

Landscape diversity enhances biological control of an invasive species in the north-central U.S.

M. M. GARDINER¹, D. A. LANDIS¹, C. GRATTON², C. D. DIFONZO¹, M. O'NEAL³, J. M. CHACON⁴, M. T. WAYO¹, N. P. SCHMIDT³, E. E. MUELLER² and G. E. HEIMPEL⁴.

¹Department of Entomology, 204 Center for Integrated Plant Systems, Michigan State University, East Lansing, MI USA. ²Department of Entomology, 1630 Linden Dr., 237 Russell Labs, University of Wisconsin, Madison, WI USA. ³Department of Entomology, 177 Insectary, Iowa State University, Ames, IA USA. ⁴Department of Entomology, 219 Hodson Hall, 1980 Folwell Ave., University of Minnesota, St. Paul, MN 55108

The introduction of the soybean aphid, *Aphis glycines* Matusumura dramatically changed herbivore populations in soybean across the north central U.S. We examined whether existing natural enemies provide an ecosystem service to the region by suppressing soybean aphid populations and if the amount of biocontrol supplied to a soybean field was related to the structure of the surrounding landscape. We measured this in 26 replicate fields across Michigan, Wisconsin, Iowa, and Minnesota. Predators, principally coccinellid beetles, dominated the natural enemy community of soybean. In the absence of aphid predators, *A. glycines* increased significantly, with 5.3 fold higher aphid populations found on plants where predators were excluded. We calculated a biological control services index (BSI) based on relative suppression of aphid populations and related it to landscape diversity and composition at multiple spatial scales surrounding each site. We found that BSI values increased with landscape diversity, measured as Simpson's D. Landscapes dominated by corn and soybean fields provided less biocontrol service to soybean compared with landscapes with an abundance of crop and non-crop habitats. We found differences in the relationship between the abundance of native versus exotic coccinellids and the composition of the landscape surrounding soybean fields. Native species were most abundant in low-diversity landscapes with an abundance of grassland habitat while exotic coccinellid were associated with the abundance of forested habitats. We propose that grassland dominated landscapes with low structural diversity and low amounts of forested habitat may be resistant to exotic species and therefore represent landscape-scale refuges for native coccinellid biodiversity.