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Climate change and crop productivity in west africa: the case of soybean in the Nigeria savannahs

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Abstract

A well-calibrated and evaluated GROPGRO module of the Decision Support System for Agro-technological Transfer (DSSAT) was used to simulate productivity of soybean in northern Nigeria under climate change. Both historical (1990–2019) and projected climate scenarios from 5 general circulation models (GCMs) under two representative concentration pathways (RCP 4.5 and RCP 8.5) in the mid-century (2040–2069) and end of the century (2070–2099) periods were used. Depending on climate scenario, the minimum temperature is expected to rise by 1.7–4.4°C at Kano in the Sudan savannah (SS) agroecological zone (AEZ) and 1.4–4.0°C at Zaria in the northern Guinea savannah (NGS) AEZ, while maximum temperatures are projected to increase by 1.7–4.1°C in the SS and 1.3–3.6°C in the NGS. Seasonal average rainfall will increase by 4.8–14.5 % in the SS and decrease by 2.6–3.8 % in the NGS, relative to the baseline climate. The model predicted delaying trends for days to flowering and maturity for both varieties in all climate scenarios in the two AEZs. Despite the delay in flowering and increase in crop cycle length, climate change will result in grain yield reduction in most of the future scenarios. Across location, variety and time slice, the grain yield will decline by between 8.4 and 23.6 % under RCP4.5 scenario, with much higher decline by between 28.7 and 51.4 % under RCP 8.5 scenario. However, using the early maturing variety can reduce the adverse effects of climate change on grain yield. On average, the yield of the early-maturing TGX1835–10E is predicted to be 15.2 % higher under RCP4.5 scenario and up to 21.7 % under RCP8.5 than that of the medium-maturing TGX1951–3F for both centuries in the SS AEZ. In the NGS, the average yield of TGX1835–10E is predicted to be 9.0 % and 7.5 % higher than that of TGX1951–3F under RCP4.5 and RCP8.5 scenarios, respectively. Therefore, using early maturing variety is one of the strategic management option to enhance the resilience of soybean productivity under climate change in Nigeria savannahs.

Keywords: AEZs, climate change, DSSAT, *Glycine max*, Nigeria, productivity

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