UWRF Mann Valley Farm Bovine Compost Research

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DAIRY INNOVATION HUB

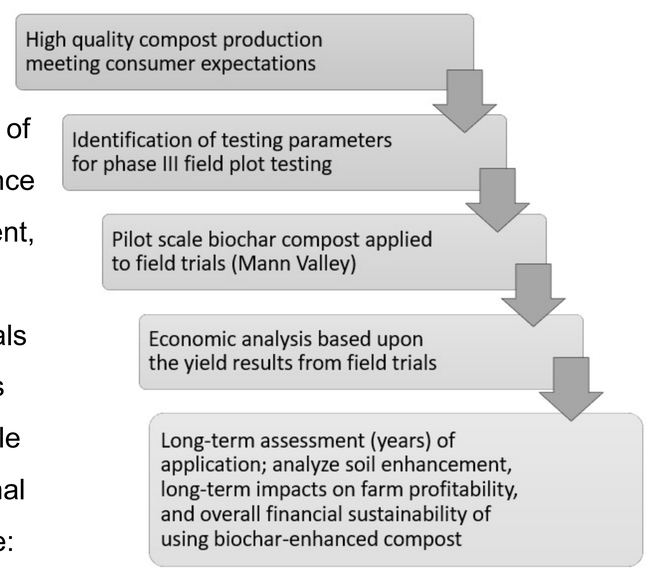
Overall Project Overview

This project is a 3-year, four-phase effort to improve Wisconsin farm profitability by developing and demonstrating initial research on a biochar-compost dairy operation. The overall goal is to diversify the product stream and improve the economic / environmental resilience of Wisconsin farms, while reducing environmental impacts compared to conventional operations. There are 4 primary elements to this proposal: 1) upgrading the current composting capability located at the Mann Valley farm to support sustainable production of high-quality compost, 2) conducting lab-scale biochar/compost mixture trials to optimize year-2 field trials located at the Mann Valley Farm, 3) conduct pilot scale biochar composting trials and field application at Mann Valley, 4) evaluate collected data for economic impacts and establish a feasible implementation plan as part of a shift toward economically sustainable regenerative agriculture for Wisconsin farmers. Initial parameters for evaluation include optimized biochar ratios for improved soil organic matter, nutrient retention, water retention and infiltration, soil porosity, and indicators of overall soil health. Additionally, the optimum ratio of compost sale to farm re-application on an annual basis will be evaluated for economic potential from anticipated reductions in fertilizer applications, reduced intensity of mechanized operations, and potential improved yields. Further areas of research include economic production of biochar, potentially as a part of a renewable energy program, biochar incorporation in bedding materials facilitating source adsorption, and long-term effects on soil regeneration.



Testing Expectations

Initial testing underway is determining the optimum amount of biochar addition required to balance nutrient retention, soil improvement, and the financial feasibility of substituting artificial fertilizer. Goals are to improve soil characteristics over a span of several years, while also providing the farmer additional income. Phases of the project are:



Composting Trials

Five treatments of char/compost were created to evaluate char performance at 0%, 2.5%, 5%, 10%, & 15% by weight. Material was composted in side-by-side bins made of 2'x2'x2' mesh wire. Daily temperatures were taken, and materials were aerated/moistened by hand when necessary (at least every four days or when temperatures were 130°F+). Large-scale trials were repeated outdoors using machinery to identify potential differences between season and scale of composting. Resulting compost mixtures were used in greenhouse experiments (see below).

Biochar from Wisconsin hardwood/softwood mix

Infrastructure Development & Student Design Project

A holistic approach to the project includes an assessment of methods to produce biochar/compost on-site economically. to facilitate a vertically integrated enterprise. A feasibility study is currently underway for a low-cost compost turner created from reclaimed farm equipment. (see below for the prototype from a retired haybine). A reference manual for this conversion is currently being created by engineering design teams at UWRF.

Laboratory & Greenhouse Preliminary Studies

First phase greenhouse studies were conducted in Spring 2021, followed by second phase and third phase greenhouse studies through Summer and Fall 2021. The intention is to validate the selection of char type from the lab studies and determine the optimal percentage by weight of char in the compost to balance cost and environmental advantages. Determining optimal biochar concentration is still underway, but initial results have indicated that optimal processing type may be the chip geometry when considering combined parameters of surface area (i.e. adsorption sites) and phosphorous adsorption performance. Current experiments on nitrogen compound retention suggests a trend agreeing with recent literature: that the primary driver in nitrogen retention may be the potential presence of an active surface layer that develops on the char during the composting process. Additional testing is underway taking this information into account to finalize biochar percentages for pilot trials.