

# BIOAg Project Report

Report Type: Final

Title: Compost Teas for Enhanced Nutrient Cycling

Principal Investigator(s) and Cooperator(s):

**Principal Investigator(s)**

Lynne Carpenter-Boggs

Maren L. Friesen

Carol McFarland

Syed Shah

**Cooperators:**

Brentley Uhlorn, Darrel Uhlorn (Uhlorn Family Farms), Sheryl Zakarison, Ariel Zakarison, Douglas Poole, Lindsay Myron, Clay Erskine, Chris Eckhart, Josh Riddle, and Jesse Brunner: producers interested in compost teas

Aaron Esser: Extension specialist, Scott Deatherage: owner-operator of Barr-Tech Compost in Spokane County.

**Abstract:**

With rising fertilizer and fuel costs, producers are increasingly keen to improve on-farm nutrient cycling through biologically intensive methods. Currently, poor plant-soil-microbe interactions do not support healthy nutrient flow, which limits crop yield and favors fertilizer-dependent farming. Slow residue breakdown also inhibits direct seeding adoption and adherence since heavy residue at seeding time impedes direct seeding and may inhibit seedling emergence. The use of compost teas might address all of these goals while increasing economic, environmental, and social sustainability. Our team will conduct on-farm interviews of growers who use compost tea to document current practices and grower observations. We will collect samples of farm-brewed teas and previously researched lab-brewed teas and characterize their chemical makeup and microbial communities. Lab studies will determine effects of teas on residue breakdown rate and nutrient availability, two producer driven goals. These data will position the team to pursue larger funds to conduct on-farm trials.

**Project Description:**

Compost teas, also known as agricultural teas held longer than 1 hr, are a solution of water, a base compost material, and additives that may promote microbial growth in the solution or plant growth upon field application (Food Safety Modernization Act 2011). Compost tea has been studied and used as an organic fertilizer, soil amendment, and disease antagonist. Several studies have found positive effects of compost teas on plant growth (Gharib et al., 2008), seed germination (Manandhar and Yami, 2008), soil microbial activities, and soil structure (Fritz et al., 2012; Siddiqui et al., 2011). Most tea studies have compared the effectiveness of a small number of teas to water, inorganic fertilizer, or each other. However, teas are often poorly characterized.

Recent work in the Carpenter-Boggs lab has defined a set of four compost tea recipes that can be made with any compost. Greenhouse trials at WSU and in other published studies correlate most plant benefits with soluble nitrogen content. One tea enhanced plant growth more than others, and more

than any of the standardized sterile nutrient solutions; this growth was tied to a wider set of nutrients and beneficial microorganisms. A multivariate analysis found soluble nitrogen, protozoan population, B, P, Fe, and Zn explained up to 99% of plant biomass variability (Almesmari, 2021).

With increasing fertilizer and fuel costs, and declining soil and crop quality, producers are increasingly keen to use on-farm resources, incorporate micronutrient fertility, and maximize plant-soil-microbe benefits. The use of compost teas may present a good option to address all of these goals while increasing economic, environmental, and social sustainability. Theoretically, use of compost tea could increase purchased nutrient use efficiency by increasing nutrient release from soils, supporting beneficial plant-microbe relationships, adding soluble micronutrients to balance overall nutrient supply, and improving soil tilth and rooting depth. Adding benefits such as these would decrease purchased inputs (improving environmental sustainability by reduced leaching and mining), and improve farm economics. Social sustainability and quality of life are improved by strengthening the bond of farmer with soil and microbe, and supporting a growing brother/sisterhood of sustainable-minded farmers.

In 2020-2022, in five workshops (McFarland et al., 2022) producers voiced a need for effective approaches to building soil health in this region where cover crops and biomass return are limited by low precipitation, cold winters, and dry summers. Producers specifically voiced interest in compost teas. Growers indicated that their information on compost teas is being obtained through Acres USA, private consultants, and the internet at large. While Acres USA is a source of rare information on regenerative and biological methods, much of the information is not research-based or reliable. There is a wide gap between research, interest, and use. Stakeholders have expressed that a lack of complete information, low confidence in the information available being adequate to consistently produce a quality product, the best use and timing for compost tea use, and lack of appropriate equipment for brewing and application are other barriers to adoption.

