United States Department of Agriculture

# Hoolehua Plant Materials Center 2021 Progress Report of Activities

4101 Maunaloa Highway, P.O. Box 236, Hoolehua, Hawaii 96729 Tel: 808-567-6885 January 2022

The Hoolehua Plant Materials Center (HIPMC) supports the conservation goals that the Natural Resources Conservation (NRCS) Field Offices implement with farmers, ranchers, and landowners. Support for Field Offices include plant technology development, plant materials propagation, and training. This report is a summary of support activities during the period from October 1, 2020, to September 30, 2021.

## Studies

**Improving Estimation of Available Forage to Avoid Over-grazing**

Over-grazing is a serious problem in the Pacific Island Area (PIA) and NRCS Field Office staff have identified it as a high priority plant need. To assist ranchers with implementing the Prescribed Grazing practice, the PIA Prescribed Grazing Tool (PGT) was developed to balance animal demand and available forage in pastures. The embedded forage prediction model of the PIA-PGT estimated available forage by correlating forage production with monthly rainfall and temperature. While the tool was useful, the predicted forage yield was considered the most important data to improve.

The HIPMC proposed to improve the PIA Prescribed Grazing Tool by embedding a better forage model. Five forage models developed in the tropics, including the model in the current PIA-PGT, and a combination of the five models (designated as the "Ensemble" model), were tested to determine which one would be the most consistently accurate. To conduct the test, actual forage yield data were collected from six naturalized pastures located on the islands of Molokai and Hawaii (figure 1).

*Figure 1. John Colon (kneeling-left, Biological Science Technician) and Nanea Babila (kneeling-right, Soil Conservationist, Hilo) clip Guinea grass to determine monthly forage yield at Kainalu, Molokai Island, Hawaii, on July 1, 2021, while looking on are (standing left to right) David Duvauchelle (PMC Manager), Spencer Nagata (acting District Conservationist, Hilo), Lexis Kalawe (Conservation Technician, Soil and Water Conservation District), Kori Hisashima (District Conservationist, Hilo), and Rachel Lee Loy (Soil Conservationist, Hilo). The Hilo Field Office staff was shown how to establish and maintain a forage clipping site for future expansion of test locations and forage species.*

Site selection was paramount to assure a wide variety of climatic conditions that would provide a robust test for the models. At the selected sites, annual total rainfall ranged from 15 to 51 inches and annual mean air temperature from 70 to 76 °F. Using the clipping method, forage yield data was collected monthly by Carolyn Auweloa (State Grazing Lands Management Specialist), Elena Dosamontes (former Range Technician), Pila Young (Range Technician), and HIPMC staff. In addition to Guinea (*Urochloa maxima*), yield data of other dominant forage species was collected, including Buffel (*Pennisetum ciliare*), and Kikuyu (*Pennisetum clandestinum*). Monthly Guinea grass dry yield at four sites ranged from 0 to 6,311 dry lbs/acre. Kikuyu and Buffel grass ranged from 0 to 1626 and 0 to 733 dry lbs/acre, respectively.

During the process of model evaluation, the accuracy of predicted yield to actual yield was measured with Wilmott's Index of Agreement. The index ranges from 0 (predicted yield has no relation to actual yield) to 1 (predicted yield matches actual yield perfectly). The forage prediction model in the existing PIA-PGT had an Index of Agreement value of 0.49. The best alternative model, Ensemble, had an index value of 0.60. The forage prediction model of existing PIA-PGT was replaced with the Ensemble model because it proved to be more accurate. The newly revised PIA Prescribed Grazing Tool is currently undergoing further testing before release to Field Office staff.

**Warm-Season Cover Crop Adaptability Study**

Cover Crop is a rapidly growing conservation practice across the United States. Defining cover crop varietal characteristics in a tropical environment would provide Field Office staff with options to increase soil organic matter, suppress weeds, fit cover crops in cropping schedules, and fulfill other conservation purposes. Year-2 of a 2-year warm-season cover crop trial was planted on July 21, 2021, at HIPMC. The objective of this study is to evaluate the adaptability and growth characteristics of commercially available varieties of cover crops to the climate of the Pacific Islands Area. Emergence rating, canopy cover, bloom date, and biomass data were collected for 17 varieties of species Alfalfa (*Medicago sativa*), Cowpea (*Vigna unguiculata*), Lablab (*Lablab purpureus*), Mung Bean (*Vigna radiata*), Pearl Millet (*Pennisetum glaucum*), Pigeon Pea (*Cajanus cajan*), Sorghum (*Sorghum bicolor*), Sorghum-Sudan (*S. bicolor* x *S. bicolor ssp. drummondii*), Soybean (*Glycine max*), Sunn Hemp (*Crotalaria juncea*), White Sweet Clover (*Melilotus alba*), and Yellow Blossom Clover (*Melilotus officinalis*). Biomass yield data were collected at full bloom or 91 days after planting, whichever came first. Results from this second trial confirm high biomass yields (> 7,500 dry lbs/acre) from 'Growers Choice' Sorghum, 'Piper' Sudan grass, 'Leafy 22' Pearl Millet, 'Honey Graze' Sorghum-Sudan, 'Rongai' Lablab, and 'Tropic Sun' Sunn Hemp (figure 2). The low biomass yields of 'Georgia Two' Pigeon Pea and 'Large Lad' Soybean resulted from heavy bird predation immediately after planting through emergence. The biomass yield data and other varietal characteristics will provide a sound basis for cover crop options in conservation planning.

