PARAMETERIZATION OF THE SIMULATION MODEL TO PREDICT THE EVOLUTION OF GLYPHOSATE RESISTANCE IN BARNYARDGRASS IN COTTON

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Abstract

Herbicide-resistant barnyardgrass (*Echinochloa crus-galli*) is a growing issue in Midsouth rice, and evidences suggest that glyphosate-resistance in this species is highly likely in glyphosate-resistant cotton. A glyphosate-resistance simulation model has been developed to simulate the evolution of resistance under various management scenarios and to identify best management practices for resistance mitigation/management. The model was implemented in the STELLA^{TM} modeling software and was parameterized using field collected data, published literature, and using expert opinions when such information was not available elsewhere. The model represented a 60-ha cotton field with an initial barnyardgrass seedbank density of 2,000 viable seeds m^{-2}. The mutation rate was assigned to vary from $5e^{-8}$ to $1e^{-7}$ on a lognormal scale, and the genotype composition (RR, Rr and rr) of the initial seedbank was determined using the Hardy-Weinberg equilibrium. A cumulative emergence curve of barnyardgrass, which was characterized in Arkansas, was used to define various cohorts relative to their time of emergence. Efficacies for each management option for each barnyardgrass cohort were determined based on published data and expert opinions. The model accounted for the possibilities of new mutations during the period of simulation. Although the model is spatially implicit, a constant immigration and emigration of 1 seed m^{-2} was assumed at Hardy-Weinberg equilibrium frequencies for different genotypes. Barnyardgrass is a highly selfing species, and an outcrossing of 3% was assigned based on experimental data. The model also accounted for the presence of density dependence in barnyardgrass populations; exponential curves of density-dependent survival and fecundity were used as sub-models for this purpose. It was assumed that glyphosate-resistance in barnyardgrass is conferred by a single nuclear gene with incomplete dominance as this was the case in other species investigated. However, no fitness penalty or advantage was assumed for glyphosate resistance in barnyardgrass. Future works will include performing sensitivity analysis to understand the sensitivity of the model to changes in parameter values for different variables.