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DSSAT MODEL AS A TOOL FOR WATER AND NITROGEN MANAGEMENT IN INTENSIVE IRRIGATED AREAS: CALIBRATION AND VALIDATION

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Introduction and objective

The DSSAT model has been used worldwide to simulate crop biomass and yield, and soil N dynamics under different management practices and various climatic conditions (Li et al, 2015). There is a continuous need to test and update the models under a wide range of environments and cropping practices (López-Cedrón et al., 2008).

This study was focused on the evaluation of the performance of CERES-Maize to study the response (total biomass, grain yield and N uptake) of irrigated maize to different soil nitrogen availability under semi-arid condition.

Materials and Methods

- Three field experiments in Montañana 2010 (Mon10), Almudévar 2011 (Alm11) and 2012 (Alm12) (Spain), were performed under sprinkler irrigation system.
- Maize Pioneer 'PR34N43'.
- Five rate of N fertilizer (0 to 400 kg N ha^{-1}) were applied at each field that included four replications.
- The DSSAT (V4.5) was **calibrated** using plots managed under optimum N conditions and **validated** using other plots managed under variable soil N available (from 60 to 871 kg N ha^{-1}, preplant soil N + N fertilizer).

Results and Discussion

The best RMSE of grain yield achieved during the calibration process was about 844 kg ha^{-1}. The DSSAT validation process indicates an overestimation of grain yield, biomass and crop N uptake by the model (Table 1). The best result was obtained in Alm12 site with a RMSE of 1023 kg ha^{-1} for grain yield and 2516 kg ha^{-1} for total biomass. The model underestimated the residual soil N in the upper part of the soil profile while overestimated soil N in deeper layers (Table 2).

Table1. Validation results of DSSAT model to simulate grain yield and total biomass of maize.

	Grain yield (kg ha^{-1})			Total biomass (kg ha^{-1})		
Field	**Bias**	**RMSE**	**R^2**	**BIAS**	**RMSE**	**R^2**
Mon10	883	2031	0.55***	2516	3656	0.58***
Alm11	271	1340	0.54***	1033	2874	0.46***
Alm12	388	1023	0.83***	1231	2516	0.67***

Table2. Validation results of DSSAT model to simulate the residual soil N in Alm12.

Depth (m)	Bias (kg ha^{-1})	RMSE (kg ha^{-1})
0.0-0.3	-31	49
0.3-0.6	8	17
0.6-0.9	11	15
0.9-1.2	9	13

- DSSAT model tended to overestimate the total nitrogen content in grain and plant (Figure 1).
- An additional calibration modifying the CTCNP2 parameter value allowed an improvement of grain N and total crop N uptake RMSE by 22% and 14%, respectively.
- A good agreement was obtained between observed and simulated grain yield and a moderate agreement for total plant N uptake comparing with other studies (Liu et al., 2012; Salmerón et al., 2014).

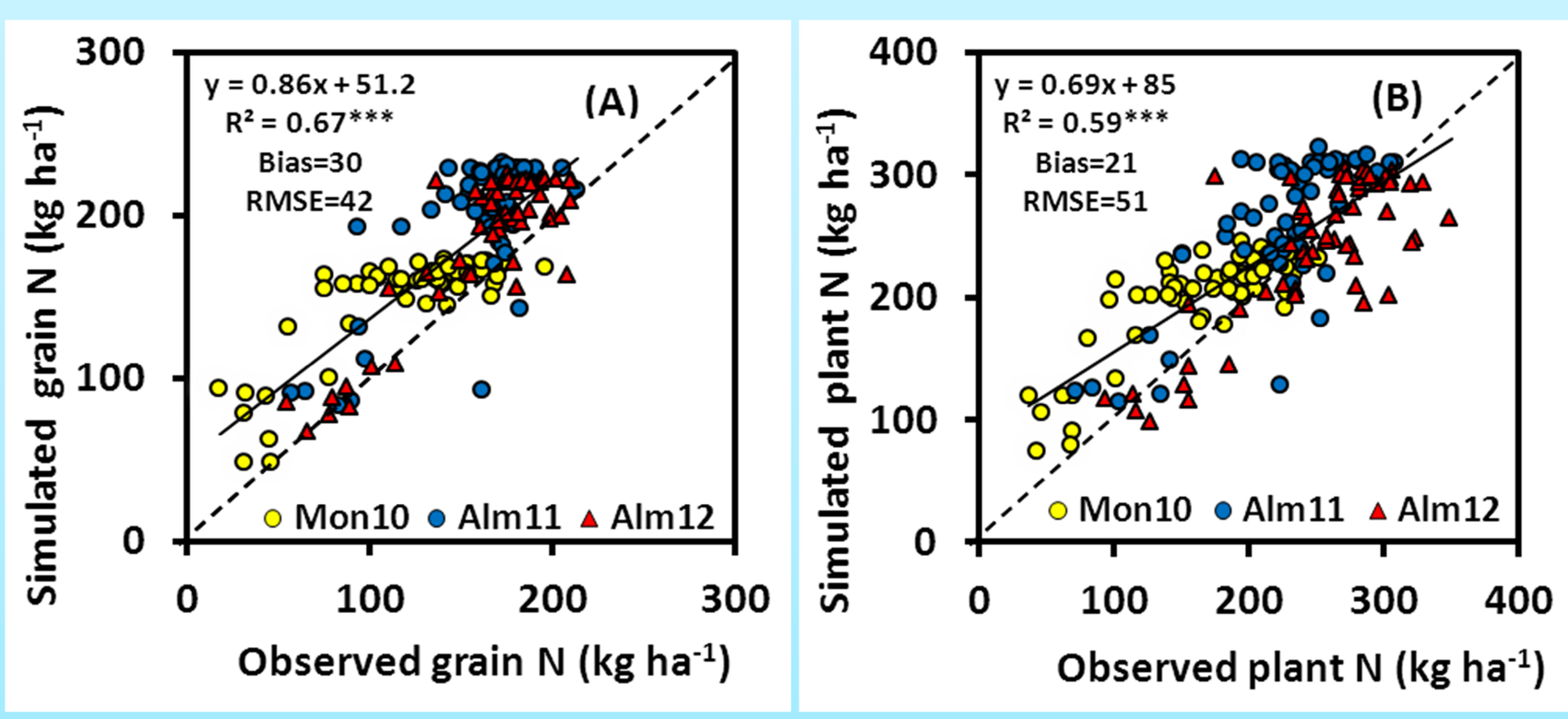

Figure 1. Relationship between simulated and observed of (A) grain N and (B) plant N uptake (kg N ha^{-1}) in Mon10, Alm11 and Alm12; (n =158), the dashed line represents the 1:1 relationship.

Conclusions

- The model evaluation could be considered acceptable comparing with other published works. However, the model calibration and validation needs to be improved with further data.
- A better CTCNP2 parameter adjustment to specific field conditions is important to obtain more accurate maize N uptake estimation.
- The application of calibrated model could be helpful to assess management practices for reducing N leaching in intensive irrigated areas.

References

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