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Simulating pest risks and impact in maize production outlooks for Nigeria under climate change

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Abstract

Agriculture in many developing countries is expected to be severely affected by climate change. The majority of Africa's population traditionally depends on maize for their livelihoods. The recent invasion and spread of the fall armyworm (FAW), white grubs and other maize pests in Africa is therefore one of the major factors hindering sustainable food security on the continent. Estimating the simultaneous impact of climate change and major pests on maize yields, its spatio-temporal pattern and narrow time windows is most useful for early warning, but is not addressed in the current literature. We present an approach based on remotely sensed climate and biophysical data and agro-system modelling to fill this gap, using Nigeria as an example. We start from a baseline maize yield simulation that produces mean yields of 800–1200 kg ha–1, 1000–1700 kg ha–1 and 1200–2300 kg ha–1 under low, medium and high nitrogen supply, respectively. Potential pest impacts can be responsible for mean yield losses of up to 18–75 % and 8–73 % (USD 72.4 – 675.3 ha–1) for white grub and FAW, respectively, under different severity thresholds, depending on locations and when maize was sown. Importantly, our findings reveal the influence of changing sowing windows on the magnitude of yield losses. Early sowing resulted in higher yield losses, while medium and late sowing generated lower yield losses for all simulated years. Our pest risk predictions show moderate to high growth index numbers for FAW to occur in Nigeria, especially in the 2021–2060 windows, and most favourable in the cropping seasons in all agro-ecological zones (AEZs). Favourable breeding conditions for FAW decreased over time and were almost absent in the savannahs by 2100. However, the risk projections show higher stress indices occurring from 2081 to 2100 and a decline in growth index counts. This information is key to understanding pest adaptation in Nigeria, and how crop management can support sustainable yield improvements. The findings can be used to improve organic crop management and facilitate policy formulation for future climate change adaptation and mitigation for optimised agricultural production, innovative chemical control, sustainable pest management, and secure access to food.

Keywords: Climate change, fall armyworm, suitability, white grub, yield loss

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