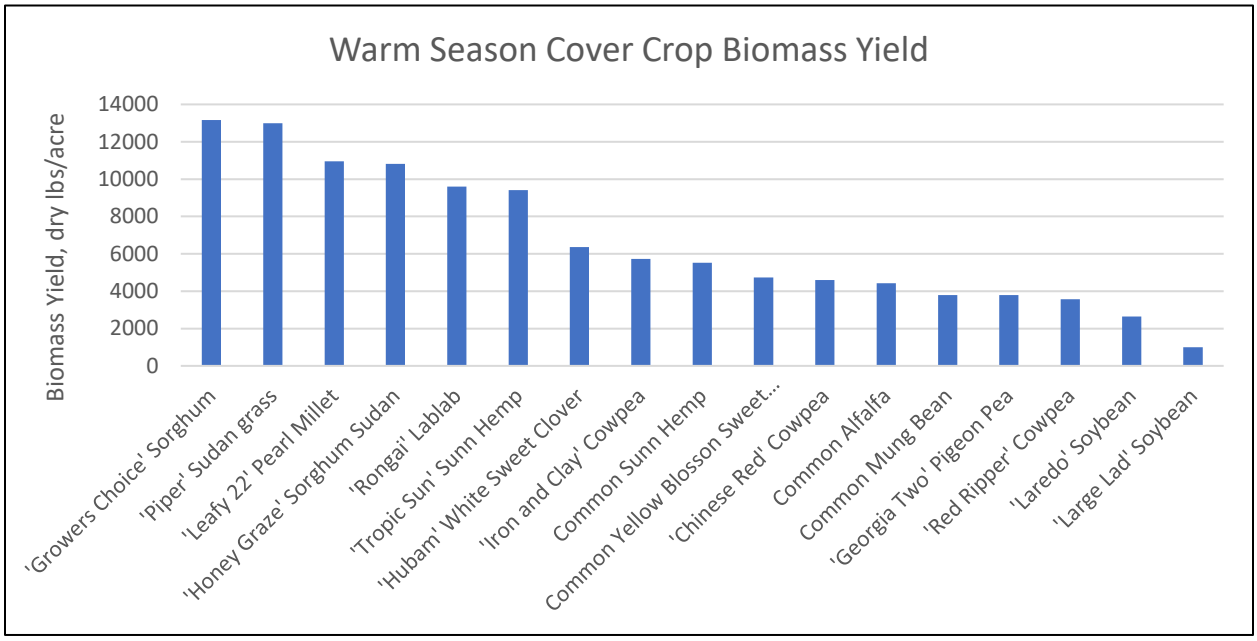


*Figure 2. Dry biomass yield from 17 varieties of 12 cover crop species grown at the HIPMC in the summer of 2021.*

**Evaluation of Growth Characteristics and Biomass Production of Cool-Season Cover Crop Varieties**

Cover crops provide a host of benefits including reduced fertilizer costs, reduced herbicide costs, improved yields, and reduced soil erosion. Incorporating cover crops into a cropping system improves soil health, conserves energy, and builds resilience and manages climate risk. Leguminous cover crop species produce nitrogen for subsequent commodity crops. Non-leguminous cover crop species, such as small grains, are effective in reducing nitrate leaching. Biomass production is essential to achieve benefits such as erosion control, weed suppression, nutrient retention, soil crust prevention and increased soil organic matter.

Very similar to the warm-season cover crop study, the objective of this study was to evaluate growth characteristics and biomass production of commercially available varieties/cultivars and local sources of selected cover crops identified by NRCS State Agronomists, Soil Health collaborators and PMC staff. Seven cool-season cover crop species were evaluated in a trial as part of the National Adaptability Study initiated in 2015. Plant Materials Centers across the country participated in this trial. The HIPMC trial started this year. Fifty-five varieties of seven cool-season cover crop species were planted on December 23, 2020, at HIPMC. Emergence rating, canopy cover, bloom date, and biomass data were collected. Biomass yield was determined at full bloom or 91 days after planting, whichever came first. Only 'Soil Saver' Black Oat had high biomass yield of greater than 7,500 dry lbs/acre that is presumably sufficient to suppress weeds, one of the many purposes for cover crops (figure 3). A second trial will be conducted next year to confirm these results.