The objectives of this project are twofold. First, we will survey producers in Eastern Washington and the adjacent regions across various production systems, to better understand needs and their research questions surrounding compost tea. We will also aim to better understand their capacity to produce and deliver the technology within their production system. Second, we will conduct laboratory incubation trials and analyses to characterize tea microbial communities and effects on residue decomposition.

## Outputs:

### Overview of Work Completed and in Progress:

- We have conducted an online survey, which was completed by 38 people.
- We have obtained 29 compost tea/extract samples from 4 farms and analyzed the bacterial communities in them.
- An experiment has been conducted to evaluate the impact on wheat straw breakdown of 4 compost teas at 3 timings.
- WSU Farmers Network Coffee Hour, May 31, 2023, garnered 50 registrations, 22 participants, and 25 YouTube Views. [Soil Health Coffee Hour: May 2023 - YouTube](#).
- Dr. Carpenter-Boggs presented at the January 2024 Pacific Northwest Direct Seed Association meeting in the Tri-Cities to an audience of ~100 mixed producers and professionals from the ag community and additional contacts were made.
- We attended the Tilth Conference 2024 and made contacts with additional farms in both Eastern and Western WA that are actively using compost teas and extracts.
- We presented a poster on the project at the WSU 2024 Regenerative Ag Symposium.

- We conducted a workshop including a farmer cooperater at the 2025 Tilth Alliance Conference.

### **Methods, Results, and Discussion:**

#### *Methods:*

- Our team surveyed growers who are pursuing their interest in using compost tea to document current practices and grower observations. Information was gathered using a standardized question set developed by the researcher-producer community. The questions and interview plan were submitted to the WSU Institutional Review Board and deemed exempt from full review.
- We collected samples of farm-brewed teas and previously researched lab-brewed teas and characterized their chemical makeup and bacterial communities through 16S analysis.
- Lab studies will determine effects of teas on residue breakdown rate and nutrient availability, two producer driven goals. Incubations will be conducted in controlled conditions to assess crop residue decomposition. Two temperature regimes will be assessed and at least two soils. Carbon dioxide respiration will be quantified, as well as total biomass reduction. Changes in nutrient availability of the soil will be assessed by standard soil nutrient analyses.
- To assess microbial community composition, we extracted DNA using the Earth Microbiome Project protocol implemented using a Kingfisher instrument in Friesen's lab. The 16S region was sequenced using the Illumina MiSeq platform to characterize bacterial communities, respectively. Data were analyzed using Qiime II to assign taxonomic information to the sequences and test for relative differences in abundance of different microbial groups between the teas.

#### *Results:*

- The producer survey was completed by 38 people.
  - The top 5 recurring desired outcomes from compost tea use were:
    1. **Improved Soil Health and Microbiology:** Numerous responses mentioned enhanced soil microbiome, increased microbial diversity, improved soil health, and stronger mycelial biomass.
    2. **Reduced Need for Synthetic Inputs:** References to reducing or eliminating industrial/synthetic fertilizers while maintaining yields.
    3. **Enhanced Plant Resilience:** Comments about increased pest and disease resistance, plant vitality, and resilience against climate stress.
    4. **Better Crop Performance:** Multiple responses mentioned increased yields, improved growth, better taste, and larger produce.
    5. **Economic Benefits:** References to reduced input costs and achieving the same yields with fewer synthetic materials.
  - Several producers indicated that they observed improved seedling emergence and rooting with the use of compost teas.
  - Many indicated barriers to use including lack of equipment, knowledge, and guidelines for use. Respondents want field testing and reliable information on both successes and failures of compost extracts and teas.
- Bacterial communities in our four lab-developed compost teas were highly distinct (Figure 1). Lab replicates of the same tea were highly consistent, lending credence to the methods used. Communities shifted dramatically over time from day 0 to after 1 day and 6 days brewing.

