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MPSG ANNUAL EXTENSION REPORT

PROJECT TITLE: **Determining the role of crop and non-crop habitats to provide sustainable aphid suppression in soybeans**

PROJECT START DATE: 1 May 2017 **PROJECT END DATE: 31 March 2020**

DATE SUBMITTED: 3 July 2019

PART 1: PRINCIPAL RESEARCHER

PRINCIPAL

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PART 2: EXECUTIVE SUMMARY

Outline the project objectives, their relevancy to pulse and soybean farmers, and a summary of the project to date, including methods and preliminary results.

Soybean aphids are major pests in North America and reach outbreak levels in some fields in Manitoba every year. Our previous research demonstrated widespread control of soybean aphid by generalist predators in Manitoba. The ecosystem service of pest control depends on the presence and quality of habitats supporting predator populations in agricultural landscapes. The quality of the resources present in different habitats affects the fitness of the predators present in the landscape, which in turn affects their mobility (i.e. how far they will travel from their original habitat and into field crops to attack pests) and their fecundity (how many predacious offspring are they able to provide to control pest population outbreaks). Our objectives are: 1) Determine the effect of field size and distance to the nearest source of natural enemies on soybean aphid control; 2) Determine landscape effects on the fitness of predators suppressing aphids in soybeans, and 3) Identify key crop and non-crop habitats in the agricultural landscape that produce healthy and effective assemblages of generalist predators. We have conducted predator exclusion experiments and sampled for predators and aphids July-August 2017 and 2018. In 2017 there was an outbreak year of soybean aphids in the majority of our fields. We saw increased numbers of lady beetles, syrphids and nabid bugs in response to the high aphid populations. In 2017, we saw larger seven-spotted lady beetle females in alfalfa earlier in the season than in soybean and found male weight to be affected by aphid abundance, but not habitat type. We are currently analyzing the results of the 2018 season.

PART 3: PROJECT ACTIVITIES AND PRELIMINARY RESULTS

Outline project activities, preliminary results, any deviations from the original project and communication activities. You may include graphs/tables/pictures in the Appendix.

Prepared by Crystal Almdal (M.Sc. student in the project) and Alejandro Costamagna
Field sites: A total of 23 soybean fields sites in Manitoba, were selected in 2017(12) and 2018(11). Each soybean field was located beside either canola (Brassica napus), spring wheat (Triticum aestivum), alfalfa (Medicago sativa), or woody vegetation. The soybean field sites ranged from being in low, medium, to highly vegetated landscapes, so that each adjacent habitat type was in each category of vegetated landscape. See appendix for field locations and breakdown of habitats sampled. Field Manipulations: Predator exclusion cages were set up in each of the soybean field sites the week of July 17-21 (2017) and July 16-20 (2018), for a total of 5 exclusion and 5 open cages. The exclusion cages consisted of a wire tomato cage (0.4 m diameter × 1 m tall) covered by fine mesh (white no-see-um netting with 0.24 mm2 openings). The cages were placed 75 m from the road border and 20 m from the field border (shared with adjacent habitat). Each cage pair was separated by 5 m and within cage pairs were separated by 1m. In 2017, potted plants were transplanted into the soybean fields for the predator exclusion experiment. Untreated soybean seeds were grown in greenhouse conditions three weeks prior to transplantation into the cage treatments. Two soybean plants at vegetative stage 3 or 4 were transplanted into the field in each cage. In 2018, field plants were used for the predator exclusion experiment. We used one field plant per cage. Seven aphids were placed on each potted plant in 2017 for a total of 14 aphids per cage, and in 2018, a total of 14 aphids were placed on one field plant per cage. Aphids were taken from a colony at the University of Manitoba, Department of Entomology. Weekly aphid counts were conducted to determine the abundance of Aphis glycines at two different times during the experiment. Destructive plant counts were conducted within soybean fields to determine the abundance of aphids within the fields during the predator exclusion experiment. 10-20 plants were selected randomly within the field. Aphids were counted, plant height was measured, and the vegetative and reproductive stage of soybean was recorded. Sweep net samples were conducted weekly in each habitat 25 m from the shared border for a period of three weeks, starting the week of July 17-21 (2017) and July 16-20 (2018). Sweep net samples consisted of twenty-five 180-degree sweeps, for a total of 5 subsamples per habitat. Sticky traps were placed in each habitat in 2017, placed 5 m apart, directly in front of the experimental cage pairs. They were set up for the period of the predation exclusion experiment, and were changed weekly, for a total of two collection dates. Timed samples were conducted in woody vegetation habitats as it was often difficult or impossible to take sweep net samples in 2017. Timed samples consisted of walking around for 15 minutes with an aspirator to collect insects within the woody vegetation. In 2018, we conducted weekly quadrat samples in all habitats sampled, for a period of three weeks. The quadrats were 0.3x0.3m and were placed haphazardly within each habitat for a total of 5 subsamples per habitat. One bi-directional malaise trap was placed between soybean and the selected adjacent habitat in each of the soybean field sites approximately 75 m from the road border. The traps were placed the week of July 17-21 (2017) and July 16-20 (2018) and were changed once, for a total of two collection dates. Crop and non-crop habitats in a 2 km radius surrounding the focal soybean fields were mapped. Habitat identification was ground-truthed in person, August 2017 & 2018.

