PROSPECTS OF WEED SEEDBANK REGULATION BY SEED PREDATORS. Paula R. Westerman, Matt Liebman, Fabián D. Menalled*, Andrew H. Heggenstaller, and Megan O'Rourke, Postdoctoral Scientist, Professor, Assistant Professor, Graduate Research Assistant, and Graduate Research Assistant, Department of Agronomy, Iowa State University, Ames, IA 50011-1010, and *Department of Land Resources and Environmental Sciences, 719 Leon Johnson Hall, Montana State University, Bozeman, MT, 59717-3120.

There is a growing body of evidence showing that seed predators consume a large proportion of the weed seeds produced in arable fields. At the same time, an increasing number of modeling studies show that post-dispersal losses have a major impact on long-term weed seed bank densities. Consequently, seed predation is a natural addition to applied weed control, and farmers may consider measures to favor it. However, because we are only beginning to understand the factors influencing seed predation, we do not yet know how to favor seed predators or enhance seed mortality due to predators. Post dispersal seed losses vary considerably, both spatially and temporally. Detecting patterns and elucidating causes of variability may be keys to understanding and utilizing seed predation in biological weed control. Here, we will mainly focus on patterns emerging from seed predation trials done in experimental and commercial cereal and sugarbeet fields in the Netherlands and in a field experiment in Boone, IA, comparing corn, soybean, triticale and alfalfa in 2-, 3-, and 4-yr crop rotation systems. Patterns emerging from these trials will be supplemented with data available in the literature.

Seed losses due to predation are a function of the intersection between temporal patterns of seed predation ('demand') and seed availability ('supply'), as defined by both seed deposition and seed residence time on the soil surface. Temporal patterns of seed predation in spring, summer and autumn are related to changes in the numbers and activity of seed predators present in the field, which appear to be positively correlated with the amount of crop canopy present (Iowa and the Netherlands). Seed deposition differs among weed species, crops and climates; differences in the potential annual losses due to predation among weed species are mainly caused by differences in the timing of seed shed (the Netherlands). Preliminary data, furthermore, indicate that predation rates in winter are high, despite the absence of a canopy (the Netherlands). Seed burial can be accomplished by tillage, which varies among crops and rotations. In no-till situations, seed burial is caused by natural causes. Preliminary trials in Iowa and the Netherlands have shown that seed size, crop type, rotation system and weather conditions are important in the process of seed burial.

At least part of the variability in seed predation is the result of the involvement of different groups of seed predators. The principal seed predators can be either vertebrates, such as birds and rodents (the Netherlands, Iowa), or invertebrates, such as slugs, ants, ground beetles (the Netherlands), and crickets (Iowa). These groups differ in numbers, activity, mobility, food requirements, food and habitat preferences, and population dynamics. While it is likely that they respond differently to crops, crop management practices, and tillage regimes, it is currently unknown what factors determine the presence or absence of certain groups of predators at specific locations.

Seed preference in relation to seed availability is an unresolved issue. Preliminary evidence suggests that rodents are less choosy when seeds are scarce, and that they show preference when food is abundant (The Netherlands). Invertebrates, such as crickets and ground beetles, show a clear seed preference in laboratory trials with abundant seed (Iowa). Seed abundance should also affect the numbers and behavior of predators (numerical and functional response) and the predation rate (density dependent response). The scale at which these processes take place depends on the mobility of the principal predators. For example, the addition of a large amount of weed seeds to cereal plots caused an increase in seed demand in the Netherlands, where rodents were prevalent.

Understanding the temporal patterns of seed demand and supply provides the best opportunities to manipulate and maximize weed control by seed predators. Of the above factors, the farmer may be able to use crop choice, rotation system, and tillage regime as tools to facilitate natural weed control.

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