Seedling Survivability of Zeba-Treated Seeds of Two Native Hawaiian Plant Species: *Eragrostis variabilis* and *Dodonaea viscosa*

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Introduction

Zeba is a unique superabsorbent polymer based on natural cornstarch, making it biodegradable, non-toxic and odorless and safe for use on all crops, including food crops. It is a patented soil amendment that improves plant yield and plant quality over the course of a growing season by reducing water application requirements through better water utilization. Instead of water being dispersed into the soil or evaporating, the water is absorbed by the Zeba-polymer to form a hydrogel and held for the plant to use as needed.

This starch-based polymer has several advantages over polyacrylamide formulations (PAMs) and other petroleum-based "super-absorbents". The primary advantage is that the Zeba hydrogel readily relinquishes stored water to plants when plants need it. PAMs, on the other hand, tend to hold water tightly and often will compete with plants for water. Also, the immense size and weight of its molecular structure sets Zeba apart. These anionic units are able to absorb moisture more than 500 times their original weight. In addition, Zeba particles are also an attractive food source for soil microorganisms. Over time, microbes consume the Zeba particles, producing a richer soil environment. The microenvironment created provides plants with the moisture and nutrients necessary for successful growth. By keeping the right amount of moisture available to plants as needed, Zeba facilitates plant production from seed germination through harvest.

Eragrostis variabilis and *Dodonaea viscosa* are very drought tolerant plants that were probably one of the first pioneer plants of the early Hawaiian Islands. If native plants like these were given an advantage to increase their survivability rate over invasive species in critical areas, more cooperators would be inclined to tackle such problems. Zeba is a seed coat product that is claimed to increase certain plants' survivability in low rainfall conditions. The general consensus is that drought tolerant plants are most vulnerable at the seedling stage. With enough moisture, provided by a Zeba seed-coat, seedlings would have a better chance to survive. The goal of this study is to determine if the seed coating developed by Zeba would increase the survivability of plant seedlings under natural rainfall conditions, particularly *Eragrostis variabilis* and *Dodonaea viscosa*. If so, the ZEBA seed-coat could prove to be a valuable tool in re-vegetating natives in critical areas.

Method

The two accessions sent to Zeba for seed-coat treatment were:

Eragrostis variabilis (ACC#9079729)

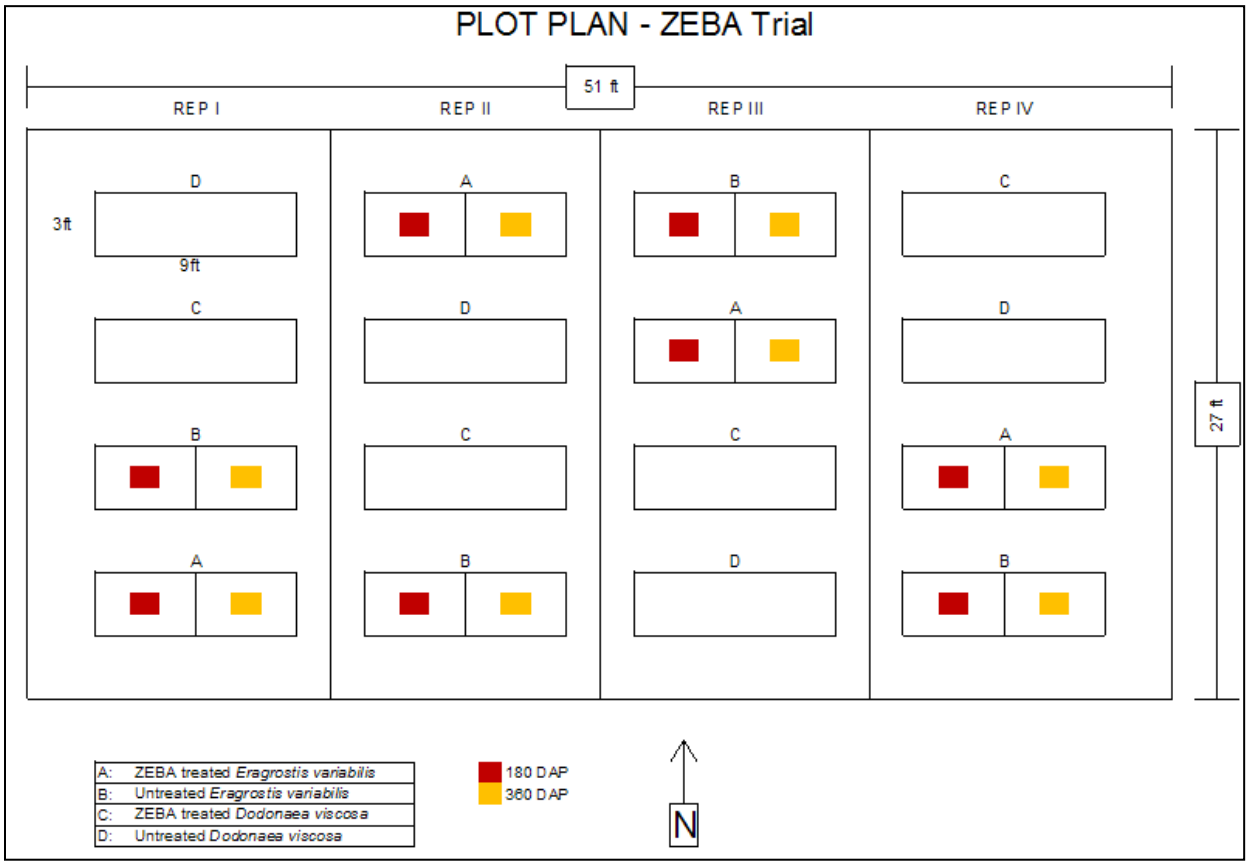
Dodonaea viscosa (ACC#9079682)

