Hoolehua Plant Materials Center

Annual Technical Report FY2011

Hoolehua Plant Materials Center
Annual Technical Report FY2011

Advisory Committee
Angel L. Fiqueroa, Director, Pacific Islands Area (PIA)
Anthony Ingersol, Assistant Director for Technology, PIA
Robert J. Joy, Plant Materials Specialist, PIA
Jim Briggs, West Regional Plant Materials Specialist

Resource Staff
Gregory Koob, State Biologist, PIA
Kara Nelson, Resource Conservationist, PIA
Adam Reed, Water Quality Specialist, PIA
Valerie Russell, Cultural Resource Specialist, PIA
Michael Constantinides, State Forester, PIA

Hoolehua Plant Materials Center Staff
Glenn S. Sakamoto, Hoolehua Plant Materials Center Manager
David Duvauchelle, Natural Resource Specialist
Keni Reyes, Biological Technician
Andres Juario, Biological Technician Aid

Hoolehua PMC Staff

Table of Contents

Hoolehua Plant Materials Center
Annual Technical Report FY2011

Introduction

Mission
The mission of the Natural Resources Conservation Service (NRCS) Plant Materials Program is to develop, test and transfer state-of-the-art plant science technology to meet customer and resource needs.

The Hoolehua Plant Materials Center
The Hoolehua Plant Materials Center was originally established on the island of Maui in l957. The center was moved to an 80 acre site on the island of Molokai in 1973. Molokai, the fifth largest island in the Hawaiian chain, is 38 miles long and 11 miles wide (261 sq. miles). Now located in the Hoolehua plains area of Molokai, the Center is situated on the leeward or 'dry' side of the island at an elevation of 400 ft. The annual rainfall at the Center is approximately 21-22 inches per year with most of the rainfall occurring during the months of November through March.

The soil at the Hoolehua PMC consists of the Holomua series. This well-drained soil of the uplands of Molokai was formed from volcanic ash and material weathered from andesite rock. The surface layer is a dark reddish-brown silt loam about 9 inches deep. The upper part of the subsoil is dark reddish-brown silt loam, and the lower part of the subsoil is dark reddish-brown and dark-brown silty-clay loam that has a prismatic structure. The subsoil is 40 to 60 inches deep and the substratum is soft, weathered rock. Permeability is moderate, runoff is slow, and erosion hazard is slight. The mean annual soil temperature is 74 degrees Fahrenheit.

The Hoolehua PMC receives its gravity fed water from the Molokai Irrigation System (MIS). This water is a mixture of both well and surface water that originates approximately 10 miles from the Hoolehua PMC from the central mountainous slopes of Molokai.

Hoolehua PMC Service Area

The Hoolehua Plant Materials Center's activities are consistent with the objectives of the current United States Department of Agriculture and NRCS Strategic Plan. The Hoolehua PMC is responsible for servicing the needs of the State of Hawaii, the Territory of Guam, The Republic of Palau, the Republic of the Marshall Islands, the Territory of American Samoa, the Commonwealth of Northern Mariana Islands and the Federated States of Micronesia. These entities are collectively known as the Pacific Island Area or PIA.

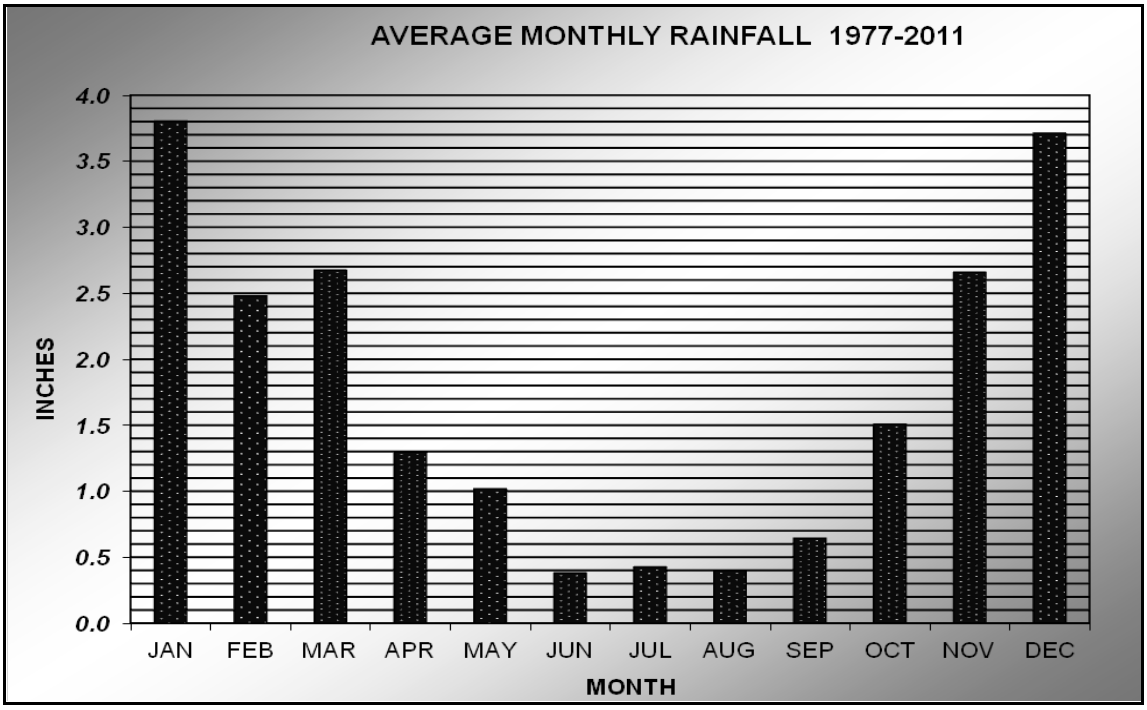
The Pacific Islands owe their shape primarily to volcanic building and have been modified by erosion under strongly localized conditions. Soils are derived from volcanic lava, eruptive deposits of ash, tuff and cinders, and limestone and alluvial deposits from coral reefs. Age and a variety of parent material, plus extreme ranges in rainfall have resulted in a complexity of soils.

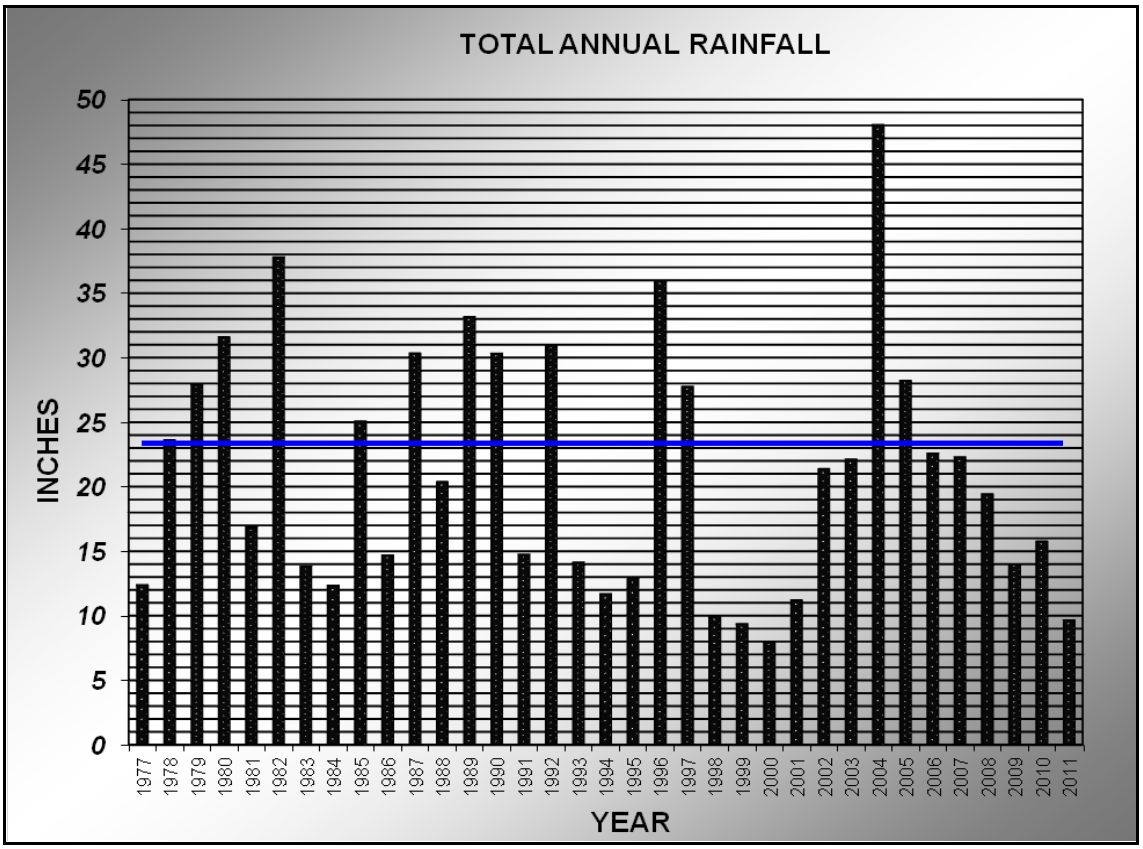
Rainfall ranges from less than 10 inches to over 390 inches annually, with elevations of the various islands varying from sea level to over 13,000 feet. The heaviest rains generally fall on the windward side of the mountains. The driest areas are semi-desert in character and vegetation is generally sparse. The difference in temperature between the coolest and warmest months of the year, at a given location, will usually not exceed six or seven degrees. Tradewinds are fairly constant throughout the year with 15-25 miles per hour velocity being common.

Land use is diversified and ranges from large acreages devoted to ranching, sugarcane, macadamia nuts, and pineapple to smaller acreages planted to truck crops, fruit and nut orchards, and subsistence farming. Some of the many different crops produced on these small farms include: banana, taro, bean, cucumber, watermelon, green pepper, tapioca, tomato, bitter melon, coconut, sweet potato, yam, papaya, onion, cabbage, radish, lettuce, cantaloupe, pumpkin, guava, sweet corn, betel nut, avocado, citrus, macadamia nut, coffee, breadfruit, and ornamental plants.

Agricultural operations range from highly mechanized agri-business plantations to hand-cultivated subsistence farms. These operations occupy crop lands that may range from relatively flat to very steep terrain. Primary conservation needs requiring plant materials include cover crops for orchards (especially macadamia nuts). Examples of use: protect sugarcane land between harvests, low-competing cover crops for inter-planting with sugarcane to protect the soil for the first six months, green manure crops for soil improvement and cover, windbreak plants, plants for stabilizing aqua-culture pond banks and shorelines, plants for permanent vegetative cover on waterways and other erosion prone areas, improved plants for range and pasture, plants for new practices such as vegetative row barriers (contour hedgerows), alley cropping, living mulch, and plants for filter strips.

Hoolehua Plant Materials Center Rainfall Data





Hoolehua PMC Current Priorities and Objectives

The Hawaii PMC is currently involved in addressing the following concerns:

- Cover/Green Manure Crops
- Bioengineered Solutions for Hillside / Stream Bank Problems
- Windbreaks for Crop Lands
- Plants for Vegetative Barriers
- Plants for Agro-forestry
- Provide Plant Materials and Technical Assistance to the Kahoolawe Island Reserve Commission (KIRC)
- Plant Techniques to Control Invasive Species
- Improved Pasture and Range Grasses and Legumes

The Plant Materials Testing Process

1. *Identification of Problem*
   A particular problem is identified and is prioritized in the Long Range Plan.
2. *Assembly*
   A collection of accessions having the potential for solving a problem or part of a problem is assembled from local and foreign collections, other Plant Materials Centers, Universities, plant breeders, and commercial seed companies.
3. *Initial observation*
   Assembled planting materials are planted in rod row plantings and growth characteristics are noted and compared to each other and to the standards now in use. Accessions with better characteristics than the standard are then selected for further testing.
4. *Initial increase*
   Promising accessions from the initial observation are increased in small plots to supply material for further testing.
5. *Secondary testing*
   Further observations and comparisons to the standard are made using appropriate techniques. Information on establishment, management, and seed production is gathered. Plants that continue to exhibit better characteristics than the standard are selected for further testing.
6. *Large scale increase*
   Large increase plantings are made of accessions selected from secondary testing to provide sufficient materials for final testing in field size plantings on farms of district cooperators.
7. *Release*
   Plants that have proven themselves in actual field plantings are named and released in cooperation with the University Of Hawaii Institute Of Tropical Agriculture and Human Resources, University of Guam, and other agencies. Seeds and plants are then made available for commercial production.

Hoolehua Plant Materials Center Releases

Crotalaria juncea
'Tropic Sun' crotalaria

Description

Legume family (Fabaceae). Branched, erect, herbaceous shrubby annual growing 3 to 9 feet high with bright green simple, elliptical leaves. It has deep yellow terminal flowers (open raceme to 10 inches long) and the light brown pods are small (1 inch long and 1/2 inch wide) and inflated. It has a well-developed root system, with a strong taproot. The number of seeds per pound is 15,000. Sunn hemp is a tropical or sub-tropical plant that when grown in the continental United States performs like a summer annual. It can be planted year round in Hawaii below an elevation of 1,000 feet. However, it does not perpetuate itself well and is not found in the wild. Sunn hemp is adapted to a wide range of soils and performs better on poor sandy soils than most crops. It is for such situations that it has attracted attention. It grows best on well-drained soils with a pH from 5.0 to 7.5.

Use

Used as a cover crop, sunn hemp can improve soil properties, reduce soil erosion, conserve soil water, and recycle plant nutrients. When grown as a summer annual, sunn hemp can produce over 5,000 pounds of biomass and 100 pounds of nitrogen per acre. It can produce this amount within 60 to 90 days, so it has the potential to build organic matter levels and sequester carbon in the soil. It is known to suppress nematodes.

Establishment

To establish a successful stand, seed should be broadcast or drilled and covered ½ to 1 inch deep into a well prepared, weed-free seedbed. If broadcasted, seed at a rate of 40 to 60 pounds of live seed per acre. If drilled, the rate should be 30 to 50 pounds per acre in 6-inch rows. The higher rates should be used if the crop will be terminated in less than 60 days or if severe weed competition is expected. Where weed competition is mild, drilled rates as low as 20 pounds of live seed per acre have been satisfactory. Inoculate with the cowpea-type rhizobia bacteria.

Using a winter cover-crop/green-manure is a conservation practice that provides soil-improving characteristics. A common problem, however, is that the relatively short period between cash crop harvests in the fall and planting the following spring can result in less than optimum biomass production of the cover crop. Sunn hemp, because of its rapid growth and relatively short growing season requirement, can be an excellent alternative. Where conditions are favorable, it can provide the benefits of a winter legume prior to a killing frost in the fall and also in the summer after the winter crop has been harvested.

Erythrina variegata
‘Tropic Coral’ erythrina

Description
A leguminous tree approximately (40) feet tall, very erect with numerous branches coming out of a single trunk. Growth habit resembles common panax, only on a larger scale. It is related to the wiliwili tree, but is not as well adapted to the dry lands as the ‘Tropic Coral’. A fast-growing tree when adequate moisture is available.

Use
It has been used extensively as a windbreak, but may have uses as a vegetative row barrier and for alley cropping.

Culture
Established by rooted cuttings or by cuttings placed directly in the field. Supplemental irrigation should be provided in areas with less than 50 inches of rainfall.

Paspalum vaginatum
‘Tropic Shore’ paspalum

Description
A salt-tolerant perennial grass. Will grows to heights of 22 inches. It produces a thick mat of stolons at or just above the low-tide level which makes it excellent for stabilizing banks from wave action. It is adapted to coral sands of denser soils. Prawns will utilize the forage.

Use
Stabilizing banks on fish ponds, shoreline stabilization, re-vegetation of saline soils, and for lawns, pastures, and fairway where salt is a problem.

Culture
Established vegetatively. Seed is not available.

Paspalum hieronymi
‘Tropic Lalo’ paspalum
Description
A low-growing stoloniferous grass. Its growth habit is similar to hilograss, but it forms a much tighter sod. When mowed, it becomes mat-like. Normal growth height is 4 to 10 inches. However at the PMC it has reached a height of 35 inches when grown under irrigation and not mowed for (6) months. It will tolerate heavy use such as equipment traffic.

Use
Ground cover in orchards, critical areas, filter strips to enhance water quality, heavy use areas, and grassed waterways.

Culture
Established by stolons and seed. The plant is a poor seed producer so propagation is mainly by vegetative means. Depending on growing conditions, it normally needs mowing once every 1 to 2 months. It can be mowed very close, less than one-half inch. It will grow in approximately 50 to 60 percent shade. Planting rates on 3 feet centers is equivalent to 40 bushels of stolons per acre.

Neonotonia wightii
‘Tropic Verde’ glycine
Description
A trailing, twining, herbaceous, perennial legume with slender, well branched stems. It grows to height of about 2½. Bright green leaves are trifoliate. There are approximately 58,000 seeds per pound.

Use
Recommended as a drought tolerant legume for range and pasture improvement and erosion control.

Culture
Established best by seed using standard seed drill or broadcasting in well prepared, weed free seedbed at a rate of 2 to 5 pounds per acre pure live seed (pls) for range, pasture, and hayland plantings. Increase rate to 40 pounds pls per acre for critical eroding areas. Plant seed ½ to 1 inch deep and lightly cover with harrow or roller.

Heteropogon contortus
Kahoolawe Germplasm Piligrass

Description

Tanglehead is a member of the *Andropogoneae* tribe of grasses. It is an erect, warm season, perennial that may form rather large bunches reaching heights of 1 to 3 feet tall under natural conditions. At the Hoolehua PMC, under optimum conditions, tanglehead has been known to grow to heights of up to 5 feet tall. There is a wide range of morphological and phenological variations within this species because of its wide range of adaptability. The stems are flattened, rather tough, smooth, and a pale bluish-green. Leaves are produced throughout the length of the stem and are flat or folded, 4-12 inches long, about 0.25 inches wide and rough to the touch. The flowering heads have narrow, crowded flower spikes up to 4 inches long. The spikelets overlap and each fertile one bears a conspicuous red-brown awn about 4 inches long, made crooked with two bends. The long-awned seeds are sharp pointed forming tangled masses as they mature. When the seeds come in contact with moisture, the hygroscopic awns and sharp barbed tips arch and twist planting them into the soil. The species is mostly apomictic (producing seed without pollination), but sexual reproduction has also been known to occur. Tanglehead has a high degree of adaptability that has allowed it to survive in locations around the world for many years. It can be found on every major landmass between 35º N latitude and 35º S latitude. In Texas, it is found in sandy prairies, the coastal regions, the Trans-Pecos Mountains, and persists in well-managed pastures, although it was once a common grass in the coastal prairies. In Hawaii, tanglehead occurs naturally on all the major islands at sea level to about 2,000 feet elevation and favors dry habitats and rocky cliffs close to the ocean.

Establishment

Tanglehead can be reproduced from seeds or vegetative transplants. A stand of tanglehead was established at the Kika de la Garza Plant Materials Center using vegetative bunches split off of mature plants. The seeds have a dormancy period of about 6 months. Although seeds will germinate before this period, the germ-rate will be very low. Studies indicate that this dormancy can be broken with gibberelic acid. Plant propagules in a sterile, well drained medium. Germination should occur within 5-7 days. One week after germination, it is recommended that time-release fertilizer supplements be added. After 2 months, place propagules in full sunlight to harden off. Propagules should be ready to plant within 3-4 months.

Use

Primary recommendation for this grass would be vegetation to aid erosion control. Piligrass also has the potential for ecosystem restoration, re-vegetation of degraded habitats, and to increase diversity in riparian and other communities.

Dodonaea viscosa
Kamiloloa Germplasm Aalii

Description

Dodonaea viscosa is a shrub or sometimes a small tree ranging in height from 6-25 feet. Its long and slender leaves have margins that are usually wavy or crinkled. Plants usually bloom in the early part of the year and seed before summer. The flowers are fairly small and the female flowers develop into papery capsules that may be red, pink, green, yellow, or tan. Seeds are roundish, black and very small; about 1/16 inch wide. There are about 84,200 seeds per pound. *D. viscosa* is adapted to a wide range of habitats, from sea-level to nearly 8,000 feet and tolerating annual rainfall of 12-98 inches. *D. viscosa* is found throughout the tropical regions of the world including Arizona, California, Florida, Hawaii, and Puerto Rico.

Establishment

It is recommended that *D. viscosa* be propagated in a shade house with 50 percent shade, after the last frost. To aid in germination, seeds can be soaked overnight in hot tap water or scarified. Seeds are planted ¼ inch deep in a sterile medium and irrigated daily. Dibble tubes are recommended. Germination should occur within 10 days. Fertilizer can be applied to seedlings at four weeks after germination. After four months, seedlings should be exposed to direct sunlight and allowed to adjust to the new environment. The seedlings should be ready for planting into the field after one month of exposure to direct sunlight. Some advantageous attributes of *D. viscosa,* if considering it for conservation use, are that it takes well in any kind of soil and it tolerates ocean winds and also dry dessert heat. Water regularly to establish the plant, but once it is established it requires very little water.

Use

The fibrous spreading root system, rapid growth, and spreading canopy make it an effective soil stabilizer which is particularly useful in controlling gully and coastal dune erosion. It is drought-tolerant and has the ability to withstand wildfires. Aalii shrubs are somewhat shade tolerant and suitable for riparian and restoration projects. They are also very wind hardy and useful as an in-field windbreak system.

Chenopodium oahuense
Kahoolawe Germplasm aweoweo

Description

A weakly scented shrub, the aweoweo can reach 5-20m in height. Its leaves are 3-lobed and somewhat fleshy. Leaves are also pubescent with the bottom half more pubescent and a lighter green as well. Flowers are small on leafless panicles producing seeds that are dark-brown and about 0.8mm in diameter.

Aweoweo is endemic to the Hawaiian Islands. It can be found on the northwestern Hawaiian islands of Lisianski, Laysan, French Frigate Shoals, Necker, and Nihoa. It is also found throughout the main Hawaiian Islands, but according to the Manual of the Flowering Plants of Hawaii (1999), aweoweo has not been observed to be occurring naturally on the island of Kahoolawe. Aweoweo is adapted to dry habitats of coastal and dry forests and can also be found in subalpine shrublands as well, ranging in elevation from 0 – 2,520 meters.

Establishment

Aweoweo can be propagated either by seed or by vegetative cuttings. Dibble tubes with sterile planting medium are recommended for starting cuttings. Seedlings should be started in 200-cell flats and then transplanted to dibble tubes. Seeds germinate within 5-10 days. Propagules should be ready to plant in the field by 5-6 months after starting in a shade-house. It is recommended that they be placed in direct sunlight about a month before planting. Irrigation is recommended for the first 6 months after planting in the field at which time the plants should be able to survive simply on natural rainfall.

Uses

The potential uses for aweoweo include ecosystem restoration, erosion control, and enhancing diversity in riparian and other communities.

Eragrostis variabilis
Kahoolawe Germplasm Kawelu

Description

E. variabilis is a somewhat variable, tufted perennial grass. Under natural conditions in Hawaii, it usually grows 1-3 feet tall by approximately 2 feet wide. The stems are erect and smooth. There is considerable variation in length of leaves and flowering panicles. The leaf blades are flat at the base and rolled inward at the upper part. Leaves are 0.50-0.60 inch wide and up to 32 inches long. The flowering head or panicles are narrow and range from 8-16 inches long. They are either somewhat open or dense and spike-like, with branches strongly upright to spreading. The oval, dark reddish brown seeds are 0.03-0.06 inch long, with minute groove and there are about 3.136 million per pound. There are about 3.136 million seeds in a pound.

Kawelu, a lovegrass, is endemic to the Hawaiian island chain. It is found on the Pearl and Hermes atolls, Kure, Midway, Lisianski, Laysan, Nihoa, and all of the main Hawaiian islands. It occurs on sand dunes, grasslands, open sites in dry forest, and exposed slopes and ridges or cliffs at elevations ranging from sea level to 3,500 feet.

Establishment

Kawelu germinates readily within 5-7 days by either planting seeds in a sterile meadium/potting-mix or direct seeding into a selected field/area. Although germination rates are relatively high, seedlings need to be kept moist during the beginning stages of growth. Since kawelu is prone to damping-off, it is recommended that some sort of fertilizer be applied 2 weeks after germination to promote growth. Seedlings that were propagated in a shade-house should be ready for transplanting after 3 months. Kawelu will grow in degraded soils, but soil amendments are highly recommended to help establish a healthy root system.

Uses

Conservation: The potential uses for kawelu include ecosystem restoration, erosion control, and enhancing diversity in riparian and other communities.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	HIPMC-P-0603
Title	*Sporobolus virginicus*: Tested Release
National Project No.	Critical Area 1.1
Study Type	Advance Evaluation
Study Status	Active
Location	Hoolehua Plant Materials Center
Study Leader	David Duvauchelle
Duration	2006 - 2013
Cooperators	University of Hawaii at Manoa Diagnostics Center University College of Tropical Agriculture and Human Resources
Land Use	Cropland
Vegetative Practices	Primary 342 CRITICAL AREA PLANTING Secondary 327 CONSERVATION COVER

Resource Concern(s)

Resource	Consideration / Problem
Soil	Soil Erosion / wind
Water	Soil Erosion / water

Long Range Plan Study falls under Objective 2.1, Section B of the HIPMC Long Range Plan

Objective This will be a comparative trial between five different accessions of *Sporobolus virginicus* that were collected from various locations throughout the Hawaiian Islands. Various characteristics of this species will be evaluated; including 1) propagation; 2) rate to cover ground; 3) rate of spread over ground; 4) forage yield; and 5) nutrient content. The accession that proves to be the most exceptional in all these areas combined will be selected to be recommended as a 'Tested Release' for the Hoolehua Plant Materials Center.

Status of Knowledge Streambank and hillside protection is becoming increasingly important and plants that are easily propagated and established are needed for these situations. Rapid establishment of permanent vegetative

cover on these critical areas is often difficult because of erosion, infertile soil, and unfavorable hydrology.

The PIA (Pacific Island Area) is in need of commercially available quantities of plant varieties and the technology to establish them. Plant species selected should 1) establish rapidly; 2) have good root structure and strength; 3) be adapted adverse conditions of low soil fertility and fluctuating soil moisture; and 4) have low maintenance requirements. *Sporobolus virginicus* has the potential to fill this need.

Sporobolus virginicus is a low-growing vigorous perennial grass that spreads by rhizomes. The height ranges from 4 to 8 inches tall. Roots can grow down to 18" deep. Leaves are 1-4" long and 0.04-0.12" wide with distinctly two-ranked and salt crystals common on leaves and stems. The leaf sheath is overlapping and hairy at the throat. Its inflorescence is dense and spike-like. The panicle, 3" long, is shorter than other Sporobolus species.

S. virginicus is commonly found in coastal dune habitats and it does best if sea water level fluctuates from 2 inches above soil surface to 6 inches below. It also does well in a variety of different soils from clays to sands. Being a plant that is adapted to low rainfall and high salinity, *S. virginicus* is fairly wide spread throughout the tropical regions and is native to the Pacific Islands Region as well as the continental United States. It also occurs in Africa, western seaboard of India, Sri Lanka, and Australia.

Large-scale projects require plants that are easy to propagate with high survival rates. *S. virginicus* will produce viable seed, but in very minute quantities. It is easier to propagate this particular species by vegetative sprigs. The mortality-rate of the propagules will be evaluated to determine which accession would be suited for large-scale production.

Experimental Design	Randomized Complete Block Design
Treatment 1	*Sporobolus virginicus*: HA-4840
Treatment 2	*Sporobolus virginicus*: HA-4846
Treatment 3	*Sporobolus virginicus*: HA-4861
Treatment 4	*Sporobolus virginicus*: HA-4894
Treatment 5	*Sporobolus virginicus*: HA-5802

Materials / Methods

Sprig samples were collected from five different locations within the Hawaiian Islands. HA-4840 is from Moomomi, Molokai, HA-4846 is from Papohaku, Molokai, HA-4861 is from Kaena, Oahu, HA-4894 is from Wailuku, Maui, and HA-5802 is from Rocky Road Beach, Kahoolawe. Each sprig sample had been planted at the Hoolehua PMC as 'increase blocks'. Sprigs will be taken from these 'increase-blocks' and propagules will be started under a shade-house.

Propagation

There is some concern with the vigor of the plants in the 'increase-blocks', so two separate propagation trials will be run. To confirm the findings of the initial propagation trial, a second propagation trial will be run using vegetative material taken from the main trial plots after all other evaluations are made. This is under the assumption that the main trial plots will be more vigorous than the 'increase-blocks'. The second propagation trial will essentially be the same as the initial propagation trial, but utilizing material that is in an actively growing stage as opposed to a somewhat dormant stage of the 'increase-blocks'. Propagules from the initial trial will be utilized for the main evaluation plots.

1.) Each propagation-plot will consist of 98 propagules. (1 dibble tube rack)
2.) Propagation trial will be replicated 4 times. (5 accessions – 20 plots)
3.) Survival rate will be measured by counting the amount of live propagules at 60 days after planting (DAP).