Project progress to date: We have conducted all predator exclusion experiments and sampling planned for 2017 and 2018. All sweep net samples have been processed for predators and pests. All sticky card samples have been processed for predators and aphids. The bi-directional malaise traps have been processed for predators. All Arc GIS maps have been completed. All data has been entered except for the quadrat samples. Individuals belonging to the lady beetle species Coccinella septempunctata have been weighed and their body size measured from both malaise traps and sweep net samples from 2017. Data analyses are ongoing.

APPENDIX

Field Sites

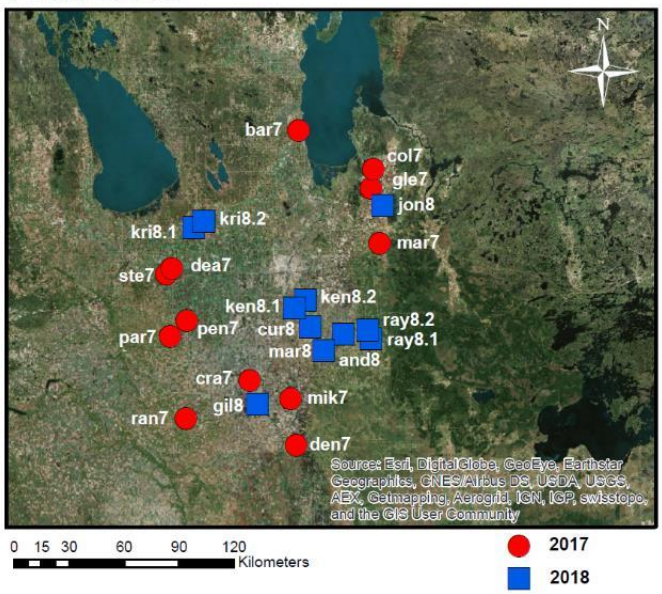

Table 1. Number of each habitat type sampled in 2017 and 2018.

	2017	2018	Total Sites
Soybean	12	11	23
Alfalfa	3	3	6
Woody Vegetation	3	4	7
Spring Wheat	3	1	4
Canola	3	3	6

a) Extension and communication events

- Almdal, C (April 2019) Predator-Prey Relationships in Agroecosystems University of Manitoba, Department of Entomology Seminar Series

- Almdal, C & AC Costamagna (2018)The impact of habitat quality on the generalist predator *Coccinella septempunctata* Oral Presentation at the Joint Annual Meeting of the Entomological Society of America, Canada, and British Columbia, November 11-14, 2018, Vancouver, BC, Canada.

- Costamagna, AC (2018) Mechanisms of landscape structure effects on pest control in agricultural landscapes: timing and movement of natural enemies into crops. Invited presentation in P-IE Section Symposium "How Crop Diversification across Space and Time Influences Herbivory" Joint Annual Meeting of the Entomological Societies of America and Canada, November 11-14, 2018, Vancouver, BC, Canada.

- Almdal, C & AC Costamagna (2018) Effect of landscape on *Aphis glycines* Matsumura (Hemiptera: Aphididae)Oral Presentation at the Entomological Society of Manitoba

- Costamagna, AC (2018) "Invasive species in prairie agroecosystems" Entomological Society of Manitoba Annual Meeting, October 19 -20, 2018. Winnipeg, MB.

- Costamagna, AC (2018) Can soybean seed treatments protect against soybean aphid in Manitoba? Pulse Beat, Spring 2018, 83: 37

b) Publications

- Samaranayake, KGLI, and AC Costamagna (2019) Adjacent habitat type affects the movement of predators suppressing soybean aphids. PLoS ONE 14(6): e0218522. https://doi.org/10.1371/journal.pone.0218522

- Samaranayake, KGLI, and AC Costamagna (2018) Levels of predator movement between crop and neighboring habitats explain pest suppression in soybean across a gradient of agricultural landscape complexity. *Agriculture, Ecosystems and Environment* 259: 135 - 146