Site-Specific Variable Nitrogen Rate Model in Corn

Guillermo R. Balboa[1-2], Gabriel P. Esposito[2], Cecilia Cerliani[2] and Ignacio A. Ciampitti[1]
[1]Kansas State University, Manhattan, KS. - [2]Rio Cuarto National University, Rio Cuarto, Argentina
balboa@ksu.edu

INTRODUCTION

Global nitrogen use efficiency (NUE) was estimated in 33% for cereals. Uniform N applications are considered as standard N practice, but is not accounting for the potential spatial variability encountered at the field-scale. A site-specific variable N rate model was developed with the goal of improving NUE, minimizing cost and increasing farmers' profits.

OBJECTIVE

The objective of this research project was to evaluate the model developed (including a topographic index, CTI) in four trials performed in 2010-11-12 in Cordoba, Argentina.

MATERIALS AND METHODS

Criteria I = Fertilizer N rates were applied following a mathematical model (MEME) based on CTI. The model is divided into 3 equations as related to the predicted forecasted weather conditions:

-Wet year (Yield= 8848 +25.04N -0.06N^2 +37.69CTI -0.49CTIN),

-Normal Year (Yield=6617+15.95N-0.025N^2+47.89CTI-0.63CTIN),

-Dry year (Yield=5406 +3.18N -0.02N^2 +21.45CTI +0.27CTIN).

were N is the fertilizer N rate applied, CTI (Compound Topographic Index)

Criteria II = Determine the economically optimal N rate (EONR) via implementation of strip N research trials. A total of ten combinations resulted from five N strips (N rates = 0, 40, 80, 160, and 320 kg N ha^{-1}) and two management zones (low vs. high production). Specific-management zones were defined by a cluster analysis from previous yield information.

Criteria III = Farmer fertilizer N rate (43 kg N ha^{-1}), this rate was obtained via surveying 175 farmers around the area as related to the fertilizer N rate applied to corn.

RESULTS

In “Santa Clara” trial (dry year) in the 93% of the area, the Criteria I recommended 0 kg N ha^{-1}. The rate for 7% of the fertilized area ranged from 22 to 89 kg N ha^{-1}. The average fertilizer N rate for the Criteria I was 4.5 kg N ha^{-1}. As a predicted dry season, Criteria I recommended to apply fertilizer N to the areas where the CTI showed high values. In opposite, in “El Piquete” trial, in a normal season high CTI values were related to low fertilizer N rates.

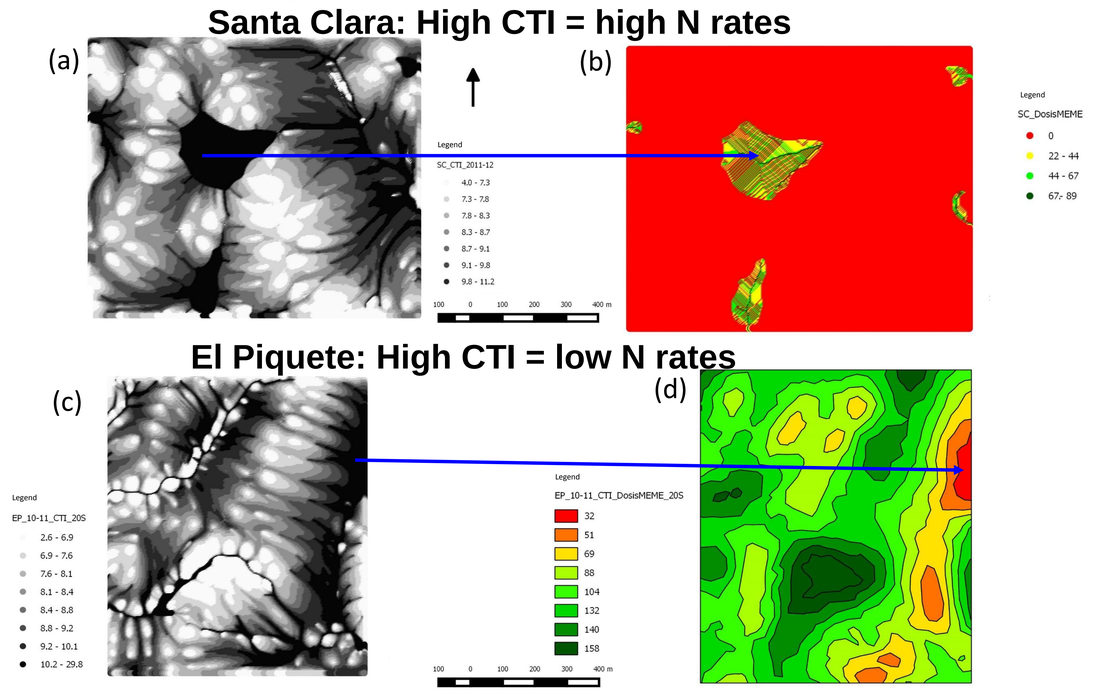

Figure 1 : CTI (panels a and c), and recommended N rates by criteria I (panels b and d) for “Santa Clara” (dry year) and “El Piquete” (normal year) research trials.

