

January 7, 2014

Shannon Lotthammer, Director
Environmental Analysis and Outcomes Division
Minnesota Pollution Control Agency
520 Lafayette Road N.
St. Paul, MN 55155-4194

Re: Minnesota Chamber of Commerce Hydroponics Research on Wild Rice and Sulfate

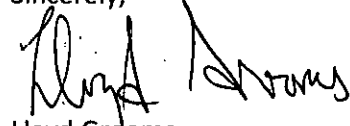
Dear Ms. Lotthammer:

The Minnesota Chamber of Commerce (Chamber) is pleased to provide you with additional research on the effects of sulfate on the growth of wild rice

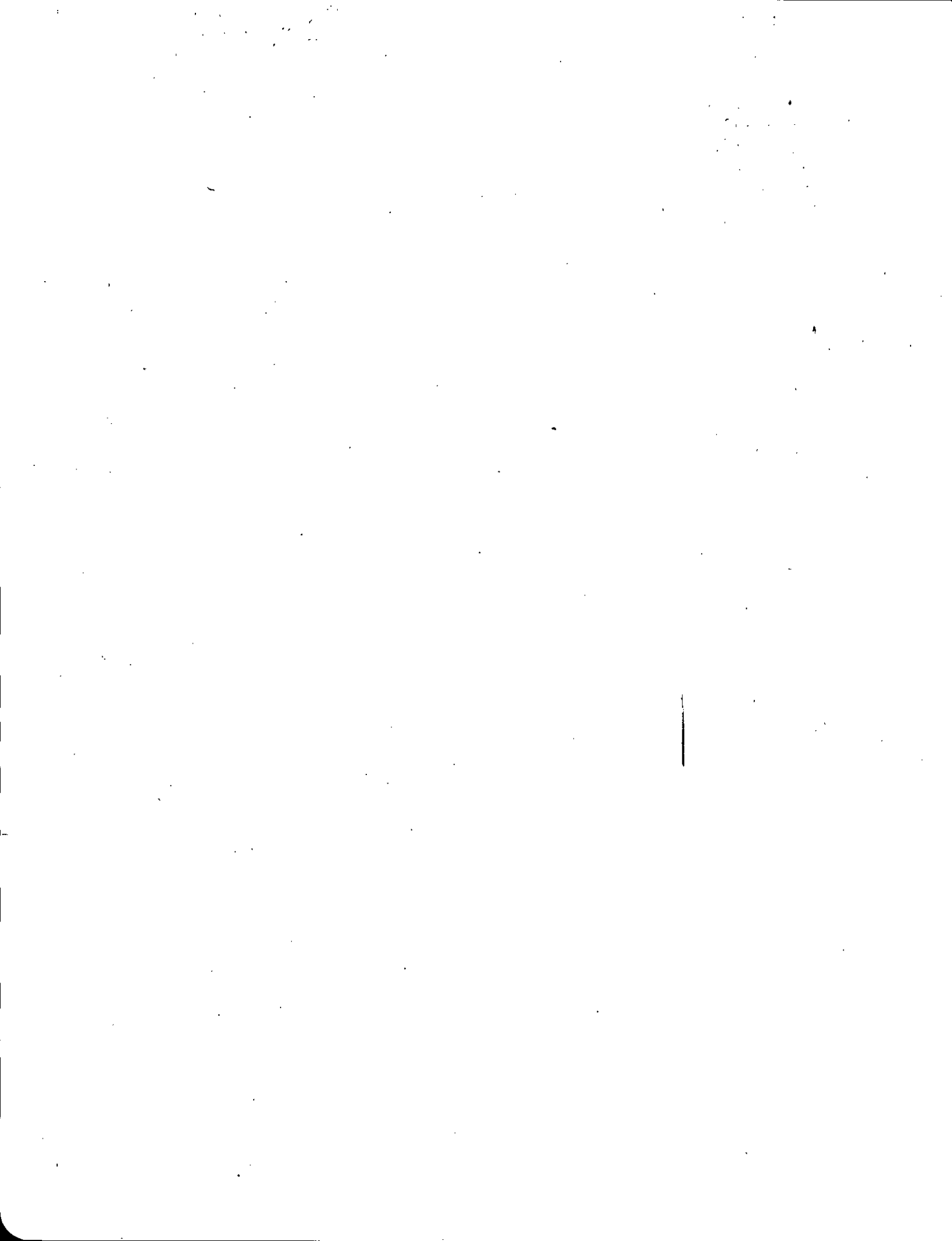
The Chamber looks forward to reviewing the data by the MPCA contractors, and to continued discussion around the rulemaking which the Chamber believes is necessary to update the water quality standards, including designating uses and water quality criterion, for protection of wild rice in Minnesota. Please don't hesitate to contact me should you have any questions.

Thank you.

Sincerely,



Lloyd Grooms



SPONSOR

Minnesota Chamber of Commerce
400 Robert Street N.
St. Paul, MN 55101

TEST ITEM

Sulfate

STUDY TITLE

Definitive Hydroponics-Based Wild Rice (*Zizania palustris*) Sulfate Toxicity Testing

DATA REQUIREMENT

Definitive Phase

STUDY DIRECTOR AND AUTHOR

Douglas J. Fort, Ph.D.

STUDY COMPLETION DATE

December 31, 2013

PERFORMING LABORATORY

Fort Environmental Laboratories, Inc.
515 South Duncan Street
Stillwater, OK 74074

REPORT NUMBER

ENVI01-00325

Total Pages: 173

COMPLIANCE STATEMENT

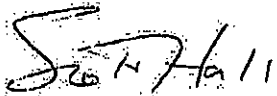
This study was conducted in compliance with United States Environmental Protection Agency, TSCA, Good Laboratory Practice (GLP) Standards, Final Rule (40 CFR Part 792, 1989) (1) with the following exception: 1) analysis of the laboratory dilution water for organics, pesticides and metals at Red River Laboratory (Oklahoma City, Oklahoma) using standard EPA methods. Since the analyses were conducted following standard validated methods, this exception had no impact on the study results.

Definitive Hydroponics-Based Wild Rice (*Zizania palustris*) Sulfate Toxicity Testing

Study: ENVI01-00325

Test Item: Sulfate

The following personnel of ENVIRON International Corporation, representative of the sponsor, have reviewed this report and agree with the interpretation of the data presented herein:



Scott Hall
(Sponsor Representative)

12/31/13

Date

The following individual is responsible for the design, conduct, and supervision of this study and for the data reported herein:



Douglas J. Fort, Ph.D.
(Study Director)

12/31/2013

Date

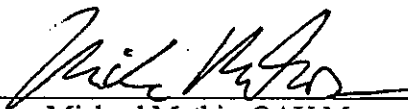
STATEMENT OF QUALITY ASSURANCE UNIT

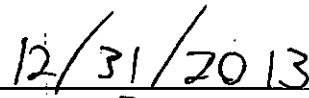
The FEL Quality Assurance Unit conducted the inspections detailed below:

Type of inspection	Inspection	Dates	
		Reported to Study Director	Reported to Management
Protocol Review	8/27/2013	8/28/2013	8/28/2013
Technical Systems Audit	9/5/2013	9/6/2013	9/6/2013
Technical Systems Audit	9/26/2013	9/27/2013	9/27/2013
Audit of Data Quality	10/23/2013	10/24/2013	10/24/2013
Draft Report Audit	11/19/2013	11/20/2013	11/20/2013
Final Report Audit	12/31/2013	12/31/2013	12/31/2013

The inspections were performed in compliance with FEL Quality Assurance Unit procedures and the principles of Good Laboratory Practices (1).

The final report is considered to constitute an accurate and complete reflection of the study raw data.


 Michael Mathis, QAU Manager


 Date

CERTIFICATION

We, the undersigned, declare that this report provides an accurate evaluation of the data obtained from this study.

Study Director:

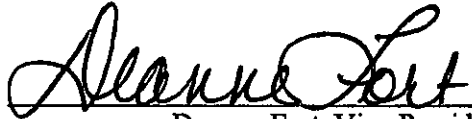


Douglas J. Fort, Ph.D., Study Director, FEL

12/31/2013

Date

Performing Laboratory Management:



Deanne Fort, Vice President, FEL

12/31/13

Date

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LIST OF ACRONYMS

ANOVA – analysis of variance
B – boron
ChV - Chronic value (geometric mean of NOEC and LOEC value)
DO – dissolved oxygen
dw – dry weight
EC – effective concentration
FEL – Fort Environmental Laboratories
GLP – Good Laboratory Practices
IC – inhibitory concentration
KW ANOVA – ANOVA on ranks
L - liter
LC – lethal concentration
LOEC –lowest observed effects concentration
MDP – Method Development Phase
meq – milliequivalents
MET – median time to emergence
NOEC – no observed effects concentration
ORP – oxidation/reduction potential
PAH – polyaromatic hydrocarbon
QAU – Quality Assurance Unit
SEM – standard error of the mean
SOP – standard operating procedure
SD – Study Day

1. SUMMARY

Guidelines:	Protocol ENVI01-00325
Study Initiation Date:	August 28, 2013
Experimental Start / End Dates:	September 4, 2013 / September 25, 2013
Test Treatments:	1) Sulfate Treatments - HS-1 (1:4 ammonia-N:nitrate-N) [control], 10, 250, 1,000, 2,500, 5,000 mg/L sulfate, and 2) Chloride Treatments - 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L (chloride)
Mean Measured Test Concentrations:	1) Sulfate Treatments – 52 (control, HS-1 1:4), 13, 239, 1,044, 2,545, and 4,980 mg sulfate/L (conductivity ranging from 554 - 8,507 μ mhos/cm), and 2) Chloride Treatments conductivity- 699, 1,960, 2,906, 4,224, and 8,509 μ mhos/cm (sulfate concentration ranging from 50 - 54 mg sulfate/L)
Age of Test Subject:	Seed
Source of Seeds:	Little Round Lake in Becker County (03-0302-00), Gerald Blaha (MPCA, St. Paul, MN)
Summary of Endpoints	See Table 1

1.1. METHOD

A definitive concentration-response study was performed in general accordance with the methods of Malvick and Percich (1993) (3) using a static-renewal format with a test solution renewal volume of 0.7 performed daily (results summarized in Table 1), which was consistent with the replacement rate used in the Method Development Phase (MDP) testing (FEL study ENVI01-00324). Each of four replicates per solution had two 1 L mesh-lined baskets (one basket for day 10 endpoints and one basket for day 21 endpoints). The inert plastic mesh served as the inert medium on which the seeds were placed as required for hydroponic culture. Each basket contained 30 seeds (60/replicate and 240/treatment at T0), which was adequate to evaluate concentration-response and assess significant differences in the treatments relative to the control. The test method germinated and grew rice in place without transfer of plants to different media, thereby eliminating transfer stress. The initial 10 study days (SD) were performed in the dark to promote mesocotyl emergence and development. The mesocotyl is the first shoot element to emerge from the germinated seed (Figure 1). Based on results from the MDP tests, HS-1 media prepared in accordance with Malvick et al and Percich (1993) (3) and Hoagland and Arnon

(1950) (4) with an ammonia:nitrate ratio of 1:4 (molar basis) (Table 2) served as the diluent, and a combination of the sulfate salts of sodium, potassium, calcium and magnesium was used to prepare the sulfate stock solutions such that the ratio of the monovalent to divalent salts was 2:1. A combination of salts was used to minimize cationic imbalances that could pose an additional abiotic stress to the germinating seedlings. The following nominal concentrations of sulfate were used: 10, 50 (HS-1 (1:4) [control]), 250, 1,000, 2,500, and 5,000 mg sulfate/L (nominal). Sulfate in the form of monovalent and divalent cationic salts were used to prepare the sulfate treatments as described in Table 3. The measured sulfate concentration in the HS-1 control solution was ca. 50 mg/L. A modified HS-1 (1:4) solution was prepared (Table 4) in order to reduce the sulfate concentration of this media to 10 mg sulfate/L nominal, and it was used for the 10 mg sulfate/L test concentration (Table 3). The sulfate concentrations were measured on Study Day 0, 10, and 21 in each replicate of the control and in all treatments. To determine if effects potentially observed in the study are the result of exposure to sulfate or a non-ion-specific result of exposure to dissolved solids (i.e. an osmotic stress), five additional chloride treatments, designed to be similar to the conductivity of the five highest sulfate test concentrations, were included in the study design. This allowed a comparison between seedling performances in similar osmotic solutions with differing ionic composition. Dissolved solids in the form of non-sulfate salts were used to prepare the chloride treatments described in Table 5. The following dissolved solids (from chloride salts) concentrations were used: 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L.

One basket per replicate (30 of the 60 seeds in the replicate) was randomly-selected and sacrificed at study day (SD) 10 to evaluate:

- Seed activation expressed a % activation;
- Mesocotyl emergence (in the dark) expressed as % emergence, and time to emergence expressed as a median at the replicate and treatment levels;
- Seedling survival, %;
- Shoot (mesocotyl, coleoptile and primary leaf) weight expressed as dry weight, or dw;
- Shoot (mesocotyl, coleoptile and primary leaf) lengths;
- Root (seminal and rootlets) dw;
- Seminal Root length; and
- Free leaf number and biomass dw
- Phytotoxicity

The remaining baskets were evaluated for these endpoints during the free leaf stage at study conclusion (Study Day 21). Summaries of test conditions and test endpoints for the sulfate and chloride treatments are presented in Tables 6 and 7.

Since the frequency of mesocotyl emergence was likely to be 100% based on the results of the MDP, an acceptable frequency of mesocotyl emergence was determined (Table 8). In addition to the HS-1 (1:4) negative control, a 100 mg B/L treatment in HS-1 (1:4) media were included as a positive control toxicant.

For all endpoint assessments, seedlings were carefully removed at the appropriate time intervals using watch maker forceps and placed into Petri dishes for each replicate to evaluate the appropriate endpoints. Each set was digitally photographed and length measurements of shoots and roots were recorded using digitization to the nearest mm. Seedlings were rinsed with deionized water to remove salts that had accumulated on their surfaces. Weights (dw at 105°C) were recorded using an analytical balance capable of recording to the nearest 0.1 mg. The seminal root tissue was dissected from the seed as was the primary leaf (shoot) material to specifically evaluate root tissue length (development).

1.2. RESULTS AND CONCLUSIONS

Results from the ENVI01-00325 (00325) study met the performance criteria established from the MDP (ENVI01-00324). A summary of the 00325 results is provided in Table 1. A consistent and anticipated adverse response to 100 mg B/L exposure was noted. Therefore, results from study 00325 were considered valid. Results from the present 00325 study indicated that exposure of developing wild rice to sulfate generally did not induce an adverse response at concentrations $\leq 2,500$ mg sulfate/L at SD 10 (Table 1) and $\leq 5,000$ mg/L at SD 21. For example, the no observed effects concentration (NOEC) for three of the ten SD 10 NOEC values were 2,500 mg/L sulfate or lower, and seven of ten SD 10 NOEC values were 5,000 mg/L sulfate. For SD 21, eight of ten concentration endpoints exhibited NOEC values of 5,000 mg/L sulfate, indicating that sulfate was generally not toxic at the highest concentration that could be tested within the limits of solubility of the salts.

Shoot length, root length, and phytotoxicity were affected by sulfate exposure at SD 10, and shoot length was the most sensitive endpoint at SD 10 (NOEC value 1,000 mg/L sulfate); whereas root length and phytotoxicity were the most sensitive endpoints at the study's conclusion (NOEC value 2,500 mg/L sulfate). The SD 21 NOEC values were the same as or higher than the SD 10 NOEC values for all test endpoints, indicating that prolonged exposure to sulfate beyond 10 days to 21 days did not further induce toxicity.

Exposure of developing wild rice to the chloride treatments reduced shoot length at each concentration at SD 10 (Table 1), but only at 103.2 meq/L (chloride treatment) at SD 21. Shoot weight, shoot length, root length, and phytotoxicity were affected by chloride treatment exposure at SD 10. Shoot length was the most sensitive endpoint at SD 10 (NOEC value < 0.8 meq/L), whereas shoot length, root length, and phytotoxicity were affected by chloride exposure and were the most sensitive endpoints at SD 21. As was observed for sulfate, all SD 21 NOEC values for chloride treatment exposures were the same as or higher than the SD 10 NOEC values, indicating that exposure to chloride treatments for longer than 10 days to the full 21 day test duration did not cause further toxic effects.

Each of the endpoints adversely affected by sulfate exposure was also adversely affected by the corresponding chloride treatment. In addition, shoot length at both SD 10 and 21 was markedly adversely affected by exposure to the chloride treatments, but not the sulfate treatments. The least sensitive endpoints measured were activation, mesocotyl emergence and seedling survival, regardless of study day.

Seeds exposed to the sulfate treatments generally had faster and more consistent mesocotyl emergence and shoot weight at both SD 10 and 21 compared to the chloride treatments. For example, the median emergence time for seeds exposed to 1,000 to 5,000 mg/L sulfate was less than 10 days as compared to a median emergence time of > 21 days for the HS-1 control exposure.

The SD 10 effects induced in the 2,500 and 5,000 mg sulfate/L exposures (three measurement endpoints) were also observed in the chloride treatments, indicating that the response was likely due to osmotic stress rather than sulfate toxicity. Overall, results from the 21 day exposures indicated that sulfate concentrations of up to 5,000 mg/L generally did not adversely affect the majority of wild rice test endpoints. Only two of the ten concentration endpoints (root length and phytotoxicity) indicated an adverse response from 5,000 mg/L sulfate exposure following the 21 day study period.

Table 1. Summary of Results from Wild Rice Tests at SD 10 and SD 21¹

Endpoint	Sulfate Treatments					
	Day 10			Day 21		
	NOEC ² (mg/L SO ₄ ²⁻)	LOEC ³ (mg/L SO ₄ ²⁻)	ChV ⁴ (mg/L SO ₄ ²⁻)	NOEC (mg/L SO ₄ ²⁻)	LOEC (mg/L SO ₄ ²⁻)	ChV (mg/L SO ₄ ²⁻)
Activation	5000	>5000	>5000	5000	>5000	>5000
Emergence ⁵	5000	>5000	>5000	5000	>5000	>5000
Survival	5000	>5000	>5000	5000	>5000	>5000
Shoot Weight	5000	>5000	>5000	5000	>5000	>5000
Shoot Length	1000	2500	1581	5000	>5000	>5000
Root Weight	5000	>5000	>5000	5000	>5000	>5000
Root Length	2500	5000	3535	2500	5000	3535
Leaf Number	5000	>5000	>5000	5000	>5000	>5000
Leaf Biomass	5000	>5000	>5000	5000	>5000	>5000
Phytotoxicity	2500	5000	3535	2500	5000	3535
Endpoint	Chloride Treatments					
	Day 10			Day 21		
	NOEC (meq/L)	LOEC (meq/L)	ChV (meq/L)	NOEC (meq/L)	LOEC (meq/L)	ChV (meq/L)
Activation	103.2	>103.2	>103.2	103.2	>103.2	>103.2
Emergence ⁶	103.2	>103.2	>103.2	103.2	>103.2	>103.2
Survival	103.2	>103.2	>103.2	103.2	>103.2	>103.2
Shoot Weight	19.8	51.1	31.8	103.2	>103.2	>103.2
Shoot Length	0.0	0.8	0.009	51.1	103.2	72.6
Root Weight	103.2	>103.2	>103.2	103.2	>103.2	>103.2
Root Length	51.1	103.2	72.6	51.1	103.2	72.6
Leaf Number	103.2	>103.2	>103.2	103.2	>103.2	>103.2
Leaf Biomass	103.2	>103.2	>103.2	103.2	>103.2	>103.2
Phytotoxicity	51.1	103.2	72.6	51.1	103.2	72.6

¹ Nominal concentrations.

² No observed effects concentration

³ Lowest observed effects concentration

⁴ Chronic value (geometric mean of NOEC and LOEC value)

⁵ Median time to emergence (MET) values for the day 21 sulfate treatments were >21 days for HS-1 control, >21 days for 10 mg/L, >21 days for 250 mg/L, 6.5 days for 1000 mg/L, 5 days for 2500 mg/L, and 9.5 days for 5000 mg/L.

⁶ Median time to emergence (MET) values for the day 21 chloride treatments were >21 days for 0.8 meq/L, >21 days for 4.2 meq/L, >21 days for 19.8 meq/L, >17 days for 51.1 meq/L, 0 mg/L, and >21 days for 103.2 meq/L.

2. INTRODUCTION

FEL was retained by the Minnesota Chamber of Commerce, and represented by ENVIRON International Corporation to conduct a study of sulfate toxicity to wild rice (*Zizania palustris*) using hydroponic exposure. The study will ultimately be used to assist in understanding the water-column based sulfate toxicity to wild rice. The sulfate toxicity thresholds determined will support the efforts to re-evaluate the State of Minnesota's 10 mg/L sulfate standard for the protection of wild rice. The study was conducted in accordance with the specifications identified in FEL's Quality Assurance Management Plan (QAMP) (2), relevant facility standard operating procedures (SOPs), Study Protocol No. ENVI01-2 prepared specifically for FEL Study No. ENVI01-00325, and in accordance with modified methods of Malvick and Percich (1993) (3).

The primary objective of the study ENVI01-00325 was to determine the toxicity of sulfate to wild rice (*Zizania palustris*) seeds and early post-germination live stages from the State of Minnesota, USA. A Method Development Phase (MDP) was previously conducted to determine the most appropriate culture media and establish an experimental design including the testing format and statistical design needed to provide a definitive toxicity evaluation of sulfate to wild rice (ENVI01-00325). Concentration-response data, including No and Lowest Observed Effect Concentrations (NOEC and LOEC values) and chronic values (ChV) were determined for each endpoint. Median lethal, effective or inhibitory concentrations (LC, EC or IC50) were not determined due to lack to lethal effects on the developing seedlings and the nature of the concentration-response for the sub-lethal endpoints.

3. STUDY PERSONNEL

- Mr. Scott Hall, ENVIRON International Corporation – Sponsor Representative
- Dr. Douglas J. Fort, FEL – Study Director
- Ms. Deanne Fort, FEL – Manager, In-life study facility
- Mr. Mark Blackburn, FEL – Study Lead
- Mr. Michael Mathis, FEL – QAU Manager

4. MATERIALS AND METHODS

4.1. DILUTION WATER

FEL used deionized water as the base water for this study. The deionized laboratory water was prepared by passing tap water through a four-filter system: a multimedia filter to remove suspended solids in the feed water; a 10 inch pre-treatment filter (5 μ m) to remove any additional solids; a 3.6 ft³ activated virgin carbon treatment filter to remove chlorine, ammonia, and higher molecular weight organics; 1.2 ft³ cation, 1.2 ft³ anion, and two 1.2 ft³ mixed bed ion exchange polishing filters in series to deionize the water. Both polishing filters were equipped

with conductivity detection systems. Water exceeding 5 μ mhos/cm was signaled by a warning light. A 5 μ m solid filter completed the water treatment process and ensures no solids are released during deionization. Water quality characteristics of the laboratory water were monitored twice per month for pH, dissolved oxygen (DO), conductivity, hardness, alkalinity, ammonia, residual oxidants; and at least annually for iodide, polyaromatic hydrocarbons (PAHs), pesticides, and metals. The dilution water was most recently analyzed for pesticides, PAHs, and metals on February 5, 2013, and all water quality measurements cited above met the U.S. EPA and American Society for Testing and Materials (ASTM) criteria for aquatic toxicity test culture water. Deionized water was used to prepare the culture media in accordance with Tables 2-5. Basic water chemistry parameters such as pH, hardness, and conductivity were documented on a representative sample of each test medium evaluated.

4.2. TEST SUBSTANCE

The test substance was sulfate comprised of sodium sulfate (Fisher Scientific, Houston, TX, lot no. 130197, 99.5%), potassium sulfate (Fisher Scientific, Houston, TX, lot no. 131540, 99.0%) calcium sulfate (Fisher Scientific/Acros, Houston, TX, lot no. A0314953, >98%), and magnesium sulfate (Fisher Scientific, Houston, TX, lot no. 130420, >98%). Chloride salts used to prepare the dissolved solids/chloride treatment control series included sodium chloride (Fisher Scientific, EMD Chemicals - Merck, Darmstadt, Germany, lot no. 43167330, 99%), potassium chloride (Spectrum, Gardena, CA, lot no. OX0154, >99%), calcium chloride (Sigma Chemical Company, St. Louis, MO, lot no. 072K0114, >99%), and magnesium chloride (Spectrum, Gardena, CA lot no. PJ0288, >99%).

4.3. TEST SYSTEM

The test system in the present study was wild rice (*Zizania palustris*). Given that wild rice seeds were obtained from natural stands in Minnesota, care was taken to assure that damaged or deformed seeds were not selected for the experiment. Seeds were sieved through a #5 (4 mm) sieve followed by a #10 (2 mm) sieve to separate quality seeds from debris. Visual inspection was also conducted as seeds are loaded into test systems to ensure damaged, discolored, or deformed seeds are not utilized.

4.3.1. ORIGIN AND HANDLING

Wild rice was hand-harvested from Little Round Lake in Becker County (03-0302-00) on August 30, 2012. Three over-winter storage techniques were employed: 1) four two-liter general chemistry plastic bottles were partially filled with wild rice and Little Round Lake water, wrapped in aluminum foil, and transferred to MPCA offices in St. Paul for storage in the water quality laboratory walk-in refrigerator; 2) four gallon-size Ziploc bags were partially filled with wild rice (dry stored), wrapped in aluminum foil, and transferred to MPCA offices in St. Paul for storage in the water quality laboratory walk-in refrigerator; and 3) approximately 3.5 pounds of wild rice was placed in a woven plastic bag and submerged in Little Round Lake beginning on August 30, 2012 for in-lake, over-winter storage.

The woven plastic bag of wild rice was still partially frozen in the lake sediments when it was retrieved on May 17, 2013. At that time it was placed in a sealable, five-gallon food grade plastic bucket containing Little Round Lake water and placed in an iced cooler. Four two-liter plastic general chemistry bottles of Little Round Lake water were also collected on May 17, 2013 and placed in the iced shipping cooler. The iced cooler containing the wild rice and the four bottles of lake water were delivered to the MPCA offices in St. Paul on May 21, 2013. The lake water was decanted into four new general chemistry two liter plastic bottles. Approximately five grab-handfuls of wild rice were placed into each of the four bottles. The bottles were labeled, wrapped in aluminum foil, and placed in the water quality laboratory walk-in refrigerator (Gerald Blaha, MPCA, personal communication). One 1-gallon plastic foil-wrapped bottle was shipped to FEL on May 1, 2013 and received by FEL on May 2, 2013. No record of the quantity of seeds in the bottle received from MPCA was provided. However, a sufficient number of seeds was provided to perform the MDP (00325) and the definitive study described in the present report.

4.4. EXPOSURE SYSTEM

Test solutions were administered and maintained using a static-renewal design in master 10 L hydroponic aquaria (Figure 2). The renewal frequency was daily with 0.7 volume exchanges/day. Daily cleaning of the tanks using a turkey baster was performed to remove biomass that grew during the course of the study. This minimized bio-fouling and helped maintain water quality, including minimizing ammonia accumulation, in the tanks. Care was taken not to disturb the seeds and seedlings. The test method germinated and grew rice in place without transfer of plants to different media, thereby eliminating transfer stress. Tanks were 10 L aquaria equipped with basket insets with an inert mesh to support the seeds and seedlings. Each of the four replicates per treatment was equipped with two baskets to house 30 seeds each (60 seeds per replicate). Seedlings were evaluated on study day 10 and study day 21 (study termination). Following the 10-d germination and mesocotyl development phase conducted in the dark, a combination of incandescent and fluorescent plant grow lights were used to provide a photoperiod of 16 hours (h) light and 8 h dark at an intensity that ranges from $5,000 \pm 1,000$ lux (lumens/m²) at the surface of the seeds or seedlings. Water temperature was maintained at $21^\circ \pm 2^\circ\text{C}$ (day) and $12 \pm 2^\circ\text{C}$ (night), and pH maintained between 6.0 and 7.5 s.u. The pH was maintained by consistent renewal of test solutions. A summary of the study conditions is provided in Table 6.

4.4.1. EXPOSURE SYSTEM MAINTENANCE

Exposure tanks were siphoned on a daily basis to remove waste and any accumulated debris. Care was taken to minimize stress and trauma to the seeds/seedlings, especially during movement, cleaning of aquaria, and manipulation. Potentially stressful conditions and rapid changes in environmental conditions (light availability, temperature, pH, DO) were avoided.

4.5. WATER QUALITY ANALYSES

4.5.1. WATER (CULTURE) QUALITY ANALYSES

In each replicate tank, temperature and light intensity (lux) were measured daily throughout the study and following the 10-d germination and epicotyl development phase. Dissolved oxygen (DO), pH, and oxidation/reduction potential (ORP) were measured three times per week (7-d per week) in one replicate tank of the various media in succession (A, B, C, D). In addition to the other parameters, total hardness (EPA Method 130.2), total alkalinity (EPA Method 310.1), total residual oxidants (EPA Method 8167/10070), ammonia-nitrogen (EPA Method 350.2), nitrate-nitrogen (EPA Method 353.2), sulfate (EPA Method 375.4), and phosphate-phosphorus (EPA Method 365.2) were measured in the out-flowing media in two replicates (A and B) of each treatment at test initiation, and in the other two replicates (C and D) at the conclusion of the in-life phase.

4.6. TEST METHOD

The definitive concentration-response study was performed using a static-renewal format with test solution renewal performed daily at a renewal replacement volume of 0.7, which was consistent with the replacement rate used in the MDP (ENVI01-00325). Each of 4 replicates per solution had two 1 L mesh-lined baskets. The inert plastic mesh served as the medium on which the seeds were placed and served as the inert medium required for hydroponic culture. Each basket contained 30 seeds (60/replicate and 240/treatment at T0), which was deemed adequate to quantitatively determine a concentration-response relationship and assess significant differences in the treatments relative to the control. The initial phase of 10 study days (SD) was performed in the dark to promote mesocotyl emergence and development. The mesocotyl was the first shoot element to emerge from the germinated seed (Figure 1). The HS-1 media (3,4) with ammonia:nitrate ratio of 1:4 (molar basis) (Table 2) served as the diluent, and a combination of sodium, potassium, calcium and magnesium sulfate salts was used to prepare the sulfate stock solutions such that the ratio of the monovalent to divalent salts was 2:1 (Table 3). A combination of monovalent (sodium and potassium) and divalent (calcium and magnesium) sulfate salts was used to establish sulfate exposures in order to minimize cationic imbalance caused by using monovalent sulfate salts alone. This approach minimized potential effects caused by osmotic stress and deficiency in calcium and magnesium. The following concentrations of sulfate were used: 10, 50 (HS-1 (1:4) [control]), 250, 1,000, 2,500, and 5,000 mg sulfate/L (nominal). Sulfate in the form of monovalent and divalent cationic salts were used to prepare the sulfate treatments as described in Table 2. The average measured sulfate concentration in the HS-1 control solution was ca. 50 mg/L. A modified HS-1 (1:4) solution was prepared (see attached nutrient composition) in order to reduce the sulfate concentration of this standard media to 10 mg sulfate/L nominal and thus be used for the 10 mg sulfate/L test concentration (Table 4). The sulfate concentrations were measured with an approved analytical method (5,6) on Study Day 0, 10, and 21 in each replicate of the control and in all treatments.

To determine if effects potentially observed in the study are the result of exposure to sulfate or a non-specific result of exposure to an osmotically adverse mixture of dissolved solids,

five additional exposures were established as a chloride treatment designed to be similar to the conductivity of the five highest sulfate test concentrations. To establish the chloride treatments, chloride-based non-sulfate salts were used to prepare the exposures described in Table 5. To ensure osmotic similarity between the sulfate treatments and the chloride treatments, the chloride concentration was expressed as meq/L. The chloride treatment concentrations were: 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L. The conductivities were measured with an approved analytical method (EPA Method 120.1) on Study Day 0, 10, and 21. The experimental conditions and endpoints measured followed those specified in Tables 6 and 7.

