

Crop density effects on interseeded cover crop productivity and weed seed predation

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Introduction

Background

- Corn and soybean farmers face major challenges with weed suppression and soil fertility during the transition to certified organic production.
- Weed seed predation is an important aspect of ecological weed management.⁴ However, rates of predation can be variable,⁶ and often dependent on management practices and landscape context.²
- More light transmittance to interseeded cover crops correlates with greater cover crop biomass.¹
- Vegetation cover has a positive correlation with weed seed predation.^{5,7}

Objective

- We established an experiment in NY (Figure 1) in 2015 to evaluate the effects of crop density on the performance of interseeded cover crops, weed suppression, and weed seed predation during the transition to certified organic production.

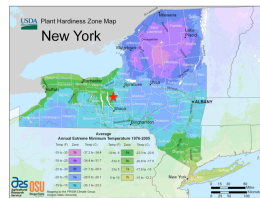


Figure 1. Experiment location in Aurora, NY.

Hypotheses

1. Lower corn and soybean densities increases light transmittance and interseeded cover crop biomass.
2. Weed seed predation increases with cover crop biomass.
3. Seed predation will be greater in open arenas than closed arenas (Figure 2).
4. Cover crop seeds are consumed as frequently as weed seeds by weed seed predators.



Figure 2. Open (left) and closed (right) seed arenas between soybean rows.

Methods

Experimental Design

- **Design:** 2-year corn-soybean rotation, in transition to organic. Experiment established at the Cornell Musgrave Research Farm, Aurora, NY.
- **Planting:** Corn and soybean were planted at five rates in 15 x 8 m plots on June 19 and June 5, respectively. Crop density treatments were arranged in a randomized complete block design with four replications.
- **Weed Management:** Two blind cultivations (before and after cash crop emergence) and two inter-row cultivations.
- **Interseeding:** A cover crop polyculture was drill interseeded (Figure 3) at 66 kg seed/ha on the same day in corn and soybean when corn reached V5 stage (July 31). The polyculture contained 51% cereal rye (Huron), 25% annual ryegrass (KB Supreme), 14% hairy vetch (VNS), and 10% medium red clover (VNS).



Figure 3. Interseeding cover crop between soybean rows.

Recurring Sampling (20, 40, 60 days after interseeding)

- **Photosynthetically Active Radiation:** Light transmittance through the corn and soybean canopy was assessed using a line quantum sensor (LI-191) and a point quantum sensor (LI-190).
- **Invertebrate Biodiversity:** Pitfall traps (2 per plot) were left for 48 hrs; specimens were collected and preserved for identification (Figure 9).
- **Weed Seed Predation:** Seed arenas were constructed of 15 cm diameter inverted petri dishes and sandpaper; 25 seeds each of *Setaria faberii*, *Amaranthus powellii*, *Secale cereale*, and *Trifolium pratense* were lightly glued to the arena; arenas were left for 48 hrs; four arenas were set in each plot, two were fitted with 1 cm wire mesh enclosures (i.e. closed).

One-time Sampling

- **Biomass:** Cover crop biomass and weed biomass were collected from each plot at peak weed growth. Biomass was collected from 0.5 m² quadrats centered in each plot. Samples were dried and weighed and cash crop density recorded.

Statistical Analysis

- Average predation of each seed species was subjected to an ANOVA with a mixed model in R using package nlme.

Light and Biomass

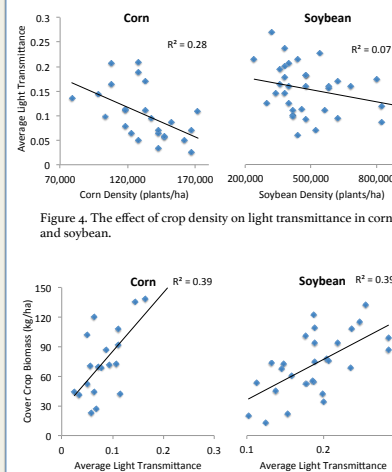


Figure 4. The effect of crop density on light transmittance in corn and soybean.

Figure 5. The effect of light transmittance on interseeded cover crop biomass in corn and soybean.



Figure 6. Interseeded cover crops Aug. 13 2015 (left) and Nov. 3 (right) in corn.

References

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Predation

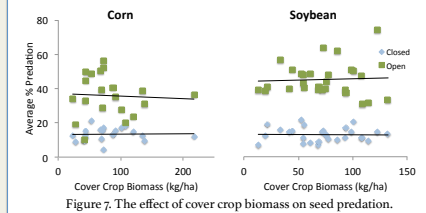


Figure 7. The effect of cover crop biomass on seed predation.

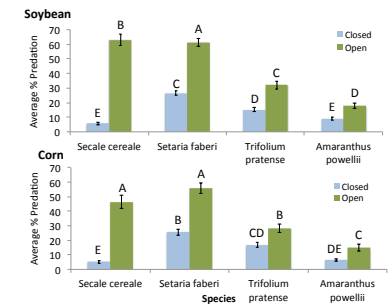


Figure 8. Average percent predation by each seed species in corn and soybean.



Figure 9. Pitfall trap specimens: both beneficial and pest species. From left to right: Orthoptera, Coleoptera, and Arachnids.

Conclusions

- **Hypothesis 1:** Light transmittance and cover crop biomass decreased with increasing cash crop density (Figures 4 & 5).
- **Hypothesis 2:** We cannot support our hypothesis that weed seed predation increases with cover crop biomass (Figure 7); sampling should have continued into the fall as cover crop growth increased, e.g. 80 days after interseeding (Figure 6).
- **Hypothesis 3 & 4:** Interaction between arena type and species was noted (Figure 8, $P < 0.0001$). Predation tended to be greater in open compared to closed arenas, which agrees with previous work.^{3,5,6} Invertebrates did not feed on cover crop seeds and weed seeds equally.
- **Observation:** Seed predator preferences were not different between corn or soybean (Figure 8).