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Development of a rice tungro epidemiological model for seasonal pest risk prediction in the Philippines

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Through an integration of seasonal climate forecasts (SCF) and rice pest epidemiological models, a potential risk for rice pest epidemics can be predicted even before a cropping season starts. A seasonal pest would outlook allows agricultural stakeholders to proactively assess and manage risk on a seasonal scale. The objective of the study was to develop and evaluate an epidemiological "rtdSim" model for tungro, a vector-born rice disease, aiming at producing a seasonal tungro outlook for the Bicol Region of the Philippines. Given the complex nature of three-cornered pathosystems (virus, vector, and host) and their interactions with environmental variables (temperature and rainfall), a simplified model capable of predicting tungro epidemics makes use of many assumption-based, simplified model algorithms. The rtdSim model calculates the rate of rice hill infection with the rice tungro virus by its vector, the green leafhopper (GLH), through two linked modules: the "GLH population growth module" simulating GLH population dynamics of a complete life cycle and their immigration from nearby rice paddies; and the "Infection module" simulating virus transmissions from infected rice hills to the GLH vector, and viruliferous GLH to healthy hills. The rtdSim was successfully calibrated and validated, resulting in a reasonably high level of agreement between the observed and the simulated epidemics in most cases, allowing prediction of yield loss. Some limitations remain, include failure to allow for non-climatic confounding factors in modeling, insufficient validation due to limited ground-truth data, and low predictability of the SCF during the dry season in the region. The present study highlights the potential for developing a climate-based early warning system for rice pests, with SCF data as input, thus allowing better decision-making and prevention on a seasonal level.