California Department of Food and Agriculture
Dairy Digester Research and Development Program
Research Project Selected for Award

Project Title
Converting Manure to Reduce Greenhouse Gas Emissions, Minimize Environmental Impacts, and Enhance the Economic Feasibility of Dairy Operations

Project Leaders
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Award Amount: $225,909.00

Project Description
Total anthropogenic methane (CH_4) and nitrous oxide (N_20) emissions in California are greatly influenced by manure production in dairy operations and management practices. In the United States, current approaches to managing manure from livestock operations contribute over 60 million metric tons of CO_2 equivalent (MMT CO_2 Eq.) of CH_4, while soil and manure management combined generate over 280 MMT CO_2 Eq. of N_2O annually (US EPA 2015).

The Project Leaders will evaluate a new method capable of converting large amounts of manure and/or urine from dairy operations into a more stable sterile soil amendment with a predictable nitrogen mineralization response that reduces greenhouse gas (GHG) emissions. This project targets a 25% GHG reduction in overall CO_2 Eq. emission rates from manure and subsequent amended soils, which can be scaled to intensive livestock operations throughout the state of California and beyond.

The objectives of the lab and field research are to measure the effects of 'converted' manure on N_2O, CH_4 and CO_2 emissions, as well as the effects of the converted manure on crop productivity, compared to conventionally handled manure and cropland fertility management. The 'conversion' process for manure involves the hydrodynamic cavitation of homogenized solid or liquid livestock waste slurry, which is pumped through attenuating tubules that suddenly open. This physical process causes the formation of hydroxyl radicals and localized high-temperature implosions to occur, breaking tertiary bonds in the manure, which sterilizes and deodorizes it.

This study will test the following hypotheses: (i) the application of converted/stabilized manure on soil physical, chemical and biological properties will result in lower emissions of N_2O, CH_4 and CO_2. Furthermore, less nitrate (NO_3^-) would leach from soils fertilized with converted manure that has a predictable N mineralization response, so it may be expected that (ii) crop yields will be maintained with less added synthetic fertilizer required to maintain yield potential and (iii) soils treated with converted manure will sequester more soil carbon due to organo-mineral complexation, a mechanism shown to stabilize carbon inputs to soil.

The over-arching goal of this research is to provide an alternative to business as usual waste management in dairy operations that will reduce GHGs while maximizing economic and environmental benefits.