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Using a landscape ecological model to assess effective pest management strategies for the wheat stem sawfly (Cephus cinctus) in the Northern Plains

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Abstract: Ecological models are valuable tools for exploring the factors that influence species distributions and abundances. In agricultural systems, landscapes can vary from stable and homogeneous to highly dynamic and heterogeneous depending on how they are managed. Accurately predicting crop pest dynamics is challenging enough as a result of these landscape variables; pest dispersal only compounds this complexity.

We constructed a mathematical landscape model of the wheat stem sawfly (Cephus cinctus) to examine how landscape structure, habitat connectivity, and habitat stability affect sawfly population dynamics, distribution, and abundance. The wheat stem sawfly (WSS) is a major pest of wheat in the Northern Plains of North America, and effective control has proven elusive.
Our model tracked WSS populations in thousands of lattice grid cells, each assigned a vegetation type (wheat, non-host crops, or grassland with host grasses). Using a matrix population model approach, we incorporated age-specific life history traits and annual dispersal and oviposition into predictions of population dynamics. Simulations varied by the proportion of the landscape covered by grassland habitat, habitat connectivity, and crop rotation frequency.
Model output included population size, infestation level, sawfly distribution, and spatiotemporal variability in landscape-level population size. The proportion of the landscape that was grassland, crop rotation frequency, and wheat habitat cohesion were all highly significant predictors of WSS population size and variability. Two- and three-way interactions among these factors were also highly significant, indicating context-dependent outcomes.

These results highlight the complexity ways in which multiple landscape factors influence WSS population size and distribution, and help explain why growers struggle to achieve reliable sawfly control.

Wednesday, September 24th | 2:00pm-3:15pm | Science Hall 126 & Zoom

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