One randomly-selected basket was sacrificed from each of the four replicates per exposure at study day (SD) 10 to evaluate:

- Activation expressed as a % activation;
- Mesocotyl Emergence (in the dark) expressed as % emergence and time to emergence expressed as a median (MET) at the replicate and treatment levels;
- Seedling survival;
- Shoot (mesocotyl, coleoptile and primary leaf) weight expressed as dry weight, or dw;
- Shoot (mesocotyl, coleoptile and primary leaf) lengths;
- Root (seminal and rootlets) dw;
- Seminal Root length; and
- Free leaf number and biomass dw
- Phytotoxicity

The remaining baskets were evaluated for these endpoints, as well as signs of phytotoxicity during the free leaf stage at study conclusion (Study Day 21).

Since the frequency of mesocotyl emergence was not likely to be 100% based on the results of the MDP (ENVI01-00325), an experimentally acceptable frequency of mesocotyl emergence was determined and is listed in Table 6. In addition to the HS-1 (1:4) negative control, a 100 mg B/L (boron, as boric acid) treatment in HS-1 (1:4) media were included as a positive control toxicant.

For all endpoint assessments, plants were carefully removed at the appropriate time intervals using watch maker forceps and placed into Petri dishes for each replicate to evaluate the appropriate endpoints. Each set was digitally photographed and length measurements of shoots and roots were recorded using digitization to the nearest mm. Weights (dw at 105°C) were recorded using an analytical balance capable of recording to the nearest 0.1 mg. The seminal root tissue was dissected from the seed as was the primary leaf (shoot) material to specifically evaluate root and shoot tissue length (development).

4.7. BIOLOGICAL ENDPOINTS / OBSERVATIONS

4.7.1. DATA COLLECTION AND BIOLOGICAL ENDPOINTS

Endpoints selected for the present study were based on those required by OECD Test No. 208 (4). Test data and daily observations were recorded in the study records. Study records included study tracking sheets, test information sheets, study calendars identifying major events, study logs for recording detailed observations and comments, daily mortality, germination, emergence, test termination data sheets, and representative digital photographs taken during the conduct of the test. These photographs documented the study design, study milestones, and endpoints (length measurements and signs of phytotoxicity). The measurement endpoints of the study are summarized in section 4.6. Table 7 provides an overview of the measurement endpoints and the corresponding observation times. These endpoints were measured at SD 10 (as appropriate) and SD 21 (study termination).

4.7.1.1. ACTIVATION

For this study, activation was defined by the absorption of water by the seed and seed coat disruption. All seeds were evaluated for activation using a magnification lens. Activation data are presented as a percentage of the total seeds per basket, by replicate, and by treatment.

4.7.1.2. MESOCOTYL EMERGENCE

For this study, mesocotyl emergence was defined as the appearance of plant life in the form of shoots or roots from the germinated seed. Emergence data were presented as a percentage of the total germinated seeds per pot, by replicate, and by culture media (treatment), as well as by the time required for mesocotyl emergence expressed as the median time to emergence (MET) for a given pot within each replicate. MET represented the time for 50% of the seeds in each pot to demonstrate mesocotyl emergence.

4.7.1.3. SEEDLING SURVIVAL

Survival only applied to the seeds with emerged plant tissue. Mortality was defined as degradation of emerged plant tissue with no additional signs of growth. Survival data were presented as a percentage of the total seeds with emerged plant tissue per pot, by replicate, and by culture media (treatment).

4.7.1.4. ROOT AND SHOOT WEIGHT AND LENGTH

Seminal root and shoot weight were measured to the nearest mg. Shoot weight consisted of the combined weight of the mesocotyl, coleoptile and primary leaf (see Figure 1). Prior to collecting digital photographs and drying of the plant material, plant tissue was rinsed to removed external salt deposits that may have accumulated during the exposure period. Root

weight consisted of the combined weight of the seminal root and associated rootlets. All weights were expressed as dry weight (dw) to the nearest mg by drying the appropriate plant tissue at 105°C overnight. Length was measured by digitizing a digital photograph of the root and shoot to the nearest mm using commercial software (Sigma Scan, SPSS, Chicago, IL) which allowed for measurement of shoot and root curvatures to generate linear length. Shoot length was based on the combined length of the mesocotyl and primary leaf.

4.7.1.5. FREE LEAF BIOMASS (FREE LEAF PHASE)

Free-leaf number (counts) and biomass (mg) were determined by carefully separating the shoot from the leaf tissue. Free leaves included the second leaf and all free leaves that developed thereafter. Free leaf biomass (as dw) was determined after overnight drying at 105°C.

4.7.1.6. PHYTOTOXICITY (FREE LEAF PHASE)

Signs of phytotoxicity, including chlorosis of the leaves, darkening of the plant tissue (rot), wilting (loss of turgor pressure), and deformity were recorded and expressed as a percent of the seeds with emerged plant tissue. Because this endpoint was somewhat subjective and is a descriptive endpoint, peer-review was used to verify results.

4.7.2. DAY 0 TEST INITIATION AND SAMPLE COLLECTION

Treatment tanks were randomly assigned to a position in the exposure system in order to account for possible variations in temperature and light intensity. On SD 0, seeds selected for the study were randomly placed in each pot. Specifically, five seeds were added to each pot in accordance with a randomized design chart until each pot contained a total of 30 seeds. Samples of the different culture media were collected and analyzed for the water quality parameters described in Table 6.

4.7.3. MEASUREMENTS AT SD 10

At SD 10, each of the endpoints identified as appropriate for the degree of development were measured. One randomly selected pot from each replicate of each culture media was sacrificed (n=30/replicate or 1200/treatment). Seeds were carefully removed and photographed for documentation and length measurement. Plant tissues were carefully removed and weighed. Signs of phytotoxicity were documented in the study journal and maintained with the raw data.

4.7.4. MEASUREMENTS AT TEST TERMINATION (SD 21)

At SD 21, each of the endpoints identified as appropriate for the degree of development were measured. The remaining pots from each replicate (n=20/replicate or 80/treatment) of each culture medium were sacrificed. Seeds and seedlings were carefully removed and photographed

for documentation and length measurement. Plant tissues were carefully removed and weighed. Subsequently, since leaf material was present, leaf tissue was carefully removed from the shoot for analysis of leaf biomass. Signs of phytotoxicity were documented in the study journal and maintained with the raw data. Samples of the different culture media from two replicates (C and D) were collected and analyzed for parameters described in Table 6.

4.8. DATA ANALYSIS

All data from in-life portions of the study were tabulated in spreadsheets. The experimental unit for the present study was the replicate. The statistical tests used to compare the culture media (HS-1) to the sulfate, boron positive control, and the chloride treatment controls varied between the measurement endpoints and were analyzed using SigmaStat 11.0® (Systat Software Inc., Chicago, IL). In all cases, a one-way analysis for toxic effects in all sulfate, or all boron, or all chloride treatments was conducted to determine statistically significant differences relative to the HS-1 culture media control. For determination of concentration-based endpoints (NOEC and LOEC numerical endpoints), data that were expressed as a percent or proportion were transformed using the arcsine square root prior to further analysis. The NOEC value represents the highest concentration tested that did not illicit a statistically significant response for a given endpoint. The LOEC value represents the lowest concentration tested that produced a significant response for a given endpoint. The ChV was determined based on the geometric means of the NOEC and LOEC value for each appropriate endpoint. Data sets which met a normal data distribution (Shapiro-Wilk's test) and equal variance (Equal Variance Test) assumption were considered to be parametric. Data sets that did not meet normality and equal variance assumptions were considered non-parametric. Based on the size of both discrete (survival and phytotoxicity) and continuous (weight and length) endpoint data sets, and the limitations of the Fisher's Exact test for discrete endpoint analysis, one-way analysis of variance (ANOVA) or ANOVA on ranks (Kruskal Wallis [KW] ANOVA) for parametric or non-parametric data sets were used, respectively. Bonferroni t-test for parametric data sets and Dunn's test for non-parametric data sets were used for *post hoc* analyses when significance was detected in the ANOVA or KW ANOVA, respectively. By standard convention, p values were cited follow specific statistical test performed. In the event a *post hoc* test was not cited, the p value for the ANOVA or KW ANOVA was provided. In the event a *post hoc* test was performed, the p value for the ANOVA or KW ANOVA was ≤ 0.05 . The standard error of the mean (SEM) was reported where appropriate. Alpha was set at 0.05 for each statistical test performed. The MET was determined for each replicate for each for the controls and each treatment. A treatment median was determined based on the median of the four replicate median values.

5. RESULTS

Results are tabulated in Tables 9-29. The effect of sulfate and chloride on the endpoints measured in Wild Rice on SD 10 and 21 are provided in Figures 3 and 4, respectively. Figures 3 and 4 describe the concentration-response relationships for each of the endpoints measured at SD 10 and 21. The protocol and protocol amendments, seed information, statistical analyses, and

raw data are presented as Appendices A-D, respectively. An assessment of study performance is provided in Table 8.

5.1. SUMMARY OF WATER QUALITY PARAMETERS

A summary of water quality measurements and study parameters for the negative control (HS-1) and positive control (boron, as boric acid) are presented in Tables 9 and 10, in Tables 11-15 for the sulfate treatments, and in Tables 16-20 for the chloride treatments. Results met all study performance criteria (Table 8).

5.2. SULFATE ANALYTICAL CHEMISTRY

Nominal sulfate concentrations for the sulfate treatment set were 10, 50 (HS-1 [1:4] control), 250, 1,000, 2,500, and 5,000 mg sulfate/L. The average measured sulfate exposure concentrations were 13, 52, 239, 1,044, 2,545, and 4,980 mg sulfate/L, indicating good agreement between nominal and measured sulfate concentrations. The average conductivity measured over the course of exposure in the sulfate treatments was 554, 572, 1,044, 2,797, 4,423, and 8,507 $\mu\text{mhos/cm}$, respectively. The nominal sulfate concentration for the chloride treatment was 50 mg sulfate/L; i.e., only chloride was varied. The average measured sulfate exposure concentrations for the 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L chloride treatments were 53, 50, 50, 54, and 53 mg sulfate/L, respectively. The average conductivity values measured over the course of exposure in the chloride treatments were 699, 1,960, 2,906, 4,224, and 8,509 $\mu\text{mhos/cm}$, respectively (see Appendix D, Raw Data). General agreement between average conductivity in the chloride treatments and their corresponding sulfate exposure was observed.

5.3. ACTIVATION

Seed activation was 100% in all treatments in the study, therefore the statistical analysis did not reveal significant differences (KW ANOVA, $p=1.000$, Tables 23-28).

5.4. STUDY DAY 10

5.4.1. MESOCOTYL EMERGENCE

The SD 10 control endpoint and sulfate treatment summary are presented in Tables 23 and 24, respectively. The percent mesocotyl emergence and associated standard error of the mean (SEM value) for the HS-1 (1:4) control and 100 mg B/L positive control were 49.2 (3.9)% and 22.5 (2.8)%, respectively (Table 23). Mesocotyl emergence in the 100 mg B/L positive control was not significantly different from the HS-1 (1:4) (ANOVA, Bonferroni t-test, $p=0.088$). The mean percent mesocotyl emergence (SEM) for the 10, 250, 1,000, 2,500, and 5,000 mg sulfate/L treatments were 55.0 (11.3)%, 61.7 (7.9)%, 62.5 (7.1)%, 67.5 (7.9)%, and 70.8 (6.3)%, respectively (Table 24). Mesocotyl emergence in the various sulfate treatments was not significantly different from the control (ANOVA, Bonferroni t-test, $p>0.05$).

The SD 10 endpoint summary for the chloride treatments is presented in Table 25. The percent mesocotyl emergence (SEM) for the 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L treatments were 35.8 (3.7)%, 30.0 (4.5)%, 31.7 (4.2)%, 48.3 (10.4)%, and 30.0 (2.4)%, respectively. Mesocotyl emergence in the chloride treatments was not significantly different from the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $p > 0.05$).

5.4.2. SEEDLING SURVIVAL

Seedling survival was 100% in all treatments (KW-ANOVA, $p = 1.000$) (Tables 23-25).

5.4.3. ROOT AND SHOOT WEIGHT AND LENGTH

The mean seminal root and shoot biomasses for the HS-1 (1:4) control and 100 mg B/L positive control were 0.0005(0.0001) g and 0.0027 (0.0003) g, and 0.0003 (0.0001) g and 0.0020 (0.0001) g, respectively (Table 23). Seminal root and shoot weights of seedlings exposed to 100 mg B/L were not significantly different from the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $p = 0.262$ and KW ANOVA, Dunn's test $p > 0.05$, respectively). The mean seminal root and shoot lengths (SEM) for the HS-1 (1:4) control and 100 mg B/L positive control were 3.977 (0.4906) cm and 3.783 (0.2321) cm, and 1.908 (0.2263) cm and 2.875 (0.1919) cm, respectively (Table 23). Seminal root and shoot lengths of seedlings in the 100 mg B/L positive control were significantly less than the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $p < 0.001$ and $p = 0.001$, respectively).

The mean seminal root and shoot biomasses for the 10, 250, 1,000, 2,500, and 5,000 mg sulfate/L treatments were 0.0005 (0.0001) g and 0.0035 (0.0006) g, 0.0007 (0.0000) g and 0.0030 (0.0007) g, 0.0005 (0.0000) g and 0.0021 (0.0001) g, 0.0004 (0.0000) g and 0.0019 (0.0001) g, and 0.0005 (0.0000) g and 0.0018 (0.0001) g, respectively (Table 24). Seminal root biomass of seedlings in the 250 mg sulfate/L treatments was significantly greater than the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $p = 0.013$), however none of the seminal root or shoot biomasses were significantly different from the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $p = 1.000$ [seminal root biomass] and KW-ANOVA, Dunn's test, $p > 0.05$ [shoot biomass]). The mean seminal root and shoot length (SEM) for the 10, 250, 1,000, 2,500, and 5,000 mg sulfate/L treatments were 3.929 (0.0367) cm and 4.148 (0.2043) cm, 4.226 (0.6027) cm and 3.599 (0.1634) cm, 3.640 (0.2663) cm and 3.333 (0.1321) cm, 3.362 (0.3551) cm and 2.915 (0.1779) cm, and 2.076 (0.2087) cm and 2.242 (0.0455) cm, respectively (Table 24). Seminal root length of seedlings exposed to the 5,000 mg sulfate/L treatment were significantly less than the HS-1(1:4) control (ANOVA, Bonferroni t-test, $p = 0.002$), however seminal root length in the other sulfate treatments was not significantly different from the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $p = 1.000$ in all cases). Shoot length of seedlings exposed to the 2,500 and 5,000 mg sulfate/L treatment were significantly less than the HS-1(1:4) control (ANOVA, Bonferroni t-test, $p = 0.002$ [2,500 mg sulfate/L] and $P < 0.001$ [5,000 mg sulfate/L]), however shoot length in the other sulfate treatments were not significantly different from the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $p > 0.05$).

The mean seminal root and shoot biomasses for the 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L chloride treatments were 0.0004 (0.0000) g and 0.0015 (0.0001) g, 0.0004 (0.0000) g and 0.0018 (0.0001) g, 0.0004 (0.0000) g and 0.0015 (0.0001) g, 0.0004 (0.0000) g and 0.0015 (0.0003) g, and 0.0004 (0.0000) g and 0.0014 (0.0001) g, respectively (Table 25). Seminal root biomass of seedlings exposed to the chloride treatments were not significantly different than the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $P=1.000$ in all five tests). Mean shoot biomass for seedlings exposed to the 0.8, 51.1, and 103.2 meq/L chloride treatments were significantly less than the HS-1 (1:4) control (KW-ANOVA, Dunn's test, $p<0.05$). The mean seminal root and shoot length (SEM) for the 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L chloride treatments were 3.364 (0.237) cm and 2.311 (0.1137) cm, 4.320 (0.2748) cm and 2.700 (0.0758) cm, 2.792 (0.04239) cm and 2.188 (0.1071) cm, 3.217 (0.2808) cm and 2.540 (0.1330) cm, and 2.051 (0.0413) cm and 2.095 (0.1016) cm, respectively (Table 25). Seminal root length of seedlings exposed to the 103.2 meq/L chloride treatment were significantly less than the HS-1(1:4) control (ANOVA, Bonferroni t-test, $P=0.002$), however seminal root length in the other sulfate treatments were not significantly different from the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $p>0.05$). Shoot length of seedlings exposed to the each of the chloride treatments were significantly less than the HS-1(1:4) control (ANOVA, Bonferroni t-test, $p<0.001$).

5.4.4. FREE LEAF NUMBER AND BIOMASS

The mean secondary leaf number and biomass for the HS-1 (1:4) and 100 mg B/L positive control on SD 10 was 0.9 (0.04) and 0.002 (0.0001) g, and 0.6 (0.10) and 0.001 (0.0001) g, respectively (Table 23). Free leaf biomass, but no leaf number in the 100 mg B/L positive control was significantly lower than in the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $p=0.001$ and KW-ANOVA, Dunn's test, $p>0.05$, respectively).

The mean secondary number and leaf biomass for the 10, 250, 1,000, 2,500, and 5,000 mg sulfate/L treatments were 0.9(0.03) and 0.002 (0.0004) g, 1.0 (0.03) and 0.002 (0.0002) g, 0.9 (0.02) and 0.002 (0.0002) g, 1.0 (0.01) and 0.002 (0.0002), and 0.9 (0.04) and 0.001 (0.0001) g, respectively (Table 24). Neither free leaf number nor free leaf biomass in the sulfate treatments was significantly different from those of the HS-1 (1:4) control (KW-ANOVA, Dunn's test, $p>0.05$ and ANOVA, Bonferroni t-test, $p>0.05$).

The mean secondary number and leaf biomass for the 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L chloride treatments were 0.9(0.03) and 0.002 (0.0003) g, 0.9 (0.04) and 0.002 (0.0004) g, 0.9 (0.02) and 0.002 (0.0003) g, 0.9 (0.05) and 0.002 (0.0001), and 1.0 (0.02) and 0.001 (0.0001) g, respectively (Table 25). Neither free leaf number nor free leaf biomass in the chloride treatments was significantly different from those of the HS-1 (1:4) control (KW-ANOVA, Dunn's test, $p>0.05$ and ANOVA, Bonferroni t-test, $p>0.05$).

5.4.5. PHYTOTOXICITY (FREE LEAF PHASE)

The mean occurrence of phytotoxicity for the HS-1 (1:4) and 100 mg B/L positive control on SD 10 was 0.0 (0.0) % and 71.0 (9.9) %, respectively (Table 23). The mean occurrence of phytotoxicity for the 100 mg B/L positive control was significantly greater than the HS-1(1:4) control (ANOVA, Bonferroni t-test, $p < 0.001$).

The mean occurrence of phytotoxicity for the 10, 250, 1,000, 2,500, and 5,000 mg sulfate/L treatments on SD 10 was 0.0 (0.0)% for each treatment with the exception of the 5,000 mg sulfate/L treatment which was 39.1 (4.1)% (Table 24). The mean occurrence of phytotoxicity for the 5,000 mg sulfate/L treatment was significantly greater than the HS-1(1:4) control (ANOVA, Bonferroni t-test, $p < 0.001$).

The mean occurrence of phytotoxicity for the 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L chloride treatments on SD 10 was 0.0 (0.0)% for each treatment with the exception of the 51.1 and 103.2 meq/L which were 5.9 (2.1)% and 40.5 (9.5)% (Table 25). The mean occurrence of phytotoxicity for the 103.2 meq/L, but not the 51.1 meq/L treatment was significantly greater than the HS-1(1:4) control (ANOVA, Bonferroni t-test, $p < 0.001$ and ANOVA, Bonferroni t-test, $p = 0.225$, respectively).

5.5. STUDY DAY 21

5.5.1. MESOCOTYL EMERGENCE

SD 21 control endpoint and sulfate treatment summaries are presented in Tables 26 and 27, respectively. The percent mesocotyl emergence (SEM) for the HS-1 (1:4) control and 100 mg B/L positive control were 38.3 (2.2) % and 19.2 (2.5)%, respectively (Table 26). Mesocotyl emergence in the 100 mg B/L control was not significantly different from each the HS-1 (1:4) (KW-ANOVA, Dunn's test, $p > 0.05$). The percent mesocotyl emergence (SEM) for the 10, 250, 1,000, 2,500, and 5,000 mg sulfate/L treatments were 45.8 (9.5)%, 45.0 (9.5)%, 58.3 (9.1)%, 73.3 (6.1)%, and 55.0 (7.0)%, respectively (Table 27). Mesocotyl emergence in the various sulfate treatments was not significantly different from the control (KW-ANOVA, Dunn's test, $p > 0.05$).

The SD 21 endpoint summary for the chloride treatments is presented in Table 28. The percent mesocotyl emergence (SEM) for the 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L treatments were 29.2 (2.8)%, 35.8 (5.7)%, 37.5 (5.0)%, 50.8 (7.6)%, and 34.2 (2.4)%, respectively. Mesocotyl emergence in the chloride treatments was not significantly different from the HS-1 (1:4) control (KW-ANOVA, Dunn's test, $p > 0.05$ for all five treatments).

The MET for the HS-1 (1:4) control and 100 mg B/L positive control were both > 21 days (Table 29). The MET for the 10, 250, 1,000, 2,500, and 5,000 mg sulfate/L treatments were > 21 , > 21 , 6.5, 5, and 9.5 days, respectively. The addition of sulfate at concentrations of 1,000 to 5,000 mg/L accelerated the rate of emergence relative to the HS-1 control and the 10 and 250 mg/L sulfate exposures. The reason for enhance emergence with the addition of sulfate is unknown,

but consistent for sulfate additions of 1,000 mg/L and greater. The MET for the 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L treatments were all >21 days with the exception of the 51.1 meq/L treatment which was >17 days. The MET value of 17 days may be anomalous given the lack of a dose-response (i.e., the MET value was 21 days for all chloride treatment exposures above and below that exhibiting the MET value of 17 days).

5.5.2. SEEDLING SURVIVAL

Seedling survival was 100% in all treatments (KW ANOVA, $p=1.000$) (Tables 26-28).

5.5.3. ROOT AND SHOOT WEIGHT AND LENGTH

The mean seminal root and shoot biomasses for the HS-1 (1:4) control and 100 mg B/L positive control were 0.0005 (0.0001) g and 0.0024 (0.0002) g, and 0.0003 (0.0000) g and 0.0028 (0.0004) g, respectively (Table 26). Seminal root and shoot weights of seedlings exposed to 100 mg B/L were not significantly different from the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $p=1.000$ and KW ANOVA, Dunn's test $p>0.05$, respectively). The mean seminal root and shoot lengths (SEM) for the HS-1 (1:4) control and 100 mg B/L positive control were 4.495 (0.3817) cm and 3.412 (0.2651) cm, and 2.069 (0.0380) cm and 3.320 (0.3563) cm, respectively (Table 26). Seminal root, but not the shoot lengths of seedlings in the 100 mg B/L positive control were significantly less than the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $p<0.001$ and KW-ANOVA, Dunn's test, $p>0.05$, respectively).

The mean seminal root and shoot biomasses for the 10, 250, 1,000, 2,500, and 5,000 mg sulfate/L treatments were 0.0005 (0.0000) g and 0.0023 (0.0002) g, 0.0006 (0.0001) g and 0.0023 (0.00072) g, 0.0007 (0.0001) g and 0.0024 (0.0001) g, 0.0007 (0.0000) g and 0.0027 (0.0002) g, and 0.0005 (0.0001) g and 0.0036 (0.0003) g, respectively (Table 27). Seminal root and shoot biomasses of seedlings exposed to the sulfate treatments were not significantly greater than the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $p>0.05$ and KW-ANOVA, Dunn's test, $p>0.05$, respectively). The mean seminal root and shoot length (SEM) for the 10, 250, 1,000, 2,500, and 5,000 mg sulfate/L treatments were 5.436 (0.1996) cm and 3.143 (0.4103) cm, 5.037 (0.2297) cm and 3.202 (0.1385) cm, 4.556 (0.0920) cm and 3.151 (0.0443) cm, 3.984 (0.02178) cm and 2.815 (0.0656) cm, and 2.565 (0.1851) cm and 2.052 (0.0386) cm, respectively (Table 27). Seminal root length of seedlings exposed to the 5,000 mg sulfate/L treatment were significantly less than the HS-1(1:4) control (ANOVA, Bonferroni t-test, $p<0.001$), however seminal root length in the other sulfate treatments were not significantly different from the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $p>0.05$). Shoot length of seedlings exposed to the sulfate treatments were not significantly different than the HS-1(1:4) control (KW-ANOVA, Dunn's test, $p>0.05$).

The mean seminal root and shoot biomasses for the 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L chloride treatments were 0.0005 (0.0001) g and 0.0014 (0.0000) g, 0.0005 (0.0001) g and 0.0017 (0.0001) g, 0.0005 (0.0001) g and 0.0016 (0.0001) g, 0.0005 (0.0001) g and 0.0020 (0.0002) g, and 0.0010 (0.0001) g and 0.0028 (0.0006) g, respectively (Table 28). Seminal root biomass of seedlings exposed to the 103.2 meq/L chloride treatment was significantly greater than the HS-1

(1:4) control (ANOVA, Bonferroni t-test, $P < 0.001$), however the seminal root biomasses of the other chloride treatments were not significantly different from the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $P > 0.05$). Mean shoot biomass for seedlings exposed to the 0.8, 51.1, and 103.2 meq/L chloride treatments were not significantly different than the HS-1 (1:4) control (KW-ANOVA, Dunn's test, $p > 0.05$). The mean seminal root and shoot length (SEM) for the 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L chloride treatments were 5.170 (0.5520) cm and 2.670 (0.3053) cm, 3.780 (0.2464) cm and 2.434 (0.1797) cm, 3.230 (0.3364) cm and 2.325 (0.0368) cm, 3.679 (0.2887) cm and 2.499 (0.0694) cm, and 2.862 (0.2011) cm and 1.906 (0.0488) cm, respectively (Table 28). Seminal root length of seedlings exposed to the 103.2 and 19.2 meq/L chloride treatment were significantly less than the HS-1(1:4) control (ANOVA, Bonferroni t-test, $p = 0.002$ and 0.031 , respectively), however seminal root length in the other chloride treatments were not significantly different from the HS-1 (1:4) control (ANOVA, Bonferroni t-test, $p > 0.05$). Shoot length of seedlings exposed to the 103.2 meq/L chloride treatment was significantly less than the HS-1(1:4) control (KW-ANOVA, Dunn's test, $p < 0.05$), however shoot length in the other chloride treatments was not significantly different from the HS-1 (1:4) control (KW-ANOVA, Dunn's test, $p > 0.05$).

5.5.4. FREE LEAF NUMBER AND BIOMASS

The mean secondary leaf number and biomass for the HS-1 (1:4) and 100 mg B/L positive control on SD 10 was 3.6 (0.25) and 0.0055 (0.0002) g, and 2.7 (0.05) and 0.0031 (0.0005) g, respectively (Table 26). Neither free leaf biomass nor leaf number in the 100 mg B/L positive control was significantly different than the HS-1 (1:4) control (KW-ANOVA, Dunn's test, $p > 0.05$, for both).

The mean secondary number and leaf biomass for the 10, 250, 1,000, 2,500, and 5,000 mg sulfate/L treatments were 3.8(0.08) and 0.0069 (0.0003) g, 3.9 (0.15) and 0.0069 (0.0003) g, 3.5 (0.06) and 0.0068 (0.0005) g, 3.2 (0.10) and 0.0065 (0.0004), and 2.6 (0.12) and 0.0049 (0.0004) g, respectively (Table 27). Neither free leaf number nor free leaf biomass in the sulfate treatments was significantly different from the HS-1 (1:4) control (KW-ANOVA, Dunn's test, $p > 0.05$, for both).

The mean secondary number and leaf biomass for the 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L chloride treatments were 3.4(0.13) and 0.0063 (0.0006) g, 2.9 (0.19) and 0.0070 (0.0008) g, 3.1 (0.08) and 0.0060 (0.0005) g, 3.3 (0.12) and 0.0070 (0.0005), and 2.9 (0.11) and 0.0085 (0.0013) g, respectively (Table 28). Neither free leaf number nor free leaf biomass in the chloride treatments was significantly different from the HS-1 (1:4) (KW-ANOVA, Dunn's test, $p > 0.05$, for both).

5.5.5. PHYTOTOXICITY (FREE LEAF PHASE)

The mean occurrence of phytotoxicity for the HS-1 (1:4) and 100 mg B/L positive control on SD 10 was 0.0 (0.0) % and 100.0 (0.0) %, respectively (Table 26). The mean occurrence of phytotoxicity for the 100 mg B/L positive control was significantly greater than the HS-1(1:4) control (ANOVA, Bonferroni t-test, $p < 0.001$).

The mean occurrence of phytotoxicity for the 10, 250, 1,000, and 2,500 mg sulfate/L treatments on SD 10 was 0.0 (0.0)% for each treatment, but the 5,000 mg sulfate/L treatment had phytotoxicity in 89.4 (0.8)% of seedlings (Table 27). The mean occurrence of phytotoxicity for the 5,000 mg sulfate/L treatment was significantly greater than the HS-1(1:4) control (ANOVA, Bonferroni t-test, $p < 0.001$).

The mean occurrence of phytotoxicity for the 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L chloride treatments on SD 10 was 0.0 (0.0)% for each treatment with the exception of the 103.2 meq/L which were 100.0 (0.0)% (Table 28). The mean occurrence of phytotoxicity for the 103.2 meq/L treatment was significantly greater than the HS-1(1:4) control (ANOVA, Bonferroni t-test, $p < 0.001$).

6. PERFORMANCE CRITERIA AND VALIDITY

Results from the 00325 study met the performance criteria established from the MDP (00325), including the performance of the 100 mg B/L treatment. Therefore, results from study 00325 were considered to be valid.

7. DISCUSSION

Results from this study suggested that exposure of developing wild rice to sulfate did not induce an adverse response at concentrations $\leq 1,000$ mg sulfate/L at SD 10 for all study endpoints (Table 1) and at $\leq 2,500$ mg sulfate/L at SD 21 for all study endpoints. The following general relationships were identified during the course of the study, and are illustrated in Figures 3 and 4:

- In the sulfate treatments, shoot length, root length, and phytotoxicity were significantly affected by sulfate exposure at SD 10, and shoot length was the most sensitive endpoint at SD 10 (NOEC value 1,000 mg/L sulfate). At SD 21 (study conclusion), root length and phytotoxicity were significantly affected by sulfate, both with NOEC values of 2,500 mg/L sulfate.
- The least sensitive endpoints measured were activation, mesocotyl emergence, and seedling survival regardless of study day. The most consistently affected endpoint regardless of treatment was phytotoxicity.
- Exposure of developing wild rice to the chloride treatments reduced shoot length at each concentration at SD 10 (Table 1), but only in the 103.2 meq/L chloride treatment at SD 21. Shoot length was also reduced in developing wild rice to sulfate at 2,500 and 5,000 mg sulfate/L at SD10, but not at SD 21. Thus, results from the present study indicated that length may have been a more sensitive measure of growth than weight.
- Similar trends in response between SD 10 and 21 in sulfate treatments were observed with activation, mesocotyl emergence, survival, shoot and root weight, root length, phytotoxicity, secondary leaf number, and secondary leaf biomass.

