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Climate change impacts on maize yields in Cameroon as mediated by heat-tolerance adaptation

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Abstract

Sub-Saharan Africa is projected to be exposed to above-average climate change and possesses thereto substantial exposure to climate change hazards, especially in its agricultural sector, so adaptation will be necessary to safeguard food security. This is urgent, because tropical and subtropical maize production regions approach critical temperature thresholds in the growing season already in today's climate. Adaptation requires an understanding and assessment of potential impacts of climate change on crop production and possible adaptation options. These can be studied using process-based crop models. Here, the agricultural production systems SIMulator APSIM was used to model climate change impacts on maize in Cameroon in a spatially disaggregated, grid-based approach as to represent Cameroon's diverse agro-ecological zones. This was done for the two climate change scenarios SSP1–2.6 and SSP3–7.0 for the time period 2020–2100. The impact of heat tolerance adaptation in maize was assessed by parametrising one unadapted baseline variety and one synthetic heat-tolerant variety in APSIM and comparing yield outcomes. Model performance was satisfactory, and results indicated major yield losses for unadapted maize under both climate change scenarios. Yield losses were highest in Cameroon's semiarid north and under the high emissions scenario SSP3–7.0 in which case national mean yield losses exceeded 60 % compared to the baseline period 1995–2015. Climate change impacts on maize yield could be dominantly attributed to heat stress. Heat tolerance adaptation substantially mitigated yield losses under climate change and also led to yield increases in the baseline period, indicating the presence of limitations to maize yield due to heat stress already now. Mean yield gains conferred by heat tolerance adaptation were over 0.5 t ha^{-1} and yields of the adapted cultivar were higher than for the baseline cultivar in all time periods and for both scenarios. The magnitude of the gains however was time- and scenario-dependent. When compared to the baseline period, yields of the adapted cultivar still substantially declined under the high emissions scenario after 2050, which implies insufficiency of heat tolerance adaptation alone for completely mitigating impacts of severe warming in tropical maize production regions.

Keywords: Adaptation, APSIM, Cameroon, climate change, crop model

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