EVALUATION PLOTS

1.) The main trial will be replicated four times consisting of 20 plots.
2.) Propagules will be planted directly into the soil without any fertilizer amendments.
3.) Each plot will measure 9 ft x 9 ft.
4.) Each plot will consist of 16 propagules planted in block form, 4 x 4 plants, with 1 ft spacing between propagules.
5.) A woven weed mat, 6ft wide, will be laid down to separate the plots and also to help control weeds. Irrigation will be provided by micro-sprinklers set on a timer to irrigate once a week at 4 hour intervals.

Rate of Spread

1.) The runners reaching furthest out from each plot will be measured (length and width of the plot)
2.) Measurements will be taken 4 times. 60DAP, 120DAP, 240DAP, 345DAP

Percent-Cover

Canopy-cover is any vegetative material that covers soil; this includes leaves and stems that are not necessarily in contact with the soil. Stolen-cover, on the other hand, is only the live vegetative material that is in direct contact with the soil. Percent-cover is the measurement of canopy-cover and/or stolen-cover over a given area. By measuring the percent-cover over a period of time, the rate to cover ground can be established.

1.) Percent-cover will be measured with a point-frequency grid of 100 points - a 10 x 10 point grid over a $4ft^2$ block. Any vegetation present at a certain point (leaf, stem or stolen) will be considered a 'hit'. The total number of 'hits' divided by the total number of points on the grid will equivalent to the percent-cover.
2.) Percent-canopy-cover will be measured at 60DAP and 120DAP.
3.) Percent-stolen-cover will be measured at 255DAP and 360DAP after forage yield samples are taken and the entire plot has been cut back to about 2 inches in height.

Forage Yield

1.) Forage yield will be measured at three different times – 240DAP, 345DAP, 480DAP.
2.) Vegetation within a $2ft^2$ block from the center of each plot will be cut to about 2 inches in height. All vegetative material from within each block will be collected and weighed 'wet'. A subsample will then be taken from this and also weighed.
3.) The subsamples will then be placed in a drier-oven for one week and then re-weighed. The dry subsample divided by the wet subsample is equivalent to the percent-moisture-loss. By applying the percent–moisture-loss to the original 'wet' sample, the dry-forage-yield of $2ft^2$ can be determined. This number ($g/2ft^2$) can be converted further to tons per acre.

Forage Analysis

After the forage yield is established the samples will be sent to the University of Hawaii at Manoa Diagnostics Center for a forage analysis to determine nutrient content.

Technology Transfer Products

PMC release documentation

RESULTS – PROPAGATION TEST

Before Trial

REP	ACC	LIVE Propagules	%	AVERAGE %
1	PAPOHAKU	74	75.51%	
2	PAPOHAKU	77	78.57%	
3	PAPOHAKU	80	81.63%	
4	PAPOHAKU	76	77.55%	78.32%
1	MOOMOMI	55	56.12%	
2	MOOMOMI	51	52.04%	
3	MOOMOMI	64	65.31%	
4	MOOMOMI	74	75.51%	62.24%
1	KAHOOLAWE	50	51.02%	
2	KAHOOLAWE	52	53.06%	
3	KAHOOLAWE	56	57.14%	
4	KAHOOLAWE	52	53.06%	53.57%
1	MAUI	42	42.86%	
2	MAUI	46	46.94%	
3	MAUI	53	54.08%	
4	MAUI	46	46.94%	47.70%
1	OAHU	16	16.33%	
2	OAHU	23	23.47%	
3	OAHU	23	23.47%	
4	OAHU	14	14.29%	19.39%

Tukey HSD All-Pairwise Comparisons Test of ALIVE for ACC

ACC	Mean	Homogeneous Groups
Papohaku	76.750	A
Moomomi	61.000	B
Kahoolawe	52.500	BC
Wailuku	46.750	C
Kaena	19.000	D

Alpha 0.05 Standard Error for Comparison 3.6015
Critical Q Value 4.5 Critical Value for Comparison 11.499
Error term used: REP*ACC, 12 DF
There are 4 groups (A, B, etc.) in which the means are not significantly different from one another

After Trial

REP	ACC	LIVE Propagules	%	AVERAGE %
1	Kahoolawe	82	83.67%	
2	Kahoolawe	74	75.51%	
3	Kahoolawe	76	77.55%	
4	Kahoolawe	72	73.47%	77.55%
1	Moomomi	92	93.88%	
2	moomomi	79	80.61%	
3	moomomi	88	89.80%	
4	moomomi	77	78.57%	85.71%
1	Kaena	84	85.71%	
2	Kaena	73	74.49%	
3	Kaena	84	85.71%	
4	Kaena	76	77.55%	80.87%
1	Papohaku	92	93.88%	
2	Papohaku	81	82.65%	
3	Papohaku	90	91.84%	
4	Papohaku	85	86.73%	88.78%
1	Wailuku	89	90.82%	
2	Wailuku	76	77.55%	
3	Wailuku	87	88.78%	
4	Wailuku	86	87.76%	86.22%

Tukey HSD All-Pairwise Comparisons Test of ALIVE for ACC

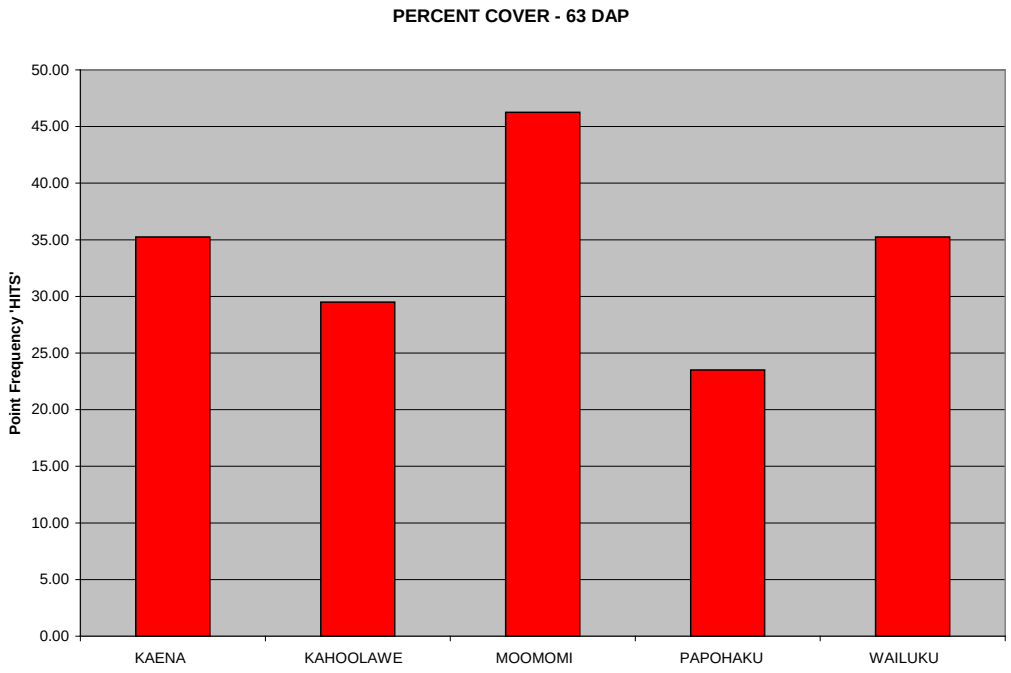
ACC	Mean	Homogeneous Groups
Papohaku	87.000	A
Wailuku	84.500	AB
Moomomi	84.000	AB
Kaena	79.250	BC
Kahoolawe	76.000	C

Alpha 0.05 Standard Error for Comparison 1.8484
Critical Q Value 4.5 Critical Value for Comparison 5.9016
Error term used: REP*ACC, 12 DF
There are 3 groups (A, B, etc.) in which the means are not significantly different from one another.

RESULTS – PERCENT COVER

Percent Cover – 63 DAP (3/21/07)

At 63 days after planting, the Moomomi accession exhibited the most point frequency 'HITS'. On the other hand, the Papohaku accession exhibited the lowest amount of point frequency 'HITS'.



STATISTICAL ANALYSIS OF DATA - 63DAP

Tukey HSD All-Pairwise Comparisons Test of PTFRQ for ACC

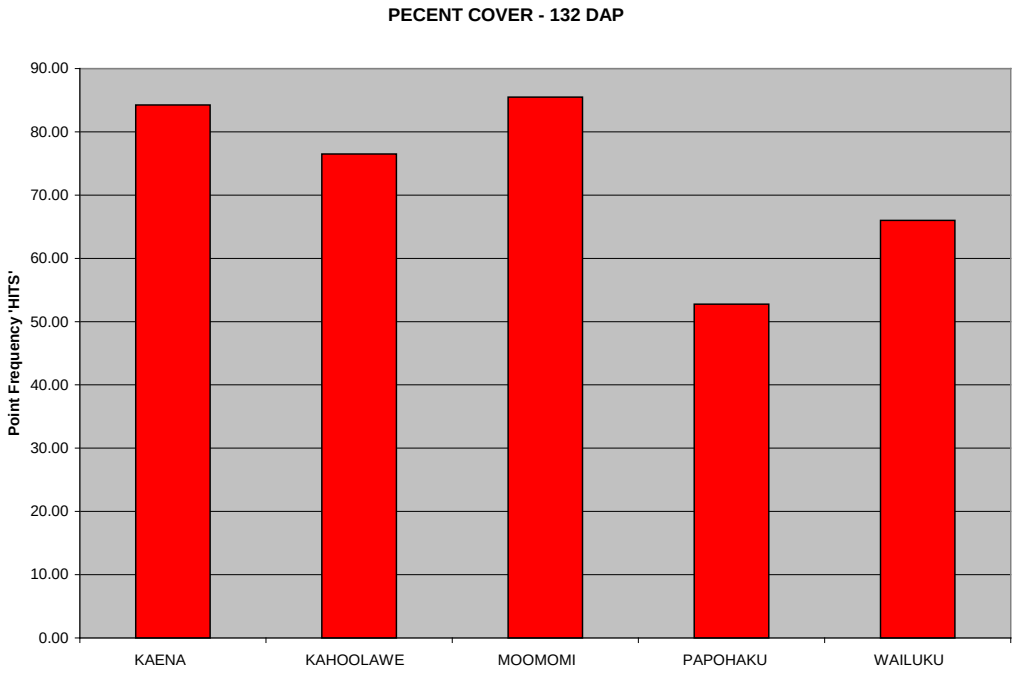
ACC	Mean	Homogeneous Groups
MOOMOMI	46.250	A
KAENA	35.250	AB
WAILUKU	35.250	AB
KAHOOLAWE	29.500	B
PAPOHAKU	23.500	B

Alpha	0.05	Standard Error for Comparison	4.7771
Critical Q Value	4.5	Critical Value for Comparison	15.252

Error term used: REP*ACC, 12 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.

Percent Cover – 132 DAP (5/29/07)

At 132 days after planting, the Moomomi accession continued exhibit the most point frequency 'HITS'. On the other hand, the Papohaku accession continued to exhibit the lowest amount of point frequency 'HITS'.



STATISTACAL ANALYSIS OF DATA - 132DAP

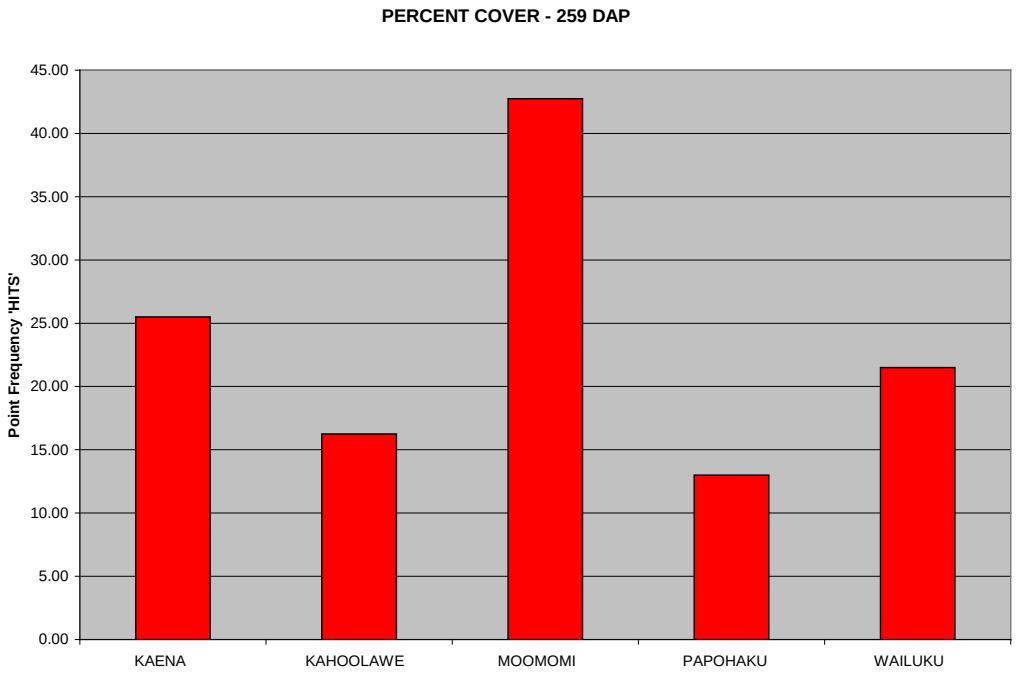
Tukey HSD All-Pairwise Comparisons Test of PTFRQ for ACC

ACC	Mean	Homogeneous Groups
MOOMOMI	85.500	A
KAENA	84.250	A
KAHOOLAWE	76.500	AB
WAILUKU	66.000	AB
PAPOHAKU	52.750	B

Alpha 0.05 Standard Error for Comparison 7.8345
Critical Q Value 4.5 Critical Value for Comparison 25.014
Error term used: REP*ACC, 12 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.

Percent Cover – 259 DAP (10/3/07)

Forage yield samples were taken on 9/20/07. After forage yield samples were taken, the entire plot was cut to a reasonably uniform height of about 1" high to measure rhizome percent cover as opposed to canopy cover. The percent cover data was taken 13 days later (10/3/2007) to allow vegetation to regrow and only “live material” point frequency ‘HITS’ were recorded. At 259 days after planting, the Moomomi accession again exhibited the most point frequency ‘HITS’, and the Papohaku accession again exhibited the lowest amount of point frequency ‘HITS’.



STATISTICAL ANALYSIS OF DATA – 259DAP

Tukey HSD All-Pairwise Comparisons Test of PTFRQ for ACC

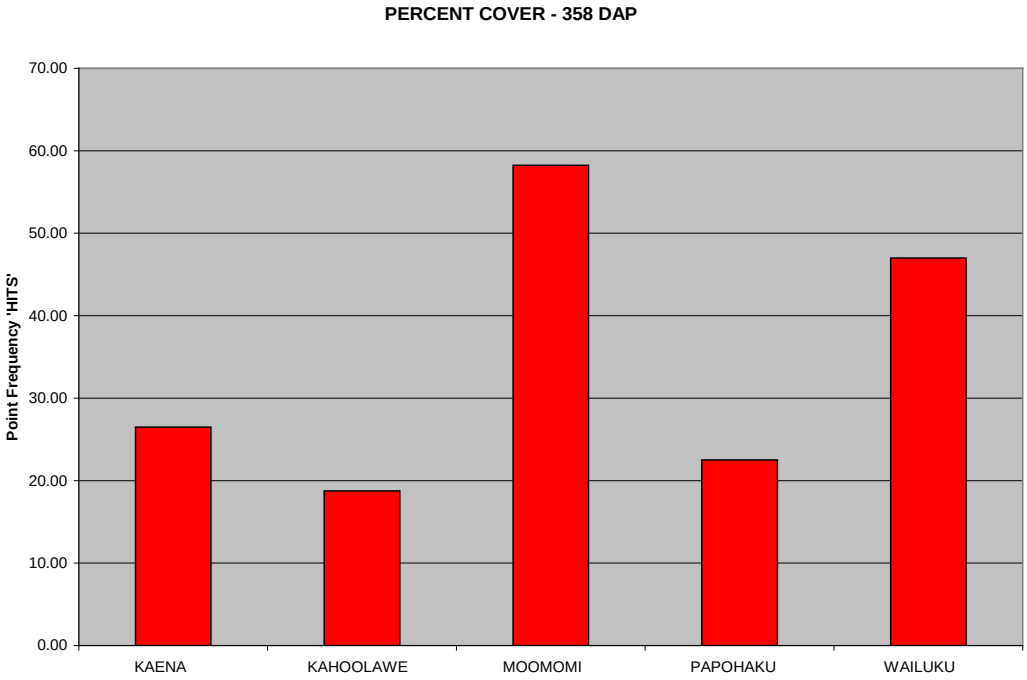
ACC	Mean	Homogeneous Groups
MOOMOMI	42.750	A
KAENA	25.500	AB
WAILUKU	21.500	AB
KAHOOLAWE	16.250	B
PAPOHAKU	13.000	B

Alpha	0.05	Standard Error for Comparison	7.0861
Critical Q Value	4.5	Critical Value for Comparison	22.624

Error term used: REP*ACC, 12 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.

Percent Cover – 358 DAP (1/10/08)

Forage yield samples were again taken on 12/18/07. After forage yield samples were taken, the entire plot again was cut to a reasonably uniform height of about 1" high. The percent cover data was taken 23 days later (1/10/2008) to allow vegetation to regrow and only “live material” point frequency ‘HITS’ were recorded. At 358 days after planting, the Moomomi accession again exhibited the most point frequency ‘HITS’, and the Kahoolawe accession exhibited the lowest amount of point frequency ‘HITS’.



STATISTICAL ANALYSIS OF DATA - 358DAP

Tukey HSD All-Pairwise Comparisons Test of PTFRQ for ACC

ACC	Mean	Homogeneous Groups
MOOMOMI	58.250	A
WAILUKU	47.000	A
KAENA	26.500	B
PAPOHAKU	22.500	B
KAHOOLAWE	18.750	B

Alpha 0.05 Standard Error for Comparison 5.8320
Critical Q Value 4.5 Critical Value for Comparison 18.620
Error term used: REP*ACC, 12 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.

RESULTS – RATE OF SPREAD

Rate of Spread – 63 DAP (3/21/07)

According to the statistical analysis, at 63 DAP, there was no significant difference in the rate of spread between the different accessions.

DATA SUMMARY

DATE: March 23, 2007 — 63 DAP

REP	ACC	LENGTH (cm)	WIDTH (cm)
1	MOOMOMI	145	135
2	MOOMOMI	150	145
3	MOOMOMI	140	135
4	MOOMOMI	150	130
1	KAHOOLAWE	155	145
2	KAHOOLAWE	165	155
3	KAHOOLAWE	150	155
4	KAHOOLAWE	130	110
1	WAILUKU	155	140
2	WAILUKU	145	155
3	WAILUKU	145	130
4	WAILUKU	140	130
1	PAPOHAKU	135	140
2	PAPOHAKU	150	150
3	PAPOHAKU	130	130
4	PAPOHAKU	130	110
1	KAENA	160	150
2	KAENA	165	155
3	KAENA	150	125

STATISTICAL ANALYSIS OF DATA - 63DAP

Tukey HSD All-Pairwise Comparisons Test of LENGTH for ACC

ACC	Mean	Homogeneous Groups
KAENA	150.00	A
KAHOOLAWE	150.00	A
MOOMOMI	146.25	A
WAILUKU	146.25	A
PAPOHAKU	136.25	A

Alpha 0.05 — Standard Error for Comparison 6.1998
Critical Q Value 4.5 — Critical Value for Comparison 19.794
Error term used: REP*ACC, 12 DF
There are no significant pairwise differences among the means.

Tukey HSD All-Pairwise Comparisons Test of WIDTH for ACC

ACC	Mean	Homogeneous Groups
KAHOOLAWE	141.25	A
WAILUKU	138.75	A
KAENA	137.50	A
MOOMOMI	136.25	A
PAPOHAKU	132.50	A

Alpha 0.05 — Standard Error for Comparison 6.4307
Critical Q Value 4.5 — Critical Value for Comparison 20.532
Error term used: REP*ACC, 12 DF
There are no significant pairwise differences among the means.

Rate of Spread – 132 DAP (5/29/07)

At 132 DAP there continues to be no significant difference in the rate of spread between the accessions with the exception of the Papohaku accession. The Papohaku accession is significantly slower to spread as compared to the other accessions.

DATA SUMMARY

DATE: May 29, 2007 132 DAP

REP	ACC	LENGTH (cm)	WIDTH (cm)
1	MOOMOMI	210	230
2	MOOMOMI	250	235
3	MOOMOMI	230	200
4	MOOMOMI	195	170
1	KAHOOLAWE	220	195
2	KAHOOLAWE	225	225
3	KAHOOLAWE	220	190
4	KAHOOLAWE	190	175
1	WAILUKU	250	220
2	WAILUKU	195	240
3	WAILUKU	205	180
4	WAILUKU	160	155
1	PAPOHAKU	170	170
2	PAPOHAKU	195	180
3	PAPOHAKU	130	145
4	PAPOHAKU	135	130
1	KAENA	230	215
2	KAENA	225	205
3	KAENA	210	185
4	KAENA	155	160

STATISTACAL ANALYSIS OF DATA - 132DAP

Tukey HSD All-Pairwise Comparisons Test of LENGTH for ACC

ACC	Mean	Homogeneous Groups
MOOMOMI	221.25	A
KAHOOLAWE	213.75	A
KAENA	205.00	A
WAILUKU	202.50	A
PAPOHAKU	157.50	B

Alpha 0.05 Standard Error for Comparison 13.901
Critical Q Value 4.5 Critical Value for Comparison 44.381
Error term used: REP*ACC, 12 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.

Tukey HSD All-Pairwise Comparisons Test of WIDTH for ACC

ACC	Mean	Homogeneous Groups
MOOMOMI	208.75	A
WAILUKU	198.75	A
KAHOOLAWE	196.25	A
KAENA	191.25	A
PAPOHAKU	156.25	B

Alpha 0.05 Standard Error for Comparison 7.2169
Critical Q Value 4.5 Critical Value for Comparison 23.042
Error term used: REP*ACC, 12 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.

Rate of Spread – 240 DAP (9/14/07)

At 241 DAP there continues to be no significant difference in the rate of spread between the accessions with the exception of the Papohaku accession. The Papohaku accession is significantly slower to spread as compared to the other accessions.

DATA SUMMARY

DATE: September 14, 2007 240 DAP

REP	ACC	LENGTH	WIDTH
1	MOOMOMI	260	250
2	MOOMOMI	270	250
3	MOOMOMI	240	210
4	MOOMOMI	205	155
1	KAHOOLAWE	225	235
2	KAHOOLAWE	220	215
3	KAHOOLAWE	230	220
4	KAHOOLAWE	210	175
1	WAILUKU	300	225
2	WAILUKU	300	255
3	WAILUKU	245	185
4	WAILUKU	160	165
1	PAPOHAKU	270	260
2	PAPOHAKU	245	200
3	PAPOHAKU	190	160
4	PAPOHAKU	155	115
1	KAENA	270	250
2	KAENA	220	250
3	KAENA	255	240
4	KAENA	165	190

STATISTICAL ANALYSIS OF DATA – 240 DAP

Tukey HSD All-Pairwise Comparisons Test of LENGTH for ACC

ACC	Mean	Homogeneous Groups
WAILUKU	251.25	A
MOOMOMI	243.75	A
KAENA	227.50	A
KAHOOLAWE	221.25	A
PAPOHAKU	215.00	A

Alpha 0.05 Standard Error for Comparison 19.566
Critical Q Value 4.5 Critical Value for Comparison 62.468
Error term used: REP*ACC, 12 DF
There are no significant pairwise differences among the means.

Tukey HSD All-Pairwise Comparisons Test of WIDTH for ACC

ACC	Mean	Homogeneous Groups
KAENA	232.50	A
MOOMOMI	216.25	AB
KAHOOLAWE	211.25	AB
WAILUKU	207.50	AB
PAPOHAKU	183.75	B

Alpha 0.05 Standard Error for Comparison 14.934
Critical Q Value 4.5 Critical Value for Comparison 47.680
Error term used: REP*ACC, 12 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.

Rate of Spread – 335 DAP (12/18/08)

At 419 DAP there continues to be no significant difference in the rate of spread between the accessions with the exception of the Papohaku accession. The Papohaku accession is significantly slower to spread as compared to the other accessions.

DATA SUMMARY

DATE: January 10, 2008 335 DAP

REP	ACC	LENGTH	WIDTH
1	MOOMOMI	277	285
2	MOOMOMI	277	256
3	MOOMOMI	275	185
4	MOOMOMI	257	200
1	KAHOOLAWE	200	195
2	KAHOOLAWE	217	267
3	KAHOOLAWE	195	173
4	KAHOOLAWE	203	188
1	WAILUKU	281	290
2	WAILUKU	283	265
3	WAILUKU	258	177
4	WAILUKU	195	166
1	PAPOHAKU	287	293
2	PAPOHAKU	262	254
3	PAPOHAKU	200	184
4	PAPOHAKU	135	133
1	KAENA	266	283
2	KAENA	256	250
3	KAENA	235	230
4	KAENA	205	185

STATISTICAL ANALYSIS OF DATA – 335DAP

Tukey HSD All-Pairwise Comparisons Test of LENGTH for ACC

ACC	Mean	Homogeneous Groups
MOOMOMI	271.50	A
WAILUKU	254.25	AB
KAENA	240.50	AB
PAPOHAKU	221.00	AB
KAHOOLAWE	203.75	B

Alpha 0.05 Standard Error for Comparison 19.136
Critical Q Value 4.5 Critical Value for Comparison 61.096
Error term used: REP*ACC, 12 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.

Tukey HSD All-Pairwise Comparisons Test of WIDTH for ACC

ACC	Mean	Homogeneous Groups
KAENA	237.00	A
MOOMOMI	231.50	A
WAILUKU	224.50	A
PAPOHAKU	216.00	A
KAHOOLAWE	205.75	A

Alpha 0.05 Standard Error for Comparison 19.943
Critical Q Value 4.5 Critical Value for Comparison 63.675
Error term used: REP*ACC, 12 DF
There are no significant pairwise differences among the means.

RESULTS – FORAGE YEILD

Forage Yield – 246 DAP (September 28, 2007)

The Kaena accession proved to have the highest forage yield.

DATA SUMMARY - Forage Yield

DATE: September 28, 2007 246 DAP

REP	ACC	DryYLD	TONperAC	AVERAGE
1	Moomomi	500.42	12.01	
2	Moomomi	349.62	8.39	
3	Moomomi	146.04	3.51	
4	Moomomi	116.88	2.81	6.68
1	Kahoolawe	985.85	23.67	
2	Kahoolawe	387.39	9.30	
3	Kahoolawe	296.11	7.11	
4	Kahoolawe	296.11	7.11	11.80
1	Wailuku	774.36	18.59	
2	Wailuku	336.27	8.07	
3	Wailuku	242.83	5.83	
4	Wailuku	94.98	2.28	8.69
1	Papohaku	400.52	9.62	
2	Papohaku	400.52	9.62	
3	Papohaku	159.10	3.82	
4	Papohaku	49.40	1.19	6.06
1	Kaena	809.38	19.43	
2	Kaena	755.32	18.13	
3	Kaena	608.42	14.61	
4	Kaena	184.04	4.42	14.15

Tukey HSD All-Pairwise Comparisons Test of TONperAC for ACC

ACC	Mean	Homogeneous Groups
Kaena	14.148	A
Kahoolawe	11.798	AB
Wailuku	8.693	AB
Moomomi	6.680	B
Papohaku	6.062	B

Alpha 0.05 Standard Error for Comparison 2.1972
Critical Q Value 4.5 Critical Value for Comparison 7.0152
Error term used: REP*ACC, 12 DF
There are 2 groups (A and B) in which the means
are not significantly different from one another.

Forage Yield – 335 DAP (December 18, 2007)

There appears to be no significant difference in forage yield between accessions.

DATA SUMMARY - Forage Yield

DATE: December 18, 2007 335 DAP

REP	ACC	DryYLD	TONperAC	AVERAGE
1	Moomomi	205.02	4.92	
2	Moomomi	172.48	4.14	
3	Moomomi	161.85	3.89	
4	Moomomi	127.57	3.06	4.00
1	Kahoolawe	238.34	5.72	
2	Kahoolawe	128.59	3.09	
3	Kahoolawe	43.00	1.03	
4	Kahoolawe	53.00	1.27	2.78
1	Wailuku	223.10	5.36	
2	Wailuku	163.83	3.93	
3	Wailuku	131.15	3.15	
4	Wailuku	89.76	2.16	3.65
1	Papohaku	242.86	5.83	
2	Papohaku	111.32	2.67	
3	Papohaku	150.00	3.60	
4	Papohaku	48.00	1.15	3.31
1	Kaena	182.18	4.37	
2	Kaena	180.83	4.34	
3	Kaena	108.54	2.61	
4	Kaena	82.48	1.98	3.33

Tukey HSD All-Pairwise Comparisons Test of TONperAC for ACC

ACC	Mean	Homogeneous Groups
Moomomi	4.0025	A
Wailuku	3.6500	A
Kaena	3.3250	A
Papohaku	3.3125	A
Kahoolawe	2.7775	A

Alpha 0.05 Standard Error for Comparison 0.5663
Critical Q Value 4.5 Critical Value for Comparison 1.8082
Error term used: REP*ACC, 12 DF
There are no significant pairwise differences among the means.