- Similar trends in response between SD 10 and 21 in chloride treatments were observed with activation, mesocotyl emergence, survival, root weight, root length, phytotoxicity, secondary leaf number, and secondary leaf biomass.
- Effects on the biological measurement endpoints occurred at a conductivity of ca. 4,000 $\mu\text{mhos/cm}$, regardless of origin (sulfate or chloride treatment).
- Each of the endpoints adversely affected by sulfate exposure was also adversely affected in the corresponding chloride treatment.

8. CONCLUSION

Overall, results from the present study suggested that sulfate did not adversely affect early development and leafing in wild rice at concentrations $\leq 1,000$ mg sulfate/L (10 day results) or at $\leq 2,500$ mg/L for the full 21 day exposure. The day 10 effects induced in the 2,500 and 5,000 mg sulfate/L were also observed in the chloride treatments, indicating that the response was likely the result of a general osmotic stress and not due to sulfate toxicity specifically.

9. RECORDS AND SAMPLE STORAGE

FEL will retain facility-related records (personnel training, equipment calibration and maintenance, storage temperature records, etc.) (7). No records will be disposed of without the authorization of the Sponsor. The records will be organized and include an index.

Raw data, derived data, QA reports, study guidance documents, correspondence, and draft and final reports will be electronically maintained at the FEL facility in accordance with facility SOPs (8,9) until study finalization. Printed copies of the original study materials and report will be kept in designated file cabinets located in a secured file room at FEL. After final approval of all reports and the study has been officially concluded, all electronic files will be transferred to compact discs (CDs). All original CDs and original printed/paper files associated with the study will be shipped to ENVIRON International Corporation and archived. All tissues derived from this study were consumed, thus not requiring archiving. All waste was properly disposed (10).

10. STUDY PROTOCOL ADHERENCE

The study was performed in accordance with Study Protocol No. ENVI01-1 for study ENVI01-00325 (Appendix A). There were two amendments and no deviations to the Study Protocol, ENVI01-2.

11. REFERENCES

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7. SOP 4.10, Study File Document Collection and Organization, Fort Environmental Laboratories, 2001.
8. SOP 4.11, Maintenance of Study Archives, Fort Environmental Laboratories, 2001.
9. SOP 12.1, Archiving of Test Specimens, Fort Environmental Laboratories, 2003.
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TABLES AND FIGURES

Table 2. Modified Hoagland's Solution – HS-1 with 1:4 Ammonia:Nitrate

Primary Ingredient	Media HS-1 (1:4) mL Stock/L
1 M $\text{NH}_4\text{H}_2\text{PO}_4$	0.12
1 M NH_4NO_3	0.70
1 M KNO_3	1.10
1 M $\text{Ca}(\text{NO}_3)_2$	0.75
1M MgSO_4	0.50
Micronutrients (Stock B)	
2.860 g H_3BO_3	1.00
1.810 g $\text{MnCl}_2 \cdot 4 \text{H}_2\text{O}$	
0.220 g $\text{ZnSO}_4 \cdot 7 \text{H}_2\text{O}$	
0.080 g $\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$	
0.024 g $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$	
14.527 g FeCl_3	

Table 3. Preparation of Sulfate Concentrations using Monovalent and Divalent Salts

Concentration SO ₄ (mg/L)	1:2 Ratio of Monovalent to Divalent Salts						Master (g or L) ¹		
	mg Required for SO ₄ Concentration in 1 L HS-1				Hardness (mg/L CaCO ₃)		Na ₂ SO ₄	49.3	17.4
	Na ₂ SO ₄	K ₂ SO ₄	CaSO ₄	MgSO ₄	Ca and Mg as basis	Ca as basis	K ₂ SO ₄	60.5	17.4
10 ²	---	---	---	---	---	---	CaSO ₄	29.9	8.7
50 ³	---	---	---	---	---	---	MgSO ₄	20.9	8.7
250	123.3	151.3	74.8	52.3	86.8	43.5	HS-1	20.0	
1000	492.9	604.7	298.7	208.8	347.3	173.7			
2500	1232.2	1511.8	746.8	522.1	868.3	434.2			
5000	2464.4	3023.5	1493.6	1044.2	1736.6	868.3			

¹ 5,000 mg/L sulfate (nominal). Amount (mL) of stock required to prepare 10 L of: 5000 (10 L), 2500(5 L), 1000 (2 L), and 250 (0.5 L). 20 L required.

² Prepared as modified HS-1 medium (see attachment).

³ HS-1 (1:4) medium.

Table 4. Modified HS-1 with 1:4 Ammonia:Nitrate – 10 mg/L Sulfate (nominal)

Primary Ingredient	Media HS-1 (1:4) (g/L)	Media HS-1 (1:4) mL Stock/L
1 M $\text{NH}_4\text{H}_2\text{PO}_4$	115.00	0.12
1 M NH_4NO_3	80.00	0.70
1 M KNO_3	101.10	1.10
1 M $\text{Ca}(\text{NO}_3)_2$	164.10	0.75
0.26 M MgSO_4	31.10	0.40
0.74 M MgCl_2	151.00	0.54
Micronutrients (Stock B)		
2.860 g H_3BO_3	1.00	---
1.810 g $\text{MnCl}_2 \cdot 4 \text{H}_2\text{O}$		
0.220 g $\text{ZnSO}_4 \cdot 7 \text{H}_2\text{O}$		
0.080 g $\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$		
0.024 g $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$		
14.527 g FeCl_3		

Table 5. Preparation of Chloride Treatment Controls using Chloride (Non-Sulfate) Salts

Estimated Conductivity ² (µmhos/cm)	Low Sulfate (Chloride) Salts						Master (g or L) ¹		
	mg Required for SO ₄ Concentration in 1 L HS-1				Hardness (mg/L CaCO ₃)		NaCl	41.9	35.8
	NaCl	KCl	CaCl ₂	MgCl ₂	Ca and Mg as basis	Ca as basis	KCl	51.4	34.5
770	20.7	25.8	12.8	8.9	---	---	CaCl ₂	25.4	8.6
1890	104.8	128.6	63.6	44.5	73.8	37.0	MgCl ₂	17.8	4.4
2830	365.4	514.0	253.9	177.5	295.2	147.6	HS-1	20.0	
4100	1047.4	1285.0	634.8	443.8	738.1	369.1			
8350	2094.7	2570.0	1269.6	887.6	1476.1	738.1			

¹ 103.2 mcq/L (nominal). Amount (mL) of stock required to prepare 10 L of: 103.2 (10 L), 51.1(5 L), 19.8 (2 L), 250 (0.5 L), and 0.8 (0.1 L). 20 L required.

² Based on experimentally-derived conductivity conversion factor of 0.85 to convert from sulfate to chloride salts.

Table 6. Experimental Conditions for Hydroponic Study – Definitive Phase

Test Substance	Sulfate (2:1 mixed monovalent:divalent salts)	
Test System (species)	<i>Zizania palustris</i> (wild rice)	
Initial Stage	Seed	
Exposure Period	10- d (mesocotyl emergence phase in dark) and 21- d (free leaf phase)	
Selection Criteria	Seed uniformity, visual quality, and activation	
Exposure System	Static-renewal in controlled environmental chambers	
Exposure Route	Water (hydroponics)	
Exchange frequency	Daily, 0.7 volumes/day	
Water Source	Deionized water	
Media	HS-1 with 1:4 ammonia:nitrate	
Seed Density	30 seeds/1 L pot (240 seeds per treatment or control)	
Test Vessel	1 L pots equipped with mesh bottom supports for seeds	
Replication	4 replicates with each replicate containing two (2) 1 L pots. In summary, there were 60 seeds/replicate and 240 seeds/treatment at SD 0. Thirty seeds or seedlings/replicate (120 seeds/seedlings treatment) were evaluated on SD 10 and test termination.	
Vessel Placement	Random	
Positive Control	Boric Acid (100 mg B/L) and 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L conductivity control series	
Test Performance Criteria (control)	See Table 7	
Test Endpoints	Daily	Activation, mesocotyl emergence, and visual inspection of development (emergence and normalcy of development)
	SD 10	Activation, mesocotyl emergence (%), time to emergence [TTE] expressed as a median [MTE] if possible), shoot (mesocotyl, coleoptile, and primary leaf)/seminal root length and weight (mesocotyl, coleoptile, and primary leaf)/seminal root and rootlets, and signs of phytotoxicity
	Conclusion	Activation, mesocotyl emergence (%), time to emergence [TTE] expressed as a median [MTE] if possible), shoot (mesocotyl, coleoptile, and primary leaf)/seminal root length and weight (mesocotyl, coleoptile, and primary leaf)/seminal root and rootlets, second and free leaf biomass, and signs of phytotoxicity
Feeding	Nutrient/Micronutrients	HS-1 (Malvick and Percich, 1993) modified with 1:4 ammonia:nitrate
	Frequency	Daily, 0.7 volumes renewed
Lighting	Photoperiod	Dark through SD 10, then 16 h light : 8 h dark
	Intensity (post SD 10)	5,000 ± 1,000 lux (measured daily at water surface)
Temperature	In all replicates, daily, 21° ± 2°C (day), and nightly, 12 ± 2°C (night)	
pH, ORP, DO, conductivity	3x per week in one replicate in rotation to include SD 0 and conclusion	
Alkalinity, hardness, ammonia, nitrate, phosphate	Initiation and conclusion of study in two replicates (A and B at initiation and C and D at conclusion).	
Sulfate	Study Day 0, 10, and 21 in all replicates of control and treatments	

Table 7. Observation Time Points for Primary Endpoints

Physiological Endpoints:	Daily	SD 10 ² Emergence Phase	SD 21 Free-Leaf Phase
Survival	•		
Germination	•		
Emergence	•		
Shoot ¹ weight and length		•	•
Root ² weight and length		•	•
Leaf biomass			•
Phytotoxicity		•	•

Table 8. General Test Performance Criteria

Criterion	Acceptable Limits	Criterion Passed? (d21 value, if applicable)
Control activation	95%	√ (100%)
Control mesocotyl emergence	≥30%	√ (38.3%)
Control survival	≥90%	√ (100%)
Positive control (BA) phytotoxicity	≥80%	√ (100%)
pH	6-7.5 in all replicates of control and treatments	√ (within range)
Water temperature	21° ± 2°C (day), and nightly, 12 ± 2°C (night) in all replicates of control and treatments	√ (within range)
Sulfate concentration	Inter-replicate CV ≤20% for control and treatments for individual measurement set (Study Day 0, 10, and 21)	√

¹Includes mesocotyl, coleoptile, and primary leaf measured combined for weight and individually by structure for length.

²Seminal roots and rootlets for weight and seminal root for length.

Table 9. HS-1 (1:4) Nutrient Media Treatment Water Quality Summary

	Hardness (mg/L)	Alkalinity (mg/L)	Residual Oxidants (mg/L)	NH₃-N (mg/L)	NO₃-N (mg/L)	PO₄-P (mg/L)	Sulfate (mg/L)	Conductivity (µmhos/cm)
MIN	112	16	<0.1	7.29	65	4.26	48	523
MAX	196	20	<0.1	7.83	68	4.92	56	663
MEAN	146	19	N/A	7.55	67	4.70	52	572
SEM	19.9	1.0	N/A	0.12	0.6	0.15	1.2	15.5

Table 10. Boric Acid Treatment Water Quality Summary

	Hardness (mg/L)	Alkalinity (mg/L)	Residual Oxidants (mg/L)	NH₃-N (mg/L)	NO₃-N (mg/L)	PO₄-P (mg/L)	Sulfate (mg/L)	Conductivity (µmhos/cm)
MIN	114	14	<0.1	7.20	56	4.61	52	586
MAX	192	20	<0.1	7.51	69	5.12	54	649
MEAN	157	18	N/A	7.36	64	4.88	53	611
SEM	18.0	1.5	N/A	0.06	2.8	0.12	0.4	6.7

Table 11. 10 mg/L SO₄²⁻ Treatment Water Quality Summary

	Hardness (mg/L)	Alkalinity (mg/L)	Residual Oxidants (mg/L)	NH ₃ -N (mg/L)	NO ₃ -N (mg/L)	PO ₄ -P (mg/L)	Sulfate (mg/L)	Conductivity (µmhos/cm)
MIN	120	8	<0.1	7.12	59	4.88	12	508
MAX	208	12	<0.1	7.79	60	5.08	14	638
MEAN	160	10	N/A	7.45	59	4.99	13	554
SEM	22.6	1.2	N/A	0.15	0.3	0.05	0.4	13.2

Table 12. 250 mg/L SO₄²⁻ Treatment Water Quality Summary

	Hardness (mg/L)	Alkalinity (mg/L)	Residual Oxidants (mg/L)	NH ₃ -N (mg/L)	NO ₃ -N (mg/L)	PO ₄ -P (mg/L)	Sulfate (mg/L)	Conductivity (µmhos/cm)
MIN	146	6.00	<0.1	7.04	52	4.61	230	1623
MAX	328	12.00	<0.1	7.48	69	4.93	256	1784
MEAN	248	8.50	N/A	7.26	62	4.81	239	1729
SEM	45.4	1.50	N/A	0.09	4.3	0.07	3.7	13.1

Table 13. 1000 mg/L SO₄²⁻ Treatment Water Quality Summary

	Hardness (mg/L)	Alkalinity (mg/L)	Residual Oxidants (mg/L)	NH ₃ -N (mg/L)	NO ₃ -N (mg/L)	PO ₄ -P (mg/L)	Sulfate (mg/L)	Conductivity (µmhos/cm)
MIN	426	4	<0.1	7.40	50	4.39	1024	2732
MAX	780	12	<0.1	7.66	62	4.76	1080	2916
MEAN	589	8	N/A	7.52	57	4.59	1044	2797
SEM	91.0	1.8	N/A	0.05	3.0	0.08	8.1	18.0

Table 14. 2500 mg/L SO₄²⁻ Treatment Water Quality Summary

	Hardness (mg/L)	Alkalinity (mg/L)	Residual Oxidants (mg/L)	NH ₃ -N (mg/L)	NO ₃ -N (mg/L)	PO ₄ -P (mg/L)	Sulfate (mg/L)	Conductivity (µmhos/cm)
MIN	888	8	<0.1	6.82	59	4.56	2510	4210
MAX	1930	12	<0.1	7.08	65	5.08	2592	4884
MEAN	1348	10	N/A	6.99	61	4.85	2545	4423
SEM	269.0	0.8	N/A	0.06	1.3	0.14	12.6	76.2

Table 15. 5000 mg/L SO₄²⁻ Treatment Water Quality Summary

	Hardness (mg/L)	Alkalinity (mg/L)	Residual Oxidants (mg/L)	NH ₃ -N (mg/L)	NO ₃ -N (mg/L)	PO ₄ -P (mg/L)	Sulfate (mg/L)	Conductivity (µmhos/cm)
MIN	1590	8	<0.1	6.96	60	4.09	4900	8341
MAX	2960	18	<0.1	7.54	67	4.91	5022	8886
MEAN	2240	12	N/A	7.25	63	4.66	4980	8507
SEM	352.9	2.4	N/A	0.13	1.8	0.19	19.1	59.3

Table 16. 0.8 meq/L Treatment Water Quality Summary

	Hardness (mg/L)	Alkalinity (mg/L)	Residual Oxidants (mg/L)	NH ₃ -N (mg/L)	NO ₃ -N (mg/L)	PO ₄ -P (mg/L)	Sulfate (mg/L)	Conductivity (µmhos/cm)
MIN	156	8	<0.1	6.96	53	4.66	48	642
MAX	400	12	<0.1	7.82	57	5.10	56	763
MEAN	259	10	N/A	7.37	56	4.87	53	699
SEM	56.6	0.8	N/A	0.22	0.9	0.11	1.3	11.0

Table 17. 4.2 meq/L Treatment Water Quality Summary

	Hardness (mg/L)	Alkalinity (mg/L)	Residual Oxidants (mg/L)	NH ₃ -N (mg/L)	NO ₃ -N (mg/L)	PO ₄ -P (mg/L)	Sulfate (mg/L)	Conductivity (µmhos/cm)
MIN	280	6	<0.1	6.90	54	4.39	46	1858
MAX	550	12	<0.1	7.36	59	5.08	54	2116
MEAN	410	9	N/A	7.11	57	4.83	50	1960
SEM	75.2	1.3	N/A	0.10	1.2	0.15	1.2	26.6

Table 18. 19.8 meq/L Treatment Water Quality Summary

	Hardness (mg/L)	Alkalinity (mg/L)	Residual Oxidants (mg/L)	NH ₃ -N (mg/L)	NO ₃ -N (mg/L)	PO ₄ -P (mg/L)	Sulfate (mg/L)	Conductivity (µmhos/cm)
MIN	372	6.00	<0.1	7.12	49	4.56	46	2836
MAX	740	10.00	<0.1	7.31	62	5.16	56	3032
MEAN	539	8.00	N/A	7.23	56	4.86	50	2906
SEM	94.4	0.82	N/A	0.04	3.0	0.13	1.7	20.9

Table 19. 51.1 meq/L Treatment Water Quality Summary

	Hardness (mg/L)	Alkalinity (mg/L)	Residual Oxidants (mg/L)	NH ₃ -N (mg/L)	NO ₃ -N (mg/L)	PO ₄ -P (mg/L)	Sulfate (mg/L)	Conductivity (µmhos/cm)
MIN	480	6	<0.1	7.36	58	4.78	50	4098
MAX	1120	10	<0.1	7.52	60	4.88	56	4396
MEAN	795	7	N/A	7.42	59	4.84	54	4224
SEM	173.6	1.0	N/A	0.04	0.4	0.02	1.1	28.2

Table 20. 103.2 meq/L Treatment Water Quality Summary

	Hardness (mg/L)	Alkalinity (mg/L)	Residual Oxidants (mg/L)	NH ₃ -N (mg/L)	NO ₃ -N (mg/L)	PO ₄ -P (mg/L)	Sulfate (mg/L)	Conductivity (µmhos/cm)
MIN	900	4	<0.1	6.88	49	4.32	46	8326
MAX	2210	6	<0.1	7.28	64	4.86	54	8902
MEAN	1468	6	N/A	7.08	56	4.63	53	8509
SEM	335.3	0.5	N/A	0.08	4.1	0.11	1.3	59.8

Table 21. SO_4^{2-} Treatment Sulfate and Conductivity Measurements

SO_4^{2-} Concentration (mg/L)	Day 0				Day 10				Day 21				Exposure	
	Sulfate (mg/L)		Conductivity ($\mu\text{mhos/cm}$)		Sulfate (mg/L)		Conductivity ($\mu\text{mhos/cm}$)	Sulfate (mg/L)		Conductivity ($\mu\text{mhos/cm}$)	Sulfate (mg/L)	Conductivity ($\mu\text{mhos/cm}$)		
	Mean	SEM	Mean	SEM	Mean	SEM		Mean	SEM		Mean	Mean		
10	12	0.0	515	3.2	13	1.0	552	13	1.0	638	13	554		
50 (HS-1) Control	49	1.0	528	1.7	51	1.0	555	55	1.0	656	52	572		
250	235	5.0	833	4.1	235	0.5	1694	248	8.0	1780	239	1729		
1000	1065	15.0	2746	6.1	1036	6.0	2793	1031	7.0	2916	1044	2797		
2500	2520	10.0	4243	13.1	2581	11.0	4288	2535	11.0	4884	2545	4423		
5000	4955	55.0	8356	6.3	4969	16.5	8402	5017	5.0	8886	4980	8507		

Table 22. Chloride Treatment Sulfate and Conductivity Measurements

Dissolved Solids Concentration (meq/L / $\mu\text{mhos/cm}$)	Day 0				Day 10				Day 21				Exposure	
	Sulfate (mg/L)		Conductivity ($\mu\text{mhos/cm}$)		Sulfate (mg/L)		Conductivity ($\mu\text{mhos/cm}$)	Sulfate (mg/L)		Conductivity ($\mu\text{mhos/cm}$)	Sulfate (mg/L)	Conductivity ($\mu\text{mhos/cm}$)		
	Mean	SEM	Mean	SEM	Mean	SEM		Mean	SEM		Mean	Mean		
0.8 / 770	51	3.0	659	7.7	53	3.0	709	54	2.0	763	53	699		
4.2 / 1890	52	0.0	1884	6.4	49	1.0	1962	50	4.0	2110	50	1960		
19.8 / 2830	52	2.0	2851	7.8	46	0.0	2883	52	4.0	3032	50	2906		
51.1 / 4100	53	3.0	4154	23.5	52	0.0	4204	56	0.0	4396	54	4224		
103.2 / 8350	54	0.0	8354	10.4	50	4.0	8432	54	0.0	8902	53	8509		

Table 23. Study Day 10 Control Endpoint Summary

Treatment	Rep	Per Replicate													
		Activated Seed (n)	Activation (%)	Mesocotyl Emerged (n)	Mesocotyl Emergence (%)	Seedling Survival (n)	Survival (%)	Mean Seminal Root Biomass (g, dw)	Mean Seminal Root Length (cm)	Mean Shoot Biomass (g, dw)	Mean Shoot Length (cm)	Mean 2 ^o Leaf Biomass (g, dw)	Mean Free Leaf (n)	Phytotox: Abnormal Appearance	
														(n)	(%)
HS-1	A	30	100.0	18	60.0	18	100.0	0.0004	3.187	0.0032	3.922	0.0020	0.9	0	0.0
	B	30	100.0	13	43.3	13	100.0	0.0004	3.405	0.0027	3.838	0.0025	0.9	0	0.0
	C	30	100.0	15	50.0	15	100.0	0.0004	3.949	0.0020	3.136	0.0023	0.8	0	0.0
	D	30	100.0	13	43.3	13	100.0	0.0006	5.368	0.0029	4.236	0.0025	0.8	0	0.0
	Mean:	30	100.0	14.75	49.2	14.8	100.0	0.0005	3.977	0.0027	3.783	0.002	0.9	0.0	0.0
	SEM:	0.0	0.0	1.2	3.9	1.2	0.0	0.0001	0.4906	0.0003	0.2321	0.0001	0.04	0.00	0.00
100 mg/L BA	A	30	100.0	6	20.0	6	100.0	0.0002	1.245	0.0020	2.763	0.0007	0.5	6	100.0
	B	30	100.0	5	16.7	5	100.0	0.0001	2.229	0.0017	2.625	0.0010	0.4	3	60.0
	C	30	100.0	7	23.3	7	100.0	0.0002	2.001	0.0021	3.445	0.0008	0.9	4	57.1
	D	30	100.0	9	30.0	9	100.0	0.0006	2.159	0.0022	2.669	0.0010	0.7	6	66.7
	Mean:	30	100.0	6.75	22.5	6.8	100.0	0.0003	1.908 ¹	0.0020	2.875 ²	0.001 ³	0.6	4.75	71.0 ⁴
	SEM:	0.0	0.0	0.9	2.8	0.9	0.0	0.0001	0.2263	0.0001	0.1919	0.0001	0.10	0.75	9.9

¹ Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).

² Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p=0.001).

³ Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p=0.001).

⁴ Significantly greater than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).

Table 24. Study Day 10 Sulfate Exposure Endpoint Summary

Treatment	Rep.	Per Replicate													
		Activated Seed (n)	Activation (%)	Mesocotyl Emerged (n)	Mesocotyl Emergence (%)	Seedling Survival (n)	Survival (%)	Mean Seminal Root Biomass (g. dw)	Mean Seminal Root Length (cm)	Mean Shoot Biomass (g. dw)	Mean Shoot Length (cm)	Mean 2* Leaf Bio-mass (g. dw)	Mean Free Leaf (n)	Phytotox: Abnormal Appearance (n) (%)	
10 mg/L SO ₄ ²⁻	A	30	100.0	15	50.0	15	100.0	0.0003	3.890	0.0025	3.756	0.0016	0.9	0	0.0
	B	30	100.0	24	80.0	24	100.0	0.0005	3.996	0.0036	4.229	0.0022	1.0	0	0.0
	C	30	100.0	19	63.3	19	100.0	0.0004	3.985	0.0031	4.685	0.0026	0.9	0	0.0
	D	30	100.0	8	26.7	8	100.0	0.0006	3.846	0.0051	3.921	0.0033	1.0	0	0.0
	Mean:	30	100.0	16.5	55.0	16.5	100.0	0.0005	3.929	0.0035	4.148	0.002	0.9	0	0.0
	SEM:	0.0	0.0	3.4	11.3	3.4	0.0	0.0001	0.0367	0.0006	0.2043	0.0004	0.03	0.00	0.0
250 mg/L SO ₄ ²⁻	A	30	100.0	25	83.3	25	100.0	0.0007	4.760	0.0052	3.437	0.0023	0.9	0	0.0
	B	30	100.0	15	50.0	15	100.0	0.0005	5.672	0.0024	3.988	0.0021	1.0	0	0.0
	C	30	100.0	19	63.3	19	100.0	0.0006	3.326	0.0020	3.728	0.0019	0.9	0	0.0
	D	30	100.0	15	50.0	15	100.0	0.0005	3.144	0.0024	3.244	0.0030	1.0	0	0.0
	Mean:	30	100.0	18.5	61.7	18.5	100.0	0.0007 ¹	4.226	0.0030	3.599	0.002	1.0	0	0.0
	SEM:	0.0	0.0	2.4	7.9	2.4	0.0	0.0000	0.6027	0.0007	0.1634	0.0002	0.03	0.00	0.0
1000 mg/L SO ₄ ²⁻	A	30	100.0	20	66.7	20	100.0	0.0005	2.942	0.0024	3.700	0.0024	1.0	0	0.0
	B	30	100.0	14	46.7	14	100.0	0.0004	3.509	0.0019	3.110	0.0019	0.9	0	0.0
	C	30	100.0	17	56.7	17	100.0	0.0005	4.052	0.0021	3.345	0.0027	0.9	0	0.0
	D	30	100.0	24	80.0	24	100.0	0.0005	4.029	0.0020	3.176	0.0021	0.9	0	0.0
	Mean:	30	100.0	18.75	62.5	18.8	100.0	0.0005	3.640	0.0021	3.333	0.002	0.9	0	0.0
	SEM:	0.0	0.0	2.1	7.1	2.1	0.0	0.0000	0.2664	0.0001	0.1321	0.0002	0.02	0.00	0.0

¹ Significantly greater than HS-1 control (ANOVA, Bonferroni t-test, p=0.013).

Table 24. (continued) Study Day 10 Sulfate Exposure Endpoint Summary

Treatment	Rep	Per Replicate													
		Activated Seed (n)	Activation (%)	Mesocotyl Emerged (n)	Mesocotyl Emergence (%)	Seedling Survival (n)	Survival (%)	Mean Seminal Root Biomass (g, dw)	Mean Seminal Root Length (cm)	Mean Shoot Biomass (g, dw)	Mean Shoot Length (cm)	Mean 2° Leaf Biomass (g, dw)	Mean Free Leaf (n)	Phytotox: Abnormal Appearance (n)	(%)
2500 mg/L SO ₄ ²⁻	A	30	100.0	27	90.0	27	100.0	0.0003	3.769	0.0019	3.329	0.0016	1.0	0	0.0
	B	30	100.0	17	56.7	17	100.0	0.0005	4.023	0.0021	3.064	0.0027	1.0	0	0.0
	C	30	100.0	17	56.7	17	100.0	0.0005	2.416	0.0019	2.750	0.0022	1.0	0	0.0
	D	30	100.0	20	66.7	20	100.0	0.0004	3.241	0.0018	2.516	0.0020	1.0	0	0.0
	Mean:	30	100.0	20.25	67.5	20.3	100.0	0.0004	3.362	0.0019	2.915 ¹	0.002	1.0	0	0.0
	SEM:	0.0	0.0	2.4	7.9	2.4	0.0	0.0000	0.3551	0.0001	0.1779	0.0002	0.01	0.00	0.0
5000 mg/L SO ₄ ²⁻	A	30	100.0	16	53.3	16	100.0	0.0004	1.570	0.0019	2.319	0.0014	0.8	6	37.5
	B	30	100.0	25	83.3	25	100.0	0.0006	2.551	0.0019	2.291	0.0013	0.8	7	28.0
	C	30	100.0	22	73.3	22	100.0	0.0005	1.949	0.0019	2.114	0.0016	1.0	10	45.5
	D	30	100.0	22	73.3	22	100.0	0.0004	2.233	0.0016	2.246	0.0012	0.9	10	45.5
	Mean:	30	100.0	21.25	70.8	21.3	100.0	0.0005	2.076 ²	0.0018	2.242 ³	0.001	0.9	8.25	39.1 ⁴
	SEM:	0.0	0.0	1.9	6.3	1.9	0.0	0.0000	0.2087	0.0001	0.0455	0.0001	0.04	1.03	4.1

¹ Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p=0.002).

² Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p=0.002).

³ Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).

⁴ Significantly greater than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).

Table 25. Study Day 10 Chloride Treatment Endpoint Summary

Treatment	Rep	Per Replicate													
		Activated Seed (n)	Activation (%)	Mesocotyl Emerged (n)	Mesocotyl Emergence (%)	Seedling Survival (n)	Survival (%)	Mean Seminal Root Biomass (g, dw)	Mean Seminal Root Length (cm)	Mean Shoot Biomass (g, dw)	Mean Shoot Length (cm)	Mean 2* Leaf Biomass (g, dw)	Mean Free Leaf (n)	Phytotox: Abnormal Appearance (n)	(%)
0.8 meq/L Dissolved Solids	A	30	100.0	10	33.3	10	100.0	0.0004	3.112	0.0013	2.101	0.0031	0.9	0	0.0
	B	30	100.0	14	46.7	14	100.0	0.0004	3.013	0.0014	2.133	0.0026	0.9	0	0.0
	C	30	100.0	10	33.3	10	100.0	0.0003	3.282	0.0018	2.457	0.0025	0.8	0	0.0
	D	30	100.0	9	30.0	9	100.0	0.0005	4.047	0.0014	2.552	0.0015	0.9	0	0.0
	Mean:	30	100.0	10.75	35.8	10.8	100.0	0.0004	3.364	0.0015 ¹	2.311 ²	0.002	0.9	0	0.0
	SEM:	0.0	0.0	1.1	3.7	1.1	0.0	0.0000	0.2347	0.0001	0.1137	0.0003	0.03	0.00	0.0
4.2 meq/L Dissolved Solids	A	30	100.0	8	26.7	8	100.0	0.0004	4.799	0.0021	2.814	0.0030	1.0	0	0.0
	B	30	100.0	7	23.3	7	100.0	0.0004	4.029	0.0018	2.569	0.0023	0.9	0	0.0
	C	30	100.0	13	43.3	13	100.0	0.0003	3.689	0.0016	2.570	0.0011	1.0	0	0.0
	D	30	100.0	8	26.7	8	100.0	0.0005	4.762	0.0019	2.848	0.0024	0.9	0	0.0
	Mean:	30	100.0	9	30.0	9.0	100.0	0.0004	4.320	0.0018	2.700 ³	0.002	0.9	0	0.0
	SEM:	0.0	0.0	1.4	4.5	1.4	0.0	0.0000	0.2748	0.0001	0.0758	0.0004	0.04	0.00	0.0
19.8 meq/L Dissolved Solids	A	30	100.0	12	40.0	12	100.0	0.0004	2.869	0.0016	2.103	0.0025	0.9	0	0.0
	B	30	100.0	6	20.0	6	100.0	0.0003	1.620	0.0015	1.976	0.0017	0.8	0	0.0
	C	30	100.0	10	33.3	10	100.0	0.0004	3.043	0.0015	2.480	0.0023	0.9	0	0.0
	D	30	100.0	10	33.3	10	100.0	0.0004	3.637	0.0015	2.192	0.0013	0.9	0	0.0
	Mean:	30	100.0	9.5	31.7	9.5	100.0	0.0004	2.792	0.0015	2.188 ⁴	0.002	0.9	0	0.0
	SEM:	0.0	0.0	1.3	4.2	1.3	0.0	0.0000	0.4239	0.0000	0.1071	0.0003	0.02	0.00	0.0

¹ Significantly less than HS-1 control (KW ANOVA, Dunn's Method, p<0.05).² Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).³ Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).⁴ Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).

