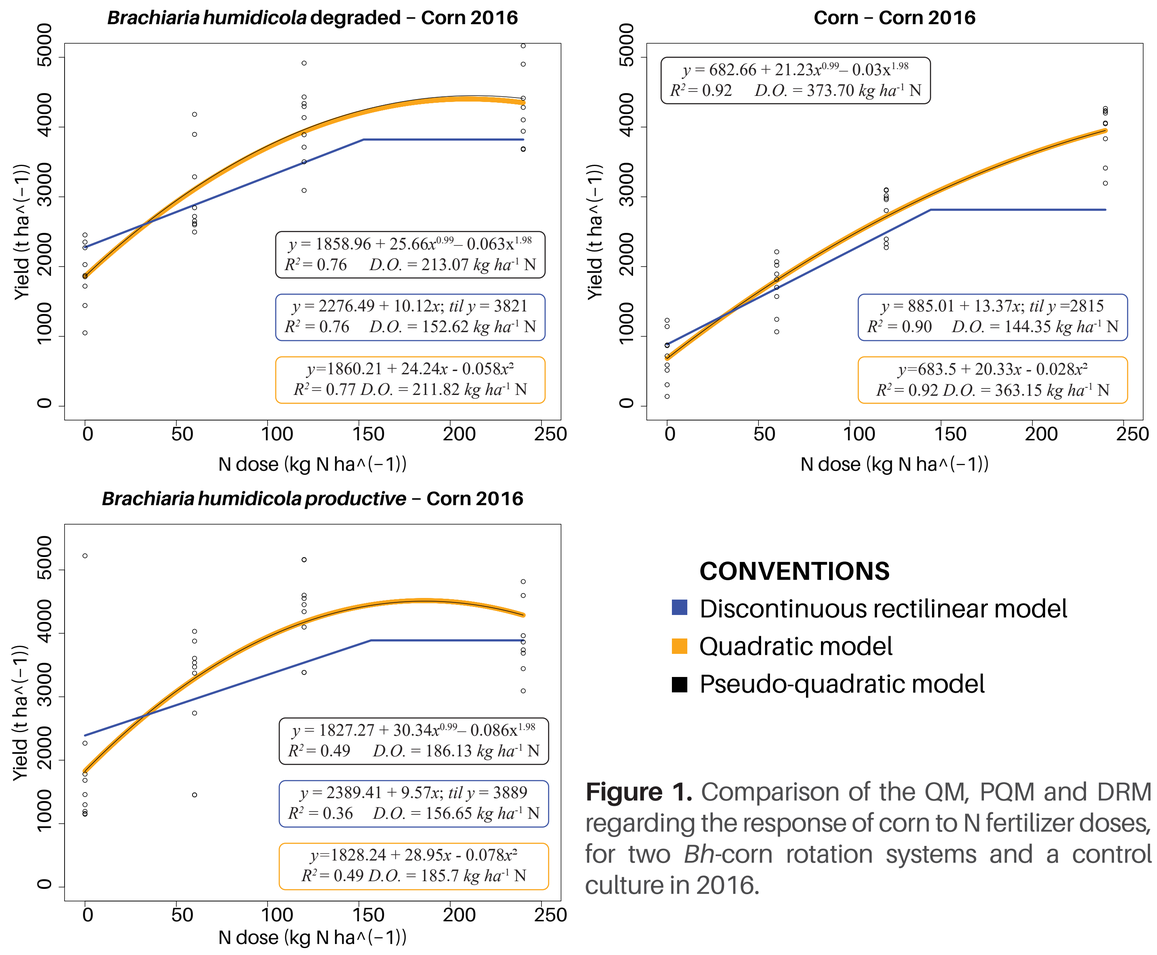

Figure 1. Comparison of the QM, PQM and DRM regarding the response of corn to N fertilizer doses, for two *Bh*-corn rotation systems and a control culture in 2016.

Table 1. Table 1. OTD, OED and maximum average production in 2016.

Variable	Discontinuous rectilinear model			Quadratic model			Pseudo-quadratic model		
	Corn	*Bh*Deg	*Bh*Prod	Corn	*Bh*Deg	*Bh*Prod	Corn	*Bh*Deg	*Bh*Prod
OTD (N/ha)	144	152	156	363	211	185	373	213	186
MP$_{OTD}$ (kg/corn/ha)	2815	3821	3889	4374	4454	4515	4421	4350	4506
OED (N/ha)	NA	NA	NA	278	170	155	283	170	154
MP$_{OED}$ (kg/corn/ha)	NA	NA	NA	8511	7730	8201	4208	4350	4432

MP: Maximum average production; *Bh*Deg: *Brachiaria humidicola*, degraded; *Bh*Prod: *Brachiaria humidicola*, productive.

» The OTD estimate generally presented higher values in all three treatments when applying the QM and PQM.

» The behavior of the OTD variable in the analyzed period was different in the three models. This results from each model getting its best fit depending on the distribution of the data.

» The OED is lower than the OTD in the QM and PQM models for the three treatments. For maximizing profits, a lower N dose is required than for maximizing yields. Fertilization costs do not justify higher N doses.

» *Bh*-corn treatments require lower OTD and OED compared to the control scenario. This results of the residual BNI effect.

Conclusions

» The PQM and DRM models turn out to be the most suitable for estimating the OTD. Given the best fit of the data distribution, required N doses are not being overestimated.

» N input and corn sales prices are definitive to determine the optimum dose that maximizes the producer's profits.

» The results of this study will be key for providing recommendations to primary producers on the correct N doses to apply in a Bh-corn rotation system. This will contribute to improving both efficiency in production and profitability, and help to avoid the excessive and unnecessary application of nitrogen fertilizers and its associated negative effects on the environment.

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