

Cereal rye in corn systems: Benefits and challenges

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Implementation of cover crops in no-till corn and soybean systems in Nebraska

- Project developed in cooperation with NE Corn and Soybean Boards
- Evaluated cover crop management (crop rotation, species, planting times) for soil health benefits

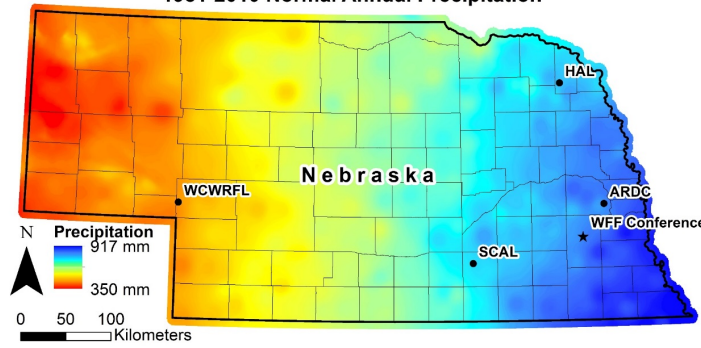


Interest in cover crops is increasing in Nebraska

Locations

North-east: Concord
Rainfed

1981-2010 Normal Annual Precipitation



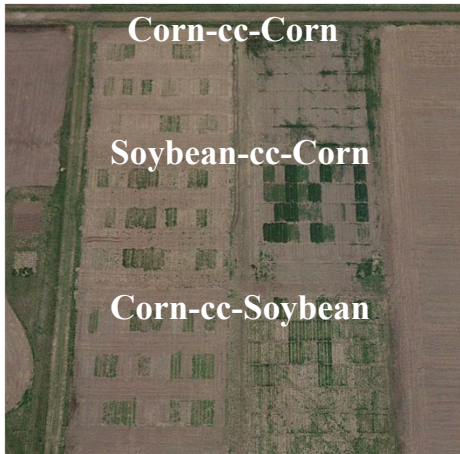
East: Mead
Rainfed

South-central: Clay Center
Irrigated

Graph by Burdette Barker, PhD, 2017
Nebraska map source: USDA-NRCS. (2009). *Processed TIGER 2002 Counties plus NRCS additions and Processed TIGER 2002 Counties plus NRCS additions dissolve*. Retrieved from: <http://datagateway.nrcs.usda.gov/>

PRISM precipitation from: USDA-NRCS (2012). *Precipitation rasters for each month plus yearly*. U.S. Department of Agriculture, Natural Resources Conservation Service, National Geospatial Management Center, Fort Worth, Texas

Experimental design



- RCBD with 4 reps (3 at Mead), same cover crop in same plot for 4 years (2014/2015 – 2017/2018)
- No-till
- 3 cropping sequences
 - Continuous corn with cover crops (cc)
 - Soybean-cover crops-corn
 - Corn-cover crops-soybean

Cover crops planted into corn, followed by corn. Cover crops planted into soybean, followed by corn. Cover crops planted into corn, followed by soybean

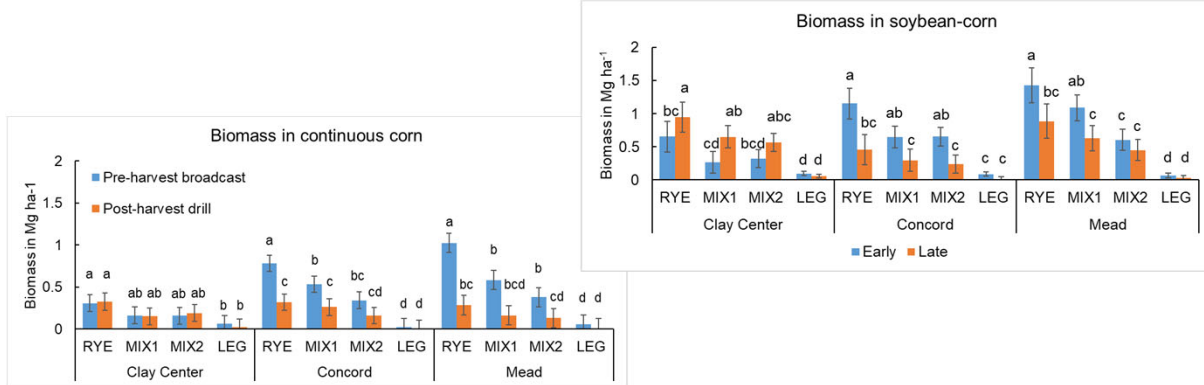
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Early planted cover crops (broadcast into corn and soybean in mid-September)