Forage Yield – 484 DAP (May 15, 2008)

There continues to be no significant difference in forage yield between accessions.

DATA SUMMARY - Forage Yield

DATE: May 15, 2008 484 DAP

REP	ACC	DryYLD	TONperAC	AVERAGE
1	Moomomi	183.04	4.39	
2	Moomomi	256.03	6.15	
3	Moomomi	173.47	4.16	
4	Moomomi	142.41	3.42	4.53
1	Kahoolawe	313.46	7.53	
2	Kahoolawe	193.01	4.63	
3	Kahoolawe	165.15	3.96	
4	Kahoolawe	82.58	1.98	4.53
1	Wailuku	351.71	8.44	
2	Wailuku	188.09	4.52	
3	Wailuku	221.75	5.32	
4	Wailuku	111.75	2.68	5.24
1	Papohaku	191.26	4.59	
2	Papohaku	202.10	4.85	
3	Papohaku	86.57	2.08	
4	Papohaku	69.20	1.66	3.30
1	Kaena	209.26	5.02	
2	Kaena	308.57	7.41	
3	Kaena	143.56	3.45	
4	Kaena	103.01	2.47	4.59

Tukey HSD All-Pairwise Comparisons Test of TONperAC for ACC

ACC	Mean	Homogeneous Groups
Wailuku	5.2400	A
Kaena	4.5875	A
Moomomi	4.5300	A
Kahoolawe	4.5250	A
Papohaku	3.2950	A

Alpha 0.05 Standard Error for Comparison 0.9009
Critical Q Value 4.5 Critical Value for Comparison 2.8763
Error term used: REP*ACC, 12 DF
There are no significant pairwise differences among the means.

DISCUSSION

By visual observation, three different forms of Sporobolus virginicus can be distinguished between the five different accessions studied in this particular trial.

The Kaena and the Kahoolawe accessions are very similar to each other with a seashore paspalum “look”. These accessions do spread by rhizomes, but have a higher tendency to produce long wiry runners that have a low tendency to ‘tack’ down or produce roots.

The Papohaku and Wailuku accessions are also very similar to each other. These two have bluish-green colored leaves that are noticeably wider than the other accessions. These accessions have a strong tendency to produce rhizomes with some the new growth stems tending to bury itself back into the soil.

The Moomomi accession has a growth form the stays relatively low to the ground. It is the shortest of all the accessions studied. This accession also has a very strong tendency to spread by rhizomes. Its leaves and stems, which produce a nice soft mat, are thinnest of all the accessions.

PROPAGATION (see figure 1.)

PERCENT COVER (see figure 2.)

The Moomomi accession proved to be the accession with the highest percent cover for the duration of this trial. This is due to the fact that it has a high tendency to spread by rhizomes. The Wailuku accession also has a high tendency to spread by rhizome, but it proved slower to fill in. On the other hand, it did seem to produce more rhizomes after being cut back. The Papohaku accession also has a high tendency to spread by rhizomes, but it proved to be the slowest of all the accessions to cover ground. The Kaena and Kahoolawe accessions initially had a high percent canopy cover, but because their tendencies to produce rhizomes are lower than the other accessions, the percent stolen cover measurements were lower.

RATE OF SPREAD (see figure 3.)

The Moomomi accession proved to be the fastest to spread in the beginning. However, the other accessions soon caught up. There appeared to be no significant difference in the rate of spread after

FORAGE YIELD (see figure 4.)

Initially, the Kaena accession proved to be the highest producer of vegetation. However, after being cut back, all the accessions produced yields that were not significantly different from each other. The Moomomi accession, on the other hand, produces a leaf that is much thinner and softer than the other accessions and could prove more palatable to animals.

Figure 1.

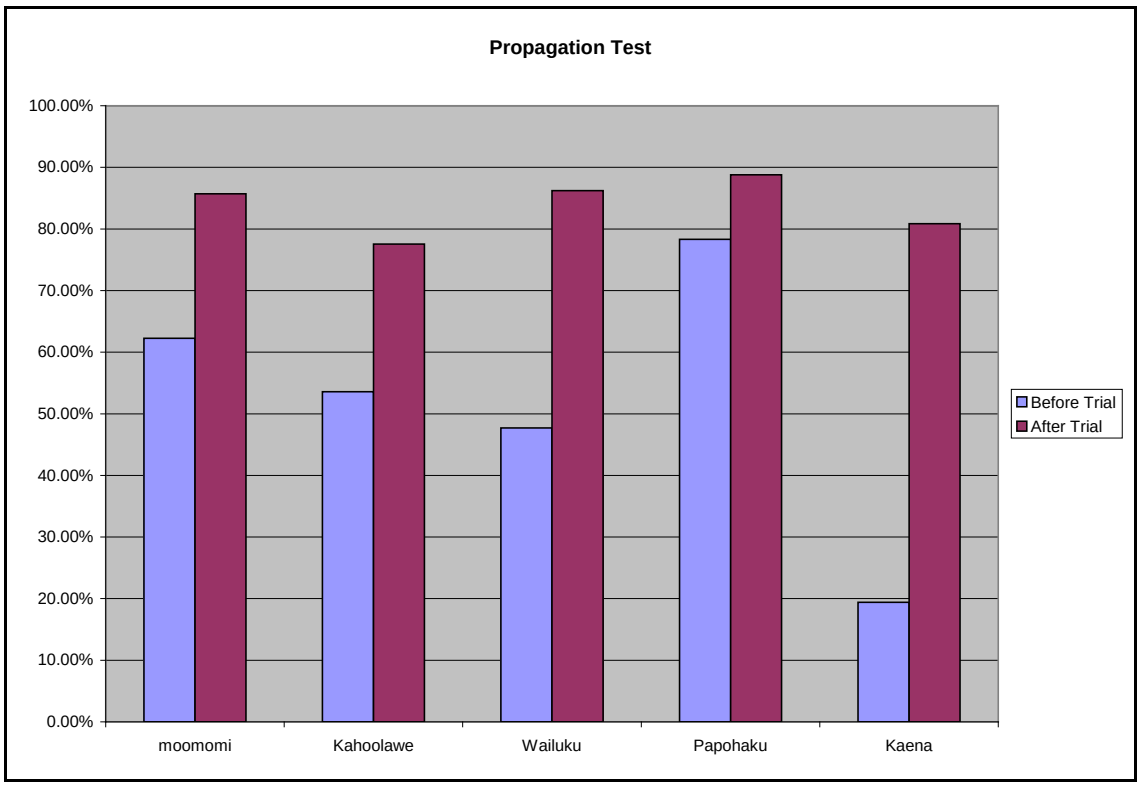


Figure 2.

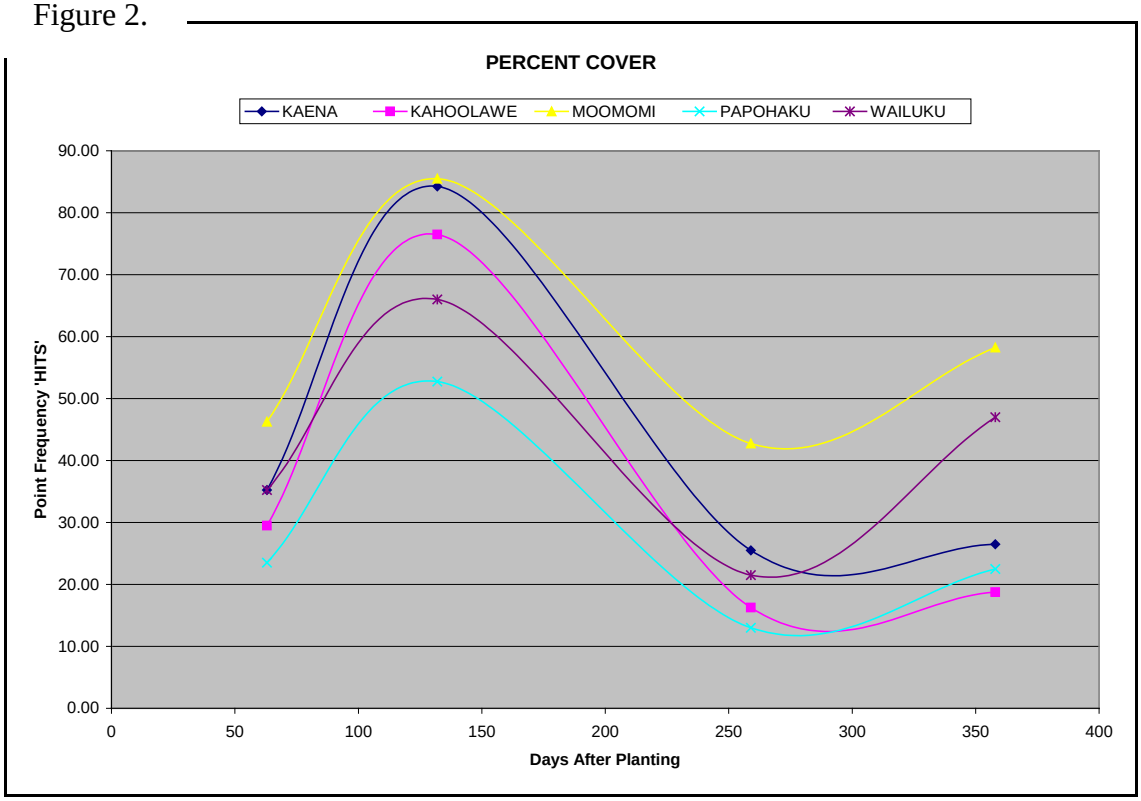


Figure 3.

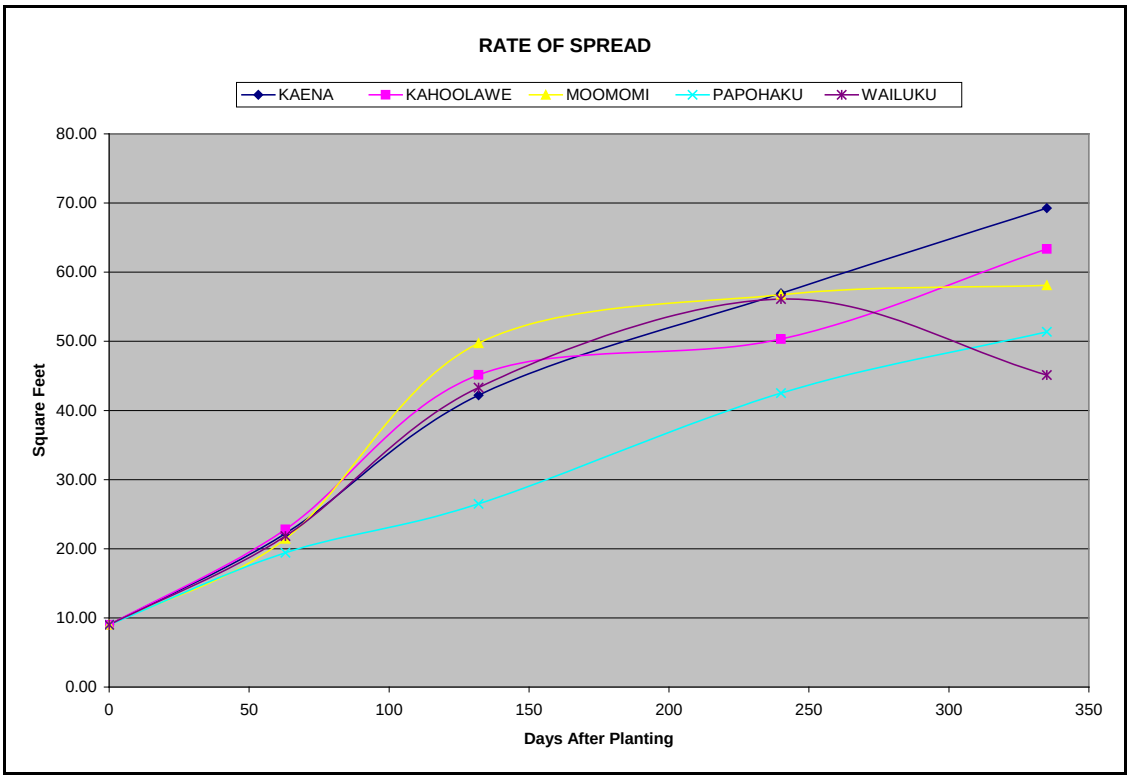
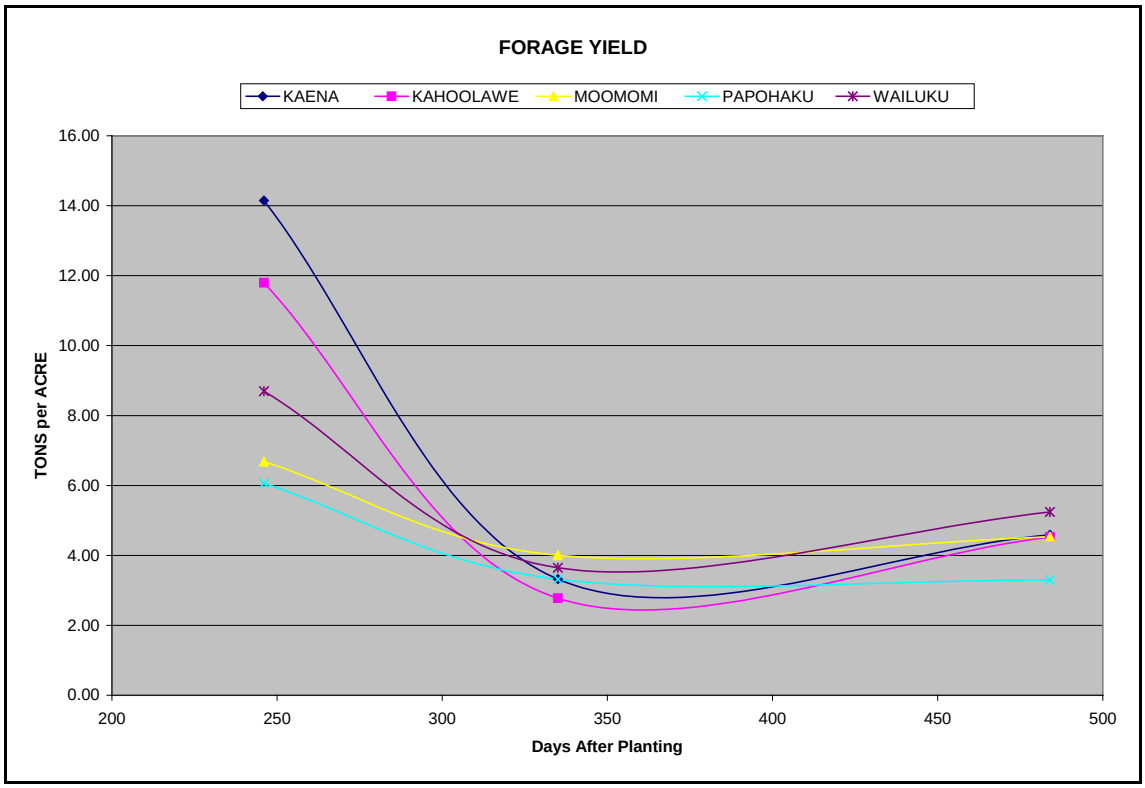


Figure 4.



FISCAL YEAR SUMMARY

FY2009

According to the date gathered, the *Sporobolus virginicus* accession that was obtained from Moomomi, Molokai exhibited traits that were most desirable as a conservation cover in areas that need soil stabilization such as hillside and streambanks.

The only issue that has been of concern is the lack of viable seed and the difficulty to propagate vegetatively on a large-scale (sprigging). Further collaboration with Dr. Joe DeFrank of the University of Hawaii will look at various roadside revegatation practices which could be applied to *Sporobolus virginicus.* His research will investigate propagation techniques as well as herbicide tolerance for long-term management.

The Moomomi accession will not be considered for release until the Hoolehua PMC is confident in a propagation technique for large-scale applications. Furthermore, the Wailuku accession also possessed traits that's could prove useful for conservation. The Hoolehua PMC will investigate possible propagation techniques of both these accessions.

FY2010

Plant establishment continues to be the deciding factor for the release of this species. Research has indicated that only some genetic varieties of *Sporobolus virginicus* will produce viable seed. Unfortunately, a DNA test is needed to determine this. Also, the difficulty collecting naturally occurring sample accessions from throughout the island chain is very costly. The alternative is to attempt to establish the various accessions vegetatively. Dr. DeFrank has made some advances in this area, but has yet to perfect the technique. On the other hand, he has also determined potential herbicides to use when trying to establish a stand. Garlon and Ronstar proved to be the herbicides to use. Suppressing weeds in an established stand is also a need that needs to be addressed; unfortunately there was no funding to support Dr. DeFrank's further study. Though a partnership with the University of Hawaii is beneficial, the cost of it says the Hoolehua PMC may have to tackle the task on its own.

The remainder of the year was dedicated to increasing the various accessions so a propagation trial and/or an herbicide trial can be conducted in FY2011.

FY2011

This year was dedicated to increasing the Moomomi accessions so a propagation trial and/or an herbicide trial can be conducted in FY2012. All the accession are doing very well. We plan on doing a large scale direct planting test with the Moomomi accession. An amendment to the existing study plan was made. We plan to test is soaking the vegetative sprigs and various solutions will have any effect on the grasses ability to take with planted directly. Initially, the test will be conducted on a small scale then eventually taken to a bigger scale. To conduct the large scale

test, a lot of material is needed, so we need to increase the amount of our existing material. We should have enough material by April-May of 2012.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	HIPMC-P-0803
Title	Native Hawaiian Ground Cover: Assembly of Potential Species
National Project No.	Cropland 2.1
Study Type	Initial Evaluations
Study Status	Active
Location	HIPMC
Study Leader	David Duvauchelle
Duration	2008 through 2013
Cooperators	Hawaii Soil Water Conservation District
Land Use	Cropland
Vegetative Practices	Primary Secondary

Resource Concern(s)

Resource	Consideration / Problem
Soil	Soil Erosion / wind
	Soil Erosion / water

Long Range Plan Study falls under NRCS Objective 2.1 Part B of the HIPMC Long Range Plan.

Objective: The objective of this study is to monitor the growth characteristics of various low-growing native Hawaiian plants that have potential to be utilized for conservation cover practices.

Status of Knowledge Every year the push to use native plants for conservation work grows stronger and stronger. This will be strictly an observational trial to isolate promising species. Plants included in this trial were selected because they were low growing, somewhat drought tolerant, and had a tendency to spread over ground. It will be from this trial that species will be selected for further study.

Materials / Methods Selected accessions will be planted out into the field for observation. Species traits that will be evaluated are growth rate, canopy cover, potential for large-scale seed production, and anything else that may be potentially useful.

Each accession will be planted 25 feet apart to allow ample growing room. Each plot will be irrigated will stroblers once a week at eight hour intervals. There will be no schedule for visual observations. Casual observations will be made during regulars maintenance activities.

Accessions being observed:

Achyranthes splendens
Cenchrus agremeneoides
Cocculus trilobus
Cypreus javanicus
Eragrostis variabilis (4 acc.)
Fimbristylis cymosa (2 acc.)
Plumbago sp.
Scaevola sp.
Sesbania tomentosa
Sida falax
Vigna marina
Vitex rotundifolia
Waltheria indica

Technology Transfer Products Newsletter Article

FISCAL YEAR SUMMARY

FY2009

The species that are exhibiting potential for continued testing are:

Vitex rotundifolia
Plumbago sp.
Waltheria indica
Cenchrus agremeneoides
Achyranthes splendens

Achyranthes splendens and *Waltheria indica* have been selected for large scale production trials. The seed obtained as a result of these trials will be provided to the Kahoolawe Island Reserve Commission.

FY2010

The Plumbago species is emerging as a plant the exhibits enormous potential. It is somewhat drought tolerant and also somewhat shade tolerant. It is found naturally growing in dry-land forest under trees in the gulches. It also sends out long runners that eventually send down roots that can stabilize the soil. This will be a species that further study is of interest. The only problem that is foreseeable is the fact that the seeds are very sticky. Harvesting the seed may pose a problem on a large-scale basis. Vegetative propagation may be the only means to reproduce this species on a large-scale. Sida falax is also showing potential as an addition to the "native-seed" mix. It is very drought tolerant and produces a lot of seed. A study to determine seed harvesting technology is needed.

FY2011

Vigna marina is a native legume. It is a sprawling liana that is somewhat drought tolerant. It is found naturally along coastal areas. The V. marina plants in the observation block exhibit good vigor and they also have a good cover. Low growing legumes are commonly used for cover crops. There is evidence of this species being used for fodder and as a food crop as well. We would like to further investigate this species for a possible native Hawaiian variety.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	HIPMC-P-0902
Title	*Vitex rotundifolia*: Tested Release
National Project No.	Cropland 2.1
Study Type	Initial Evaluations
Study Status	Active
Location	Hoolehua Plant Materials Center
Study Leader	David Duvauchelle
Duration	2006 - 2008
Cooperators	University of Hawaii at Manoa Diagnostics Center University College of Tropical Agriculture and Human Resources
Land Use	Cropland
Vegetative Practices	Primary 342 CRITICAL AREA PLANTING Secondary 327 CONSERVATION COVER
Resource Concern(s)	Resource — Consideration / Problem Soil — Soil Erosion / wind Water — Soil Erosion / water
Long Range Plan	Study falls under Objective 2.1, Section E of the HIPMC Long Range Plan
Objective	This will be a comparative trial between a number of different accessions of *Vitex rotundifolia* that were collected from various locations throughout the Hawaiian Islands. Various characteristics of this species will be evaluated; including 1) propagation; 2) rate to cover ground; and 3) rate of spread over ground. The objective is to determine what accession exhibits the best characteristics as a hill-side soil stabilizer.
Status of Knowledge	Stream bank and hillside protection is becoming increasingly important and plants that are easily propagated and established are needed for these situations. Rapid establishment of permanent vegetative cover on these critical areas is often difficult because of erosion, infertile soil, and unfavorable hydrology. Vegetative material native to the PIA is desired as an alternative to introduced species.

The PIA (Pacific Island Area) is in need of commercially available quantities of plant varieties and the technology to establish them. Plant species selected should 1) establish rapidly; 2) have good root structure and strength; 3) be adapted adverse conditions of low soil fertility and fluctuating soil moisture; and 4) have low maintenance requirements. *Vitex rotundifolia* has the potential to fill this need.

Vitex rotundifolia is a sprawling shrub 6 to 8 feet in diameter and 6 inches to 2 feet tall, but reaching 4 feet in height and 12 feet in width when protected from wind and salt spray. The round leaves are gray-green to silvery and 1 to 2 inches long and have a sage-like aroma when crushed. The 1 inch flowers are bluish purple and are produced in small clusters at the ends of the branches throughout the year. The round fruits are about 1/4 inch in diameter and bluish purple to black when ripe.

Vitex rotundifolia is a widespread strand plant. Its natural range spans from China, Taiwan and Japan south to Malaysia, India, Sri Lanka, Mauritius, Australia, Pacific Islands, and Hawaii. In Hawaii, pohinahina grows along the coast on sandy beaches, dunes, and rocky shorelines. It occurs naturally up to elevations of 50 feet on all the main islands except Kahoolawe, but it can grow at higher elevations.

Materials/ Methods

When a sufficient representation of the as many wild populations of *Vitex rotundifolia* is collected, a method of comparison will be determined.

Initial Evaluation:

1. Take [5] uniform cuttings from each accession; each cutting will have 5 nodes
2. Cuttings will be started in the shade-house and be planted 2 nodes deep in Sunshine Mix4.
3. After 2-3 months, 1 of the 5 cuttings from each accession will be planted in the field in a single row, with plants spaced 40-50 feet apart.
4. Plants will be irrigated with 2pgm emitters, once a week until plants are established (about 2 months), then switched to once a month.
5. At 180 and 360 DAP point-frequency data for 1 meter^2 will be gathered for each accession.
6. 2-3 accessions that exhibit highest point frequency for canopy cover will be selected for advanced evaluations.

Advanced Evaluation:

1. Take [x] uniform cuttings from each selected accession; each cutting will have 5 nodes.
2. Cuttings will be started in the shade-house and be planted 2 nodes deep in Sunshine Mix4.
3. Plants will be planted in the field according to the plot plan.

FISCAL YEAR SUMMARY

FY2009

A previous collection from Papohaku Beach on Molokai is currently growing fine on the Hoolehua PMC. Volunteers sent in cuttings from a population at Kalaupapa, Molokai. Seed collections were sent in from the Kauai Field Office. Cuttings were sent in from Maui Field Office. Collections were made from 5 locations on Oahu. There is evidence of 2 populations on the Big Island and 1 more population on the north shore of Molokai. It is crucial that we obtain samples from these populations in order to evaluate any significant differences. Once all collections are made, increase plots of each accession will be initiated. Once enough material is obtained the evaluation can proceed.

FY2010

In regards to the vitex populations on the Big Island, only samples from one population were collected. Glenn Sakamoto was able to collect a vitex sample from a site at Keaukaha. The other population was rumored to be located at South Point, but a reliable source that could identify the location could not be found. David Duvauchelle was able to collect a sample from Pelekunu, Molokai.

Currently, there are 10 accessions of Vitex rotundifolia that have been collected

1.) ACC# 9079733 - Papohaku
2.) ACC# 9079946 - Kauai
3.) ACC# 9079947 - Maui
4.) ACC# 9079948 - Makapuu Lookout
5.) ACC# 9079949 - Waimanalo
6.) ACC# 9079950 - Lanikai
7.) ACC# 9079951 - Laie
8.) ACC# 9079952 - Kalaupapa
9.) ACC# 9107186 - Pelekunu
10.) ACC# 9107187 - Keaukaha

These accessions will be started in the shade house and by FY2011, should be able to be planted into the field to increase planting materials for the comparison study.

FY2011

In October 2011, the decision was made to cut back all the older vitex plots in preparation for the rainy season. The Hawaiian Immersion class of Molokai High School was invited to participate in the activity. We wanted to expose the kids to scientific data collection. We had the student take length and width measurements of all of the plots that were to be cut back. After the measurements were taken, they help to cut the all the older plots back to a 3ftx8ft block. All of the material removed was then weighed. The data gained during this activity was merely to expose the kids to data collection. The data gathered will not be used in the selection process due to the different planting times of all the accessions. By the middle of FY2012, we should have enough material to start the initial evaluations.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCE CONSERVATION SERVICE
STUDY PLAN

Study ID Code HIPMC-T-9803
Title *Vetiver zizanioides*: Maximizing Material Production

National Project No. Cropland 2.1
Study Type Advanced Evaluation
Study Status Active

Location HIPMC
Study Leader Glenn Sakamoto
Duration 1998 - 2013

Cooperators Hawaii Soil Water Conservation Districts

Land Use Cropland
Vegetative Practices Primary VEGETATIVE BARRIER
Resource Concern(s)

Resource	Consideration / Problem
Soil	Soil Erosion / wind
Air	Air Quality / air pollutants
Water	Water Quality / Run-off

Long Range Plan Study falls under Objective 2.1, Section H of the HIPMC Long Range Plan

Objective To determine the amount of vegetative slips a vetiver plant will produce over a period of time to better gauge a more efficient planting schedule for commercial producers.

Status of Knowledge Currently, there is a growing demand for vetiver grass and plant material availability is quite low. A cost effective way to produce vetiver for commercial sale is needed.

Vetiver slips becomes too difficult to handle and process if the clumps reach over 24 months of age. Therefore a planting rotation needs to be determined in order to produce vetiver clumps that are ideally 18 months old and suitable for commercial sale. The number of slips produced per clump over a certain period of time will help determine the optimum time to harvest the clumps to be commercially feasible. If large scale production is the goal, then the produces also needs to consider requirements such as land, irrigation, soil amendments, and weed control measures. These requirements are in addition to labor costs to harvest the slips.

Method / Methods

The vetiver grass accession selected for this trial was obtained from the ARS Plant Introduction Center in Griffin, Georgia. Material for this trial was produced by the Hoolehua PMC

1. Study area will be well prepped, w/ amendments added.
2. Study will be irrigated by drip-tape.
3. Rooted slips will be direct planted into the soil.
4. Plant spacing will be spaced 2 feet part, single row.
5. Each plot will consist of 10 slips
6. There will a total of 5 plots.
   - Plot 1 - 90 DAP
   - Plot 2 - 180 DAP
   - Plot 3 - 270 DAP
   - Plot 4 - 360 DAP
   - Plot 5 - 420 DAP
7. At each DAP interval the plants from the corresponding plot will be removed from the ground and the number of slips produced will be counted.

