ROSHOLT FARM

Nitrogen and Water Quality Research

DEPARTMENT OF AGRICULTURE

Pope County, Minnesota

Status

Installation
2015 – 2016

Data collection
2016 – 2022

Contact

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Partners

Collaborative effort between multiple government agencies, agricultural businesses and organizations, and the University of Minnesota

List of partners on the reverse.

CLEAN WATER LAND & LEGACY AMENDMENT

GOAL

To evaluate the management of nitrogen fertilizers and cover crops in irrigated crop production and their impacts on water quality.

OBJECTIVE

Quantify the impact of a living mulch (kura clover), cover crop (cereal rye), or no cover crop on nitrate leaching and nitrogen management for irrigated row crops. The project is intended to provide local information to help improve nitrogen fertilizer management in irrigated row crop production systems.

LOCATION

The study site is located at the Rosholt Research Farm in Westport, Minnesota. The 40-acre farm is owned by Pope Soil & Water Conservation District and is devoted to water quality research and crop production demonstration (see aerial photo on reverse side). The site has a long history of research dating back to 1968.

MONITORING

To assess the effect of kura clover, cereal rye and no cover crop on nitrate leaching and on crop response the following monitoring efforts are conducted.

- Collect weekly soil water samples from 200+ lysimeters placed below the root zone, and analyze water samples for nitrate-nitrogen
- Collect water volume data from six drain gauges
- Track soil moisture throughout the growing season
- Conduct whole plant tissue analysis at R6 in corn
- Sample soil for nitrogen in the spring and fall
- Assess nitrogen content of kura clover and cereal rye in late fall to determine nitrogen uptake
- Measure corn and soybean yield at the end of the season to evaluate impact of nitrogen fertilizer and cover treatments

Kura clover plot established in 2016

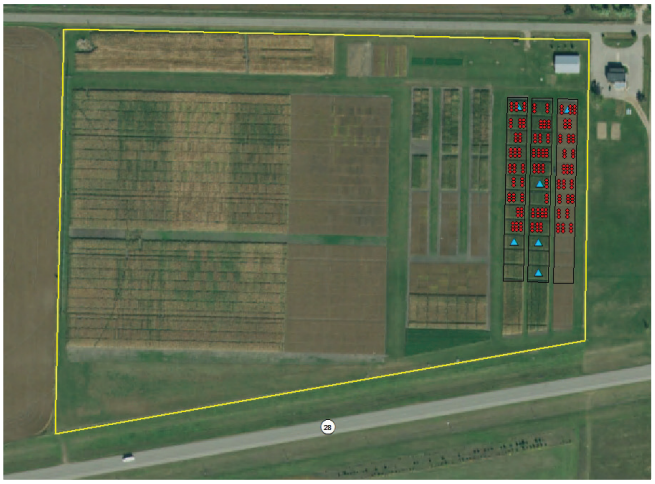
RESEARCH STUDY DESIGN

The study design includes 12 treatments in a randomized complete block design, each treatment is replicated four times.

Treatments include:

- Varying nitrogen rates 0, 90, 180, 225 and 270 lbs./acre
- Nitrogen applications are split-applied in four equal rates
- Crop rotations include: continuous corn, corn following soybean, and soybean following corn
- Cover types include: cereal rye cover crop, kura clover living mulch, and no cover

A living mulch provides continuous cover with the crop(s) planted into the mulch. A cover crop can be planted into the crop during the growing season, is left to grow after crop harvest, and provides soil cover over winter into the following spring where it is terminated.



Rosholt Research Farm Boundary
Plot Area Boundaries
Lysimeters (suction cup)
Drain Gauges

LESSONS LEARNED

The following results are preliminary, continued research is underway to better define these findings.

Impact on Nitrogen (N) Loading

- Cereal rye's ability to reduce nitrate concentrations is dependent upon rotation.
  - In corn following soybean, nitrate concentrations were reduced by 48% and nitrate load by 50%
  - There was no observed reduction in annual nitrate leaching load when rye is planted in continuous corn or in soybean following corn. This is likely explained by two points: 1.) Rye establishment was more difficult and growth smaller in corn residue (less potential for rye to make an impact relative to when planted in soybean residue and 2.) The large amount of corn residue immobilizes N, thus protecting it from leaching.
- Kura clover substantially reduced nitrate leaching but management to minimize yield loss for cash crops needs further refinement. (Reductions: 92% in corn-soybean, 88% in continuous corn, and 84% in soybean after corn).

Establishing living mulch and cover crop

- ***Kura clover:*** It takes one year to establish this living mulch; prior to planting a cash crop. It must be managed in order to reduce competition with the cash crop. (Currently investigating how best to do this.)
- ***Cereal Rye:*** Establishment of the cover crop can be challenging, especially in corn residue. Once established, growth and N uptake are dependent on fall and spring weather conditions. Dry and cold conditions substantially reduce growth and N uptake.

Impact to Rate and Yield

- ***Kura clover:*** Cash crop yield was reduced when planted with kura clover and requires some refinement.
  - When using the Economic Optimum N Rate (EONR) for corn without a cover crop, corn grown with kura clover had approximately a 25% yield reduction. This was similar for both corn-corn and corn-soybean systems.
  - Soybean grown with kura clover had approximately a 20% yield reduction.
- ***Cereal rye:*** Corn grown after winter rye requires additional nitrogen to achieve EONR, but yield at the EONR was similar for rye and no-rye treatments
  - Continuous corn: Rye cover crops increased the EONR by 21 lbs. N/ac (average of three years)
  - Corn after soybean: Rye cover crops increased the EONR by 14 lbs. N/ac (average of two years) In one year, rye actually reduced the amount of N needed.

PROJECT PARTNERS

DEPARTMENT OF AGRICULTURE

POPE SOIL & WATER CONSERVATION DISTRICT

STEARNS COUNTY SOIL & WATER SWCD CONSERVATION DISTRICT