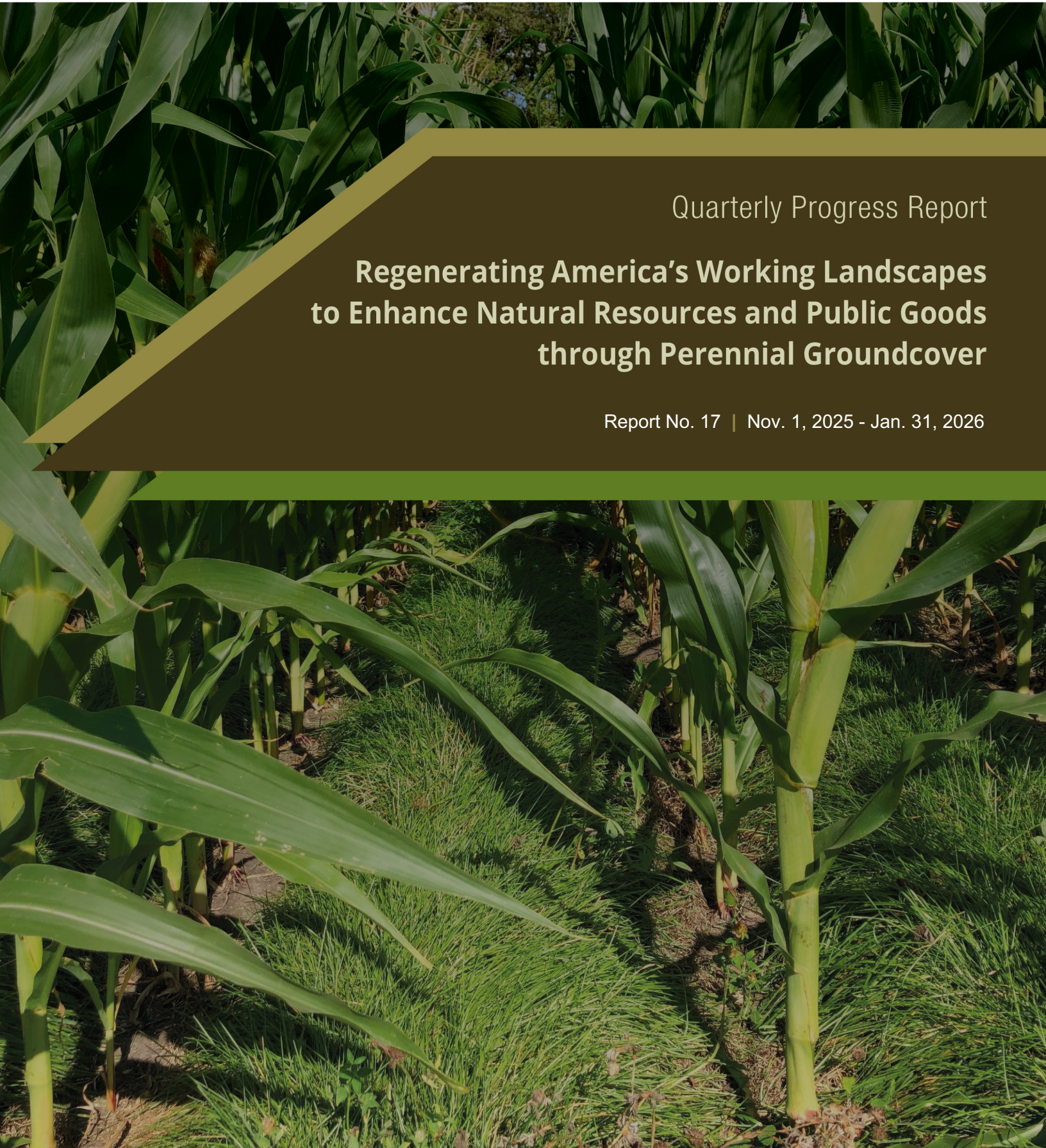




Quarterly Progress Report

**Regenerating America's Working Landscapes  
to Enhance Natural Resources and Public Goods  
through Perennial Groundcover**

Report No. 17 | Nov. 1, 2025 - Jan. 31, 2026



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For more information, [visit the RegenPGC website](#).

## Acknowledgment

*Regenerating America's Working Landscapes to Enhance Natural Resources and Public Goods through Perennial Groundcover* (RegenPGC) is supported by Agriculture and Food Research Initiative Competitive Grant No. 2021-68012-35923 from the USDA National Institute of Food and Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the U.S. Department of Agriculture.

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## Abstract

Achieving the SAS program goal of transforming the U.S. agricultural system to sustainably increase production by 40% requires large-scale production agriculture across multiple crops to profoundly change its bare-soil winter-fallow practices. These conventional practices negatively impact soil health and natural resources conservation – the pillars of agricultural systems sustainability. A scalable solution to this challenge is the implementation of perennial groundcover (PGC) cropping systems, which use an ecologically complementary, permanent groundcover in fields where annual cash crops are grown. This transformative approach to large-scale agricultural production increases the duration and extent of groundcover on cropland, enhancing resiliency and improving the quality of water, air, and soil. Working closely with farmers, NGOs, and industry stakeholders, this project will develop and refine PGC approaches enabling high-yielding row-crop production while improving soil and water quality, providing large increases in the availability of lignocellulosic feedstocks, and preserving or increasing farm income. This project will develop best management practices for growing crops and suppressing weeds with PGC, develop improved crop and groundcover genetics, develop appropriate soil and nutrient management practices, quantify the environmental impacts, and determine the policy and socioeconomic implications of the adoption of PGC approaches. Knowledge gained through this project will be used to educate a new generation of undergraduate and graduate students who recognize the opportunities to enhance agriculture using PGCs. We will provide a multi-pronged extension effort using a combination of hands-on field days, farmer meetings, and online resources to educate practitioners about the opportunities and challenges of the system.