RESULTS (continued)

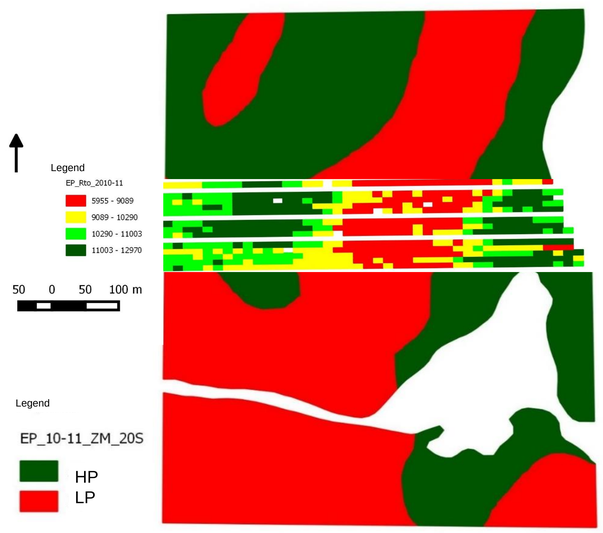

Figure 2: Management zones for criteria II, and strips yield map for “El Piquete” trial, season 2010-11.

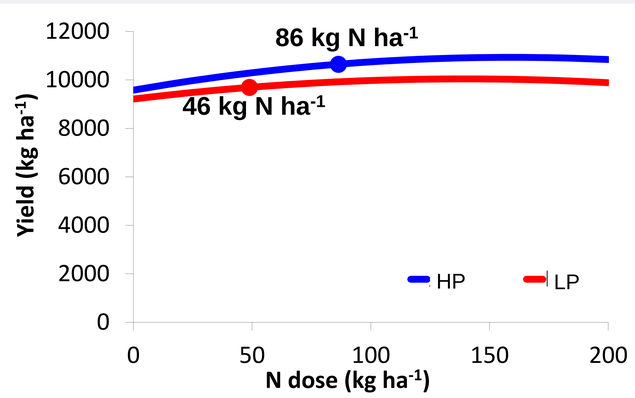

Figure 3: Yield (lines) and economically optimal N rate (EONR) (points) by management zones for “El Piquete” site, season 2010-11.

Table 1: Fertilizer N rate and grain yield for Criteria I, II and III for each site and forecasted weather (season).

Site	Season	Forecasted Weather	Criteria I		Criteria II*		Criteria III
			N rate kg N ha^{-1}	Yield kg ha^{-1}	N rate kg ha^{-1}	Yield. kg ha^{-1}	Yield. kg ha^{-1}
El Piquete	2010/11	Normal	66	10130	57	10206	9904
Don Nicolas II	2010/11	Normal	41	7702	45	8090	7719
Don Nicolas I	2011/12	Dry	0	1588	0	1367	1588
Santa Clara	2011/12	Dry	0	3448	4	3904	4109
Las Vertientes	2012/13	Wet	48	10154	79	10828	10114

*For criteria II N rate and Yield were adjusted by management zones proportion.

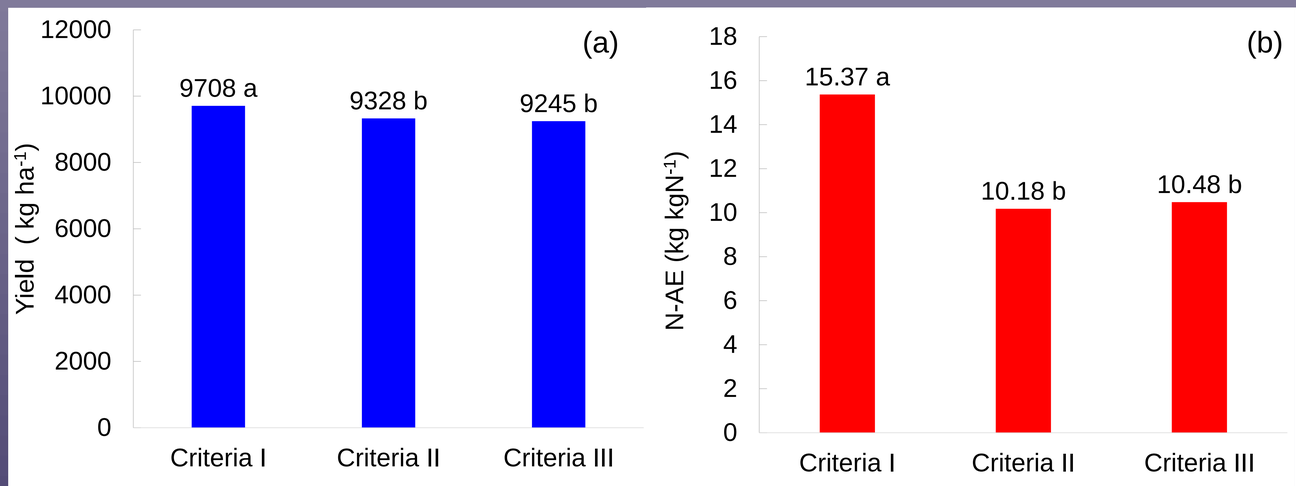

Figure 4: Mean yield (a) and Nitrogen agronomic efficiency (b) by fertilizer criteria for all sites with response to N application. Letters indicates differences at 5%.

CONCLUSIONS

Criteria I allowed yields increments of 4-5% as compared to Criteria II and III. The most important impact were in Nitrogen Agronomic Efficiency (N-AE). The model used in Criteria I increase the N-AE in 49% as compared with II and III. In dry seasons with less likelihood of N response, Criteria I recommended to apply N in less than 10% of the area evaluated.