Evaluation of the Effect of Salinity on Root Growth of Vetiver Grass Plants

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Objective:

Evaluation of the effect of different concentrations of salinity on vetiver grass root growth.

Materials and Methods:

Two large vetiver plants were obtained from a collection of vetiver grass plants at Dr. Gregg Henderson's home (St. Gabriel, LA) and transported to a pool of water at the Louisiana State University Aquaculture Research Station (Baton Rouge, LA) in July 2007. The flower pots were obtained from Mr. Donald O. Heumann's home in Metairie, LA in August 2007. All of the other materials such as pruners, shovels, Instant Ocean Sea Salt (Aquarium Systems, Inc. Mentor, OH), and hydrometer (Aquarium Systems, Inc. Mentor, OH) were purchased from a home improvement warehouse and pet store respectively. Eight pools measuring 461.54 cu. ft. at the LSU-BR Aquaculture Research Station were used with ten plants in each pool.

On August 3, 2007 seven of the eight pools identified as H2 to H8 (Fig. 11) at the Aquaculture Research Station were drained. The pools were assigned a letter and number (H1-H8) based on the pre-existing assignments of the research station and each concentration was randomly assigned to each pool by drawing numbers out of a hat. Each group was assigned a number from 1-4 and eight drawings were made starting with pool H5 (Control – 1, 3 ppt – 2, 13 ppt – 3, 22 ppt – 4). The following were the assignments:

- Control (0 parts per thousand): H1 & H5
- 3 parts per thousand: H6 & H8
- 13 parts per thousand: H4 & H7
- 22 parts per thousand: H2 & H3

The first pool in the row, H1, was not drained at this time because it still contained the vetiver plants used in this study. On August 6, three days later, the seven pools that were previously drained were cleaned by using wide-blade shovels to remove the mud and debris that was left after draining them. The sea salt and hydrometer were purchased also on this day. The following day, the vetiver plants in pool H1 were removed and placed in an adjacent pool that contained water while H1 was drained and cleaned in the same manner as the other pools. Later that day all of the pools were filled with approximately 493 gallons of water. The water was pumped from a nearby lake into a well where it filtered and supplied clean water to the pools.

From August 14 to 15, the vetiver grass plants were split by cutting the massive root in half with an axe then into fourths until the pieces were small enough to pull apart by hand. All of the roots were trimmed to approximately 2½ to 3 inches and the stalks were pruned to about 6 inches over a two day period. The pruned plants were individually potted using soil with a heavy clay content that was available to us at the aquaculture station. Fifty-eight plants were potted using the clay type of soil from a mound approximately 100 yards from the pools. The plants were then placed in pool H1. The next day, twenty-two of the remaining twenty-five plants were potted with the same

type of soil and placed into pool H1. The remaining three plants served as our standard plants from which we would compare the root growth of the plants at the end of the study.

The amount of Instant Ocean Sea Salt placed into each pool to yield to desired salinities was determined by first taking the dimensions of the pool to calculate the total volume:

$V = \pi r^2 h$; $r = \frac{1}{2} d$ & $d = 12$ ft. and $h = 4.92$ ft.
$= (3.14)(36)(4.92)$
$=$ 461.54 cu. ft.
1 cu. ft. = 7.48 gal.
461.54 cu. ft. x 7.48 gal. = 3,452 .32 gal. H_2O

Next, the height of the plant pots (6 in.) is used to determine the height level of water we would need in order to have a water level approximately one inch above the top of the pot.

7 in. H_2O = 0.583 ft. H_2O
$V = \pi r^2 h$
$= (3.14)(36)(0.583)$
$=$ 65.94 cu. ft.

65.94 cu. ft. x 7.48 gal. = 493.23 gal. H_2O

Then, we calculated the amount of Instant Ocean Sea Salt we would need to add to each pool to obtain the desired salinity according to the container recommendations for a **30ppt** (parts per thousand) / **1.022 S.G.** (Specific Gravity) solution. **[1.5 lbs of salt per 5 gal. H_2O solution]**

- 30 ppt = 30 ‰ = 3.0% = 30000 ppm
  - this means that there are 30 lbs. of salt per 1000 lbs. of sea H_2O
- At 7 in. H_2O:

  - 3 ppt = 3 ‰ = 0.3% = 3000 ppm
  - 13 ppt = 13 ‰ = 1.3% = 13000 ppm
  - 22 ppt = 22 ‰ = 2.2% = 22000 ppm

In order to add the correct amount of Instant Ocean to yield each desired salinity we used a salinity calculator from the website: www.cnykoi.com/calculators/calcsalt.asp. We input the salt concentration percentages into the calculator and received the exact amount of Instant Ocean measured in pounds.