# REGENERATING AMERICA'S WORKING LANDSCAPES TO ENHANCE NATURAL RESOURCES AND PUBLIC GOODS THROUGH PERENNIAL GROUND COVER (REGENPGC)

AFRI Competitive Grant No. 2021-68012-35923

Year 5 –1<sup>st</sup> Quarter Project Activities

August 1, 2025 – October 31, 2025

## PROJECT ADMINISTRATION AND GOVERNANCE

### 1. Planned Activities

Continue regular meetings with CoPds groups and ad hoc meetings with individual CoPds.

### 2. Actual Accomplishments

#### A. Meetings

- **Stakeholder Advisory Board Meetings.** Met with the Stakeholder Advisory Board as part of the 2025 project annual meeting.
- **Theme Leader Meetings.** We averaged one ad hoc meeting per month.
- **Co-PD Meetings.** The Cafés had high CoPD attendance, and we also had a highly engaged 4th-year project meeting.
- **RegenPGC Café.** The Cafés are highly attended and with significant engagement among the participants, with approx 9 total meetings during this quarter.

#### B. Project Leadership

- The Project Director and Deputy Director meet regularly.

### 3. Plans for Next Quarter

- We will be looking carefully at individual budget lines and subawards as we think about the last year and a potential NCE.
- We will kick off the new year (Spring 2026) café program and are considering opening it to a wider audience.

- The Project Director will support efforts to present work at ICM (Integrated Crop Management workshop).

#### 4. Publications, Presentations, Stakeholder Engagement, Proposals Submitted, and Awards and Recognition

##### A. Awards and Recognition

CoPd Dr. Susana Goggi was recently recognized by @SeedWorld United States magazine as one of thirty "high-impact women" in the U.S. seed industry. According to SeedWorld, Dr. Goggi and her distinguished peers have "carved out space in a field long dominated by others, proving that grit, skill, and collaboration are the true markers of excellence. From the lab to the boardroom, from seed physiology to supply chain, they are rewriting what impactful leadership looks like in our industry." Having Dr. Goggi on our team, we could not agree more with this assessment! Learn more about Dr. Goggi and the SeedWorld high-impact group at: Michaels, Julia. (2025, September 23). She's in a League of Her Own – Part 3. SeedWorld.

<https://www.seedworld.com/us/2025/09/23/shes-in-a-league-of-her-own-2/>

## THEME 1. RESEARCH AND DEVELOPMENT

The cross-cutting Research and Development Theme focuses on establishing organizational structures for data management and modes of communication among the research teams and individual participants – the foundation of integrated research. **Brandon Schlautman** (The Land Institute) leads this theme.

### 1. Planned Activities

- Summarize the potential scalability of PGC suppression practices when Liberty (glufosinate) herbicide is used.
- Revise data collection and storage protocols for 2025 on-farm trial reporting based on lessons learned from the 2024 curation process.
- Continue curating datasets from 2025 small-plot and on-farm trials into Zenodo and other shared repositories.
- Launch the fall RegenPGC Café series, focusing on cross-objective integration and student research updates.
- Explore opportunities for cross-site comparisons of PGC image analysis datasets to strengthen algorithm validation.

### 2 Year 5 – Q1 - Quarterly Progress Report

## **2. Actual Accomplishments**

- Initial synthesis and internal review of data relevant to the scalability of PGC suppression practices using Liberty (glufosinate) herbicide were conducted. These efforts focused on harmonizing datasets across locations, identifying data gaps, and outlining analytical approaches needed to support broader scalability assessments.
- Revisions to data collection and storage protocols for 2025 on-farm trial reporting were developed based on lessons learned during the 2024 data curation process. These revisions emphasized improved metadata standardization, clearer definitions of management variables, and streamlined workflows to support multi-site reporting.
- Curation of early 2025 small-plot and on-farm trial datasets continued, with data organized for eventual deposition into shared repositories such as Zenodo. These efforts prioritized consistency across sites and alignment with agreed-upon research standard operating procedures.
- Weekly RegenPGC Café meetings were conducted during the quarter to facilitate communication and coordination across research teams. These meetings provided a forum for sharing updates, discussing data integration challenges, and supporting cross-objective alignment among investigators and trainees.
- Planning and coordination activities advanced to support future cross-site comparisons of PGC image analysis datasets, including identifying candidate datasets and preliminary discussions among research partners to strengthen future algorithm validation efforts.

## **3. Explanation of Variance**

No major variances from the planned activities were identified during this reporting period.

## **4. Plans for Next Quarter**

- Complete modeling and inference related to the scalability of PGC suppression practices using Liberty (glufosinate) herbicide. Results will be used to initiate preparation of a peer-reviewed manuscript and to inform updates to the design of ongoing and future PGC suppression studies.
- Continue curation and synthesis of on-farm trial datasets to assess the current “state of PGC” at scale, including system functionality and performance across locations and management contexts.

- Begin analysis of PGC image datasets using an improved modeling framework to evaluate the ability to estimate PGC intensity and characterize PGC recovery dynamics following suppression events.

## **5. Publications, Presentations, Stakeholder Engagement, Proposals Submitted**

None this quarter.

## **THEME 2. EXTENSION**

This cross-cutting theme extends the project's reach by developing a robust platform to share science-based knowledge, existing and potential commercial opportunities, and policy recommendations to an expanded set of stakeholders. Dan Andersen (Iowa State University) leads this theme.

Our comprehensive extension education efforts, which are geared towards ensuring and strengthening PGC adoption, target five stakeholder groups:

- Extension educators
- Farmers
- Technical service providers and crop advisers
- The scientific community
- The general public

### **1. Actual Accomplishments**

During this reporting period, the project team prepared and delivered a session at the Iowa State Integrated Crop Management (ICM) Conference focused on perennial ground cover options in corn–soybean systems. The presentation emphasized risk framing for PGC adoption, specifically how different ground cover choices shift the risk profile between ground cover longevity and potential yield exposure. Rather than positioning PGC as a single practice, the session highlighted decision-making tradeoffs that advisors and producers must consider when selecting species and management strategies.