To assure plant seedling identification during evaluations, the plots were flushed of weeds and the isles between the plots were covered with wood chips to help suppress weeds. The isles were 3ft wide to facilitate evaluations. Each plot measured 3ft x 9ft. The trial consisted of 4 replications with 4 treatments for a total of 16 plots (Figure 1).

The treatments were as follows:

Treatment A	*Eragrostis variabilis*: treated with ZEBA coating
Treatment B	*Eragrostis variabilis*: untreated
Treatment C	*Dodonaea viscosa*: treated with ZEBA coating
Treatment D	*Dodonaea viscosa*: untreated

Figure 1 (plot plan).



Seeding rate treatments were a bit tricky to measure. To be assured that each treatment was seeded with the same amount of seed, we needed to determine the weight of coated seed as compared to uncoated seed. To accomplish this, a known amount of coated seed was weighed. The seed coat was removed and the seed was weighed again. The seeding rates were as follows:

Eragrostis variabilis – 10 lb/A = 3.125 g/plot
Dodonaea viscosa – 10 lb/A = 3.125 g/plot

The plots were well prepped and leveled by hand with a rake. Seeds were spread by hand and pressed into the soil with a heavy log. The moisture for the trial was from natural rainfall only with no supplemental irrigation provided. On average the annual rainfall for the Hoolehua Plant Materials Center is 20-21 inches. To increase the potential of germination of the seeds, the trial was initiated in December, during the rainy season. Survivability was measured by determining the percentage of live seedlings in a square foot after 2 rainy seasons. Essentially, if the seedlings are able to survive the dry season into the next rainy season, they would have a very good chance of surviving on their own.

Keni Reyes (left) and David Duvauchelle (right) level the study plots before seeding.

Plot evaluations were taken at 188 days after the first seedlings emerged and 415 days after the first seedlings emerged. We wanted to compare seedlings emergence after the first rains and seedling ability to survive into the next rainy season. For the *Dodonaea viscosa* plots, the seedlings that germinated and survived were counted. For the *Eragrostis variabilis* the seeding rate was exceptionally high which made it difficult to

count the number of live seedlings. Because of this, for the first evaluation forage yield samples were taken and for the second evaluation, point-frequency data was collected.