Table 25. (continued) Study Day 10 Chloride Treatment Endpoint Summary

Treatment	Rep	Per Replicate													
		Activated Seed (n)	Activation (%)	Mesocotyl Emerged (n)	Mesocotyl Emergence (%)	Seedling Survival (n)	Survival (%)	Mean Seminal Root Biomass (g, dw)	Mean Seminal Root Length (cm)	Mean Shoot Biomass (g, dw)	Mean Shoot Length (cm)	Mean 2 ^o Leaf Bio-mass (g, dw)	Mean Free Leaf (n)	Phytotox: Abnormal Appearance (n)	(%)
51.1 mcq/L Dissolved Solids	A	30	100.0	21	70.0	21	100.0	0.0003	2.409	0.0007	2.524	0.0018	0.9	2	9.5
	B	30	100.0	12	40.0	12	100.0	0.0003	3.361	0.0015	2.546	0.0018	1.0	1	8.3
	C	30	100.0	7	23.3	7	100.0	0.0005	3.390	0.0019	2.870	0.0021	0.9	0	0.0
	D	30	100.0	18	60.0	18	100.0	0.0005	3.709	0.0016	2.219	0.0019	0.8	1	5.6
	Mean:	30	100.0	14.5	48.3	14.5	100.0	0.0004	3.217	0.0015 ¹	2.540 ²	0.002	0.9	1	5.9
	SEM:	0.0	0.0	3.1	10.4	3.1	0.0	0.0001	0.2808	0.0003	0.1330	0.0001	0.05	0.41	2.1
103.2 mcq/L Dissolved Solids	A	30	100.0	9	30.0	9	100.0	0.0004	2.005	0.0015	2.174	0.0015	1.0	2	22.2
	B	30	100.0	8	26.7	8	100.0	0.0004	1.980	0.0014	2.113	0.0014	1.0	5	62.5
	C	30	100.0	11	36.7	11	100.0	0.0005	2.051	0.0012	1.810	0.0013	0.9	3	27.3
	D	30	100.0	8	26.7	8	100.0	0.0004	2.166	0.0016	2.284	0.0013	1.0	4	50.0
	Mean:	30	100.0	9	30.0	9.0	100.0	0.0004	2.051 ³	0.0014 ⁴	2.095 ⁵	0.001	1.0	3.5	40.5 ⁶
	SEM:	0.0	0.0	0.7	2.4	0.7	0.0	0.0000	0.0413	0.0001	0.1016	0.0001	0.02	0.65	9.5

¹ Significantly less than HS-1 control (KW ANOVA, Dunn's Method, p<0.05).

² Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).

³ Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p=0.002).

⁴ Significantly less than HS-1 control (KW ANOVA, Dunn's Method, p<0.05).

⁵ Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).

⁶ Significantly greater than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).

Table 26. Study Day 21 Control Endpoint Summary

Treatment	Rep	Per Replicate													
		Activated Seed (n)	Activation (%)	Mesocotyl Emerged (n)	Mesocotyl Emergence (%)	Seedling Survival (n)	Survival (%)	Mean Seminal Root Biomass (g, dw)	Mean Seminal Root Length (cm)	Mean Shoot Biomass (g, dw)	Mean Shoot Length (cm)	Mean 2 ^o Leaf Bio-mass (g, dw)	Mean Free Leaf (n)	Phytotox: Abnormal Appearance	
														(n)	(%)
HS-1	A	30	100.0	11	36.7	11	100.0	0.0004	4.953	0.0027	3.518	0.0053	3.7	0	0.0
	B	30	100.0	12	40.0	12	100.0	0.0007	4.809	0.0026	4.004	0.0058	4.3	0	0.0
	C	30	100.0	13	43.3	13	100.0	0.0006	4.866	0.0020	2.718	0.0058	3.1	0	0.0
	D	30	100.0	10	33.3	10	100.0	0.0002	3.354	0.0022	3.411	0.0049	3.4	0	0.0
	Mean:	30	100.0	11.5	38.3	11.5	100.0	0.0005	4.495	0.0024	3.412	0.0055	3.6	0	0.0
	SEM:	0.0	0.0	0.6	2.2	0.6	0.0	0.0001	0.3817	0.0002	0.2651	0.0002	0.25	0.00	0.0
100 mg/L BA	A	30	100.0	5	16.7	5	100.0	0.0002	2.079	0.0036	3.814	0.0027	1.6	5	100.0
	B	30	100.0	5	16.7	5	100.0	0.0003	2.116	0.0030	3.447	0.0042	3.8	5	100.0
	C	30	100.0	5	16.7	5	100.0	0.0004	2.122	0.0019	2.278	0.0018	2.2	5	100.0
	D	30	100.0	8	26.7	8	100.0	0.0003	1.959	0.0029	3.741	0.0037	3.3	8	100.0
	Mean:	30	100.0	5.75	19.2	5.8	100.0	0.0003	2.069 ¹	0.0028	3.320	0.0031	2.7	5.75	100.0 ²
	SEM:	0.0	0.0	0.8	2.5	0.8	0.0	0.0000	0.0380	0.0004	0.3563	0.0005	0.50	0.75	0.0

¹ Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).

² Significantly greater than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).

Table 27. Study Day 21 Sulfate Exposure Endpoint Summary

Treatment	Rep	Per Replicate													
		Activated Seed (n)	Activation (%)	Mesocotyl Emerged (n)	Mesocotyl Emergence (%)	Seedling Survival (n)	Survival (%)	Mean Seminal Root Biomass (g. dw)	Mean Seminal Root Length (cm)	Mean Shoot Biomass (g. dw)	Mean Shoot Length (cm)	Mean 2 nd Leaf Biomass (g. dw)	Mean Free Leaf (n)	Phytotox: Abnormal Appearance (n) (%)	
10 mg/L SO ₄ ²⁻	A	30	100.0	12	40.0	12	100.0	0.0006	5.962	0.0026	4.197	0.0075	3.9	0	0.0
	B	30	100.0	9	30.0	9	100.0	0.0006	5.529	0.0024	3.376	0.0063	3.7	0	0.0
	C	30	100.0	12	40.0	12	100.0	0.0004	5.153	0.0022	2.606	0.0063	3.6	0	0.0
	D	30	100.0	22	73.3	22	100.0	0.0005	5.099	0.0019	2.391	0.0076	3.9	0	0.0
	Mean:	30	100.0	13.75	45.8	13.8	100.0	0.0005	5.436	0.0023	3.143	0.0069	3.8	0	0.0
	SEM:	0.0	0.0	2.8	9.5	2.8	0.0	0.0000	0.1996	0.0002	0.4103	0.0003	0.08	0.00	0.0
250 mg/L SO ₄ ²⁻	A	30	100.0	11	36.7	11	100.0	0.0006	5.072	0.0023	3.015	0.0076	4.1	0	0.0
	B	30	100.0	11	36.7	11	100.0	0.0003	4.677	0.0020	3.026	0.0068	3.5	0	0.0
	C	30	100.0	10	33.3	10	100.0	0.0005	5.674	0.0025	3.605	0.0062	3.9	0	0.0
	D	30	100.0	22	73.3	22	100.0	0.0007	4.725	0.0021	3.161	0.0069	4.0	0	0.0
	Mean:	30	100.0	13.5	45.0	13.5	100.0	0.0006	5.037	0.0023	3.202	0.0069	3.9	0	0.0
	SEM:	0.0	0.0	2.8	9.5	2.8	0.0	0.0001	0.2297	0.0002	0.1385	0.0003	0.15	0.00	0.0
1000 mg/L SO ₄ ²⁻	A	30	100.0	11	36.7	11	100.0	0.0007	4.555	0.0024	3.232	0.0055	3.5	0	0.0
	B	30	100.0	22	73.3	22	100.0	0.0009	4.545	0.0022	3.033	0.0069	3.5	0	0.0
	C	30	100.0	15	50.0	15	100.0	0.0007	4.336	0.0025	3.205	0.0050	3.5	0	0.0
	D	30	100.0	22	73.3	22	100.0	0.0006	4.787	0.0023	3.134	0.0066	3.3	0	0.0
	Mean:	30	100.0	17.5	58.3	17.5	100.0	0.0007	4.556	0.0024	3.151	0.0068	3.5	0	0.0
	SEM:	0.0	0.0	2.7	9.1	2.7	0.0	0.0001	0.0920	0.0001	0.0443	0.0005	0.06	0.00	0.0

Table 27. (continued) Study Day 21 Sulfate Exposure Endpoint Summary

Treatment	Rep.	Per Replicate													
		Activated Seed (n)	Activation (%)	Mesocotyl Emerged (n)	Mesocotyl Emergence (%)	Seedling Survival (n)	Survival (%)	Mean Seminal Root Biomass (g, dw)	Mean Seminal Root Length (cm)	Mean Shoot Biomass (g, dw)	Mean Shoot Length (cm)	Mean 2 nd Leaf Biomass (g, dw)	Mean Free Leaf (n)	Phytotox: Abnormal Appearance	
		(n)	(%)	(n)	(%)	(n)	(%)	(g, dw)	(cm)	(g, dw)	(cm)	(g, dw)	(n)	(n)	(%)
2500 mg/L SO ₄ ²⁻	A	30	100.0	20	66.7	20	100.0	0.0007	4.429	0.0025	2.868	0.0070	3.3	0	0.0
	B	30	100.0	26	86.7	26	100.0	0.0008	4.263	0.0026	2.945	0.0065	3.1	0	0.0
	C	30	100.0	24	80.0	24	100.0	0.0006	3.743	0.0032	2.810	0.0073	3.3	0	0.0
	D	30	100.0	18	60.0	18	100.0	0.0006	3.499	0.0026	2.636	0.0054	2.9	0	0.0
	Mean:	30	100.0	22	73.3	22.0	100.0	0.0007	3.984	0.0027	2.815	0.0065	3.2	0	0.0
	SEM:	0.0	0.0	1.8	6.1	1.8	0.0	0.0000	0.2178	0.0002	0.0656	0.0004	0.10	0.00	0.0
5000 mg/L SO ₄ ²⁻	A	30	100.0	21	70.0	21	100.0	0.0007	2.601	0.0037	2.081	0.0049	2.6	19	90.5
	B	30	100.0	11	36.7	11	100.0	0.0004	2.304	0.0033	2.115	0.0038	2.5	10	90.9
	C	30	100.0	16	53.3	16	100.0	0.0004	2.281	0.0032	2.067	0.0054	2.3	14	87.5
	D	30	100.0	18	60.0	18	100.0	0.0007	3.076	0.0044	1.946	0.0054	2.9	16	88.9
	Mean:	30	100.0	16.5	55.0	16.5	100.0	0.0005	2.565 ¹	0.0036	2.052	0.0049	2.6	14.75	89.4 ²
	SEM:	0.0	0.0	2.1	7.0	2.1	0.0	0.0001	0.1851	0.0003	0.0368	0.0004	0.12	1.89	0.8

¹ Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).

² Significantly greater than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).

Table 28. Study Day 21 Chloride Treatment Endpoint Summary

Treatment	Rep	Per Replicate													
		Activated Seed (n)	Activation (%)	Mesocotyl Emerged (n)	Mesocotyl Emergence (%)	Seedling Survival (n)	Survival (%)	Mean Seminal Root Biomass (g, dw)	Mean Seminal Root Length (cm)	Mean Shoot Biomass (g, dw)	Mean Shoot Length (cm)	Mean 2 nd Leaf Biomass (g, dw)	Mean Free Leaf (n)	Phytotox: Abnormal Appearance (n)	(%)
0.8 meq/L Dissolved Solids	A	30	100.0	7	23.3	7	100.0	0.0006	6.139	0.0014	2.133	0.0071	3.4	0	0.0
	B	30	100.0	11	36.7	11	100.0	0.0004	4.953	0.0015	3.369	0.0060	3.5	0	0.0
	C	30	100.0	9	30.0	9	100.0	0.0005	5.888	0.0015	2.183	0.0074	3.6	0	0.0
	D	30	100.0	8	26.7	8	100.0	0.0004	3.702	0.0015	2.994	0.0048	3.0	0	0.0
	Mean:	30	100.0	8.75	29.2	8.8	100.0	0.0005	5.170	0.0014	2.670	0.0063	3.4	0	0.0
	SEM:	0.0	0.0	0.9	2.8	0.9	0.0	0.0001	0.5520	0.0000	0.3053	0.0006	0.13	0.00	0.0
	4.2 meq/L Dissolved Solids	A	30	100.0	15	50.0	15	100.0	0.0003	3.644	0.0017	2.836	0.0059	3.5	0
B	30	100.0	12	40.0	12	100.0	0.0007	4.367	0.0015	2.639	0.0082	2.8	0	0.0	
C	30	100.0	8	26.7	8	100.0	0.0004	3.916	0.0018	2.127	0.0085	2.8	0	0.0	
D	30	100.0	8	26.7	8	100.0	0.0005	3.191	0.0018	2.136	0.0054	2.6	0	0.0	
Mean:	30	100.0	10.75	35.8	10.8	100.0	0.0005	3.780	0.0017	2.434	0.0070	2.9	0	0.0	
SEM:	0.0	0.0	1.7	5.7	1.7	0.0	0.0001	0.2464	0.0001	0.1797	0.0008	0.19	0.00	0.0	
19.8 meq/L Dissolved Solids	A	30	100.0	12	40.0	12	100.0	0.0006	3.712	0.0014	2.250	0.0064	2.8	0	0.0
	B	30	100.0	15	50.0	15	100.0	0.0004	2.433	0.0020	2.395	0.0071	3.1	0	0.0
	C	30	100.0	10	33.3	10	100.0	0.0003	3.857	0.0016	2.377	0.0052	3.2	0	0.0
	D	30	100.0	8	26.7	8	100.0	0.0006	2.918	0.0015	2.274	0.0051	3.1	0	0.0
	Mean:	30	100.0	11.25	37.5	11.3	100.0	0.0005	3.230 ¹	0.0016	2.325	0.0060	3.1	0	0.0
	SEM:	0.0	0.0	1.5	5.0	1.5	0.0	0.0001	0.3364	0.0001	0.0368	0.0005	0.08	0.00	0.0

¹ Significantly less than HS-I control (ANOVA, Bonferroni t-test, p=0.031).

Table 28. (continued) Study Day 21 Chloride Treatment Endpoint Summary

Treatment	Rep	Per Replicate													
		Activated Seed (n)	Activation (%)	Mesocotyl Emerged (n)	Mesocotyl Emergence (%)	Seedling Survival (n)	Survival (%)	Mean Seminal Root Biomass (g, dw)	Mean Seminal Root Length (cm)	Mean Shoot Biomass (g, dw)	Mean Shoot Length (cm)	Mean 2 nd Leaf Biomass (g, dw)	Mean Free Leaf (n)	Phytotox: Abnormal Appearance (n)	(%)
51.1 meq/L Dissolved Solids	A	30	100.0	20	66.7	20	100.0	0.0004	2.894	0.0016	2.537	0.0059	3.1	0	0.0
	B	30	100.0	13	43.3	13	100.0	0.0005	4.149	0.0018	2.514	0.0073	3.6	0	0.0
	C	30	100.0	10	33.3	10	100.0	0.0008	3.598	0.0025	2.638	0.0081	3.2	0	0.0
	D	30	100.0	18	60.0	18	100.0	0.0005	4.075	0.0019	2.307	0.0066	3.1	0	0.0
	Mean:	30	100.0	15.25	50.8	15.3	100.0	0.0005	3.679	0.0020	2.499	0.0070	3.3	0	0.0
	SEM:	0.0	0.0	2.3	7.6	2.3	0.0	0.0001	0.2887	0.0002	0.0694	0.0005	0.12	0.00	0.0
103.2 meq/L Dissolved Solids	A	30	100.0	12	40.0	12	100.0	0.0010	3.054	0.0019	1.841	0.0092	3.2	12	100.0
	B	30	100.0	10	33.3	10	100.0	0.0010	2.311	0.0024	2.022	0.0119	2.7	10	100.0
	C	30	100.0	8	26.7	8	100.0	0.0013	2.841	0.0045	1.949	0.0068	2.8	8	100.0
	D	30	100.0	11	36.7	11	100.0	0.0009	3.241	0.0027	1.811	0.0061	2.9	11	100.0
	Mean:	30	100.0	10.25	34.2	10.3	100.0	0.0010 ¹	2.862 ²	0.0028	1.906 ³	0.0085	2.9	10.25	100.0 ⁴
	SEM:	0.0	0.0	0.9	2.8	0.9	0.0	0.0001	0.2011	0.0006	0.0488	0.0013	0.11	0.85	0.0

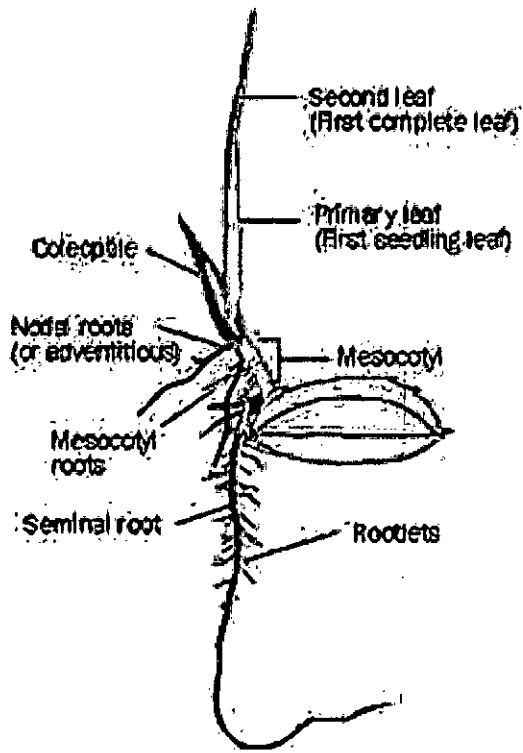
¹ Significantly greater than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).² Significantly less than HS-1 control (ANOVA, Bonferroni t-test, p=0.002).³ Significantly less than HS-1 control (KW ANOVA, Dunn's Method, p<0.05).⁴ Significantly greater than HS-1 control (ANOVA, Bonferroni t-test, p<0.001).

Table 29. Median Emergence Time (MET) in Wild Rice on SD 21

Treatment	Median Emergence Time (d)											
	HS-1	100 mg/L BA	10 mg/L SO ₄ ²⁻	250 mg/L SO ₄ ²⁻	1000 mg/L SO ₄ ²⁻	2500 mg/L SO ₄ ²⁻	5000 mg/L SO ₄ ²⁻	0.8 meq/L Dissolved Solids	4.2 meq/L Dissolved Solids	19.8 meq/L Dissolved Solids	51.1 meq/L Dissolved Solids	103.2 meq/L Dissolved Solids
Rep A	>21	>21	>21	>21	>21	5	7	>21	12	>21	8	>21
Rep B	>21	>21	>21	>21	5	5	>21	>21	>21	5	>21	>21
Rep C	>21	>21	>21	>21	8	5	7	>21	>21	>21	>21	>21
Rep D	>21	>21	6	7	5	6	12	>21	>21	>21	13	>21
Median	>21	>21	>21	>21	6.5	5	9.5	>21	>21	>21	>17	>21

Figure 1. Morphology of Wild Rice Seedling (A) and Measurement Definitions (B) including Seminal Root, Shoot (mesocotyl and primary leaf), and Secondary Leaf (Leaf biomass)

A



B

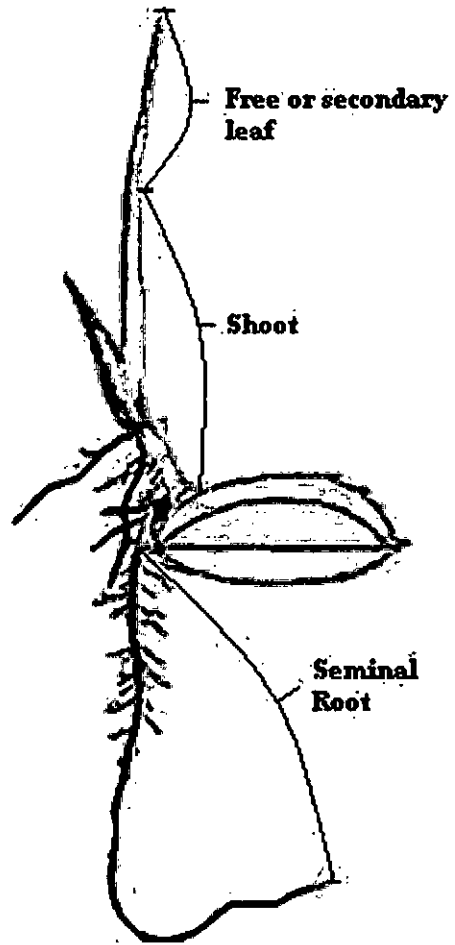


Figure 2. Exposure System Setup

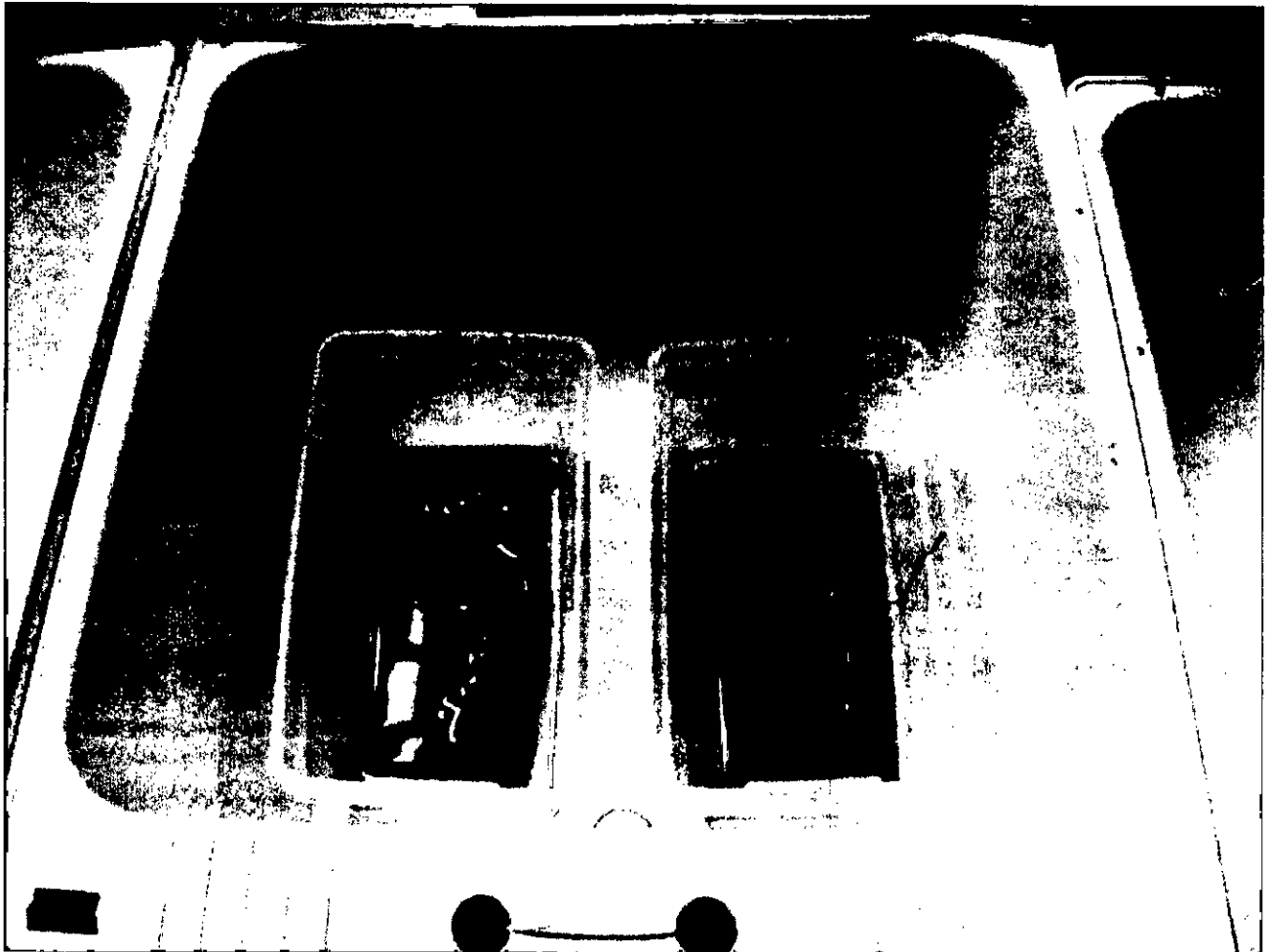


Figure 3. Effect of Sulfate and Chloride on Endpoints in Wild Rice on SD 10

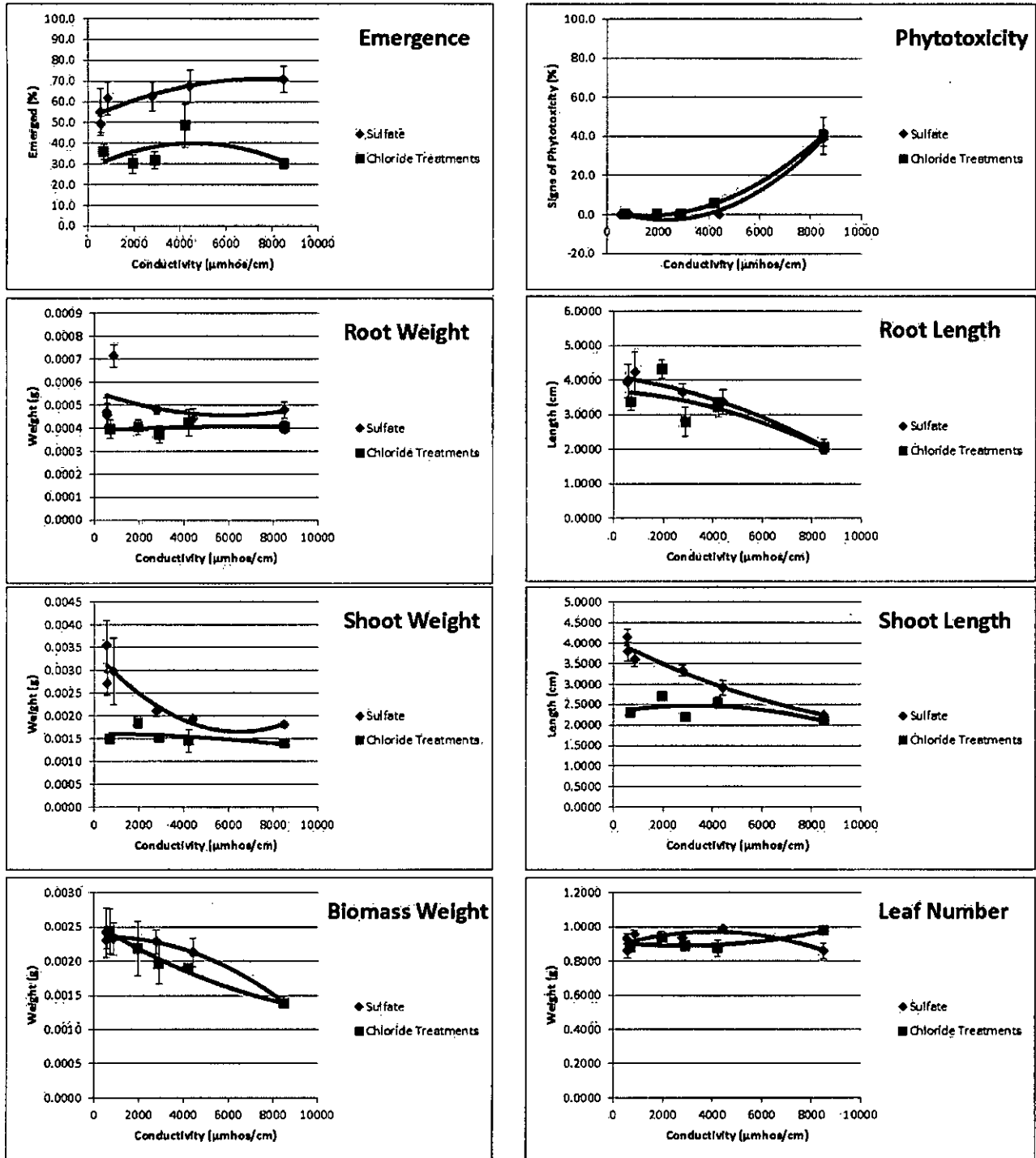


Figure Legend: Sulfate concentrations and respective conductivity for sulfate treatments were 13 mg/L and 554 µmhos/cm, 52 mg/L and 572 µmhos/cm, 239 mg/L and 1729 µmhos/cm, 1044 mg/L and 2797 µmhos/cm, 2645 mg/L and 4423 µmhos/cm, and 4980 mg/L and 8507 µmhos/cm. Sulfate concentrations and respective conductivity for chloride treatments were 53 mg/L and 699 µmhos/cm, 50 mg/L and 1960 µmhos/cm, 50 mg/L and 2906 µmhos/cm, 54 mg/L and 4224 µmhos/cm, and 53 mg/L and 8509 µmhos/cm.

Figure 4. Effect of Sulfate and Chloride on Endpoints in Wild Rice on SD 21

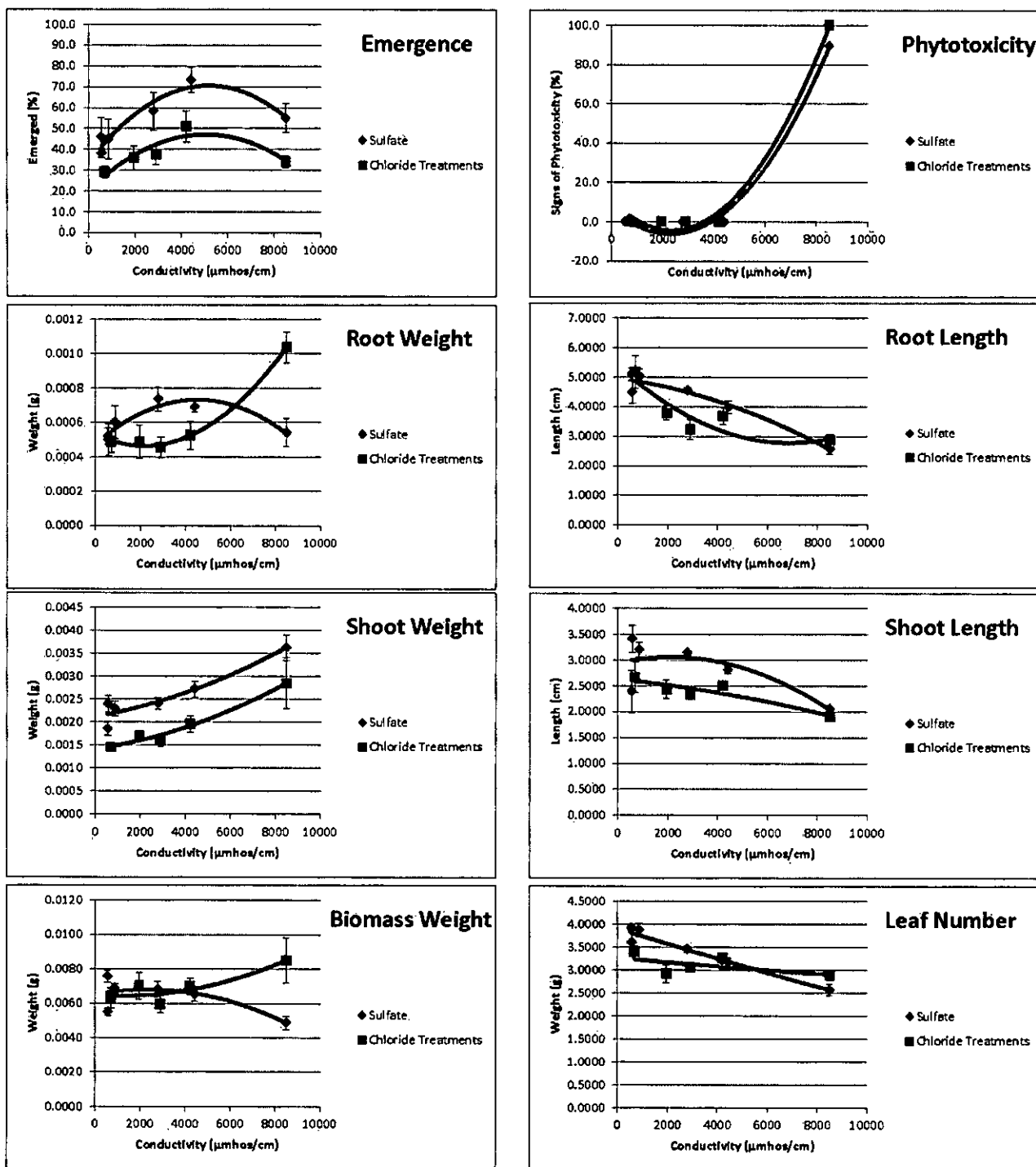


Figure Legend: Sulfate concentrations and respective conductivity for sulfate treatments were 13 mg/L and 554 µmhos/cm, 52 mg/L and 572 µmhos/cm, 239 mg/L and 1729 µmhos/cm, 1044 mg/L and 2797 µmhos/cm, 2645 mg/L and 4423 µmhos/cm, and 4980 mg/L and 8507 µmhos/cm. Sulfate concentrations and respective conductivity for chloride treatments were 53 mg/L and 699 µmhos/cm, 50 mg/L and 1960 µmhos/cm, 50 mg/L and 2906 µmhos/cm, 54 mg/L and 4224 µmhos/cm, and 53 mg/L and 8509 µmhos/cm.

