Research Report for The Ceres Trust

2011 Graduate Student Organic Research Grant

Project Title: Efficacy of Intercropping in Organic Soybeans for Management of the Soybean Aphid

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Project Objectives: To validate whether buckwheat intercropped with organic soybean can suppress soybean aphid populations and determine if natural enemy recruitment is the cause for suppression.

Project Abstract

Organic soybean producers lack effective management options for controlling the economically damaging soybean aphid, *Aphis glycines* Matsumura. Biological control by natural enemies is an important control measure in organic agricultural systems, and intercropping with flowering crops such as buckwheat can enhance biological control by attracting natural enemies. The purpose of this research project was to investigate whether intercropping organic soybeans with buckwheat can be an effective management option for suppressing soybean aphid populations. In 2010 and 2011 field experiments were conducted in Minnesota to investigate 1) whether a soybean/buckwheat intercrop could effectively manage soybean aphid populations and 2) if so, whether natural enemy recruitment was a mechanism involved. Comparisons between intercropped plots and soybean-only plots showed slight differences between aphid and natural enemy numbers for all location, however none of these differences were statistically significant. While natural enemy populations did follow fluctuations in aphid numbers over the season, the natural enemies contributing toward biological control did not exhibit a strong positive response to the presence of buckwheat in this study. Since aphid populations did not decrease due to the presence of buckwheat, there is little evidence that natural enemy recruitment is occurring in this system. Soybean aphid populations in both sample years were relatively low, and both years barely exceeded the economic threshold of 250 aphids/plant before early August. Further aphid suppression measures beyond naturally occurring biological control would not have been recommended in either year.

Research Objectives

Organic soybean producers lack effective management options for controlling the economically damaging soybean aphid (SBA), *Aphis glycines*. Biological control by natural enemies is an important control measure in organic agricultural systems, and intercropping with flowering crops such as buckwheat can enhance biological control by

attracting natural enemies to a sugary food source. The purpose of this project was to investigate whether intercropping organic soybeans with buckwheat can be an effective management option for suppressing SBA populations. We had two overall research objectives:

Objective 1: To determine if a soybean/buckwheat intercrop can aid in suppression of the soybean aphid

Objective 2: To determine if aphid suppression (if found) is caused by increased biological control from recruitment of soybean aphid natural enemies (e.g. ladybeetles) to buckwheat

Materials and Methods

Field experiments were conducted at different locations in Minnesota during the summer of 2010 and 2011. In 2010, the study was conducted at two locations: Lamberton, MN at the University of Minnesota Southwest Research and Outreach Center (SWROC) organically certified research area and Evansville, MN in organic farmer fields managed by Mr. Bob Henneman. In 2011, all study locations were located near SWROC and Lamberton, MN. In 2011, farmer fields managed by Mr. Ryan Batalden and Mr. Phil Batalden were utilized for this study. In both years, buckwheat was intercropped with soybean in half the plots. At the SWROC in Lamberton, buckwheat strips were either planted along the edge of soybean plots (2010) or within soybean plots (2011). The location of buckwheat strips was changed in 2011 to better assess the community of soybean aphid natural enemies (Figure 1).

Figure 1. Placement of buckwheat strips in soybean plots for 2010 and 2010 at SWROC in Lamberton, MN.

The layout of buckwheat/soybean in farmer fields varied from 2010 to 2011. In 2010, the Evansville buckwheat strips were planted in the middle of a soybean field, and sampling plots were randomly selected within the field. This was replicated in two fields. To determine whether distance from buckwheat affected aphid and natural enemy abundance, we also sampled specific distances from the buckwheat strip in the Evansville fields. In 2011, the sampled Lamberton farmer fields consisted of a hand-planted strip of buckwheat in a soybean field, and aphids and natural enemies were sampled specific distances from the buckwheat plot. In addition, we sampled natural enemies within buckwheat strips in 2011 to determine the natural enemies directly associated with buckwheat.

