Piligrass: Mulching Rates with Seeded Hay-Bales

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INTRODUCTION

Piligrass has a world-wide distribution and is found in the warm tropical regions of both hemispheres. There is extensive variation within this species throughout its range. Piligrass is an erect, branching perennial grass that may form rather large bunches. At the Hoolehua Plant Materials Center, piligrass has grown to heights of up to 5 feet tall; on the other hand, under natural conditions in Hawaii, it usually grows only 1 to 3 feet in height. The stems are flattened, relatively tough, smooth, and pale bluish-green in color. Leaves are produced throughout the length of the stem and are flat or folded, 4-12 inches long, approximately 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 one that is fertile bears a conspicuous red-brown awn about 4 inches long, made crooked with two bends. The long-awned seeds are sharp and pointed, forming tangled masses as they mature. When the seeds come in contact with moisture its hygroscopic awns and sharp-barbed tips arch and twist, aiding in planting them into the soil.

Undesirable plants have invaded grazing lands and native plant communities. They consume needed moisture and are generally not as well-suited for controlling erosion as other more desirable species. Experimentation with high seeding rates of native and other desirable plants in order to provide a dense cover to compete with invasive species is needed. *Heteropogon contortus* has the potential of filling this need. 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 increasing diversity in riparian and other native plant communities.

It is speculated that mulch layer thickness has a direct effect on seed germination of incorporated seed. The objective for this trial was to evaluate the effect that *Heteropogon contortus* (piligrass) seeded-hay mulch thickness may have on piligrass seed germination by measuring Percent-Cover of the emerging plants.

MATERIALS and METHODS

The accession that was utilized for this evaluation was *Heteropogon contortus*, Accession #9079683. It is a Source Identified strain from the island of Kahoolawe that has been cultivated at the Hoolehua Plant Materials Center. The *H. contortus* hay bales produced at the Hoolehua PMC are approximately 35 pounds and contain, on average, 0.5 pounds of bulk seed. *H. contortus* seed has a dormancy period of at least 6 months. The bales used were harvested on October 11, 2007. The plots were started on May 12, 2008. Tests have shown that the germination rate of *H. contortus* seed peaks at about 45-50%. A germination test verified that the seed

contained in the bales that were utilized for this evaluation had a germination rate of roughly 12%.
Using the above numbers, the seeding rates of the various mulch rates were calculated as follows:

35 lbs.	= 1.00 bale	= 0.50 lb. bulk seed	= **0.06 lb pure live seed**
¼ ton hay/A	= 14.25 bales/A	= 7.125 lb. bulk seed	= **0.86 lb. pls/A**
½ T hay/A	= 28.50 bales/A	= 14.25 lb. bulk seed	= **1.72 lb. pls/A**
¾ T hay/A	= 42.75 bales/A	= 21.38 lb. bulk seed	= **2.58 lb. pls/A**
1 T hay/A	= 57.00 bales/A	= 28.50 lb. bulk seed	= **3.44 lb. pls/A**
2 T hay/A	= 114.00 bales/A	= 57.0 lb. bulk seed	= **6.88 lb. pls/A**
3 T hay/A	= 228.00 bales/A	= 114.0 lb. bulk seed	= **13.76 lb. pls/A**

