DEPARTMENT OF NATURAL RESOURCES

Evaluating exposure of grassland wildlife to soybean aphid insecticides in Minnesota's farmland region

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Background

Concerns about the impact of insecticides on birds, pollinators, and other wildlife are gaining increasing attention. Chlorpyrifos, lambda-cyhalothrin, and bifenthrin (hereafter, target chemicals) are three insecticides commonly used to control soybean aphids in Minnesota's farmland region. Lab studies have shown these chemicals to be highly toxic to non-target organisms including several bird and beneficial insect species, but few studies have investigated the exposure of free-ranging wildlife to these chemicals. Chemical drift has been reported in other studies but very little Minnesota-specific data exists to understand this issue.

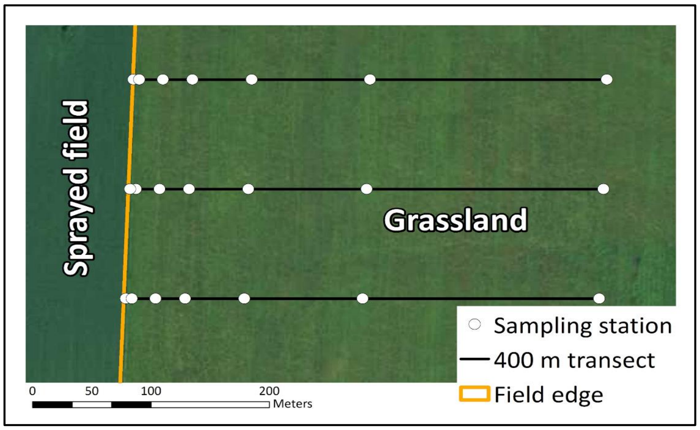
Objectives

Determine the environmentally-relevant exposure of Minnesota's grassland wildlife to insecticides sprayed to control soybean aphids. In particular:

1) Quantify the concentration of target chemicals along a gradient from soybean field edge to grassland interior to see if wildlife are (a) directly exposed via contact with spray drift and (b) indirectly exposed through their food (insect prey).

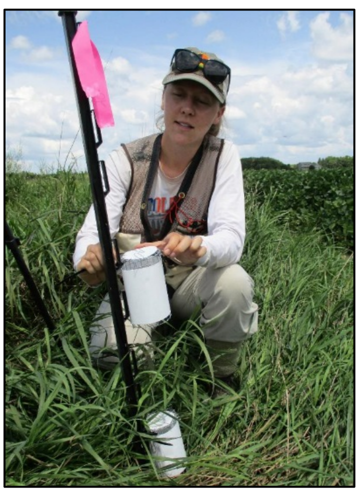
2) Compare relative abundance, richness, diversity, and biomass of insects along a gradient from soybean field edge to grassland interior prior to and post-spraying to assess the indirect impact of target chemicals on food availability for grassland nesting birds and other insectivorous wildlife.

Methods



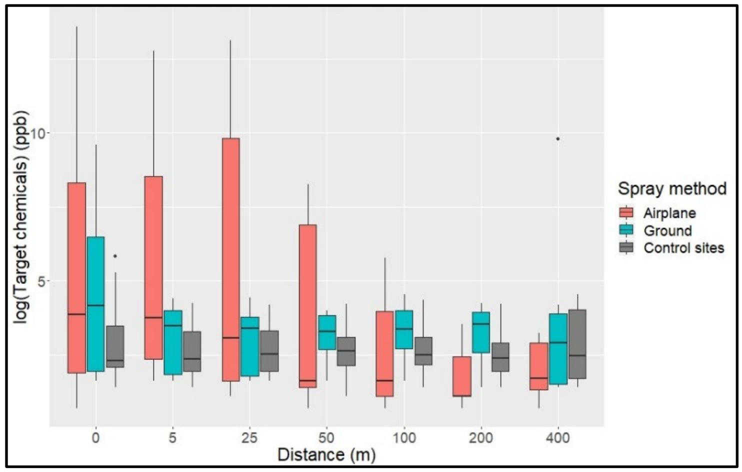
Our treatment sites were Wildlife Management Areas (WMAs) that had soybean fields immediately adjacent to the WMA. Our control sites were WMAs with a corn field immediately adjacent to the WMA. During summers 2017 and 2018, we worked closely with private landowner cooperators to precisely time our field data collection. At each Wildlife Management Area (WMA) site, we established three transects perpendicular to the soybean field edge. We then established sampling stations at various distances (0-400 m) along each transect.

