Finding Ways to Increase the Large Scale Utilization of Native Hawaiian Plants for Erosion Control

The use of native plant seeds for erosion control in Hawaii is a challenging one. There are two major factors that influence its use and applicability, they are, the lack of large quantities of native seeds and the technology to successfully apply and establish native seeds on large parcels of land. In recent years the general public and its emotional and political stance on the use of native plants has driven State and Federal agencies to utilize native plants wherever possible.

The lack of large quantities of native seed: This is in part the biggest obstacle in the use of native plants for erosion control. There are no reliable sources of native seeds (commercial) in the quantities needed to address its targeted use. What are large quantities of seed? Large quantities of seed can be defined as the amount of seed needed to address several acres to several hundreds acres of land. In terms of pounds of seed this could be a few pounds of seeds per acre or several pounds for a few thousand square feet. The amount of seed used differs and is dependant on severity of erosion to be treated and the overall intent on the use of seed for conservation work. For example, on steep highly erodible slopes, seeding rates may need to be higher to provide quick cover and establishment. Another example is in the use of native seeds for native plant restoration use. In this scenario the use of seeds may not be used solely to control erosion but to also provide adequate representation of native plant population in a given area. The amount of seeds used may only be a few pounds per acre. The amount of seed used in this scenario may seem small but in the event when hundreds of acres need to be treated, such as in wildfires the amount of seed required can be large.

The application method of large quantities of native seed: The application method and establishment of native seeds to control erosion on a large scale has not been thoroughly investigated. Indeed the large scale application of non-native seeds for erosion control has been practiced by the use of planes, helicopters, manual and mechanical broadcasting and hydro-mulching/hydro-seeding (hydroplanting) techniques. These seed application practices is commonly done after wildfires have scorched the landscape or to stabilize roadside cuts, fills and steep slopes. These application methods have met with some success and this is especially true in the hydro-mulching/hydro-seeding field. Hydroseeding is a term used to describe the application of a slurry, which is a mixture of water, grass seed, fertilizer, and fiber mulch to a site where vegetation is desired. Hydromulching is the same process, except it utilizes a heavier slurry, which only a mechanical agitation machines can achieve. Hydoseeding generally refers to recirculating jet agitation type machines.

Although the use of natives may not in all cases be the only way to treat erodible sites, it is to some degree an alternative to the application of non-native seeds. In 2007, Dr. Joeseph Defrank, Weed Science Specialist with the University of Hawaii and along with graduate student Orville Baldos conducted a study on three hydroplanting techniques with native plant seeds. Dr. Defrank was successful in establishing *Frimbristylis cymosa*, or commonly called Mau`u aki `aki with hydroplanting techniques. The success of this study could further the incentive to increase the commercial production of native plant seed industry in Hawaii. The following study was conducted in partnership with the Universtiy of Hawaii at Manoa and the USDA NRCS Hoolehua Plant Materials Center. For further information or questions you may email Dr. Defrank at defrenk@hawaii.edu or visit his website at http://www2.hawaii.edu/~defrenk/

ASSESSING THREE HYDROPLANTING TECHNIQUES FOR ESTABLISHING *FIMBRISTYLIS CYMOSA* R.BR., A NATIVE HAWAIIAN SEDGE

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Introduction

The development of hydroplanting techniques for native Hawaiian groundcover species provides an opportunity for utilization in large-scale erosion control, roadside re-vegetation and restoration projects. *Fimbristylis cymosa* R. Br. is a potential native Hawaiian sedge that can be established through hydroplanting. Referred to as mau‘u ‘aki ‘aki in Hawaiian, this coastal sedge is an ideal groundcover because it is easy to propagate, is low growing and drought/salt tolerant. Though easily propagated by seeds or by division, it is not known if this species can be established using hydroplanting techniques. This study evaluated the establishment success of three hydroplanting techniques (handsowing-hydromulching, hydroseeding and hydroplanting) in terms of percent visual cover and plant counts.