Experimental Design Randomized Complete Block Design, RCB

Treatment 1 Title: T1 - ¼ ton per acre of hay
Description: 0.71 lbs. per plot

Treatment 2 Title: T2 - ½ ton per acre of hay
Description: 1.42 lbs. per plot

Treatment 3 Title: T3 - ¾ ton per acre of hay
Description: 2.14 lbs. per plot

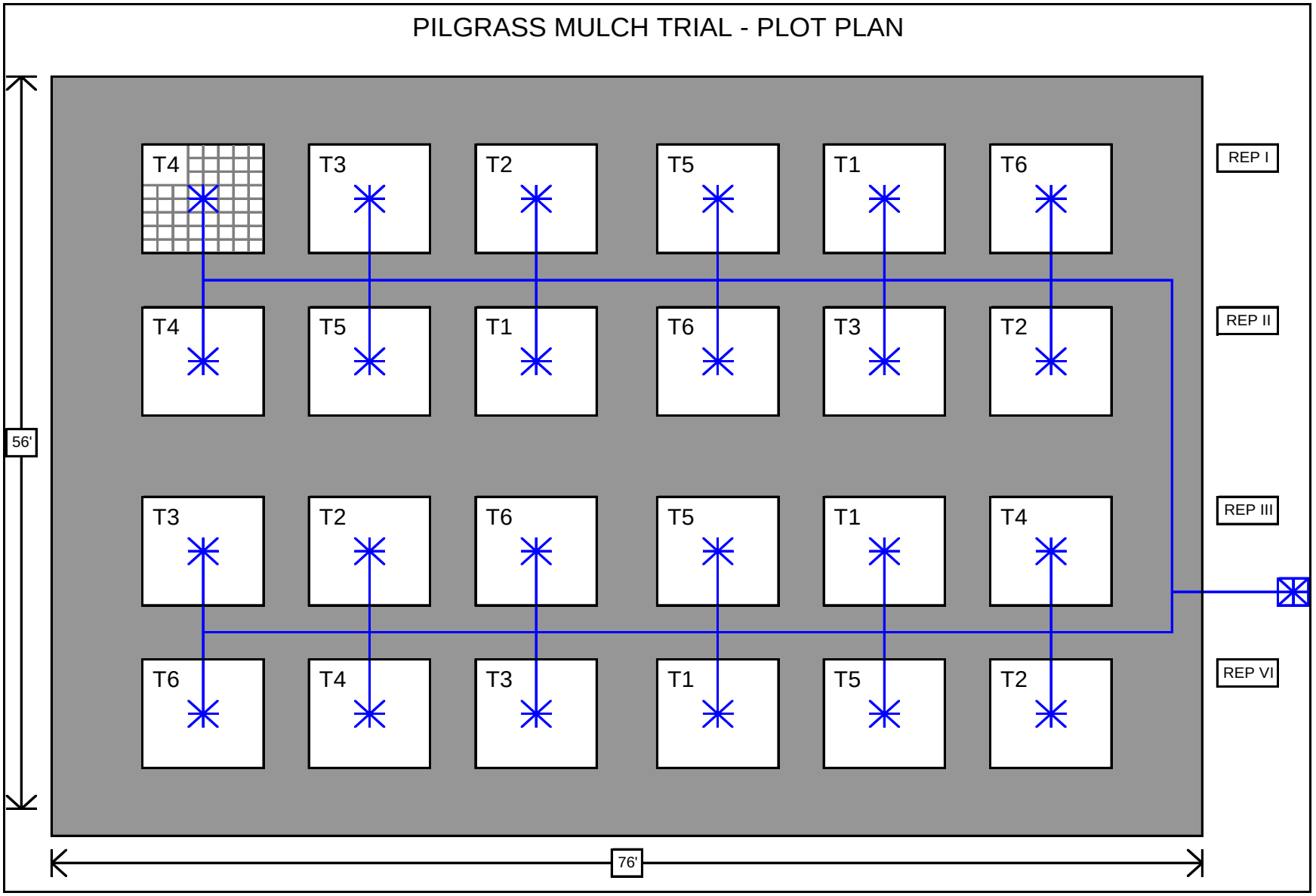
Treatment 4 Title: T4 - 1 ton per acre of hay
Description: 2.85 lbs. per plot

Treatment 5 Title: T5 - 2 ton per acre of hay
Description: 5.69 lbs. per plot

Treatment 6 Title: T6 - 3 ton per acre of hay
Description: 8.54 lbs. per plot

The design for this trial is a Randomized Complete Block design with six treatments and four replications (24 plots). In order to control weeds, Sunshine MIX1™ potting mix was utilized as the planting medium. The potting mix was put in above-ground "pots" that measured 8 ft x 8 ft and constructed of wooden 2x4's with a plastic-lined bottom containing holes to let water drain. Irrigation was supplied by micro-sprinklers set to automatically come on twice a day at 30 minute intervals. A mesh type wire was laid over each plot to protect the mulch from blowing away.

Vegetative cover was measured through the use of a "point frequency" method. Photos were taken from 10 ft directly above each plot and overlaid with a transparent grid of 420 points (20 x 22). Points touching vegetation were counted as "hits". Total hits divided by total points equaled "percent cover". The plots were evaluated twice, at two months and at five months. The data obtained was analyzed using the Statistix8 program. The photo that follows is an example of a plot photo with an overlaid transparent grid. Yellow spots are considered "hits".