Aphid abundance was estimated at each location by conducting destructive full-plant aphid counts. The number of plants counted varied from 20 to 5 depending on the % aphid infestation rate of soybean plants in the plot/field. Natural enemies were sampled using a combination of sweep net sampling and visual plant inspections. Sampling was conducted weekly at Lamberton and bi-weekly at Evansville.

Research Results

Objective 1: Comparisons between intercropped plots and soybean-only plots showed some differences between aphid abundance during the two years at the locations surveyed (Figure 2 A&B). While no difference at Lamberton was observed in overall aphid

abundance, Evansville exhibited some aphid population reduction in the buckwheat-intercropped fields, though there were no significant differences between treatments.

At Evansville, we also studied whether distance from buckwheat can have an effect on SBA and natural enemy abundance. Although no significant differences were found between the distances sampled, we observed that SBA abundance generally decreased closer to the buckwheat strips, particularly at the highest aphid abundance.

Overall in both 2010 and 2011, SBA pressure was relatively low for much of the season. Neither location reached the 250-aphids/plant treatment threshold before early August, at which point further aphid suppression measures would not have been recommended.

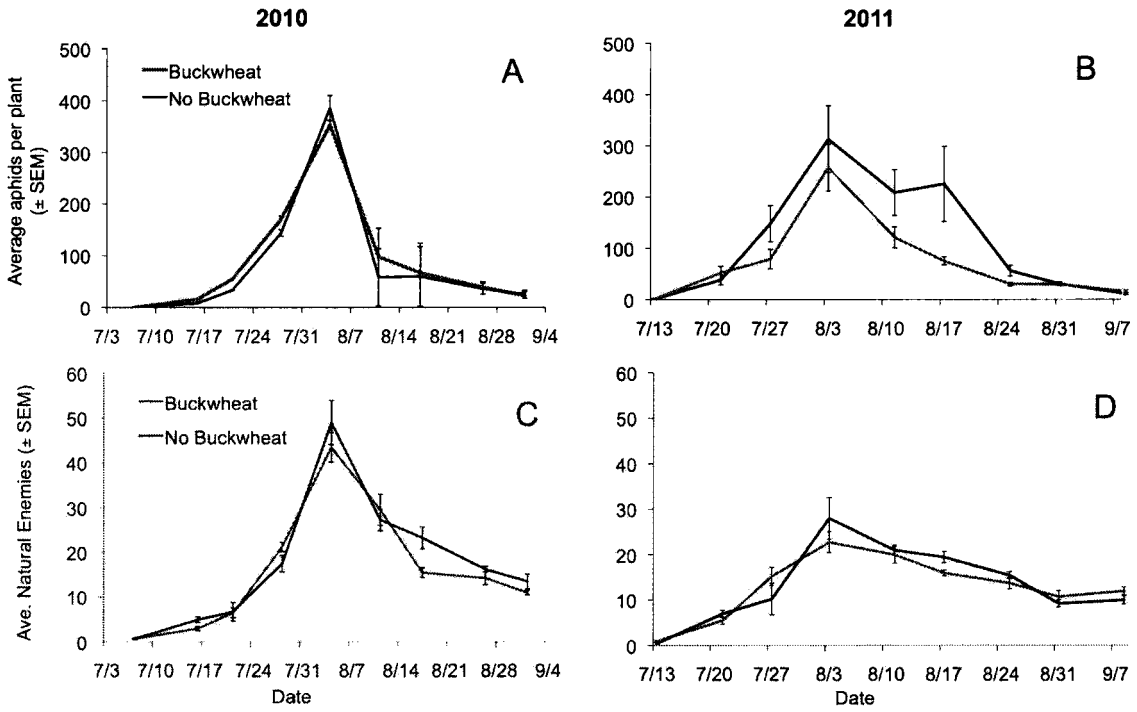


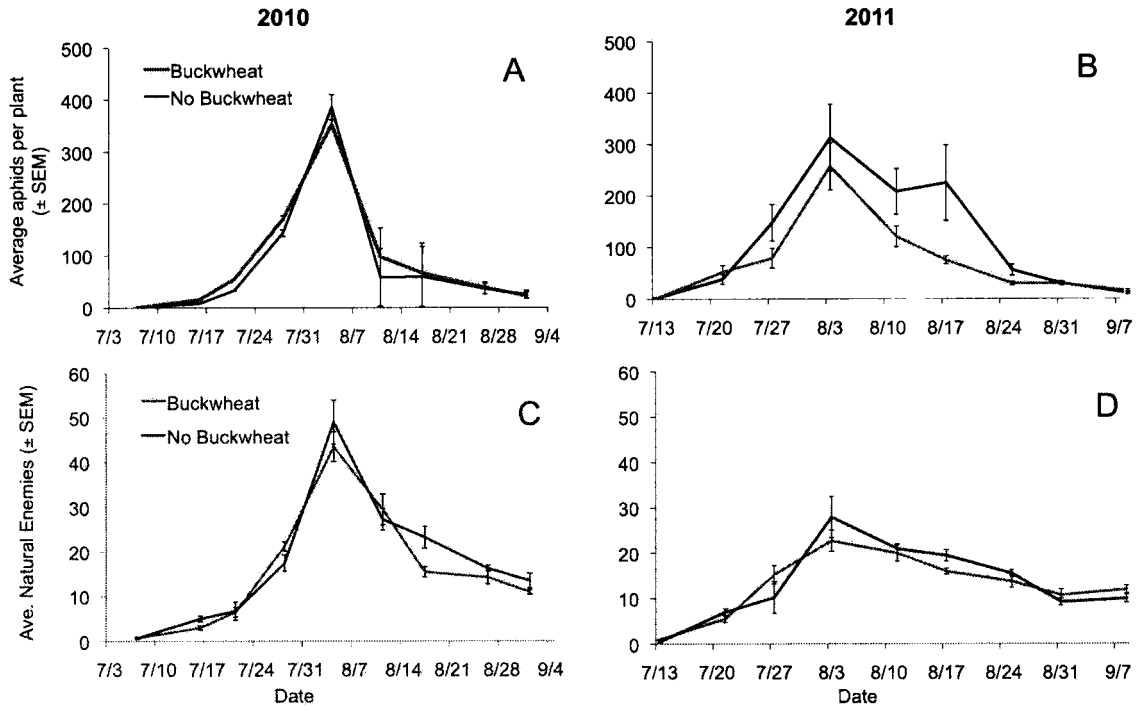
Figure 2. Effect of buckwheat on soybean aphid populations (A, B) and aphid natural enemy populations (C, D) at SWROC in Lamberton, MN from 2010-11.