Materials and methods

The establishment success of three hydroplanting methods were evaluated in compost filled plots (3.05 m x 3.05 m x 5.08 cm) for six months (Figure 1). Two months prior to hydroplanting, seeds and plantlets of mau‘u ‘aki‘aki (*Fimbristylis cymosa*) were prepared. For treatments involving plantlets, seeds were sown in aluminum trays filled with a mixture comprised of 40 percent cinder and 60 percent Promix (Premier Horticulture). Seeding rate was approximately 0.85 grams per square meter or an average of 0.15 grams per aluminum tray. Seeds were allowed to germinate and grow for two months under irrigated field conditions. A day prior to hydromulching, the sod was separated into individual plantlets by teasing it in a bucket of water. Plantlets were cleared of growing medium and kept moist. Approximately 70 grams of plantlets (equivalent to 616 plants) were used in both handsown seedlings capped with hydromulch and hydroplanted seedling treatments. This is equivalent to a sowing rate/planting density of 199 plants/m^2. For the hydroseeded treatment, 0.1 grams of sedge seed/m^2 (containing approximately 1,490 seeds) was used (Figure 2) to have a seeding density of 481 seeds/m^2. Table 1 lists the amount of tackifier (C:tac, Hamilton Manufacturing Inc.), paper mulch and water used for each treatment.

The treatments were applied unto a compost medium, which was limed at a rate of 2.241 tons per hectare and fertilized with superphosphate at a rate of 224 kilograms per hectare. Except for seedlings covered with hydromulch, all the materials of the other two treatments were mixed in a hydroseeder before applying onto the prepared surface. The hydromulch system (Turbo Turf Modular Hydroseeding System Model No. HS-50-M) consisted of a 189.27 liter (50 gallon) tank and a 2”x 2” centrifugal pump applying approximately 113.56 liters per minute (30 gallons per minute). To reduce contamination of treatments within each plot, areas other than the treatment to be applied were covered with weed cloth. Each treatment covered approximately 3.1 square meters per plot.

Irrigation was set to open 3 times a day for five minutes to keep the plots from drying out. After four months, irrigation was reduced to once a day for 10 minutes. Due to the presence of a moisture gradient within each plot, three permanent sample areas were established within each treatment. The size of the sample areas were 30.48 cm x 30.48 cm (1 ft^2). Plant counts were collected during the first two months while percentage cover for the first six months was evaluated visually through digital photographs of the sample areas (Figure 3).

Table 1. Amount of planting material, tackifier, paper mulch and water used for each of the hydroplanting treatments.

Hydroplanting treatments	Planting material	Tackifier	Mulch	Water
Hand drop seedlings + hydromulch cap	70 g seedlings (199 plants/m^2)	3.3 g	1.36 kg (4400 kg/ha)	13.36 gal (50.57 liters)
Hydroplanting (plantlets)	70 g seedlings (199 plants/m^2)	3.3 g	1.36 kg (4400 kg/ha)	13.36 gal (50.57 liters)
Hydroseed	0.1 g seeds (481 plants/m^2)	65 g	0.682 kg (2200 kg/ha)	6.68 gal (25.29 liters)

Results

Hydroseeded treatments showed the highest plant density after two months (25 plants per ft^2) followed by the handsown treatment (7.5 plants per ft^2) and the hydroplanted seedlings (2.7 plants per ft^2) (Figure 4). Percent survival after two months based on initial (live/viable) seeding density was highest in hydroseeded plots (62%) followed by handsown plots (41%). Hydroseeded plots exhibited the highest percent visual cover over the six month observation period (Figure 5). Percent visual cover of handsown plots did not significantly differ with that of hydroseeded plots. Hydroplanted seedlings had the lowest percent survival (1%) and produced very little plant cover (6.76%) over the six month observation period (Figure 6).

