Straw Management and Crop Rotation Alternatives to Stubble Burning: Assessing Economic and Environmental Trade-offs

Co-Principle Investigators

Dave Huggins, Soil Scientist

Tim Paulitz, Plant Pathologist

Kate Painter, Ag. Economist

Assessing trade-offs has not adequately addressed:

- Quantities of residues and associated nutrients (eg. N, P, S) lost via burning
- Field burning impacts on labile soil organic matter that effect crop nutrient availability (e.g. N, P, S)
- Soil-borne disease or straw toxicity effects
- Field-scale variation and site-specific effects (Precision Ag. Applications)

Project Objectives (1)

- (1) Document and economically assess wheat stubble burning effects on:
  - Soil organic matter
  - Site-specific soil erosion estimates
  - Soil condition index (SCI)
  - Residue C and nutrient (N, P, S) losses

Cook Agronomy Farm

Direct Seed and Precision Farming Systems

Develop principles and strategies that reduce risk, increase profits and improve environmental quality

Methods (Objective 1)

- Evaluate the loss of C and nutrients (N, P, S) from residue burning:
  - (1) fall burning of winter wheat residues
  - (2) spring burning of winter wheat residues
  - (3) no burning of winter wheat residues
- 15 locations

Project Objectives (2)

- (2) Identify and economically assess crop rotations and sequences that benefit from retaining winter wheat residues in direct-seed systems

Methods (Objective 2)

- Evaluation of spring chickpea and winter wheat performance (yield, net returns) following winter wheat under tillage, burning and direct-seed treatments (sequence study)
- Evaluation of direct-seed crop rotation alternatives following winter wheat with and without burning (rotation study)

Methods (Objective 2)
Crop Sequence Study

- **Randomized-block, small-plot study will establish chickpeas and winter wheat following winter wheat**
  - **Conventional tillage**
  - **Fall burning and direct seeding with a low disturbance drill (Cross-slot drill)**
  - **Spring burning and direct seeding (chickpeas only) with a low disturbance drill (Cross-slot drill)**
  - **No burning and direct seeding with a low disturbance drill (Cross-slot drill)**
  - **No burning and direct seeding with a high disturbance drill (Horsch-Anderson drill)**

Methods (Objective 2)
Rotation Study

- Treatments (fall burn) will be established following winter wheat harvest in three of the existing three-year crop rotations:
  - (1) winter wheat/spring wheat/sp. chickpea
  - (2) winter wheat/winter wheat/sp. chickpea
  - (3) winter wheat/spring barley/sp. wheat

- All field crops will be seeded with a Horsch-Anderson direct-seed drill (hoe-type opener)
- Crop performance (yield, quality, net returns) will be evaluated for all treatments

Methods (Objective 2) Rotation Study

- Treatments will be established following winter wheat harvest in four of the existing three-year crop rotations
  - Treatments will consist of fall burn and no burn on small plots (15 ft by 30 ft) established in high and low wheat residue field locations with four replications (64 total plots)
  - All field crops will be seeded with a Horsch-Anderson direct-seed drill (hoe-type opener)
  - Crop performance (yield, quality, net returns) will be evaluated for all treatments

Project Objectives (3)

- (3) Document effects of wheat straw management and rotation alternatives on root pathogens

Methods (Objective 3)
Root Pathogen Study

- This objective will rely on the crop sequence and rotation studies described under objective 2
- We will use real-time quantitative PCR methods to quantify the levels of soil-borne pathogens in these treatments to determine if the populations of fungal pathogens are affected by residue management or rotations
- We can now readily quantify levels of Rhizoctonia, Fusarium, and Pythium
- Specific diseases will be quantified on wheat, barley and chickpea