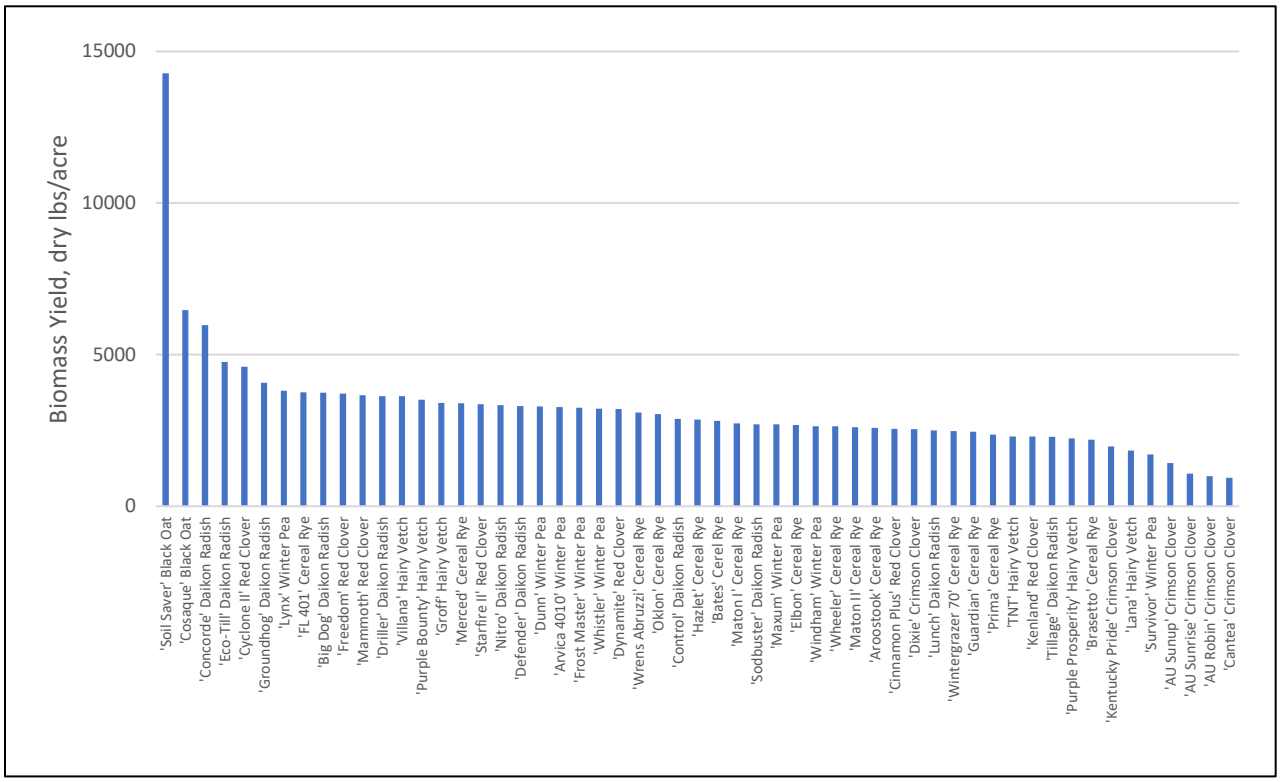


*Figure 3. Dry biomass yield of 55 varieties of seven cool season cover crop species planted at the HIPMC on December 23, 2020. Biomass yield was determined at full bloom or 91 days after planting, whichever came first.*

**Plant Release Seed Production**

The most popular plant release maintained at HIPMC is 'Tropic Sun' Sunn Hemp (*Crotalaria juncea*). Sunn Hemp is an erect, branching, leguminous plant native to India that is used in conservation practices. Tropic Sun is an excellent green manure that can be included in rotation with vegetable, ornamental, and other crops to add nitrogen and organic matter to soil, suppress weeds, and reduce root-knot nematodes.

The seed was originally purchased from a farmer on the Island of Kauai, Hawaii, in 1958. Since obtaining the seed, HIPMC has maintained a supply of 'Tropic Sun' seed for distribution to seed producers within the United States. After receiving several requests for foundation seed in 2020, HIPMC produced 'Tropic Sun' seed in 2021 (figure 4). Seed was planted on December 9, 2020, and harvested on May 25, 2021. A total of 600 pounds of pure live seed were shipped to three seed producers in Hawaii, Florida, and Nebraska. With the foundation seed in seed growers' hands, 'Tropic Sun' seed will soon be available commercially.

