The Ceres Trust Final Project Report: 2011- 2012

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Project Title: Combining alternating cover crop strips, living mulches and strip tillage for effective weed and nutrient management in organic sweet corn production.

Project Summary

N deficiency and weed competition are the two greatest limitations to achieving maximum yields in organic systems. Increasing the synchrony between soil nitrogen (N) availability and crop demand could potentially decrease fertilizer costs, N losses to the environment, as well as weed emergence and vigor.

The goal of this project is to evaluate whether tillage and organic nutrient amendments can be more effectively utilized to improve N and weed management in organic vegetable systems through a combination of segregated cover crop strips and strip tillage. Strip-tillage is a form of conservation tillage that isolates soil tillage to narrow strips directly in row with crop establishment. Tillage in the in-row strip incorporates residue to supply rapid nutrient release, a fine seedbed, and rooting environment beneficial to crop establishment.

Cereal rye (Secale *cereale* L.) and hairy vetch (Vicia *villosa* Roth) are commonly used winter cover crops in northern climates, often planted in a uniform mixture. An alternative to this planting arrangement is a stripped intercropping of rye and vetch: with vetch planted in strips directly in line with future sweet corn rows (IR) and rye is planted in the between row zone (BR). When combined with strip tillage, the N supplying vetch is incorporated prior to sweet corn planting, and we hypothesized that sweet corn N uptake efficiency would increase due to the concentration of the N rich vetch residue within the sweet corn rooting zone. Additionally, by planting hairy vetch within the IR and incorporating it with strip tillage we may reduce the potential for hairy vetch re-growth as a weed during the

cropping season. The rye residue in the between-row area gets left on the soil surface to immobilize N, and decrease N and light available to stimulate weed emergence.

The objectives of this project were to evaluate the effect of vetch and rye alternating strips and strip-tillage on:

1. *Weed suppression and community composition within the in- and between-row environments.*
2. *Cover crop contribution of N and soil N-dynamics.*
3. *Yield and quality of organic sweet corn.*
4. *Soil quality by utilizing short-term indicators of changes in soil health.*

Project activities in 2011-2012:

In summer 2011, we conducted a preliminary trial looking at the effects of segregating rye and vetch into strips on sweet corn yield, N dynamics, and weed emergence and growth. We also frost seeded a white clover living mulch into cereal rye in the BR to provide N and additional weed suppression during the sweet corn growing season.

Information gathered from the 2010-2011 preliminary trial was used to expand the study and further examine how the spatial arrangement of cereal rye and hairy vetch impact cover crop growth, as well as soil N, weeds, and sweet corn yields. Two different versions of segregated rye and vetch (2 rows rye: 2 rows vetch; 3 rows rye: 1 row vetch) strips were compared to a control of uniform spatial arrangement for effects on cover crop biomass, hairy vetch survival, N fixation, and time of flowering. Two different levels of weed management (high and low) were imposed to evaluate effect of weed competition on crop yields and N uptake. We examined weed emergence, biomass, and N availability, mineralization, and leaching in both combinations of cover crop spatial arrangement and tillage. However, we have not finished processing and analyzing the N component.

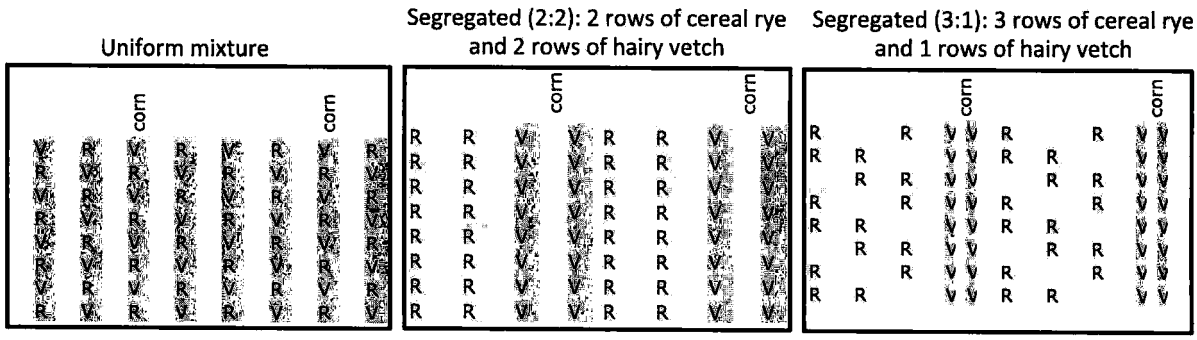
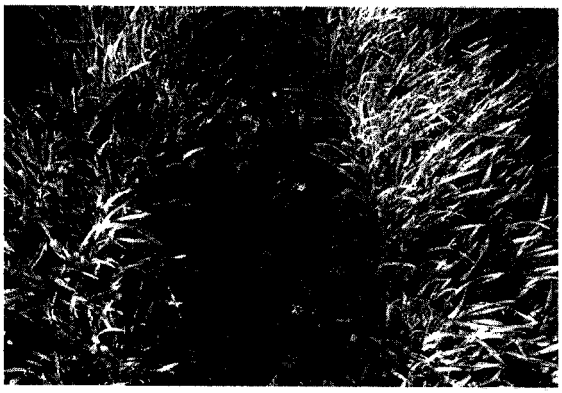


Figure 1: Spatial arrangement treatments of cereal rye and hairy vetch.