- 3 ppt = 3 ‰ = **0.3%** = 3000 ppm → 12.348 lbs. Instant Ocean
- 13 ppt = 13 ‰ = **1.3%** = 13000 ppm → 53.510 lbs. Instant Ocean
- 22 ppt = 22 ‰ = **2.2%** = 22000 ppm → 90.555 lbs. Instant Ocean

The Instant Ocean sea salt was added to each of the pools that were designated to be treated with the aforementioned amounts of salt on August 16. The pools were stirred with aerated stirrers and allowed to settle overnight (Fig. 9 & 10). The subsequent day, seventy of the total eighty three plants were taken from H1 and ten plants each were placed into pools H2 to H8 (Fig. 11 & 12). The remaining three plants served as the standard plants for later root growth comparison. The standard plants were taken back to the laboratory and the stalks were measured then cut to approximately ½ inch above the roots. The experiment was officially begun on August 17, 2007 and weekly readings were taken thereafter. The weekly observations consisted of maintaining the proper water level at 7", maintaining the proper salinities of each pool, and monitoring the leaf growth of each plant.

Observations and Results

The eleven week observation period was begun on August 24, 2007 and concluded on November 16, 2007 when all of the plants were removed from each of the pools and brought back to John M. Parker Agricultural Coliseum to wash the roots. The roots were allowed to dry for three days then the longest leaves of each individual plant were measured and recorded. The stalks were cut to approximately ½ inch above the root then the roots were weighed using an Ohaus Adventurer laboratory scale. The roots were placed directly on the scale and weighed. The standard roots were then weighed and an average weight of 2g was obtained and recorded. Weekly observations of the leaf growth of each individual plant within each group are included in Appendix C.

A significant difference in above ground growth was observed among the four groups as the control group (Fig. 7 & 8) displayed the greatest percentage of plants that had leaf growth throughout the entire study. The average root weight of the two control groups combined was 25g. Compared to the average root weight of the three standard plants of 2g, there was a 1,250 % growth in control plant roots over the eleven week observation period. The 3ppt group (Fig. 1& 2) had the second highest percentage of plants that displayed leaf growth throughout the study. The average root weight of the two 3ppt groups combined was 17g. This was an 850 % growth compared to the standard root weight. The third group, 13ppt (Fig. 3 & 4), displayed leaf growth mostly during the first three weeks of the study then the leaves started to turn brown. However, there was a 700% increase in root growth in this group as the average root weight of these plants was 14g. The highest salt concentration, 22ppt (Fig. 5 & 6), displayed the worst percentage of leaf growth with only half of the total plants in this group showing leaf growth for the firs three weeks of the study. Again, the leaves began appearing brown after the third week with no further growth. The average root weight of the plants in the 22ppt group was 16g, an 800 % increase in growth. A picture representation of each concentration is included to allow for comparison of root growth between the concentrations. (Fig. 13)

The recorded salinities for each pool fluctuated 1-2 parts per thousand for each observation but was returned to the initial salinities by adding approximately one-quarter

to one half foot of water. We used a meter stick placed along the inside wall of the pool to measure the level of water added.

Conclusions

The control pool plants displayed the greatest ability for growth in a no salt concentration environment than the 22ppt pool plants which were in a high salinity environment. Furthermore, the 3ppt and 13ppt pool plants displayed the second and third greatest abilities respectively to grow throughout the observation period. The percentage of plants that displayed leaf growth initially and throughout the study or just at any given time during the observation period decreased with the increase in salinity (Fig. 14). The salinity fluctuations reported were a result of the evaporation of water in the pools due to the increase in water temperature. Additionally, the differences in the final root weights compared to the standard root weights indicated that the root growth was affected by salinity which decreased in weight with the increase in salinity (Fig.15). However, there was an unexplained greater disparity between the average root weights of the two 13ppt groups.

