# Soil Biochar Amendment to Improve Nitrogen and Water Management

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## Abstract

Using a systematic and integrated approach, the proposed project is to increase our understanding on the interaction between biochar and nitrogen including major mechanisms and processes affecting the fate of N fertilizers applied to soil followed by field determination of effective biochar materials and application rate that increase plant uptake and reduce leaching and volatilization losses. Biochar products from different feedstocks from California orchards will be prepared, characterized, and selected for field tests. Thus, this project will also provide the information for the biochar industry to produce effective products. Data on plant uptake, major N losses, leaching potential, NH3 volatilization as well as improvement on soil properties and water movement will all be measured in order to determine effective biochar products and amendment rate from which costs can be estimated and evaluated as a practical solution for the growers. Vegetable cropping systems will be studied as they present more challenges in N management due to shallow root zone compared to perennial crops. Particularly, as one of the most significant factors affecting the fate of N, irrigation will be included in the field tests of this project, leading to the development of effective biochar amendment practice for irrigated agriculture in the SJV.

## Project Objectives

1. Determine effects of soil amendment with biochars produced from different feedstocks found in the San Joaquin Valley of California on adsorption capacity for NH4+ and NO3- and N transformation (urea hydrolysis and nitrification) rates as well as soil-water retention.
2. Determine effective amendment rate of biochar products and irrigation rates on crop response and N fate under field conditions.

Co-Project Leaders: Dong Wang, United States Department of Agriculture, Agricultural Research Service

Project No: 16-0662

# Evaluation of Biochar for On-Farm Soil Management in California

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## Abstract

The proposed project will utilize a series of field, greenhouse, and lab studies to examine a variety of soil, biochar types, and application rates under management conditions, which represent mixed agricultural systems. Field plots will be established at the UC Davis Campbell Tract (Yolo County) and UC West Side Research and Extension Center (Fresno County) and biochar will be incorporated in combination with synthetic N-P-K fertilizer. Additionally, a robust set of greenhouse trials will be conducted at UC Davis to examine impacts on crop growth, nutrient retention/leaching, and water relations. As biochar feedstock and production parameters will have a significant impact on its performance and outcome as a soil amendment, full characterization and evaluation of the biochars, with different soils, will be conducted. We will work with our cooperators in Placer County to generate biochars from unwanted forestry and orchard biomass wastes, as well as utilize other common and locally available feedstocks. Additionally, biochars from two other producers operating in CA will be included in the study. Biochars pre-reacted with synthetic N-P-K fertilizers will be included in the experimental matrix. Fertilizer rates will be based on soil sample analysis and both low- and high-end of the recommended application rates will be used to evaluate biochar impact on nutrient use efficiency. This project will also assess the economic and agronomic efficacy of using biochars produced from locally available waste feedstocks to be used for agronomic benefits for CA crops (i.e., tomato, corn, sorghum). This project will provide critical baseline data for biochar use in California agriculture.

## Project Objectives

1. Characterize biochars produced from locally available biomass (e.g., Placer County);
2. Evaluate the impact of biochar amendments on soil water and nutrient availability and loss (e.g., $NO_3^-$, $NH_4^+$, $PO_4^{3-}$), carbon stocks, and soil aggregation;
3. Evaluate soil conditions and biochar parameters, including biochar and fertilization application rates, which are most likely to lead to beneficial outcomes from biochar amendment;
4. Create the California Biochar Initiative as a central point for objective information regarding biochar use in CA agriculture.

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Co-Project Leaders: William Horwath, Daniel Geisseler, Toby O'Geen, Kate Scow, University of California, Davis; Milt McGiffen, University of California, Riverside; Michelle Leinfelder-Miles, University of California Cooperative Extension, San Joaquin County

Project No: 16-0670

# Evaluation of Certified Organic Fertilizers for Long-Term Nutrient Planning

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## Abstract

The goal of this project is to develop guidelines for the efficient use of organic fertilizer sources by demonstrating general nitrogen mineralization patterns and combine the findings with modeling exercises to extend the results to predict long term responses to repeated organic fertilizer applications and C sequestration in many soil types. Key to effectively use the information on nitrogen mineralization generated in this research is the parameterization of the DayCent model, so that the model can accurately predict nitrogen mineralization rates at different soil temperatures under soil conditions in CA throughout the year. Most models use default values resulting in poor prediction outcomes. We will develop Q10 temperature coefficients for microbial nitrogen and carbon mineralization in a temperature range from 10 to 30$^{o}$C across a range of soils (3 - 4 major agricultural soil series) and various types of organic fertilizer amendments. Because the DayCent model includes crop nitrogen uptake and yield, it can be used to reassess fertilizer nitrogen inputs. We will initially use the FREP fertilizer guidelines and other sources for crop nitrogen requirements to run the model. Our results will provide for adjustments of nutrient management guidelines depending on organic fertilizer sources, soil type, and climate data. The information generated in this research will be used by UC Extension, CCAs and farmers to reassess nitrogen management across a variety of crops.

