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

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Introduction

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 maize field experiments using *Pioneer 'PR34N43'* were performed in Montañana 2010 (Mon10), Almudévar 2011 and 2012 (Alm11 and Alm12) (Spain) under sprinkler irrigation system. 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 different soil N available (from 60 to 871 kg N ha^{-1}, preplant soil N+ N fertilizer). To assess the performance of DSSAT, Bias, RMSE and R^2 were used.

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 (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. Performance (validation) of DSSAT model (Bias, RMSE and R^2) to simulate grain yield and total biomass of maize

	Grain yield ($kgha^{-1}$)			Total biomass ($kgha^{-1}$)		
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. Performance (validation) of DSSAT model (RMSE and Bias) to simulate the residual soil N in Alm12.

Prof (m)	BIAS ($kgha^{-1}$)	RMSE ($kgha^{-1}$)
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). The obtained RMSE were 51 and 42 kg N ha^{-1} for plant and grain N uptake respectively. 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).

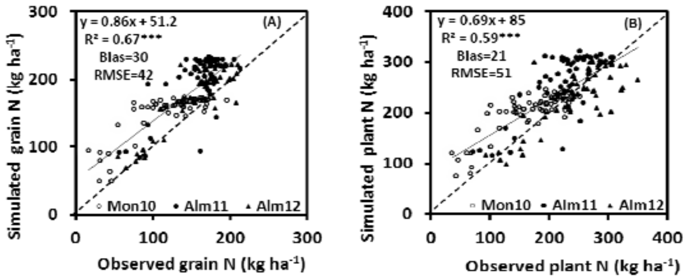

Figure 1. Relationship between simulated and observed of (A) grain N and (B) plant N uptake (kg N ha^{-1}) in the three experiments (Mon10, Alm11 and Alm12; n =158). The dashed line represents the 1:1 relationship.

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 area.

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