Fig. 9 Measure of initial salinities.

Fig. 10 Measure of initial salinities.

Fig. 11 Pools at Aquaculture Station.

Fig. 12 Control pool with ten potted vetiver plants.

Fig. 13 (From L to R) Control, 3ppt, 13ppt, 22ppt, and Standard.

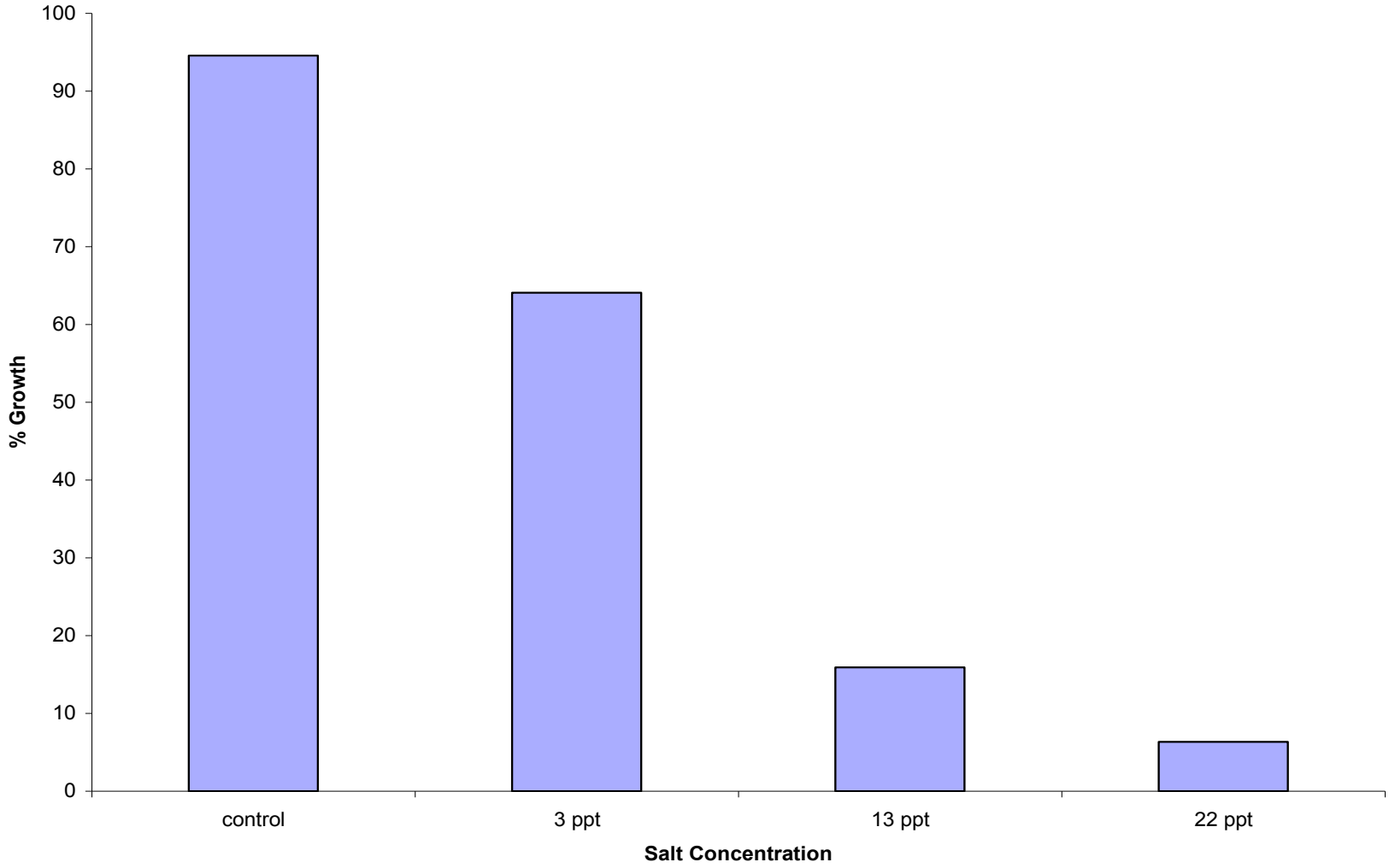
100
90
80
70
60
50
40
30
20
10
0
% Growth
control
3 ppt
13 ppt
22 ppt
Salt Concentration