FISCAL YEAR SUMMARY

FY2011

Increase plantings were installed reconfirm data gathered in the past. Study is scheduled to be installed in FY2012.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	HIPMC-T-9902
Title	*Heteropogon contortus*: Investigating Large-Scale Seed Production
National Project No.	Natural Areas 1.1
Study Type	Advanced Evaluation
Study Status	Active
Location	HIPMC
Study Leader	Glenn Sakamoto
Duration	1999 - 2008
Cooperators	Kahoolawe Island Reserve Commission (KIRC)
Land Use	Cropland
Vegetative Practices	Primary 342 CRITICAL AREA PLANTING Secondary 550 RANGE PLANTING
Resource Concern(s)	Resource: Soil Consideration / Problem: Soil Erosion / wind; Soil Erosion / water
Long Range Plan	Study falls under Objective 2.2, Section A of the HIPMC Long Range Plan
Objective	Develop large-scale management techniques for *Heteropogon contortus*, to include propagation, establishment, harvesting, and seed cleaning. The technical data and plant materials produced will be provided to the K.I.R.C. to aid in the restoration of highly erodible sites on the island of Kahoolawe.
Status of Knowledge	Conservation efforts with the use of native plants have been an ongoing challenge for the island of Kahoolawe. Efforts in re-introducing natives to the island have been somewhat successful, but only on a very small magnitude. There is a need to develop a plant material source and technology in the large-scale production of native plant species. *Heteropogon contortus,* or more commonly known as piligrass, has the potential for ecosystem restoration, re-vegetation of degraded habitats, and to increase diversity in dry-land and other communities.

Piligrass is an erect, branching perennial that may form rather large bunches up to 5 feet tall under optimum conditions. Under natural conditions in Hawaii, it grows 1 to 3 feet tall. There is extensive variation within this species throughout its range. The stems are flattened, rather tough, smooth, and a pale bluish-green. Leaves are produced throughout the length of the stem and are flat or folded, 4-12 inches long, about 0.25 inches wide and rough to the touch. The flowering heads have narrow, crowded flower spikes up to 4 inches long. The spikelets overlap and each fertile one bears a conspicuous red-brown awn about 4 inches long, made crooked with two bends. The long-awned seeds are sharp pointed forming tangled masses as they mature. When the seeds come in contact with moisture the hygroscopic awns and sharp barbed tips arch and twist planting them into the soil. Piligrass has a world-wide distribution and is found in the warm tropical regions of both hemispheres.

Materials / Methods

Since plant materials produced by this trial will be strictly used only for the Kahoolawe re-vegetation project, only seed collected from the Maui Nui island group will be utilized. *Heteropogon contortus*, Acc# 9079683, was collected from the island of Kahoolawe in the early 1990's. An increase plot of this seed was established to provide planting material for this production trial.

Propagation:

1.) Seedlings for field increase will be propagated in a shade-house that provides 50% light.
2.) Seeds for field increase will be planted in 13 x 26 x 3inch, 200 cell trays. Commercial sterile potting mix and perlite, 2:1 ratio, will be used as the planting media. Seeds will be sown ¼ inches deep and irrigated once daily. At 2 weeks of growth, a soluble fertilizer (10-20-10) will be applied at a rate of 1 tbs. per gallon, once a week for three weeks. At 5-6 weeks, a slow-release fertilizer (14.5-14.5-14.5) will be applied at a rate of 36 grams per tray.
3.) At 8 weeks, seedlings will be placed in 100% sunlight to harden off before planting into the field.

Establishment:

1.) Fields will be installed between mature windbreak systems.
2.) Irrigation will be provided by an over-head sprinkler system at rate of 1 acre inch per week.

3.) Fertilizer amendments will be made according to soil tests.
4.) Chemical and manual weed control will be performed regularly.
5.) Seedlings 3 months old will be transplanted with a single-row mechanical transplanter in a well prepared, firm, weed free seedbed.
6.) Rows will be space 3 feet apart and plants will be spaced 2 feet apart within rows. This spacing was pre-determined by the wheel-base measurement of the tractor being utilized.

Harvesting:

Various harvesting techniques will be tried to determine which will be ideal for *H. contortus*. Further testing will be done to refine the best technique.

1.) Combine (M-17 Massey Fergusen)
2.) Grass Stripper (Flail-VAC by AgRenewel)
3.) Fabricated Attachment ("PILI COMB")
4.) Bailing

Seed Cleaning and Storage:

1.) Various seed cleaning machine will be tested to evaluate which machine can do the best job.
2.) Improved seed will be stored in different methods. Germination tests will be performed on a regular basis to determine the ideal storage conditions and also peak germination rates.

FISCAL YEAR SUMMARY

FY1999

COMBINE (M-17 MASSEY FERGUSEN)

There were two methods that we wanted to try using the combine to harvest the pili. One method was combining with no manipulation to the crop (green). Another method was to desiccate the field using a contact-herbicide (Finale), followed by the combine. Both attemps to harvest *H. contortus* with the combine failed to condition the seeds to an acceptable state due to the sharp pointed callus of the seed, and the long tangling characteristics of the awns. The combine's concave, straw walkers, shakers, sieves, augers, everything became clogged preventing seeds from entering the hopper. Numerous attempts were made to try and minimize the clogging; adjusting fan speeds, removing screens, concave adjustment, installation of plates on the concave, and even constructing a catchment system that was pulled behind the combine to catch seeds being blown out. Fortunately, we were able to harvest some seed but only for a short duration before the combine would get clogged. It was obvious that using the combine was not the way to harvest *H. contortus* seed.

GRASS STRIPPER (FLAIL-VAC BY AGRENEWEL)

Failed attempts with the combine prompted the use of the Flail-VAC. The Flail-VAC is a rotary brush stripper that is attached to the front-end loader of a farm tractor and powered by an independent PTO-driven hydraulic system. The grass stripper enabled the harvesting of seeds without the use of desiccants and also provided the opportunity to repeatedly enter the field to collect remaining seeds as they matured. The amount of stems/foliage (unwanted material) collected along with the seed was minimal and could be separated during the cleaning phase. The Flail-VAC is able to harvest *H. contortus* seed sufficiently.

FY2000

BALING

Bales have had a lot of success being used for erosion control. It was only natural for the PMC to consider baling the *H. contortus*. At maturity the field is cut down with a VICON rotary-mower to a height of about 12-16 inches. The field is then allowed to dry for 2-3 days. The cut-grass is then flipped and raked into windrows with a BEFCO Side Delivery Rake for easier baling. These windrows are then allowed to dry for another day. After the final day of drying, the field is ready to be baled. Next fiscal year will be our first harvest for bales.

SEED CLEANING

Numerous attempts were made at cleaning *H. contortus* seed to a usable state. Brush machines, hammermills, cement mixers, and threshers all failed at the task. The barbed callus and twisting nature of *H. contortus* awns made cleaning the seed very difficult. The hammermill did separate seeds and awns, but seed damage occurred regardless of blade adjustments. The small portable threshers worked best but did not break the awns small enough to pass through any seed clipper cleaners. The Almaco thresher is a portable, intermediate, thresher with an 8 HP gas engine, rasp bar type cylinder and grass concave. The overall dimensions are

112” x 72” x 54”. Seed that was harvested was run through the thresher twice using a 6mm grass sieve, concave was fully closed and cylinder speed set at slowest speed. We were able to condition the seed with the Almaco thresher so final seed cleaning could be done with The Seedburo100. The Seedburo100 seed and grain cleaner was used more as a seed scalper. Attempts to use the cleaner under “normal” seed cleaning conditions failed. The physical nature of *H. contortus* made separation of seed and awns virtually impossible with the machinery available. Seeds were not able to flow through hoppers, grain elevator or flow over screens. Fan speeds did not allow for appreciable separation of seeds and was not used. In the end a 1/16 round holed screen was used to separate as much awns as possible from the seed.

FY2001

An additional 1.4 acres has been planted in Field10A to increase production. The entire field was planted by hand with the help from volunteers (TREE). 1tbs. of 10-30-10 fertilizer was applied for each plug. 10,584 plants were planted on 3/7/2001. Field was irrigated with a “Big Gun” waterwheel sprinkler. The “Big Gun” did not have enough reach to cover the entire field, so over-head impact sprinklers had to be installed. Two rows of pili had to be removed to make room for the new irrigation lines. Together with the insufficient irrigation and the direct application of fertilizer, there was a very high mortality rate for the seedlings. 5,605 seedlings had to be replanted by hand.

FABRICATED ATTACHMENT (“PILI COMB” by David Duvauchelle):

Even though the Flail-VAC was ‘doing’ the job, we needed something a little more effective. Developed on the PMC, the “PILI COMB” is a simple fabrication of angle iron and re-bar. The angle iron provided the frame that re-bars lengths could be welded to, forming a large “comb” that could be attached to the bucket of the front-end loader. The tractor would then drive through the field with the height of “comb” set to the height of the seed heads. Only mature seed was removed and immature seed was left behind. At the end of the field the tractor would dump the seed that was collected into a truck and it would be ready for another pass. Virtually no unwanted material was collected along with the seed. Whatever immature seed that was left behind could be harvested a week or so later when they had matured. The “PILI COMB” proved to be the best way to harvest bulk *H. contortus* for seed with the awns attached.

FY2002

Heteropogon contortus is a native perennial grass that does very well as a crop. At the Molokai PMC we are able to harvest our fields about every 3 months. After the last harvest, the field will grow for about 2 months. After 2 months the seed heads are just about 50% mature and beginning to ‘tangle’. We would then cut the irrigation and let the field mature for another month or so, depending on when the field is at least 75% mature. At that point in time the field is ready to harvest. After the field is harvested, it is mowed down to a uniform 10-12 inches high. Grass clippings are left on the field to be utilized as mulch to aid control weeds and moisture retention. Supplemental fertilizers were added after every other harvest at

a rate of 100 lbs. of nitrogen per acre, alternating between “Triple-16” and “Urea”. Our data shows significantly higher yields during the months from June to September.

Total hay-bales: 954 Total seed-bales: 11
February 2002, Field10A had its first harvest; 96 hay-bales.

SEED BALES

It was discovered that the awn of the seed actually planted the seed into the soil. Not separating the seed from the awn could be beneficial to conservation work. With this in mind we tried baling the harvested seed. These seed- bales were a lot less bulky than the hay bales. For each harvest there was less material to work with as well. Because of the harsh conditions of pili seed-cleaning we will no longer be cleaning the seed. On the other hand, if the seed is desired for conservation work, we bale the seed harvested with the “PILI COMB”.

FY2003

Total hay-bales: 2050
An additional 0.8 acres was been planted in Field6A to increase production for the Kahoolawe project.

FY2004

Total hay-bales: 1940 Total seed-bales: 12

FY2005

Total hay-bales: 2381

FY2006

Total hay-bales: 1927

The total number of bales produced is an indication that soil fertility has diminished. Soil samples were taken from each field and sent to the University of Hawaii for analysis. The results confirmed our suspicions that indeed nutrient levels were low and pH had dropped to unacceptable levels. With this information we can speculate that from a single planting one can expect about 4-5 years of good hay-bale production. After that time it is recommended that the field be conditioned to raise the pH level.

Due to the cut of all Congressional Earmark monies, this will be the last year that plant materials will be produced for the KIRC. It is anticipated that a reimbursable contract will be initiated to continue production. Until that time, no more bales will be produced. With production halted, this is an ideal time to turn the fields under for conditioning according to the soil tests.

FY2007

Minimal effort was put into the maintenance of all the piligrass fields since the stop of the Congressional Earmark. The fields were mowed regularly to hinder them from producing seed. No bales were harvested.

FY2008

A Congressional Earmark has mandated the Hoolehua Plant Materials Center to continue the production of native Hawaiian plant materials for the revegetaion project on the island Kahoolawe. The production process of piligrass bales is continuously being refined.

a. Piligrass can be harvested every 3 months.
b. Production peaks during the summer months (June, July, Aug)
c. Bales can be harvested during the winter months but not worth the effort
d. Yeilds average 150-160 bales per acre (35 lb. bales – 16x18x30 inches)
e. The mulch layer produced from clippings is a vital part to a successful weed control program
f. Moisture can be applied with overhead irrigation. Interval should be once a week at 1 acre inch, for 8 weeks, at which time the irrigation is cut until harvest, about 4 weeks later
g. High levels nitrogen will boost piligrass hay-bale yield. Piligrass can tolerate rates of 200-400 lbs of nitrogen per acre. Tests have shown that a field will become more acidic over time. Higher nitrogen rates will speed up this process. A production field will tolerate about 4-5 years of harvesting, at which time yields begin to diminish. The field will have to go fallow and be reconditioned according to soil tests.

To date the Hoolehua PMC has a total of 4.3 acres of piligrass to support the project. Two older fields were set fallow due to diminishing yields and being overridden with weeds, while [2] more acres were planted to support the increased demand for piligrass bales. It was too late in the season before there was notification of receiving the Earmark monies. Consequently, the next harvest for piligrass bales will not be until June 2009. This gives the KIRC ample time to secure resources to transport the bales to Kahoolawe.

Future studies will involve developing an improved method to clean the piligrass seed. This is planned for fiscal year 2010. Having clean seed will aid in large-scale seed dispersal. This will also lead into further study of techniques for large-scale seed dispersal.

FY2009

During the rainy season piligrass bale production is usually on the low side. There is also the risk of the hay getting soaked by an unpredictable rain after a field has been cut. During this time, the piligrass fields at the Hoolehua PMC are kept cut low to help maintain any weeds that may grow and also to hinder the piligrass grass from going to seed. Fortunately, it was a “dry” rainy season, so weed maintenance was at a minimal. In March 2009 the fields were cut again, 100 lbs nitrogen was applied,

and the regular irrigation schedule of 1 acre inch per week was resumed. All fields were harvested on the first week of June 2009 for a total of 607 bales. Another 100 lbs of nitrogen was applied after the June harvest. The second harvest for fiscal year 2009 was on the first week of September for a total of 951 bales. There has been some interest with using piligrass seed for direct-seed or hyhdro-mulching projects. In FY2010, testing various piligrass seed cleaning techniques will be a top priority.

FY2010

On December 1, 2009, all of the production fields (4.3 acres) were harvested with the pili-comb. The bulk-seed was then stored on the floor of the seed-building to allow the material to dry down.

On February 10, 2010 an attempt was made to clean the bulk-seed harvested by the pili-comb by hand-feeding the material directly into the combine. The awns were clogging-up in the concave area. Also, the awns were balling-up over the sifting screens, clogging it and preventing seeds from falling through. The seed that was able to pass through the screen was acceptably "clean", but the combine needed to be cleared of awns frequently. It appears that the piligrass awn is the limiting factor for combine harvesting. There is to be a way to stop the awns from clogging every crevice that it gets into.

Combine settings

- Concave width – 15
- Concave speed – 1000 rpm
- Sieve – flat
- Screen – smallest
- Fan strength – 1
- Fan direction – 8
- Fan shoot – open

Maybe the reason why the awns are clogging everything is because it is initially entering the combine as a tangled mass. If this mass could be diluted then there may be a chance that the combine can do its job. The combine had been used to harvest the seed directly from the field in the past by gathering only the material at the very top of the grass (the tangled seed/awn mass). This was essentially the same thing as we tried in FEB and yielded similar results.

The new idea is to dilute the tangled seed/awn mass with piligrass straw. The plan is to cut the fields down with the Vicon rotary-mower and rake the hay into wind-rows as if to bale the hay. Instead of the baler, the combine would pick up the rows. By using the combine to take up the seeded-straw material in wind-rows, the seed/awn mass will be diluted, which may prevent the awns from clogging the combine. The concave will be adjusted to a wide setting to prevent it from getting clogged.

On May 21, 2010, the fields were cut with the rotary mower. On May 24, the hay was raked into windrows. On May 25, an attempt to harvest/clean the seeds with the combine was made.

Combine settings
- Concave width – 20
- Concave speed – 1000 rpm
- Sieve – flat
- Screen – smallest
- Fan strength – 1
- Fan direction – 8
- Fan shoot – open

The combine picked up windrows easily. The rock trap became slightly clogged up with awns and needed to be manually removed by hand after every other pass, but the majority of the material moved to screens without balling up. The screens sifted seeds fairly well. Improved seed moved up to hopper without clogging augers. Trash material moved out through chopper without getting clogged. Although we were able to harvest a fair amount of seed, there was a lot of seed being lost through the chopper. This may be due to the concave setting being too wide. For the next harvest, the concave will be changed to a narrower setting to knock the seeds free from the awn.

The seed from the combine was then run through one of the seed cleaning machines to improve it further. Although the seed was improved somewhat, the machine is not suited to improve piligrass seed. The screens are not positioned steep enough to create a nice flow and they are enclosed which prevents manual clearing as it runs.

FY2011

In June 2011 the fields were cut down and another attempt to collect and clean the piligrass seed was made. Slight changes to the combine setting were made.

Combine settings
- Concave width – 6-9
- Concave speed – 1000 rpm
- Sieve – flat
- Screen – smallest
- Fan strength – 1
- Fan direction – 8

Fan shoot – open

Initially, with the narrower concave setting, the combine was cleaning the seed fairly well with very little loss through the chopper, but it eventually began to clog up again. We were still getting some seed, but we were definitely losing seed all over the place. Also, the rock trap got clogged up as well and prohibited the augers from

feeding the combine. We are not sure why this is happening, but we still have to unclog the rock-trap after every other pass. Also, there seems to be a lot of stem stubble that is taken up to the hopper. Not sure if this grass can be harvested...

After cleaning out the combine it was discovered that the area getting clogged was right behind the concave/thresher. This may be due to a “flap” directly behind this area that was probably designed to slow the flow of material moving toward the “walkers”. For the next harvest we will try to increase the thresher rpm. Hopefully this will solve the clogging issue as well as the stubble and rock trap issue. The idea is that with the increased amount of material being fed to the machine, clogging would be less likely to occur. The next harvest is scheduled for October 2011.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	HIPMC-T-9903
Title	*Dodonaea viscosa*: Large-Scale Seed Production
National Project No.	Critical areas 1.1
Study Type	Advanced Evaluation
Study Status	Active
Location	HIPMC
Study Leader	Glenn Sakamoto
Duration	1999 - 2006
Cooperators	Kahoolawe Island Reserve Commission (KIRC)
Land Use	Cropland
Vegetative Practices	Primary 342 CRITICAL AREA PLANTING Secondary 550 RANGE PLANTING
Resource Concern(s)	Resource — Consideration / Problem Soil — Soil erosion / wind Soil — Soil Erosion / water Air — Air Quality / air pollutants
Long Range Plan	Study falls under Objective 2.2, Section A of the HIPMC Long Range Plan

Objective

To develop large-scale management techniques for *Dodonaea viscosa*, this will include propagation, establishment and harvesting. The technical data and plant materials produced will be provided to the KIRC to aid in the restoration of highly erodible sites on the island of Kahoolawe.

Status of Knowledge

Conservation efforts with the use of native plants have been an ongoing challenge for the island of Kahoolawe. Efforts in re-introducing natives to the island have been somewhat successful, but only on a very small magnitude. There is a need to develop a plant material source and technology in the large-scale production of native plant species. *D. viscosa,* or more commonly known as aalii, has the potential to fill this need.

Dodonaea viscosa is a shrub or sometimes a small tree ranging in height from 6-25 feet. Its long and slender leaves have margins that are usually wavy or crinkled. The flowers are fairly small and the female flowers develop into

papery capsules that may be red, pink, green, yellow, or tan. Seeds are roundish, black and very small; about 1/16" wide. There are about 84,200 seeds per pound. ʻAʻaliʻi is found throughout the tropical regions of the world. Until recently, *D. viscosa* is considered indigenous to all of the main Hawaiian islands except Kahoʻolawe. However, it has since been observed on Kahoʻolawe, possibly as a result of the removal of the feral goats. *D. viscosa* is adapted to a wide range of habitats, from sea-level to nearly 8,000 feet and tolerating annual rainfall of 12-98 inches.

The fibrous spreading root system, rapid growth, and spreading canopy make it an effective soil stabilizer which is particularly useful in controlling gully and coastal dune erosion. It is drought-tolerant and has the ability to withstand wildfires. *D. viscosa* shrubs are somewhat shade tolerant and suitable for riparian and restoration projects. They are also very wind hardy and useful as an in-field windbreak system.

Materials / Methods

1. Kamiloloa Germplasm Aalii will be used for this trial.
2. Seeds will be scarified and immersed in hot tap water for 24 hours. They will be planted into 11" x 17" x 2" seedling flats (200 cells).
3. Planting media will consist of a sterile potting mix and perlite at a ratio of 2:1 respectively. Seeds will be sown ¼ inches deep and be irrigated once daily under 50% shade.
4. At four weeks or when true leaves emerge; a slow release fertilizer (14.5-14.5-14.5) will be applied at eight-week intervals.
5. Seedlings will be transplanted into 1" x 7" dibble tubes at 12 weeks.
6. Seedlings in dibble tubes will be planted into the field at 24-32 weeks. Spacing between transplants will be 6ft. in Field7 and 10ft. in Field11.
7. Supplemental fertilizer (16-16-16) will be incorporated into the soil prior to planting at a rate of one pound per linear foot.
8. The irrigation will be a drip-system using ¾ inch poly tube and 2 gph emitters, applied at 4hrs/day once per week for the first 3 months and increased to 8hrs/day once per week from 4-12 months. At 12 months of growth irrigation will be supplied at a rate of 18hrs/day once per week.
9. Blooming period will be noted.
10. Various seed harvesting techniques will be tested.
11. Seed cleaning processes will be evaluated.

FISCAL YEAR SUMMARY

FY1999

Disease problems were minimal with powdery mildew being the main disease during the second through fourth month of seedling growth. Weekly spraying of a commercial fungicide (Garden Dust) was necessary to prevent dieback. High humidity during the rainy season and being under 50% shade may have attributed to the increase of the disease. Seedlings were hardened off in direct sun at four months of growth. In December 1998 through March of 1999 the *D. viscosa* increase fields were established. A total of 2000 linear feet was planted in Fields7 and Field11 with 6-8 month old seedlings.

FY2000

In March and April an additional 1.2 acres were transplanted with 818 seedlings for an additional four thousand linear feet. Rows were spaced 15 feet apart with 5 feet spacing within rows. Supplemental fertilizer (10-30-10) was incorporated prior to planting at a rate of 300 lbs. of phosphorus per acre. Black plastic woven mulch was used to reduce weed maintenance and increase moisture retention. In the summer of 2000 the initial increase rows were manually harvested by hand and seeds were cleaned. Methods on how to mechanically harvest is still undetermined. Cleaning was accomplished by use of a brush machine, LA-H from Westrup. The seed was conditioned using the paddles and No. 7 size wire mantle (screen). Final cleaning was done with the conventional seed clipper. A modest yield of approximately four pounds of seeds was harvested.

Current seed yields are below projections and are anticipated to increase as plants mature. One of the concerns of seed production is the plant's individual characteristic as being dioecious and monoecious. The ratio in which this occurs in a given population is still uncertain and provides a challenge in producing high yielding seed fields. Under ideal conditions *D. viscosa* is a fast growing plant that can attain an average height of 5.6 feet in one year.

FY2001-2005

In 2005, plants were pruned back to an average of 7 feet in height and 5 feet wide to aid in harvesting. The seeds were getting hard to reach and the aisles were starting to close up. Before the pruning, yields continued to be very low. 2001 produced 6.5 lbs. 2002 produced 14 lbs. 2003 produced 3.3 lbs. 2004 produced 6.5 lbs. In 2005 the yield was 7.4 lbs.

FY2006

The field was pruned in late 2005. Only the side branches were cut because we do not have the right equipment to handle the pruning of the tops. Although D. viscosa does well if it is pruned, it is important to note that only the new growth should be cut. If the woody branches are cut, for some reason, D. viscose has a difficult time recovering. Pruning should be done regularly to avoid trimming the larger branches. Weed maintenance is down to a minimum with the removal of irrigation. Dodonaea viscosa is very drought tolerant, and there have been many recommendations to cut the water to increase seed production. The harvesting was still done by hand with the help of three Americorps volunteers. Although it took about 4 weeks, working 2-

3 hours in the mornings, this year's harvest was the largest with 22.4 pounds of cleaned seed.

Due to the cut of all Congressional Earmark monies, this will be the last year that plant materials will be produced for the KIRC. It is anticipated that a reimbursable contract will be initiated to continue production. Because this field has such low maintenance requirements, we will continue to harvest the seed. Dodonaea viscosa is highly sought after as a conservation plant, but there is no mechanical means to harvest the seed on a large scale. During the following fiscal year, we will try to develop a mechanical harvester to reduce the amount of labor required to harvest the seed of Dodonaea viscosa. We also will experiment with this plants ability to recover from extreme pruning.

FY2008

Although the funding behind the Congressional Earmark that supported the production of aalii for the Kahoolawe revegetation project ended, the aalii field was still maintained at a minimum level. This was not difficult to do since the existing field already required very low maintenance. Despite this fact yields appeared to be high. This initiated a push to develop a more efficient method to harvest the seed. In the past, the Hoolehua PMC was dependent on summer workers to harvest the seed by hand. Although last year's yield proved to be the largest, it still took a long alt of man hours over a long period of time.

The basic idea behind the development of the apparatus to harvest aalii seed was to utilize the frequent high tradewinds. A large screen measuring 8ft x 8ft was attached to a wooden frame. The frame was built so that the fork-lift on the farm tractor was able to pick it up. The screen was attached in a way that it faced side-wards so it could run length-wise along the aalii rows. The tractor could now lift the frame and position the screen down-wind of each tree in a row. Workers would then use sticks to whack the larger braches, shaking the mature seed pods loose. The see pods are light enough that the wind blows them into the screen. By using this method, the entire field can be harvested in 2 days, as compared to 1 month harvesting by hand. The total yield for 2008 was 25 lbs. This was the highest yield to date.

FY2009

Low rainfall during 2009 proved to be beneficial for weed maintenance, but detrimental to plant vigor. Usually, the aalii field does fine under natural rainfall. In fact, aalii is one of the more drought tolerant plants. Unfortunately, a lot of the trees were very stressed and many even died. Also, unexpected high winds over extended periods during the time before harvesting led to low yields. The new harvesting technique proved very efficient, but a lot of the seed was lost during this windy period. Total yield for 2009 was 10lbs. Replanting of dead trees is planned for FY2010.

FY2010

In October, 400 seedlings were started in the shade-house. These seedlings were to be used to replant the dead trees in F-11 in March or April of 2010, but plans changed.

A better method to harvest the seed is still desired. Although harvesting time has been significantly reduced, much of the seed is still being lost. The nature of the position of the maturing seed on the shrub give aalii the potential be harvested with a blueberry/coffee bean harvester. The managers of Coffees of Hawaii agreed to let the PMC borrow their harvester, but the existing trees are too large. Unfortunately, even though the younger branches of aalii take well to pruning, the larger branches do not. The existing trees require major pruning to "fit" the harvester. This could potentially kill the majority of the trees.

Using the 400 seedlings, a new field was established to test coffee bean picker. The new plants will be pruned and trained early on to be able to utilize the coffee harvester. If the harvester works, then the PMC may consider acquiring one. The first harvest may not be ready until summer of 2012 or 2013.

FY2011

In November 2010, transplants were planted into F-7B. At six months after planting the irrigation was cut. In September 2011, the plants were pruned to 4 feet in height. We plan to prune regularly to keep the plant at a manageable size and to also fit through the coffee/blueberry harvester.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	HIPMC-T-0201
Title	*Eragrostis variabilis*: Large-Scale Seed Production
National Project No.	Natural Areas 1.1
Study Type	Advanced Evaluation
Study Status	Active
Location	HIPMC
Study Leader	Glenn Sakamoto
Duration	2001 - 2009
Cooperators	Kahoolawe Island Reserve Commission (KIRC)
Land Use	Cropland
Vegetative Practices	Primary 342 CRITICAL AREA PLANTING
	Secondary 550 RANGE PLANTING
Resource Concern(s)	Resource / Consideration / Problem
	Soil / Soil Erosion / wind
	Soil Erosion / water

Long Range Plan

Study falls under Objective 2.2, Section A of the HIPMC Long Range Plan

Objective

To develop large-scale management techniques for *Eragrostis variabilis*, this will include propagation, establishment, and harvesting. The technical data and plant materials produced will be provided to the KIRC (Kahoolawe Island Reserve Commission) to aid in the restoration of highly erodible sites on the island of Kahoolawe.

Status of Knowledge

Conservation efforts with the use of native plants have been an ongoing challenge for the island of Kahoolawe. Efforts in re-introducing natives to the island have been somewhat successful, but only on a very small magnitude. There is a need to develop a plant material source and technology in the large-scale production of native plant species. *Eragrostis variabilis,* or more commonly known as kawelu or emoloa, has the potential to fill this need. Conservation uses for kawelu include ecosystem restoration, erosion control, and enhancing diversity in riparian and other communities.

Kawelu, a love grass, is endemic to the Hawaiian island chain. It is found on the Pearl and Hermes atolls, Kure, Midway, Lisianski, Laysan, Nihoa, and all of the main Hawaiian Islands. It occurs on sand dunes, grasslands, open sites in dry forest, and exposed slopes and ridges or cliffs at elevations ranging from sea level to 3,500 feet.

E. variabilis is a somewhat variable, tufted perennial grass. Under natural conditions in Hawaii, it usually grows 1-3 feet tall by approximately 2 feet wide. The stems are erect and smooth. There is considerable variation in length of leaves and flowering panicles. The leaf blades are flat at the base and rolled inward at the upper part. Leaves are 0.50-0.60 inch wide and up to 32 inches long. The flowering head or panicles are narrow and range from 8-16 inches long. They are either somewhat open or dense and spike-like, with branches strongly upright to spreading. The oval, dark reddish brown seeds are 0.03-0.06 inch long, with minute groove and there are about 3.136 million per pound. There are about 3.136 million seeds in a pound.

