Proposal for the Development Large Scale Seed Production and Roadside Establishment Protocols for Five Native Hawaiian Groundcovers.

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Introduction

Establishing native plants along transportation corridors has been recognized as an effective means of reducing the spread of invasive plant species. In Hawaii, the use of native Hawaiian plants in state sponsored plantings in conservation areas as well conventional landscapes has been mandated by various laws. As the interest and use of native plants increases in Hawaii the question arises: Where do you get seeds of native Hawaiian plants for large plantings along roadways, filter strips for farms and restoring degraded water shed areas? The answer, to date has been collections from undisturbed native habitats, governmental agencies like the USDA/NRCS or I just don/t know. Land managers seeking to use native Hawaiian plants for a variety of reasons are frustrated with the lack of native seeds either for field collection or outright purchase.

It would seem logical, that as the demand for native Hawaiian plants increases, growers would be willing to produce seeds and plants as part of a for-profit enterprise. However, the profitable production and processing of a seed requires special attention to weed control to improve the collection of clean seeds and maximizing the efficiency of resources such as labor, water and access to productive farm land. It is well established that modern herbicides offer the most cost effective means of weed control for large scale production of most any agricultural commodity.

The use of herbicides and other pesticides on crops grown for commercial enterprise requires that the pesticide label contain specific instruction allowing for the application to that particular crop. Since native Hawaiian plants are relatively rare with in comparison to conventional agricultural crops it is unlikely that any pesticide manufacture would ever expend resources to add native Hawaiian plants to their product label. The question then becomes: How can I produce large quantities of native Hawaiian plants and make use of commercial pesticides to maximize yields and harvest efficiencies?

Almost every herbicide brought to market in America has label wording allowing for application to road way rights of way. Therefore, if a host of commercial herbicides are available for use on highway rights of way it becomes clear that these areas represent a unique and desirable locations for producing seed of native plants while maintaining a use pattern consistent with label wording.

In this proposal, 5 species of native Hawaiian plants have been selected and a seed production protocol will be developed for each. The selection of these species was based on characteristics that include; drought tolerance (thrives in less than 20 inches annual rainfall), can contribute to erosion control, are prolific seeders, produces seed with good viability and vigorous seed germination, can sever as pollinator habitat/food source and lend themselves to mechanical seed collection and planting (hydroseeding, minimal till seeders and range planters).

The selection of these 5 species was based on in-person discussion with staff of the NRCS/USDA Plant Materials Center on Molokai (02/03/212) as well as follow up phone discussions. Local experts in the

field of native Hawaiian plant use and ecology were also polled (via email to [HIPLANTS-L@lists.hawaii.edu] on 02/24/2012) for their list of suggested candidates that fit the descriptions provided above. Their suggested species list included: Aalii (*Dodonaea viscosa*), Ilima (*Sida fallex*), Uhaloa (*Waltheria indica*), Kookoolau (*Bidens sandwicense*), Mao (*Gossypium tomentosum*), Iliee (*Plumbago zeylanica*), Ulei (*Osteomeles anthyllidifolia*), *Wikstroemia* spp., *Dianella* spp.,`Ahua`wa, (*Mariscus javanicus)*, Pua O Hiiaka (*Jacquemontia ovalifolia* subsp. *Sandwicensis*), Pua Kala / Hawaiian Poppy (*Argemone glauca*), Ahinahina (*Achyranthes splendens*), Aweoweo (*Chenopodium oahuense*), Kookoolau (*Bidens sandwicense*), Pohinahina (*Vitex rotundifolia*),. Kului (*Nototrichium sandwicense*), Maiapilo (*Capparis sandwichiana*) and Kooloaula (*Abutilon menziesii*).

The five species selected for extensive development in this proposal are: Aalii (*Dodonaea viscosa*), Ahinahina (*Achyranthes splendens*), Aweoweo (*Chenopodium oahuense*), Ilima (*Sida fallex*) and Uhaloa (*Waltheria indica*). An additional species that will be evaluated for adaptability for seed production and roadside use will be Maiapilo, a very drought tolerant perennial with a low growing habit. Essential aspects that need to be researched include the development of source identified seeds/planting materials; establishment techniques for large scale seed production, identification of small farm equipment for seed harvest and cleaning and development of large scale planting (e.g.hydroseeding / hydromulching) protocols for roadways and conservation areas as well as post establishment and maintenance protocols.

Proposed Research and Demonstration Objectives

Nursery seed lots will be obtained from the Plant Materials Center on Molokai. This USDA/NRCS station has been actively collecting and evaluating native plant for many years for adaptability to large scale seed production and high potential for successful establishment in disturbed ecosystem, such as the island of Kahoolawe.

Establishing seed production nurseries on Oahu.

Seed obtained from the NRCS or locally sourced locations will be used to produced transplants and establish a seed nursery at the CTAHR Waimanalo Research Station. This nursery will be maintained in a manner consistent with mechanical seed harvesting equipment. Plant structure and spacing for seed production will appear vastly different than plants grown in settings designed to simulate and restore native plant ecosystems. Seed nurseries of all 5 native Hawaiian species will be included.