Late-planted cover crops (drilled after harvest)

Benefits - productivity



LEGU=vetch+pea MIX2=rye+oat+legume+brassicas MIX1=rye+legume+brassica RYE=cereal rye

Benefits – soil health

- In Nebraska, rye is the only cover crop to consistently meet biomass thresholds for soil health
- Increased aggregate stability, particulate organic matter (Ruis et al., 2020), microbial abundance
- May reduce nitrate leaching (Koehler-Cole et al., 2020)

This is what 1,000 lb/ac of rye biomass looks like.

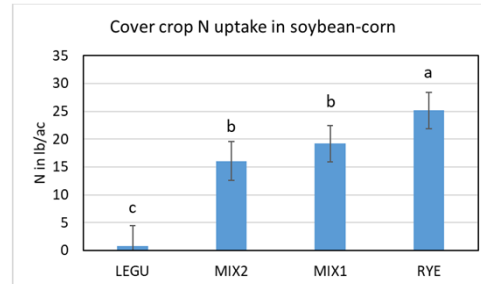
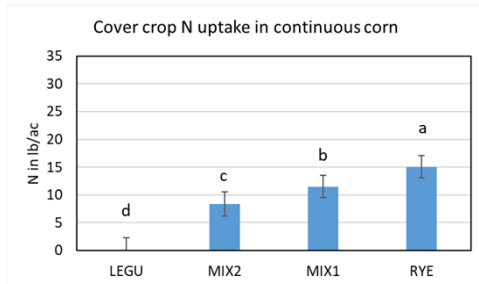
Nitrate leaching is loss for farmer, contaminant in environment, bad in drinking water. We have to keep the N in the soil where crops can reach it. Rye is great because it has many small fine roots that suck up N. May bring it up from deeper in profile – we don't know. Rye mulch decomposes slowly while corn and beans are growing and can take up N.

Benefits – weed suppression

- High biomass and long-lasting residue (Osipitan et al., 2018)
- 4,000 lb/ac of biomass for weed control (Finney et al., 2016)
 - Only achieved in 1 of 12 site years



Benefits - Cover crop N uptake



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- Prevents nitrate leaching, improves water quality

Rye is good N scavenger

Greatest N uptake before soybean

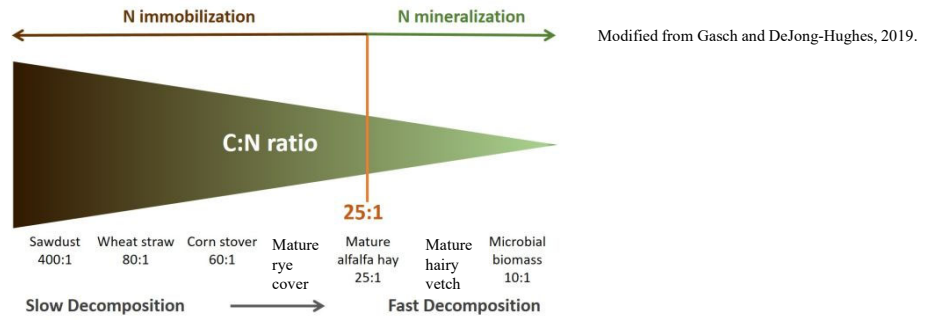
Period before soybean planting has highest N loss

(Castello, 2016; Syswerda et al., 2012)

