(105)

Application of Crop Simulation Models as a Strategy for Climate Change Risk Assessment and Adaptation in Agricultural Systems.

Wijekoon W.M.P.C.*, Jayasinghe G.Y, Maheepala S.A.D.S.S

Department of Agricultural Engineering, Faculty of Agriculture, University of Ruhuna, Sri Lanka
**prabuddhiwijekoon@gmail.com*

Abstract

Continuing global population growth which is projected to be reaching 9.8 billion by 2050, will remain a substantial risk on global food security remaining an unprecedented demand for food which will exceeding by 70%-100%. Agricultural systems are focusing on fulfilling the increasing demands intensively where agricultural systems are greatly influenced by climate change which is hardly adaptable; leading reduction of crop yields due to its high dependency on variations in weather. Elevated temperature and carbon dioxide affects the biological processes like respiration, photosynthesis, plant growth, reproduction and water use. Thus, the variability of climate and associated weather extremes has become a major concern of modern science where crop models are accepted as adequate tools for decision making in relevant aspects. Crop simulation models are computer programs that use quantitative descriptions of physiological processes to mimic plant growth and development as influenced by environmental conditions and crop management. The applications of crop models have been extended across regions at multiple scales to assess the impacts of climate change and identify adaptation strategies. Proper understanding of the effects of climate change will help optimising crop management decisions initiating from selection of crop cultivars, sowing dates, fertilising and irrigation scheduling, to minimize the risks. Crop models are functional in assisting the breeding programs, developing new crop rotations and maximising the value of seasonal climate forecasts. They have facilitated extrapolation and establishment of new hypothesis for climate change studies, stimulated investigations into climate change adaptation, and assisted in communicating to the public and policy makers. Much of the current focus on climate change risk assessment is concentrated on stringent 1.5–2^{o} C limit on global warming as agreed at international climate negotiations in Paris, 2015 (COP21). Decision Support System for Agro-Technology Transfer (DSSAT), Agricultural Production Systems Simulator (APSIM), CERES (Crop Environment Resource Synthesis) and Aqua crop models are among widely using crop models in worldwide. Combining climate change and crop models to predict impacts of climate change on crop productivity can ultimately guide planning of climate change adaptation strategies to ensure future food security. However, the consistency of these models and experimental data has been debated where the ability to simulate impacts of high CO_2 and climate variability are doubted. Integrated limiting factors including soil nutrients, pests and weeds are neither fully understood nor well implemented in prominent models. Targeted model developments are important to be focused on the interactions of abiotic; biotic factors and plant genetic variability with elevated CO_2 and temperatures together with their effects on harvest. Future crop modeling will incorporate risk assessment approach with greenhouse gas emission scenarios and regional climate models. This paper reviews applications of crop models in climate change simulation with their advantages, disadvantages and future perspectives.

Keywords: Climate change, Crop models, Agriculture, Risk assessment, Adaptation