PILGRASS MULCH TRIAL - PLOT PLAN
T4
T3
T2
T5
T1
T6
REP I
T4
T5
T1
T6
T3
T2
REP II
56'
T3
T2
T6
T5
T1
T4
REP III
T6
T4
T3
T1
T5
T2
REP VI
76'

ANALYSIS

There are two discrepancies associated with this trial: 1) the method used for sampling the amount of mulch for each plot and 2) the timing of the planting. It has been observed here at the Hoolehua PMC that it is unlikely that there will be an even distribution of seed throughout a single piligrass seeded-hay bale. If the bale is going to be used for a large scale project, namely anything larger than 1 acre, then this would not pose a problem. The variations in seed distribution over a large area will not dramatically impact the desired outcome of providing adequate cover. However, for a small scale trial such as this, ensuring a decent representation of the amount of seed needed, can pose a problem. The same variations in seed distribution over a smaller area will be magnified; thus skewing the data.

We did not realize this situation until after the mulch plots were laid out. A total of only eight bales were used for the entire trial. It is understandable that, given this variable, there will be some plots with more viable seeds than others. The more statistically sound approach to gaining an accurate representation of the amount of seed in each bale would have been to obtain one sample from one bale for each plot, instead of from 8 bales for 24 plots.

Also, due to windy conditions, all four replications could not be planted at the same time. REP I and REP II were planted on May 12, 2008 and REP III and REP IV were planted on May 17, 2008. It is understood that if the replications are to be planted on different days, then each replication in its entirety should be planted on the same day. The planting of REP I and II are separated by only 6 days from REP III and IV, and will probably have little effect on the data after five months.

At 63 days after planting (DAP) the data indicates that the three lowest mulching rates had the three lowest amounts of vegetative cover. The 500 lbs/A rate had 1.6% cover; the 1000 lbs/A rate had 1.6% cover; and the 1500 lbs/A had 2.4% cover. This suggests that these mulch rates have no significant difference from each other. At 63 DAP, the 2000 lb/A rate had 6.5% cover and the 6000 lb/A rate had 9.7% cover. These two rates were similar to each another and also showed a slight increase in vegetative cover over the 500 lb/A, 1000 lb/A, and 1500 lb/A, but the Statistix8 program proved that this increase in cover was not significantly different from the lower rates. At 63 DAP, the 4000 lb/A rate had 37.6% vegetative cover. According to the Staistix8 program, this was a significant difference.

At 158 DAP, the data showed a similar trend to the previous evaluation. The three lowest mulching rates, again, had the three lowest amounts of vegetative cover. The 500 lb/A rate increased to 18.7% cover; the 1000 lb/A rate increased to 17.9% cover; and the 1500 lb/A rate increase to 23.5% cover. This suggests that these mulch rates have no significant difference from each other. At 158 DAP, the 2000 lb/A rate increase to 49.2% cover and the 6000 lb/A rate increased to 49.3% cover. Once again, these two rates were similar to each another and also showed an increase in vegetative cover over the 500 lb/A, 1000 lb/A, and 1500 lb/A, but the Statistix8 program proved that this increase in cover was not significantly different from the lower rates. At 158 DAP, the 4000 lb/A rate had 74.1% vegetative cover. According to the Staistix8 program, this was a significant difference.

Piligrass Seeded Haybales Mulch Trial (158DAP)

RATE: 500lbs/Acre (¼ ton/Acre)

REP I

REP II

REP III

REP IV

Piligrass Seeded Haybales Mulch Trial (158DAP)

RATE: 1000lbs/Acre (½ ton/Acre)

REP I

REP II

REP III

REP IV

Piligrass Seeded Haybales Mulch Trial (158DAP)

RATE: 1500lbs/Acre (¾ ton/Acre)

REP I

REP II

REP III

REP IV

Piligrass Seeded Haybales Mulch Trial (158DAP)

RATE: 2000lbs/Acre (1ton/Acre)

