Cooperative Extension
University of Hawai'i at Mānoa
College of Tropical Agriculture and Human Resources

Silvopasture with Seedless Hybrids of Leucaena

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Challenges and Opportunities for Livestock Production in Hawai'i

Livestock production is an important part of agriculture in Hawai'i. It comprises two-thirds of the managed agricultural land in the state, contributing one-fourth of the total value, among the largest commodity categories (NASS 2019). Despite its importance, pasture grazing faces significant challenges to sustainability due to the small size and heterogeneity of pasture lands and the high costs of land, labor, and inputs (Lee, 2019). Between 70-80% of beef cattle are shipped out of state for finishing because of the high cost of importing grain (Shehata et al. 2003). In addition, a novel pest, the two-lined spittlebug (*Prosapia bicincta*), has established itself on Hawai'i Island and is severely affecting hundreds of thousands of acres of Kikuyu grass (*Pennisetum clandestinum*) and pangola grass (*Digitaria eriantha*), two of the most widely used pasture grasses in the state (Thorne et al. 2017). As well, the state has set a goal of net neutrality for greenhouse gas (GHG) emissions by 2045. Developing an efficient livestock production system with a proper feeding program will contribute to it.

Despite these challenges, there is great opportunity to sustain and increase local livestock production. The state has set a goal of doubling local food production, and there is great potential to substitute for imported animal products. With the reduction of pineapple and end of large-scale sugar cane production, active agricultural land use has declined by over half (Lyte, 2017). Given that these were plantations of sometimes tens of thousands of acres, there is interest and active work to convert some of this abandoned crop land for grazing, including pasture-finished local beef (Imada 2018). A survey of beef cattle operations in Hawaii revealed that the majority of operations already finish some of their cattle in the pasture.

Silvopasture to Improve Productivity and Sustainability

To support this transition and improve the sustainability of new and existing operations, we are beginning a research and education project to evaluate the integration of a seedless interspecific hybrid of the multipurpose nitrogen-fixing tree Leucaena as an in-field high-protein livestock forage crop. A giant variety of *Leucaena leucocephala*, originally developed in Hawai‘i, is now grown on over 300,000 acres of pasture land in Queensland, Australia. In Hawai‘i, a preliminary trial demonstrated that it increases daily cattle weight gain by ~50% and improves meat quality of pasture-finished beef (Fukumoto et al., 2018). In addition, the tannin content of Leucaena significantly reduces methane production and emission from cattle, a potent greenhouse gas (Soltan et al., 2013). The combination of carbon sequestration in tree biomass and soils with reduced methane emissions from cattle can cut net GHG emissions from a grazing operation by more than half (Taylor et al., 2016).

Evaluating Seedless Hybrids of Leucaena for Silvopasture

The commercial varieties of *Leucaena leucocephala* are considered an invasive species in the US and other parts of the tropics, so current interest for expanded use has focused on developing sterile varieties. There are 24 recognized species in the genus, including diploid and tetraploid members (Hughes, 1998). The University of Hawai‘i developed triploid interspecific hybrids that are

largely or completely seedless, e.g. variety ‘KX4-Hawaii’ (Brewbaker, 2013). Interest in evaluating seedless hybrids for various uses has grown over time as the benefits of this multipurpose tree have become more well-known and the need for more sustainable agricultural production has increased in urgency.

The objectives of our project are to:

1. optimize and scale up vegetative propagation of seedless Leucaena hybrids,
2. develop cost-effective practices to establish rooted cuttings of this hybrid in existing and new pastures to create a silvopasture system,
3. evaluate the productivity and forage quality of this silvopasture system in different climates and soil types, and
4. develop a financial model of Leucaena silvopasture in varying growing conditions.

We have explored various means of vegetative propagation of these hybrids (Idol et al. 2019). For the scale needed for silvopasture systems, we feel that propagation by rooted cuttings is likely to be the most accessible and cost-effective method; however, we are actively engaging with commercial nurseries to test out this method and explore other options, including tissue culture, which can rapidly scale up production in a small, but appropriately outfitted, indoor environment. The cost of vegetative propagation is undoubtedly going to be more expensive than by seed, so developing cost-effective practices is vital.

We are partnering with three private ranches at present to plant out variety ‘KX4-Hawaii’ in established pastures that vary in climate, soils, and dominant pasture grass. The Leucaena will be planted in rows with grass in between. We will be comparing different row spacings to balance the production of Leucaena and grass to meet cattle nutritional needs. We will also compare different plant container sizes to compare the potential tradeoff of planting cost (possibly higher for larger containers) with establishment and early growth and the subsequent need to manage competition between the young Leucaena plants and the pasture grasses or weeds.

The productivity of the Leucaena and grass will be monitored over two to three years, with rotational grazing of the experiment by cattle after giving the Leucaena one year to establish. Samples of the plants will be taken prior to each grazing cycle to estimate productivity and forage quality. While the field experiments will be too small to measure

effects on cattle weight gain directly, the data from the Leucaena and grass will be used in a cattle productivity model to estimate weight gain and time to market weight.

Once these estimated costs and returns have been calculated, we will adapt existing livestock financial models to incorporate this silvopasture system. This will provide producers and professionals with a preliminary projection of the needed investment to get this system up and running and the expected return on investment over time. We anticipate the productivity of the Leucaena will increase well beyond the timeline of this initial project, so we plan to continue to monitor these experiments at least annually to provide long-term data.

Extension and Education Resources

That does not mean those interested in this system have to wait until then to learn more and begin trying it out themselves. We are putting together extension materials and will be holding workshops and a field day over the next three years to share more information, get feedback from stakeholders, and provide updates on our progress. We recorded an episode of the Livestock Wala‘au podcast (https://livestockwalaau.buzzsprout.com/) recently that summarizes the project objectives and plans. We are working on a project website that will have information, resources, and photos about this project and Leucaena silvopasture systems. Our first workshop will be held on Friday, Mar 22, 2024 from 4:30 - 6:00 pm at the Hawai‘i Community College Pālamanui campus in North Kona on Hawai‘i Island. We will also livestream the event via Zoom. Visit our project website or contact our CTAHR livestock extension agent on Hawai‘i Island, Mele Oshiro (mabran@hawaii.edu), for more information.

Ranchers, other livestock producers, and plant nurseries interested in collaborating with us on this project are also welcome. Contact Dr. Travis Idol (idol@hawaii.edu) to express your interest and ask questions about how you can collaborate with us. We know there is no substitute for the experience of actual producers in testing out, adapting, improving, and promoting innovations in sustainable agriculture.

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