The session was presented twice and reached an estimated 85 participants, including crop advisors, extension professionals, and producers. Participant discussion indicated strong interest in practical approaches to evaluating and managing risk in PGC systems.

### **2. Research Progress and Preliminary Outcomes**

Field research at the Nashua research site was highly successful during this reporting period. Lessons learned from prior-year management were incorporated, with particular emphasis on achieving effective early-season ground cover control. As a result, plots with Rhizomatous herbaceous ground cover (RHb) produced significantly greater corn and soybean yields compared to control plots.

Preliminary observations indicate that RHb contributed to improved early-season water management, which likely supported crop establishment and yield performance. Water quality data from the site are currently being compiled and analyzed and will be summarized in a future reporting period.

### **B. Overall Impact**

Collectively, these activities advanced both the technical understanding and practical risk management framework for perennial ground cover systems. Outreach efforts are increasingly focused on equipping advisors and producers with the tools needed to responsibly evaluate, adapt, and implement PGC systems while minimizing agronomic and economic risk. Ideas that research work has coalesced around as being key themes we need to address for wider implementation.

### **3. Explanation of Variance**

None noted.

### **4. Upcoming Programming and Planning**

Building on momentum from prior efforts, the team initiated planning for a virtual webinar series to be delivered in May–June, modeled after the previous PGC webinar program. This series will culminate in field days located across Iowa and the broader project region, leveraging established demonstration and research sites.

Key features of the planned program include:

- Continuing Certified Crop Adviser (CCA) credits for educational content.
- Expanded framing around “why perennial ground covers and why now,” including alignment with federal and state regenerative agriculture and conservation frameworks.
- Detailed guidance on ground cover selection, management strategies to optimize system performance, and approaches to limit yield exposure during establishment and early-season crop development.
- A strong focus on the information advisors need to de-risk implementation and support informed, site-specific decision-making by producers.

## 5. Publications, Presentations, Stakeholder Engagement, Submitted Proposals

None this quarter.

### THEME 3. EDUCATION

The cross-cutting Education Theme coordinates educational efforts that impact students from pre-college through undergraduate and graduate levels at multiple institutions. The aim of each educational program is tailored to the audience. The Educational Theme Coordinator and the project Objective Leaders will ensure that these programs are not siloed, providing rich, cross-disciplinary training and engagement opportunities for undergraduate and graduate students to meet the workforce education and training requirements for successfully adopting PGC production systems.

**Ken Moore** (ISU) leads this theme, with **Maureen Griffin** (ISU, focusing on REU and RET), **Dennis Miller** (independent contractor, focusing on FFA), and **Maya Hayslett** (ISU, focusing on 4-H) serving as collaborators.

#### 1. Instructional Development (Moore)

Development of instructional materials related to the science and practice behind PGC systems for use at all levels of instruction.

##### A. Planned Activities

Development of instructional materials will continue. Modules will be shared in the project's Teams directory as they are finalized.

##### B. Actual Accomplishments

The development of instructional materials is ongoing, and materials are being posted to the shared Teams directory as they become available.

##### C. Explanation of Variance

No variance was noted.

##### D. Plans for Next Quarter

Development of instructional materials will continue. Modules will be shared in the Teams directory as they are finalized.

#### 2. Undergraduate REU Program (Griffin)

### **A. REU Planned Activities**

We have one REU student teaching in the fall, and she has expressed a desire to meet every other week to support her transition to teaching. Also, she will collaborate with one of the RETs from this project (also a math teacher) to incorporate their research topics into her math teaching this fall. She has received a mini-grant to help her set up her classroom and purchase materials to support the ideas she learned from the summer professional learning.

We will also facilitate this REU in helping her stay connected to her mentor, as both expressed in their feedback. We will host several gatherings monthly and throughout the winter to keep the cohort connected. These sessions will be held virtually after the school day ends, allowing everyone to reconnect and continue sharing and learning.

### **B. REU Actual Accomplishments**

Griffin served on a panel at the REU Workshop on October 18, 2025, as part of a joint effort between ISU and Des Moines Area Community College. Over 80 students registered, and we provided students with information and resources about these summer opportunities. The overarching goal for the faculty panel was for students to get a broader sense of what an REU is and more details about our specific REU, gain a broader understanding of what an REU is, as well as more details about our specific REU program, including what the experience entails, what the experience is like, and what a successful application looks like. Continue to communicate regularly and Zoom with two of the REGEN REU students from the summer as they complete their final semester before student teaching. Also, email the other REU students and support them with questions and concerns they have about their practicum experiences and issues with the content they are teaching.

### **C. REU Explanation of Variance**

We completed all planned activities.

### **D. REU Plans for Next Quarter**

Presenting a session at the 2025 National Science Teachers Association meeting in Minneapolis in November on the program and the work we do with REUs. Provide a full-day learning experience on November 8<sup>th</sup> for all participants from the summer program. Materials for the day were delivered in early November. The focus of the session is on work from the summer, particularly the *Disengagement Gap* study by the Brookings Institute. The plan is for students to respond to the survey, and we will analyze the data to inform our work. Ongoing Zoom meetings to continue, as do Second Tuesday cohort gatherings. We will begin a book club with the book *Culture Code* by Daniel Coyle in

December for all participants. The 2026 REU and RET recruitment will start in late November and extend through March.

### **3. Research Experience for Teachers**

#### **A. RET Planned Activities**

We will send teachers monthly activities to use in their classrooms, modeled during the summer professional development time. All teachers received a mini-grant to purchase equipment and materials to sustain their summer learning in their classrooms. Teachers will also continue to meet with the entire cohort throughout the academic year on the Second Tuesday of each Month (SToM) for learning and reconnection. They will meet virtually with Griffin every other week to provide close support for their classroom work. All mentors requested staying in touch with their teachers, and Griffin will also facilitate these efforts.

#### **B. RET Actual Accomplishments**

We are very active with this group of teachers and supporting them in applying the learning from the summer in their classrooms. Continue to meet on the second Tuesday of the Month with the entire cohort and meet every other week via Zoom with teachers to support their work. Boxes were mailed to all participants for the full-day online learning session on November 8, 2025.