REP I

REP II

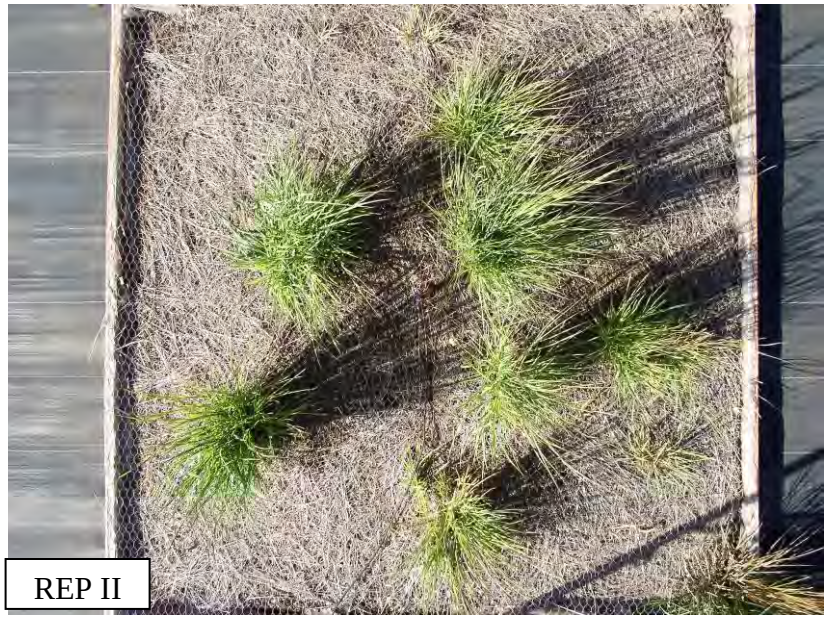
REP III

REP IV

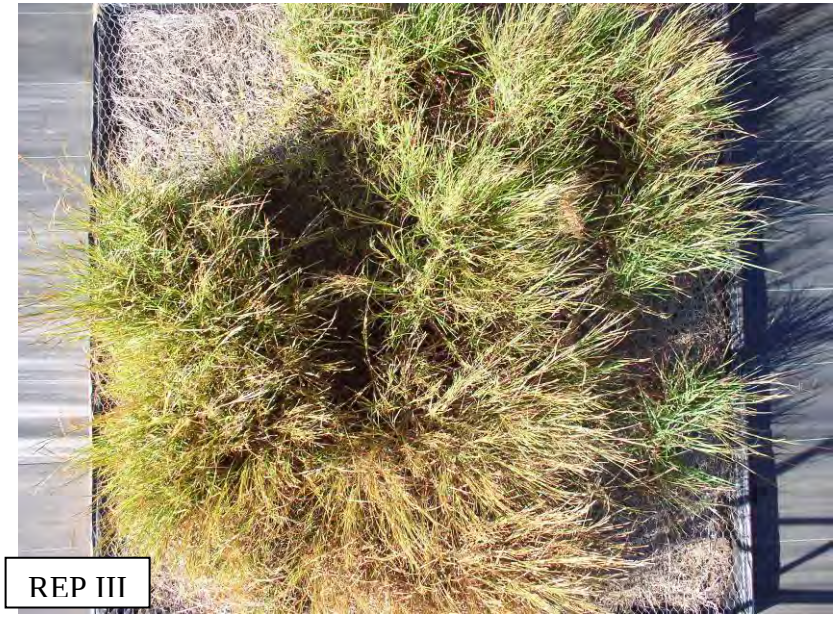
Piligrass Seeded Haybales Mulch Trial (158DAP)

RATE: 4000lbs/Acre (2tons/Acre)

