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Virtual Crop Modelling for Technology Impact Assessment - Lessons from a Potato Crop Growth Model

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Abstract

Efforts are under way in the agricultural research for development community to employ crop growth simulation models for the *ex-ante* assessment of the impacts of agricultural technologies, in particular improved crop varieties. The approach, dubbed "virtual crop modelling", consists in the manipulation of genetic coefficients of the cultivars contained in crop growth models to simulate productivity effects of genetic improvements brought about by future breeding efforts and assesses the impacts of these improvements under field conditions. However, the suitability of the models for this purpose is not yet proven.

In an effort to explore the suitability of crop growth models for virtual crop modelling, the DSSAT-SUBSTOR potato growth model, a model which simulates potato growth as a function of abiotic, but not of biotic factors, is used to carry out a sensitivity analysis of changes in genetic coefficients of a modern tropical potato cultivar. Yields are simulated across a wide range of genetic coefficients of the crop model at sites located in four contrasting tropical, subtropical and temperate environments.

Simulation results show that the model responds to parameter changes as expected and that it gives meaningful results in all tested environments. Site characteristics appear to play an important role for potential simulated yield levels and for the responses of the model to changes in genetic coefficients. However, there is substantial unexploited potential for productivity growth from improved management practices. This potential appears to be greater than the benefits from genetic improvements that appear likely today.

The analysis shows that, by helping to identify yield constraints for different environments, crop modelling can make substantial contributions to *ex-ante* impact assessment of agricultural technologies. Virtual crop modelling, however, is only a viable option if crop growth is actually constrained by those genetic factors which are represented by adjustable genetic coefficients of a given crop model. Furthermore, the scope of many crop models is limited to abiotic yield-limiting factors and an extension towards biotic factors, *e.g.* a linkage with disease models, might be necessary for some environments.

Keywords: Crop improvement, crop modelling, DSSAT, *ex-ante* impact assessment, potatoes, SUBSTOR

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