#### **C. Explanation of Variance**

No variance noted.

#### **D. RET Plans for Next Quarter**

Presenting a session at the 2025 National Science Teachers Association meeting in Minneapolis in November on the program and the work we do with REUs. Provide a full-day learning experience on November 8<sup>th</sup> for all participants from the summer program. Materials for the day were delivered in early November. The focus of the session is on work from the summer, particularly the Disengagement Gap study by the Brookings Institute. The plan is for students to complete the survey, and we will analyze the data to inform our work. Ongoing Zoom meetings will continue, as will the *Second Tuesday* cohort gatherings. In December, we will launch a book club featuring Daniel Cbookoyle's book, *Culture Code*, for all participants. Also, Curiosity Cycles will start with teachers in December. Starting a virtual book club in December with the book *Culture Code*, Daniel Coyle, for all participants. The 2026 recruitment of participants is scheduled to begin in late November and will extend through March.

#### **4. Undergraduate Internship Program (Moore)**

We planned to develop an undergraduate internship program for students at participating institutions. We have discontinued the project due to insufficient interest by undergraduate students working in the labs of the project CoPDs.

#### **5. Graduate Student Community (Moore)**

##### **A. Planned Activities**

The graduate student community will resume weekly meetings in the fall semester. Students will participate in the RegenPGC Café and attend professional development workshops.

##### **B. Actual Accomplishments**

The Graduate Student Community was focused on carrying out their field research projects. The RegenPGC Café/graduate student seminar resumed in August with the start of the fall semester. Six graduate students prepared abstracts for presentations at the CANVAS (ASA-CSSA-SSSA) Annual meeting in Salt Lake City.

##### **C. Explanation of Variance**

None noted.

##### **D. Plans for Next Quarter**

The graduate student community will continue to hold weekly meetings in the fall and spring semesters. Students will participate in the RegenPGC Café and attend professional development workshops.

#### **6. FFA and 4H Programs (Hayslett, Miller)**

##### **A. 4H Program Planned Activities (Hayslett)**

Youth outreach events for the next quarter are RegenPGC Day on August 9, 2025, at the 4-H Building during the Iowa State Fair; Obrien County Precision Ag Day on September 3, 2025; Chickasaw County Precision Ag Day on September 9, 2025; and Career Inspire on September 25-26, 2025. Four lesson plans will be published and available through the ISUEO Extension Store by the end of next quarter. We are planning to promote these lessons next quarter. Note: The FFA subtask program has been completed.

##### **B. Actual Accomplishments (Hayslett)**

Programs were carried out as planned for RegenPGC Day on August 9, 2025, at the 4-H Building during the Iowa State Fair, Obrien County Precision Ag Day on September 3, 2025, Chickasaw County Precision Ag Day on September 9, 2025, and Career Inspire on September 25 and 26, 2025. Additionally, youth programs in Avoca, Iowa, and the 4-H *Connect Retreat* in Boone, Iowa, were requested and implemented.

Altogether, approximately 870 youth and 100 adults participated in educational programs this quarter. Lesson plans have not yet been published. However, educator training is being provided based on the final drafts. Twenty-four ISU extension specialists, primarily county 4-H and youth staff, attended a workshop at *Youthfest* (Iowa 4-H educators conference) on the RegenPGC youth lesson plans and how to implement them, and received kits of supplies to implement the lessons.

This brings the total 4-H youth program reach to 3,230 contacts (youth, educators, and the general public combined). (Miller) The FFA subtask program has been completed.

### **C. Explanation of Variance**

Two additional youth programs were added at the request of county and state 4-H staff. The process for publishing lesson plans through Iowa 4-H and the ISU Extension Store has been significantly slower than expected. Maya Hayslett is continuing to work with 4-H staff to get these processed, but does not know how much longer it will take.

### **D. Plans for Next Quarter**

Youth outreach events for the next quarter are scheduled as follows: Kirkwood STEAM Institutes on December 11, 2025, in Washington, Iowa; December 15 and 16, 2025, in Hiawatha, Iowa; and December 17, 2025, in Monticello, Iowa. Training for county 4-H and youth staff on the lessons will be provided at ISUEO Region 23 on January 6, 2026. Maya Hayslett will continue to work with 4-H State Staff on lesson publication.

### **E. Publications, Presentations, Stakeholder Engagement, and Proposals Submitted**

None this quarter.

## **THEME 4. COMMERCIALIZATION**

Our goals are to:

- Work with Project Director Raj Raman and Deputy Director Anne Kinzel to engage stakeholders by establishing a Stakeholder Advisory Board (SAB) and a Farmer/Landowner Advisory Group (FLAG).

- Establish on-farm trials and conduct field days with producers to gain input and advice on how to make PGC approaches more practical, reliable, and profitable.
- Engage ag sector commercial entities in research partnerships and further identification of investment and development opportunities.

**Sara Lira** (Corteva Agrisciences) leads this theme.

### **1. Planned Activities**

- Collect final data in the herbicide trial; analyze it to amend the 2026 protocol.
- Complete summary of all data gathered between 2021-2024.
- Prepare a final analysis of the hybrid/variety trial small plot data.

### **2. Actual Accomplishments**

- Collect final data in herbicide trial; analyzed it
- Complete summary of all data 2021-2024
- Final analysis of hybrid/variety trial small plot data

### **3. Explanation of Variance**

We are doing another run of the herbicide trial analysis with some changes, so we have not completed any potential changes to the 2026 herbicide trial.

### **4. Plans for Next Quarter**

- Finalize herbicide trial protocol for 2026
- Finalize data QC for upload to Zenodo database

### **5. Publications, Presentations, Stakeholder Engagement, and Proposals Submitted**

None this quarter.