▪ Appendix A.
Study Protocol and Protocol Amendments

FEL Protocol No.: ENVI01-2

Study Title: Definitive Hydroponics-Based Sulfate Toxicity to Wild Rice (*Zizania palustris*)

Test Guideline: None

FEL Study No.: ENVI01-00325

Environ Study No.: 20-30449B

Proposed Start Date: September 2013

Test System: *Zizania palustris*

Test Article: Sulfate

Sponsor: ENVIRON International Corporation
201 Summit View Drive, Suite 300
Brentwood, TN 37027




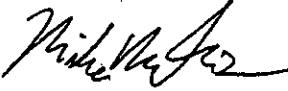
Study Facility: Fort Environmental Laboratories, Inc. (FEL)
515 South Duncan Street
Stillwater, OK 74074

Amendments:

Number	Date	Section(s)	Page(s)
1			
2			
3			
4			

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1. SIGNATURE PAGE

Title/Name	Signature	Date
STUDY DIRECTOR: Douglas J. Fort, Ph.D.		8/28/2013
SPONSOR REPRESENTATIVE: ¹ Scott Hall ENVIRON International Corporation		8/27/13
STUDY LEAD: Mark Blackburn		8/27/13
QAU MANAGER: Michael Mathis		8/28/2013

¹Study Monitor.

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2. GOOD LABORATORY PRACTICE

This study will be conducted in compliance with the following GLP principles:

- United States Environmental Protection Agency, TSCA, Good Laboratory Practice (GLP) Standards, Final Rule (40 CFR Part 792, 1989) (1), and
- The final report will contain a statement indicating whether the study data comply with the above GLP guidelines. The statement will be signed by the Study Director.

3. QUALITY ASSURANCE

The test facility shall have a Quality Assurance Unit (QAU) with the responsibilities and functions as described in the OECD Principles on Good Laboratory Practice. Critical phase inspections shall be conducted during the course of the study. The Quality Assurance Unit must provide written reports of all inspections to the Study Director. Any problems found during the course of an inspection which are likely to affect study integrity shall be immediately brought to the attention of the Study Director and the Test Facility Management. The Study Director shall be responsible for reporting findings, including corrective actions taken, affecting the study integrity to the Sponsor Study Monitor as soon as possible in writing. The Sponsor or Sponsor's QAU staff may inspect this study if required, and the raw data will be made available for their examination.

The Test Facility QAU shall provide a QA Statement that includes the phases or documents inspected, the dates of inspection, and the dates that the inspections were reported to the Study Director and Test Facility Management. This statement shall be signed by the responsible QAU.

4. INTRODUCTION

FEL has been contracted by ENVIRON International Corporation to conduct a study of sulfate toxicity to wild rice (*Zizania palustris*) using hydroponic exposure. The study will ultimately be used to assist in the understanding of water-column based sulfate toxicity to wild rice. The sulfate toxicity thresholds determined will support the efforts to re-evaluate the State of Minnesota's sulfate water quality standard for wild rice of 10 mg/L sulfate. The study will be conducted in accordance with the specifications identified in FEL's Quality Assurance Management Plan (QAMP) (2), relevant facility standard operating procedures (SOPs), and Study Protocol No. ENVI01-2 prepared for FEL Study No. ENVI01-0325.

5. OBJECTIVE

The primary objective of the study ENVI01-00325 is to determine the toxicity of sulfate to wild rice (*Zizania palustris*) seed from the State of Minnesota, USA. A Method Development Phase (MDP) was previously conducted to determine the most appropriate culture media and establish an experiment design including the testing format and statistical design needed to provide a definitive toxicity evaluation of sulfate to wild rice. Concentration-response data, including No and Lowest Observed Effect Concentrations (NOEC and LOEC) and median lethal, effective or inhibitory concentrations (LC, EC or IC50); and sulfate toxicity thresholds,

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including Maximum Allowable Toxicant Concentration (MATC) for the effect of sulfate on wild rice will be determined. The MDP (ENVI01-00324) was not performed under GLP guidelines.

6. STUDY FACILITIES AND CONTACT

The in-life (hydroponics) portion of the study, to include the pre-exposure equilibration period and exposure phases of the MDP, will be performed at Fort Environmental Laboratories, Inc., 515 South Duncan Street, Stillwater, OK, USA, 74074. The Study Director, Dr. Douglas Fort, will serve as the study contact for this facility and may be reached at 405.624.6771 or difort@fortlabs.com.

7. STUDY SCHEDULE

The experimental study is proposed to start in September 2013 after Sponsor approval of the Final Study Protocol. Since the exposure period required to collect the specified endpoints is 21 days, the in-life test duration is estimated to be no greater than 30 days.

8. EXPERIMENTAL DESIGN

The definitive concentration-response study will be performed using a static-renewal format with test solution renewal performed daily at a renewal replacement volume of 0.7, which is consistent with the replacement rate used in the MDP (ENVI01-00324). HS-1 media (3,4) with ammonia:nitrate ratio of 1:4 (Table 1) will serve as the diluent, and a combination of sodium, potassium, calcium and magnesium sulfate salts will be used to prepare the sulfate stock solutions such that the ratio of the monovalent to divalent salt will be 2:1. A combination of salts was used to minimize cationic imbalance and minimize effects caused by osmotic stress. The following concentrations of sulfate will be used: control (HS-1), Concentrations recommended for the definitive study of sulfate toxicity are: 10, 50 (HS-1 (1:4) [control]), 250, 1,000, 2,500, and 5,000 mg sulfate/L (nominal). Sulfate in the form of monovalent and divalent cationic salts will be used to prepare the sulfate treatments as described in Table 2. The measured sulfate concentration in the HS-1 control solution is ca. 50 mg/L. A modified HS-1 (1:4) solution will be prepared (see attached recipe) in order to reduce the sulfate concentration of this media to 10 mg sulfate/L nominal and used for the 10 mg sulfate/L test concentration. The sulfate concentration will be measured on Study Day 0, 10, and 21 in each replicate of the control and all treatments. To determine if effects potentially observed in the study are the result of exposure to sulfate or a non-specific result of exposure to dissolved solids, five additional conductive dissolved solids controls designed to be similar to the conductivity of the upper five highest sulfate test concentrations will also be included in the design. Dissolved solids in the form of non-sulfate salts will be used to prepare the conductive solids controls and are described in Tables 3 and 4. The following dissolved solids concentrations will be used: 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L. The experimental conditions and endpoints measured will follow those specified in Tables 5 and 6.

8.1. Test Substance

The test substance will be sulfate comprised of sodium sulfate (Fisher Scientific, Houston, TX, lot no. 130197, 99.5%), potassium sulfate (Fisher Scientific, Houston, TX, lot no. 131540, 99.0%) calcium sulfate (Fisher Scientific/Acros, Houston, TX, lot no. A0314953, >98%), and magnesium sulfate (Fisher Scientific, Houston, TX, lot no. 130420, >98%). Chloride salts used

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to prepare the dissolved solids/conductivity control series will include sodium chloride (Fisher Scientific, EMD Chemicals - Merck, Darmstadt, Germany, lot no. 43167330, 99%), potassium chloride (Spectrum, Gardena, CA, lot no. OX0154, >99%), calcium chloride (Sigma Chemical Company, St. Louis, MO, lot no. 072K0114, >99%), and magnesium chloride (Spectrum, Gardena, CA lot no. PJ0288, >99%).

8.2. Dilution and Laboratory Control Water

FEL will use deionized water as the base water for this study. The deionized laboratory water will be prepared by passing tap water through a 4 filter system: a multimedia filter to remove suspended solids in the feed water; a 10" pre-treatment filter (5 μm) to remove any additional solids; a 3.6 ft^3 activated virgin carbon treatment filter to remove chlorine, ammonia, and higher molecular weight organics; 1.2 ft^3 cation, 1.2 ft^3 anion, and two 1.2 ft^3 mixed bed ion exchange polishing filters in series to deionize the water. Both polishing filters are equipped with conductivity detection systems. Water exceeding 5 $\mu\text{mhos/cm}$ is signaled by a warning light. A 5 μm solid filter completes the water treatment process and ensures no solids are released during deionization. Water quality characteristics of the laboratory water are monitored twice per month for pH, dissolved oxygen (DO), conductivity, hardness, alkalinity, ammonia, residual oxidants; and at least annually for iodide, polyaromatic hydrocarbons (PAHs), pesticides, and metals. The dilution water was most recently analyzed for pesticides, PAHs, and metals on February 5, 2013, and all water quality measurements cited above met the U.S. EPA and American Society for Testing and Materials (ASTM) criteria for aquatic toxicity test culture water. Deionized water will be used to prepare the culture media and test solutions in accordance with Tables 1-4. Basic water chemistry parameters such as pH, hardness, and conductivity will be documented on a representative sample of each test medium evaluated.

8.3. Test System

The test system in the present study will be wild rice (*Zizania palustris*).

8.3.1. Origin and Handling

Wild rice was hand-harvested from Little Round Lake in Becker County (03-0302-00) on August 30, 2012. Three over-winter storage techniques were employed: 1) four two-liter general chemistry plastic bottles were partially filled with wild rice and Little Round Lake water, wrapped in aluminum foil, and transferred to MPCA St. Paul for storage in the water quality laboratory walk-in refrigerator; 2) four gallon-size Ziploc bags were partially filled with wild rice (dry stored), wrapped in aluminum foil, and transferred to MPCA St. Paul for storage in the water quality laboratory walk-in refrigerator; and 3) approximately 3.5 pounds of wild rice was placed in a woven plastic bag and submerged in Little Round Lake beginning on August 30, 2012 for in-lake, over-winter storage.

The woven plastic bag of wild rice was still partially frozen in the lake sediments when it was retrieved on May 17, 2013. At that time it was placed in a sealable, five-gallon food grade plastic bucket containing Little Round Lake water and placed in an iced cooler. Four two-liter plastic general chemistry bottles of Little Round Lake water were also collected on May 17, 2013 and placed in the iced shipping cooler. The iced cooler containing the wild rice and the four bottles of lake water were delivered to the MPCA on May 21, 2013. The lake water was

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decanted into four new general chemistry two liter plastic bottles. Approximately five grab-handfuls of wild rice were placed into each of the four bottles. The bottles were labeled, wrapped in aluminum foil, and placed in the water quality laboratory walk-in refrigerator.¹

One of these bottles containing Little Round Lake wild rice seed was sent to FEL on June 11, 2013 by Gerald Blaha (MPCA, St. Paul, MN) and received by FEL on June 12, 2013. Upon receipt the wild rice seed was unpacked, assigned sample number ENVI01-00324-003 and stored at 4°C in the dark.

8.4. Exposure System

Test solutions will be provided using a static-renewal design in master 10 L hydroponic tanks. The renewal frequency will be daily with 0.7 volume exchanges/day. Daily cleaning of the tanks using a turkey baster will be performed to remove biomass that may grow during the course of the study. This will help minimize bio-fouling and help maintain water quality, including ammonia accumulation, in the tanks. Care will be taken not to disturb the seeds and seedlings. Tanks will be glass aquaria (with approximate measurements of 35 x 20 x 15 cm deep) equipped with basket insets with an inert mesh to support the seeds and seedlings. Each of the four replicates per treatment will have baskets and the baskets will be equally sub-divided to house seeds and seedlings evaluated on study day 10 and study day 21 (study termination). Following the 10-d germination and mesocotyl development phase that will be conducted in the dark, a combination of incandescent and fluorescent plant grow lights will be used to provide a photoperiod of 16 hours (h) light and 8 h dark at an intensity that ranges from $5,000 \pm 1,000$ lux (lumens/m^2) at the surface of the seeds or plants. Water temperature will be maintained at $21^\circ \pm 2^\circ\text{C}$ (day) and $12 \pm 2^\circ\text{C}$ (night), and pH maintained between 6.0 and 7.5 s.u. A summary of the study conditions is provided in Table 5.

8.5. Water Quality Analyses

8.5.1. Water (Culture) Quality Analyses

In each replicate tank temperature and light intensity (lux) will be measured daily throughout the study and following the 10-d germination and epicotyl development phase. DO, pH, oxidation/reduction potential (ORP), and conductivity will be measured three times per week (7-d week) in one replicate tank of the various media in succession (A, B, C, D). In addition to the other parameters, total hardness, total alkalinity, total residual oxidants, ammonia-nitrogen, sulfate, and phosphate will be measured in the test solutions in two replicates of each treatment at the initiation (A and B) and the other two replicates (C and D) at the conclusion (study day 21) of the in-life phase.

8.6. Equipment

The following equipment will be utilized:

- Study book (daily observations and data recording)

¹ Information provided by Gerald Blaha (MPCA, St. Paul, MN).

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- Glass aquaria;
- UV sterilization tubes and 0.2 μm bacteriostatic filters (as needed);
- Aquarium chiller/heaters (adjustable to 12-22°C);
- Thermometer;
- Binocular dissection microscope;
- Digital camera with at least 4 mega pixel resolution and macro-function (general test photo documentation, test termination for digitizing [lengths to nearest mm] and documentation);
- Image digitizing software;
- Petri dish (100 x 15 mm) or transparent plastic chamber of comparable size;
- Analytical balance capable of measuring to 3 decimal places (mg);
- Dissolved oxygen meter;
- pH meter capable of measuring ORP;
- Light intensity meter capable of measuring in lux units;
- Miscellaneous glassware (beakers, volumetric flasks, Erlenmeyer flasks, graduated cylinders, etc.);
- Adjustable pipetters (10 to 5,000 μL) or assorted pipettes of equivalent sizes;
- Top stirrer;
- Sample collection bottles;
- Water baths; and
- Turkey basters

8.7. Seed Selection

Considering the wild-collected nature of the seeds, care will be given to ensure seeds are selected using a consistent screening process to eliminate damaged or deformed seeds. Seeds will be sieved through a #5 (4 mm) sieve followed by a #10 (2 mm) sieve to separate quality seeds from debris. Visual inspection will also be conducted as seeds are loaded into test systems to ensure damaged, discolored, or deformed seeds are not utilized. Seeds will be placed in the study from a set of pre-selected normal-appearing seeds that are of uniform size.

8.8. Test Method

The definitive toxicity study of sulfate in wild rice will be conducted in a static-renewal format as prescribed by the MDP (ENVI01-00324) in an environmental chamber equipped for hydroponic studies (Table 5). Test solution (0.7 of total volume) will be renewed daily. Each of the 4 replicates per solution will have two 1 L mesh-lined pots. The inert plastic mesh will serve as the medium on which the seeds will be placed and will serve as the inert medium required for hydroponic culture. Each pot will contain 30 seeds (60/replicate and 240/treatment at T0), which will be adequate to evaluate concentration-response and assess significant differences in the treatments relative to the control. The initial 10 study days (SD) will be performed in the dark to promote mesocotyl emergence and development.

One randomly-selected pot will be sacrificed from each of the four replicates per exposure at study day (SD) 10 to evaluate:

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- Activation expressed as a % activation;
- Mesocotyl Emergence (in the dark) expressed as % emergence and time to emergence expressed as a median at the replicate and treatment levels;
- Seedling survival;
- Shoot (mesocotyl, coleoptile and primary leaf) weight expressed as dry weight, or dw;
- Shoot (mesocotyl, coleoptile and primary leaf) lengths;
- Root (seminal and rootlets) dw;
- Seminal Root length; and
- Free leaf number and biomass dw

The remaining pots will be evaluated for these endpoints, as well as signs of phytotoxicity during the free leaf stage at study conclusion (Study Day 21).

Since the frequency of mesocotyl emergence will not likely be 100%, an acceptable frequency of mesocotyl emergence was determined from the MDP (ENVI01-00324) and is listed in Table 5. In addition to the HS-1 (1:4) negative control, a 100 mg B/L treatment in HS-1 (1:4) media will be included as a positive control toxicant.

For all endpoint assessments, plants will be carefully removed at the appropriate time intervals using watch maker forceps and placed into Petri dishes for each replicate to evaluate the appropriate endpoints. Each set will be digitally photographed and length measurements of shoots and roots will be recorded using digitization to the nearest mm. Weights (dw at 105°C) will be recorded using an analytical balance capable of recording to the nearest 0.1 mg. The seminal root tissue will be dissected from the seed as will the coleoptile and primary leaf (shoot) material to specifically evaluate root tissue length (development).

8.9. Data Collection and Biological Endpoints

Test data and daily observations will be recorded in the study records. Study records will include study tracking sheets, test information sheets, study calendars identifying major events, study logs for recording detailed observations and comments, activation, daily mesocotyl emergence, seedling survival, test termination data sheets, and representative digital photographs taken during the conduct of the test. Endpoints selected for the present study are based on those required by OECD Test No. 208 (5). These photographs will document the study design, study milestones, and endpoints (length measurements and signs of phytotoxicity). The primary endpoints of the study will be activation, mesocotyl emergence, and seedling survival measured daily; and shoot and root lengths, shoot and root dry weights (see section 7.8), leaf biomass, and signs of phytotoxicity (wilting, chlorosis, stem and root rot). Table 4 provides an overview of the measurement endpoints and the corresponding observation time points. These endpoints will be measured at SD 10 (as appropriate) and SD 21 (study termination).

8.9.1. Activation

For the purpose of the present study, activation is defined by the absorption of water by the seed and seed coat disruption. All seeds will be evaluated for activation using a

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magnification lens. Activation data will be presented as a percentage of the total seeds per pot, by replicate, and by culture media (treatment).

8.9.2. Mesocotyl Emergence

For the purpose of the present study, mesocotyl emergence is defined as the appearance of plant life in the form of shoots or roots from the germinated seed. Emergence data will be presented as a percentage of the total germinated seeds per pot, by replicate, and by culture media (treatment) and by the time required for mesocotyl emergence expressed as the median time to emergence for a given pot within each replicate (MME). MME will represent the time for 50% of the seeds in each pot to demonstrate mesocotyl emergence.

8.9.3. Survival

Survival will only apply to seeds with emerged plant tissue. Mortality will be defined as loss of living emerged plant tissue. Survival data will be presented as a percentage of the total seeds with emerged plant tissue per pot, by replicate, and by culture media (treatment).

8.9.4. Root and Shoot Weight and Length

Seminal root and shoot (mesocotyl, coleoptile and primary leaf) weight (mg) and length (mesocotyl, coleoptile, and primary leaf) will be measured (mm). All weights will be expressed as dry weight to the nearest mg by drying the appropriate plant tissue at 105°C overnight. Length will be measured by digitizing a digital photograph of the root and shoot to the nearest mm using commercial software (Sigma Scan, SPSS, Chicago, IL) which allows for measurement of shoot and root curvatures to generate linear length.

8.9.5. Free Leaf biomass (free leaf phase)

Free leaf number and biomass (mg) will be determined by carefully separating the shoot from the leaf tissue to the nearest mg. Free leaves include the second leaf and all free leaves that develop.

8.9.6. Phytotoxicity (free leaf phase)

Signs of phytotoxicity including chlorosis of the leaves, darkening of the plant tissue (rot), wilting (loss of turgor pressure), and deformity will be recorded and expressed as a percent of the seeds with emerged plant tissue. This endpoint will be verified by a second analyst.

8.10. Day 0 Test Initiation and Sample Collection

Treatment tanks will be randomly assigned to a position in the exposure system in order to account for possible variations in temperature and light intensity. On study day 0, seeds selected for study will be randomly placed in each pot such that 5 seeds are added to each pot in accordance with a randomized design chart until each pot contains 30 seeds. Samples of the test solutions will be collected and analyzed for parameters described in Table 3.

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8.11. Measurements at SD 10

At Study Day 10, each of the endpoints outlined that are appropriate for the degree of development will be measured. One randomly selected pot from each replicate of each culture media will be sacrificed (n=30/replicate or 120/treatment). Seeds will be carefully removed and photographed for documentation and length measurement. Plant tissues will be carefully removed and weighed. Signs of phytotoxicity will be documented in the study journal and maintained with the raw data.

8.12. Measurements at Test Termination (SD 21)

At Study Day 21, each of the endpoints outlined that are appropriate for the degree of development will be measured. The remaining pot from each replicate (n=30/replicate or 120/treatment) of each culture medium will be sacrificed. Seeds and seedlings will be carefully removed and photographed for documentation and length measurement. Plant tissues will be carefully removed and weighed. Subsequently, since leaf material should be present, leaf tissue will be carefully removed from the shoot for analysis of leaf biomass. Signs of phytotoxicity will be documented in the study journal and maintained with the raw data. Samples of the test solutions will be collected and analyzed for parameters described in Table 5. Sulfate concentrations will be measured in all replicates on Study Days 0, 10, and 21.

8.13. Data Analysis and Statistics

All data from in-life portions of the study will be tabulated in spreadsheets. The experimental unit for the present study will be the replicate. The statistical tests that will be used to compare the culture media to the sulfate, B positive control, and the dissolved solids controls will vary between the measurement endpoints. For determination of concentration-based endpoints (NOEC and LOEC numerical endpoints), data that are expressed as a percent or proportion will be transformed using the arcsine square root prior to further analysis. For discrete endpoints (survival and phytotoxicity), it is expected that comparisons will be made using Fisher's Exact test or the equivalent depending on the adequacy of the data sets. For continuous endpoints (weight and length), it is expected that the comparisons between the treatments will be performed using the Wilcoxon Rank Sum (WRS) Test if the data are non-normal and performed using t-statistics if the data are normally distributed. Other statistical tests that may be appropriate include one-way analysis of variance (ANOVA) or an ANOVA on ranks. *Post hoc* tests may also be used such as Dunnett's test or Bonferroni t-test for parametric sets, or Dunn's test for non-parametric tests. For determination of point estimates (LC50, EC or IC50), trimmed Spearman Karber (LC and EC50), or bootstrap or the equivalent (IC50) will be used. Concentration-response curves will be compared statistically to the conductive solids controls to determine using probit-parallelism tests, if warranted.

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Table 1. Modified Hoagland's Solution - IIS-1 with 1:4 Ammonia:Nitrate

Primary Ingredient	Medin HS-1 (1:4) mL Stock/L
1 M $\text{NH}_4\text{H}_2\text{PO}_4$	0.12
1 M NH_4NO_3	0.70
1 M KNO_3	1.10
1 M $\text{Ca}(\text{NO}_3)_2$	0.75
1M MgSO_4	0.50
Micronutrients (Stock B)	
2.860 g H_3BO_3	1.00
1.810 g $\text{MnCl}_2 \cdot 4 \text{H}_2\text{O}$	
0.220 g $\text{ZnSO}_4 \cdot 7 \text{H}_2\text{O}$	
0.080 g $\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$	
0.024 g $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$	
14.527 g FeCl_3	

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Table 2. Preparation of Sulfate Concentrations using Monovalent and Divalent Salts

Concentration SO ₄ (mg/L)	1:2 Ratio of Monovalent to Divalent Salts						Master (g or L) ¹ mM		
	mg Required for SO ₄ Concentration in 1 L HS-1				Hardness (mg/L CaCO ₃)		Na ₂ SO ₄		
	Na ₂ SO ₄	K ₂ SO ₄	CaSO ₄	MgSO ₄	Ca and Mg as basis	Ca as basis			
10 ²	---	---	---	---	---	---	49.3	17.4	
50 ³	---	---	---	---	---	---	60.5	17.4	
250	123.3	151.3	74.8	52.3	86.8	43.5	29.9	8.7	
1000	492.9	604.7	298.7	208.8	347.3	173.7	20.9	8.7	
2500	1232.2	1511.8	746.8	522.1	868.3	434.2	20.0		
5000	2464.4	3023.5	1493.6	1044.2	1736.6	868.3			

Table 3. Preparation of Conductive Solids Controls using Chloride (Non-Sulfate) Salts

Estimated Conductivity ² (µmhos/cm)	Low Sulfate (Chloride) Salts						Master (g or L) ⁴ mM		
	mg Required for SO ₄ Concentration in 1 L HS-1				Hardness (mg/L CaCO ₃)		NaCl		
	NaCl	KCl	CaCl ₂	MgCl ₂	Ca and Mg as basis	Ca as basis			
770	20.7	25.8	12.8	8.9	---	---	41.9	35.8	
1890	104.8	128.6	63.6	44.5	73.8	37.0	51.4	34.5	
2830	365.4	514.0	253.9	177.5	295.2	147.6	25.4	8.6	
4100	1047.4	1285.0	634.8	443.8	738.1	369.1	17.8	4.4	
8350	2094.7	2570.0	1269.6	887.6	1476.1	738.1	20.0		

¹ 5,000 mg/L sulfate (nominal). Amount (mL) of stock required to prepare 10 L of: 5000 (10 L), 2500(5 L), 1000 (2 L), and 250 (0.5 L) 20 L required.

² Prepared as modified HS-1 medium (see attachment).

³ HS-1 (1:4) medium.

⁴ 103.2 meq/L (nominal) Amount (mL) of stock required to prepare 10 L of: 103.2 (10 L), 51.1(5 L), 19.8 (2 L), 250 (0.5 L), and 0.8 (0.1 L), 20 L required.

⁵ Based on experimentally-derived conductivity conversion factor of 0.85 to convert from sulfate to chloride salts.

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Table 4. Modified HS-1 with 1:4 Ammonia:Nitrate – 10 mg/L Sulfate (nominal)

Primary Ingredient	Media HS-1 (1:4) (g/L)	Media HS-1 (1:4) mL Stock/L
1 M NH ₄ H ₂ PO ₄	115.00	0.12
1 M NH ₄ NO ₃	80.00	0.70
1 M KNO ₃	101.10	1.10
1 M Ca(NO ₃) ₂	164.10	0.75
0.26 M MgSO ₄	31.10	0.40
0.74 M MgCl ₂	151.00	0.54
Micronutrients (Stock B)		
2.860 g H ₃ BO ₃	1.00	---
1.810 g MnCl ₂ • 4 H ₂ O		
0.220 g ZnSO ₄ • 7 H ₂ O		
0.080 g CuSO ₄ • 5 H ₂ O		
0.024 g Na ₂ MoO ₄ • 2H ₂ O		
14.527 g FeCl ₃		

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Table 5. Experimental Conditions for Hydroponic Study – Definitive Phase

Test Substance	Sulfate (2:1 mixed monovalent:divalent salts)	
Test System (species)	<i>Zizania palustris</i> (wild rice)	
Initial Stage	Seed	
Exposure Period	10- d (mesocotyl emergence phase in dark) and 21-d (free leaf phase)	
Selection Criteria	Seed uniformity, visual quality, and activation	
Exposure System	Static-renewal in controlled environmental chambers	
Exposure Route	Water (hydroponics)	
Exchange frequency	Daily, 0.7 volumes/day	
Water Source	Deionized water	
Media	HS-1 with 1:4 ammonia:nitrate	
Seed Density	30 seeds/1 L pot (240 seeds per treatment or control)	
Test Vessel	1 L pots equipped with mesh bottom supports for seeds	
Replication	4 replicates with each replicate containing two (2) 1 L pots. In summary, there will be 60 seeds/replicate and 240 seeds/treatment at SD 0. Thirty seeds or seedlings/replicate (120 seeds/seedlings treatment) will be evaluated on SD 10 and test termination.	
Vessel Placement	Random	
Positive Control	Boric Acid (100 mg B/L) and 0.8, 4.2, 19.8, 51.1, and 103.2 meq/L conductivity control series	
Test Performance Criteria (control)	See Table 7	
Test Endpoints	Daily	Activation, mesocotyl emergence, and visual inspection of development (emergence and normalcy of development)
	SD 10	Activation, mesocotyl emergence (%), time to emergence [TTE] expressed as a median [MTE] if possible, shoot (mesocotyl, coleoptile, and primary leaf)/seminal root length and weight (mesocotyl, coleoptile, and primary leaf)/seminal root and rootlets, and signs of phytotoxicity
	Conclusion	Activation, mesocotyl emergence (%), time to emergence [TTE] expressed as a median [MTE] if possible, shoot (mesocotyl, coleoptile, and primary leaf)/seminal root length and weight (mesocotyl, coleoptile, and primary leaf)/seminal root and rootlets, second and free leaf biomass, and signs of phytotoxicity
Feeding	Nutrient/Micronutrients	HS-1 (Malvick and Percich, 1993) modified with 1:4 ammonia:nitrate
	Frequency	Daily, 0.7 volumes renewed
Lighting	Photoperiod	Dark through SD 10, then 16 h light : 8 h dark
	Intensity (post SD 10)	5,000 ± 1,000 lux (measured daily at water surface)
Temperature	In all replicates, daily, 21° ± 2°C (day), and nightly, 12 ± 2°C (night)	
pH, ORP, DO, conductivity	3x per week in one replicate in rotation to include SD 0 and conclusion	
Alkalinity, hardness, ammonia, nitrate, phosphate	Initiation and conclusion of study in two replicates (A and B at initiation and C and D at conclusion).	
Sulfate	Study Day 0, 10, and 21 in all replicates of control and treatments	

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Table 6. Observation Time Points for Primary Endpoints

Apical/Molecular/Biochemical Endpoints:	Daily	SD 10 Emergence Phase	SD 21 Free-Leaf Phase
	Survival	•	
Germination	•		
Emergence	•		
Shoot ¹ weight and length		•	•
Root ² weight and length		•	•
Leaf biomass			•
Phytotoxicity		•	•

¹Includes mesocotyl, coleoptile, and primary leaf measured combined for weight and individually by structure for length.

²Seminal roots and rootlets for weight and seminal root for length.

