Kura clover living mulch replaces nitrogen fertilizer for corn silage and grain production

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Introduction

Nitrogen background information:

•Nitrogen (N) fertilizer use for corn (Zea Mays L.) grain (Figure 1) increased from the 1960's until 1975, and has leveled off since.

• N fertilizer prices (Figure 2) have been unstable and increasing since the energy crisis in 1973.

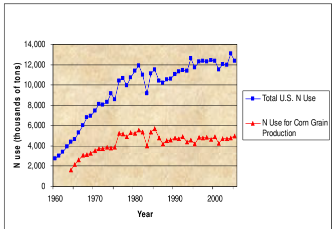

Figure 1. Total N fertilizer use and N use for corn grain production in the U.S. since the 1960's.

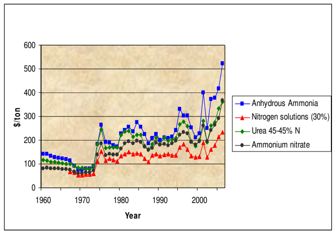

Figure 2. N fertilizer prices for typical forms of N used in the U.S. since the 1960's.

• High yielding corn in the north-central U.S. accumulates 310 kg N ha.$^{-1}$, with over half of this amount typically coming from N fertilizer.

• In rotations where corn follows alfalfa, all N for first year corn and as much as half of the N for a second year of corn is provided by killed alfalfa stands.

Living mulch and kura clover background information:

• In living mulch systems, a second crop is planted into an established stand of a mulch crop, which is maintained throughout the growing season or permanently.

• Kura clover (Trifolium ambiguum M Bieb.) is a perennial, rhizomatous legume with excellent persistence in the northern U.S.

• Herbicide suppression of kura clover living mulch reduces competition for light and moisture while releasing N from decaying plant tissue.

• Corn silage and grain yields have been shown to be similar where kura clover was killed and where it was suppressed, but 50 kg N ha^{-1} was always applied to living mulch treatments

• The N-replacement value of kura clover living mulch for corn production is not known.

Objective and Hypothesis

• The **objective** of this experiment is to determine if there are corn silage and grain yield responses to N fertilizer in kura clover living mulch.

• Our **hypothesis** is that suppressed kura clover living mulch will provide enough N for optimal corn growth, and there will not be a corn yield response to N fertilizer.

Treatments

• Living mulch treatments consisted of N fertilizer rates of 0, 22, 45, 67, and 90 kg N ha^{-1}.

• A control treatment of killed kura clover and 90 kg N ha^{-1} fertilizer was included.

Materials and Methods

• Research was conducted at the Arlington and Lancaster Wisconsin Agricultural Research Stations in 2006 and 2007.

• Kura clover experimental line KTA202 had been established for two years before experimentation took place.

• Initial herbicide suppression of established kura clover in living mulch plots with Clarity and glyphosate and killing of kura clover in control plots with Hornet, Clarity, and glyphosate was performed in late April when kura clover was 8 to 10 cm tall.

• DeKalb glyphosate resistant hybrids DKC48-53 and DKC48-46 were planted in 2006 and 2007, respectively, into suppressed kura clover and killed kura clover with a no tillage planter in late April or early May.

• Plots were 4 rows wide by 9.1 meters long.

• A 20-cm band of kura clover over the corn row was killed on the corn planting date using a tank mix of Hornet, Clarity, and glyphosate.

•The glyphosate resistant corn hybrids allowed post emergent glyphosate application. Additional herbicide suppression of kura clover about 35 days after corn planting also provides annual weed control.

• N fertilizer (NH_4NO_3) treatments were sidedressed when corn was at V5.

• One center row of each 4-row plot was used to determine silage yield at 50% milk-line.

• Corn grain yield was determined from the other center corn row at black layer. Grain yields were adjusted to 155g kg $^{-1}$ moisture content.

• Data were analyzed with PROC MIXED using SAS software.

Results

• Corn silage and grain yields were significantly different (P<0.0001) between living mulch treatments and the control treatment (Table 1).

Table 1. Corn silage dry matter and grain yields of the control and living mulch treatments with N rates listed in kg N ha^{-1}. Values sharing the same letter are not significantly different (p=0.05).

Kura Treatment	N Rate (kg /ha)	Silage Yield (Mg/ha)	Grain Yield (Mg/ha)
Killed control	90	21.17a	14.18a
Living Mulch	0	16.10b	11.04b
	22	17.12b	11.94b
	45	17.22b	12.04b
	67	17.25b	12.20b
	90	17.34b	11.74b

• Corn silage (Figure x) and grain (Figure y) yields were not different at p=0.05 in living mulch treatments with data combined across four environments.

• The small scale plots inserted in Figure 4 and Figure 5 reveal a non-significant tendency for corn silage and grain yields to be lower when no N fertilizer is applied to living mulch.

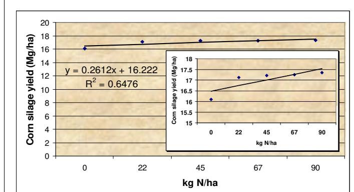

Figure 4. Corn silage yile dresponse to N ferrtilizer in kura clover living mulch. Means over four environments are plotted with a regression line with slope not significantly different from zero (p=0.05).

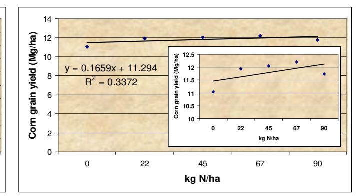

Figure 5. Corn grain yield response to N fertilizer in kura clover living mulch. Means over four environments are plotted with a regression line with slope not significantly different from zero (p=0.05).

Conclusions

• In living mulch treatments, we did not observe a yield response to N fertilizer rates, leading us to believe that kura clover living mulch can provide much or all of the N needed for corn production.

• Other factors reduce corn yields in living mulch compared to monoculture corn with sufficient N.

Figure 3. Timeline of corn and kura clover development throughout the season.