Results

The study was planted on December 3, 2009. 56 days after planting and over 6 inches of rain, seedlings had germinated in most of the plots. Three weeks after the first observation the plot received only .12 inches of additional rain. The Zeba-treated *E. variabilis* plots appeared to be more vigorous while the non-treated *E. variabilis* plots appeared slightly chlorotic with some seedlings dying off. For the D. viscosa germination was low in both the treated and untreated plots, ranging from 3-6 seedlings per plot. In general, the non-treated D. viscosa plots had more seedlings than the Zeba-treated plots.

FIRST EVALUATION: 188 days after the first seedlings emerged, dry season

Eragrostis variabilis

There appeared to be a noticeable difference between the treated and untreated plots. The treated plots seemed to tolerate the dry period better than the untreated seedlings. According to the data, the Zeba treated plots produced an average of 20% more vegetation as compared to the untreated plots.

Dodonaea viscosa

The seedlings in all plots appear to be healthy and unstressed. On average, there are more seedlings in the untreated plots.

SECOND EVALUATION: 415 days after the first seedlings emerged, rainy season

Eragrostis variabilis

The Zeba-treated plots appear to be significantly healthier as compared to the untreated plots. There were a lot more plants that had died in the untreated plots as well. According to the data, the treated plots exhibited an 87% higher point frequency rate than the untreated plots.

Dodonaea viscosa

Overall the existing plants in the untreated plots were a lot taller and healthier as compared to the untreated plots. On the other hand, there was a bit more seedlings that emerged from the treated plots as compared to the untreated plots, but it was not significant.

Figure 2.

Dodonaea viscosa

188 DAE (8/10/10)		
number new of seedlings		
REP	ZEBA	untreated
I	3	7
II	7	18
III	4	7
IV	3	3
AVERAGE	4.25	8.75

415 DAE (3/25/11)		
number new of seedlings		
REP	ZEBA	untreated
I	46	69
II	84	31
III	74	65
IV	65	77
AVERAGE	67.25	60.5

Eragrostis variabilis

188 DAE - 8/10/2010		
Vegetative Yeild (g)		
REP	ZEBA	untreated
I	20	61
II	82	50
III	30	9
IV	49	31
AVERAGE	45.25	37.75

415 DAE - 3/25/2011		
Point Frequency (60 pts.)		
REP	ZEBA	untreated
I	60	32
II	22	9
III	53	33
IV	35	17
AVERAGE	42.5	22.75

Study plots at 1 year after planting under natural rainfall.

Discussion

If native plants were given an advantage to increase their survivability rate over invasive species in critical areas, more cooperators would be inclined to apply conservation practices in low rainfall areas. Zeba is a seed-coat product that claims to increase certain plants' survivability in low rainfall conditions. The general consensus is that drought tolerant plants are most vulnerable at the seedling stage. With enough moisture, provided by a Zeba seed-coat, seedlings would have a better chance to survive. The goal of this study was to determine if the seed coating developed by Zeba will increase the survivability of *Eragrostis variabilis* and *Dodonaea viscosa* seedlings under natural rainfall conditions.

It was apparent that *Eragrostis variabilis* seedlings benefited significantly from Zeba-treatment of seeds. Although the treatment did not increase the number of seedlings that germinated, it did, however, produce seedlings that were significantly more vigorous as compared to untreated seeds. When seedlings are healthier, they stand a better chance of surviving through drier season. This proved exactly so with the last evaluation of this study. There were a lot more live plants in the treated plots, and the plants were more vigorous as well.
Dodonaea viscosa seedlings appeared not to require the Zeba-treatment of seeds. Initially there were more seedlings emerging from untreated plots. During the last evaluation, plants of untreated seeds were taller and healthier. On the other hand, the average number of seedlings in treated plots was slightly higher than the untreated plots. This could be due to the shading effect from the larger plants.

In conclusion, the benefits from Zeba–treated seeds vary from one species to the next. More studies need to be made to determine which species would benefit from the Zeba seed-coat treatment. Also, the Zeba seed-coat treatment is a costly process. Zeba also has a product that can be added to the soil. For large-scale applications in critical areas, adding the polymer to the soil may be more feasible for the cooperator. Investigation of the advantage that this option may provide to Native Hawaiian plants in critical areas may prove valuable to cooperators.