Materials and Methods

Because we are sending the plant materials produced by this trial directly to Kahoolawe, we want to use seed that is from the gene pool of the Maui Nui island group. *E. variabilis*, Acc# 9079729, was collected by Stefanie Aschmann, Soil Conservationist for the U.S. Navy in 1990 on the island of Kahoolawe. It is uncertain if this accession was collected from a naturally occurring stand or from native plant testing sites instituted by the Navy and the Native Hawaiian Plant Society in mid 1980's. An increase plot of this accession will be established in F-2 to provide seed material for a larger increase.

Propagation:

1.) Seedlings for field increase will be propagated in a shade-house that provides 50% light.
2.) Seeds for field increase will be planted in 13 x 26 x 3 inch, 200 cell trays. Commercial sterile potting mix and perlite, 2:1 ratio, will be used as the planting media. Seeds will be sown ¼ inches deep and irrigated once daily. At 2 weeks of growth, a soluble fertilizer (10-20-10) will be applied at a rate of 1 tbs. per gallon, once a week for three weeks. At 5-6 weeks, a slow-release fertilizer (14.5-14.5-14.5) will be applied at a rate of 36 grams per tray.
3.) At 8 weeks, seedlings will be placed in 100% sunlight to harden off before planting into the field.

Establishment:

1.) Fields will be installed between mature windbreak systems.
2.) Irrigation will be provided by an over-head sprinkler system at rate of 1 acre inch per week.
3.) Fertilizer amendments will be made according to soil tests.
4.) Chemical and manual weed control will be performed regularly.
5.) Seedlings 3 months old will be transplanted with a single-row mechanical transplanter in a well prepared, firm, weed free seedbed.
6.) Rows will be space 3 feet apart and plants will be spaced 2 feet apart within rows. This spacing was pre-determined by the wheel-base measurement of the tractor being utilized.

Harvesting:

Various harvesting techniques will be tried to determine which will be ideal for *H. contortus*.

1.) Combine (M-17 Massey Fergusen)
2.) Grass Stripper (Flail-VAC by AgRenewel)
3.) Bailing

Seed Cleaning and Storage:

1.) Various seed cleaning machine will be tested to evaluate which machine can do the best job.
2.) Improved seed will be stored in different methods. Germination tests will be performed on a regular basis to determine the ideal storage conditions and also peak germination rates.

.

DISCUSSION:

Eragrostis variabilis is a perennial grass with a relatively short-lived life span and a weak root system. At the Molokai PMC, *E. variabilis* flowers emerge once a year from the middle of November to January. It can be harvested from late February to March when the seed heads are ~75% mature. After the harvest with the combine, fertilizer is dropped, the irrigation is turned back on and the ratooned crop is ready for the next season. Usually, we can get two harvests from one planting, and after the second harvest yields tend to go down. On average, *E. variabilis* produces about 100 lbs. of seed per acre. The field is then allowed to go fallow for several months. A cover crop of *Crotalaria juncea* can then planted to condition the soil. *E. variabilis* seeds are usually started in February to March. By May to June the seedlings are ready to be transplanted into the field. We have been investigating the direct seeding of *E. variabilis*; unfortunately we have had very little success due to seedlings dampening off and the lack of an herbicide that in able to control grasses in an *E. variabilis* crop. What follows is our yearly account of activities related to *E. variabilis*.

FISCAL YEAR SUMMARY

FY2000

In July, our initial seed increase plot was planted in Field 2 (F-2) by hand. Four double-rows were planted with about 200 plants in each row. In each double-row, the plants were staggered in a 1 foot by 1 foot configuration with 3 foot spacing between double rows. Two months after planting a pre-emergent herbicide was applied at a rate of 1oz. to 1 quart of water to test the tolerance level of *E. variabilis'* to the herbicide. After a month, there were no signs of damage to the plants and there was exceptional weed control. By November 22, the first heads had emerged with an average plant height of 28 inches.

After the harvest of F-2 we will cut the plot to a height of 6-8 inches to see if *E. variabilis* will be able to be ratooned. With the seed harvested from F-2, we plan to plant an increase field in Field 6 (F-6, 0.8 acre). We anticipate the field to be 0.8 acres, about 90ft by 400ft.

FY2001

In February, to insure as much seed as possible from the plot, F-2 was harvested by hand. *E. variabilis* has a very small, but flowable seed. We used a seed scalper to do the seed cleaning. Total cleaned seed was 8.85 lbs. After the seed was harvested we tried to use the rotary mower to cut the grass. This did not work because *E. variabilis* is very fibrous when green. We instead had better success using a standard mower attached to the farm tractor. On February 27, 100 lbs. of 10-30-10 fertilizer was applied to the ratooned crop in F-2. By May, the plot showed promise of re-growing.

March 21, we started 50 trays (200 cells each) of *E. variabilis* in the shade house for our increase in F-6. By June the seedlings were ready to plant. We prepared F-6A by incorporating into the soil 500 lbs. of 10-30-10 fertilizer. Three irrigation lines 420 feet long were installed 50 feet apart. Before we planted the field, the soil was

spike-toothed to achieve a uniform seed bed. On June 14, we planted 29 rows of *E. variabilis* seedlings. Each row contained about 200 plants. Manual weed control was performed on a regular because weeds were a big problem. We plan to work with Dr. Defrank of the University of Hawaii to ascertain any potential chemicals that would be suitable to use on *Eragrostis variabilis*. We will also attempt to harvest F-2 and F-6 with our Massey-Ferguson combine. This will require the desiccation of the field with a contact herbicide before harvest.

Increase fields planned for next year include Field 15A (F-15A, 1.0 acre) and Field 16A (F-16A, 1.0 acre). Both fields will be approximately 1 acre in size and will have the same irrigation and plot layout as F-6A. Both fields have already plowed.

FY2002

By early January F-2 and F-6 were at least 75% mature. Finale was applied to desiccate F-2 on January 17 and to F-6 January 31 at a rate of 6 quarts per acre. F-2 was harvested with the combine on February 1 and F-6 was harvested on February 7, also with the combine. F-2 produced 2.6 lbs. of seed and F-6 produce 225lbs. of seed.

After F-6 was harvested, its vigor appeared to be very low due to the harvesting process. Anticipating that the field would 'die' we decided to remove it. The majority of the vegetative material was removed from the field with a front-end loader and the remaining residue was burned in the field. F-2 on the other hand will be kept to observe it ability to recover from the desiccant.

By April we were ready to increase F-15A and F-16A. The irrigation system was installed. Both fields were then disked and 700 lbs. of 16-16-16 fertilizer was applied and incorporated it into the soil with a tiller. The weeds were flushed and then sprayed with Round-Up. In June, the fields were leveled to a firm seed bed with a rake attachment.

On June 26, we planted 34 rows of *E. variabilis* in F-15A with the mechanical transplanter followed by an application of a preemergent herbicide 1 week after planting. On July 9, we planted 33 rows of *E. variabilis* in F-16A with the mechanical transplanter followed by an application of a preemergent herbicide 1 week after planting. I month after each of the plantings a second application of the preemergent herbicide was applied.
In October, a rust (fungus) was observed in both fields. Samples were sent to the University of Hawaii for analysis. In November a fungicide was applied to both fields at a rate of 1 lb. per 50 gallons of water to reduce the effects of the rust.

Next year we plan to replant F-15A and ratoon F-16A to compare the yields and determine if there may be differences. We also plan to increase Field 15B (F-15B, 1.0 acre) which has already been prepped and the irrigation system installed. Also, Dr. DeFrank will perform a screening trial in Field 12B (F-12B) for preemergent herbicides for native grasses including *E. variabilis*. Fields planned for increase in

2004 include Field 14A (F-14A, 1.0 acre), Field 14B (F-14B, 1.0 acre), and Field 16B (F-16B, 1.0 acre). These fields have already been plowed.

FY2003

In February, F-2 was harvested for the last time. The crop had regrown, but it had a significantly lower yield from the year before. F-2 was sprayed with RoundUp and the vegetative material was allowed to decompose in the field.

Also in February, Dr. DeFrank's chemical trial was installed onto F-12B and by July, he had finished evaluating it. Details of this trial can be viewed at the Hoolehua PMC website. After this trial we decided to replant the crop to increase overall seed production and to also test a different irrigation system using drip tape.
In July, 500 lbs. of 10-20-20 fertilizer was applied and incorporated into the soil of F-12B. A total of seven irrigation lines were installed by burying the drip tapes below the surface of the soil. On July 22, 14 rows of E. variabilis were planted, 2 rows per drip tape, using the mechanical transplanter. An application of preemergent herbicide was applied 2 days after planting.

F-15A and F-16A had matured in February. Both fields were desiccated and allowed to dry down. On February 26 we began harvesting F-15A and the combine got clogged up. We were able to remove the stuck material and continued with the harvesting. F-15A produced 100 lbs. of seed. On March 3 we harvested F-16A and the combine had clogged up again. We speculate that this could have been due to the wrong combine setting. F-16A also produced 100 lbs. of seed.

We knew that E. variabilis could tolerate being ratooned, therefore, we wanted to compare yields from a "second harvest" ratooned crop and a "first harvest" crop planted from seedlings. F-15A will be designated as the crop to be replanted and F-16A will be the crop to be ratooned.

In F-16A, we ran the baler through the field in order to remove the vegetative material to expose the soil. The preemergent herbicide works better if it has direct contact with the soil. On May 30, the preemergent was applied.

In F-15A, we also ran the baler through the field, but set it lower to the ground than F-16A, to remove as much of the vegetative material as possible. The field was then prepped to be replanted. A fertilizer application of 850 lbs. of 16-16-16 wad incorporated into the soil and the irrigation system installed. On July 8, we planted 31 rows with the mechanical transplanter followed by the first application of preemergent. A second application of preemergent herbicide was applied 41 days after planting.

F-15B had been prep for planting the year before. This field is primarily for seed increase. In June, fertilizer was incorporated into the soil. In July, 32 rows were planted with the mechanical transplanter. Two applications were applied, one after planting and another application 1 month after that.

We plan to increase F-14A and Field 14B next year. Both fields have already been plowed and seedlings have been started in the shadehouse. Fertilizer will be incorporated into the soil before planting. We also plan to use a green manure crop of Crotalaria juncea in F-16B. We want to compare yields of this fields and a field using commercial fertilizers. Crotalaria seed will be planted in December at a rate of 60 pounds of pure live seed per acre. We expect F-16B to have the higher yield.

FY2004

By early February all of the emoloa fields were ready to harvest. Finale was applied to each field and within two weeks they had all been desiccated and ready to harvest. The combine was use to harvest the seed. F-12A produced 10 pounds of seed. We suspect the low yield to be related to the drip irrigation system. Next year, we will harvest this field for seed bales as per request by the KIRK. This will be the last emoloa crop for F-12A. F-15B produced 80 pounds of seed. This amount is closer to the average harvest.

We were interested in comparing the harvest yields from a “second harvest” ratooned crop and a “first harvest” crop planted from seedlings. F-15A was the crop that replanted and F-16A was the crop that was ratooned. F-15A produced 60 pounds of seed while F-16A produced 125 pounds of seed. This was a very dramatic difference between the two fields and it was apparent that the second harvest will produce a larger harvest yield.

The KIRC wanted us to bale the emoloa field to compare the bales to piligrass bales. F-15A produced 41 bales, F-15B produced 53 bales, and F-16A produced 139 bales. F-16A produced more bale due to the fact that we wanted to remove as much material from the field as possible since we were going to prep the field to be replanted. F-15A and F-15B will be ratooned crops.

In February F-14A and F-14B were prepped and ready to be planted. The seedlings were started in March in the in the shadehouse and would be ready to transplant in early June. In an attempt to reduce labor time in production we direct-seeded emoloa into F-14A. We used a Nivex direct-seed planter to plant 34 rows using 1.4 pounds of seed. Within a week the seeds began to germinate nicely. Captan (fungicide) was applied to help protect the plants from damping off, which they tend to do in the shadehouse. Also, Dr. Defrank recommended that we apply Buctril, a broadleaf preemergent herbicide, at a rate of 1 quart per acre. Buctril was applied 19 days after planting. Urea was also applied through the overhead irrigation system at a rate of 200 pounds per acre. On March 19, plants were showing signs of damping off and although we had controlled the broadleaf weeds, there were a lot of grassy weeds that were beginning to become a problem. We used a tractor pulled cultivator to try and knock down the grassy weeds. This worked fine between the rows, but there were grassy weeds growing within the emoloa clumps that could only be removed by hand. By March 30, much of the field had damped off and the grassy weeds were a huge problem, so we tilled the field under. I was obvious that we needed to do more research if we wanted to direct-seed the emoloa. We need to find a better fungicide to stop the damping off of new seedlings and we also need

an herbicide that allows us to control grassy weeds in a grass crop. In June we installed 30 rows in F-14A and 23 rows in F-14B. F-14B was smaller because we did not anticipate that our attempt to direct-seed F-14A to fail. These fields will be primarily for seed increase for the Kahoolawe project.

On February 17, we cut down the Crotalaria green manure crop in F-16B and allowed it to decompose. On March 30, we tilled the dried up crotalaria material into the soil. In May, we planted 30 rows in F-16B. We want to compare yields of this field and a field using commercial fertilizers. We planted 32 rows in F-16A for this comparison.

This year we have seven emoloa fields. They will all be for seed increase with the exception of F-12A, which will be harvested for seed bales. Next year, we plan to decrease production to 4 fields. The objective is to have 2 newly planted fields, 2 ratooned fields, and 2 fallow fields in rotation. The fallow fields will be planted with a green manure crop at the end of the year so it can be planted with emoloa the following year. We will also try to transplant the emoloa seedlings in March as compared to May or June. We speculate that a ratooned crop has a more established root system there by producing a larger yield. By planting the seedlings earlier, they have more time to develop a healthy root system.

FY2005

On February 11, all *Eragrostis* fields were sprayed with finale for desiccation. F-12B produced 96 seeded bales. For some reason, F-14A and F-14B did not dry out as much as we anticipated. Instead of reapplying chemical, we decided to harvest the field as is. On March 1, we harvested the fields and apparently, the combine had no problem with the green vegetation in 14A and 14B. F-14A produced 93 pounds of seed, F-14B also produced 93 pounds of seed, F-15A produce 96 pounds of seed, F-15B produced 187 pounds of seed, F-16A produced 90 pounds of seed, and F-16B produced 127 lbs of seed. F-16B had a significantly higher yield as compared to F-16A. These numbers indicate that a green manure crop will increase *Eragrostis variabilis'* seed crop yield more than commercial fertilizers. More research is needed to confirm these results.

For next year's crop F14A, F14B, F16A, and F16B will be ratooned, and the fields will be harvested without using any desiccant. F15A and F15B will be allowed to go fallow until November at which time a green manure crop of 'Tropic Sun' will be planted and then incorporated into the soil. We will replant F-15A and F-15B in 2006.

FY2006

Ratooned Fields were harvested in February 2006. Total Yeild for 4 acres: 715 lbs.
F-14A: 244 lbs, F-14B: 257lbs, F-16A: 14lbs., F-16B: 100lbs
F-14A and B looked very healthy, so it was decided that those fields would be saved for and additional year. On the other hand, F-16A and B did not look as healthy so those fields were set fallow.

Crotalaria juncea was planted in F-15A and B. November 2005, 32,000 kawelu seedlings were started. In April 2006, only 8270 seedling survived and were transplanted into F-15A and B. This is roughly a 25% survival rate. Apparently, a lot of the seedlings were damping-off during the first few weeks after germination. It is speculated that a fungus is causing the problem. Samples were sent to the University of Hawaii Diagnostics lab, but the samples were lost due to the lab flooding. More tests need to be conducted in order to determine for sure what is causing the damping-off of the kawelu seedlings.

FY2007

Harvested fields in February 2007, total yield 4 Acres: 329 lbs.
F-14A: 97.8 lbs, F-14B: 106 lbs., F-15A: 108 lbs., F-15B: 17 lbs
F-14A and B yields have diminished and F-15A and B have increased. This can be attributed to the fact that the roots of kawelu are not very strong and are greatly affected by tractor traffic.

F-15A and B were ratooned and F-14A and B were set fallow. The Congressional Earmark monies have ceased. No new kawelu fields will be planted in FY2008. Since F-15A and B are still healthy, they will be kept until February 2008 for harvest. The seed will be reserved for the KIRC.

FY2008

F-15A and B were harvested and yielded xxx lbs.
Congress reinstated the Earmark monies for Kahoolawe, but it was too late to start new seedlings to plant this fiscal year. F-15A/B and F-16A/B were prepped and crotalaria will be planted there in November 2008 to condition the fields. The seedlings will be planted at the beginning of FY2009 and to be harvested in February 2010.

FY2009

Almost 20,000 kawelu seedlings were started in December 2008. By January 2009 the seedlings were in very bad shape. The planting was a total lost due to the seedlings damping-off. The problem was attributed to either a fungus or too much moisture. Because of this problem a trial was initiated to test various fungicides. The test confirmed that treating the seed with a fungicide dramatically reduced the damping-off of seedlings. Controlling the moisture also help protect against damping-off, as well. Too much water is bad and produces an environment conducive to fungus growth.

In February 2009, 10,200 seedlings were started with seed that was treated with a fungicide. Although damping-off was reduced, only about 40% of seedlings were strong enough to be transplanted. The fungicide did help, but a leaf blotch also attacked the seedlings. Fortunately, there were enough seedlings to plant in F-16B (1 acre). Kawelu seedlings do not do well with too much water. Moisture has to be strictly controlled. It was too late in the year to start more seedlings. In April 2010, more seedlings will be started with seeds treated with a fungicide and the moisture strictly monitored.

FY2010

F-16B was harvested late in February. The field was weeded by had before harvesting. After harvesting a pre-emergent (RONSTAR) was applied. After 30 days a second treatment was applied. This technique for weed control has proven very effective for suppressing weeds for the entire growing season. It may be necessary to hand weed 1 or 2 times right before harvest, but it is usually very minimal. F-16B will be maintained for one more season then laid to fallow.

In April 2010, 12,000 seedlings were started in the shade-house using seed that was treated with a fungicide (APRON). The moisture was strictly monitored to be sure the planting medium was not too wet or too dry. In the past, over-over watering contributed to fungal growth. At 14 DAP, the seedlings were treated with another fungicide (CAPTAN). Miracle Gro fertilizer was applied on a weekly basis until the seedlings were ready to plant at 90DAP. An infestation of webworm started, but it was quickly stopped with a few applications of SEVIN with no detrimental effects to the seedlings. These seedlings were planted in F-15A and F15B in July.

Eragrostis variabilis appears to be somewhat sensitive at the seedling stage. The application of a fungicide is required to increase survivability in critical area plantings. Once seedlings have become established, they are very resilient in harsh environments.

FY2011

On March 18, 2011, F-15A, F-15B and F-16B were harvested with the combine. Everything went as schedule with no problems. The material was laid to dry in the seed build to be cleaned at a later date. After cleaning the total yield for the 3 fields was 131 pounds. This is significantly lower as compared to previous years. Upon inspection of the combine during cleaning, a rat had eaten a hole in the seed hopper. We apparently lost a lot of seed through the hole.

F-16B had been harvested twice and the field was laid fallow. The excess material was removed from the field with the baler. We attempted to remove as much of the material as possible since kawelu takes a very long time to break down.

Urea was applied to F-15A and 15B at a rate of 100lb/Acre of nitrogen. Two applications of Ronstar pre-emergent was made to control weeds. The two fields are scheduled for harvest in FEB-MAR 2012 which will be the last harvest of kawelu until a need is established. The seed will be utilized for further testing of a native seed mixture for critical area plantings.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	HIPMC-T-0202
Title	*Chenopodium oahuense*: Investigating Large-Scale Seed Production
National Project No.	Natural Areas 1.1
Study Type	Advanced Evaluation
Study Status	Active
Location	HIPMC
Study Leader	Glenn Sakamoto
Duration	2001 - 2010
Cooperators	Kahoolawe Island Reserve Commission (KIRC)
Land Use	Cropland
Vegetative Practices	Primary 342 CRITICAL AREA PLANTING Secondary 550 RANGE PLANTING
Resource Concern(s)	Resource: Consideration / Problem Soil: Soil Erosion / wind Soil Erosion / water
Long Range Plan	Study falls under Objective 2.2, Section A of the HIPMC Long Range Plan
Objective	The objective is to develop large-scale management techniques for *Chenopodium oahuense*, which will include propagation, establishment, and harvesting. The technical data and plant materials produced will be provided to the KIRC to aid in the restoration of highly erodible sites on the island of Kahoolawe.
Status of Knowledge	Kahoolawe has been highly degraded by overgrazing, military bombing and feral goats. The annual rainfall on Kahoolawe averages 20-25 inches per year. Vast areas of hard pan are windswept and make it challenging to get any plant to establish itself and many deep gullies only compound the erosion problem. Streambank and slope protection is becoming increasingly important and plants that are easily propagated and established are needed. Rapid establishment of permanent vegetative cover on critical areas such as streambanks, roadsides, and steep hillsides is often difficult because of erosion, infertile soil, and unfavorable hydrology.

Needs

The KIRC desires plant materials that are:

- native to the Maui Nui region
- drought tolerant
- wind tolerant
- fast establishing
- have low maintenance requirements

The PIA needs commercially available quantities of plant varieties and the technology to establish them. Plant species selected should:

- establish rapidly
- have good root structure and strength
- be adapted adverse conditions of low soil fertility, fluctuating soil moisture
- have low maintenance requirements

Conservation efforts with the use of native plants have been an ongoing challenge for the island of Kahoolawe. Efforts in re-introducing natives to the island have been somewhat successful, but only on a very small magnitude. There is a need to develop a plant material source and technology in the large-scale production of native plant species. *Chenopodium oahuense,* or more commonly known as aweoweo, has the potential to fill this need. The potential uses for aweoweo include ecosystem restoration, erosion control, and enhancing diversity in riparian and other communities. A weakly scented shrub, the aweoweo can reach 5-20m in height. Its leaves are 3-lobed and somewhat fleshy. Leaves are also pubescent with the bottom half more pubescent and a lighter green as well. Flowers are small on leafless panicles producing seeds that are dark-brown and about 0.8mm in diameter. *C. oahuense* is endemic to the Hawaiian Islands. It can be found on the northwestern Hawaiian islands of Lisianski, Laysan, French Frigate Shoals, Necker, and Nihoa. It is also found throughout the main Hawaiian Islands, but, according to the Manual of the Flowering Plants of Hawaii (1999), ‘aweoweo has not been observed to be occurring naturally on the island of Kaho’olawe. *C. oahuense* is adapted to dry habitats of coastal and dry forests and can also be found in subalpine shrublands as well, ranging in elevation from 0 – 2,520 meters.

Materials and Methods:

Naturally occurring accession (ACC# 9000000) of aweoweo was collected at the Hoolehua PMC and will be utilized for this evaluation.

PLANTING

1.) Seedlings will be propagated in dibble tubes and transplanted into the field.
2.) Field 12B of the Hoolehua PMC will be prepped and free of weeds before planting.
3.) Seedlings will be planted in single rows with 5 feet spacing between plants and 15 feet spacing between rows. 5 rows will be established.
4.) Plants will be drip irrigated.
5.) Weeds will be controlled with a pre-emergent herbicide and also by hand.

HARVESTING

1.) Time of harvest will be determined when over 50% of the seed is mature.
2.) A Massey Fergusson Combine will be utilized for harvesting.
3.) Settings for the combine will be determined at the time of harvest. Settings from the previous harvest will be the starting point.

SEED CLEANING

1.) Various seed cleaning machines will be tested to evaluate which one can improve the seed best.
2.) Seed will be sent to the University of Hawaii for germination tests. Seeds from a natural stand will be compared to the seeds from the cultivated stand.

Technology Transfer Products

Fact Sheet; Planting Guide

FISCAL YEAR SUMMARY

FY2009

On October 7 and 8, 2009, the Field 12B aweoweo was harvested. It yielded 12 lbs. of bulk seed. This was a relatively low yield. This was the third harvest from the field and there were a lot of plants that had died. The whole field needed to be replanted. At the time, there were rumors that there would not be any more funding from the KIRC Earmark for native seed production, so plans were made to let the field go fallow. By September 2010, the State Office conveyed that funding for native seed production if the Kahoolawe revegetation project would continue for 2010. Unfortunately it was too late in the year to start aweoweo seedlings. Seedlings for the production field will not be started until December 2009.

FY 2010

In December 2009, aweoweo seedlings were started in flat trays. This method was used since the germ-rate of aweoweo seed stock was very low (< 5%). Seed was scattered on sterile planting medium and covered with about ¼" of planting medium. When the seedlings were large enough they were transplanted into dibble tubes. Osmocote was applied and Miracle Gro was also applied once a week.

In June 2010, the seedlings were transplanted into F-12B. Irrigation was applied for 2 months with drip tape. The irrigation was then stopped. Once established, aweoweo is very drought tolerant. A pre-emergent (RONSTAR) was applied to the field in 2 applications, 1 month apart. Very little hand weeding was required after that. The field should be ready to harvest by summer 2011.

FY2011

RONSTAR G had proven to be very useful in suppressing weeds in the aweoweo crop. Very little maintenance was required once the chemical was applied. The low weed competition could also be due to minimal watering that was done. Aside from the initial two months of weekly watering, the field grew virtually on natural rainfall alone. The plants did reasonably well. On July 6, 2011, the field was harvested with the combine There was minimal damage inflicted to the cut-shrubs by the combine and the rows were irrigated soon after the harvest in anticipation for an additional crop in 2012. Two applications of Ronstar G were also done for weed control.

The harvested seed was allowed to dry down for a few weeks. On July, 25, 2011, the seed was run through a Clipper seed cleaning machine. Aweoweo seed is reasonably flowable and can be cleaned easily with the Clipper. The four rows yielded 40lbs of bulk seed. This worked out to be about 10 lbs per 400ft row.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	HIPMC-T-0602	
Title	*Polyscias guilfoylei*(1): Growth-Rate Effects from Nitrogen Treatments	
National Project No.	Cropland 1.1	
Study Type	Advanced Evaluations	
Study Status	Active	
Location	HIPMC	
Study Leader	David Duvauchelle	
Duration	March 2006 through March 2011	
Cooperators	Alton Arakaki, University of Hawaii, Cooperative Extension	
Land Use	Cropland	
Vegetative Practices	Primary	650 - WINDBREAK ESTABLISHMENT
	Secondary	380 - WINDBREAK RENOVATION
		422 - HEDGEROW PLANTING
		311 - ALLEY CROPPING
Resource Concern(s)	Resource	Consideration / Problem
	Soil	Soil Erosion / wind
		Soil Erosion / water
	Air	Air Quality / air pollutants

Long Range Plan Study falls under Part 3 of the HIPMC LRP

Objective The objective is to produce a growth rate in panax that is comparable to that of *Erythrina variegata* or 'Tropic Coral'. Various nitrogen treatments will be applied to two accessions of *Polyscias guilfoylei* in an attempt to stimulate a faster growth rate and also to determine if there are growth rate differences between the two.

Status of Knowledge Many areas of cropland are subject to frequent strong winds. Velocities of 10 to 25 miles per hour or more may be expected much of the time. Permanent and semi-permanent windbreaks are needed on much of this land. Fire may destroy certain tree species that do not have the capacity of renewal. There is a need for rapid-growing annual or perennial plants for windbreaks. These plants could be used as primary windbreaks and for crops requiring additional windbreaks in fields already planted to

windbreak trees. They should have the capability of renewal after fire. They should produce a minimum of root competition, be relatively pest-free, esthetically pleasing, and have a low maintenance requirement. Additionally, there is a need for windbreaks for farmsteads and feedlots to serve as screens on highway medians and other areas. *Polyscias guilfoylei* may be a suitable choice for a windbreak. It is a slender tree that can attain heights in excess 20 feet. As good of a windbreak as panax is, 'Tropic Coral' has been the choice of many of the local farmers because of its taller growth and faster growth rate. Recently, the Erythrina Gall Wasp (EGW) has devastated Hawaii's 'Tropic Coral' windbreak systems. *Polyscias guilfoylei* could be a potential substitute for Hawaii's local farmers.

Polyscias guilfoylei is a columnar shrub with erect branches up to 24ft tall; leaves mostly 5.9-19.7" long, 1-pinnate, leaflets opposite, blades variable, but commonly broadly ovate or elliptic and coarsely dentate or lacerate, commonly variegated with white or pale yellow margins, or sometimes all dark green; leaflets mostly 1.9-3.9" long; inflorescence a compound panicle. The origin of panax is unknown, but it is widely cultivated in the paleotropics and in some parts of the neotropics.

