Native Plant Establishment in Late Summer Phase II

Introduction:

Native vegetation evolves to survive and flourish in local climates, soil types, and ecosystems. Due to lands being disturbed by a variety of events, habitats require either mitigation of disturbed lands and/or restoration of wildlife habitat. The most widespread method of establishing plants has been to replant containerized materials in late fall or early winter, protecting plants from harsh summer temperatures while providing them springtime moisture. The new method presented in this study will provide results that show a better outcome by taking a different approach.

Objective:

To determine potential benefits of using a time released water gel (TRWG) with the added nutrients zinc and acetic acid over hand watering for greater root mass and plant growth. To determine if a single application of TRWG could provide enough moisture to successfully establish a root system that could survive through the following growing season with no additional irrigation. To determine if additional photosynthesis (on the front side of transplanting) would have a substantial effect on greater root mass growth, plant height and survivability the following season.

Background and Theory:

A time-release water gel (TRWG) is a carboxymethylcellulose cross-linked polymer. The gel is degraded by microorganisms to yield free water. Cellulose degrading microorganisms can be found in all soil types and produce enzymes for breakdown of cellulose (Wheeler, PhD & Peterson, 2006, p. 2). With the combination of continuous moisture, zinc and -3 acetic acid plant are able to increase both initial root mass and upper plant growth within the first season. An increase in a plants root mass will result in enhanced plant growth, better appearance, and improved nutrition uptake. Essential to this study and the TRWG product is the micronutrient zinc. Zinc is essential to many enzyme systems in plants with three main functions including catalytic, co-catalytic, and structural integrity. Zinc contributes to the production of important growth regulators which affect photosynthesis, new growth, and development of roots (Mordvedt, Cox, Shuman, & Welch, 1991) (as cited in Wheeler, PhD & Peterson, 2006, p. 2) and improves stress tolerance. If zinc is in short supply, plant utilization of other essential plant nutrients such as nitrogen will decrease.

During the research and development of TRWG the selection of zinc sulfate as the source of zinc was based on scientific literature. Many sources of zinc have been tested to see which compound would be utilized more efficiently by plant species. Zinc sulfate is the most readily available form for plants (Amrani, Westfall, & Peterson, 1993, p. 1-10). Zinc sulfate also contains a sulfate ion. The sulfate ion (SO_4^{2-}) is a beneficial nutrient which naturally occurs in soil. Sulfur is used to bind amino acids together by sulfide bridging to create enzymes and proteins, the building blocks of life (Wheeler, PhD & Peterson, 2006, p. 2).

Results and Analysis:

This study indicates that root mass growth improved most dramatically with plants that were established in August with TRWG. The first analysis compares August TRWG plantings to controls. Results show the dry root mass weight of TRWG plantings were an average of a 139% greater that controls.

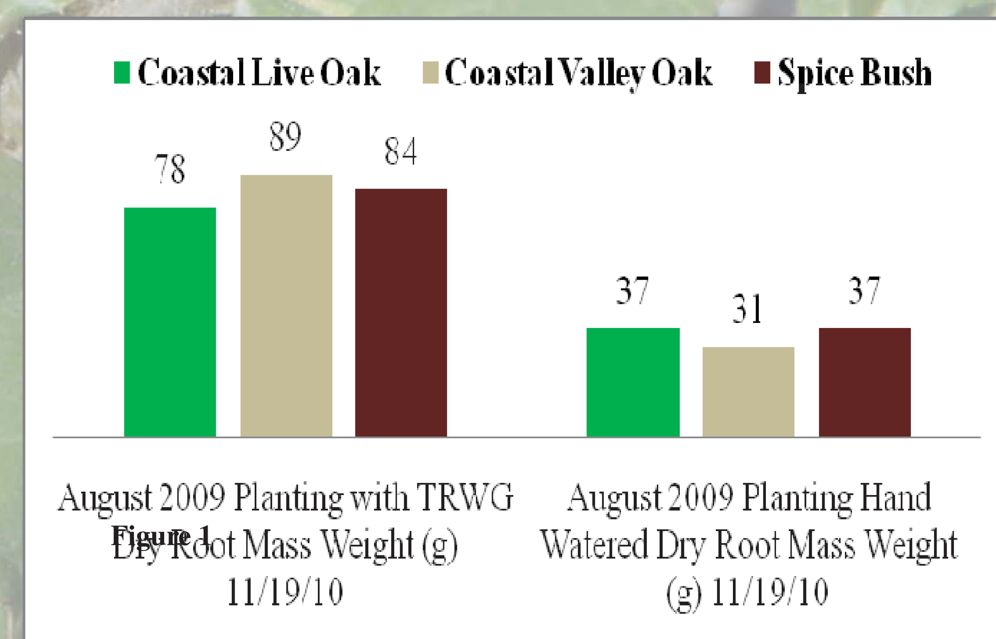
Our second analysis showed that planting in August with TRWG resulted in a 607% increase in root mass growth over September plantings and a 1000% increase in root mass growth over October plantings (See Analysis #2). This result indicates that plants that have more time to establish with the aid of TRWG did substantially better than the plants.