*Figure 4. John Colon (Biological Science Technician) harvests 'Tropic Sun' Sunn Hemp seed at the HIPMC on May 25, 2021, for distribution to seed producers throughout the United States.*

## Trainings

**Growing Degree Days**

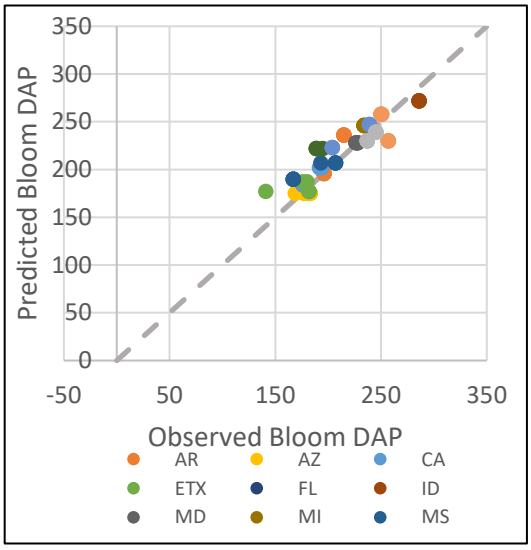


*Figure 5. Validation chart showing that a modified Growing Degree Day equation can accurately predict bloom days after planting (DAP) of 'Rymin' Cereal Rye at 13 PMCs across the United States.*

HIPMC staff held a virtual training on the Growing Degree Day concept for any PMC personnel who was interested. The training was broadcast through Teams on September 8, 2021. Growing Degree Day is a temperature-based method to calculate the duration of a plant development phase such as planting to bloom. An example of the calculation was demonstrated using data from 18 PMCs that had collected data for a national cool-season cover crop trial. The planting and bloom dates of 15 varieties of Cereal Rye (*Secale cereale*) from five PMCs were used to calibrate the Growing Degree Day equation. The calibrated equation was validated against actual bloom dates of the remaining 13 PMCs. The results showed inadequate performance of the calibrated equation. However, the Growing Degree Day equation modified with a daylength factor resulted in adequate accuracy and precision of predicted bloom date at the 13 PMCs (figure 5). This training showed that the modified Growing Degree Day equation is an accurate predictor of bloom date and this information can help conservation planners select cover crop varieties to fit into a cropping schedule.

**Utility Terrain Vehicle Operator Certification**

*Figure 6. David Duvauchelle (left, PMC Manager) signals a highspeed-left turn to trainee Spencer Nagata (right, acting District Conservationist) during the evasive maneuvering portion of the UTV certification course held at the HIPMC on June 30, 2021.*

Utility Terrain Vehicle (UTV) is a valuable tool for conservation planners when performing their work across large landscapes. Like all tools, operating them safely is a primary concern. All PIA NRCS staff are required to be certified UTV operators whether driving or riding in these vehicles. Fortunately, David Duvauchelle (PMC Manager) is a certified UTV trainer accredited by the Recreational Off-Highway Vehicle Association. A total of 16 NRCS and Soil and Water Conservation District personnel attended one of four half-day training classes held on May 13 and 27, June 30, and July 8, 2021, at the HIPMC. Trainees reviewed operation, maintenance, and safety materials in class followed by hands-on driving a UTV through several obstacle courses, evasive maneuvering, and an off-road course (figure 6). All trainees agreed that they gained a greater appreciation of the UTV capabilities and limitations that make them a safe operator of this indispensable tool.

## Technology Transfer

Technical Note: Understanding Pure Live Seed
https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/hipmctn13770.pdf

Release Brochure: PIA Conservation Plant Release 'Tropic Sun' Sunn Hemp (Crotalaria juncea)
https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/hipmcrb13809.pdf

Final Study Report: Gliricidia
https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/hipmcsr13769.pdf

# Hoolehua Plant Materials Center - 2021 Progress Report of Activities

## Who We Are

The Hoolehua Plant Materials Center (HIPMC) is one of 25 centers operated by the NRCS PIA. The HIPMC services the PIA which includes the State of Hawaii, American Samoa, Guam, Commonwealth of the Northern Mariana Islands, The Federated States of Micronesia, The Republic of Palau, and The Republic of the Marshall Islands. The HIPMC was initially established on the island of Maui in 1957 and was later relocated to the island of Molokai in 1973.

## What We Do

The mission of the NRCS Plant Materials Program is to develop and transfer effective plant technology for the conservation of natural resources. In working with a broad range of plant species, including grasses, forbs, trees, and shrubs, the program seeks to address priority needs of NRCS field offices and land managers in both public and private sectors. Where practical the use of native plants to solve conservation problems and to protect and restore ecosystems is emphasized. Center personnel develop research projects and technical reports for use in developing technical guides for agency personnel and landowners on the use of plant materials in various conservation practices.

## HIPMC Staff

David Duvauchelle – Center Manager
Dr. Richard Ogoshi – Agronomist
John Colon – Biological Science Technician