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"Filling gaps and removing traps
for sustainable resource management"

The Role Crop Modelling Can Play in Supporting Diversification of Cropping Systems in Southern Africa

Munir Hoffmann[1], Corrie Swanepoel[2], William Nelson[3], Danie Beukes[2], Michael van der Laan[4], Reimund P. Rötter[3]

[1] *Leibniz Centre for Agric. Landscape Res. (ZALF), Landscape Res. Synthesis, Germany*
[2] *Agricultural Research Council (ARC), Inst. for Soil, Climate and Water, South Africa*
[3] *Georg-August-Universität Göttingen, Dept. of Crop Sciences; Tropical Plant Production and Agricultural Systems Modelling (TROPAGS), Germany*
[4] *University of Pretoria, Dept. of Plant Production and Soil Science, South Africa*

Abstract

Diversifying cropping practices is perceived as an important part of sustainable and productive and resource efficient farming systems in southern Africa. However, there are few field experiments to evaluate the long-term effects (10 years) of the different farming systems (such as fertiliser application, residue management, tillage practices and cropping systems). Given that each practice interacts with the environment (soil and climate), process-based crop modelling could be a useful tool, but has been scarcely applied to investigate long-term effects of cropping practices in southern Africa.

On this background, we first evaluated the widely used crop model APSIM against field data from two environmentally different sites in South Africa: Zeekoegat (heavy clay soil) and Buffelsvlei (sandy soil). Experiments were conducted for six and eight years, respectively, comparing a wide range of cropping practices: fertiliser rate (low, high), system (intercropping, rotation), tillage (reduced and conventional), and crop (cowpea, soy, maize, pearl millet, sunflower, and oats). Field measurements included grain yield, dry matter, N_{min} and soil organic carbon (SOC). APSIM was capable of reproducing the crop growth dynamics at both sites. At Zeekoegat, high yields in the first two years were associated with good rainfall and high available N_{min} resulting from a fallow period prior to the trial. After the two years, unfavourable rainfall patterns and soil compaction reduced yields substantially. At Buffelsvlei, yields were higher, as the sandy soil allowed deeper rooting and more efficient water use than the clay soil at Zeekoegat. Simulated and observed SOC at both sites did not differ strongly from the initial conditions.

Secondly, we used the evaluated model to investigate the effect of increased diversification in cropping practices on profitability, yield, water use, N_{min}, and SOC at both sites over a 10-year period. Simulations showed high diversification is most beneficial in dry years, in particular with pearl millet. While legume integration improved soil fertility and the productivity of the following crop, it may reduce the profitability of cropping at current price levels. These few findings already illustrate the usefulness of crop models to improve management decisions, particularly when data availability is limited.

Keywords: APSIM, intercropping, legumes, maize, rotation

Contact Address: Munir Hoffmann, Leibniz Centre for Agric. Landscape Res. (ZALF), Landscape Res. Synthesis, Eberswalderstr. 84, 15374 Müncheberg, Germany, e-mail: munir.hoffmann@zalf.de