Discussion

Both hydroseeding and the hand sowing-hydromulching treatments were successful in establishing a percent visual cover greater than 50% within six months. Although handsown seedlings had an advantage in terms of plant development, it did not differ with hydroseeding in terms of monthly percent cover. This may be due to lower plant densities and slow recovery due to transplanting shock. In contrast to hand sowing, the hydroseeding operation requires less labor and resource inputs.

Low plant density and percent visual cover observed in the hydroplanted seedling treatments was due to mechanical damage of seedlings as seedlings passed through the centrifugal pump (Figure 7). Seedlings were probably too big to deliver with the type of pump used in the study.

Conclusion

The results of the experiment indicate the feasibility of hydroseeding as a suitable method for large-scale establishment of *Fimbristylis cymosa*.

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Acknowledgements

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Figures

Figure 1. The three hydroplanting techniques evaluated in this study: A) handsown seedlings covered with mulch; B) hydroseeding and C) hydroplanted seedlings

Figure 2. The amount of seed used in the hydroseeding treatment. The vial contains approximately 1490 seeds.

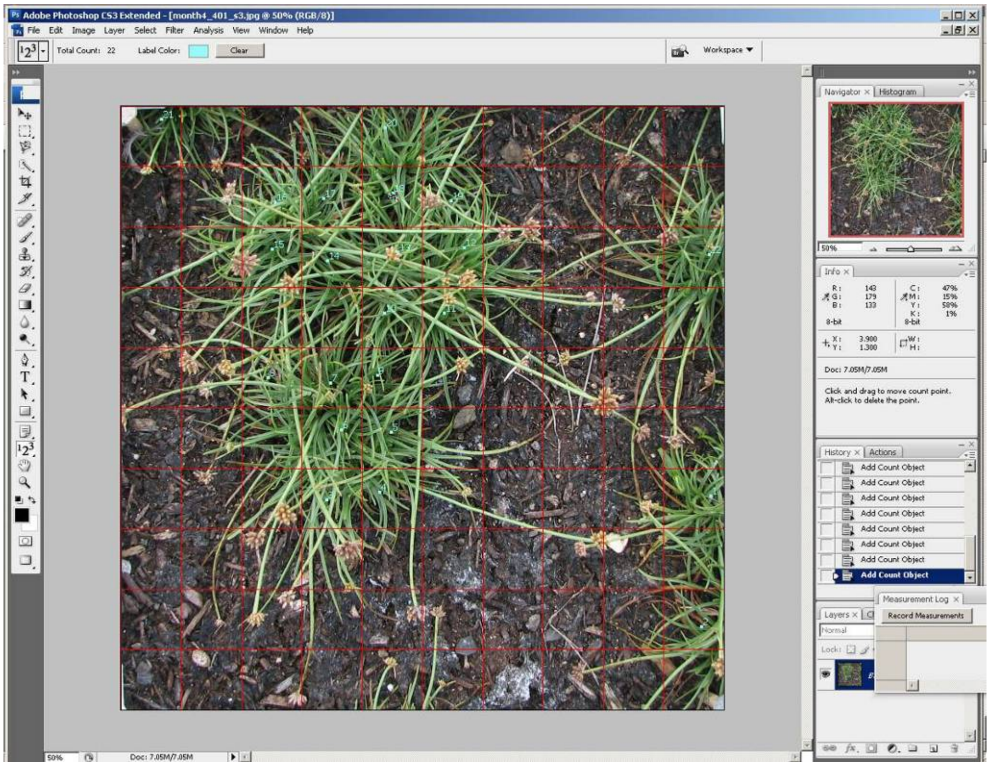

Figure 3. Estimating percent visual cover in Adobe Photoshop. Digital photographs of the sample were superimposed with 100 square grids. Percent visual cover was estimated by counting the number of squares occupied by foliage.