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8.14. Performance Criteria and Test Validity

General test performance criteria are provided in Table 6. Criteria

Table 7. General Test Performance Criteria

Criterion	Acceptable Limits
Control activation	95%
Control mesocotyl emergence	≥30%
Control survival	≥90%
Positive control (BA) phytotoxicity	≥80%
pH	6-7.5 in all replicates of control and treatments
Water temperature	21° ± 2°C (day), and nightly, 12 ± 2°C (night) in all replicates of control and treatments
Sulfate concentration	Inter-replicate CV ≤20% for control and treatments for individual measurement set (Study Day 0, 10, and 21)

9. SAMPLE HANDLING AND CUSTODY

All samples generated during the course of this study will be handled in accordance with facility SOPs (6). Samples generated will be entered into a sample check-in logbook and assigned a unique sample tracking number to FEL. FEL sample numbers consist of the client number (ENVI01), the study number (00325), and the sample identifier (00XXX) (7). Each sample will also be properly labeled with its assigned sample tracking number. Samples, when not in use, will be properly preserved and stored, based on sample matrix.

10. REPORTING

FEL will provide progress reports to the Study Monitor throughout the study, as specified by the Sponsor. At the conclusion of the Study, a Final Report will be prepared as described below and will be provided to the Sponsor. The report will include the following:

- **Executive Summary**
- **Test Article:**
 - Test article

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- Chemical data.
- **Test System:**
 - Organism
- **Test conditions:**
 - Test method
 - Operational parameter records
 - Analytical methods
 - Statistical techniques and justification of techniques used
 - Deviations from the test method
- **Results:**
 - Biological observations and data
 - Analytical results
 - *Ad hoc* observations
- **Discussion of results**
- **Conclusions**

Appendices containing raw data and statistical results will be included in the final report. The Final Study Report will be sent to the Sponsor after all comments on the draft report have been addressed and approved.

11. STUDY AMENDMENTS AND DEVIATIONS

Permanent changes to the final Study Protocol will require written amendments be prepared and submitted to the QAU Manager and Study Sponsor for approval. Any amendments will be reviewed to determine the potential impact on the study. If accepted, the amendment will be attached to the Study Protocol and become an active component of the study. Any deviations from the protocol (temporary changes due to unforeseen problems) will be recorded in the study records, dated, and initialed by the Study Director. Deviations will also be addressed in detail in the Final Study Report.

12. RECORD MAINTENANCE AND ARCHIVAL

FEL will retain facility-related records (personnel training, equipment calibration and maintenance, storage temperature records, etc.) (8). No records will be disposed of without the authorization of the Sponsor. The records will be organized and include an index.

Raw data, derived data, QA reports, study guidance documents, correspondence, and draft and final reports will be electronically maintained at the FEL facility in accordance with facility SOPs (9,10) until study finalization. Printed copies of the original study materials and report will be kept in designated file cabinets located in a secured file room at FEL. After final approval of all reports and the study has been officially concluded, all electronic files will be transferred to compact discs (CDs). All original CDs and original printed files associated with the study will be shipped to ENVIRON International Corporation and archived.

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13. SPECIMENS ARCHIVAL

Following study finalization, disposition of the study specimens will be determined by the Sponsor and FEL in consideration of potential future use (9). We anticipate that the tissues derived from the present study will be consumed, thus not requiring archiving.

14. TEST SUBSTANCE WASTE DISPOSAL

Disposal of waste material generated by the study will be performed in accordance with those requirements provided in the facility SOPs (11).

15. QUALITY ASSURANCE UNIT (QAU)

The QAU is established as an objective, independent monitor of the work performed at FEL. The QAU will review data summaries prior to inclusion into the final report as part of the final report audit. Outside facilities providing support of the study will be responsible for auditing their data and reports through their QAU. The specific responsibilities for QA representatives from FEL include but are not limited to:

- Interact with the Study Director to ensure that personnel understand QA and Quality control (QC) procedures,
- Conduct technical systems and data quality audits to evaluate the implementation of the study protocol and applicable facility SOPs. Prepare and distribute reports of the audits to management,
- Consult with the Study Director on actions required to correct deficiencies noted during the conduct of the in-life portion of the study,
- Ensure that all staff participating in the in-life portion of the study are adequately trained,
- Maintain complete facility and study-specific QA records related to the in-life portion of the study, and review data reports and respective audits from support facilities.

The draft and final reports will be reviewed for protocol compliance, as well as to assure that the methods and standard operating procedures used were followed. A signed statement will be included in the report specifying types of inspections made, the dates inspections were made, and the dates inspections were reported to the Study Director and management.

16. REFERENCES

1. USEPA, Toxic Substance Control Act (TSCA), Good Laboratory Practice Standards, 40 CFR Part 792, Chapter 1, Subchapter R, 1989.
2. FEL Quality Assurance Management Plan (QAMP), Fort Environmental Laboratories, Stillwater, OK, July 23, 2010 (current version).
3. Malvick, D.K. and Percich, J.A. (1993). Hydroponic culture of wild rice (*Zizania palustris* L.) and its application to studies of silicon nutrition and fungal brown spot disease. *Can. J. Plant Sci.* 73: 969-975.

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4. Hoagland, D.R. and Arnon, DI (1950). The water-culture methods for growing plants without soil. Circular 347, University of California Agricultural Experiment Station, Berkley, CA.
5. OECD/OCDE. OECD Guideline for the Testing of Chemicals 208: Terrestrial plant test: Seedling emergence and seedling growth test. Organisation for Economic Co-operation and Development. July, 2006.
6. SOP 6.1.2, Sample Tracking and Handling, Fort Environmental Laboratories, 2010.
7. SOP 6.4, Receipt, Storage, and Distribution of Test Substances, Fort Environmental Laboratories, 2010.
8. SOP 4.10, Study File Document Collection and Organization, Fort Environmental Laboratories, 2001.
9. SOP 4.11, Maintenance of Study Archives, Fort Environmental Laboratories, 2001.
10. SOP 12.1, Archiving of Test Specimens, Fort Environmental Laboratories, 2003.
11. SOP 6.2, Waste Collection, Storage, and Disposal, Fort Environmental Laboratories, 2001.

FEL Protocol No./Study No. ENVI01-2/ENVI01-00325
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ATTACHMENTS

(HS-1 Media Recipes and Morphology of a developing wild rice seedling)

Recipe for HS-1 with 1:4 NH₄:NO₃

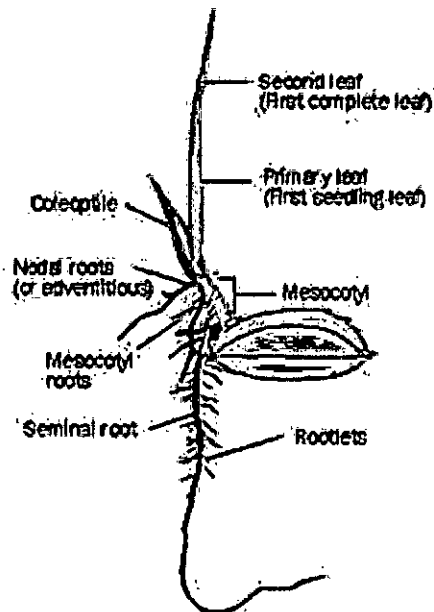
	g/L for 1 M Solutions
NH ₄ H ₂ PO ₄	115.0
KNO ₃	101.1
Ca(NO ₃) ₂	236.2
NH ₄ NO ₃	80.0
MgSO ₄	120.4

Stock B Ingredient	Amount Needed (g) for 1 L Stock B
	HS-1
H ₃ BO ₃	0.556
MnCl ₂ · 4H ₂ O	9.163
ZnSO ₄ · 7H ₂ O	0.219
CuSO ₄ · 5H ₂ O	0.077
Na ₂ MoO ₄ · 2H ₂ O	0.121
FeCl ₃	2.417

Ingredient	mL/L Nutrient Media
	NH ₄ :NO ₃ Ratio (HS-1 Base)
	1:4
1 M NH ₄ H ₂ PO ₄	0.12
1 M NH ₄ NO ₃	0.70
1 M KNO ₃	1.10
1 M Ca(NO ₃) ₂	0.75

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Morphology of Wild Rice Seedling.

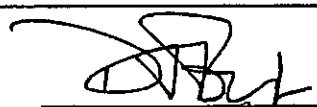


DOCUMENT AMENDMENT FORM
Fort Environmental Laboratories

Document or Study Title: Definitive Hydroponics-Based Sulfate Toxicity to Wild Rice (<i>Zizania palustris</i>)	
Amendment Number: 1	Document ID Number: ENVI01-2
Submitted By: Douglas J. Fort	Date: 9/6/2013
Amendment Relating To: ENVI01-00325	
<input checked="" type="checkbox"/> Protocol <input type="checkbox"/> Study Plan <input type="checkbox"/> QAPP <input type="checkbox"/> QAMP <input type="checkbox"/> SOP <input type="checkbox"/> Other (describe):	
Original Specifications: Page 8, 8.5.1 Water (Culture) Quality Analyses ... In addition to the other parameters, total hardness, total alkalinity, total residual oxidants, ammonia-nitrogen, sulfate, and phosphate will be measured in the test solutions in two replicates of each treatment at the initiation (A and B) and the other two replicates (C and D) at the conclusion (study day 21) of the in-life phase. Page 16, Table 5 - Sulfate	
Planned Change: Sulfate analyses will be performed in two replicates (A and B at initiation, C and D at SD 10, and A and B at study conclusion (SD 21). Nitrate analysis will be performed as directed in Table 5.	
Reason for Change: Need for consistency between analyses specified in Table 5 and Section 8.5.1.	

Approval:

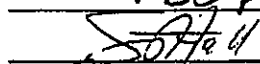
Study Director:



Date:

9/6/2013

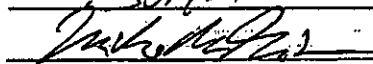
Sponsor:



Date:

9/6/13

QAU Manager:



Date:

9/6/2013

DOCUMENT AMENDMENT FORM
Fort Environmental Laboratories

Document or Study Title: Definitive Hydroponics-Based Sulfate Toxicity to Wild Rice (<i>Zizania palustris</i>)	
Amendment Number: 2	Document ID Number: ENVI01-2
Submitted By: Douglas J. Fort	Date: 11/14/2013
Amendment Relating To: ENVI01-00325	
<input checked="" type="checkbox"/> Protocol <input type="checkbox"/> Study Plan <input type="checkbox"/> QAPP <input type="checkbox"/> QAMP <input type="checkbox"/> SOP <input type="checkbox"/> Other (describe):	
Original Specifications:	
Page 1, Title (and throughout document)	
Definitive Hydroponics-Based Sulfate Toxicity to Wild Rice (<i>Zizania palustris</i>)	
Page 1, Sponsor (and throughout document)	
ENVIRON International Corporation 201 Summit View Drive, Suite 300 Brentwood, TN 37027	
Planned Change:	
Page 1, Title (and throughout document)	
Definitive Hydroponics-Based Wild Rice (<i>Zizania palustris</i>) Sulfate Toxicity Testing	
Page 1, Sponsor (and throughout document)	
Minnesota Chamber of Commerce 400 Robert Street N. St. Paul, MN 55101	
Reason for Change:	
Change requested by Sponsor representative.	

Approval:

Study Director:



Date:

11/14/2013

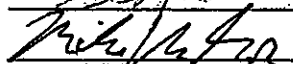
Sponsor:



Date:

11/14/13

QAU Manager:



Date:

11/14/2013

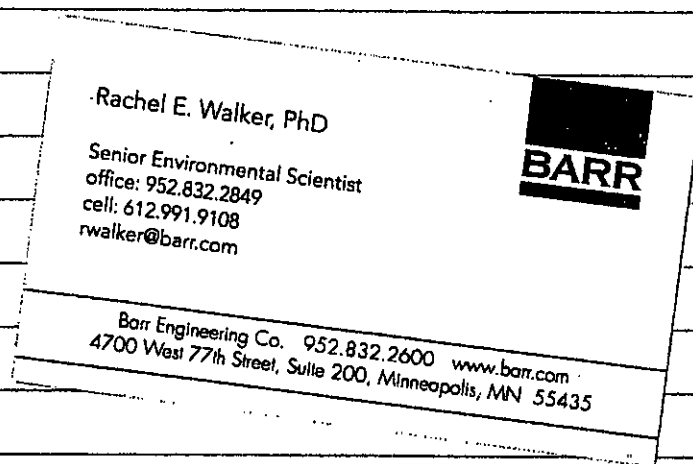
**Appendix B.
Seed Information**

Received wild rice (*Zizania
palustris*) from Rod Ustipak and
Gerald Blaha. Harvested on Sept. 14, 2012.
(date needs to be double checked). Received at
4:00 p.m. on May 1, 2013.

Source for both 2-liter jars (3 total)
and bag of rice that was taken out of
lake this week after over-wintering. Lake is
Rice Hesitation. Gerald Blaha provided rice in
2-liter jars. Rod Ustipak provided rice in plastic bag.

Rachel Walker

May 1, 2013



Appendix C.
Statistical Analyses

Descriptive Statistics:

Data source: SD 10 Emergence in 00325_SD 10_101613

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	0.491	0.079	0.040	0.126
100 mg B/L	4	0	0.225	0.057	0.028	0.090
10 mg/L SO4	4	0	0.550	0.225	0.113	0.358
250 mg/L SO4	4	0	0.617	0.157	0.079	0.250
1000 mg/L SO4	4	0	0.625	0.142	0.071	0.226
2500 mg/L SO4	4	0	0.675	0.157	0.079	0.250
5000 mg/L SO4	4	0	0.708	0.126	0.063	0.200
0.8 meq/L	4	0	0.358	0.075	0.037	0.119
4.2 meq/L	4	0	0.300	0.090	0.045	0.143
19.8 meq/L	4	0	0.317	0.084	0.042	0.133
51.1 meq/L	4	0	0.483	0.208	0.104	0.331
103.2 meq/L	4	0	0.300	0.047	0.024	0.075

Column	Range	Max	Min	Median	25%	75%
HS-1	0.167	0.600	0.433	0.467	0.433	0.550
100 mg B/L	0.133	0.300	0.167	0.217	0.184	0.267
10 mg/L SO4	0.533	0.800	0.267	0.567	0.384	0.717
250 mg/L SO4	0.333	0.833	0.500	0.567	0.500	0.733
1000 mg/L SO4	0.333	0.800	0.467	0.617	0.517	0.734
2500 mg/L SO4	0.333	0.900	0.567	0.617	0.567	0.784
5000 mg/L SO4	0.300	0.833	0.533	0.733	0.633	0.783
0.8 meq/L	0.167	0.467	0.300	0.332	0.315	0.400
4.2 meq/L	0.200	0.433	0.233	0.267	0.250	0.350
19.8 meq/L	0.200	0.400	0.200	0.333	0.267	0.367
51.1 meq/L	0.467	0.700	0.233	0.500	0.317	0.650
103.2 meq/L	0.100	0.367	0.267	0.283	0.267	0.334

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	1.190	0.416	0.271	0.341	0.848	0.221
100 mg B/L	0.770	0.385	0.194	0.651	0.970	0.842
10 mg/L SO4	-0.386	-0.025	0.162	0.708	0.993	0.971
250 mg/L SO4	1.196	0.446	0.270	0.342	0.848	0.220
1000 mg/L SO4	0.289	-0.689	0.159	0.709	0.993	0.970
2500 mg/L SO4	1.516	1.976	0.271	0.340	0.814	0.130
5000 mg/L SO4	-1.129	2.227	0.329	0.138	0.895	0.406
0.8 meq/L	1.753	3.336	0.379	0.046	0.798	0.099
4.2 meq/L	1.804	3.463	0.393	0.031	0.776	0.065
19.8 meq/L	-1.120	2.215	0.328	0.140	0.896	0.411
51.1 meq/L	-0.330	-2.234	0.212	0.590	0.964	0.804
103.2 meq/L	1.425	1.550	0.260	0.389	0.826	0.158

Column	Sum	Sum of Squares
HS-1	1.966	0.985
100 mg B/L	0.900	0.212
10 mg/L SO4	2.200	1.362
250 mg/L SO4	2.466	1.595
1000 mg/L SO4	2.501	1.624
2500 mg/L SO4	2.701	1.898
5000 mg/L SO4	2.832	2.053
0.8 meq/L	1.430	0.528
4.2 meq/L	1.200	0.384
19.8 meq/L	1.266	0.422
51.1 meq/L	1.933	1.064
103.2 meq/L	1.201	0.367

One Way Analysis of Variance

Data source: SD 10 Emergence in 00325_SD 10_101613

Normality Test (Shapiro-Wilk) Passed (P = 0.424)

Equal Variance Test: Passed (P = 0.301)

Group Name	N	Missing	Mean	Std Dev	SEM
asinsqrt(col(1))	4	0	0.777	0.079	0.0397
asinsqrt(col(2))	4	0	0.492	0.068	0.0337
asinsqrt(col(3))	4	0	0.839	0.237	0.1190
asinsqrt(col(4))	4	0	0.910	0.172	0.0860
asinsqrt(col(5))	4	0	0.917	0.152	0.0758
asinsqrt(col(6))	4	0	0.977	0.187	0.0937
asinsqrt(col(7))	4	0	1.006	0.138	0.0688
asinsqrt(col(8))	4	0	0.640	0.077	0.0384
asinsqrt(col(9))	4	0	0.577	0.096	0.0480
asinsqrt(col(10))	4	0	0.595	0.093	0.0466
asinsqrt(col(11))	4	0	0.766	0.216	0.1080
asinsqrt(col(12))	4	0	0.579	0.051	0.0254

Source of Variation	DF	SS	MS	F	P
Between Groups	11	1.365	0.124	6.028	<0.001
Residual	36	0.741	0.0206		
Total	47	2.106			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 0.999

Multiple Comparisons versus Control Group (Bonferroni t-test):

Comparisons for factor:

Comparison	Diff of Means	t	P	P<0.050
asinsqrt(col vs. asinsqrt(col	0.285	2.809	0.088	No
asinsqrt(col vs. asinsqrt(col	0.229	2.257	0.332	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.201	1.977	0.614	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.2	1.971	0.621	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.198	1.95	0.648	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.182	1.797	0.888	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.14	1.38	1	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.137	1.352	1	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.133	1.313	1	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.0619	0.61	1	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.0105	0.104	1	Do Not Test

Descriptive Statistics:

Data source: Secondary Leaf Biomass in 00325_SD 10_10162013

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	0.0023	0.000235	0.000118	0.000374
100 mg B/L	4	0	0.000871	0.000146	0.0000728	0.000232
10 mg/L SO4	4	0	0.00242	0.000725	0.000362	0.00115
250 mg/L SO4	4	0	0.00232	0.000479	0.00024	0.000762
1000 mg/L SO4	4	0	0.00228	0.000338	0.000169	0.000538
2500 mg/L SO4	4	0	0.00213	0.000427	0.000214	0.00068
5000 mg/L SO4	4	0	0.0014	0.000169	0.0000847	0.00027
0.8 meq/L	4	0	0.00244	0.000659	0.00033	0.00105
4.2 meq/L	4	0	0.00218	0.000793	0.000396	0.00126
19.8 meq/L	4	0	0.00195	0.000565	0.000282	0.000898
51.1 meq/L	4	0	0.0019	0.000135	0.0000676	0.000215
103.2 meq/L	4	0	0.00138	0.00012	0.0000599	0.000191

Column	Range	Max	Min	Median	25%	75%
HS-1	0.00052	0.0025	0.00198	0.00236	0.00212	0.00248
100 mg B/L	0.0003	0.001	0.0007	0.000892	0.00075	0.000992
10 mg/L SO4	0.00174	0.00331	0.00157	0.00239	0.0019	0.00294
250 mg/L SO4	0.00109	0.00301	0.00191	0.00219	0.00201	0.00264
1000 mg/L SO4	0.000759	0.00267	0.00191	0.00227	0.00201	0.00255
2500 mg/L SO4	0.00103	0.00268	0.00165	0.00209	0.00183	0.00242
5000 mg/L SO4	0.0004	0.0016	0.00121	0.00139	0.00127	0.00153
0.8 meq/L	0.00157	0.0031	0.00153	0.00256	0.00203	0.00285
4.2 meq/L	0.0019	0.00299	0.00109	0.00233	0.00168	0.00269
19.8 meq/L	0.00126	0.00254	0.00128	0.002	0.0015	0.00241
51.1 meq/L	0.000294	0.0021	0.00181	0.00185	0.00182	0.00198
103.2 meq/L	0.000269	0.00154	0.00128	0.00135	0.00129	0.00147

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	-1.076	0.132	0.239	0.479	0.906	0.463
100 mg B/L	-0.381	-3.726	0.28	0.301	0.882	0.345
10 mg/L SO4	0.178	0.53	0.173	0.696	0.996	0.986
250 mg/L SO4	1.446	2.28	0.291	0.259	0.887	0.368
1000 mg/L SO4	0.0763	-2.516	0.194	0.65	0.97	0.84
2500 mg/L SO4	0.491	0.927	0.208	0.607	0.984	0.924
5000 mg/L SO4	0.204	-0.403	0.141	0.705	0.997	0.99
0.8 meq/L	-1.064	2.099	0.304	0.212	0.918	0.525
4.2 meq/L	-1.028	2.002	0.292	0.255	0.928	0.58
19.8 meq/L	-0.325	-2.414	0.217	0.571	0.96	0.776
51.1 meq/L	1.875	3.635	0.392	0.031	0.757	0.045
103.2 meq/L	1.182	0.861	0.222	0.551	0.912	0.493

Column	Sum	Sum of Squares
HS-1	0.0092	2.13E-05
100 mg B/L	0.00348	3.1E-06
10 mg/L SO4	0.00967	0.000025
250 mg/L SO4	0.00929	2.23E-05
1000 mg/L SO4	0.00912	2.12E-05
2500 mg/L SO4	0.0085	1.86E-05
5000 mg/L SO4	0.00559	7.91E-06
0.8 meq/L	0.00974	0.000025
4.2 meq/L	0.00873	2.09E-05
19.8 meq/L	0.00781	1.62E-05
51.1 meq/L	0.0076	1.45E-05
103.2 meq/L	0.00552	7.65E-06

One Way Analysis of Variance

Data source: Secondary Leaf Biomass in 00325_SD 10_10162013

Normality Test (Shapiro-Wilk) Passed (P = 0.089)

Equal Variance Test: Passed (P = 0.281)

Group Name	N	Missing	Mean	Std Dev	SEM
HS-1	4	0	0.0023	0.000235	0.000118
100 mg B/L	4	0	0.000871	0.000146	0.0000728
10 mg/L SO4	4	0	0.00242	0.000725	0.000362
250 mg/L SO4	4	0	0.00232	0.000479	0.00024
1000 mg/L SO4	4	0	0.00228	0.000338	0.000169
2500 mg/L SO4	4	0	0.00213	0.000427	0.000214
5000 mg/L SO4	4	0	0.0014	0.000169	0.0000847
0.8 meq/L	4	0	0.00244	0.000659	0.00033
4.2 meq/L	4	0	0.00218	0.000793	0.000396
19.8 meq/L	4	0	0.00195	0.000565	0.000282
51.1 meq/L	4	0	0.0019	0.000135	0.0000676
103.2 meq/L	4	0	0.00138	0.00012	0.0000599

Source of Variation	DF	SS	MS	F	P
Between Groups	11	0.0000108	0.000000984	4.592	<0.001
Residual	36	0.00000771	0.000000214		
Total	47	0.0000185			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 0.984

Multiple Comparisons versus Control Group (Bonferroni t-test):

Comparisons for factor:

Comparison	Diff of Means	t	P	P<0.050
HS-1 vs. 100 mg B/L	0.00143	4.364	0.001	Yes
HS-1 vs. 103.2 meq/L	0.00092	2.811	0.087	No
HS-1 vs. 5000 mg/L SO4	0.000901	2.753	0.101	Do Not Test
HS-1 vs. 51.1 meq/L	0.0004	1.222	1	Do Not Test
HS-1 vs. 19.8 meq/L	0.000346	1.058	1	Do Not Test
HS-1 vs. 2500 mg/L SO4	0.000174	0.532	1	Do Not Test
HS-1 vs. 0.8 meq/L	0.000136	0.417	1	Do Not Test
HS-1 vs. 10 mg/L SO4	0.000119	0.362	1	Do Not Test
HS-1 vs. 4.2 meq/L	0.000116	0.355	1	Do Not Test
HS-1 vs. 250 mg/L SO4	0.0000239	0.0731	1	Do Not Test
HS-1 vs. 1000 mg/L SO4	0.0000183	0.0559	1	Do Not Test

Descriptive Statistics:

Data source: Free Leaf Number in 00325_SD 10_10162013

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	0.892	0.125	0.063	0.199
100 mg B/L	4	0	0.481	0.371	0.186	0.591
10 mg/L SO4	4	0	0.930	0.060	0.030	0.096
250 mg/L SO4	4	0	0.617	0.157	0.079	0.250
1000 mg/L SO4	4	0	0.932	0.049	0.025	0.079
2500 mg/L SO4	4	0	0.988	0.025	0.013	0.040
5000 mg/L SO4	4	0	0.859	0.089	0.044	0.141
0.8 meq/L	4	0	0.933	0.078	0.039	0.124
4.2 meq/L	4	0	0.300	0.090	0.045	0.143
19.8 meq/L	4	0	0.887	0.037	0.019	0.059
51.1 meq/L	4	0	0.873	0.093	0.046	0.147
103.2 meq/L	4	0	0.977	0.046	0.023	0.072

Column	Range	Max	Min	Median	25%	75%
HS-1	0.231	1.000	0.769	0.900	0.785	1.000
100 mg B/L	0.857	0.857	0.000	0.533	0.200	0.762
10 mg/L SO4	0.133	1.000	0.867	0.927	0.881	0.979
250 mg/L SO4	0.333	0.833	0.500	0.567	0.500	0.733
1000 mg/L SO4	0.118	1.000	0.882	0.923	0.900	0.964
2500 mg/L SO4	0.050	1.000	0.950	1.000	0.975	1.000
5000 mg/L SO4	0.195	0.955	0.760	0.861	0.786	0.932
0.8 meq/L	0.143	1.000	0.857	0.938	0.866	1.000
4.2 meq/L	0.200	0.433	0.233	0.267	0.250	0.350
19.8 meq/L	0.083	0.917	0.833	0.900	0.867	0.908
51.1 meq/L	0.222	1.000	0.778	0.857	0.817	0.929
103.2 meq/L	0.091	1.000	0.909	1.000	0.955	1.000

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	-0.0522	-5.6990	0.3060	0.2070	0.7860	0.0790
100 mg B/L	-0.6780	-0.4060	0.1910	0.6580	0.9690	0.8380
10 mg/L SO4	0.2110	-2.9290	0.2200	0.5610	0.9530	0.7380
250 mg/L SO4	1.1960	0.4460	0.2700	0.3420	0.8480	0.2200
1000 mg/L SO4	1.0510	1.8810	0.2770	0.3150	0.9350	0.6260
2500 mg/L SO4	-2.0000	4.0000	0.4410	0.0060	0.6300	0.0010
5000 mg/L SO4	-0.0720	-3.2470	0.2140	0.5850	0.9500	0.7190
0.8 meq/L	-0.0456	-5.7370	0.3060	0.2060	0.7820	0.0740
4.2 meq/L	1.8040	3.4630	0.3930	0.0310	0.7760	0.0650
19.8 meq/L	-1.7200	3.2650	0.3820	0.0410	0.8010	0.1030
51.1 meq/L	0.9890	2.0540	0.3180	0.1670	0.9080	0.4700
103.2 meq/L	-2.0000	4.0000	0.4410	0.0060	0.6300	0.0010

Column	Sum	Sum of Squares
HS-1	3.569	3.232
100 mg B/L	1.924	1.339
10 mg/L SO4	3.720	3.470
250 mg/L SO4	2.466	1.595
1000 mg/L SO4	3.728	3.481
2500 mg/L SO4	3.950	3.902
5000 mg/L SO4	3.436	2.975
0.8 meq/L	3.732	3.500
4.2 meq/L	1.200	0.384
19.8 meq/L	3.550	3.155
51.1 meq/L	3.492	3.074
103.2 meq/L	3.909	3.826

One Way Analysis of Variance

Data source: Free Leaf Number In 00325_SD 10_10162013

Normality Test (Shapiro-Wilk) Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: Free Leaf Number In 00325_SD 10_10162013

Group	N	Missing	Median	25%	75%
HS-1	4	0	0.900	0.777	1.000
100 mg B/L	4	0	0.533	0.100	0.810
10 mg/L SO4	4	0	0.927	0.874	0.990
250 mg/L SO4	4	0	0.567	0.500	0.783
1000 mg/L SO4	4	0	0.923	0.891	0.982
2500 mg/L SO4	4	0	1.000	0.962	1.000
5000 mg/L SO4	4	0	0.861	0.773	0.943
0.8 meq/L	4	0	0.938	0.862	1.000
4.2 meq/L	4	0	0.267	0.242	0.391
19.8 meq/L	4	0	0.900	0.850	0.913
51.1 meq/L	4	0	0.857	0.798	0.964
103.2 meq/L	4	0	1.000	0.932	1.000

H = 30.926 with 11 degrees of freedom. (P = 0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

Multiple Comparisons versus Control Group (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
4.2 meq/L vs HS-1	23.750	2.399	No
100 mg B/L vs HS-1	18.625	1.881	Do Not Test
250 mg/L SO4 vs HS-1	17.500	1.768	Do Not Test
2500 mg/L SO4 vs HS-1	12.250	1.237	Do Not Test
103.2 meq/L vs HS-1	11.125	1.124	Do Not Test
5000 mg/L SO4 vs HS-1	5.375	0.543	Do Not Test
1000 mg/L SO4 vs HS-1	4.625	0.467	Do Not Test
0.8 meq/L vs HS-1	4.125	0.417	Do Not Test
51.1 meq/L vs HS-1	4.000	0.404	Do Not Test
10 mg/L SO4 vs HS-1	3.500	0.354	Do Not Test
19.8 meq/L vs HS-1	2.375	0.240	Do Not Test

Descriptive Statistics:

Data source: Phytotoxicity in 00325_SD 10_101613

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	0.000	0.000	0.000	0.000
100 mg B/L	4	0	0.710	0.198	0.099	0.315
10 mg/L SO4	4	0	0.000	0.000	0.000	0.000
250 mg/L SO4	4	0	0.000	0.000	0.000	0.000
1000 mg/L SO4	4	0	0.000	0.000	0.000	0.000
2500 mg/L SO4	4	0	0.000	0.000	0.000	0.000
5000 mg/L SO4	4	0	0.391	0.083	0.042	0.132
0.8 meq/L	4	0	0.000	0.000	0.000	0.000
4.2 meq/L	4	0	0.000	0.000	0.000	0.000
19.8 meq/L	4	0	0.000	0.000	0.000	0.000
51.1 meq/L	4	0	0.059	0.042	0.021	0.067
103.2 meq/L	4	0	0.405	0.190	0.095	0.302

Column	Range	Max	Min	Median	25%	75%
HS-1	0.000	0.000	0.000	0.000	0.000	0.000
100 mg B/L	0.429	1.000	0.571	0.633	0.585	0.834
10 mg/L SO4	0.000	0.000	0.000	0.000	0.000	0.000
250 mg/L SO4	0.000	0.000	0.000	0.000	0.000	0.000
1000 mg/L SO4	0.000	0.000	0.000	0.000	0.000	0.000
2500 mg/L SO4	0.000	0.000	0.000	0.000	0.000	0.000
5000 mg/L SO4	0.175	0.455	0.280	0.415	0.328	0.455
0.8 meq/L	0.000	0.000	0.000	0.000	0.000	0.000
4.2 meq/L	0.000	0.000	0.000	0.000	0.000	0.000
19.8 meq/L	0.000	0.000	0.000	0.000	0.000	0.000
51.1 meq/L	0.095	0.095	0.000	0.070	0.028	0.089
103.2 meq/L	0.403	0.625	0.222	0.387	0.248	0.563