Cereal rye and hairy vetch segregated intro strips.

Results

Cover crop performance. In spring 2011 we frost seeded clover into cereal rye within the BR zone. White clover emergence in the spring was high, but cereal rye suppression of the white clover living mulch resulted in little white clover survival into the summer. Our primary objective was to obtain maximum cereal rye biomass for weed suppression during the sweet corn growing season. However, this also resulted in suppression of the white clover living mulch. After the first year resulting in little clover survival, we decided to focus our efforts on examining the rye and vetch system.

Due to poor vetch biomass production in the 2010-2011 preliminary trial, we did not see significant differences in N availability or yields of sweet corn when vetch was segregated within the IR, compared to seeded across the entire plot. We also did not see significant differences in emergence of either common lambsquarters or giant foxtail.

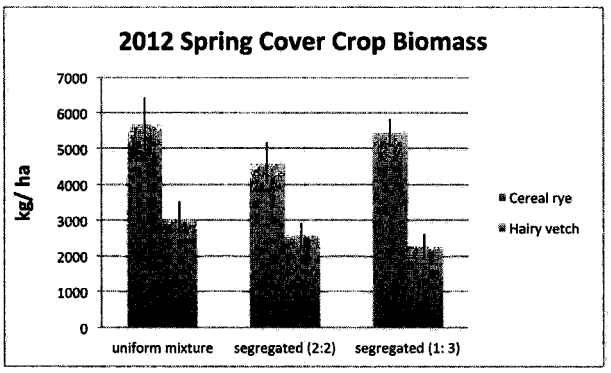


Figure 2. Spring 2012 aboveground biomass of cereal rye and hairy vetch when in uniform mixture and segregated arrangement. .

In 2012, we saw the highest cereal rye and hairy vetch biomass production in the uniform mixture, but these differences were not significant (see Fig.2).

Crop yields and weed competition. When weeds were intensively managed, there were no significant differences in sweet corn yields due to tillage (strip or conventional) or cover crop spatial arrangement (mixed or segregated). When weeds were managed less intensively (2 hand weedings as opposed to 5), sweet corn yields were higher in ST compared to CT. Emergence of both common lambsquarters and giant foxtail was significantly reduced in the BR area of strip-tilled treatments compared to CT when a cover crop was present.

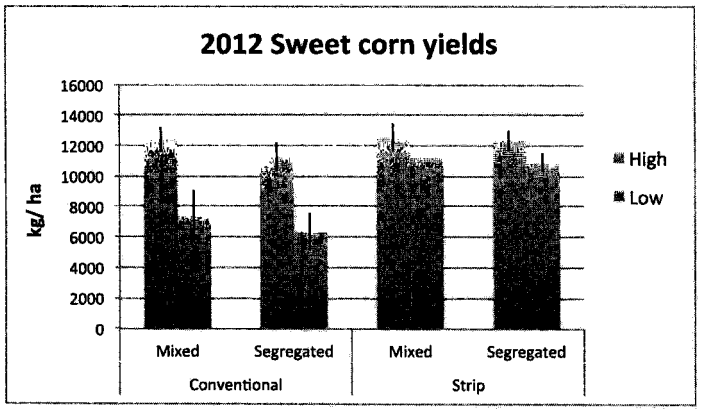


Figure 3: 2012 sweet corn yields under levels of both high and low weed management.

Future research will examine differences in crop N uptake, as well as N movement through the cropping system by looking at how tillage and cover crop placement effect N

mineralization, leaching, and denitrification. We plan on conducting two more years of this study and hope to gain new insight on how to manage cover crops to reduce lodging and maximize the benefit of segregated cover crop strips. We also plan on expanding outreach to farmers in order to gain greater insight on how to tailor reduced tillage systems for organic vegetable growers.

Outreach. Results were presented to a group of organic farmers during a cover crop field day at the Kellogg Biological Station in Hickory Corners, MI. Additional results will be presented at the Great Lakes Fruit and Vegetable Expo, as well as the Annual MOSES Organic Conference.

Field day with organic growers at the Kellogg Biological Station.