Experimental Design Randomized Complete Block Design, RCB

BLOCK P

Treatment 1 Title: Acc# 9079789 (P1)
Description: no nitrogen (control)

Treatment 2 Title: Acc# 9079789 (P2)
Description: 25 lbs. of nitrogen per acre

Treatment 3 Title: Acc# 9079789 (P3)
Description: 50 lbs. of nitrogen per acre

Treatment 4 Title: Acc# 9079789 (P4)
Description: 100 lbs. of nitrogen per acre

BLOCK B

Treatment 1 Title: Acc# 9079807 (B1)
Description: no nitrogen (control)

Treatment 2 Title: Acc# 9079807 (B2)
Description: 25 lbs. of nitrogen per acre

Treatment 3 Title: Acc# 9079807 (B3)
Description: 50 lbs. of nitrogen per acre

Treatment 4 Title: Acc# 9079807 (B4)
Description: 100 lbs. of nitrogen per acre

Materials / Methods

Both accessions were collected on the island of Molokai. The non-variegated sample (acc# 9079789) a variety from the Hoolehua PMC. It had been collected from a residence from the Kalae area. The variegated sample (acc# 9079807) is a variety that was collected from the Bauman's residence in the Kamililoa area. Each accession was planted in separate rows / blocks to simulate a windbreak in actual windy situations. The accessions were kept separate because this trial was planted to also serve as increase plots for further study. Although the accessions were kept separate, each replicated treatment within both accession blocks were arranged in random order. This trial was replicated (4) times.

1.) Before the cuttings are planted, a base fertilizer (10-20-20) application of 50 pounds of nitrogen per acre will be incorporated into the soil of both rows.
2.) The planting will be irrigated with t-tape once a week at 8 hour intervals.
3.) The cuttings will be cut to (18) inches in length and planted (6) inches deep with 2 foot spacing between each cutting.
4.) Each treatment will consist of (9) 'trial' cuttings separated by (3) 'buffer' cuttings.
5.) Ammonium Sulfate (21-0-0) was selected to be the source of nitrogen. The fertilizer treatments will be split into (4) applications and applied at (3) month intervals. The first treatment application will be applied at 3 months after planting to insure there will be enough root development for nutrient uptake.
6.) Evaluation of the trial will be done at 180, 270, 360, 720, 1080, 1440, 1600 DAP.

FISCAL YEAR SUMMARY

FY2006

Observation: 190 DAP

The panax cuttings started to show signs of growth at around 3-4 weeks after planting. Compared to 'Tropic Coral this is relatively slow. There was a noticeable boost in vigor for all plants after the first fertilizer treatment.

During the week of July 17, the plants of the variegated accession had lost its new growth leaves and shoots. Chickens and other birds, and locus were observed in the vicinity and could be the cause of the leaf damage. Although some organism may have eaten the new leaves, something else has hindered the plants ability to recover. The cause could be from an herbicide application to control weeds. Because the damage was only to the variegated accession, the data collected will not be totally accurate. We will continue to apply the fertilizer treatments with hopes that the plants will recover.

The non-variegated accession progressed fine with no or very little damage. A number of leaves had shown some sort of 'spotting' effect. The cause is unknown, but was monitored closely for any detrimental effects. There wass some leaf damage due to leaf eating insects, but had affected plant vigor. The measurements indicated no significant difference between the fertilizer treatments of the non-variegated accession.

The objective of this trial was to evaluate the effects that various nitrogen supplements will have on two accessions of panax. Unfortunately, we discovered a design flaw in the trial. With the two accessions being planted completely separate from each other, we cannot be certain that the effects that occurred were due to accession or location differences. The trial had set up as two 'separate' Randomized Complete Blocks. We should have designed it as a Split Plot Design with Randomized Complete Blocks. This would have been a more reliable way to determine differences between accessions. Since we can still gain valuable information from this trial, the evaluations will continue with the understanding that the data that is collected will need to be confirmed with different trial design.

FY2007

Observations: 274 DAP

The variegated accession had suffered severely from chemical drift, although it is uncertain what chemical had affected the plants. Initially the planting was not affected all at once. The east end of the line had been affected first and, gradually over a 2 week period, the entire line was affected. The cause is still unknown, but the plants were slowly recovering in the same manner in which they were affected. Many of the plants were recovering normally and sending out new shoots from the top of the plant. On the other hand, there were also many plants that seemed to be stunted and formed galls where there should have been new shoots. If new shoots had emerged they were generally from beneath the soil.

The non-variegated accession continued to progress with little damage to any plants. The leaf 'spotting' was more apparent among more plants, but still had no affect on plant vigor. Some sort of organism continues to eat the new leaves of both accessions, though the affect of the damage is having little effect on plant vigor. Another locus was found and we suspect that this could be the leaf-eating culprit. Ants are beginning to farm aphids on some plants, but currently they are not causing any problems. Some lady bugs are present and we hope the two insects will balance out. The second measurements have shown that there is no significant difference between the different fertilizer treatments.

Observations: 379 DAP

According to the data collected, there still appears to be no significant differences between the different fertilizer treatments. Apparently, a secondary factor is affecting the growth rate of the trial. Plants at both ends of the rows are shorter and gradually become taller toward the center. We are speculating that this could be due to the fact that a 'Tropic Coral' windbreak was planted in the same spot before the trial may have left some residual amounts of nitrogen. It has been 1 year since the panax cuttings were planted in the ground and they have already reached an average height of 84 cm or 7ft with some trees reaching above 8ft. This is quite close 'Tropic Coral's' 1 year growth of 10ft. Although we are not seeing any significant difference between the fertilizer treatments, the facts remains that the addition of nitrogen has increased the growth-rate of panax.

Observations: 449DAP

Despite the growth-rate increase that we are pleased to see, there are some negative results. More trees have continued to break off due to high winds. These trees appear to have fallen at random and not related to the treatments, but the majority of them are the taller trees toward the center of the row. After 15 months since the panax cuttings were planted in the ground and they had reached an average height of 247cm or about 8ft with some trees reaching above 9ft. This is very close 'Tropic Coral's' 1 year growth of 10ft.

The data collected support the fact that there are no significant differences between the different fertilizer treatments of this particular trial. A secondary factor that is affecting the growth rate of the trees seems to be the only plausible explanation. It has been observed that plants at both ends of the rows are shorter and gradually become taller toward the center. This could be due to some residual amounts of nitrogen left by the 'Tropic Coral' windbreak that had been growing in the same spot before the trial. Another explanation is that a base fertilizer application was applied to the entire trial; therefore, we are not seeing the low end of the growth-rate spectrum. Although we are not seeing any significant differences between the fertilizer treatments, the facts remains that the addition of nitrogen has increased the growth-rate of panax significantly.

FY2008

Observations: 776 DAP

One year after the last evaluation, measurements were randomly taken from the two different accession lines. It was agreed that only random measurements be taken since during the application of fertilizer treatments the data had indicated that there were no significant differences between the various treatments. Visual observations of the trial only confirm that the trees are very uniform in height with differences that are hardly noticeable by the naked eye. Both accessions are now over 2 years old and appear to be in good health with good vigor.

There are some important differences between the two accessions at 2 years of age that should be noted. According to the data, the non-variegated accession is, on average, 1.37 feet taller than the variegated accession. From the very start of this trial, the non-variegated accession had remained the taller of the two. Also, there have been a number of trees that have fallen due to the occasional high winds. Overall, the non-variegated accession had lost more trees to high winds. It should be mentioned that the variegated accession is in a position that would probably provide more wind protection. The new panax trial is designed to eliminate this situation. Additionally, the "main" stem widths were measured and averaged, though it was not a factor that was previously evaluated. After 2 years of growth, on average, the 'main" stem width of the non-variegated accession was 1– 1 ½ inches wide and the variegated accession was ½-1 inch wide. The number of "main" stems produced also differed with the variegated accession producing more.

Despite the growth-rate increase that we are pleased to see, there are some negative results. Recently, the trail had been exposed to exceptionally high winds and individual plants had broken off at the lower potions of the trees. These trees appear to have fallen at random and not related to the treatments, but the majority of them are the taller trees toward the center of the row. This could be related to the increased growth-rate, but we cannot be certain.

We will continue to monitor this trial to determine the age at which panax is able to reach its maximum height of 20-25ft. We plan conduct another new trial to confirm our findings here and to eliminate some factors that might have contributed to growth differences.

FY2010

As panax continues to grow, it slowing loses its lower leaves. This is apparent in both accessions in this trial and it is not noticeable if one is losing more leaves than the other. Vegetative material has been taken from sections of both accessions and it is in these areas where the effects of pruning have had on panax can be seen. If the tops are pruned back this stimulates more growth from the lower portion of the trees. Regular pruning may be a requirement if a full windbreak is desired. More tests are needed to see how soon or how often this needs to happen.

We will continue to monitor this trial to determine the age at which panax is able to reach its maximum height of 20-25ft. We plan conduct another new trial to confirm

our findings here and to eliminate some factors that might have contributed to growth differences.

FY2011

The majority of the trees have lost the bottom third of their leaves. We are uncertain if this is characteristic of the species or attributed to chemical drift. To “rejuvenate” leaf growth, a designated section was cut to a height of about 4ft. After about 9 months, there was a tremendous amount of regrowth. Looking at how the trees responded to being cut but, it may be possible to cut the trees back even further, to a height of about 2ft. During fiscal year 2012, we will test our theory and cut back another section to see how the trees respond.

There have also been some trees with lodging branches. Overall it has been fairly minimal, but the fact that there is instances of lodging. The lodging branches were trimmed back.

On April 12, 2011, we took 10 random height measurements from the variegated section and 10 from the non-variegated section. At 1815 DAP or about 5 years old, the variegated trees are an average height of 18 feet tall, and the non-variegated trees are about 19 feet tall. That is still shorter than the expected. We will continue to take annual measurements until we can confirm a height plateau has been reached.

Polyscias guifoylei (Panax) - Growth Effects of Nitrogen Treatments

DATA SUMMARY

DATE: 12-Sep-06 DAP: 190

Non-Variegated -- Accession #9079789				
REP	TREATMENT	HT-AVG	WD-AVG	VI-AVG
I	NonVAR1	80.56	61.11	3.33
II	NonVAR1	100.00	80.56	1.56
III	NonVAR1	87.86	70.00	2.14
IV	NonVAR1	66.00	56.67	3.83
I	NonVAR2	75.63	64.38	3.38
II	NonVAR2	85.56	70.00	2.33
III	NonVAR2	81.25	69.38	2.50
IV	NonVAR2	83.13	65.63	2.50
I	NonVAR3	77.78	63.33	3.00
II	NonVAR3	83.13	71.25	2.13
III	NonVAR3	93.13	76.88	2.50
IV	NonVAR3	68.33	47.50	3.83
I	NonVAR4	81.43	68.57	2.71
II	NonVAR4	91.67	69.17	2.17
III	NonVAR4	83.13	65.63	2.38
IV	NonVAR4	60.00	51.25	4.75

Variegated -- Accession #9079807				
REP	TREATMENT	HT-AVG	WD-AVG	VI-AVG
I	VAR1	47.78	37.22	7.00
II	VAR1	40.56	23.33	7.00
III	VAR1	59.44	33.89	6.22
IV	VAR1	67.22	45.56	5.33
I	VAR2	37.78	29.44	7.00
II	VAR2	40.56	30.00	7.00
III	VAR2	62.22	36.11	6.00
IV	VAR2	64.38	38.13	4.25
I	VAR3	44.44	35.00	7.00
II	VAR3	46.67	31.67	7.00
III	VAR3	50.00	34.44	6.67
IV	VAR3	68.33	47.22	3.44
I	VAR4	43.33	35.56	7.00
II	VAR4	47.22	28.13	7.00
III	VAR4	62.78	36.11	6.33
IV	VAR4	59.44	36.11	4.89

Treatments	HT - height (cm)
1 - no nitrogen	WD - width (cm)
2 - 100lb/A	VI - vigor (scale)
3 - 200lb/A	1 - excellent
4 - 400lb/A	5 - average
	9 - poor

Polyscias guifoylei (Panax) - Growth Effects of Nitrogen Treatments

DATA SUMMARY

DATE: 6-Dec-06 DAP: 274

Non-Variegated -- Accession #9079789				
REP	TREATMENT	HT-AVG	WD-AVG	VI-AVG
I	NonVAR1	135.56	106.67	3.11
II	NonVAR1	168.89	144.44	2.00
III	NonVAR1	152.14	130.00	2.00
IV	NonVAR1	110.83	90.00	3.17
I	NonVAR2	133.13	111.88	2.88
II	NonVAR2	150.00	131.11	2.22
III	NonVAR2	141.88	122.50	2.13
IV	NonVAR2	143.13	120.63	2.00
I	NonVAR3	137.22	110.56	2.22
II	NonVAR3	145.00	128.13	2.00
III	NonVAR3	160.00	141.88	2.00
IV	NonVAR3	120.00	96.67	2.67
I	NonVAR4	140.71	119.29	2.71
II	NonVAR4	158.33	140.00	2.17
III	NonVAR4	148.13	123.13	2.00
IV	NonVAR4	103.75	81.25	3.25

Variegated -- Accession #9079807				
REP	TREATMENT	HT-AVG	WD-AVG	VI-AVG
I	VAR1	55.00	21.67	5.67
II	VAR1	51.67	24.44	6.22
III	VAR1	84.44	43.33	3.89
IV	VAR1	98.89	51.11	3.89
I	VAR2	35.00	26.11	6.11
II	VAR2	43.33	20.56	6.56
III	VAR2	93.89	61.11	2.56
IV	VAR2	98.13	50.00	3.75
I	VAR3	50.56	26.67	6.00
II	VAR3	56.67	31.11	5.89
III	VAR3	67.22	42.78	4.00
IV	VAR3	114.44	90.00	2.00
I	VAR4	43.33	32.78	6.22
II	VAR4	53.33	27.78	6.00
III	VAR4	81.67	46.11	3.44
IV	VAR4	86.67	44.44	4.67

Treatments	HT - height (cm)
1 - no nitrogen	WD - width (cm)
2 - 100lb/A	VI - vigor (scale)
3 - 200lb/A	1 - excellent
4 - 400lb/A	5 - average
	9 - poor

Polyscias guifoylei (Panax) - Growth Effects of Nitrogen Treatments

DATA SUMMARY

DATE: 12-Mar-07 DAP: 379

Non-Variegated -- Accession #9079789				
REP	TREATMENT	HT-AVG	WD-AVG	VI-AVG
I	NonVAR1	201.67	114.44	3.67
II	NonVAR1	243.89	150.00	2.11
III	NonVAR1	220.71	127.14	3.29
IV	NonVAR1	187.50	100.00	3.50
I	NonVAR2	200.00	125.63	3.13
II	NonVAR2	226.11	138.33	2.33
III	NonVAR2	216.25	125.63	2.38
IV	NonVAR2	221.25	127.50	2.38
I	NonVAR3	215.56	125.56	2.22
II	NonVAR3	226.25	126.88	2.25
III	NonVAR3	225.00	133.13	2.63
IV	NonVAR3	193.33	96.67	3.67
I	NonVAR4	215.00	117.86	3.86
II	NonVAR4	230.00	134.17	2.50
III	NonVAR4	221.25	131.88	2.75
IV	NonVAR4	173.75	88.75	3.75

Variegated -- Accession #9079807				
REP	TREATMENT	HT-AVG	WD-AVG	VI-AVG
I	VAR1	82.22	51.67	5.67
II	VAR1	81.11	47.22	6.22
III	VAR1	134.44	80.00	3.89
IV	VAR1	157.78	103.89	3.89
I	VAR2	43.89	37.78	6.11
II	VAR2	52.22	32.78	6.56
III	VAR2	158.33	108.33	2.56
IV	VAR2	150.00	107.86	3.75
I	VAR3	72.78	52.78	6.00
II	VAR3	84.22	57.22	5.89
III	VAR3	117.22	79.44	4.00
IV	VAR3	180.56	127.78	2.00
I	VAR4	66.11	47.22	6.22
II	VAR4	88.89	55.00	6.00
III	VAR4	135.00	96.11	3.44
IV	VAR4	141.11	91.67	4.67

Treatments	HT - height (cm)
1 - no nitrogen	WD - width (cm)
2 - 100lb/A	VI - vigor (scale)
3 - 200lb/A	1 - excellent
4 - 400lb/A	5 - average
	9 - poor

Polyscias guifoylei (Panax) - Growth Effects of Nitrogen Treatments

DATA SUMMARY

DATE: 29-May-07 DAP: 449

Non-Variegated -- Accession #9079789				
REP	TREATMENT	HT-AVG	WD-AVG	VI-AVG
I	NonVAR1	247.00	125.00	3.25
II	NonVAR1	274.38	170.00	2.00
III	NonVAR1	256.67	148.33	2.33
IV	NonVAR1	220.83	114.17	3.50
I	NonVAR2	227.50	146.67	3.00
II	NonVAR2	255.00	152.00	2.20
III	NonVAR2	249.29	153.57	2.29
IV	NonVAR2	255.00	138.13	2.38
I	NonVAR3	245.00	135.00	2.33
II	NonVAR3	260.63	145.00	2.25
III	NonVAR3	255.00	190.00	2.00
IV	NonVAR3	225.00	120.00	3.67
I	NonVAR4	244.17	135.00	3.50
II	NonVAR4	271.25	151.25	2.25
III	NonVAR4	256.43	145.00	2.43
IV	NonVAR4	213.75	105.00	3.75

Variegated -- Accession #9079807				
REP	TREATMENT	HT-AVG	WD-AVG	VI-AVG
I	VAR1	124.38	75.00	5.63
II	VAR1	115.00	68.33	6.22
III	VAR1	191.67	112.78	3.89
IV	VAR1	208.13	133.13	3.89
I	VAR2	76.11	61.67	6.11
II	VAR2	82.22	56.67	6.56
III	VAR2	203.33	137.78	2.56
IV	VAR2	190.63	129.38	3.75
I	VAR3	98.89	72.78	6.00
II	VAR3	115.00	78.89	5.89
III	VAR3	160.00	103.33	4.00
IV	VAR3	227.78	146.67	2.00
I	VAR4	93.33	65.00	6.22
II	VAR4	120.56	75.56	6.00
III	VAR4	173.89	125.00	3.44
IV	VAR4	170.56	115.56	4.67

Treatments	HT - height (cm)
1 - no nitrogen	WD - width (cm)
2 - 100lb/A	VI - vigor (scale)
3 - 200lb/A	1 - excellent
4 - 400lb/A	5 - average
	9 - poor

Polyscias guifoylei (Panax) - Tested Release

EVALUATION Sheet

DATE: April 21, 2008

DAP: 776

	Variegated -HEIGHT		Non-Variegated - HEIGHT	
	CENTIMETERS	FEET	CENTIMETERS	FEET
1	228	7.48	306	10.04
2	219	7.19	288	9.45
3	165	5.41	329	10.79
4	247	8.10	298	9.78
5	275	9.02	241	7.91
6	232	7.61	341	11.19
7	270	8.86	353	11.58
8	265	8.69	365	11.98
9	341	11.19	272	8.92
10	342	11.22	348	11.42
11	328	10.76	349	11.45
12	332	10.89	316	10.37
13	362	11.88	343	11.25
AVERAGE	**277.38**	**9.10**	**AVERAGE**	**319.15**	**10.47**

Polyscias guifoylei (Panax) - Tested Release

EVALUATION Sheet

DATE: April 2, 2010

DAP: 1440

	Variegated -HEIGHT		Non-Variegated - HEIGHT	
	CENTIMETERS	FEET	CENTIMETERS	FEET
1	438	14.37	577	18.93
2	476	15.62	532	17.45
3	494	16.21	556	18.24
4	467	15.32	517	16.96
5	490	16.08	592	19.42
6	507	16.63	582	19.09
7	531	17.42	576	18.90
8	543	17.81	538	17.65
9	561	18.41	531	17.42
10	559	18.34	522	17.13
11				
12				
13				
AVERAGE	**506.60**	**16.62**	**AVERAGE**	**552.30**	**18.12**

Polyscias guifoylei (Panax) - Tested Release

EVALUATION Sheet

DATE: April 12, 2011

DAP: 1815

	Variegated -HEIGHT		Non-Variegated - HEIGHT	
	CENTIMETERS	FEET	CENTIMETERS	FEET
1	566	18.57	547	17.95
2	649	21.29	529	17.36
3	640	21.00	602	19.75
4	512	16.80	602	19.75
5	566	18.57	570	18.70
6	526	17.26	624	20.47
7	496	16.27	634	20.80
8	509	16.70	628	20.60
9	450	14.76	540	17.72
10	553	18.14	584	19.16
AVERAGE	**546.70**	**17.94**	**AVERAGE**	**586.00**	**19.23**

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	HIPMC-T-0802		
Title	*Syzigium myrtifolia*: Windbreak Plant Spacing		
National Project No.	Cropland 2.1		
Study Type	Initial Evaluations		
Study Status	Active		
Location	HIPMC		
Study Leader	David Duvauchelle		
Duration	2008 through 2010		
Cooperators	-Hawaii Soil Water Conservation District		
Land Use	Cropland		
Vegetative Practices	Primary	650	WINDBREAK/SHELTERBELT ESTABLISHMENT
	Secondary	380	WINDBREAK/SHELTERBELT RENOVATION
Resource Concern(s)	Resource	Consideration / Problem	
	Soil	Soil Erosion / wind	
		Soil Erosion / water	
	Air	Air Quality / air pollutants	
Long Range Plan	Study falls under NRCS Objective 2.1 Part C of the HIPMC Long Range Plan.		

Objective: The objective of this study is to evaluate the growth characteristics of Eugenia, it particular height and width, to determine plant spacing for in-field windbreak systems.

Status of Knowledge: Many areas of cropland are subject to frequent strong winds. Velocities of 10 to 25 miles per hour or more may be expected much of the time. Permanent and semi-permanent windbreaks are needed on much of this land. Fire may destroy certain tree species that do not have the capacity of renewal. There is a need for rapid-growing annual or perennial plants for windbreaks. These plants could be used as primary windbreaks and for crops requiring additional windbreaks in fields already planted to windbreak trees. They should have the capability of renewal after fire. They should produce a minimum of root competition, be relatively pest-free, esthetically pleasing, and have a low maintenance requirement. Additionally, there is a need for windbreaks for farmsteads and

feedlots to serve as screens on highway medians and other areas. Eugenia has the potential to fill this need.

Eugenia is a slender tree that will grow to an average height of about 20-25 feet. There are cases where older trees have reached 35-40 feet tall. It will tolerate cool temperatures between 45-65 degrees, but it prefers the hot tropical climates with high humidity. It is most happy in full sun, but it will tolerate partial shade. It has relatively small dark shiny leaves. It has a white flower and produces a bright red fruit that is edible. It is not salt tolerant and requires frequent watering. Its primary use is ornamental for bonsai enthusiasts.

Materials and Methods:

The accession that will be utilized for this trial was obtained from the Hilo Field Office on the Big Island of Hawaii. Bare-root seedlings were potted and allowed to recover in the shade house. Before planting into the field the seedlings will be allowed to adjust to 100% sunlight for at least 1 month.

1. A single row of 21 plants will be established for this particular trial. Plant spacing will be 20 ft to allow each plant to grow without any restrictions from nearby plants.
2. Irrigation will be once a week at 24 hour intervals using 2 gal/hr emitters. The only nutrients that were provided were 2 fertilizer tabs for each seedling during the initial planting.
3. Height and width measurements will be evaluated at 12 months after planting and 24 months after planting, as well as overall plant vigor and presence of disease or pests.

Technology Transfer Products

Fact Sheet; Planting Guide

FISCAL YEAR SUMMARY

FY2008

Seedlings were planted into the field on March 3, 2008. First evaluation will be conducted in March 2009.

FY2009

DATE: **July 3, 2009**									DAP: 483														
PLANT #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	AVE	AVE (ft)
HT (cm)	312	321	303	230	280	334	214	280	305	295	331	260	270	290	341	323	336	311	325	300	90	**288.14**	**9.45**
WD (cm)	195	175	190	130	200	175	165	170	205	195	185	150	190	165	175	175	205	205	195	160	70	**175.00**	**5.74**

During the first 6 months the seedlings had been very susceptible to rose beetles. This was easily controlled with Sevin at a rate of 1 tbsp per gallon.
At 16 months after planting, the trees looked healthy and disease-free.

At 483 days after planting, the Eugenia trees had grown to an average of about 9.45 feet tall and 5.74 wide. These are very nice looking trees that would make a good in-field windbreak.

FY2010

DATE: **April 2, 2010**									DAP: 750														
PLANT #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	AVE	AVE (ft)
HT (cm)	387	400	367	282	352	389	389	363	396	385	399	352	359	348	411	419	430	402	418	400		**382.40**	**12.55**
WD (cm)	220	225	235	199	265	230	230	225	250	260	225	215	255	225	240	225	260	230	230	190		**231.70**	**7.60**

The second year of growth seemed to slow down a bit. Weed problem has been minimal due to mulch cover. The trees looked very healthy with the exception of the last tree in the row which did not recover from the rose beetle attacks. Since the trees have gotten larger, the emitters were replaced with stroblers to increase the watering. Monitoring will continue until the average maximum width of mature trees can be determined.

FY2011

DATE: **April 12, 2011**									DAP: 1125														
PLANT #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	AVE (cm)	AVE (ft)
HT (cm)	466	506	434	320	356	464	473	426	451	451	438	387	400	384	462	525	466	460	520	408		**439.85**	**14.43**
WD (cm)	317	294	307	255	328	292	300	290	316	296	315	230	299	282	291	303	335	281	251	229		**290.55**	**9.53**

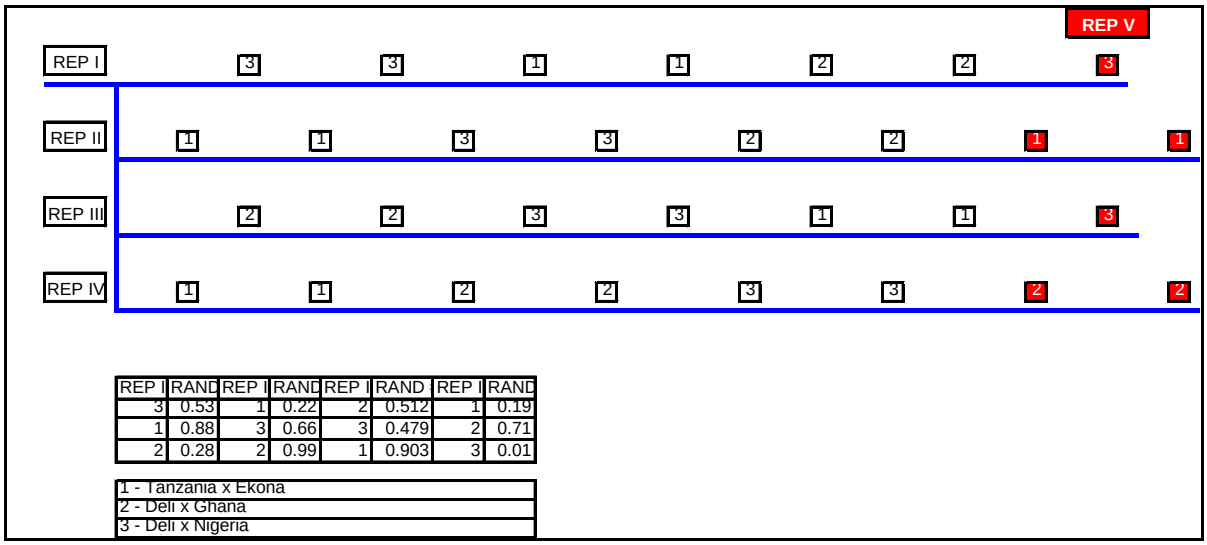
At 3 years old the trees have reached an average height of about 14 feet with the tallest tree measuring over 17 feet tall. There were some flowers but they did not produce any seed. This is a very attractive tree and may have a lot of potential as

an infield windbreak. The growth form is relatively uniform and it is not very wide either. Up until now there have been no problems aside from the rose beetles that were damaging the young trees. As the trees matured, they were able to withstand any damage inflicted by rose beetles. We are hoping that the tree begins to bear fruit. We know that the tree will produce viable fruit because the collected material that we received for this trial was seedlings from under a tree. It is just a matter of determining how old the tree needs to be before it produces seed.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	HIPMC-T-0804
Title	*Elaeis guineensis*: Adaptability to Pacific Island Area Climate
National Project No.	Cropland 2.1
Study Type	Initial Evaluations
Study Status	Active
Location	HIPMC
Study Leader	David Duvauchelle
Duration	March 2008 through 2010
Cooperators	-Hawaii Soil Water Conservation District
Land Use	Cropland
Vegetative Practices	Primary Secondary
Resource Concern(s)	Resource Consideration / Problem
Long Range Plan	Study falls under NRCS Objective 2.1 Section E of the HIPMC Long Range Plan.
Objective:	The objective of this study is to evaluate the growth characteristics of 3 accessions of oil palm, in particular height, width and yield, to determine the specie's adaptability to the Pacific Island Area Climate.
Status of Knowledge:	According to some data a farmer may be able to produce enough biodiesel using oil palm dates to run his personal machinery to operate his farm.
Materials and Methods	The accessions that will be evaluated were obtained by Jeff Knutson of the Hoolehua Field Office. 1.) Tanzania x Ekona – ACC#xxxxxxx 2.) Deli x Ghana – ACC#xxxxxxx 3.) Deli x Nigeria – ACC#xxxxxxx A. Planting scheme will be a staggered formation with 10m X 10m spacing. B. Moisture will be controlled using 2 gal/hr emitters and irrigated once a week at 24 hour intervals. C. Evaluations will be conducted once a year over a [10] year period

Oil Palm Observation Trial - Plot Plan



REP I	RAND	REP I	RAND	REP I	RAND	REP I	RAND
3	0.53	1	0.22	2	0.512	1	0.19
1	0.88	3	0.66	3	0.479	2	0.71
2	0.28	2	0.99	1	0.903	3	0.01

1 - Tanzania x Ekona
2 - Deli x Ghana
3 - Deli x Nigeria

FISCAL YEAR SUMMARY

FY2008

A total of 30 palms were planted on April 1, 2008. First evaluation will be on April 1, 2009.