Once a sufficient quantity of seed is produced at the Waimanalo station, a seed nursery of each of the will be installed at the H1 Halawa interchange. An area of 8000 ft^2 of each of the 5 native plant species will planted in a manner consistent with mechanical harvesting operations. Plantings at the UH Waimanalo Research station, H1 Halawa and H1/University Ave interchange will make use of woven black plastic weed mat to insure weed free seed production and easy pick up of fallen seed from the surface of the weed mat.

Weed control research with native plants.

There will be two distinct types of herbicide screening research proposed here. Research will be designed to identify herbicides and use patterns that can be used to establish large plantings of these 5 species using direct seeding and transplants. Pre and post emergence research on transplants will be designed for the establishment and maintenance of seed production nurseries. Research designed for direct seeded plantings will focus on preplant weed control treatments as well as research on seedling tolerance to pre and post emergence spray applications in the 4-6 week old range.

Adaption of small farm equipment for mechanical seed harvest of native plants.

Small farm equipment manufactures will be contacted that can supply devices that can be used for mechanical seed harvest in roadway settings. These machines may be sourced from manufactures that produce small scale versions of larger seed harvesters and are generally used by agricultural researchers at Universities, small scale grain producers and native plant seed suppliers. The objective is to find off the shelf equipment that can be adapted to mechanically collection seed from species selected for this proposal. Seed cleaning equipment will also be selected in a similar manner.

Roadway demonstration of natural style establishment and formation of mixed species landscapes.

A clearly different form of native plant establishment will be based on the ultimate landscape image of native plants growing in a natural form and juxtaposition. Here planting protocols may include methods that simulate the establishment of a stable mixture of native plants in a sequential introduction manner. For example, annuals and early pioneering species are the first to inhabit a severely disturbed landscape such as exposed bare soil resulting from a brush fire, landslide or flooding. Annuals quickly cover the soil surface and then relinquish the space gradually to more woody shrubs and tress. To simulate this form of plant succession, annual species will be introduced with mechanical methods such as hydromulching or reduced tillage planters. Once the annuals have dominated the site, then decline and leave behind their protective mulch, longer term perennials can be introduced either with transplants or seeding into a defined by natural looking spacing. Specific research outcomes will include data that specifies seeding rates of the early colonizers followed by selected perennials. Sequential methods of establishment will be compared to all-at-once introduction of seed mixtures containing both pioneering spices and later term perennials.

Location of field research and demonstration sites.

There will be several sites for this project, the DOT lot next to the on-ramp (westbound) of the H1 highway off of University Ave. in lower Manoa, the Waimanalo Research Station and the Halawa Interchange. All areas are secure and except for the Halawa Interchange, irrigation systems have already been installed. The H1University and Halawa Interchange sites will be used for conducting actual roadside seed production plantings and establishment studies while the Waimanalo Research Station will be used for herbicide screening for transplant and direct seeded plantings, evaluation and development of mechanical planting techniques and production of planting materials. Since both H/University Ave. and Halawa Interchange sites are highly visible tothey represent ideal demonstration sites for public outreach.

Information generated from these studies will be incorporated in the Hawaii DOT Specifications (e.g. Section 641) as written protocols. Project results will also be made available to the public via academic journals, conference proceedings, online resources and other forms of media (e.g. newspaper articles, TV).

Proposed Schedule:

Year 1: Site preparation for seed nurseries at Waimanalo and Halawa interchanges; prepare planting materials and growth support infrastructure (i.e. irrigation control systems) for nurseries and herbicide screening experiments, hiring of graduate research assistants.

Year 2: Acquire seed harvest and seed cleaning equipment, seed production (e.g. harvesting and processing) and follow up herbicide screening studies, condition plantings for mechanical seed collection.

Year 3: Natural area establishment studies (compare sequential species introduction to all at once seed mixture plantings), data collection and report writing; writing of protocols for amending HDOT specifications; information dissemination through field days and publications; hiring of researcher/post-doc

Interim reports will be provided at three month intervals, upon start of project.

F. Preliminary Budget:

	Year 1	Year 2	Year 3
Personnel (salary-RA)	20,467	21,490	
Fringe for grad. student (11.09%)	2,269.79	2,383.24	
Personnel (salary-post doc)		42,144	43,848
Conference fees	1,200	1,000	1,000
Material and Supplies:	6,000	4,000	12,566.19
Seed harvesting/cleaning equipment	25,000	16,000	16,600
Travel and Transportation:	2,000	2,000	1,000
Publication costs	880	2,000	3,000
Subtotal	57,816.79	91,017.24	78,014.19
UH overhead (10%)	5,781.68	9,101.72	7801.42
Totals	63,598.47	100,118.97	85,815.61
Project Total	249,533.04		

4. Deliverables.

A. Construction and maintenance specifications for each species. Protocols on seed production and establishment (pre and post) will be incorporated in the HDOT Specifications.

B. Seed nurseries (5 species-.2 acre each) at Halawe Interchange.

C. Field days and workshops on site.

D. Written reports and journal articles on the results of the studies.

E. Online content (as streaming media) regarding herbicide screening for native plant establishment on roadways for wide distribution of proposed research.

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