## Project Objectives

1. Conduct an extensive literature review on soil N and organic N fertilizers;
2. Characterize the temperature response of N mineralization of organic based fertilizers in soils of the major agriculture production areas in CA;
3. Incorporate temperature response and N mineralization kinetics and turnover rates in the DayCent model to predict long-term N availability;
4. Conduct field trials to confirm lab and DayCent model results and to inform the Comet–Farm modeling tools; and
5. Conduct extensive engagement and outreach to inform on the value and to reassess organic fertilizer amendment rates to avoid N loss and promote healthy soils.

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Co-Project Leaders and Cooperators: Xia Zhu-Barker, Department of Land, Air and Water Resources, University of California, Davis; Cole Smith, University of California Cooperative Extension, Santa Clara County

# University of California Nursery and Floriculture Alliance Fertilizers and Plant Nutrition Education Program

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## Abstract

The overall project objective is to provide greenhouse and nursery growers with knowledge to improve crop plant nutrition and fertilizer management. To achieve this, the project will develop an educational program for greenhouse and nursery growers on the proper and efficient use of fertilizers. Current outreach programs on the topics will be reviewed, assessed, revised, and translated into Spanish. Specific topics will be selected from the revised programs and short “YouTube” type videos will be produced in both English and Spanish and made available online to growers for viewing.

## Project Objectives

1. Improve the workshop program that is currently delivered based on input from attendees and instructors. Topics may be reduced, expanded, and others added. Topics that may be added include training on how to read soil and water analyses and how to interpret the information for greenhouse and nursery crop fertility and irrigation management.
2. Deliver the improved workshops to nursery and greenhouse growers in the regions of the state where there are concentrations of growers such as San Diego, Ventura, San Joaquin Valley, and Watsonville/Salinas areas.
3. Utilize the delivery of the improved workshops to produce video on specific topics. Videos would be topic specific and brief and recorded in both English and Spanish. The UC ANR videography group will be utilized to produce videos.
4. Post the videos online at the UC NFA website (UCNFA.UCANR.edu).
5. Measure impact through surveys of workshop attendees to assess implementation of nutrient management methods.

Co-Project Leaders: Dave Fujino, University of California, Nursery and Floriculture Alliance; Don Merhaut, University of California Cooperative Extension; Maria de la Fuente, University of California Cooperative Extension, Monterey County

Project No: 16-0703

# Developing a Review Process for Continuing Education Courses for Growers who Complete the Nitrogen Management Plan Training Course

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## Abstract

Central Valley growers in designated high vulnerability areas are under new requirements to keep on-farm a certified Nitrogen Management Plan (NMP). They are given the option to self-certify through a CDFA-approved grower training course. After the initial grower self-certification, additional hours of continuing education are a requirement of the program approved by the Regional Water Board. Self-certified growers must earn 3 Continuing Education Units (CEUs) in three years to maintain their certification. In September 2018, CDFA and the California Regional Water Quality Control Board (CRWQCB) approved an extension to the 3-year CEU requirement for growers who were self-certified between 2015 and 2018. Since the continuing education protocol was not in place during the first three years of the NMP Self-Certification program, 2015-2018 self-certified growers have until January 2021 to complete 3 hours of Continuing Education Units.

Funds for this project are being used to develop and manage the process for reviewing and approving Continuing Education sessions in collaboration with agriculture organizations in the Central Valley for growers who have been certified to complete their own Nitrogen Management Plans. The information presented in these sessions supports the environmentally safe and agronomically sound use of nutrients and the reduction of agricultural contributions of nitrate to groundwater in the Central Valley and agricultural regions throughout California.

## Project Objectives

1. Develop a system to review the content of Continuing Education sessions for qualified growers to fulfill this condition of the NMP certification program; also develop criteria for evaluating a session proposal (CURES, PI and CDFA staff)
2. Review and approve requests from meeting organizers for Continuing Education sessions using criteria developed in conjunction with CURES, CDFA and UC; also provide support to meeting organizers to reach all certified growers needing to complete this condition of the NMP certification process

Co-Project Leaders: Terry Prichard, Department of Land, Air and Water Resources, University of California, Davis