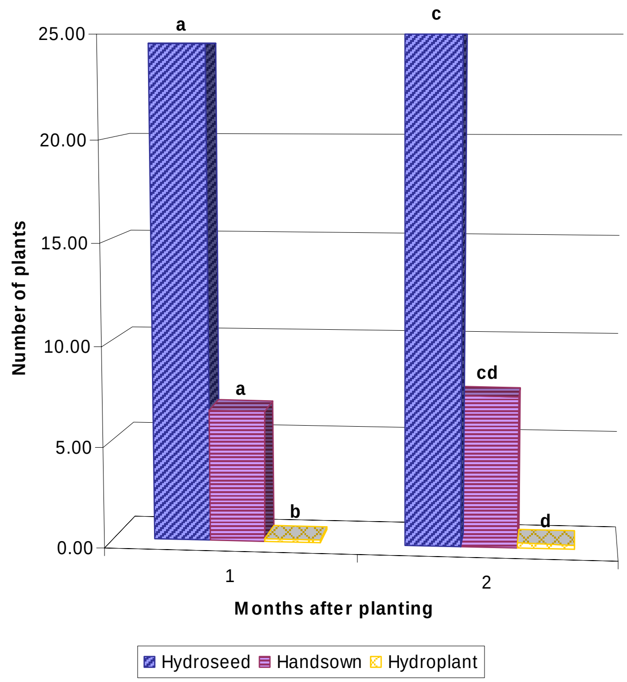

Figure 4. Average plant number of the different hydroplanting treatments during the first two months after planting. Hydroseeded treatments exhibited the highest number of plants per sample for the first and second months after planting. Columns with the same letter within each month are not significantly different (P = 0.001).

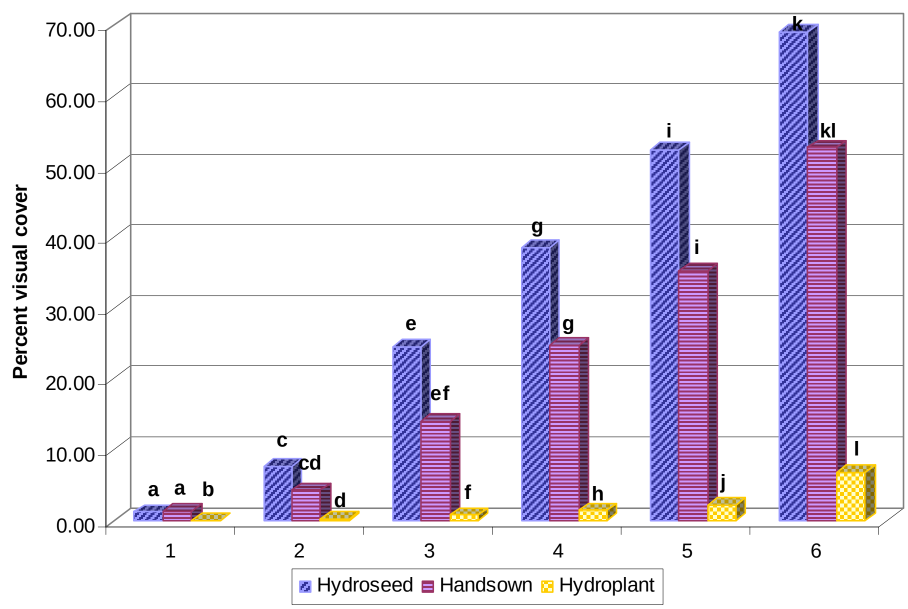

Figure 5. Average visual percent cover of each hydroplanting treatment over a period of six months. Hydroseeding and handsown plots were consistently the highest in each month. Columns with the same letter within each month are not significantly different.