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	0.000	-6.000	0.000	<0.001	0.000	<0.001
100 mg B/L	1.763	3.131	0.335	0.122	0.798	0.098
10 mg/L SO4	0.000	-6.000	0.000	<0.001	0.000	<0.001
250 mg/L SO4	0.000	-6.000	0.000	<0.001	0.000	<0.001
1000 mg/L SO4	0.000	-6.000	0.000	<0.001	0.000	<0.001
2500 mg/L SO4	0.000	-6.000	0.000	<0.001	0.000	<0.001
5000 mg/L SO4	-0.999	-0.544	0.278	0.310	0.859	0.257
0.8 meq/L	0.000	-6.000	0.000	<0.001	0.000	<0.001
4.2 meq/L	0.000	-6.000	0.000	<0.001	0.000	<0.001
19.8 meq/L	0.000	-6.000	0.000	<0.001	0.000	<0.001
51.1 meq/L	-1.208	0.954	0.226	0.535	0.908	0.473
103.2 meq/L	0.299	-3.662	0.256	0.404	0.914	0.505

Column	Sum	Sum of Squares
HS-1	0.000	0.000
100 mg B/L	2.838	2.131
10 mg/L SO4	0.000	0.000
250 mg/L SO4	0.000	0.000
1000 mg/L SO4	0.000	0.000
2500 mg/L SO4	0.000	0.000
5000 mg/L SO4	1.565	0.633
0.8 meq/L	0.000	0.000
4.2 meq/L	0.000	0.000
19.8 meq/L	0.000	0.000
51.1 meq/L	0.234	0.019
103.2 meq/L	1.620	0.764

One Way Analysis of Variance

Data source: Phytotoxicity in 00325_SD 10_101613

Normality Test (Shapiro-Wilk) Failed (P < 0.050)

Equal Variance Test: Failed (P < 0.050)

Group Name	N	Missing	Mean	Std Dev	SEM
asinsqrt(col(1))	4	0	0.000	0.000	0.000
asinsqrt(col(2))	4	0	1.067	0.338	0.169
asinsqrt(col(3))	4	0	0.000	0.000	0.000
asinsqrt(col(4))	4	0	0.000	0.000	0.000
asinsqrt(col(5))	4	0	0.000	0.000	0.000
asinsqrt(col(6))	4	0	0.000	0.000	0.000
asinsqrt(col(7))	4	0	0.674	0.087	0.043
asinsqrt(col(8))	4	0	0.000	0.000	0.000
asinsqrt(col(9))	4	0	0.000	0.000	0.000
asinsqrt(col(10))	4	0	0.000	0.000	0.000
asinsqrt(col(11))	4	0	0.211	0.144	0.072
asinsqrt(col(12))	4	0	0.684	0.198	0.099

Source of Variation	DF	SS	MS	F	P
Between Groups	11	6.109	0.555	36.638	<0.001
Residual	36	0.546	0.0152		
Total	47	6.655			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

Multiple Comparisons versus Control Group (Bonferroni t-test):

Comparisons for factor:

Comparison	Diff of Means	t	P	P<0.050
asinsqrt(col vs. asinsqrt(col	1.067	12.26	<0.001	Yes
asinsqrt(col vs. asinsqrt(col	0.684	7.861	<0.001	Yes
asinsqrt(col vs. asinsqrt(col	0.674	7.746	<0.001	Yes
asinsqrt(col vs. asinsqrt(col	0.211	2.425	0.225	No
asinsqrt(col vs. asinsqrt(col	0.000	0	1	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.000	0	1	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.000	0	1	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.000	0	1	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.000	0	1	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.000	0	1	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.000	0	1	Do Not Test

Descriptive Statistics:

Data source: SD 10 Shoot Biomass in 00325_SD 10

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	0.00271	0.00050	0.00025	0.00080
100 mg B/L	4	0	0.00198	0.00023	0.00011	0.00036
10 mg/L SO4	4	0	0.00355	0.00113	0.00057	0.00180
250 mg/L SO4	4	0	0.00298	0.00147	0.00073	0.00234
1000 mg/L SO4	4	0	0.00210	0.00022	0.00011	0.00035
2500 mg/L SO4	4	0	0.00193	0.00011	0.00005	0.00017
5000 mg/L SO4	4	0	0.00181	0.00013	0.00007	0.00021
0.8 meq/L	4	0	0.00149	0.00020	0.00010	0.00032
4.2 meq/L	4	0	0.00185	0.00023	0.00012	0.00037
19.8 meq/L	4	0	0.00185	0.00023	0.00012	0.00037
51.1 meq/L	4	0	0.00145	0.00051	0.00025	0.00081
103.2 meq/L	4	0	0.00139	0.00016	0.00008	0.00026

Column	Range	Max	Min	Median	25%	75%
HS-1	0.00120	0.00325	0.00205	0.00277	0.00237	0.00305
100 mg B/L	0.00050	0.00216	0.00166	0.00205	0.00182	0.00213
10 mg/L SO4	0.00265	0.00510	0.00245	0.00331	0.00276	0.00433
250 mg/L SO4	0.00318	0.00517	0.00199	0.00239	0.00219	0.00378
1000 mg/L SO4	0.00050	0.00239	0.00189	0.00206	0.00193	0.00227
2500 mg/L SO4	0.00026	0.00208	0.00183	0.00191	0.00186	0.00200
5000 mg/L SO4	0.00029	0.00190	0.00161	0.00187	0.00174	0.00188
0.8 meq/L	0.00047	0.00178	0.00131	0.00143	0.00136	0.00161
4.2 meq/L	0.00056	0.00214	0.00158	0.00184	0.00168	0.00201
19.8 meq/L	0.00056	0.00214	0.00158	0.00184	0.00168	0.00201
51.1 meq/L	0.00117	0.00190	0.00073	0.00159	0.00114	0.00177
103.2 meq/L	0.00038	0.00156	0.00118	0.00141	0.00127	0.00151

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	-0.706	1.300	0.235	0.497	0.969	0.834
100 mg B/L	-1.423	1.703	0.259	0.392	0.868	0.290
10 mg/L SO4	1.086	1.442	0.247	0.446	0.941	0.660
250 mg/L SO4	1.900	3.709	0.408	0.020	0.737	0.029
1000 mg/L SO4	0.822	-0.258	0.206	0.612	0.954	0.739
2500 mg/L SO4	1.197	1.940	0.276	0.318	0.924	0.562
5000 mg/L SO4	-1.927	3.780	0.405	0.021	0.728	0.024
0.8 meq/L	1.509	2.756	0.333	0.127	0.866	0.282
4.2 meq/L	0.248	0.617	0.181	0.683	0.994	0.977
19.8 meq/L	0.248	0.617	0.181	0.683	0.994	0.977
51.1 meq/L	-1.462	2.602	0.319	0.165	0.879	0.334
103.2 meq/L	-0.657	-0.030	0.175	0.693	0.977	0.882

Column	Sum	Sum of Squares
HS-1	0.0108	0.0000301
100 mg B/L	0.00791	0.0000158
10 mg/L SO4	0.0142	0.0000541
250 mg/L SO4	0.0119	0.0000421
1000 mg/L SO4	0.00840	0.0000178
2500 mg/L SO4	0.00772	0.0000149
5000 mg/L SO4	0.00724	0.0000131
0.8 meq/L	0.00595	0.00000897
4.2 meq/L	0.00739	0.0000138
19.8 meq/L	0.00739	0.0000138
51.1 meq/L	0.00581	0.00000922
103.2 meq/L	0.00557	0.00000785

One Way Analysis of Variance

Data source: SD 10 Shoot Biomass in 00325_SD 10

Normality Test (Shapiro-Wilk) Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: SD 10 Shoot Biomass in 00325_SD 10

Group	N	Missing	Median	25%	75%
HS-1	4	0	0.00277	0.00221	0.00315
100 mg B/L	4	0	0.00205	0.00174	0.00215
10 mg/L SO4	4	0	0.00331	0.00261	0.00471
250 mg/L SO4	4	0	0.00239	0.00209	0.00447
1000 mg/L SO4	4	0	0.00206	0.00191	0.00233
2500 mg/L SO4	4	0	0.00191	0.00184	0.00204
5000 mg/L SO4	4	0	0.00187	0.00167	0.00189
0.8 meq/L	4	0	0.00143	0.00134	0.00170
4.2 meq/L	4	0	0.00184	0.00163	0.00208
19.8 meq/L	4	0	0.00184	0.00163	0.00208
51.1 meq/L	4	0	0.00159	0.00093	0.00184
103.2 meq/L	4	0	0.00141	0.00123	0.00154

H = 36.354 with 11 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

Multiple Comparisons versus Control Group (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
103.2 meq/L vs HS-1	34.750	3.51	Yes
0.8 meq/L vs HS-1	33.000	3.334	Yes
51.1 meq/L vs HS-1	28.250	2.854	Yes
5000 mg/L SO4 vs HS-1	21.250	2.147	No
4.2 meq/L vs HS-1	19.250	1.945	Do Not Test
19.8 meq/L vs HS-1	19.250	1.945	Do Not Test
2500 mg/L SO4 vs HS-1	15.000	1.515	Do Not Test
100 mg B/L vs HS-1	12.000	1.212	Do Not Test
1000 mg/L SO4 vs HS-1	9.000	0.909	Do Not Test
10 mg/L SO4 vs HS-1	4.250	0.429	Do Not Test
250 mg/L SO4 vs HS-1	1.500	0.152	Do Not Test

Descriptive Statistics:

Data source: SD 10 Root Biomass in 00325_SD 10_10162013

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	0.0004550	0.0001020	0.0000512	0.0001630
100 mg B/L	4	0	0.0002820	0.0002220	0.0001110	0.0003530
10 mg/L SO4	4	0	0.0004680	0.0001250	0.0000627	0.0001990
250 mg/L SO4	4	0	0.0007130	0.0000982	0.0000491	0.0001560
1000 mg/L SO4	4	0	0.0004780	0.0000312	0.0000156	0.0000496
2500 mg/L SO4	4	0	0.0004400	0.0000854	0.0000427	0.0001360
5000 mg/L SO4	4	0	0.0004780	0.0000707	0.0000353	0.0001120
0.8 meq/L	4	0	0.0003940	0.0000800	0.0000400	0.0001270
4.2 meq/L	4	0	0.0004030	0.0000625	0.0000312	0.0000994
19.8 meq/L	4	0	0.0003730	0.0000739	0.0000369	0.0001180
51.1 meq/L	4	0	0.0004220	0.0001140	0.0000571	0.0001820
103.2 meq/L	4	0	0.0004030	0.0000494	0.0000247	0.0000786

Column	Range	Max	Min	Median	25%	75%
HS-1	0.000240	0.000600	0.000360	0.000430	0.000391	0.000519
100 mg B/L	0.000529	0.000589	0.000060	0.000239	0.000144	0.000419
10 mg/L SO4	0.000305	0.000625	0.000320	0.000463	0.000384	0.000552
250 mg/L SO4	0.000212	0.000807	0.000595	0.000726	0.000633	0.000793
1000 mg/L SO4	0.000060	0.000510	0.000450	0.000476	0.000451	0.000505
2500 mg/L SO4	0.000194	0.000524	0.000330	0.000454	0.000375	0.000506
5000 mg/L SO4	0.000150	0.000556	0.000406	0.000475	0.000419	0.000537
0.8 meq/L	0.000179	0.000489	0.000310	0.000389	0.000330	0.000459
4.2 meq/L	0.000152	0.000475	0.000323	0.000407	0.000362	0.000445
19.8 meq/L	0.000167	0.000433	0.000267	0.000395	0.000323	0.000422
51.1 meq/L	0.000213	0.000528	0.000314	0.000424	0.000324	0.000521
103.2 meq/L	0.000101	0.000464	0.000362	0.000392	0.000363	0.000443

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	1.330	2.424	0.315	0.177	0.895	0.407
100 mg B/L	1.092	2.139	0.307	0.201	0.914	0.506
10 mg/L SO4	0.216	1.209	0.214	0.584	0.980	0.905
250 mg/L SO4	-0.444	-2.874	0.251	0.426	0.925	0.567
1000 mg/L SO4	0.081	-5.450	0.291	0.258	0.824	0.154
2500 mg/L SO4	-0.728	-0.748	0.212	0.590	0.956	0.751
5000 mg/L SO4	0.130	-4.053	0.244	0.461	0.918	0.527
0.8 meq/L	0.256	-2.443	0.210	0.597	0.964	0.804
4.2 meq/L	-0.380	1.326	0.230	0.519	0.974	0.866
19.8 meq/L	-1.501	2.311	0.290	0.261	0.873	0.310
51.1 meq/L	-0.012	-5.793	0.289	0.265	0.798	0.099
103.2 meq/L	0.572	-2.797	0.292	0.255	0.861	0.265

Column	Sum	Sum of Squares
HS-1	0.00182	0.000000860
100 mg B/L	0.00113	0.000000465
10 mg/L SO4	0.00187	0.000000923
250 mg/L SO4	0.00285	0.000002060
1000 mg/L SO4	0.00191	0.000000918
2500 mg/L SO4	0.00176	0.000000798
5000 mg/L SO4	0.00191	0.000000929
0.8 meq/L	0.00158	0.000000641
4.2 meq/L	0.00161	0.000000662
19.8 meq/L	0.00149	0.000000571
51.1 meq/L	0.00169	0.000000753
103.2 meq/L	0.00161	0.000000656

One Way Analysis of Variance

Data source: SD 10 Root Biomass in 00325_SD 10_10162013

Normality Test (Shapiro-Wilk) Passed (P = 0.257)

Equal Variance Test: Passed (P = 0.554)

Group Name	N	Missing	Mean	Std Dev	SEM
HS-1	4	0	0.000455	0.000102	0.0000512
100 mg B/L	4	0	0.000282	0.000222	0.0001110
10 mg/L SO4	4	0	0.000468	0.000125	0.0000627
250 mg/L SO4	4	0	0.000713	0.000098	0.0000491
1000 mg/L SO4	4	0	0.000478	0.000031	0.0000156
2500 mg/L SO4	4	0	0.000440	0.000085	0.0000427
5000 mg/L SO4	4	0	0.000478	0.000071	0.0000353
0.8 meq/L	4	0	0.000394	0.000080	0.0000400
4.2 meq/L	4	0	0.000403	0.000063	0.0000312
19.8 meq/L	4	0	0.000373	0.000074	0.0000369
51.1 meq/L	4	0	0.000422	0.000114	0.0000571
103.2 meq/L	4	0	0.000403	0.000049	0.0000247

Source of Variation	DF	SS	MS	F	P
Between Groups	11	0.000000453	0.0000000412	3.819	0.001
Residual	36	0.000000388	0.0000000108		
Total	47	0.000000841			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.001).

Power of performed test with alpha = 0.050: 0.942

Multiple Comparisons versus Control Group (Bonferroni t-test):

Comparisons for factor:

Comparison	Diff of Means	t	P	P<0.050
HS-1 vs. 250 mg/L SO4	0.000258	3.516	0.013	Yes
HS-1 vs. 100 mg B/L	0.000173	2.36	0.262	No
HS-1 vs. 19.8 meq/L	0.0000827	1.126	1	Do Not Test
HS-1 vs. 0.8 meq/L	0.0000608	0.828	1	Do Not Test
HS-1 vs. 103.2 meq/L	0.0000525	0.714	1	Do Not Test
HS-1 vs. 4.2 meq/L	0.0000521	0.709	1	Do Not Test
HS-1 vs. 51.1 meq/L	0.0000328	0.446	1	Do Not Test
HS-1 vs. 1000 mg/L SO4	0.0000231	0.314	1	Do Not Test
HS-1 vs. 5000 mg/L SO4	0.0000229	0.312	1	Do Not Test
HS-1 vs. 2500 mg/L SO4	0.0000148	0.202	1	Do Not Test
HS-1 vs. 10 mg/L SO4	0.0000127	0.173	1	Do Not Test

Descriptive Statistics:

Data source: SD 10 Shoot Length in 00325_SD 10_101613

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	3.783	0.464	0.232	0.739
100 mg B/L	4	0	2.875	0.384	0.192	0.611
10 mg/L SO4	4	0	4.148	0.409	0.204	0.65
250 mg/L SO4	4	0	3.599	0.327	0.163	0.52
1000 mg/L SO4	4	0	3.333	0.264	0.132	0.42
2500 mg/L SO4	4	0	2.915	0.356	0.178	0.566
5000 mg/L SO4	4	0	2.242	0.091	0.0455	0.145
0.8 meq/L	4	0	2.311	0.227	0.114	0.362
4.2 meq/L	4	0	2.7	0.152	0.0758	0.241
19.8 meq/L	4	0	2.188	0.214	0.107	0.341
51.1 meq/L	4	0	2.54	0.266	0.133	0.423
103.2 meq/L	4	0	2.095	0.203	0.102	0.323

Column	Range	Max	Min	Median	25%	75%
HS-1	1.1	4.236	3.136	3.88	3.487	4.079
100 mg B/L	0.82	3.445	2.625	2.716	2.647	3.104
10 mg/L SO4	0.93	4.685	3.756	4.075	3.838	4.457
250 mg/L SO4	0.744	3.988	3.244	3.582	3.341	3.858
1000 mg/L SO4	0.59	3.7	3.11	3.26	3.143	3.523
2500 mg/L SO4	0.813	3.329	2.516	2.907	2.633	3.196
5000 mg/L SO4	0.206	2.319	2.114	2.268	2.18	2.305
0.8 meq/L	0.451	2.552	2.101	2.295	2.117	2.504
4.2 meq/L	0.279	2.848	2.569	2.692	2.57	2.831
19.8 meq/L	0.504	2.48	1.976	2.147	2.039	2.336
51.1 meq/L	0.651	2.87	2.219	2.535	2.372	2.708
103.2 meq/L	0.475	2.284	1.81	2.143	1.961	2.229

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	-1.168	2.145	0.297	0.235	0.917	0.522
100 mg B/L	1.87	3.534	0.365	0.066	0.758	0.046
10 mg/L SO4	0.821	-0.361	0.211	0.597	0.951	0.723
250 mg/L SO4	0.228	-1.863	0.19	0.661	0.978	0.893
1000 mg/L SO4	1.258	1.082	0.232	0.511	0.898	0.421
2500 mg/L SO4	0.0999	-1.869	0.178	0.687	0.982	0.916
5000 mg/L SO4	-1.392	1.841	0.266	0.361	0.89	0.383
0.8 meq/L	0.131	-5.055	0.283	0.292	0.853	0.237
4.2 meq/L	0.0434	-5.749	0.304	0.211	0.784	0.076
19.8 meq/L	1.007	1.345	0.241	0.47	0.949	0.713
51.1 meq/L	0.101	1.473	0.241	0.473	0.958	0.769
103.2 meq/L	-1.272	2.088	0.285	0.283	0.914	0.504

Column	Sum	Sum of Squares
HS-1	15.133	57.899
100 mg B/L	11.502	33.514
10 mg/L SO4	16.592	69.321
250 mg/L SO4	14.397	52.14
1000 mg/L SO4	13.331	44.64
2500 mg/L SO4	11.659	34.362
5000 mg/L SO4	8.97	20.138
0.8 meq/L	9.242	21.51
4.2 meq/L	10.801	29.234
19.8 meq/L	8.75	19.28
51.1 meq/L	10.159	26.011
103.2 meq/L	8.381	17.683

One Way Analysis of Variance

Data source: SD 10-Shoot Length in 00325_SD 10_101613

Normality Test (Shapiro-Wilk) Passed (P = 0.757)

Equal Variance Test: Passed (P = 0.755)

Group Name	N	Missing	Mean	Std Dev	SEM
HS-1	4	0	3.783	0.464	0.232
100 mg B/L	4	0	2.875	0.384	0.192
10 mg/L SO4	4	0	4.148	0.409	0.204
250 mg/L SO4	4	0	3.599	0.327	0.163
1000 mg/L SO4	4	0	3.333	0.264	0.132
2500 mg/L SO4	4	0	2.915	0.356	0.178
5000 mg/L SO4	4	0	2.242	0.0910	0.0455
0.8 meq/L	4	0	2.311	0.227	0.114
4.2 meq/L	4	0	2.700	0.152	0.0758
19.8 meq/L	4	0	2.188	0.214	0.107
51.1 meq/L	4	0	2.540	0.266	0.133
103.2 meq/L	4	0	2.095	0.203	0.102

Source of Variation	DF	SS	MS	F	P
Between Groups	11	20.476	1.861	20.799	<0.001
Residual	36	3.222	0.0895		
Total	47	23.698			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

Multiple Comparisons versus Control Group (Bonferroni t-test):

Comparisons for factor:

Comparison	Diff of Means	t	P	P<0.050
HS-1 vs. 103.2 meq/L	1.688	7.98	<0.001	Yes
HS-1 vs. 19.8 meq/L	1.596	7.543	<0.001	Yes
HS-1 vs. 5000 mg/L SO4	1.541	7.284	<0.001	Yes
HS-1 vs. 0.8 meq/L	1.473	6.962	<0.001	Yes
HS-1 vs. 51.1 meq/L	1.244	5.879	<0.001	Yes
HS-1 vs. 4.2 meq/L	1.083	5.12	<0.001	Yes
HS-1 vs. 100 mg B/L	0.908	4.292	0.001	Yes
HS-1 vs. 2500 mg/L SO4	0.869	4.106	0.002	Yes
HS-1 vs. 1000 mg/L SO4	0.45	2.129	0.442	No
HS-1 vs. 10 mg/L SO4	0.365	1.724	1	Do Not Test
HS-1 vs. 250 mg/L SO4	0.184	0.87	1	Do Not Test

Descriptive Statistics:

Data source: SD 10 Root Length in 00325_SD 10_101613

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	3.977	0.981	0.491	1.561
100 mg B/L	4	0	1.908	0.453	0.226	0.720
10 mg/L SO4	4	0	3.929	0.073	0.037	0.117
250 mg/L SO4	4	0	4.226	1.205	0.603	1.918
1000 mg/L SO4	4	0	3.640	0.533	0.266	0.848
2500 mg/L SO4	4	0	3.362	0.710	0.355	1.130
5000 mg/L SO4	4	0	2.076	0.417	0.209	0.664
0.8 meq/L	4	0	3.364	0.469	0.235	0.747
4.2 meq/L	4	0	4.320	0.550	0.275	0.875
19.8 meq/L	4	0	2.792	0.848	0.424	1.349
51.1 meq/L	4	0	3.217	0.562	0.281	0.893
103.2 meq/L	4	0	2.051	0.083	0.041	0.131

Column	Range	Max	Min	Median	25%	75%
HS-1	2.182	5.368	3.187	3.677	3.296	4.659
100 mg B/L	0.984	2.229	1.245	2.080	1.623	2.194
10 mg/L SO4	0.151	3.996	3.846	3.938	3.868	3.991
250 mg/L SO4	2.529	5.672	3.144	4.043	3.235	5.216
1000 mg/L SO4	1.141	4.082	2.942	3.769	3.225	4.056
2500 mg/L SO4	1.608	4.023	2.416	3.505	2.828	3.896
5000 mg/L SO4	0.981	2.551	1.570	2.091	1.759	2.392
0.8 meq/L	1.035	4.047	3.013	3.197	3.062	3.665
4.2 meq/L	1.109	4.799	3.689	4.395	3.859	4.780
19.8 meq/L	2.017	3.637	1.620	2.956	2.245	3.340
51.1 meq/L	1.300	3.709	2.409	3.375	2.885	3.549
103.2 meq/L	0.186	2.166	1.980	2.028	1.993	2.109

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk.W	SWilk Prob
HS-1	1.419	1.755	0.261	0.381	0.875	0.318
100 mg B/L	-1.747	3.071	0.331	0.131	0.803	0.108
10 mg/L SO4	-0.290	-4.150	0.277	0.314	0.882	0.346
250 mg/L SO4	0.452	-3.253	0.272	0.335	0.896	0.413
1000 mg/L SO4	-0.874	-1.115	0.267	0.357	0.890	0.381
2500 mg/L SO4	-0.918	-0.119	0.217	0.574	0.940	0.655
5000 mg/L SO4	-0.186	-0.615	0.147	0.709	0.996	0.986
0.8 meq/L	1.679	2.854	0.319	0.164	0.827	0.161
4.2 meq/L	-0.316	-4.165	0.289	0.265	0.862	0.269
19.8 meq/L	-1.084	1.993	0.286	0.277	0.929	0.586
51.1 meq/L	-1.510	2.824	0.351	0.097	0.853	0.237
103.2 meq/L	1.307	1.463	0.248	0.439	0.901	0.434

Column	Sum	Sum of Squares
HS-1	15.909	66.166
100 mg B/L	7.634	15.183
10 mg/L SO4	15.717	61.773
250 mg/L SO4	16.902	75.780
1000 mg/L SO4	14.562	53.862
2500 mg/L SO4	13.449	46.732
5000 mg/L SO4	8.303	17.757
0.8 meq/L	13.454	45.914
4.2 meq/L	17.279	75.543
19.8 meq/L	11.170	33.347
51.1 meq/L	12.868	42.342
103.2 meq/L	8.202	16.839

One Way Analysis of Variance

Data source: SD 10 Root Length in 00325_SD 10_101613

Normality Test (Shapiro-Wilk) Passed (P = 0.336)

Equal Variance Test: Passed (P = 0.090)

Group Name	N	Missing	Mean	Std Dev	SEM
HS-1	4	0	3.977	0.981	0.491
100 mg B/L	4	0	1.908	0.453	0.226
10 mg/L SO4	4	0	3.929	0.073	0.037
250 mg/L SO4	4	0	4.226	1.205	0.603
1000 mg/L SO4	4	0	3.640	0.533	0.266
2500 mg/L SO4	4	0	3.362	0.710	0.355
5000 mg/L SO4	4	0	2.076	0.417	0.209
0.8 meq/L	4	0	3.364	0.469	0.235
4.2 meq/L	4	0	4.320	0.550	0.275
19.8 meq/L	4	0	2.792	0.848	0.424
51.1 meq/L	4	0	3.217	0.562	0.281
103.2 meq/L	4	0	2.051	0.083	0.041

Source of Variation	DF	SS	MS	F	P
Between Groups	11	32.362	2.942	6.853	<0.001
Residual	36	15.455	0.429		
Total	47	47.817			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

Multiple Comparisons versus Control Group (Bonferroni t-test):

Comparisons for factor:

Comparison	Diff of Means	t	P	P<0.050
HS-1 vs. 100 mg B/L	2.069	4.466	<0.001	Yes
HS-1 vs. 103.2 meq/L	1.927	4.159	0.002	Yes
HS-1 vs. 5000 mg/L SO4	1.902	4.105	0.002	Yes
HS-1 vs. 19.8 meq/L	1.185	2.558	0.164	No
HS-1 vs. 51.1 meq/L	0.76	1.641	1	Do Not Test
HS-1 vs. 2500 mg/L SO4	0.615	1.328	1	Do Not Test
HS-1 vs. 0.8 meq/L	0.614	1.325	1	Do Not Test
HS-1 vs. 4.2 meq/L	0.342	0.739	1	Do Not Test
HS-1 vs. 1000 mg/L SO4	0.337	0.727	1	Do Not Test
HS-1 vs. 250 mg/L SO4	0.248	0.536	1	Do Not Test
HS-1 vs. 10 mg/L SO4	0.0481	0.104	1	Do Not Test

Descriptive Statistics:

Data source: SD 21 Emergence in 00325_SD 21_101613

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	0.383	0.043	0.022	0.068
100 mg B/L	4	0	0.192	0.050	0.025	0.080
10 mg/L SO4	4	0	0.458	0.189	0.095	0.301
250 mg/L SO4	4	0	0.450	0.189	0.095	0.301
1000 mg/L SO4	4	0	0.583	0.181	0.091	0.288
2500 mg/L SO4	4	0	0.734	0.122	0.061	0.194
5000 mg/L SO4	4	0	0.550	0.140	0.070	0.223
0.8 meq/L	4	0	0.292	0.057	0.029	0.091
4.2 meq/L	4	0	0.359	0.113	0.057	0.180
19.8 meq/L	4	0	0.375	0.100	0.050	0.158
51.1 meq/L	4	0	0.508	0.153	0.076	0.243
103.2 meq/L	4	0	0.342	0.057	0.028	0.091

Column	Range	Max	Min	Median	25%	75%
HS-1	0.100	0.433	0.333	0.384	0.350	0.416
100 mg B/L	0.100	0.267	0.167	0.167	0.167	0.217
10 mg/L SO4	0.433	0.733	0.300	0.400	0.350	0.567
250 mg/L SO4	0.400	0.733	0.333	0.367	0.350	0.550
1000 mg/L SO4	0.366	0.733	0.367	0.617	0.434	0.733
2500 mg/L SO4	0.267	0.867	0.600	0.734	0.633	0.834
5000 mg/L SO4	0.333	0.700	0.367	0.567	0.450	0.650
0.8 meq/L	0.134	0.367	0.233	0.283	0.250	0.334
4.2 meq/L	0.233	0.500	0.267	0.334	0.267	0.450
19.8 meq/L	0.233	0.500	0.267	0.367	0.300	0.450
51.1 meq/L	0.334	0.667	0.333	0.516	0.383	0.633
103.2 meq/L	0.133	0.400	0.267	0.350	0.300	0.384

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	-0.028	-1.156	0.152	0.710	0.993	0.974
100 mg B/L	2.000	4.000	0.441	0.006	0.630	0.001
10 mg/L SO4	1.614	3.037	0.371	0.057	0.825	0.156
250 mg/L SO4	1.956	3.866	0.419	0.013	0.703	0.012
1000 mg/L SO4	-0.445	-3.489	0.296	0.241	0.855	0.243
2500 mg/L SO4	0.000	-3.278	0.207	0.608	0.950	0.718
5000 mg/L SO4	-0.640	0.690	0.202	0.628	0.980	0.902
0.8 meq/L	0.746	0.371	0.193	0.655	0.972	0.855
4.2 meq/L	0.630	-2.482	0.290	0.261	0.863	0.271
19.8 meq/L	0.430	-0.431	0.164	0.707	0.988	0.950
51.1 meq/L	-0.194	-3.205	0.226	0.537	0.946	0.691
103.2 meq/L	-0.742	0.272	0.189	0.665	0.972	0.852

Column	Sum	Sum of Squares
HS-1	1.533	0.593
100 mg B/L	0.768	0.155
10 mg/L SO4	1.833	0.947
250 mg/L SO4	1.800	0.918
1000 mg/L SO4	2.333	1.459
2500 mg/L SO4	2.934	2.197
5000 mg/L SO4	2.200	1.269
0.8 meq/L	1.167	0.350
4.2 meq/L	1.434	0.553
19.8 meq/L	1.500	0.592
51.1 meq/L	2.033	1.103
103.2 meq/L	1.367	0.477

One Way Analysis of Variance

Data source: SD 21 Emergence in 00325_SD 21_101613

Normality Test (Shapiro-Wilk) Passed (P = 0.267)

Equal Variance Test: Passed (P = 0.562)

Group Name	N	Missing	Mean	Std Dev.	SEM
asinsqrt(col(1))	4	0	0.667	0.044	0.0222
asinsqrt(col(2))	4	0	0.451	0.061	0.0305
asinsqrt(col(3))	4	0	0.744	0.195	0.0977
asinsqrt(col(4))	4	0	0.736	0.195	0.0976
asinsqrt(col(5))	4	0	0.873	0.187	0.0935
asinsqrt(col(6))	4	0	1.037	0.142	0.0708
asinsqrt(col(7))	4	0	0.837	0.143	0.0714
asinsqrt(col(8))	4	0	0.569	0.063	0.0313
asinsqrt(col(9))	4	0	0.639	0.118	0.0591
asinsqrt(col(10))	4	0	0.657	0.103	0.0516
asinsqrt(col(11))	4	0	0.794	0.155	0.0777
asinsqrt(col(12))	4	0	0.623	0.061	0.0303