- Straw degradation in most treatments was rapid in the first 60 days, then slowed (Figure 2).
- 60-70% degradation was achieved with:
  - Vermicompost-only solution, not brewed or brewed 1 day
  - Recipe A, brewed 6 days
  - 300 ppm N
- In all recipes with additives, 6-day brews increased degradation over 0 or 1 day.

**Publications, Handouts, Other Text & Web Products:**

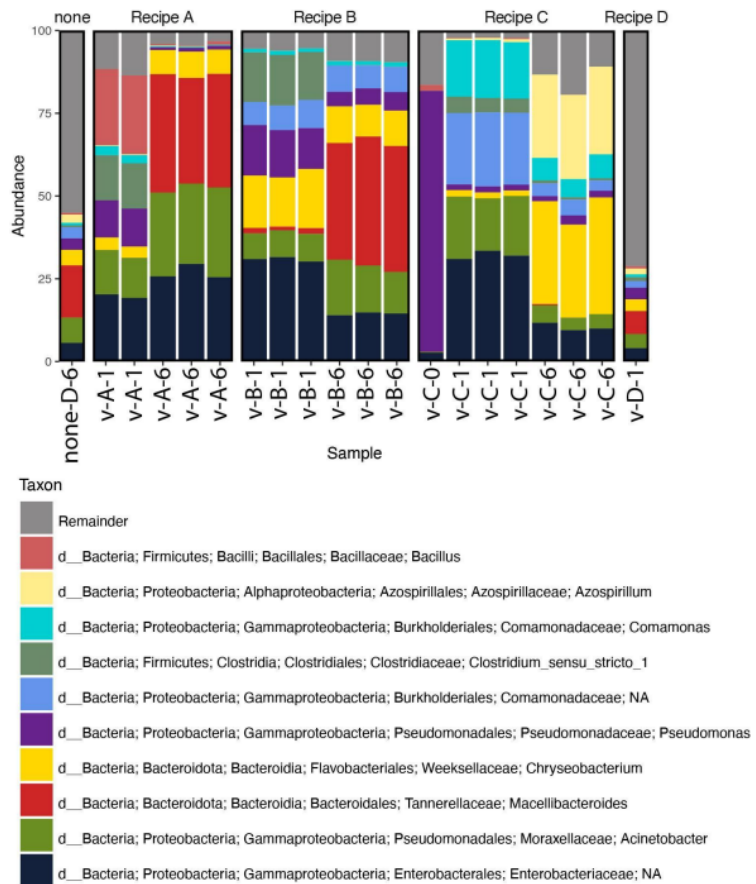
- WSU Farmers Network Coffee Hour Soil Health Coffee Hour: May 2023 - YouTube