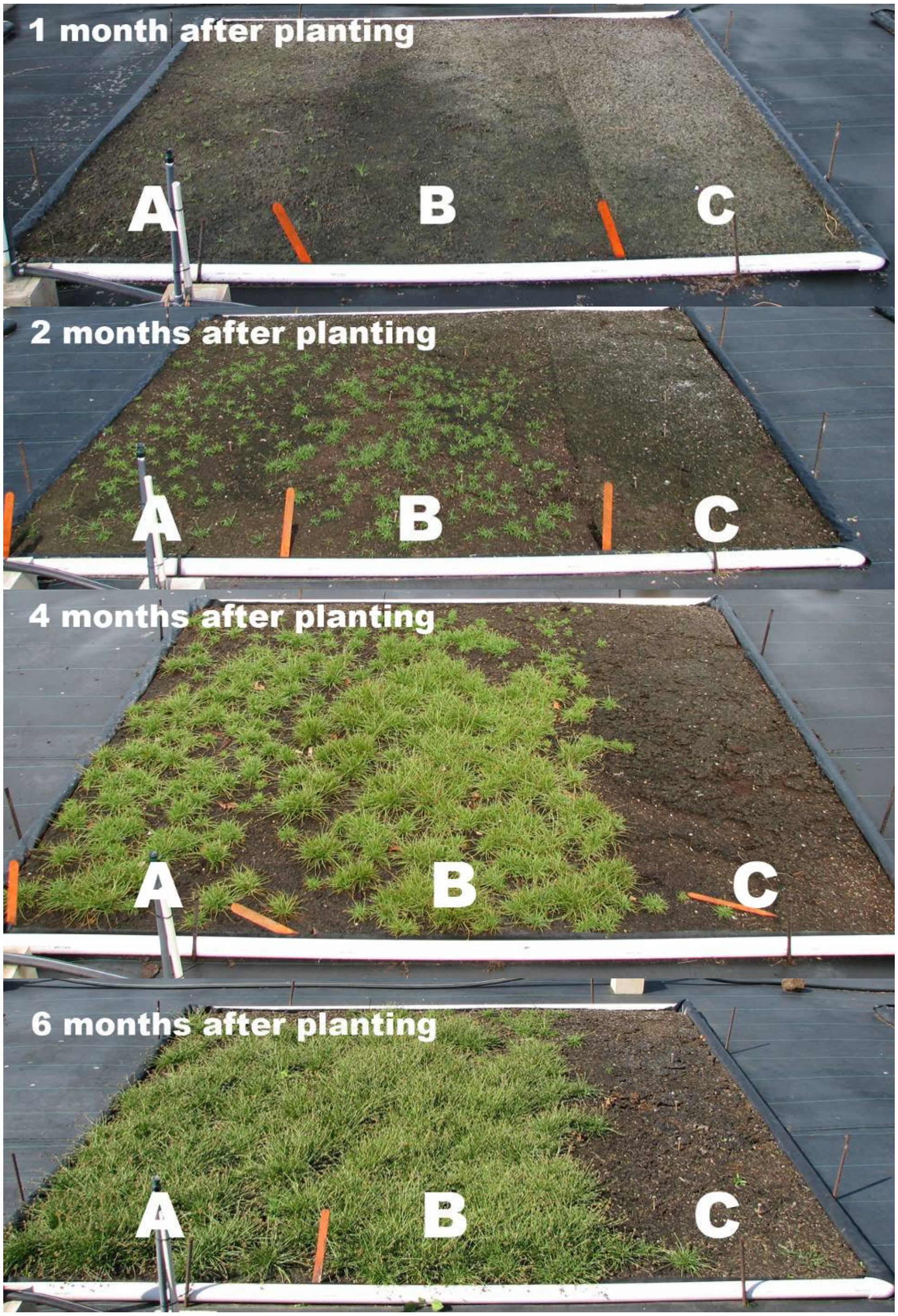

Figure 6. Hydroplanting treatments over the period of six months: A) handsown seedlings covered with hydromulch; B) hydroseeding; C) hydroplanted seedlings. After six months hydroplanted seedlings produced very little cover unlike handsown seedlings and hydroseeding.

Figure 7. Mechanical damage incurred by hydroplanted seedlings during the planting process.