



NEMA, a functional-structural model of nitrogen economy within wheat culms after flowering. II. Evaluation and sensitivity analysis

Submitted by Emmanuel Lemoine on Thu, 02/12/2015 - 13:01

Titre	NEMA, a functional-structural model of nitrogen economy within wheat culms after flowering. II. Evaluation and sensitivity analysis
Type de publication	Article de revue
Auteur	Bertheloot, Jessica [1], Wu, Qiongli [2], Cournède, Paul-Henry [3], Andrieu, Bruno [4]
Editeur	Oxford University Press (OUP)
Type	Article scientifique dans une revue à comité de lecture
Année	2011
Langue	Anglais
Date	2011/01/10
Numéro	6
Pagination	1097 - 1109
Volume	108
Titre de la revue	Annals of Botany
ISSN	0305-7364
Mots-clés	common pool [5], functional-structural plant model [6], light acclimation [7], nitrogen [8], remobilization [9], root uptake [10], Rubisco turnover [11], senescence [12], Triticum aestivum [13], wheat [14]

Résumé en
anglais

Background and Aims Simulating nitrogen economy in crop plants requires formalizing the interactions between soil nitrogen availability, root nitrogen acquisition, distribution between vegetative organs and remobilization towards grains. This study evaluates and analyses the functional-structural and mechanistic model of nitrogen economy, NEMA (Nitrogen Economy Model within plant Architecture), developed for winter wheat (*Triticum aestivum*) after flowering. Methods NEMA was calibrated for field plants under three nitrogen fertilization treatments at flowering. Model behaviour was investigated and sensitivity to parameter values was analysed. Key Results Nitrogen content of all photosynthetic organs and in particular nitrogen vertical distribution along the stem and remobilization patterns in response to fertilization were simulated accurately by the model, from Rubisco turnover modulated by light intercepted by the organ and a mobile nitrogen pool. This pool proved to be a reliable indicator of plant nitrogen status, allowing efficient regulation of nitrogen acquisition by roots, remobilization from vegetative organs and accumulation in grains in response to nitrogen treatments. In our simulations, root capacity to import carbon, rather than carbon availability, limited nitrogen acquisition and ultimately nitrogen accumulation in grains, while Rubisco turnover intensity mostly affected dry matter accumulation in grains. Conclusions NEMA enabled interpretation of several key patterns usually observed in field conditions and the identification of plausible processes limiting for grain yield, protein content and root nitrogen acquisition that could be targets for plant breeding; however, further understanding requires more mechanistic formalization of carbon metabolism. Its strong physiological basis and its realistic behaviour support its use to gain insights into nitrogen economy after flowering.

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DOI

[10.1093/aob/mcr125](https://doi.org/10.1093/aob/mcr125) [16]

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