**Outreach & Education Activities:**

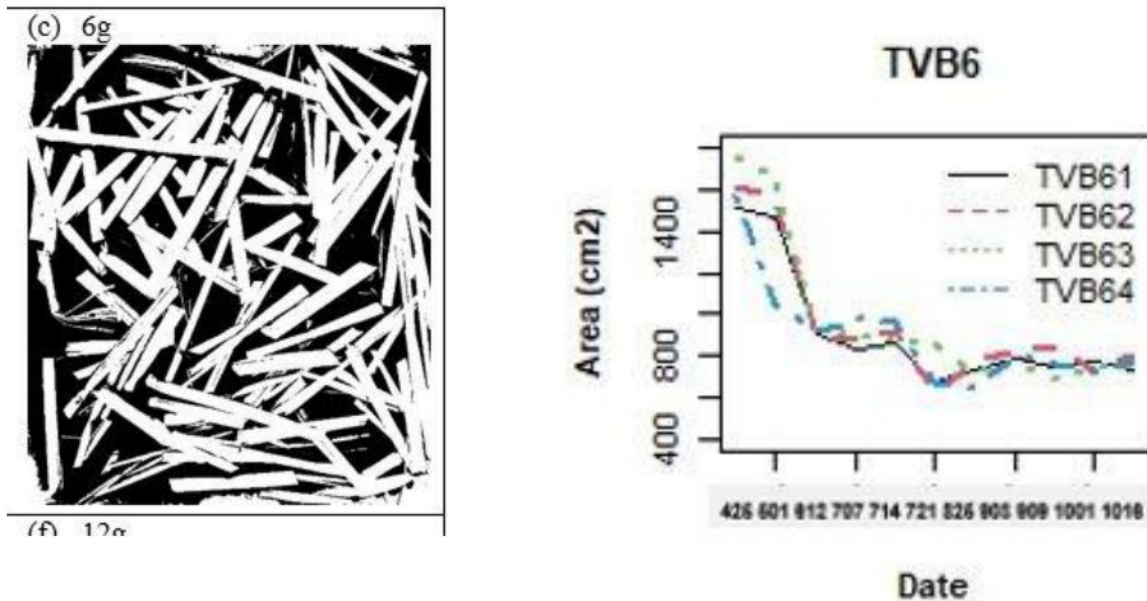
- WSU Farmers Network Coffee Hour, May 31, 2023
- Presentation at the PNDSA January 2024
- Poster at Regenerative Ag Symposium, Sept 26, 2024
- Workshop at Tilth Alliance Conference, Nov 14, 2025
- Presentation at CANVAS 2025 Conference, Nov 10, 2025

Experiment data

Barplots at the genus level



**Figure 1.** Genus-level identification of bacteria in four compost tea recipes. Where available, teas were analyzed at time 0, after 1 day brewing, and after 6 days brewing, indicated by a -0, -1, or -6 in the sample name.



**Figure 2.** Straw degradation was tracked using repeated photographs and analysis with ImageJ software. Degradation in most treatments was rapid in the first 60 days, then slowed.

### Impacts:

- **Short-term - Knowledge gained and shared:** Knowledge about current producer use of compost teas in Washington State, their methods of production, use, and intended outcomes.
- **Intermediate-term - Current & expected change in behaviors and when these may be expected:** We expect that the types of teas, materials used, and procedures for use will change due to this work. Producer and consumer safety in this process will also improve through understanding of microbial communities and relevant regulations.
- **Long-term - Potential change in economic/environmental/social situations, and when these may be expected:** The social impact of this work will begin immediately as producers and researchers engage to develop the project. Economic and environmental impacts will accrue over time, and will be greatest after we conduct on-farm trials (beyond this immediate proposal). With on-farm trials (which will depend on the current proposed work) producers will change their perspectives and use of compost teas to improve efficiency of fertilizer use and/or stop tea use that is ineffective.

### Additional funding applied for/secured:

We submitted a proposal to the USDA-NIFA Soil Health program.

### Graduate students funded:

Please provide name, degree type, and department

N/A

## Recommendations for future research:

Future research will assess the functional effects on soil health and plant growth, following the initial characterization of their chemistry and microbiology. Research will also assess how different compost teas influence soil properties, microbial communities, and nutrient availability. This will primarily involve controlled experiments to study residue decomposition, plant biomass, root development, disease resistance, and overall productivity.

After characterization, research will correlate the basic characteristics, ingredients, and preparation methods of compost teas with their observed effects on soil and plants. Identifying which specific microbial communities and chemical components are most beneficial can help optimize compost tea formulations. Comparative studies of different compost materials and brewing techniques will provide insights into the best practices for maximizing the efficacy of compost teas.

Field trials will also be valuable to understand the broader impacts of compost tea in agricultural systems. Such comprehensive research will ultimately lead to evidence-based recommendations for farmers and gardeners, promoting the sustainable use of compost teas in enhancing soil fertility and crop performance.

## References:

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