REP I



REP II

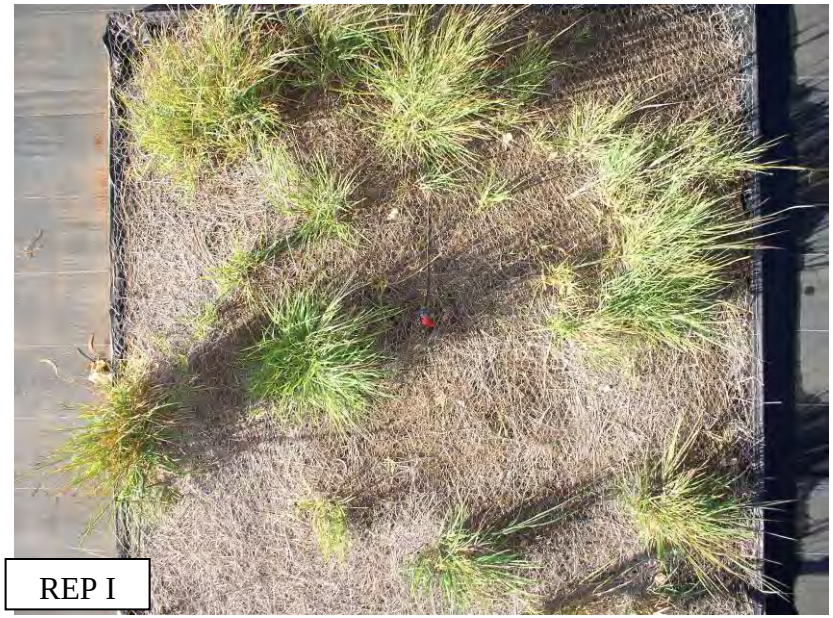


REP III

REP IV

Piligrass Seeded Haybales Mulch Trial (158DAP)

RATE: 6000lbs/Acre (3tons/Acre)



