Hawai‘i Natural Energy Institute Research Highlights

Alternative Fuels

Oil Seed Tree Crop Investigation

OBJECTIVE AND SIGNIFICANCE: The purpose of this project, initiated in 2025, is to establish long-term plantings of kukui and pongamia at agricultural experiment stations operated and maintained by the College of Tropical Agriculture and Human Resources (CTAHR) of the University of Hawai‘i.

These plantings will be used to produce information needed to evaluate the two tree crops' including:

1) Potential for oil seed production under documented growing conditions;
2) Carbon storage in both standing biomass and soil;
3) Response to cultural practices (e.g. plant density, irrigation, fertilization, etc.); and
4) Capacity to provide ecosystem services.

BACKGROUND: Current commercial production of sustainable aviation fuel (SAF) uses renewable lipids as feedstock. Adoption of SAF has an important role towards meeting the State of Hawai‘i's legislative goal to decarbonize by 2045 and demand for SAF feedstocks represents a potential market for local agriculture. Currently, the most common sources of SAF feedstock lipids include used cooking oil, tallow from animal processing, and palm oil. Oil seeds such as sunflower, safflower, and camelina have been or are currently under investigation in Hawai‘i. Jatropha and oil palm have also been investigated, but have not progressed beyond limited trial plantings.

Two trees that have potential for plant oil production in Hawai‘i are kukui (*Aleurites moluccanus*) and pongamia (*Milletia pinnata*). Prior HNEI research confirmed that kukui bears a nut that contains >60% oil[1] and pongamia produces a seed with oil content >30%[2]. Both are presently grown in Hawai‘i, however, published information on their production potential here is not available.

Data packages are based on terrestrial crop data collection requirements for purpose-grown energy crops. Establishing kukui and pongamia plots with these data packages in mind will provide the basis for future competitive grant proposals for extramural funds. Beyond SAF research, the establishment of these plantings will also provide benefits to the broader community by informing orchard management, agroforestry design, and the land rehabilitation supply chain.

PROJECT STATUS/RESULTS: Work under this project is just beginning. Year 1 will include kukui germplasm collection and greenhouse production of kukui seedlings. Pongamia saplings will be sourced from commercial vendors. Plot allocations at CTAHR experiment stations at Waimānalo and on Kaua‘i have been requested. Baseline data on carbon storage in standing biomass and soil will be collected and reported. Cultural practices, such as plant density, irrigation, and fertilization, used to plan and install the plantings will be documented and reported. These results will inform life cycle evaluations of the tree installations.

Year 2 will include maintenance of the plots installed in Year 1. Cultural practices will be documented and reported. Annual carbon storage data in standing biomass and soil will be collected and reported.

Additional efforts will occur in Year 3 and the ensuing years. After plot installations, cultural practices to maintain the plots and the trees will be done annually (or more frequently) and these activities will be documented for the life cycle record. Annual carbon storage data in standing biomass and soil will be collected and reported. As the trees mature, the growth and development will be monitored, tracked, and recorded, e.g. reproductive phenology, proportion of flowers forming fruits and fruits reaching maturity, weight of harvestable nuts, etc. Maturing trees will also provide a working laboratory for complementary fundamental and applied research needed for agroecological characterization and modeling.

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Contact: Scott Turn, sturn@hawaii.edu;
Darshi Banan, dbanan@hawaii.edu

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[1] Fu, J., Weber, S., & Turn, S. Q. (2023). Comprehensive characterization of Kukui Nuts as feedstock for energy production in Hawai‘i. ACS Omega, 8(25), 22567–22574. https://doi.org/10.1021/acsomega.3c00860

[2] Fu, J., Summers, S., Morgan, T. J., Turn, S. Q., & Kusch, W. (2021). Fuel properties of pongamia (*milletia pinnata*) seeds and pods grown in Hawai‘i. *ACS Omega*, *6*(13), 9222–9233. https://doi.org/10.1021/acsomega.1c00635