Fig. 14

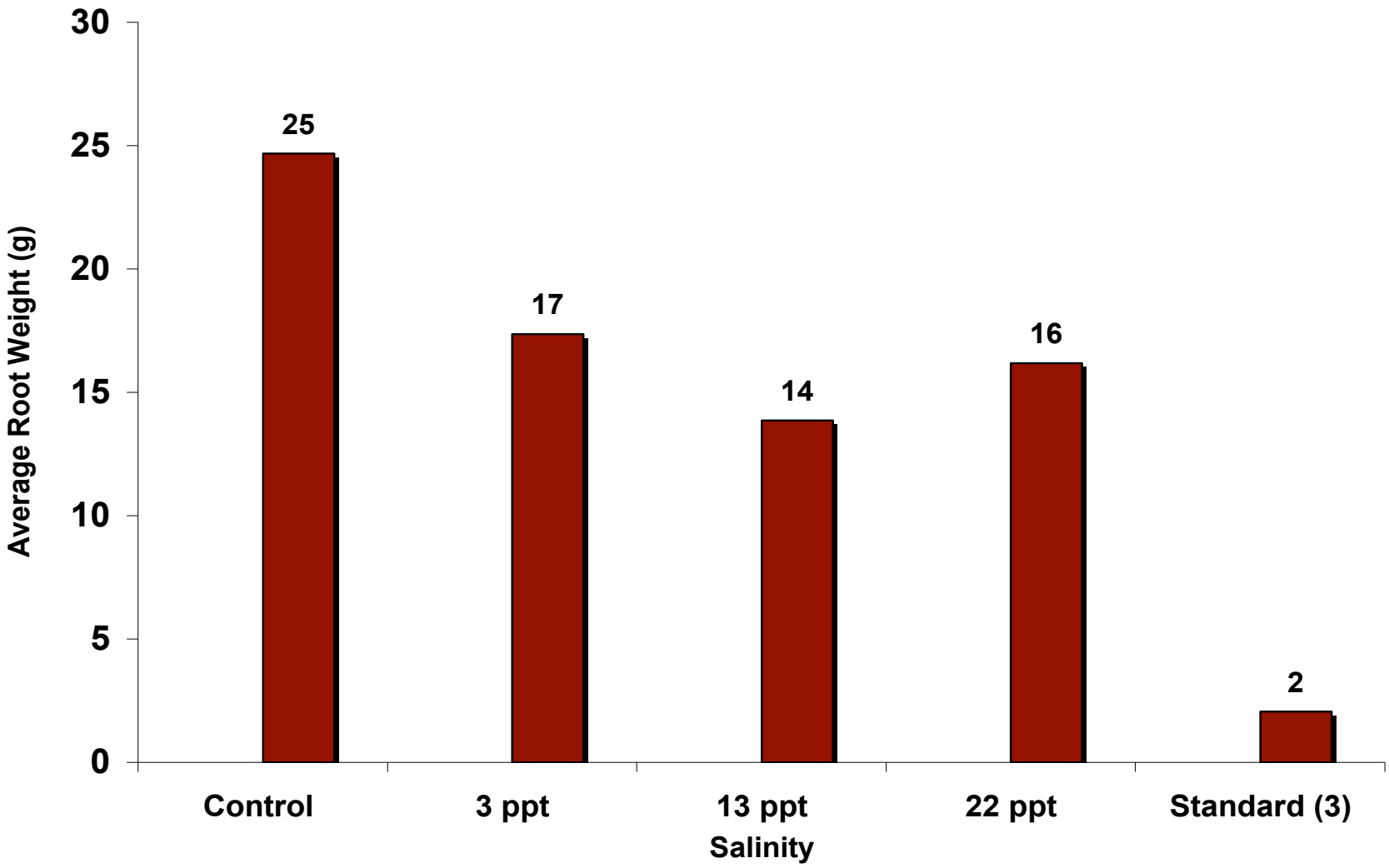
30
25
20
15
10
5
0
Average Root Weight (g)
25
17
14
16
2
Control
3 ppt
13 ppt
22 ppt
Standard (3)
Salinity

Fig. 15