

## Density-dependent predation of weed seeds in maize fields

Paula R. Westerman, Jaclyn K. Borza, Jelena Andjelkovic, Matt Liebman and Brent Danielson

### Summary

1. Seed predation can cause substantial losses of newly produced weed seeds and can therefore be important in regulating weed densities. The impact on weed population dynamics is greatest if predation acts in a directly density-dependent manner.

2. We investigated the effect of between-patch variability in seed density on seed removal. For this purpose, artificial weed seed patches were created by broadcasting giant foxtail *Setaria faberi*, at low (1000 seeds m<sup>-2</sup>), medium (4500 seeds m<sup>-2</sup>) and high densities (9500 seeds m<sup>-2</sup>) over 25·25 m areas within three maize fields in August. Changes in giant foxtail seed densities were evaluated 3 weeks and 7 weeks post-application, using soil surface sampling.

3. Observations of seed predation rate (seeds seed<sup>-1</sup> week<sup>-1</sup>), using seed cards and enclosure cages, activity–densities of invertebrates using pitfall traps, and population estimates of rodents using Sherman live traps, were conducted to understand and explain the dynamics of seeds on the soil surface.

4. Three weeks after seed addition, seed predation was strongly and inversely density dependent. After 7 weeks, the net response since the start of the experiment exhibited only a weak inverse density dependence. This means that between 3 weeks and 7 weeks after seed addition, the response had reversed from inverse to almost direct density dependence.

5. During the August–October period, seeds in maize fields were mainly consumed by invertebrates. The most abundant granivorous invertebrates were crickets *Gryllus pennsylvanicus* and *Allonemobius allardi*, and carabid beetles, especially *Harpalus pensylvanicus*. The insects appeared unable to detect and respond numerically to weed patches, resulting in inversely density-dependent predation, which favours the persistence of weed patches. The granivorous prairie deer mouse *Peromyscus maniculatus bairdi*, was present but contributed little to overall seed losses in autumn.

6. *Synthesis and applications.* The results of this study indicate that weed densities in maize fields currently are not regulated through directly density-dependent seed predation, because the time between seed shed and seed movement into soil is too short for invertebrates to respond to and level out spatial differences at the scale of weed patches. However, our results suggest that delaying crop harvest and tillage may provide invertebrate predators with more time to attack weed seeds, and may allow for subsequent predation by vertebrates, which would be directly density-dependent.