

Abstract

Quantification and modelling of nitrogen dynamics under direct seeding mulch-based cropping systems in the Brazilian Cerrados

In the Brazilian Cerrados Direct seeding Mulch-based Cropping (DMC) is based on the absence of tillage practices, the presence of a mulch of crop residues and the implementation of a cover crop following the main crop. The objective of this study was to assess the impact of DMC systems on soil nitrogen (N) dynamics.

The work combined data collection from field and laboratory experiments with simulation modelling using the STICS model. Experiments were conducted on fields planted with maize as the main crop. The treatments applied were the age under DMC, the type of cover crop and the level of N fertilization.

Firstly, we analyzed using a chronosequence the long-term impacts of DMC on soil organic matter accumulation and N mineralization. Secondly, we examined a range of cover crop species on their ability to capture N and supply it for a subsequent maize crop. Thirdly, the STICS model was calibrated for the DMC systems in which crop residues are left on the soil surface and soils are not tilled. The ability of the STICS model to predict soil N dynamics and maize yields under these systems was analyzed. Finally, the combined effects of age of DMC, type of cover crop, and level of N fertilization on the N balance and maize productivity were studied using experimental data and simulation modelling using the STICS model.

This work shows that soil total N content increases with the number of years under DMC, which results in an increase in soil N mineralization. The use of cover crops reduces the N leaching potential between two main crops due to plant N uptake. However, the N taken up by cover crops was poorly released via mineralization during the succeeding growing cycle. Positive effects of cover crops on soil N supply occur principally via the long-term increase in soil total N content. The response of maize to inorganic N fertilization was not systematic over all treatments and years. It depends greatly on the seasonal rainfall pattern that governs N leaching. Finally, the age of the DMC system and the type of the cover crop had only a secondary effect on soil N dynamics in the DMC systems under this study.

Key words: cover crop; modelling; N fertilization; N mineralization; N supply; no-tillage