

Diversity and Value of Extant Hawaiian Sugarcane (*Saccharum officinarum* [L.]) Cultivars

Objective

The primary objectives of this study were to apply morphological and genetic documentation to sort through ambiguities in the ethnobotanical collection of Hawaiian canes, known as *kō* in the Hawaiian language, building off a recent extensive ethnobotanical treatment of the Native Hawaiian sugarcane cultivars (Lincoln 2020).

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Background and Introduction

- There is a renewed interest in indigenous Hawaiian sugarcane cultivars, stemming from:
 - Revitalization of Native Hawaiian identity, knowledge, and culture, including a return to traditional crops and cultivation (Kagwa Viviani et al. 2018)
 - Increased interest in food diversity, culture, terroir, and agricultural sustainability
- A revival in knowledge and access to *kō* over the past several decades has largely been driven by grassroots efforts
- In the past decade, several distilleries of *rhum agricole* have opened locally, relying on Hawaiian cane cultivars, largely for marketing purposes
- Differences in value between user groups can create opportunities or conflict (Fig. 1)

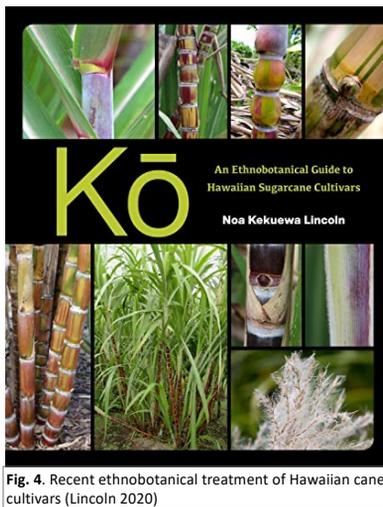


Fig. 4. Recent ethnobotanical treatment of Hawaiian cane cultivars (Lincoln 2020)

Value of *Kō*

Reciprocal Values

- Increased availability and knowledge of varieties has, in part, powered increased usage
- Increased usage of heirloom varieties has empowered new research opportunities

Conflicting Values

- The economic and biocultural values of *kō* have different priorities in their interactions with and representation of the varieties
- An economic premium in the heirloom Hawaiian values is evident, derived from, in part, the ethnobotanical knowledge, stories, etc.
- Stories of the Hawaiian cane are valuable marketing, regardless of their accuracy
- The stakeholders who have created the value through the preservation of the varieties and knowledge are not included in the generation of economic value, and are negatively affected by disingenuous representation of the varieties

Positive Interactions

- When different stakeholder groups engage, more total value is generated
- Biocultural users can help accurately portray and represent heirloom cultivars in economic markets
- Economic value can be directly shared with biocultural users

Classifying *Kō*

- Prior ethnographic research illuminated the status of many heirloom canes (Lincoln 2020)
- Strong agreement between morphologic and genetic clustering clarified providence of some varieties
- Close clustering of Hawaiian varieties suggests clades of low genetic diversity
- Critical to have historical thread inappropriately and accurately interpreting genetic or morphologic results

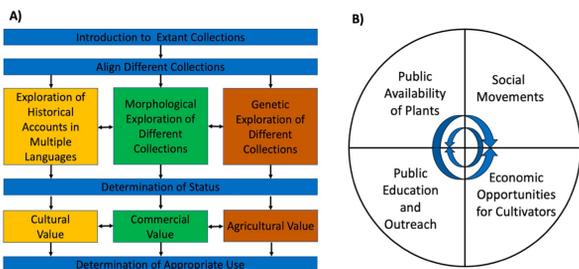


Fig. 1. A Reinvigorating historic collections, B Creating a virtuous cycle of restoration

Methods and Results

- 95 morphological features for 53 heirloom canes were observed across eight sites
- Following data assessment, 19 features were used to create reasonable separation of Hawaiian, Pacific, and hybrid varieties was achieved (Fig. 2)
- Using an established SNP array (You et al. 2019), a Bayesian phylogeny was conducted on 156 varieties utilizing 6,570 polymorphic sites (Fig. 3)
- Strong clustering of Hawaiian varieties was evident, with occasional outliers of presumed Hawaiian cultivars and “inliers” of varieties of questionable providence.
- Sub-study of somatic mutations indicated minimal genetic differences between varieties with strong morphological differences.

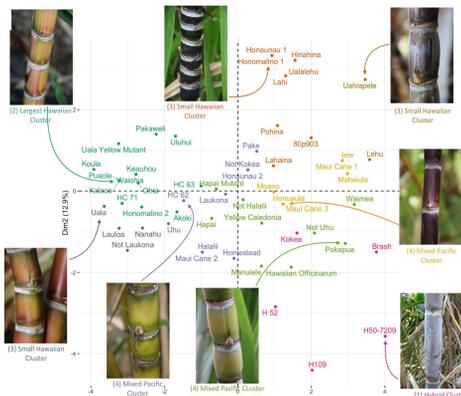


Fig. 2. Morphological clustering of cane varieties in this study.

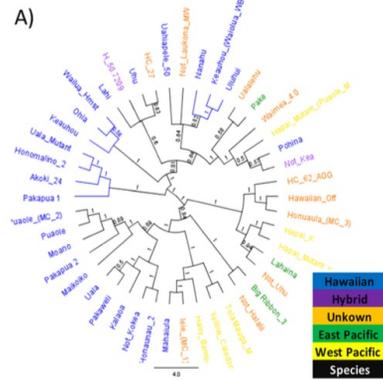


Fig. 3. Genetic phylogeny of cane varieties in this study.