FY2009

At 458 days after planting the palms were average heights of about 10 feet. There were no diseases and all the trees appeared to be very healthy. There were no signs of fruits or flowers.

2010

The palms did show some sign of producing fruit. Apparently, the trees are still too young because the young fruit just fell off and did not mature. Also, some of the palms had leaves that were turning yellow. The low rainfall at the Hoolehua PMC may be contributing to the yellowing of the leaves as well as the immature fruits falling off. Emitters were replaced with stroblers to increase the irrigation and fertilizer was applied at a rate of about 100 of nitrogen per acre.

FY2011

The oil palms have been in the ground for 3 years and they were about a year old when they were planted. All the strains are similar in size at about 12 feet tall and 17 feet wide. Although there were some trees that did produced fruit this year, the size of fruit bunches were relatively small. We assume that the trees are still too young to produce a harvestable crop. The increased irrigation had made a dramatic difference in the overall vigor of the trees. We may decide to implement a fertilizer program to help stimulate larger crop yields.

DATE: 3-Jul-2009 DAP: 458

		Tanzania x Ekona		Deli x Ghana		Deli x Nigeria	
		HT (cm)	WD (cm)	HT (cm)	WD (cm)	HT (cm)	WD (cm)
REP I	PLANT 1	353	355	317	309	371	349
	PLANT 2	297	332	253	316	275	296
	AVERAGE	325.0	343.5	285.0	312.5	323.0	322.5
REP II	PLANT 1	306	316	298	361	316	335
	PLANT 2	343	325	324	339	362	377
	AVERAGE	324.5	320.5	311.0	350.0	339.0	356.0
REP III	PLANT 1	250	264	304	315	232	294
	PLANT 2	319	334	290	343	344	307
	AVERAGE	284.5	299.0	297.0	329.0	288.0	300.5
REP IV	PLANT 1	241	251	290	343	327	364
	PLANT 2	313	309	257	271	291	331
	AVERAGE	277.0	280.0	273.5	307.0	309.0	347.5
REP IV	PLANT 1	311	374	330	345	272	319
	PLANT 2	343	322	338	326	338	374
	AVERAGE	327.0	348.0	334.0	335.5	305.0	346.5
AVERAGE (cm)		**307.60**	**318.20**	**300.10**	**326.80**	**312.80**	**334.60**
AVERAGE (ft)		**10.09**	**10.44**	**9.85**	**10.72**	**10.26**	**10.98**

DATE: 2-Apr-2010 DAP: 731

		Tanzania x Ekona		Deli x Ghana		Deli x Nigeria	
		HT (cm)	WD (cm)	HT (cm)	WD (cm)	HT (cm)	WD (cm)
REP I	PLANT 1	384	425	367	456	395	441
	PLANT 2	308	455	289	405	231	360
	AVERAGE	346.0	440.0	328.0	430.5	313.0	400.5
REP II	PLANT 1	330	460	330	510	340	425
	PLANT 2	395	420	312	515	372	480
	AVERAGE	362.5	440.0	321.0	512.5	356.0	452.5
REP III	PLANT 1	257	430	291	455	275	440
	PLANT 2	311	470	265	450	361	520
	AVERAGE	284.0	450.0	278.0	452.5	318.0	480.0
REP IV	PLANT 1	257	350	283	465	370	480
	PLANT 2	311	375	274	475	349	450
	AVERAGE	284.0	362.5	278.5	470.0	359.5	465.0
REP V	PLANT 1	312	510	320	465	323	440
	PLANT 2	395	430	367	470	357	465
	AVERAGE	353.5	470.0	343.5	467.5	340.0	452.5
AVERAGE (cm)		**326.00**	**432.50**	**309.80**	**466.60**	**337.30**	**450.10**
AVERAGE (ft)		**10.70**	**14.19**	**10.16**	**15.31**	**11.07**	**14.77**

DATE: 12-Apr-2011 DAP: 1106

		Tanzania x Ekona		Deli x Ghana		Deli x Nigeria	
		HT (cm)	WD (cm)	HT (cm)	WD (cm)	HT (cm)	WD (cm)
REP I	PLANT 1	430	604	381	603	426	511
	PLANT 2	334	502	392	607	396	537
	AVERAGE	382.0	553.0	386.5	605.0	411.0	524.0
REP II	PLANT 1	396	555	366	551	440	551
	PLANT 2	428	637	348	558	440	551
	AVERAGE	412.0	596.0	357.0	554.5	440.0	551.0
REP III	PLANT 1	293	456	338	473	334	348
	PLANT 2	324	507	324	512	348	586
	AVERAGE	308.5	481.5	331.0	492.5	341.0	467.0
REP IV	PLANT 1	325	436	318	508	420	574
	PLANT 2	360	505	328	435	377	522
	AVERAGE	342.5	470.5	323.0	471.5	398.5	548.0
REP V	PLANT 1	411	566	333	532	371	587
	PLANT 2	442	623	371	564	329	507
	AVERAGE	426.5	594.5	352.0	548.0	350.0	547.0
AVERAGE (cm)		**374.30**	**539.10**	**349.90**	**534.30**	**388.10**	**527.40**
AVERAGE (ft)		**12.28**	**17.69**	**11.48**	**17.53**	**12.73**	**17.30**

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	HIPMC-T-0903
Title	*Waltheria indica* – Investigating Large-scale Seed Production
National Project No.	Critical Area 1.1
Study Type	Advanced Evaluations
Study Status	Active
Location	HIPMC
Study Leader	David Duvauchelle
Duration	2008 through 2011
Cooperators	Hawaii Soil Water Conservation District
Land Use	Wildlife Habitat

Vegetative Practices

Primary	342	CRITICAL AREA PLANTING
Secondary	327	CONSERVATION COVER

Resource Concern(s)

Resource	Consideration / Problem
Soil	Soil Erosion / wind
	Soil Erosion / water

Long Range Plan Study falls NRCS Objective 2.2 Part A of the HIPMC LRP

Objective

A natural stand of *Waltheria indica* had established itself after a 'Tropic Sun' crotalaria field had been harvested. An attempt to harvest the seed with a combine had proved successful. The objective of this trial is to refine the large-scale harvesting technique and seed cleaning process of *Waltheria indica* (Uhaloa).

Status of Knowledge

Kahoolawe has been highly degraded by overgrazing, military bombing and feral goats. The annual rainfall on Kahoolawe averages 20-25 inches per year. Vast areas of hard pan are windswept and make it challenging to get any plant to establish itself and many deep gullies only compound the erosion problem. The KIRC is faced with the overwhelming challenge to re-vegetate the island.

Streambank and slope protection is becoming increasingly important and plants that are easily propagated and established are needed. Rapid establishment of permanent vegetative cover on critical areas such as streambanks,

roadsides, and steep hillsides is often difficult because of erosion, infertile soil, and unfavorable hydrology.

Needs

The KIRC desires plant materials that are:

- native to the Maui Nui region
- drought tolerant
- wind tolerant
- fast establishing

have low maintenance requirements

The PIA needs commercially available quantities of plant varieties and the technology to establish them. Plant species selected should:

- establish rapidly
- have good root structure and strength
- be adapted adverse conditions of low soil fertility, fluctuating soil moisture

have low maintenance requirements

Waltheria indica has the potential to fill this need. Waltheria indica, or uhaloa, is a subshrub that may grow from 60-200cm tall. Its stems, which are rather rigid, may grow erect or sometimes decumbent, with a velvety tomentose surface throughout. The leaves, 2-15cm long and 1-6cm wide, are ovate and somewhat wrinkled. Its leaf surface is also tomentose with the lower surface being a bit paler than the top. It produces a fragrant yellow flower with petals 4-6mm long. Uhaloa is found Pantropical. It is apparently indigenous to Hawaii and occurs in dry and often disturbed sites at 0-1220m. It is commonly found on Midway Atoll and all of the main Hawaiian Islands.

Materials / Materials

A naturally occuring accession (ACC# 9000000) of uhaloa was collected at the Hoolehua PMC and will be utilized for this evaluation.

PLANTING

1.) Seedlings will be propagated in dibble tubes and transplanted into the field.
2.) Field 13A of the Hoolehua PMC will be prepped and free of weeds before planting.
3.) Seedlings will be planted in single rows with 4 feet spacing between plants and 10 feet spacing between rows. 10-11 rows will be established.
4.) Plants will be drip irrigated.

5.) Weeds will be controlled with a pre-emergent herbicide and also by hand.

HARVESTING

4.) Time of harvest will be determined when over 50% of the seed is mature.
5.) A Massey Fergusson Combine will be utilized for harvesting.
6.) Settings for the combine will be determined at the time of harvest. Settings from the previous harvest will be the starting point.

SEED CLEANING

3.) Various seed cleaning machines will be tested to evaluate which one can improve the seed best.
4.) Seed will be sent to the University of Hawaii for germination tests. Seeds from a natural stand will be compared to the seeds from the cultivated stand.

Technology Transfer Products Fact Sheet; Planting Guide

FISCAL YEAR SUMMARY

FY2009

On July 2, 2009, 2500 dibble tubes were planted with 10 seeds in each dibble tube. The seeds were treated with a fungicide before planting. By the following week, at least 50% of the dibble tubes had seedlings emerging. By the end of September seedlings were still emerging. This sporadic germination could be a natural tendency that evolved as a survival tactic.

The goal is to have these seedlings planted into the field by the end of December 2009.

FY2010

In December 2009, about 650 seedlings were planted in F13-B. A pre-emergent (RONSTAR WP) was applied after planting. It had a very adverse affect on the plants and some even died. It is estimated that there was about a 70% survival rate. The vigor of the surviving plants was very low. A granular treatment of the pre-emergent would probably been less dangerous to the plants. A second application of RONSTAR Granular was applied 1 month later. Fortunately, many of the plants did recover by April. The crop will not be ready to harvest until next fiscal year.

FY2011

In December 2010, we harvested the uhaloa field. Uhaloa has a tendency to lay close to the ground, so we decided to use loppers to cut each plant below the soil surface and stacked the cut material in the isles for the combine to pick up. Doing this by hand was a bit time consuming, but it was the only way to harvest all of the material. By the end of January 2011, there were a lot of seedlings coming up in the field. To save time and resources only certain seedlings were selected at the desired spacing and everything else was removed with the weeds. The weeds in the isles were knocked down by down with a shallow till. The vegetation close to the selected seedlings was removed manually and the rest was sprayed out while a 5-gallon bucket with the bottom cut out was placed over each plant to protect it from spray drift. After all of the weeds had been sprayed an application of granular Ronstar was made. This proved to be a better approach as compared to the soluble Ronstar application. The granular Ronstar had no detrimental effects on the uhaloa seedlings. The weeds were controlled well with very little manual weed control.

During weed control, it was observed that a lot of the cut-stumps were beginning to re-grow. This observation was important in helping to decide how to harvest this next crop which is scheduled for harvest in October 2011.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	HIPMC-T-0904
Title	*Achyranthes splendens* – Investigating Large-scale Seed Production
National Project No.	Critical Area 1.1
Study Type	Advanced Evaluations
Study Status	Active
Location	HIPMC
Study Leader	David Duvauchelle
Duration	October 2009 through September 2011
Cooperators	Hawaii Soil Water Conservation District
Land Use	Wildlife Habitat

Vegetative Practices

Primary	342	CRITICAL AREA PLANTING
Secondary	327	CONSERVATION COVER

Resource Concern(s)

Resource	Consideration / Problem
Soil	Soil Erosion / wind
	Soil Erosion / water

Long Range Plan Study falls NRCS Objective 2.1 Part E and Objective 2.2 Part A of the HIPMC LRP

Objective: The objective of this trial is to develop a large-scale harvesting technique and seed cleaning process for *Achyranthes splendens*.

Status of Knowledge: Kahoolawe has been highly degraded by overgrazing, military bombing and feral goats. The annual rainfall on Kahoolawe averages 20-25 inches per year. Vast areas of hard pan are windswept and make it challenging to get any plant to establish itself and many deep gullies only compound the erosion problem. The KIRC is faced with the overwhelming challenge to re-vegetate the island. They demand native plants that are exceptional soil retainers in addition to being drought and wind tolerant.

Also, throughout Hawaii, streambank and slope protection is becoming increasingly important and native plants that are easily propagated and established are needed. Rapid establishment of permanent vegetative cover on these

critical areas is often difficult because of erosion, infertile soil, and unfavorable hydrology.

Needs

The KIRC desires plant materials that are:

- native to the Maui Nui region
- drought tolerant
- wind tolerant
- fast establishing

The PIA needs commercially available quantities of native plant species and the technology to establish them. Plant species selected should:

- establish rapidly
- have good root structure and strength
- be adapted adverse conditions of low soil fertility, fluctuating soil moisture

Achyranthes splendens has the potential to fill this need. *Achyranthes splendens*, is a shrub that may grow from 50-200cm tall. The leaves, 2-12cm long and 1.5-7.3cm wide, are obovate to broadly elliptic or subobicular, are densely white strigose, surfaces usually obscured, with hairs sometimes spreading, 0.5-1.5 mm long. The spikes are congested, 3-25 cm long and the rachis are densely white pubescent or tomentose. Natural populations are scattered in low elevation, open, dry forest remnants and open thickets, on talus or rocky slopes, and on coralline plains 0-500 m. Known to occur from the west coast of Oahu; Kaluapapa, Molokai; near Manele and Maunalei Gulch , Lanai; West Maui and Kula, East Maui.

Materials and Methods

ACC# 9000000 was collected by Hoolawa Farms and grown for seed at their nursery. These seeds were planted to dibbles tube for this increase planting here at the Hoolehua PMC.

PLANTING

1.) Seedlings in dibble tubes will be acquired from a Maui nursery, Hoolawa Farms, and transplanted into the field.
2.) Field 13A of the Hoolehua PMC will be prepped and free of weeds before planting.
3.) Seedlings will be planted in single rows with 2 feet spacing between plants and 10 feet spacing between rows. There will be 10 rows.
4.) Plants will be drip irrigated.

5.) Weeds will be controlled with a pre-emergent herbicide and also by hand.

HARVESTING

1.) Time of harvest will be determined when over 50% of the seed is mature.
7.) A Massey Fergusson Combine will be utilized for harvesting.
8.) Settings for the combine will be determined at the time of harvest. Settings from a *Waltheria indica* harvest will be the starting point.
9.) Harvesting with a leaf blower/vacuum will be evaluated.

SEED CLEANING

5.) Various seed cleaning machines will be tested to evaluate which one can improve the seed best.
6.) Seed will be sent to the University of Hawaii for germination tests. Seeds from a natural stand will be compared to the seeds from the cultivated stand.

Technology Transfer Products Fact Sheet; Planting Guide, Tech note, newsletter article

FISCAL YEAR SUMMARY

FY2010

2500 seedlings were received from Maui in October 2009. They were set in direct sunlight and was planted in the field in November. The irrigation system is comprised of sub-soil drip-lines supplied by a 2" lay-flat poly-tube sub-main. A fertilizer application was made using 21-7-14 at a rate of 100lbs of nitrogen per acre. This was incorporated into the soil with a tiller. 10 400ft rows were planted at 10ft apart with 2ft spacing between plants. Two applications of pre-emergent were made 1 month apart. The field was then irrigated with the Big Gun overhead sprinkler to help stimulate the pre-emergent.

By April the plants began to show signs of flowering and by July they were ready to harvest. The Combine was used to harvest the field with success.
Combine settings

- Concave width – 9
- Concave speed – 1000 rpm
- Sieve – flat
- Screen – smallest
- Fan strength – 1
- Fan direction – 8
- Fan shoot – open

After the harvest with the combine, fertilizer was applied ant a rate of 150lbs nitrogen per acre and 1 application of pre-emergent was made.

Seed cleaning prove somewhat difficult since the seeds were encased in a hull. The seeds needed to be run through a brush-machine to remove the hull. Unfortunately the machine at the Hoolehua PMC was designed for small scale seed cleaning and the harvest yield was too large. An attempt to use a thresher to remove the hulls was made. Although this did remove most of the hulls, a lot still remained. The bulk material was then run through the Clipper seed-cleaning machine. A total of 92 pounds of seed was cleaned.

FY2011

The Achyranthes field was ready to harvest by the end of May. We used the combine with the same settings as last year, but only yielded 4lbs total. Unfortunately, the crop had sustained a lot of damage due to a spider mite infestation. We are attributed this to both very low rainfall and stress from being harvested with the combine. Irrigation was increased in an attempt to stimulate more vegetative growth to help the crop recover from the stress, but it was unsuccessful. The damage was too great. We will continue to irrigate the field in hopes of it recovering, but it does not look good. If the field does not improve we may decide to replant or remove the crop completely.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	HIPMC-T-1001
Title	*Eragrostis variabilis* and *Dodonaea viscosa:* Testing ZEBA Polymer seed-coat under natural rainfall conditions
National Project No.	Critical Area 1.1
Study Type	Advance Evaluation
Study Status	Active
Location	Hoolehua Plant Materials Center
Study Leader	David Duvauchelle
Duration	June 2009 - Sept 2011
Land Use	Cropland
Vegetative Practices	Primary 342 CRITICAL AREA PLANTING Secondary 327 CONSERVATION COVER
Resource Concern(s)	Resource — Consideration / Problem Soil — Soil Erosion / wind Water — Soil Erosion / water
Long Range Plan	Study falls under Objective 2.2, Section A of the HIPMC Long Range Plan
Objective:	To determine if a seed coating developed by ZEBA will increase a plant's chances of survivability under natural rainfall conditions, particularly Hawaiian natives: *Eragrostis variabilis* and *Dodonaea viscosa*.
Status of Knowledge:	ZEBA has claimed the seed coating that they have developed will increase certain plants' survivability in natural rainfall conditions. *E. variabilis* and *D. viscosa* are very drought tolerant plants that were probably one of the first pioneer plants of Hawaii. If these native seeds could be given an advantage to increase their survivability rate over invasive species, the ZEBA seed coat could be a valuable tool in re-vegetating with natives in critical areas.
Experimental Design:	**Randomized Complete Block Design**
Treatment 1	*Eragrostis variabilis*: treated with ZEBA coating
Treatment 2	*Eragrostis variabilis*: untreated
Treatment 3	*Dodonaea viscosa*: treated with ZEBA coating
Treatment 4	*Dodonaea viscosa*: untreated

Materials/ Methods: Two accessions were sent to ZEBA for seed-coat treatment:

Eragrostis variabilis (ACC#9079729)
Dodonaea viscosa (ACC#9079682)

This study will compare treated seeds to untreated seeds of these two accessions under natural rainfall conditions. This will essentially be two trials combined into one. Survivability will be measured by determining the percentage of live seedlings in a square foot after 2 rainy seasons.

1.) [4] replications
2.) Natural rainfall only; No additional irrigation will be provided.
3.) Each plot will measure [3] ft x [9] ft. [16] plots total.
4.) There will be a [3] ft border between plots. Weeds will be controlled only in the surrounding border using a pre-emergent herbicide.
6.) Evaluations will be taken 180, 360, 540, 720 DAP.
7.) Aalii seedling will be counted
8.) Dry matter yield samples will be taken from the kawelu plots. Each 3X9 plot will be divided into 4 subplots measuring 3x2.25. 4 evalauations dates will be randomly assigned to each of the plots. For each evaluation, a [1ft^2] PVC square will be randomly dropped in each plot and the vegetation will be cut as close to the soil as possible. Veg samples will then be weighed dried and weighed again.
9.) Rainfall data will be recorded
10.)Seeding rate:

E. variabilis – 10 lb/PLS/A = 3.125 g/PLS/plot
D. viscosa – 10 lb/PLS/A = 3.125 g/PLS/plot

Technology Transfer Products Tech Note, Newsletter article

FISCAL YEAR SUMMARY

FY 2010

Kawelu: Germination was not affected. There was no difference in initial seedling development. As the dry season encroached, the treated plots appeared to be more vigorous, while the untreated plots were less vigorous and a bit more dried-out. This is probably because the treated seedlings were stronger from the beginning due to the extra moisture that the ZEBA treatment provided.

Aalii: Germination of treated seed was hindered. Twice as many seedlings germinated from the untreated plots as compared to the treated plots. Of the seedlings that did emerge there was no difference in vigor between the two treatments.

FY2011

It was obvious that the aalii treated seed were somewhat hindered by the ZEBA Treatment. The Eragrostis seed, on the other hand did show some signs of benefiting from the seed-coat. We decided to take cover point-frequency data as opposed to dry matter yield. This was because there was a lot of material that had died from months before and we could not separate it from the live material. We felt that the cover point-frequency data would be a better representation of what was happening in the plots. The data did confirm that Eragrostis seeds that had the ZEBA treatment produced cover with a higher point-frequency rate as compared to seeds that were not treated.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code HIPMC-T-1002
Title *Polyscias guilfoylei* (2): Growth-Rate Effects from Nitrogen Treatments

National Project No. Cropland 1.1
Study Type Advanced Evaluations
Study Status Active

Location HIPMC
Study Leader David Duvauchelle
Duration Feb 2010 through Feb 2012

Cooperators Alton Arakaki, University of Hawaii, Cooperative Extension

Land Use Cropland
Vegetative Practices

Primary	650	WINDBREAK ESTABLISHMENT
Secondary	380	WINDBREAK RENOVATION
	423	HEDGEROW PLANTING
	311	ALLEY CROPPING

Resource Concern(s)

Resource	Consideration	Problem
Soil		Soil Erosion / wind
		Soil Erosion / water
Air		Air Quality / air pollutants

Long Range Plan Study falls under Objective 2.1 Section C of the HIPMC LRP

Objective The objective is to produce a growth rate in panax that is comparable to that of *Erythrina variegata* or cv. 'Tropic Coral'. Various nitrogen treatments will be applied to two accessions of *Polyscias guilfoylei* in an attempt to stimulate a faster growth rate and also to determine if there are growth rate differences between the two.

Status of Knowledge Many areas of cropland are subject to frequent strong winds. Velocities of 10 to 25 miles per hour or more may be expected much of the time. Permanent and semi-permanent windbreaks are needed on much of this land. Fire may destroy certain tree species that do not have the capacity of renewal. There is a need for rapid-growing annual or perennial plants for windbreaks. These plants could be used as primary windbreaks and also for crops requiring additional in-field windbreaks as well. They

should produce minimum root competition, be relatively pest-free, esthetically pleasing, and have a low maintenance requirement. Additionally, there is a need for windbreaks for farmsteads and feedlots to serve as visual screens on highway medians and other areas.

Polyscias guilfoylei may be a suitable choice for a windbreak. It is a columnar shrub with erect branches reaching height near 24ft tall; leaves mostly 5.9-19.7" long, 1-pinnate, leaflets opposite, blades variable, but commonly broadly ovate or elliptic and coarsely dentate or lacerate, commonly variegated with white or pale yellow margins, or sometimes all dark green; leaflets mostly 1.9-3.9" long; inflorescence a compound panicle. The origin of panax is unknown, but it is widely cultivated in the paleotropics and in some parts of the neotropics.

As good of a windbreak as panax is, cv. 'Tropic Coral' has been the choice of many of the local farmers because of its taller growth and faster growth rate. Recently, the Erythrina Gall Wasp (EGW) has devastated all of the Pacific Island Area's cv. 'Tropic Coral' windbreak systems. *Polyscias guilfoylei* could be a potential cv. 'Tropic Coral'-substitute for Pacific Island Area farmers.

Experimental Design Split-Plot Design

Treatment 1 Title: NA1
Description: Non-Variegated - no nitrogen (control)

Treatment 2 Title: VA1
Description: Variegated - no nitrogen (control)

Treatment 3 Title: NB1
Description: Non-Variegated - no nitrogen (control)

Treatment 4 Title: VB1
Description: Variegated - no nitrogen (control)

Treatment 5 Title: NA2
Description: Non-Variegated - 25 lbs. N/Ac incorporated

Treatment 6 Title: VA2
Description: Variegated - 25 lbs. N/Ac incorporated

Treatment 7 Title: NB2
Description: Non-Variegated - 25 lb. N/Ac incorporated + 25 lb. N/Ac side-dressed 180DAP

Treatment 8 Title: VB2
Description: Variegated - 25 lb. N/Ac incorporated + 25 lb. N/Ac side-dressed 180DAP

Treatment 9 Title: NA3
Description: Non-Variegated - 50 lbs. N/Ac incorporated

Treatment 10 Title: VA3
Description: Variegated - 50 lbs. N/Ac incorporated

Treatment 11 Title: NB3
Description: Non-Variegated - 50 lb. N/Ac incorporated + 50 lb. N/Ac side-dressed 180DAP

Treatment 12 Title: VB3
Description: Variegated - 50 lb. N/Ac incorporated + 50 lb. N/Ac side-dressed 180DAP

Treatment 13 Title: NA4
Description: Non-Variegated - 100 lbs. N/Ac incorporated

Treatment 14 Title: VA4
Description: Variegated - 100 lbs. N/Ac incorporated

Treatment 15 Title: NB4
Description: Non-Variegated - 100 lb. N/Ac incorporated + 100 lb. N/Ac side-dressed 180DAP

Treatment 16 Title: VB4
Description: Variegated - 100 lb. N/Ac incorporated + 100 lb. N/Ac side-dressed 180DAP)

Treatment 17 Title: NA5
Description: Variegated - 200 lbs. N/Ac incorporated

Treatment 18 Title: VA5
Description: Non-Variegated - 200 lbs. N/Ac incorporated

Treatment 19 Title: NB5
Description: Non-Variegated - 200 lb. N/Ac incorporated + 200 lb. N/Ac side-dressed 180DAP

Treatment 20 Title: VB5
Description: Variegated - 200 lb. N/Ac incorporated + 200 lb. N/Ac side-dressed 180DAP

Materials / Methods The two accessions used for this trial were collected on the island of Molokai. The non-variegated sample (ACC# 9079789) is a variety from the Hoolehua PMC that had been collected from a residence in the Kalae area. The variegated sample (ACC# 9079807) is a variety that was collected from the Bauman's residence in the Kamililoa area. Cuttings will be taken from increase blocks at the Hoolehua PMC.

1. Each cutting will measure [3] feet in length with an average width of [1-2] inches. A pruning spray will be applied to the top of the cuttings to aid in healing.
2. Ammonium Sulfate (21-0-0) fertilizer will be utilized as the nitrogen source for this trial. Nitrogen treatments will be applied in [2] ways. (1) Nitrogen will be incorporated into the soil before planting only; and (2) nitrogen will be incorporated into the soil before planting plus a second application will be side-dressed at 180 days after planting (DAP).
3. Each cutting will be planted [12] inches deep with [2] foot spacing between each cutting. The cuttings will be planted in a single row to simulate a windbreak setting. [3] Separate windbreak-rows will be planted; each will be 400 feet long, representing [1] replication for each row planted.
4. There will be [20] fertilizer treatments for each replication. Each fertilizer treatment will consist of (20) cuttings, [10] cuttings from each accession. [2] Buffer cuttings on each end of a treatment will separate one treatment from the next. These buffers will not be included in the evaluation.
5. Moisture will be controlled with drip irrigation.
6. Evaluations will take place at 90DAP, 180DAP, 270DAP, 360DAP, 450DAP, 540DAP, 630DAP and 720DAP. Height and width will be measured and overall vigor will be evaluated.

Trial start date: February 17, 2010.

Technology Transfer Tech Note, Newsletter Article

FISCAL YEAR SUMMARY

FY2010

Preliminary evaluations indicate that there is no significant difference between fertilizer treatments. The data also shows that there is no significant difference between accessions. However, there is a visual difference between replications that indicate varying irrigation may have some affect on growth.

There were instances during periods of high winds where some trees, not very many, had broken off. There appears to be no correlation between this breaking-off, fertilizer treatments or accessions. This tendency could very well be associated with the plant itself.

The trial was set-up in a way to replicate an actual mid-field windbreak setting. There were two main windbreak (ironwoods) spaced about 300ft apart and the trial row was plant in the middle of the two rows of ironwood, 150ft from each row. This created a crop field on either side of the panax trial row. There are 3 trial rows in 3 different locations. The only difference between the 3 rows was that 2 rows are situated between fields that are irrigated by over-head sprinklers and 1 row is situated between fields that are irrigated by drip. Though not a significant difference, the rows between the fields with overhead sprinklers appear to be somewhat more vigorous. We will continue to monitor the overhead irrigation to determine if it will have any detrimental effects to the trial.

