Abstract

​​In the Midwest, current farming practices are unsustainable and leading to reduced soil quality and dead zones in water ecosystems. Cover crops are a known solution to this problem, however, there is little motivation for farmers to plant most cover crops since they are not profitable. Until recently, common cover crops that are grown in the Midwest have been limited to both cereal and annual rye with the potential addition of field pennycress. Along with qualities that make pennycress an effective cover crop, gene editing and breeding programs have enhanced characteristics that make it an oilseed crop like canola. To prove the effectiveness of pennycress as a cover crop, the decomposition of wild pennycress and gene-edited pennycress were analyzed in comparison to cereal rye and annual rye. A mesh forage bag decomposition study was conducted with preliminary data showing that rye loses more of its biomass initially than pennycress.

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These are the notes from our discussion about the paper on 6-4-21

P1:

* Very broad: water quality at gulf and deadzone → sustainable farming → how do we protect water quality without policy change (don’t make this political)

P2:

Do we need this paragraph or simply go on to paragraph 3, I’m thinking we either move on to 3 or put most of what i wrote above into here and rewrite paragraph 1.

PARAGRAPH TWO AND THREE HAVE BEEN COMBINED

* Identification of nutrient sources: agriculture, watershed reclamation districts, industry → phosphorus pollution in freshwater ecosystems, N for marine ecosystems

P3:

* 4 r’s of nutrient management to reduce nutrient loss, cover crops, edge of field practices

P4:

* Cover crops are not economical due to effects on next cash crop yield but are effective in nutrient mitigation → decomposition → midwest focus

P5:

* Somewhere in here is the economics of pennycress, either this paragraph or the one above → cover crop decomposition and rates + amount of nutrient change

P6:

* Question and objectives
* Question: What are patterns of biomass and N loss in rye relative to pennycress?

METHODS

The location of the decomposition study site was at the ISU farm in Lexington, IL. Replicates were separated into two blocks, each with a different soil type. The two soil series were representative of soils present in Mclean County. The first soil series used in the study was Saybrook, which is a deep, moderately well-draining soil. Saybrook is formed in loess or in other silty material and in the underlying loamy till on plains and moraines. Slope ranges from 0 to 20 percent. Mean annual precipitation for Saybrook is about 914 mm (36 in) and mean annual temp is about 10°C. The second soil series used was a combination of the Elpaso and Drummer series. The Elpaso series is a very deep, poor draining soil formed in loess and glacial till on uplands. Slope ranges from 0 to 2 percent. Mean annual precipitation for Elpaso is about 940 mm (37 in) and mean annual temperature is about 11°C. The Drummer series is also deep and poorly drained and formed in loess or other silty material and in the underlying loamy stratified outwash on nearly level or depressional parts of outwash plains, stream terraces, and till plains. The Drummer series also has an average annual rainfall of 940 mm and an average annual temperature of 11°C. During the study, corn was grown in both plots with litterbags placed in between rows. The study consisted of four treatment species; wild type pennycress, gene-edited *AOP2* pennycress, cereal rye, and annual rye.

Cover crop biomass was collected from various locations. WT pennycress, cereal rye, and annual rye were collected from the ISU farm. Cereal rye was harvested on May 24th, annual rye was harvested on June 1st, and Pennycress was harvested on. Gene-edited *AOP2* pennycress was received from Western Illinois University. Only aboveground biomass was collected for the study. Biomass was collected by using a scythe to cut plants right above the soil surface. The biomass was dried in an oven at ~50°C for a week. 20 g of dry biomass was weighed out for each forage bag. The bags chosen for the study were 10x20 cm mesh forage bags

Forage bags were retrieved at ten different time points indicated by days from the start of the study (0,7,14,21,28,36,45,54,63,72). The day zero forage bags were brought to the field to account for handling loss and returned to the lab the same day. 396 forage bags were used for the decomposition study. Each soil block included five replicates. Replicates were blocked by row with each row having a bag for each species at each time point. All forage bags were sealed using loop-lock labels and anchored to the ground with bamboo skewers. Soil was shoveled onto each of the bags to simulate biomass being incorporated into the soil. Forage bags were placed between rows of corn with five rows in both soil types. Each row consisted of ten sampling points with each point containing a forage bag from each species of cover crop. Every collection day, one point from each row was collected using random sampling and brought back to the lab for analysis. Forage bags were washed using deionized water and dried at ~50°C. Bags were then weighed to analyze percent biomass remaining. The biomass was ground using a Wiley Mill. Ground biomass was analyzed for total nitrogen content.

6-15-21 notes about sample regime

* We have initially decided on a weekly sampling regime following week 0 (Dhakal et al 2020, Jahanzad et al 2016, Lui et al 2019, Sievers and Cook 2018, singh et al 2020)

These are the notes from our discussion about the paper on 6-4-21

P1:

* Biomass collection and prep→ decomposition

P2:

* Sites and blocking

P3:

* Sample collection and processing for both biomass and total N

P4:

* Statistics

Discussion

P1

* Restate the hypothesis, take home message

P2

* Report results in a conversational manner - discuss the intricacies of what happened

P3

* What do the results mean/what are their implications - yield drag

P4

* Conclusion