## **OBJECTIVE 1. CROP ECOLOGY & MANAGEMENT**

This Objective focuses on developing and testing best management practices for cash crop establishment in PGC systems and managing the transition from current practices. Objective 1 will improve PGC economics by tuning and integrating groundcover and cash crop management, thereby reducing risk. The primary goal is to elucidate key mechanisms related to a) cash crop

and PGC interference, b) early cash crop growth and development in PGC systems, and c) pest dynamics.

**Erin Haramoto** (University of Kentucky) and **Scott Flynn** (Corteva Agrisciences) lead this Objective. Collaborators are **Lucas Borrás** (Corteva Agrisciences), **Susana Goggi** (ISU), **Ken Moore** (ISU), and **José Rotundo** (Corteva Agrisciences). **Hallie Sandeen (UK)** and **Kiera Searcy (UK)** are the graduate students (Master's) in this Objective.

## 1. Planned Activities

### A. Kentucky

- **Field Trials**

- **Final Data Collection.** Final stand count, number of plants with barren ears, and yield data were collected in all trials. Yield components (kernel weight, tip fill, # kernel rows per ear) were collected from key trials (Kiera Searcy - PGC Herbicide Trial and Hallie Sandeen - Species Trial).
- Maintain KBG for use in subsequent experiments.

- **Graduate Student Progress**

- Continue writing theses and preparing manuscripts.
- Defense dates are set for November and December 2025.

### B. Iowa

- Hand and machine harvesting will take place as crops mature.
- Final groundcover data will be taken before and after harvest.
- Several experiments will conclude after harvest, and plot areas will be abandoned.
- Post-harvest management of corn residue will take place in experiments that will continue into 2026.
- All faculty, staff, and graduate students will attend the annual RegenPGC project meeting at the Corteva location in Johnston, Iowa, in October.

## 2. Actual accomplishments

### A. Kentucky

- **Field Trials**

- Final data collection completed in all trials – final stand count, number of plants with barren ears, yield, and yield components.
- Kentucky bluegrass largely did not survive the summer in Kiera Searcy’s trials.

- **Graduate Student Progress**

- Graduate student Kiera Searcy progressed with data analysis for Years 1 and 2 and with writing the materials and methods for the main trial.
- Hallie Sandeen sent a complete thesis to her committee for review, with her defense planned for mid-November 2026.
- Kiera Searcy continued with writing her thesis, but her thesis defense will be delayed until January 2026.

## **B. Iowa**

- Hand and machine harvesting began in September and concluded in October 2025.
- Final groundcover data was taken before and after harvest.
- Several experiments were concluded after harvest, and the plot areas were terminated and tilled.
- Post-harvest management of corn residue took place in experiments that will continue into 2026.
- All faculty, staff, and graduate students attended the annual RegenPGC project meeting at the Corteva headquarters in Johnston, Iowa, in October.

## **3. Explanation of Variance**

### **A. Kentucky**

- Volunteer wheat pressure in all field trials may have reduced grass survival.
- Dry summer and fall conditions allowed for earlier harvest in all trials.

### **B. Iowa**

None noted

## **4. Plans for Next Quarter**

### **A. Kentucky**

- Hallie Sandeen will defend her master's thesis in November 2025, with a completion date of December 2025.
- Kiera Searcy will defend her master's thesis in January 2026, with May 2026 as her completion date.
- Hallie Sandeen prepares and submits two manuscripts: (additional submissions planned for subsequent quarters).
  - Methods paper for analyzing herbicide deposition on Kentucky bluegrass (fine blades but dense clumps) -- submitted as a short paper to *Weed Technology*.
  - Study on alternative cool-season grasses for PGC adoption – submitted to *Agronomy Journal*.
- Hallie Sandeen analyzes rooting depth data collected in November 2024 to write a short report.
- Erin Haramoto attends CANVAS (formerly called Tri Societies) and presents summary findings from student trials.

#### **B. Iowa**

- Hand-harvested ear samples will continue to be hand-shelled for determining yield components in appropriate experiments.
- Data sets and analyses will be made available to corporate partners.
- Planning for the last season of experiments will take place with an emphasis on establishment with PGC.

#### **5. Awards, Publications, Presentations, Stakeholder Engagement, Submitted Proposals**

None this quarter.

### **OBJECTIVE 2. PLANT BREEDING & GENETICS**

This Objective focuses on PGC cropping system optimization by screening for superior groundcovers and maize hybrids that minimize competition as each occupies its own temporal or spatial niche. This can enhance PGC's economic viability through yield improvement and reduced management requirements while increasing ecosystem impacts via reduced chemical inputs. Our work will also enable the design of novel breeding strategies and the development of dedicated breeding programs for PGC hybrids and varieties.

Shuizhang Fei (ISU) and Thomas Lübberstedt (ISU) lead this Objective, and Brandon Schlautman (TLI) and Sara Lira (Corteva Agriscience) serve as collaborators. Yu Ru Chen serves as a PostDoc Scholar, and current graduate students are Memis Bilgici (Lübberstedt Group), Prathyusha Cheguri (Fei Group), Cameron Krumm (Fei Group), and Vipul Kumar (Fei Group).

## **Shuizhang Fei Group**

### **1. Current Projects**

#### **A. Evaluation of PGC Species and Chemical Suppression Method on Maize Growth and Development**

The first-year study evaluating eight species for their suitability as perennial groundcover for maize production has concluded. The PGC species include Kentucky bluegrass ('Milagro'), Radix Hybrid bulbosa ('PB343'), two Sandberg bluegrasses ('High Plains' and 'Vale'), two tall fescues ('FNKY' and 'Chisolm'), Hard fescue ('Tenacity'), and creeping red fescue ('Boreal'). Data on the percentages of ground coverage, greenness, and biomass, and their effects on reflective light quality, are obtained for PGC. We also measured maize plant height, leaf chlorophyll content, stem diameter, and grain yield. Our data indicated that chemical suppression (Liberty herbicide) of PGC reduced early interspecific competition between maize and PGC. Combining suppression and the deployment of summer-dormant PGC minimizes negative impacts on maize growth and yield.

