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Cropping system effects on giant foxtail (Setaria faberi) demography: II. Retrospective perturbation analysis

Adam S. Davis
Corresponding author. Department of Agronomy, Iowa State University, Ames, IA 50011; present address: Department of Crop and Soil Science, Michigan State University, East Lansing, MI 48824; davisad7@msu.edu
Philip M. Dixon
Department of Statistics, Iowa State University, Ames, IA 50011
Matt Liebman
Department of Agronomy, Iowa State University, Ames, IA 50011

Cropping system characteristics affect weed management by altering key demographic rates of weeds, including recruitment, seedling survival, fecundity, and seed survival. To facilitate the design and improvement of cropping systems that limit weed population growth, analytical methods are needed to identify weed management ''choke points'' (weed life stages that vary in response to management and whose variation strongly affects weed population growth rate). The objectives of this study were to (1) determine whether wheat–red clover green manure can limit giant foxtail population growth rate (l) in a wheat–corn–soybean crop sequence and (2) identify choke points in the giant foxtail life cycle with respect to the green manure treatment. Demographic data were used to construct a periodic matrix model of giant foxtail population growth in a wheat–corn–soybean crop sequence, with either a wheat sole crop (W) or a wheat–red clover intercrop (R) in the wheat phase. Identification of choke points was accomplished by adapting the life-table response experiment (LTRE) design for retrospective perturbation analysis of the periodic matrix model. The difference in l (Dl) between the two treatments was decomposed into contributions from each parameter in each rotation phase of the periodic model. Each LTRE contribution was equal to the product of the sensitivity of l to changes in a given parameter by the treatment difference in that parameter. Those parameters making large contributions to Dl represented weed management choke points. Giant foxtail population growth rate in the simulation was more than twice as great in the W treatment (l 5 2.54) than in the R treatment (l 5 1.16). Retrospective perturbation analysis indicated that the proportion of seeds surviving predation in the wheat phase made the largest LTRE contribution (0.55) to Dl, followed by seedling recruitment in the soybean (0.41) and corn (0.20) phases. By identifying weed management choke points within a given system, retrospective perturbation analysis can target research and management efforts for greater reductions in weed population growth.