Another significant result was upper plant growth after the first season (see analysis #3). Results showed that plants that were established with TRWG in August showed a 68% average increase in overall upper plant growth.

DRiWATER

Analysis #1: Comparison of August plantings dry root mass weighed on November 19, 2010 (three weeks after harvest) to controls planted in August 2009. Roots are weighed in grams (g).

Plant Species	August 2009 Planting TRWG Dry Root Mass Weight (g)	August 2009 Planting Controls Dry Root Mass Weight (g)	% Difference with TRWG
Coastal Live Oak	78	37	111%
Coastal Valley Oak	89	31	187%
Spice Bush	84	37	127%
Total	**251**	**105**	**139%**



Figures 1

Coastal Live Oak dry roots TRWG - 78 (g)

Coastal Live Oak dry roots controls - 37 (g)

Analysis #2: Comparison of August 2009 plantings with September and October plantings. August 2009 dry root mass weights to September 2009 with a TRWG (top). Comparison of August 2009 dry root mass weights to October 2009 plants with a TRWG (bottom).

Plant Species	August Planting TRWG Dry Root Mass Weight (g) 11/19/10	September Planting TRWG Dry Root Mass Weight (g) 11/19/10	% Difference September to August
Coastal Live Oak	78	51	53%
Coastal Valley Oak	89	12	709%
Spice Bush	84	21	300%
Ocean Spray	442	15	2847%
Total	**693**	**98**	**607%**

Plant Species	August 2009 Planting TRWG Dry Root Mass Weight (g) 11/19/10	October Planting – TRWG Dry Root Mass Weight (g) 11/19/10	% Difference August to October
Coastal Live Oak	78	27	189%
Coastal Valley Oak	89	9	642%
Spice Bush	84	11	664%
Ocean Spray	442	13	3300%
Total	**693**	**63**	**1000%**

Figures 2a, 2b and 2c:

2a: Coastal Valley Oak dry roots Dry root weight 89 (g) August 2009 Planting

2b: Coastal Valley Oak dry roots Dry root weight 12 (g) September 2009 Planting

2c: Coastal Valley Oak dry roots Dry root weight 9 (g) October 2009 Planting

Analysis #3: Comparison of August 2009 plantings with September and October plantings. August 2009 dry root mass weights to September 2009 with a TRWG (top). Comparison of August 2009 dry root mass weights to October 2009 plants with a TRWG (bottom).

Plant Species	August 2009 Planting TRWG Plant Height in Inches	August 2009 Planting Controls Plant Height in Inches	% Difference in Height with TRWG
Coastal Live Oak	42	24	**75%**
Coastal Valley Oak	60	36	**67%**
Coastal Spice Bush	39	24	**63%**
Total	**141**	**75**	**68%**

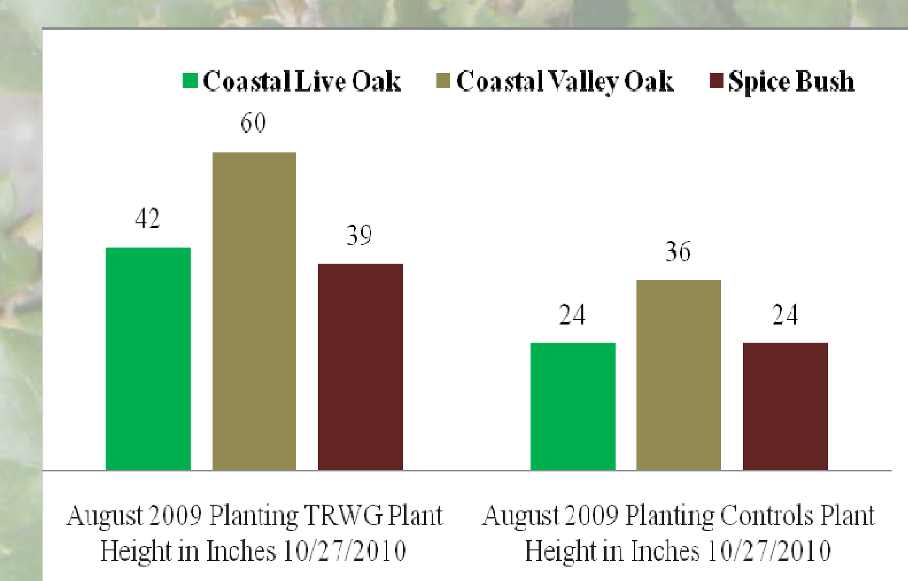


Figure 4a, 4b and 4c:

4a: Coastal Live Oak planted 8/09 TRWG on left (Height: 42 Inches) Controls on right (Height: 24 Inches) 10/27/2010

4b: Coastal Valley Oak planted 8/09 TRWG on left (Height: 60 Inches) Controls on right (Height: 36 Inches) 10/27/2010

4c: Spice Bush planted 8/09 TRWG on left (Height: 39 Inches) Controls on right (Height: 24 Inches) 10/27/2010

Materials and Methods:

The species used for the study were Quercus Agrifolia (Coastal Live Oak), Quercus Labata (Coastal Valley Oak), Calycanthus Occidentalis (Spice Bush) and Holodiscus Discolor (Ocean Spray). Three sets of plantings took place; August, September and October 2009. In August, half of the species were given a one time application of TRWG on the date of planting while controls were given 2.5 gallons of potable water every Wednesday for 12 weeks, beginning 8/4/09 with the last watering on 10/7/09. One application of TRWG was provided giving a 90 day supply of continuous moisture to the plants. 12 TRWG plants were watered once with 2.5 gallons of potable water at the time of planting.

Plots were set up at the DriWater Inc. manufacturing facility at 1042 Hopper Avenue in Santa Rosa CA. Three separate plots were created at the testing site. Each plot was 10 X 18 feet. All plots were placed to receive full sun exposure. Thirty two plants were planted in each plot on 8/4/09, 9/2/09 and 10/2/09. All plants used for the study were D-40 (40 cubic inch nursery grown plants). Planting holes were dug and watered in thoroughly; no amendments were added to the soil or the planting holes. TRWG plants were watered once at the time of planting and received only one application of a 90 day supply of TRWG in a 3 inch perforated tube placed 2 inches from the root mass. August control plants were given 2.5 gallons of potable water once a week for 12 weeks. September plants were given 2.5 gallons of potable water once a week for five weeks. Because of the closeness to the dormant season, October plants were watered once. The process of this control water regime was to make sure plants had consistent moisture until the beginning of the rainy season beginning in late October early November. Dry weight data was gathered 3 weeks after the post-harvest date. Roots were weighed on a calibrated scale at the testing facility at DriWater Inc. Dry root mass weight data was gathered on two separate occasions; the first was post spring rains, June 23, 2010; the second was post first year growing season, November 19, 2010.

Plant height data was gathered on October 27, 2010 and plants were measured for height in inches from the bottom of the plant stem to the plants apex.

Conclusion

This study gives new insight: The first is that the window of opportunity for plant establishment need not be limited to late fall and winter. In fact, this study will show that by planting during the warmest times of the year with the right tools, not only greater plant survivability can be achieved but plants can thrive from the moment they go into the ground. With the tools available to us today, by working with nature the restoration industry can have not just marginally increased survival of plants but superior plant growth and establishment. By planting during the warmest months of the year, by allowing no lapse in ground moisture for the first 90-days post-transplant, and by giving the added nutrients zinc sulfate and acetic acid, plant root mass increase can be up to 139% over plants watered by hand weekly (See analysis #1). Even with the August control group receiving the same amount of sunlight, it would appear that the combination of longer time periods of photosynthesis, continual moisture with TRWG, and the added nutrients of zinc sulfate and acetic acid, gives new transplants the advantage.

The second insight is one that we have been aware of for many years. If a plant has the ability and time to 'feed' it will grow and thrive. By planting in August (or June in climates with shorter growing periods) a plant has the ability to photosynthesize for a longer period before going into dormancy. More photosynthesis, more food, more growth, more plant stability means better plant establishment. In the past there were two problems with planting during the warmest times of the year. The first was having enough moisture available to the plant. The second was having enough moisture so the plant would produce roots and not just upper plant growth and there by burning out. By having continual moisture both of these problems are corrected.

The third being considerable conservation of water usage. August control plants were given 2.5 gallons of potable water once a week for 12 weeks. This equates to 360 gallons of potable water. August TRWG plants were given one quart of TRWG plus 2.5 gallons of potable water each at the time of planting. This equates to only 30 gallons of potable water used and 12 quarts of TRWG.

This study also shows sufficient evidence to further studies adapting these same methods to a variety of growing zones and environments throughout the world.

References:

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