#### **B. RNA-seq to Identify Candidate Genes for Summer Dormancy in *P. bulbosa*.**

RNA-seq data for leaf and basal bulb samples of *Poa bulbosa*, collected across various time points under summer dormancy-inducing conditions and during dormancy breakage, are now made available by Novogene. We are currently conducting bioinformatics analysis to identify candidate genes underlying summer dormancy in *Poa bulbosa*.

#### **C. Characterization of *Poa bulbosa* Genotypes Collected from the U.S. West in the Field**

The controlled environment study (24°C, 16-hour photoperiod) evaluating 53 new *Poa bulbosa* genotypes collected from U.S. western states has been completed, and data analysis is ongoing. We have established these same accessions in the field to evaluate their agronomic performance.

#### **D. Evaluation of freezing tolerance in *Poa secunda***

We evaluated **the** freezing tolerance of three *Poa secunda* cultivars, 'High Plains', 'Vale', and 'Hanford', by measuring ion leakage and conducting a regrowth test with or without cold acclimation. Without cold acclimation, the innate freezing tolerance across *P. secunda* genotypes is about the same, with an  $LT_{50}$  of  $\sim 8.5$  °C, compared to  $\sim 11$ °C for Kentucky bluegrass, suggesting that *Poa secunda* has a moderate level of cold hardiness compared with the more winter-hardy *P. pratensis*. Interestingly, *P. secunda* genotypes exhibited clear variation in cold response traits, reflecting differences in both developmental and physiological adaptation. These results inform breeding decisions for developing climate-resilient PGC cultivars.

## 2. Plans for Next Quarter

- Once RNA-seq data are received, transcriptome analysis will begin immediately to identify candidate genes associated with dormancy. Genome annotation efforts will be advanced for the *Poa bulbosa* reference genomes (both the hexaploid and tetraploid accessions). In parallel, a de novo transcriptome assembly will be initiated to complement reference-based approaches.
- Ploidy level determination for the 180 *Poa secunda* accessions and perform RNAseq to identify candidate genes for summer dormancy in *P. secunda* (cv. High Plains).
- Determine reproductive mode in a group of 20 geographically diverse accessions (50 seeds each) using flow cytometry, and identify sexual vs. apomictic accessions, with highly sexual accessions prioritized to facilitate crossing and breeding efforts.

## 3. Awards, Publications, Presentations, Stakeholder Engagement, Submitted Proposals

### A. Awards

In November 2025, Ph.D. student Pratyusha Cheguri (Iowa State University) received a 1st Place Award in the *5 Minute Rapid-Crop Breeding and Genetics Oral Session* for her presentation Cheguri, Unlocking sexual reproduction in *Poa bulbosa* at the 2025 TriSocieties Annual meeting CANVAS 2025 in Salt Lake City, Utah.

Ms. Cheguri was a runner-up in the Fall 2025 Iowa State University 3 Minute Thesis competition. Prathyusha shared her RegenPGC work in her presentation "Why Soil Needs a Blanket."

## Lübberstedt Group

### 1. Actual Accomplishments

- Memiş Bilgici has been selected for the Bayer Crop Sciences University Mentoring Program at Iowa State University (ISU). This is a one-year mentoring program designed

for early-career scientists and engineers in various fields. The program provides mentees with the opportunity to build relationships, expand their networks, and gain valuable industry experience. Learn more about the Iowa State University - Bayer University Mentoring Program.

As part of the program, Memiş, along with other students, had the opportunity to visit the Bayer campus in Chesterfield, St. Louis, on October 23-24. During the visit, they participated in campus tours, poster sessions, and panel discussions. The ISU Department of Agronomy provided funding for this trip.

- PostDoc scholar Yu-Ru Chen developed a new two-stage GS pipeline that includes SpATS (Spatial Analysis of Field Trials with Splines) to perform reaction norm genomic selection using the sommer package. This pipeline can remove the spatial noise caused by cover crop planting systems (i.e., border effects, fertility gradients, or soil organic matter variation), and the reaction norm GS is more powerful than doing GS separately in each environment. Therefore, it is better to identify stable maize genotypes and understand the plasticity of these genotypes across different environments.



Photo 1. Memiş Bilgici at the Bayer Chesterfield campus in St. Louis, MO. (Oct. 24, 2025)

- **Manuscript Submission.** Bilgici et al. submitted a research paper on the stomata of maize in collaboration with *Corteva Agriscience*. To our knowledge, this is the first crop-focused stomata study conducted over a (100 years) full century.

The paper, *Trends in Stomatal Density and Size in Maize Hybrids Represent 100 Years of Long-Term Breeding for Yield*, is currently under peer review and has also been posted as a preprint. (Bilgici, Memiş, Ebrahimi, Elnaz, Prada de Miranda, Leticia, Lira,

Sara, Borrás, Lucas, Young, Thomas, Yavuz, Recep, Moore, Kenneth J., Dixon, Philip, & Lübberstedt, Thomas. (2025). Trends in stomatal density and size in maize hybrids representing 100 years of long-term breeding for yield.” *bioRxiv* (2025): Submitted 2025-10).

- Maize stomatal traits changed through environmental (CO<sub>2</sub> and °C) adaptation, but total stomatal pore area effects indirectly by decreased leaf area in maize hybrids representing 100 years of long-term breeding for yield.
- A negative correlation was observed across 27 ERA hybrids between stomatal density and stomatal size, length, width, and leaf area. Stomatal density increases while stomata size, length, width, and leaf area decrease per se.
- Over the past 100 years, the total stomatal pore area on leaves decreased, while stomatal density increased as leaf area declined, revealing a connection between these two patterns.
- A negative correlation was found between total stomatal pore area and atmospheric CO<sub>2</sub> concentrations and temperature over the past century.

