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Climate-related risk modelling of banana xanthomonas wilt (BXW) disease incidence within cropland area of Rwanda

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Abstract

Banana Xanthomonas Wilt (BXW) is the major threat to banana in Rwanda, causing up to 100 % yield loss. There are no biological or chemical control measures, and little is known about potential direction and magnitude of its spread, so cultural control efforts are reactive rather than proactive. In this study, we assessed BXW risk under current and projected climate, to guide early warning and control by applying maximum entropy (Maxent) model on 1,022 georeferenced BXW datapoints and 20 environmental variables. We evaluated the variables' significance and mapped potential risk under current and future climates to assess spatial dynamics of the disease distribution. BXW occurrence was reliably predicted (mean validation AUC ranging from 0.79–0.85). Precipitation of the coldest quarter, average maximum monthly temperature, annual precipitation, and elevation were strongest predictors, explaining 21.1 %, 13 %, 12.6 %, and 9.4 % of the observed incidence variability, respectively, while mean temperature of the coldest quarter has the highest gain in isolation. Further, the most susceptible regions (in western, northern, and southern Rwanda) are characterised by elevation (1,350 m - 2,000 m), annual precipitation (900 mm - 1700 mm), and average temperature (14 °C - 20 °C), among other variables, suggesting that a consistent, rainy, and warm climate is more favourable for BXW spread. Under future climate, the risk is predicted to increase and spread to other regions. We conclude that climate change will likely exacerbate BXW-related losses of banana land area and yield, under temperature and precipitation influence. Findings support evidence-based targeting of extension delivery to farmers and national early warning for timely action.

Keywords: Banana, climate change, decision-support, digital innovation, early warning, risk, xanthomonas wilt

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