REP I

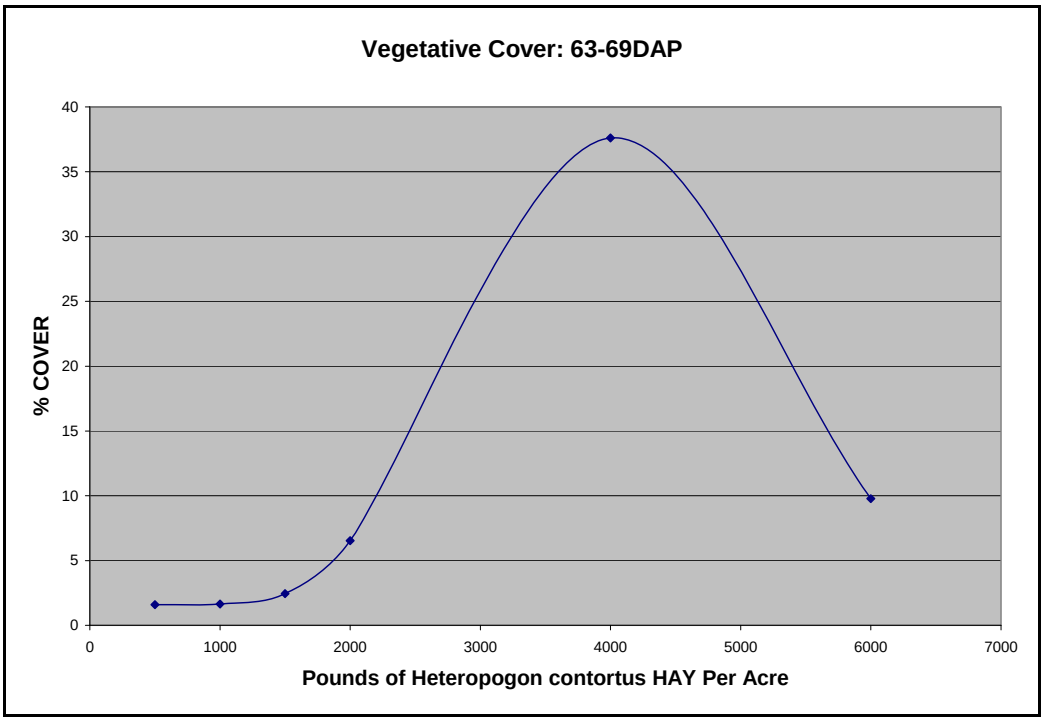
REP II

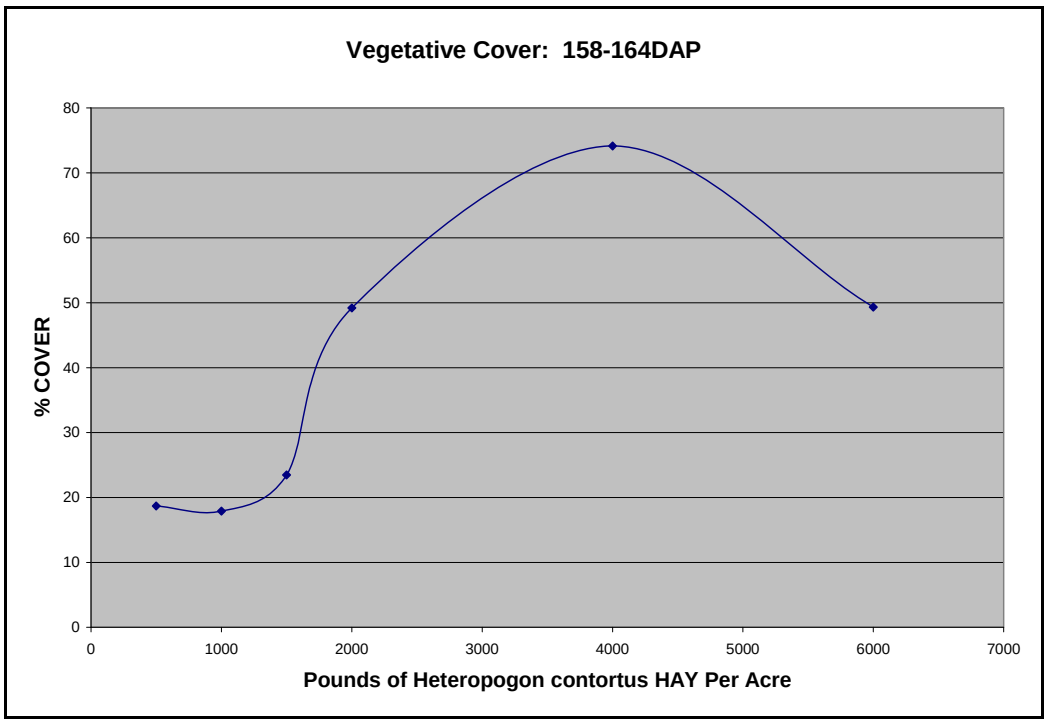
REP III

REP IV

Average Vegetative Cover

MULCH RATE	%COVER – 63DAP	%COVER – 158DAP
500 lb/A	1.591	18.693
1000 lb/A	1.648	17.898
1500 lb/A	2.443	23.466
2000 lb/A	6.534	49.205
4000 lb/A	37.614	74.148
6000 lb/A	9.773	49.318





DISCUSSION

It is speculated that mulch-layer thickness has a direct effect on seed germination of incorporated seed. The objective for this trial was to evaluate the effect that *Heteropogon contortus* (piligrass) seeded-hay mulch may have on piligrass seed germination by measuring vegetative cover.

Before the start of the trial, it was assumed that there would be a definite “bell curve” of the data gathered. When increasing the thickness of the mulch (seeded hay) the amount of seed also increases. Therefore, more mulch will indicate greater potential for more vegetative cover. On the other hand, there is a point at which the mulch will be too thick and will begin to hinder the germination of the contained seed.

We needed to determine the point of diminishing returns, at which there would be a reduction in vegetative cover caused by the mulch thickness. This would, in turn, reveal the point at which the amount of vegetative cover would be the greatest. The amount of vegetative cover began with an increasing trend as the amount of mulch increased, but vegetative cover started diminish at or somewhere before 6000 lb/A. Therefore, we can say that the vegetative cover for this particular trial peaked near 4000 lb/A. At this rate one could probably expect the maximum amount of vegetative cover to be produced using seeded-hay mulch. The germination rate of the seed used in this trial was about 12%. One can also assume that amount of vegetative cover will increase if there is an increase in germination rate. For example, if the germination rate was at 48%, one could probably expect over 92% vegetative cover with only 1500 lb/A of mulch.

Although the optimum mulch-rate for maximum vegetative-cover was found, a cooperator will be inclined to utilize his resources to the fullest potential. He would want to know the least amount of material needed to gain adequate vegetative cover. For example, if 50% vegetative-cover is adequate, then what would be the least amount of mulch required to do this and how long would it take.

Another obstacle is determining the most effective way to keep the mulch layer in contact with the soil. In the Pacific Island Area, relatively high trade-winds that blow during most of the year will blow unsecured plantings away. In this trial a wire mesh was utilized. More cost-effective, biodegradable methods need to be investigated. Also, different distribution methods for large-scale projects also need to be investigated.

Piligrass seeded-hay may be utilized for weed suppression. Under the conditions of this particular trial the amount of piligrass seeded-hay mulch needed to produce the maximum amount of vegetative cover was determined. The amount of mulch that begins to suppress seed germination was also revealed. It can be assumed that if piligrass seed germination is being suppressed then weed-seed germination would also be suppressed. More investigation needs to be done as to what weeds can be suppressed and also at what rate weed suppression begins. Piligrass seeded-hay may be an appropriate choice for conservation projects in the Pacific Islands; however more research needs to be done.