## 2. Plans for Next Quarter

- **Manuscript Submission.** We are preparing to submit a research paper on ERA maize hybrids focusing on shade avoidance and stomatal traits, in collaboration with *Corteva Agriscience*. The working title is: *Phenotypic Response to Low Red/Far-Red Light Ratio (Shade Avoidance Response) in Maize Hybrids Representing 100 Years of Long-Term Breeding for Yield*.
- **Analysis of 3-Year Field Data on Perennial Ground Cover Crops in Maize.** We are analyzing and synthesizing results from three years of field trials involving conventional systems, RHB–*Poa bulbosa*, and Kentucky bluegrass. A key objective is to determine whether a dedicated maize breeding program is needed for perennial ground cover crops.
- We harvested and collected 54 TC genotypes plant traits such as plant height, leaf angle, SPAD-based traits and flowering time, among others, in Conventional and PGC sites in 2025, evaluated BS39-derived DH testcross genotypes in *Poa bulbosa* (2<sup>nd</sup> year) and Kentucky blue grass (3<sup>rd</sup> year) PGC system in the summer of 2025 to understand phenotypic plasticity of the traits of interest in the target population of genotypes and harvested. These data will help to further refine hybrid selection criteria based on PGC system compatibility. We will explore genomic tools and advanced breeding strategies to accelerate hybrid development for PGC systems.

- **Genomic and Phenotypic Selection and Prediction.** We will initiate genomic and phenotypic selection analyses in maize for perennial ground cover traits, including the development of prediction models. This will help identify key genetic markers, estimate breeding values, and guide future efforts in optimizing perennial ground cover crops for integration into maize production systems.
- Memiş Bilgici will present one talk and two posters at the CANVAS 2025 conference, which will take place from November 9-12, 2025, in Salt Lake City, Utah. CANVAS, formerly known as the ASA, CSSA, and SSSA International Annual Meeting, is a venue where crop, agronomic, environmental, and soil sciences come together to inspire change and promote scientific advancement.

### 3. Publications, Presentations, Stakeholder Engagement, Submitted Proposals

- **Publications**
  - **Bilgici, Memiş, Ebrahimi, Elnaz, Prada de Miranda, Leticia, Lira, Sara, Borrás, Lucas, Young, Thomas, Yavuz, Recep, Moore, Kenneth J., Dixon, Philip, & Lübberstedt, Thomas.** (2025). Trends in stomatal density and size in maize hybrids representing 100 years of long-term breeding for yield." *bioRxiv* (2025): Submitted 2025-Oct).

## OBJECTIVE 4. ECOSYSTEM SERVICES AND MODELING

This Objective focuses on quantifying the provision of ecosystem services derived from PGC implementation. We consider a wide range of ecosystem services, including improved water quality, flood and drought mitigation, protection against soil erosion, carbon sequestration, and biofuel feedstock and/or fodder provision. Quantification is crucial to incentivize farmers for ecosystem services. **Amy Kaleita-Forbes** (ISU) and **Rob Anex** (University of Wisconsin-Madison) lead this Objective. In the fall of 2025, the Objective team will add graduate student Ralph Danquah-Acquah (Kaleita).

### 1. Quantify Decreased Flood Risk and Improved Drought Resiliency Compared to Conventional Cropping Systems

#### A. Planned Activities

Onboard a new graduate student, Ralph Danquah-Acquah.

#### B. Actual Accomplishments

Ralph Danquah-Acquah arrived in early September 2025. We reviewed project outcomes to date and investigated an alternative model to EPIC that is similarly capable but with more crop options (ALMANAC).

**C. Explanation of Variance**

None noted.

**D. Plans for Next Quarter**

We will statistically compare output from EPIC to that from ALMANAC with respect to runoff.

**2. Quantify PGC Impacts on Water Quality**

**A. Planned Activities**

Onboard a new graduate student, Ralph Danquah-Acquah.

**B. Actual Accomplishments**

Ralph Danquah-Acquah arrived in early September 2025. We reviewed project outcomes to date and investigated an alternative model to EPIC that is similarly capable but with more crop options (ALMANAC).

**C. Explanation of Variance**

None noted.

**D. Plans for Next Quarter**

We will statistically compare output from EPIC to that from ALMANAC with respect to runoff.

**3. Quantify PGC Ecosystem Service Sustainability Indicators and Compare them with Conventional Systems**

**A. Planned Activities**

**None:** Funds are being de-obligated in this sub-objective.

**4. Quantify the Limits on PGC Maize Stover Removal**

**A. Planned Activities**

None at this time.

## **B. Actual Accomplishments**

None at this time.

## **C. Plans for Next Quarter**

None at this time.

## **5. Publications, Presentations, Stakeholder Engagement, Submitted Proposals**

Olowoyeye, Oluwatuyi S. & Kaleita, Amy L. (2026). Towards modeling soil erosion in a perennial ground cover (PGC) system, *Ecological Modelling*, 511, Article 111365.

<https://doi.org/10.1016/j.ecolmodel.2025.111365>. OPEN ACCESS. [Read the Article Abstract](#)

## **OBJECTIVE 5: SOCIOECONOMIC IMPACTS AND POLICY**

This Objective evaluates the conditions under which the proposed practices are economically sustainable for farmers and input suppliers in the PGC supply chain and well-being enhancing for farmers and consumers. It integrates them by considering how PGC fits into existing policy frameworks. Functionally, the Objective synthesizes information from other Objectives and quantifies the overall value proposition for various versions of PGC. Keri Jacobs (University of Missouri) leads this Objective, and Amani E. Elobeid (ISU) and Cynthia A. Bartel (ISU) serve as collaborators.

Our overall team direction focuses on continuing data discussions and working toward finalizing the data and communicating it to the Data Management Team.

### **1. Actual Accomplishments**

Continued USDA outreach to establish PGC as an included USDA program practice, including USDA RMA for crop insurance consideration regarding response metrics of PGC systems; and NRCS regarding working-lands (conservation) practice standards relevant to PGC.

### **2. Publications, Presentations, Ag Press, Stakeholder Engagement, Submitted Proposals**

#### **A. Publications**

- Bartel, Cynthia A., Moore, Kenneth J., Andersen, Daniel S., Raman, D. Raj. (*anticipated 2026*). Quantifying and characterizing groundcover “intensity” in perennial groundcover (PGC) systems. In review at *Agronomy Journal*. Submitted January 9, 2026.

