

# ROSHOLT FARM

## Nitrogen and Water Quality Research



Pope County, Minnesota

### Status

**Installation:** 2015 – 2016

**Data collection:** 2016 – 2022

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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.*

### 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
- Measure nitrous oxide emissions



*Kura clover plot  
established in  
2016 will be  
strip-till planted  
to corn in 2017*



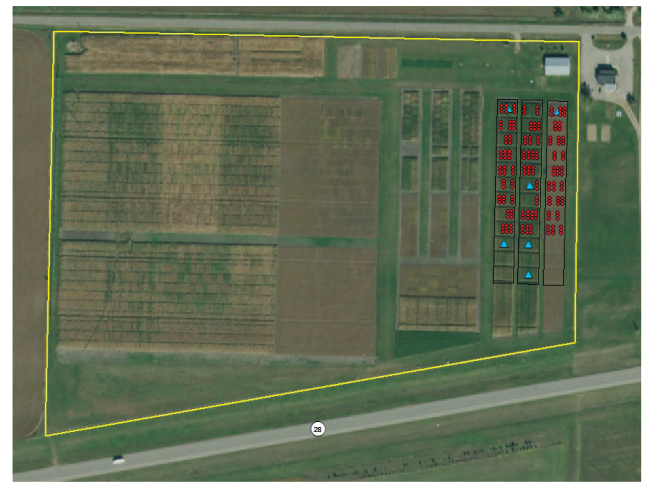
## RESEARCH STUDY DESIGN

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: continuous corn, corn following soybean, and soybean following corn
- Cover types: 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 the findings.

### Impact on nitrogen (N) loading

- Cereal rye was interseeded into the growing crop. The rye's ability to reduce nitrate concentrations was small due to poor rye stand.
  - 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: 79% in corn-soybean, 66% in continuous corn, and 77% in soybean-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 a 30-40% 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 the rye cover crop required 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