Objective 2: To determine if aphid population differences between plots was due to the recruitment of SBA natural enemies, we compared natural enemy abundance between treatments. Results from the two-year study at Lamberton failed to demonstrate a strong natural enemy recruitment response to the presence of buckwheat (Figure 2 C&D).

When we considered distance away from the buckwheat strips at the Evansville location, the natural enemy numbers did not exhibit a clear response to distance from buckwheat. This may indicate that the aphid trend is not likely due to natural enemy recruitment to buckwheat.

In 2011 we sampled the natural enemy populations directly associated with buckwheat strips. This was done through both sweep net sampling as well as visual observation of buckwheat plants. Results show that hover flies (family Syrphidae) composed the most abundant group of aphid natural enemies in buckwheat, however hover flies were not very abundant in the adjacent soybean plants (Figure 3). This indicates that while some natural enemies are recruited directly to the buckwheat, these natural enemies may not spread into the adjacent bordering crops and therefore not enhancing biological control of aphids as was predicted.

Soybean aphid natural enemies were abundant at both locations and likely played an important role in overall aphid suppression throughout the season, but results from this two-year study did not conclusively confirm that the presence of buckwheat increased natural enemy numbers as was predicted.



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Scholarly Products

Research results for this project were most recently presented at the 2012 annual MOSES conference held February 2012 in La Crosse, WI. This project was accepted as a poster in the conference's Research Forum. A publication of this research in a peer-reviewed scientific journal will also be pursued in the near future.