N retention versus N release

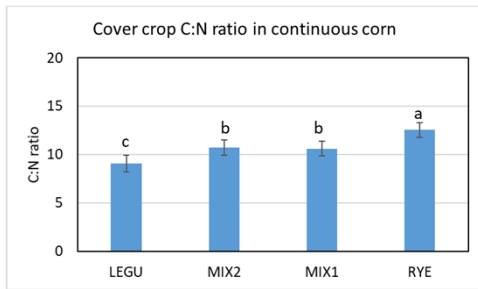
C:N ratio (physiological stage, biomass, species) determines N release

Challenges – N immobilization

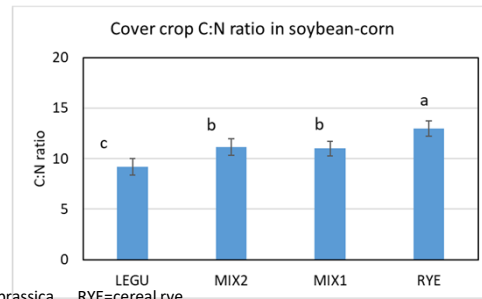


This is a study with similar C:N ratios than ours

Challenges – N immobilization



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Challenges – N immobilization

- Rye released 33% N, legume 75% N by corn V6 (Ruffo and Bollero, 2003)
- No increase in soil inorganic N after cover crops probably because microbes take up N to decompose residue (Lacey et al., 2020)
- N fertilization pre-plant, starter or split-applications can help
- Place fertilizer close to residue!

In a study with similar C:N as ours. Rye probably is not an N source. Vetch only if it produces enough N (enough biomass)

If concerned about yields

Rye released 33% N, vetch 75% N by corn V6

(Ruffo
and

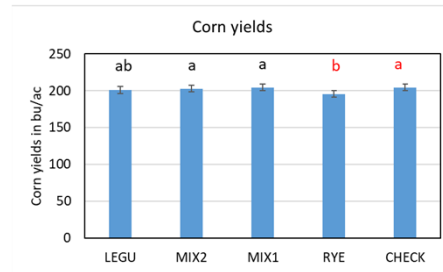
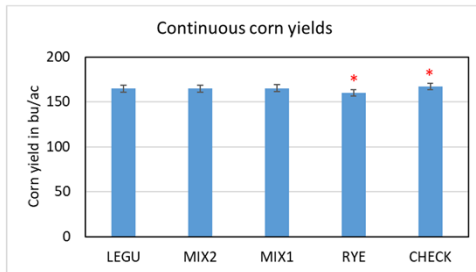
Bollero 2003)

Vetch N release peaked 4 weeks after termination, rye N immobilized

(Sievers and Cook, 2018)

In our system, expect little N immobilization from rye
In our system, expect moderate N provision from vetch

Challenges – yield impacts



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Challenges – allelopathy

- Rye secretes benzoxazinones (BX compounds)
- Suppress weed germination (Kunz et al., 2016)
 - BX compounds degrade quickly (Rice et al., 2012)
 - Affect mostly small-seeded species (Liebman & Sundberg, 2006)
- Rye extract affected corn in lab study (Burgos et al., 2000)
- Allelopathic potential in field is likely rare, but possible if
 - Low OM or sandy soil
 - BX release and corn germination overlap (Koehler-Cole et al., 2020)

Challenges – Pathogens

- Cover crops can be a “green bridge”
- Corn seedlings were more affected by Pythium and Fusarium spp. following rye (Acharya et al., 2017) than following a control

Take-home message

- Biomass production is essential, early planting is key!
- Rye is the most productive cover crop in corn systems in Nebraska, greatest potential to improve soil health, water quality, control weeds
 - Biomass may be used for grazing, haying
 - Rye seed is cheap
- Adjust cover crop and corn management for optimum corn yields
 - Timely termination, starter fertilizer, crop rotation, rotate cover crops!
 - Scout for pests and weeds
 - Avoid stressing the crop!

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N EXTENSION

Thank you

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Questions?

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