

Calibration of APSIMx for key crops in Germany with public data

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Abstract: Robust model calibration is essential for transparent and reliable crop modeling, particularly for regional applications where data availability is often limited and model performance is sensitive to crop parameterization. Manual calibration remains common practice, especially for local field studies, but is time-consuming and demands substantial modeling expertise. The APSIM classic version has been used for a variety of crops in Northern Europe, but its use has largely been restricted to local studies with manual calibration. Recent advances, such as the *croptimizR* R package (Buis et al., 2024), have introduced automated calibration workflows and standardized protocols to enhance comparability across modeling groups (Wallach et al., 2025). While these developments promote good modeling practice in international multi-model ensemble initiatives, they may present challenges for novice users. *CroptimizR* is compatible with any model executable from R, with established interfaces for the crop models STICS and APSIM.

The new APSIM Next Generation (APSIMx) offers significant advancements, yet robust crop parameter sets for European conditions remain scarce. In this study, we leveraged the *croptimizR*-APSIMx interface to derive robust crop parameters. We assessed their transferability for regional modeling objectives in Germany, where public agricultural datasets have increasingly been used in research projects such as AgriScape (<https://www.ufz.de/agriscape/>) and ErLa (<https://www.umweltbundesamt.de/ErLa>). The stepwise calibration of first phenology and then yields was done for the key German crops - winter wheat, silage maize and winter oilseed rape. Spring barley was calibrated as a complementary summer cereal crop. To ensure calibration robustness, the four crops were calibrated using only publicly available data—including weather, crop phenology, yield, and soil properties. Calibration and validation were performed at different locations with contrasting pedoclimatic conditions in Germany to evaluate spatial transferability. The entire workflow, including data preparation, calibration, and analysis, was implemented in R and is fully documented and publicly available to facilitate reproducibility in other German regions or beyond. Our results provide the first generic APSIMx crop parameters for these four crops under German conditions. Despite substantial differences in temperature, soil, and rainfall between calibration and validation sites, APSIMx demonstrated strong predictive performance for both phenological phases and yields. Automated calibration with *croptimizR* improved model predictions compared to default cultivar parameters. These findings highlight the potential of publicly accessible datasets to enable reproducible and transferable crop model calibration, supporting regional-scale studies and resource-efficient modeling. This work advances model reliability and supports broader applications in sustainable agricultural management, particularly within the German context.

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Keywords: APSIMx, Calibration, Agriculture, Germany, FAIR, *croptimizR*