FY2011

On March 25, 2011, 390DAP, the trial was evaluated once again. On average the trees had reached an average height of about 7.5 feet. As compared to our earlier trials, this seems to be very similar. According to the data there still appears to be no significant differences between the treatments. There were no signs of pests. A few more trees were knocked down by the wind. The trees appear to be in good health.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code HIPMC-T-1003
Title Hybrid Leucaena Propagation Trial

National Project No. Critical Area 1.1
Study Type Advance Evaluation
Study Status Active

Location Hoolehua Plant Materials Center
Study Leader David Duvauchelle
Duration June 2009 - Sept 2009

Land Use Cropland

Vegetative Practices Primary
Secondary

Resource Concern(s)

Resource	Consideration / Problem
Soil	Soil Erosion / wind
Water	Soil Erosion / water

Long Range Plan Study falls under Objective 2.1, Section E of the HIPMC Long Range Plan

Objective: This study will be an attempt to propagate through cuttings [2] hybrid *Leuceanas* that have sterile or low seed viability and are also known to be difficult to propagate through cuttings.

Status of Knowledge There have been a few successful attempts to propagate *Leuceanas* in the past. Consequently, there is some information to draw from. There appears to be some agreement that leaf presence plays a major part in cutting survivability. Leaf size will be tested. Also, the age of cuttings is also important and need to be taken right before they start to lignify. There is evidence that suggest that cuttings initiated during the early summer months have better chances of surviving. Although some studies have shown that the use of a rooting hormone proved to be of no benefit, it will be tested in this study.

Materials/ Methods

Two Leucaena accessions will be evaluated for this trial:

ACC#9079753 – *L. leucocephala* x *L. esculenta* K-*1000*

ACC#9079754 - *L. leucocephala* x *L.diversifolia* *KX3*

1. Adult *Leucaena* trees will be coppiced at the end of March 2010.
2. 40 days after the adult trees are coppiced; cuttings will be taken from stems that have not lignified.
3. Each cutting will consist of 1 leaf node with varying leaf areas.
4. Cuttings will be pooled and randomly assigned to each treatment. [12] Cuttings will be made for each treatment and each treatment will be replicated [4] times.
5. Cuttings will be planted in dibble tubes using a rooting hormone and Sunshine MIX4 planting medium.
6. Trial will be conducted under 50% shade.
7. Moisture will be applied via a misting system. Misting will occur for 10 seconds at 5 minute intervals.
8. At 60 DAP; the cuttings will be removed from the dibble tubes and the planting media. The root growth will then be measured and evaluated.

Experimental Design Randomized Complete Block Design

Treatment 1 Title: T11
Description: K1000 - 1/3 leaf area

Treatment 2 Title: T12
Description: K1000 - 2/3 leaf area

Treatment 3 Title: T12
Description: K1000 - Whole leaf

Treatment 4 Title: T21
Description: KX3 - 1/3 leaf area

Treatment 5 Title: T22
Description: KX3 - 2/3 leaf area

Treatment 6 Title: T22
Description: KX3 - Whole leaf

Technology Transfer Tech Note

Alternative Method 2

Materials/Method

The tested accession will be: ACC# 9079754 – KX3
K1000 will not be tested until the propagation technique for KX3 has been perfected.

1. Adult tree will be coppiced in October
2. Cutting will be taken 50 days after coppicing.
3. Braches to make cuttings will have no secondary branching and not lignified.
4. Top 4 pairs of nodes and bottom pair of nodes of each branch will be removed
5. Cuttings will consist of 1 node pair with 4 pairs of leaflets, 4-6 inches long
6. Cuttings will be immersed in Super-Thrive solution for 10 minutes
7. Bottom 2 inches on cutting surface will be lightly scraped and dipped in Dip-N-Grow solution for 5 seconds.
8. Planting medium will sand
9. Cuttings will be planted in dibble tubes
10. After cuttings are planted the planting medium will be drenched with the Super-Thrive solution + ½ strength Miracle-Gro added to the solution.
11. Cuttings will be set into mist box with clear plastic covering.
12. Misting will be set for 10 minutes at 7am, 10am, 1pm, and 4 pm.
13. The number of cuttings that take will be counted at 60 days after planting.

Alternative Method 3

Materials/Method

The accession used for testing: ACC# 9079754 – KX3
K1000 will not be tested until the propagation technique for KX3 has been perfected.

1. Adult trees will be coppiced in early April
2. Cuttings will be taken from unlignified new shoots at 40-50 days after coppicing
3. Top 4 internodes of each branch will be discarded
4. Cuttings will consist of 1 node with 4 pairs of pinnae.
5. Each cutting will be approximately 4-6 inches long
6. Planting medium will consist of potting mix and perlite, 1:2 ratio respectively
7. Cuttings will be planted in dibble tubes
8. No Fertilizer will be utilized
9. Cuttings will be set under 50% shade
10. The misting system will mist for 10 seconds at 5 minute intervals
11. The study will have 4 treatments and 3 replications with 10 cuttings per rep
12. At 56 days after planting, the number of cuttings that take will be counted. Also, for each cutting, the number of roots longer than 1cm will be counted and the length of the longest root will be measured.

Experimental Design **Randomized Complete Block Design**

Treatment 1 Title: T1
Description: Vitamin B Dip + IBA Rooting Hormone

Treatment 2 Title: T2
Description: Vitamin B Dip Only

Treatment 3 Title: T3
Description: IBA Rooting Hormone Only

Treatment 4 Title: T4
Description: Control

FISCAL YEAR SUMMARY

FY2010

On March 29, 2010 the adult Leucaena trees were cut back. On May 10, 2010, 42 days after being cut back, the cuttings were taken and planted. On July 8, 2010, 59 days after planting the cuttings evaluations were made. Out of a total of 288 cuttings, only nine had rooted. Of those rooted cuttings seven were of K1000, and two were of KX3. We believe the low number are attributed to the poor drainage of the potting mix used (Sunshine Mix4). Also, the design of the mist box could have also had some negative effects on the cuttings. It may have been too dark. The fact that we did have a few cutting take, we are certain that developing a technique to increase Leucaena cutting survivability is not impossible. We will attempt to refine our technique in the near future.

FY2011

Late in the fiscal year a cooperator had shown some interest in Leucaena hybrids. With a promise to provide plant materials we revisited trying to improve on our current technique to root Leucaena cuttings. We looked closer at past studies to determine where we could improve our technique. The first change we planned to do was to improve our mist box. Our original box was 3ft wide, 8ft long and 2ft deep. The sides were covered with wood and the top was covered with a 50% shade cloth. Dr. Joe DeFrank of the University of Hawaii pointed out that if the cuttings required the leaves to produce roots, then it was logical to provide a sufficient amount of light for this purpose. We removed the wood siding and shade-cloth and covered the entire mist-box with a semi-clear plastic (painter's drop-cloth). The second change that was planned was to use a planting medium with better drainage. We decide to use sand. Also, since the majority of the cuttings appeared to have rotted, we decide to change the misting setting of "every 5 minutes for 10 seconds" to "5 minutes, 4 times a day (7am, 10am, 1pm, and 4pm) to allow the cuttings to dry between misting. The literature also indicated that time of the year was a major factor in rooting survivability. In Hawaii, cuttings took better during the summer months. The cooperators needed the material as soon as possible, so we decided to attempt a winter batch to test the theory. The adult trees will not be cut back until next fiscal year, mid October 2011 and cuttings will be taken in early December 2011. We will then run another test in March 2012 to compare data.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
STUDY PLAN

Study ID Code	HIPMC-F-1101
Title	Native Plant Establishment: Direct Seeding Under Natural Rainfall
National Project No.	Critical Area 1.1
Study Type	Demonstration / Comparative Evaluation
Study Status	Active
Location	Molokai Land Trust
Study Leader	David Duvauchelle
Duration	DEC 2011 through DEC 2014
Cooperators	Butch Haas, Molokai Land Trust
Land Use	Critical Area
Vegetative Practices	Primary 342- CRITICAL AREA PLANTING

Resource Concerns

Resource	Consideration / Problem
Soil	Soil Erosion / Wind
Soil	Erosion / Water
Plant	Native Plants / Invasive Weeds species
Animal	Native Animals / Habitat Degradation

Long Range Plan Study falls under Objective 2.3 Section A of the HIPMC LRP

Objective The objective is to demonstrate the establishment of native Hawaiian plants by direct-seeding a native seed-mixture without irrigation in low rainfall, degraded habitats by using known critical area planting techniques, specifically shallow ripping, mulching, and the addition of nutrients. This demonstration will give land managers the tools to deal with invasive species in degraded areas.

Status of Knowledge The area located within the Molokai Land Trust offers an ideal location for this demonstration. The native Hawaiian plants selected for this demonstration are well adapted to the low rainfall, windswept, and nutrient depleted soils commonly found in highly degraded areas. Establishment of native plants is essential to compete with invasive species. Also, the use of a native seed-mixture is not a new practice, but it is new to the PIA because native seed is generally unavailable. When land managers are educated about better techniques to establish natives in degraded areas the demand for native seed may grow. This increase in demand

for native seed may encourage commercial producers to look toward native-seed production as a viable market.

Experimental Design Split-Split-Plot Design

Treatment 1 Title: A11
Description: Shallow Rip, Mulch, Fertilizer

Treatment 2 Title: A12
Description: Shallow Rip, Mulch, No Fertilizer

Treatment 3 Title: A21
Description: Shallow Rip, No Mulch, Fertilizer

Treatment 4 Title: A22
Description: Shallow Rip, No Mulch, No Fertilizer

Treatment 5 Title: B11
Description: No Rip, Mulch, Fertilizer

Treatment 6 Title: B12
Description: No Rip, Mulch, No Fertilizer

Treatment 7 Title: B21
Description: No Rip, No Mulch, Fertilizer

Treatment 8 Title: B22
Description: No Rip, No Mulch, No Fertilizer *(control)*

Materials / Methods The planting material for this study will be a native plant seed mixture created by the Hoolehua PMC. Five different native Hawaiian plant species were selected for the seed-mixture: *Dodonaea viscosa* (Kamiloloa Germplasm Aalii), *Heteropogon contortus* (Kahoolawe Germplasm Piligrass), *Waltheria indica* (uhaloa), *Eragrostis variabilis* (Kahoolawe Germplasm Kawelu), *and Achyranthes splendens.* The seeding rate for this particular mixture was predetermined using the Hawaii Vegetative Guide as a reference and a separate attachment shows the details for each plant. The bulk seeding-rate for the native plant seed-mixture is 19.05 lbs/A. To aid with the spread of the seed, a carrier made-up of *Dodonaea viscosa* seed hulls was added. Moisture will be totally dependent on natural rainfall.

This study will be replicated 4 times and evaluate 3 factors:

a) Shallow Ripping vs. Not Ripping
b) Using Mulch vs. Not Using Mulch
c) Applying Fertilizer vs. Not Applying Fertilizer

PROCEDURE (see attached plot plan)

1. Establish rows
    a. Determine contour of the site
    b. Rows will follow contour; 3’ wide, length – TBD
    c. Row Spacing: 8 rows,16’ between rows
2. Establish plots
    a. 1 replication = 2 rows = 8 plots
    b. 1 row = 4 plots
    c. 1 plot = ¼ the length of the row it is in
    d. Length of each plot - TBD
    e. For each plot a 3’ x10’ subplot will be designated
3. Shallow rip: 4-6 inches deep
4. Drop mulch: 2 tons per acre (2.75 lbs / 10’)
5. Drop fertilizer
    a. 100lbs Nitrogen per Acre
    b. 16-16-16 (200g / 10’ of row) – about ½ lb per 10’
6. Drop seed-mixture (6g per 10’ of row).
7. Evaluate Subplots
    a. 180DAP(days after planting); 360DAP; 540DAP; 720DAP; 900DAP; 1080DAP
    b. Canopy-cover point-frequency using diagonal transect-line with 50 points
    c. Number of live plants (each species)
    d. Average height of each species

Technology Transfer Tech Note, Newsletter Article

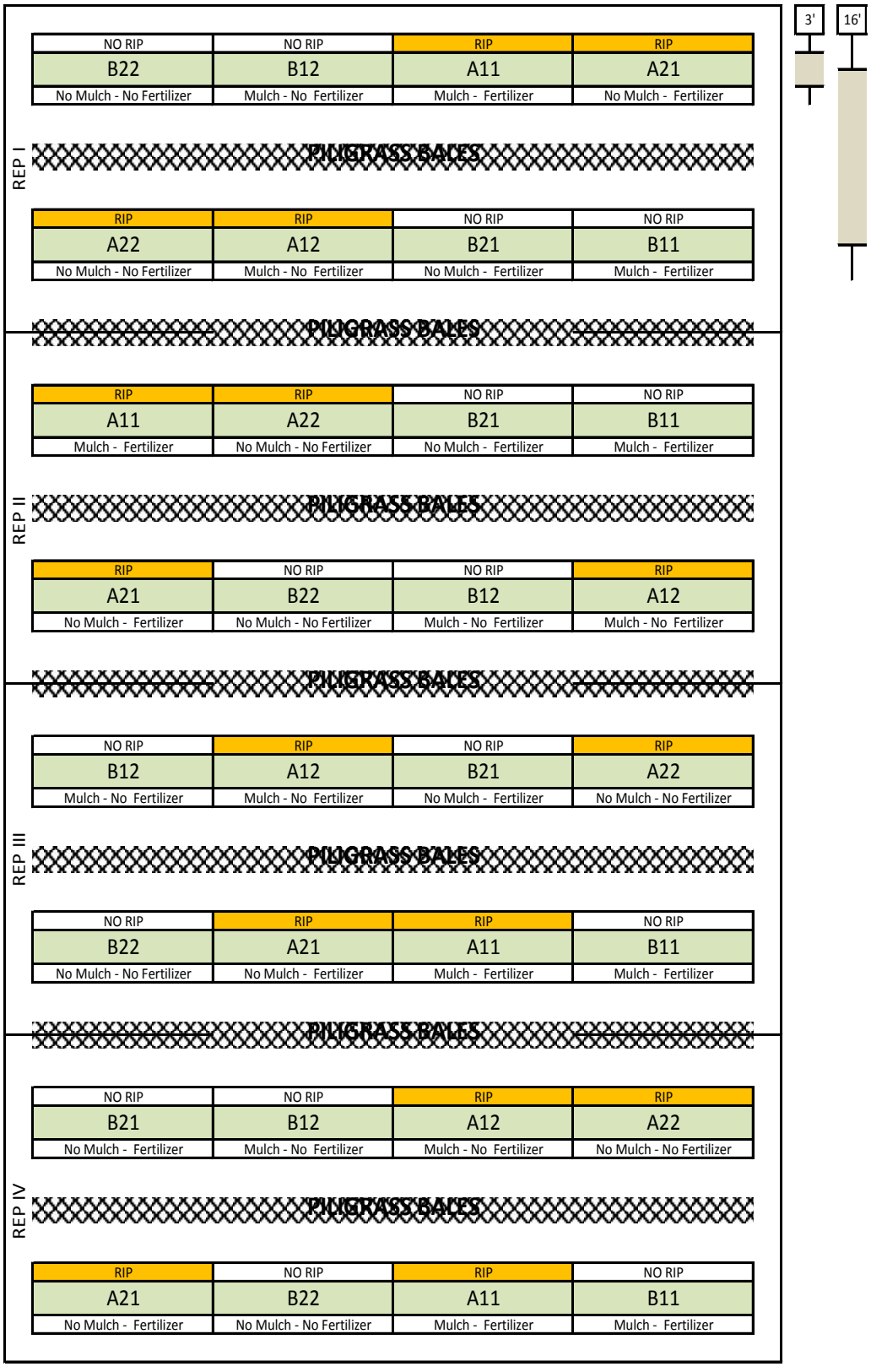
Keywords Critical Area Planting; Native Hawaiian Plants; Native Seed-Mixture

Reviewed by: _____(signed)_____
Robert Joy, PIA Plant Materials Specialist

Approved by:_____(signed)_____
Larry Yamamoto, Director for Pacific Island Area

Molokai Land Trust - Critical Area Planting Study

PLOT PLAN



Molokai Land Trust - Critical Area Planting Study

Native Plant Seed Mixture

Heteropogon contortus, Eragrostis variabilis, Achyranthes splendens, Dodonaea viscosa, Waltheria indica

Bulk Seeding Rate: 19.05 lbs / Acre

***Heteropogon contortus* – piligrass**	
BULK Seed Data - PLS (pure live seed) conversion	PLS Seeding-Rate Calculation
Harvest Date: Jun-10	1 plant / 4 ft^2 = 10890 plants /Acre
Purity: 89%	50 viable seeds / 4 ft^2 = 2% Successful-Take Plant-Spacing
Germ: 28% (OCT 2010)	50 viable seeds / 4 ft^2 = 544500 viable seeds /Acre
PLS: 25%	100 seeds = 0.21 grams
BULK seeding rate: 10.08 lb/Acre	1144 grams / Acre = 544500 viable seeds /Acre
	1144 grams / Acre = **2.52 lbs /Acre PLS**

***Eragrostis variabilis* - kawelu**	
BULK Seed Data - PLS conversion	PLS Seeding-Rate Calculation
Harvest Date: Feb-10	1 plant / 1.5 ft^2 = 19360 plants/Acre
Purity: 96%	100 viable seeds / 1.5 ft^2 = 1% Successful-Take Plant-Spacing
Germ: 24% (OCT 2010)	100 viable seeds / 1.5 ft^2 = 1936000 viable seeds /Acre
PLS: 23%	100 seeds = 0.015 grams
BULK seeding rate: 2.83 lb/Acre	290 grams / A = 1936000 viable seeds /Acre
	290 grams / A = **0.65 lb/A PLS**

Achyranthes splendens	
BULK Seed Data - PLS conversion	PLS Seeding-Rate Calculation
Harvest Date: Jun-10	1 plant / 36 ft^2 = 1210 plants /Acre
Purity: 96%	100 viable seeds / 36 ft^2 = 1% Successful-Take Plant-Spacing
Germ: 60% (OCT 2010)	100 viable seeds / 36 ft^2 = 121000 viable seeds /Acre
PLS: 58%	100 seeds = 0.26 grams
BULK seeding rate: 1.19 lb/Acre	315 grams /Acre = 121000 viable seeds /Acre
	315 grams /Acre = **0.69 lb/Acre PLS**

***Dodonaea viscosa* - aalii**	
BULK Seed Data - PLS conversion	PLS Seeding-Rate Calculation
Harvest Date: Jun-10	1 plant / 100 ft^2 = 436 plants /A
Purity: 99%	100 viable seeds / 100 ft^2 = 1% Successful-Take Plant-Spacing
Germ: 32% (OCT 2010)	100 viable seeds / 100 ft^2 = 43600 viable seed / Acre
PLS: 32%	100 seeds = 0.50 grams
BULK seeding rate: 1.50 lb/Acre	218 grams / Acre = 43600 viable seed / Acre
	218 grams / Acre = **0.48 lb/Acre PLS**

***Waltheria indica* - uhaloa**	
BULK Seed Data - PLS conversion	PLS Seeding-Rate Calculation
Harvest Date: Aug-10	1 plant / 40 ft^2 = 1089 plants /A
Purity: 97%	100 viable seeds /40 ft^2 = 1% Successful-Take Plant-Spacing
Germ: 13% (OCT 2010)	100 viable seeds /40 ft^2 = 108900 viable seeds /Acre
PLS: 13%	100 seeds = 0.19 grams
BULK seeding rate: 3.46 lb/Acre	207 grams / Acre = 108900 viable seeds /Acre
	207 grams / Acre = **0.45 lb/A PLS**

FISCAL YEAR SUMMARY

FY2011

The study was installed on January 19, 2012 with the help of the Molokai Land Trust (MLT) crew. The area had just received a significant amount of rain and the soil was ideal for planting. For the duration of the study, rainfall data was collected at the study site. The monthly totals are as follows:

JAN 2011 - 5.04”
FEB 2011 - 8.80”
MAR 2011 - 0.54”
APR 2011 - 1.10”
MAY 2011 - 0.70”
JUN 2011 - 0.00”
JUL 2011 - 0.60”
AUG 2011 - 0.15”
SEP 2011 - 0.00”

With excellent rainfall at the beginning of the trial, the seedlings were able to germinate very well. As expected, the rainfall began to lesson over the dry season. As predicted, at six months after planting many seedlings had died off. On the other hand, there were also quite a lot of seedlings that were persisting. Piligrass had germinated exceptionally well with many individuals in all plots. Of all the species, piligrass is by far the most resilient. Achyranthes splendens had also persisted very well. Although the amount of Achyranthes seed in the seed mixture was very low, the amount of seedlings that that germinated and persisted was impressive. There were many uhaloa seedlings that persisted, but they were not doing as well as the Achyranthes seedlings. According to MLT, many kawelu seedlings had germinated but, virtually all had died off by May 2011. Few aalii seedlings had germinated and all had died off by June. The plots will be evaluated again in December 2012.

The main reason for the study was to observe how the seedlings persisted through the dry season under the different treatments. It was obvious that mulch and fertilizer were essential components in establishing native plants in the very dry habitats found on the Northwest coast of Molokai. Plots that lacked one or the other did not do very well. Fertilizer is necessary in nutrient depleted soils and the mulch helps to retain any available moisture for a longer period. According to the data, ripping the soil may or may not be necessary.

By ripping the soil, roots and moisture are able to penetrate deeper giving plants the necessary advantage during the dry season. The plots with fertilizer, mulch and light ripping were doing exceptionally well. But, the plot with mulch fertilizer and no ripping were also doing well. Apparently, the mulch layer acted as a trap for top soil that was blowing in the wind. The mulch layer was able to trap enough soil for good germination. We need to look closer at this phenomenon. If plants can be established in critical areas by only dropping mulch and fertilizer, this could save agencies a lot of time and money, and could also increase the demand for seed of Native Hawaiian plants.

PLANT MATERIALS SPECIALIST REPORT

Robert J. Joy, Plant Materials Specialist

This report includes a summary of promising species that are in our Field Planting Program. Information gained from Field Plantings is incorporated into the Field Office Technical Guide to make it more useful for our Field Office personnel. New cultivars or varieties that are released through our Plant Materials Program depend on the data collected from Field Plantings to support and document their release. The Field Planting is the final phase of testing in the plant materials systematic testing process. It is where a new plant is tested on a farm or other site under actual use conditions.

Thirty one Field Plantings were established in FY 10.The excellent cooperation between Plant Materials and Field Office personnel in the Pacific Islands Area has enabled us to maintain a viable Plant Materials Program. We look forward to the continued high interest in plant materials by our field people who are so important to the success of the program.

SUMMARY OF PROMISING SPECIES IN FIELD PLANTINGS

Arachis pintoi (perennial or forage peanut)

Perennial peanuts are native to Brazil and make a dense cover, although they are slow to establish and spread. They may be grazed and are useful as a low maintenance, permanent conservation cover for erosion control and beautification. The cultivars Amarillo and Forrajero are commercially available as seed and can also be established as cuttings. They have performed well as a conservation cover in coffee in the Kona area of Hawaii. Rhizoma peanuts *(Arachis glabrata),* popular in Florida for forage, are propagated by rhizomes only and have been somewhat slower and more difficult to establish than forage peanuts.

Canavalia ensiformis (jack bean)

Jack bean is a vigorously growing annual legume that made a satisfactory cover crop for vegetable crops on Guam. It occurs mainly in cultivation in the tropics of both hemispheres. Its growth habit is somewhat bushy and it provides a good cover.

Chrysopogon zizanioides (vetivergrass)

The Sunshine cultivar is non-fertile. It is performing well for erosion control in the PIA for vegetative barriers, stream bank stabilization, and other uses. Commercial plant increases of Sunshine vetiver have been established on all the main islands in Hawaii and Guam and slips are available for sale. The American Samoa RC&D and the American Samoa Community College Land Grant have cooperated to make slips available in American Samoa. A plant guide was developed and the Oahu RC&D produced a DVD on Sunshine vetiver as a result of our Field Plantings.

Crotalaria juncea (sunn hemp)

Sunn hemp grows well throughout the Pacific Islands Area. The cultivar Tropic Sun is an excellent cover crop. It is resistant to root-knot nematodes and the seed and foliage are non-toxic. The seed is commercially produced on Oahu and approximately 10,000 pounds were produced in FY 10. In addition, it is estimated that Pioneer Seed on Oahu produced 80,000 pounds for their own cover crop use to rotate with their corn and other seed crops for their two operations on Oahu and one on Kauai. They also found that sunn hemp flowers attract a beneficial wasp. By growing sunn hemp with corn and timing the plantings so the sunn hemp produces flowers when the corn produces silk, the wasp parasitizes the corn ear worm. This is making it possible for them to use less pesticide for control of the corn ear worm.

Eragrostis variabilis (kawelu, ‘emoloa, lovegrass)

Kawelu is a perennial bunchgrass that is endemic to Hawaii. It is an attractive grass that is found on all the main islands and the Northwestern Hawaiian Islands as well. A selection collected on Kaho’olawe was formally released as Kaho’olawe Germplasm Kawelu Source Identified Class of Natural Germplasm. The native Hawaiians sometimes used kawelu as an alternative to piligrass for thatching their houses and other buildings. Restoration plantings on Kaho’olawe have been moderately successful. Damping-off disease of seedlings has been a problem that can be overcome by treating the seed with a fungicide.

Gliricidia sepium (gliricidia, quick stick, madre de cacao, rechesengel)

Gliricidia is a leguminous tree about 30 to 35 feet tall. It is easily propagated by cuttings or seeds. A windbreak planting on the Hamakua Coast is performing well; however, the annual rainfall there is apparently at the upper limit for gliricidia. It requires trimming to maintain a compact form. The trimmings are used as mulch for weed suppression, although the leaves decompose fairly quickly, and nitrogen addition. It’s a good species for agroforestry. It works well as a shade tree for coffee and cacao. Livestock will browse the foliage.

Heteropogon contortus (piligrass, tanglehead)

Piligrass is indigenous to Hawaii and is widely distributed in the tropics and subtropics. The native Hawaiians used it to thatch their houses in dry areas. It is a drought tolerant bunch grass that is currently being used for erosion control and restoration on the island of Kaho’olawe. This selection of pili was collected on Kaho’olawe and has been formally released as Kaho’olawe Germplasm Piligrass Source Identified Class of Natural Germplasm. On Kaho’olawe, it is the main grass planted in restoration plantings. It is doing a good job of erosion control where it was seeded and as intact hay bales. It also shows promise for roadside revegetation. The Kona Field Office has planted demonstration plantings of pili and kawelu at their office to show the plants to cooperators who are interested in planting natives.

Lablab purpureus (lablab)

'Rongai' lablab performed well in a cover crop Field Planting on Guam. It is a somewhat bushy legume and provides good cover.

Paspalum hieronymi (paspalum)

The cultivar Tropic Lalo is performing well throughout the Pacific Islands Area. It is a perennial, creeping grass that forms a dense cover when mowed, is tolerant of traffic, and is low maintenance. It is popular for foot paths and conservation cover in Kona. A coffee farmer who didn't believe in using conservation cover became a "convert" after planting Tropic Lalo and experiencing how easy it was to plant and maintain and appreciating the erosion controlling cover it provided.

Polyscias guilfoylei (panax, tanitani)

Panax has a relatively slow growth rate using conventional cultural methods. We have been able to achieve a reasonable growth rate of approximately 6-7 feet per year with drip irrigation and applications of nitrogen fertilizer. To achieve the equivalent wind protection of 'Tropic Coral' tall erythrina, panax rows need to be spaced closer in the field because its maximum height is only 25 to 30 feet as compared to 40 to 50 feet for Tropic Coral. The plants should also be spaced closer (2' apart) in the row. Termites will occasionally attack panax, but it is mainly in the dead stems and the frequency of occurrence is very low.

Sporobolus virginicus ('aki'aki, totoput)

Native to sandy, usually coastal sites in tropical and subtropical areas worldwide, 'aki'aki is usually found just above the high-tide mark. It will grow up to 1,000 feet in elevation, but the soil must be fairly loose for the rhizomes to spread. It shows promise for erosion control in dry, salty areas. It is drought tolerant and very salt tolerant. There is a vigorous stand of totoput on the beach near Garapan, Saipan.

Stenotaphrum secundatum (St. Augustinegrass)

A shade tolerant dwarf selection of St. Augustinegrass is performing well as a conservation cover in Kona orchards. The chinch bug has been reported to damage St. Augustine lawns on Kauai. We haven't observed damage in our Field Plantings, but it is something we must look for during our evaluations.

Urochloa brizantha (signalgrass)

Signalgrass is resistant to the yellow sugar cane aphid. The aphid can significantly reduce yields of other forage grasses. It is performing well on the limestone soils in Guam and Tinian and in pastures near Hilo and Waimea on the island of Hawaii.

Vigna unguiculata (cowpea)

'Iron Clay' cowpea was tested as a cover crop on Saipan and performed satisfactorily. It is resistant to root-knot nematodes. Seed is commercially available. Because of its good performance, Iron Clay was added to the list of species suitable for cover crop in the Pacific Islands Area Vegetative Guide.