The day before the spraying event, we collected data vegetation data at each sampling station. On the day of spraying, we deployed passive sampling devices made of filter paper immediately prior to the landowner spraying the adjacent soybean field. During the spraying event, we used a weather meter to collect data on weather conditions, including temperature, wind speed, wind direction, and relative humidity. Immediately after the spraying event, we collected our filter paper and insect samples and then properly stored these samples until later processing in the lab.



Results To Date

We sampled a total of five treatment and four control sites between July-September across our two field seasons. Our cooperators primarily sprayed chlorpyrifos but other insecticides were also used. We detected target chemicals at all distances examined (0-400 m from the grassland edge to the interior) at both treatment and control sites, suggesting that some baseline amount of spray drift occurred in the environment regardless of landowner spraying activities in the adjacent crop field.



Direct Exposure to Spray Drift

We also examined the importance of weather, vegetation, and other factors in explaining direct exposure. Our results indicate that mean air temperature and direction of the wind relative to the WMA during soybean spraying events, percent canopy cover of live vegetation (primarily grasses and flowering plants), distance from grassland field edge, and position in the grassland canopy layer were all important factors explaining deposition and drift of target chemicals onto WMAs. In particular, we found insecticide deposition was greater at the field edge than the grassland interior, and deposition was also greater at mid-canopy than ground level. Spray application method (i.e., ground or airplane) was not important in explaining patterns of target chemical deposition on our WMA sites.

Indirect Exposure to Spray Drift

We also detected target chemical residues on invertebrates at all distances examined (0-25 m) at both treatment and control sites. Further, our results showed mean air temperature and the maximum height of live vegetation best explained patterns of deposition on invertebrates. Distance to field edge had a weak relationship with chemical deposition on invertebrates, however, and is likely due to the shorter range of distances that we evaluated for this objective. Similar to direct exposure, spray application method was not important in explaining patterns of indirect exposure.

Future Work

We are still evaluating the indirect effects of spray drift on relative abundance, richness, diversity, and biomass of invertebrate prey.

Our final analyses and interpretation of all results will be completed this fall (2019) and incorporated into a thesis as part of our graduate student's Master's degree requirements for graduation. The chapters from her thesis will be turned into publications in peer-reviewed scientific journals and shared with other scientists and natural resource professionals.

We will continue to disseminate our results with DNR wildlife managers and other staff so they can incorporate our findings into their habitat acquisition, restoration, and management activities. Finally, we will also share our findings with our private landowner cooperators and the larger agricultural community to bring awareness to the issue of and factors influencing soybean aphid insecticide drift onto public grasslands. Ultimately, our research will help improve design and management of both public and private set-aside habitats for wildlife in Minnesota.

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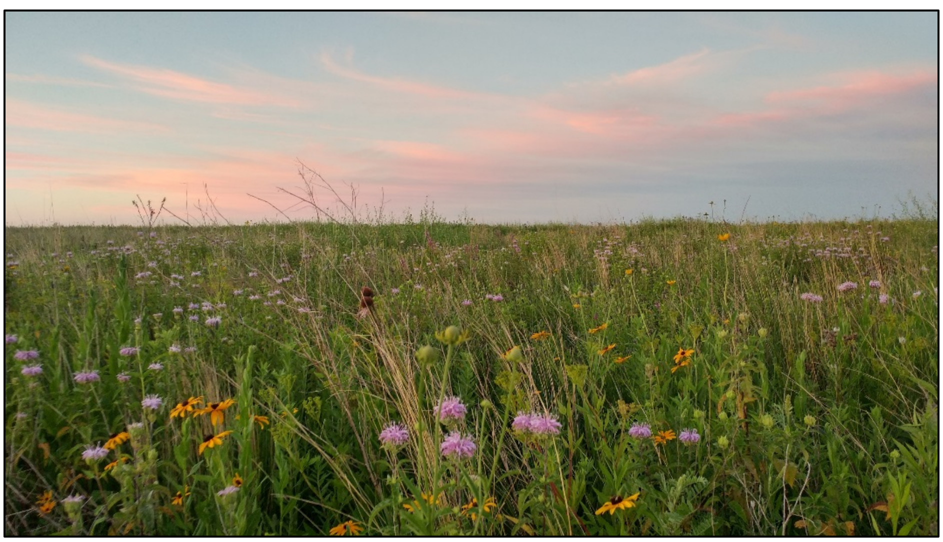

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