This submission is based on a white paper previously shared with the RegenPGC team: *Characterizing Groundcover “Intensity” in Perennial Groundcover (PGC) Systems – History and Paths Forward*. A white paper for consideration and discussion by the members of RegenPGC & FABPGC. Cynthia A. Bartel & D. Raj Raman, August 13, 2025.

## B. Ag Press

- Hoff, Stephanie (Host) & Bartel, Cynthia. (2025, October 9). SARE Grants Turn Ideas Into Action At Hurtgenlea Holsteins. [Audio podcast episode]. Midwest Farm Report - Madison. <https://omny.fm/shows/mid-west-farm-report-madison/sare-grants-turn-ideas-into-action-at-hurtgenlea-holsteins>
- Klaphake, Tiffany. (2025, September 13). New ways to farm: Hurtgen farm offers virtual tour during WDE. *Dairy Star World Dairy Expo Special Edition*, p. 36. <https://dairystar.com/stories/2025-world-dairy-expo-special-edition,29562>
- Massey, Jim. Farm Progress (2025, October 9). *Wisconsin dairy farm embraces robots, health monitoring and intercropping*. Farm Progress. <https://www.farmprogress.com/dairy-cattle/wisconsin-dairy-farm-embraces-robots-health-monitoring-boluses-and-intercropping>
- Massey, Jim. Farm Progress (2025, October 9). Wisconsin dairy farm embraces robots, health monitoring and intercropping. *Wisconsin Agriculturist Digital Edition*. <https://www.farmprogress.com/dairy-cattle/wisconsin-dairy-farm-embraces-robots-health-monitoring-boluses-and-intercropping>

## C. Stakeholder Engagement

- Hurtgen, Adam W. & Bartel, Cynthia A. (2025, September 30). World Dairy Expo Virtual Farm Tour. Madison, Wisconsin. A PGC-related site in Wisconsin was selected as one of four farms in the United States as a 2025 World Dairy Expo virtual farm tour. The farm tours showcase the top farms in the nation each year, based on environmental stewardship, quality genetics, technology advancements, diversification, and more. In person: ~80 attendees (Virtual tours are viewed by 1,000-14,000 online visits. RegenPGC Co-Pd Cynthia Bartel & farmer Adam Hurtgen presented. World Dairy Expo Virtual Tour List & release, 2025. <https://worlddairyexpo.com/pages/Virtual-Farm-Tours.php>

## PROJECT EVALUATION

Dr. Heather Dantzker is the RegenPGC External Evaluator. PD Raman and Deputy Director Kinzel meet with Dr. Dantzker regularly to review her work and plan future evaluation activities. Our goal is to use these activities to fine-tune the RegenPGC team's performance.

## **1. Planned Activities**

### **A. RegenPGC – Overall Project Activities**

- Participate in RegenPGC leadership calls (Co-PD and SAB) and evaluation calls with the project director and deputy director, as scheduled.
- Ongoing monitoring/review/analysis of project progress and milestones in relation to the main project logic model.
- Evaluation planning, including planned data collections, analysis, and any formative and summative reporting, through discussions with project leadership, across project objectives and themes (other than Education) for the remainder of the project (August 2025 – July 2026).
- Travel to and participation in RegenPGC Annual Meeting, Oct 1-3, 2025, Johnston, IA.

### **B. Regen PGC – Education Theme Focus**

- Continue meeting monthly with Education theme leaders, as scheduled.
- Ongoing monitoring/review/analysis of Education-related progress and milestones in relation to the Education Theme - specific logic model
- Education-theme focused evaluation planning, data collection, and analysis through the remainder of the project.

## **2. Actual Accomplishments**

### **A. RegenPGC – Overall Project Activities**

- Participated in RegenPGC leadership calls (Co-PD and SAB) and evaluation calls with the project director and deputy director, as scheduled.
- Ongoing monitoring/review/analysis of project progress and milestones in relation to the main project logic model.
- Evaluation planning, including planned data collections, analysis, and any formative and summative reporting, through discussions with project leadership, across project

objectives and themes (other than Education) for the remainder of the project (through July 2026).

- Traveled to and participated in RegenPGC Annual Meeting, Oct 1-3, 2025, Johnston, IA.

#### **B. Regen PGC – Education Theme Focus**

- Met with Education Theme leaders, as needed.
- Continued ongoing monitoring/review/analysis of Education-related progress and milestones in relation to the Education-specific logic model
- Continued Education Theme focused on evaluation planning, data collection, and analysis.

### **3. Explanation of Variance**

Monthly Education Theme meetings were replaced with ad hoc calls as needed.

### **4. Plans for Next Quarter**

#### **A. RegenPGC – Overall Project Activities**

- Participate in RegenPGC leadership calls (Co-PD and SAB) and evaluation calls with the project director and deputy director, as scheduled.
- Ongoing monitoring/review/analysis of project progress and milestones in relation to the main project logic model.
- Evaluation planning, including planned data collections, analysis, and any formative and summative reporting across project objectives and themes (other than Education) for the remainder of the project (Nov 2025 – July 2026).

#### **B. Regen PGC – Education Theme Focus**

- Meet with Education Theme leaders, as needed.
- Ongoing monitoring/review/analysis of Education-related progress and milestones in relation to the Education-specific logic model.
- The Education Theme focused on evaluation planning, data collection, and analysis through the remainder of the project.

### **5. Publications, Presentations, Stakeholder Engagement, and Proposals Submitted**

None this quarter.



*The long-term goal of this project is to develop and de-risk a transformative method for increasing groundcover on working landscapes, thereby realizing urgently-needed environmental benefits. Our vision is to develop a perennial cover-cropping system that requires less labor, provides equal or more ecosystem benefits, and increases resiliency while having an overall economic profile that is equivalent to, or better than conventional row-crop practices.*

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