9. Modelling the residual nitrogen effect in ley- forage maize systems

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Nitrogen (N) flows need to better understood in ley-arable systems in order to assess its potential in sustainable cropping systems, the Agricultural Production Simulator (APSIM) is a potential tool for evaluation but it needs to be further tested on sandy soils in northwest Europe. The aim of this study was to evaluate the robustness of the APSIM as a potential tool to study N flows within different forage maize systems (i.e. maize in a crop rotation, continuous maize and a maize-ley system), and to assess its suitability in simulating the residual N effect to the following crop. Experimental data from three experimental sites being located on sandy soils were used to parameterize the APSIM Maize module. For the first site seven years of maize grown in a crop rotation located in 'Vredepeel, the Netherlands' were used, the second site included a continuous maize and a maize following a grass-clover ley located in 'Jyndevad, Denmark', and the third site a continuous cropping system which included six years of maize and once a pure ryegrass ley period located in 'Schuby, Germany'. The following model adjustments were made to identify potential improvement options to predict the N release after a ley phase accounting for 1) aboveground grass residues 2) above- and belowground grass residues and 3) using a simple mineralisation model (SMM) instead of using the default approach in APSIM, which has previously been shown to be more appropriate for freshly incorporated plant residues. Model predictions for biomass, N yield and N leaching were compared to measured data using the same data sets. The results showed that APSIM predicted biomass and the N yield of maize satisfactory across the different systems and sites. Furthermore, incorporating the SMM in APSIM improved the predictions of N leaching observed in the maize following grass-clover ley system. However, APSIM had difficulties to predict the observed a delay of N leaching after the pure ryegrass sward. In conclusion, APSIM need to be modified to accurately predict N mineralization in ley-arable systems in northwest Europe. Accounting for slowly releasing belowground grass residues seems to be important for N yield predictions in general, while the SMM could be of added value to improve N mineralization patterns and N leaching after a ley phase in APSIM.

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