Source of Variation	DF	SS	MS	F	P
Between Groups	11	1.044	0.0949	5.327	<0.001
Residual	36	0.641	0.0178		
Total	47	1.685			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 0.996

Multiple Comparisons versus Control Group (Bonferroni t-test):

Comparisons for factor:

Comparison	Diff of Means	t	P	P<0.050
asinsqrt(col vs. asinsqrt(col	0.369	3.914	0.004	Yes
asinsqrt(col vs. asinsqrt(col	0.216	2.286	0.311	No
asinsqrt(col vs. asinsqrt(col	0.206	2.18	0.395	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.169	1.795	0.891	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.127	1.341	1.000	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.0979	1.038	1.000	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.077	0.816	1.000	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.0689	0.73	1.000	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.0438	0.464	1.000	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.0282	0.298	1.000	Do Not Test
asinsqrt(col vs. asinsqrt(col	0.0101	0.107	1.000	Do Not Test

Descriptive Statistics:

Data source: SD 21 Leaf Biomass in 00325_SD 21_101613

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	0.00546	0.000449	0.000224	0.000714
100 mg B/L	4	0	0.0031	0.00103	0.000517	0.00165
10 mg/L SO4	4	0	0.00693	0.000698	0.000349	0.00111
250 mg/L SO4	4	0	0.00688	0.000569	0.000285	0.000906
1000 mg/L SO4	4	0	0.00682	0.000915	0.000457	0.00146
2500 mg/L SO4	4	0	0.00653	0.000855	0.000428	0.00136
5000 mg/L SO4	4	0	0.00487	0.00077	0.000385	0.00122
0.8 meq/L	4	0	0.0063	0.00119	0.000597	0.0019
4.2 meq/L	4	0	0.00701	0.00158	0.000789	0.00251
19.8 meq/L	4	0	0.00595	0.000985	0.000493	0.00157
51.1 meq/L	4	0	0.00697	0.000931	0.000466	0.00148
103.2 meq/L	4	0	0.00849	0.00262	0.00131	0.00416

Column	Range	Max	Min	Median	25%	75%
HS-1	0.000932	0.00584	0.00491	0.00554	0.00509	0.00583
100 mg B/L	0.00235	0.00418	0.00183	0.00319	0.00228	0.00392
10 mg/L SO4	0.00125	0.00757	0.00632	0.00693	0.00633	0.00754
250 mg/L SO4	0.00139	0.00757	0.00618	0.00688	0.00651	0.00724
1000 mg/L SO4	0.00219	0.00804	0.00585	0.0067	0.0062	0.00745
2500 mg/L SO4	0.00197	0.00732	0.00535	0.00673	0.00593	0.00714
5000 mg/L SO4	0.00165	0.00544	0.00378	0.00513	0.00432	0.00541
0.8 meq/L	0.00264	0.0074	0.00476	0.00652	0.00537	0.00724
4.2 meq/L	0.00306	0.0085	0.00544	0.00706	0.00566	0.00837
19.8 meq/L	0.00201	0.00712	0.00511	0.00578	0.00514	0.00677
51.1 meq/L	0.00216	0.00808	0.00591	0.00694	0.00625	0.00769
103.2 meq/L	0.00579	0.0118	0.00606	0.00802	0.00644	0.0105

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	-0.529	-2.982	0.282	0.293	0.88	0.339
100 mg B/L	-0.39	-1.715	0.203	0.624	0.971	0.85
10 mg/L SO4	0.00538	-5.953	0.301	0.222	0.761	0.048
250 mg/L SO4	-0.00716	1.436	0.228	0.529	0.964	0.803
1000 mg/L SO4	0.743	1.334	0.238	0.485	0.967	0.82
2500 mg/L SO4	-1.147	1.207	0.236	0.494	0.931	0.597
5000 mg/L SO4	-1.392	1.409	0.252	0.421	0.845	0.209
0.8 meq/L	-0.745	-1.309	0.24	0.474	0.931	0.601
4.2 meq/L	-0.043	-5.473	0.28	0.3	0.835	0.18
19.8 meq/L	0.432	-3.538	0.289	0.267	0.868	0.288
51.1 meq/L	0.139	-1.149	0.16	0.709	0.992	0.968
103.2 meq/L	0.725	-1.366	0.239	0.481	0.934	0.616

Column	.Sum	Sum of Squares
HS-1	0.0218	0.00012
100 mg B/L	0.0124	0.0000416
10 mg/L SO4	0.0277	0.000194
250 mg/L SO4	0.0275	0.00019
1000 mg/L SO4	0.0273	0.000189
2500 mg/L SO4	0.0261	0.000173
5000 mg/L SO4	0.0195	0.0000965
0.8 meq/L	0.0252	0.000163
4.2 meq/L	0.0281	0.000204
19.8 meq/L	0.0238	0.000145
51.1 meq/L	0.0279	0.000197
103.2 meq/L	0.034	0.000309

One Way Analysis of Variance

Data source: SD 21 Leaf Biomass In 00325_SD 21_101613

Normality Test (Shapiro-Wilk) Passed (P = 0.265)

Equal Variance Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: SD 21 Leaf Biomass in 00325_SD 21_101613

Group	N	Missing	Median	25%	75%
HS-1	4	0	0.00554	0.005	0.00583
100 mg B/L	4	0	0.00319	0.00206	0.00405
10 mg/L SO4	4	0	0.00693	0.00632	0.00755
250 mg/L SO4	4	0	0.00688	0.00635	0.00741
1000 mg/L SO4	4	0	0.0067	0.00602	0.00774
2500 mg/L SO4	4	0	0.00673	0.00564	0.00723
5000 mg/L SO4	4	0	0.00513	0.00405	0.00542
0.8 meq/L	4	0	0.00652	0.00507	0.00732
4.2 meq/L	4	0	0.00706	0.00555	0.00843
19.8 meq/L	4	0	0.00578	0.00512	0.00694
51.1 meq/L	4	0	0.00694	0.00608	0.00788
103.2 meq/L	4	0	0.00802	0.00625	0.0112

H = 26.046 with 11 degrees of freedom. (P = 0.006)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.006)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

Multiple Comparisons versus Control Group (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
103.2 meq/L vs HS-1	23.75	2.399	No
51.1 meq/L vs HS-1	19.5	1.97	Do Not Test
10 mg/L SO4 vs HS-1	19.5	1.97	Do Not Test
250 mg/L SO4 vs HS-1	19.25	1.945	Do Not Test
4.2 meq/L vs HS-1	18.25	1.844	Do Not Test
1000 mg/L SO4 vs HS-1	17.25	1.743	Do Not Test
2500 mg/L SO4 vs HS-1	14.75	1.49	Do Not Test
0.8 meq/L vs HS-1	12.25	1.237	Do Not Test
100 mg B/L vs HS-1	10.25	1.035	Do Not Test
19.8 meq/L vs HS-1	7.25	0.732	Do Not Test
5000 mg/L SO4 vs HS-1	3.5	0.354	Do Not Test

Descriptive Statistics:

Data source: SD 21 Leaf Number in 00325_SD 21_101613

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	3.614	0.501	0.250	0.796
100 mg B/L	4	0	2.712	0.995	0.498	1.584
10 mg/L SO4	4	0	3.769	0.170	0.085	0.270
250 mg/L SO4	4	0	3.873	0.290	0.145	0.462
1000 mg/L SO4	4	0	3.452	0.126	0.063	0.200
2500 mg/L SO4	4	0	3.159	0.204	0.102	0.325
5000 mg/L SO4	4	0	2.569	0.247	0.124	0.394
0.8 meq/L	4	0	3.382	0.261	0.131	0.416
4.2 meq/L	4	0	2.919	0.375	0.188	0.597
19.8 meq/L	4	0	3.056	0.158	0.079	0.252
51.1 meq/L	4	0	3.257	0.243	0.122	0.387
103.2 meq/L	4	0	2.881	0.210	0.105	0.334

Column	Range	Max	Min	Median	0.250	0.750
HS-1	1.173	4.250	3.077	3.564	3.238	3.989
100 mg B/L	2.200	3.800	1.600	2.725	1.900	3.525
10 mg/L SO4	0.333	3.917	3.583	3.788	3.625	3.913
250 mg/L SO4	0.636	4.091	3.455	3.973	3.677	4.068
1000 mg/L SO4	0.273	3.545	3.273	3.494	3.364	3.539
2500 mg/L SO4	0.444	3.333	2.889	3.208	3.002	3.317
5000 mg/L SO4	0.576	2.889	2.313	2.537	2.384	2.754
0.8 meq/L	0.556	3.556	3.000	3.487	3.214	3.551
4.2 meq/L	0.842	3.467	2.625	2.792	2.688	3.150
19.8 meq/L	0.367	3.200	2.833	3.096	2.950	3.163
51.1 meq/L	0.515	3.615	3.100	3.156	3.106	3.408
103.2 meq/L	0.467	3.167	2.700	2.830	2.725	3.038

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	0.505	-0.262	0.165	0.705	0.986	0.934
100 mg B/L	-0.0474	-3.028	0.205	0.615	0.957	0.761
10 mg/L SO4	-0.203	-4.821	0.296	0.242	0.840	0.196
250 mg/L SO4	-1.567	2.305	0.287	0.273	0.842	0.201
1000 mg/L SO4	-1.452	1.722	0.260	0.389	0.847	0.216
2500 mg/L SO4	-0.927	-0.731	0.254	0.412	0.903	0.446
5000 mg/L SO4	0.643	-0.175	0.178	0.688	0.976	0.879
0.8 meq/L	-1.728	2.925	0.320	0.161	0.786	0.079
4.2 meq/L	1.688	3.061	0.340	0.111	0.831	0.170
19.8 meq/L	-1.307	1.987	0.276	0.318	0.911	0.487
51.1 meq/L	1.808	3.261	0.342	0.107	0.767	0.055
103.2 meq/L	1.078	0.211	0.234	0.501	0.911	0.488

Column	Sum	Sum of Squares
HS-1	14.454	52.983
100 mg B/L	10.850	32.403
10 mg/L SO4	15.076	56.906
250 mg/L SO4	15.491	60.245
1000 mg/L SO4	13.806	47.699
2500 mg/L SO4	12.638	40.052
5000 mg/L SO4	10.275	26.578
0.8 meq/L	13.530	45.967
4.2 meq/L	11.675	34.499
19.8 meq/L	12.225	37.438
51.1 meq/L	13.026	42.600
103.2 meq/L	11.526	33.343

One Way Analysis of Variance

Data source: SD 21 Leaf Number In 00325_SD 21_101613

Normality Test (Shapiro-Wilk) Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: SD 21 Leaf Number In 00325_SD 21_101613

Group	N	Missing	Median	25%	75%
HS-1	4	0	3.564	3.158	4.119
100 mg B/L	4	0	2.725	1.750	3.662
10 mg/L SO4	4	0	3.788	3.604	3.915
250 mg/L SO4	4	0	3.973	3.566	4.080
1000 mg/L SO4	4	0	3.494	3.318	3.542
2500 mg/L SO4	4	0	3.208	2.946	3.325
5000 mg/L SO4	4	0	2.537	2.348	2.821
0.8 meq/L	4	0	3.487	3.107	3.553
4.2 meq/L	4	0	2.792	2.656	3.308
19.8 meq/L	4	0	3.096	2.892	3.181
51.1 meq/L	4	0	3.156	3.103	3.512
103.2 meq/L	4	0	2.830	2.713	3.102

H = 29.310 with 11 degrees of freedom. (P = 0.002)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.002)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

Multiple Comparisons versus Control Group (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
5000 mg/L SO4 vs HS-1	27.625	2.791	No
103.2 meq/L vs HS-1	20.875	2.109	Do Not Test
4.2 meq/L vs HS-1	19.250	1.945	Do Not Test
100 mg B/L vs HS-1	16.250	1.641	Do Not Test
19.8 meq/L vs HS-1	16.000	1.616	Do Not Test
2500 mg/L SO4 vs HS-1	11.875	1.200	Do Not Test
51.1 meq/L vs HS-1	8.875	0.897	Do Not Test
250 mg/L SO4 vs HS-1	8.125	0.821	Do Not Test
10 mg/L SO4 vs HS-1	8.000	0.808	Do Not Test
0.8 meq/L vs HS-1	4.375	0.442	Do Not Test
1000 mg/L SO4 vs HS-1	2.000	0.202	Do Not Test

Descriptive Statistics:

Data source: SD 21 Phytotoxicity in 00325_SD 21_101613

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	0.000	0.000	0.000	0.000
100 mg B/L	4	0	1.000	0.000	0.000	0.000
10 mg/L SO4	4	0	0.000	0.000	0.000	0.000
250 mg/L SO4	4	0	0.000	0.000	0.000	0.000
1000 mg/L SO4	4	0	0.000	0.000	0.000	0.000
2500 mg/L SO4	4	0	0.000	0.000	0.000	0.000
5000 mg/L SO4	4	0	0.895	0.016	0.008	0.025
0.8 meq/L	4	0	0.000	0.000	0.000	0.000
4.2 meq/L	4	0	0.000	0.000	0.000	0.000
19.8 meq/L	4	0	0.000	0.000	0.000	0.000
51.1 meq/L	4	0	0.000	0.000	0.000	0.000
103.2 meq/L	4	0	1.000	0.000	0.000	0.000

Column	Range	Max	Min	Median	25%	75%
HS-1	0.000	0.000	0.000	0.000	0.000	0.000
100 mg B/L	0.000	1.000	1.000	1.000	1.000	1.000
10 mg/L SO4	0.000	0.000	0.000	0.000	0.000	0.000
250 mg/L SO4	0.000	0.000	0.000	0.000	0.000	0.000
1000 mg/L SO4	0.000	0.000	0.000	0.000	0.000	0.000
2500 mg/L SO4	0.000	0.000	0.000	0.000	0.000	0.000
5000 mg/L SO4	0.034	0.909	0.875	0.897	0.882	0.907
0.8 meq/L	0.000	0.000	0.000	0.000	0.000	0.000
4.2 meq/L	0.000	0.000	0.000	0.000	0.000	0.000
19.8 meq/L	0.000	0.000	0.000	0.000	0.000	0.000
51.1 meq/L	0.000	0.000	0.000	0.000	0.000	0.000
103.2 meq/L	0.000	1.000	1.000	1.000	1.000	1.000

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	0.000	-6.000	0.000	<0.001	0.000	<0.001
100 mg B/L	0.000	-6.000	0.000	<0.001	0.000	<0.001
10 mg/L SO4	0.000	-6.000	0.000	<0.001	0.000	<0.001
250 mg/L SO4	0.000	-6.000	0.000	<0.001	0.000	<0.001
1000 mg/L SO4	0.000	-6.000	0.000	<0.001	0.000	<0.001
2500 mg/L SO4	0.000	-6.000	0.000	<0.001	0.000	<0.001
5000 mg/L SO4	-0.592	-2.167	0.249	0.435	0.927	0.576
0.8 meq/L	0.000	-6.000	0.000	<0.001	0.000	<0.001
4.2 meq/L	0.000	-6.000	0.000	<0.001	0.000	<0.001
19.8 meq/L	0.000	-6.000	0.000	<0.001	0.000	<0.001
51.1 meq/L	0.000	-6.000	0.000	<0.001	0.000	<0.001
103.2 meq/L	0.000	-6.000	0.000	<0.001	0.000	<0.001

Column	Sum	Sum of Squares
HS-1	0.000	0.000
100 mg B/L	4.000	4.000
10 mg/L SO4	0.000	0.000
250 mg/L SO4	0.000	0.000
1000 mg/L SO4	0.000	0.000
2500 mg/L SO4	0.000	0.000
5000 mg/L SO4	3.578	3.201
0.8 meq/L	0.000	0.000
4.2 meq/L	0.000	0.000
19.8 meq/L	0.000	0.000
51.1 meq/L	0.000	0.000
103.2 meq/L	4.000	4.000

One Way Analysis of Variance

Data source: SD 21 Phytotoxicity In 00325_SD 21_101613

Normality Test (Shapiro-Wilk) Failed (P < 0.050)

Equal Variance Test: Failed (P < 0.050)

Group Name	N	Missing	Mean	Std Dev	SEM
HS-1	4	0	0.000	0.000	0.000
asinsqrt(col(2))	4	0	1.571	0.000	0.000
10 mg/L SO4	4	0	0.000	0.000	0.000
250 mg/L SO4	4	0	0.000	0.000	0.000
1000 mg/L SO4	4	0	0.000	0.000	0.000
2500 mg/L SO4	4	0	0.000	0.000	0.000
asinsqrt(col(7))	4	0	1.241	0.025	0.013
0.8 meq/L	4	0	0.000	0.000	0.000
4.2 meq/L	4	0	0.000	0.000	0.000
19.8 meq/L	4	0	0.000	0.000	0.000
51.1 meq/L	4	0	0.000	0.000	0.000
asinsqrt(col(12))	4	0	1.571	0.000	0.000

Source of Variation	DF	SS	MS	F	P
Between Groups	11	19.494	1.772	33394.25	<0.001
Residual	36	0.00191	0.0000531		
Total	47	19.496			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

Multiple Comparisons versus Control Group (Bonferroni t-test):

Comparisons for factor:

Comparison	Diff of Means	t	P	P<0.050
HS-1 vs. asinsqrt(col(2))	1.571	304.939	<0.001	Yes
HS-1 vs. asinsqrt(col(12))	1.571	304.939	<0.001	Yes
HS-1 vs. asinsqrt(col(7))	1.241	240.838	<0.001	Yes
HS-1 vs. 0.8 meq/L	0.000	0.000	1.000	No
HS-1 vs. 51.1 meq/L	0.000	0.000	1.000	Do Not Test
HS-1 vs. 19.8 meq/L	0.000	0.000	1.000	Do Not Test
HS-1 vs. 4.2 meq/L	0.000	0.000	1.000	Do Not Test
HS-1 vs. 2500 mg/L SO4	0.000	0.000	1.000	Do Not Test
HS-1 vs. 250 mg/L SO4	0.000	0.000	1.000	Do Not Test
HS-1 vs. 10 mg/L SO4	0.000	0.000	1.000	Do Not Test
HS-1 vs. 1000 mg/L SO4	0.000	0.000	1.000	Do Not Test

Descriptive Statistics:

Data source: SD 21 Shoot Biomass in 00325_SD 21_101613

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	0.00235	0.00036	0.00018	0.00057
100 mg B/L	4	0	0.00284	0.00070	0.00035	0.00112
10 mg/L SO4	4	0	0.00225	0.00030	0.00015	0.00048
250 mg/L SO4	4	0	0.00230	0.00033	0.00016	0.00052
1000 mg/L SO4	4	0	0.00242	0.00026	0.00013	0.00041
2500 mg/L SO4	4	0	0.00272	0.00035	0.00018	0.00056
5000 mg/L SO4	4	0	0.00363	0.00057	0.00028	0.00090
0.8 meq/L	4	0	0.00145	0.00007	0.00004	0.00012
4.2 meq/L	4	0	0.00169	0.00014	0.00007	0.00023
19.8 meq/L	4	0	0.00160	0.00027	0.00013	0.00043
51.1 meq/L	4	0	0.00196	0.00036	0.00018	0.00057
103.2 meq/L	4	0	0.00285	0.00111	0.00056	0.00177

Column	Range	Max	Min	Median	25%	75%
HS-1	0.00078	0.00274	0.00195	0.00236	0.00206	0.00265
100 mg B/L	0.00168	0.00356	0.00188	0.00297	0.00240	0.00329
10 mg/L SO4	0.00070	0.00256	0.00186	0.00230	0.00202	0.00248
250 mg/L SO4	0.00075	0.00276	0.00201	0.00222	0.00207	0.00253
1000 mg/L SO4	0.00056	0.00279	0.00223	0.00232	0.00226	0.00257
2500 mg/L SO4	0.00078	0.00324	0.00247	0.00259	0.00252	0.00292
5000 mg/L SO4	0.00126	0.00441	0.00315	0.00349	0.00322	0.00405
0.8 meq/L	0.00018	0.00153	0.00136	0.00145	0.00140	0.00149
4.2 meq/L	0.00030	0.00179	0.00148	0.00175	0.00160	0.00179
19.8 meq/L	0.00061	0.00198	0.00138	0.00152	0.00142	0.00178
51.1 meq/L	0.00085	0.00246	0.00161	0.00189	0.00172	0.00220
103.2 meq/L	0.00257	0.00445	0.00188	0.00253	0.00215	0.00355

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	-0.097	-3.233	0.216	0.577	0.950	0.717
100 mg B/L	-1.001	1.966	0.289	0.265	0.930	0.597
10 mg/L SO4	-0.682	-0.562	0.198	0.638	0.966	0.818
250 mg/L SO4	1.266	1.526	0.251	0.426	0.913	0.500
1000 mg/L SO4	1.770	3.218	0.344	0.102	0.803	0.108
2500 mg/L SO4	1.819	3.481	0.379	0.045	0.782	0.074
5000 mg/L SO4	1.128	0.437	0.233	0.507	0.907	0.465
0.8 meq/L	-0.292	1.528	0.257	0.401	0.953	0.734
4.2 meq/L	-1.729	2.922	0.320	0.162	0.776	0.065
19.8 meq/L	1.441	2.092	0.279	0.307	0.884	0.357
51.1 meq/L	1.112	1.878	0.274	0.326	0.932	0.609
103.2 meq/L	1.496	2.645	0.319	0.163	0.874	0.314

Column	Sum	Sum of Squares
HS-1	0.0094	0.0000226
100 mg B/L	0.01140	0.0000338
10 mg/L SO4	0.0090	0.0000206
250 mg/L SO4	0.0092	0.0000215
1000 mg/L SO4	0.00966	0.0000235
2500 mg/L SO4	0.01090	0.0000300
5000 mg/L SO4	0.01450	0.0000538
0.8 meq/L	0.00580	0.00000841
4.2 meq/L	0.00678	0.0000115
19.8 meq/L	0.00640	0.0000104
51.1 meq/L	0.00784	0.00001580
103.2 meq/L	0.01140	0.00003620

One Way Analysis of Variance

Data source: SD 21 Shoot Biomass in 00325_SD 21_101613

Normality Test (Shapiro-Wilk) Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: SD 21 Shoot Biomass in 00325_SD 21_101613

Group	N	Missing	Median	25%	75%
HS-1	4	0	0.00236	0.00201	0.00269
100 mg B/L	4	0	0.00297	0.00214	0.00343
10 mg/L SO4	4	0	0.00230	0.00194	0.00252
250 mg/L SO4	4	0	0.00222	0.00204	0.00265
1000 mg/L SO4	4	0	0.00232	0.00224	0.00268
2500 mg/L SO4	4	0	0.00259	0.00249	0.00308
5000 mg/L SO4	4	0	0.00349	0.00318	0.00423
0.8 meq/L	4	0	0.00145	0.00138	0.00151
4.2 meq/L	4	0	0.00175	0.00154	0.00179
19.8 meq/L	4	0	0.00152	0.00140	0.00188
51.1 meq/L	4	0	0.00189	0.00167	0.00233
103.2 meq/L	4	0	0.00253	0.00202	0.00400

H = 34.571 with 11 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

Multiple Comparisons versus Control Group (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
0.8 meq/L vs HS-1	23.5	2.374	No
19.8 meq/L vs HS-1	18.75	1.894	Do Not Test
4.2 meq/L vs HS-1	17.5	1.768	Do Not Test
5000 mg/L SO4 vs HS-1	17.500	1.768	Do Not Test
51.1 meq/L vs HS-1	10.000	1.01	Do Not Test
2500 mg/L SO4 vs HS-1	8.500	0.859	Do Not Test
100 mg B/L vs HS-1	8.000	0.808	Do Not Test
103.2 meq/L vs HS-1	4.750	0.480	Do Not Test
10 mg/L SO4 vs HS-1	2.500	0.253	Do Not Test
1000 mg/L SO4 vs HS-1	1.500	0.152	Do Not Test
250 mg/L SO4 vs HS-1	1.000	0.101	Do Not Test

Descriptive Statistics:

Data source: SD 21 Root Biomass in 00325_SD 21_101613

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	0.0004690	0.0001860	0.0000930	0.0002960
100 mg B/L	4	0	0.0003190	0.0000792	0.0000396	0.0001260
10 mg/L SO4	4	0	0.0005360	0.0000922	0.0000461	0.0001470
250 mg/L SO4	4	0	0.0006020	0.0001870	0.0000936	0.0002980
1000 mg/L SO4	4	0	0.0007350	0.0001390	0.0000696	0.0002210
2500 mg/L SO4	4	0	0.0006920	0.0000621	0.0000311	0.0000989
5000 mg/L SO4	4	0	0.0005420	0.0001670	0.0000837	0.0002660
0.8 meq/L	4	0	0.0004880	0.0001210	0.0000606	0.0001930
4.2 meq/L	4	0	0.0004880	0.0001900	0.0000949	0.0003020
19.8 meq/L	4	0	0.0004560	0.0001220	0.0000609	0.0001940
51.1 meq/L	4	0	0.0005240	0.0001600	0.0000801	0.0002550
103.2 meq/L	4	0	0.0010400	0.0001780	0.0000890	0.0002830

Column	Range	Max	Min	Median	25%	75%
HS-1	0.000430	0.000650	0.000220	0.000503	0.000333	0.000606
100 mg B/L	0.000180	0.000420	0.000240	0.000308	0.000257	0.000380
10 mg/L SO4	0.000217	0.000633	0.000417	0.000548	0.000468	0.000604
250 mg/L SO4	0.000445	0.000790	0.000345	0.000637	0.000477	0.000728
1000 mg/L SO4	0.000315	0.000930	0.000615	0.000698	0.000638	0.000833
2500 mg/L SO4	0.000130	0.000770	0.000640	0.000680	0.000642	0.000743
5000 mg/L SO4	0.000296	0.000690	0.000394	0.000542	0.000397	0.000687
0.8 meq/L	0.000270	0.000643	0.000373	0.000467	0.000393	0.000583
4.2 meq/L	0.000453	0.000733	0.000280	0.000469	0.000352	0.000623
19.8 meq/L	0.000233	0.000562	0.000330	0.000466	0.000352	0.000560
51.1 meq/L	0.000355	0.000760	0.000405	0.000466	0.000429	0.000619
103.2 meq/L	0.000415	0.001290	0.000873	0.000993	0.000920	0.001150

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	-0.911	0.400	0.199	0.636	0.954	0.742
100 mg B/L	0.638	-1.012	0.210	0.600	0.962	0.789
10 mg/L SO4	-0.631	0.150	0.180	0.684	0.980	0.902
250 mg/L SO4	-1.027	1.720	0.264	0.369	0.942	0.669
1000 mg/L SO4	1.289	1.436	0.247	0.445	0.905	0.456
2500 mg/L SO4	0.628	-2.448	0.280	0.303	0.882	0.349
5000 mg/L SO4	-0.000	-5.985	0.302	0.220	0.748	0.037
0.8 meq/L	0.690	-1.357	0.232	0.511	0.942	0.666
4.2 meq/L	-0.549	0.684	0.198	0.639	0.985	0.928
19.8 meq/L	-0.107	-5.372	0.299	0.228	0.816	0.133
51.1 meq/L	1.783	3.359	0.364	0.069	0.799	0.101
103.2 meq/L	1.303	2.141	0.287	0.273	0.910	0.481

Column	Sum	Sum of Squares
HS-1	0.00188	0.000000985
100 mg B/L	0.00128	0.000000425
10 mg/L SO4	0.00215	0.00000118
250 mg/L SO4	0.00241	0.00000156
1000 mg/L SO4	0.00294	0.00000222
2500 mg/L SO4	0.00277	0.00000193
5000 mg/L SO4	0.00217	0.00000126
0.8 meq/L	0.00195	0.000000995
4.2 meq/L	0.00195	0.00000106
19.8 meq/L	0.00182	0.000000876
51.1 meq/L	0.00210	0.00000118
103.2 meq/L	0.00415	0.00000439

One Way Analysis of Variance

Data source: SD 21 Root Biomass in 00325_SD 21_101613

Normality Test (Shapiro-Wilk) Passed (P = 0.485)

Equal Variance Test: Passed (P = 0.884)

Group Name	N	Missing	Mean	Std Dev	SEM
HS-1	4	0	0.000469	0.000186	0.0000930
100 mg B/L	4	0	0.000319	0.000079	0.0000396
10 mg/L SO4	4	0	0.000536	0.000092	0.0000461
250 mg/L SO4	4	0	0.000602	0.000187	0.0000936
1000 mg/L SO4	4	0	0.000735	0.000139	0.0000696
2500 mg/L SO4	4	0	0.000692	0.000062	0.0000311
5000 mg/L SO4	4	0	0.000542	0.000167	0.0000837
0.8 meq/L	4	0	0.000488	0.000121	0.0000606
4.2 meq/L	4	0	0.000488	0.000190	0.0000949
19.8 meq/L	4	0	0.000456	0.000122	0.0000609
51.1 meq/L	4	0	0.000524	0.000160	0.0000801
103.2 meq/L	4	0	0.001040	0.000178	0.0000890

Source of Variation	DF	SS	MS	F	P
Between Groups	11	0.00000146	0.000000133	6.158	<0.001
Residual	36	0.000000776	0.0000000215		
Total	47	0.00000224			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 0.999

Multiple Comparisons versus Control Group (Bonferroni t-test):

Comparisons for factor:

Comparison	Diff of Means	t	P	P<0.050
HS-1 vs. 103.2 meq/L	0.000567	5.468	<0.001	Yes
HS-1 vs. 1000 mg/L SO4	0.000266	2.564	0.161	No
HS-1 vs. 2500 mg/L SO4	0.000223	2.150	0.422	Do Not Test
HS-1 vs. 100 mg B/L	0.000150	1.450	1.000	Do Not Test
HS-1 vs. 250 mg/L SO4	0.000133	1.283	1.000	Do Not Test
HS-1 vs. 5000 mg/L SO4	0.0000725	0.699	1.000	Do Not Test
HS-1 vs. 10 mg/L SO4	0.0000670	0.646	1.000	Do Not Test
HS-1 vs. 51.1 meq/L	0.0000549	0.529	1.000	Do Not Test
HS-1 vs. 4.2 meq/L	0.0000185	0.178	1.000	Do Not Test
HS-1 vs. 0.8 meq/L	0.0000183	0.177	1.000	Do Not Test
HS-1 vs. 19.8 meq/L	0.0000132	0.127	1.000	Do Not Test

Descriptive Statistics:

Data source: SD 21 Shoot Length in 00325_SD 21_101613

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	3.412	0.53	0.265	0.844
100 mg B/L	4	0	3.32	0.713	0.356	1.134
10 mg/L SO4	4	0	3.143	0.821	0.41	1.306
250 mg/L SO4	4	0	3.202	0.277	0.139	0.441
1000 mg/L SO4	4	0	3.151	0.0886	0.0443	0.141
2500 mg/L SO4	4	0	2.815	0.131	0.0656	0.209
5000 mg/L SO4	4	0	2.565	0.37	0.185	0.589
0.8 meq/L	4	0	2.67	0.611	0.305	0.972
4.2 meq/L	4	0	2.434	0.359	0.18	0.572
19.8 meq/L	4	0	2.325	0.0735	0.0368	0.117
51.1 meq/L	4	0	2.499	0.139	0.0694	0.221
103.2 meq/L	4	0	1.906	0.0976	0.0488	0.155

Column	Range	Max	Min	Median	25%	75%
HS-1	1.286	4.004	2.718	3.464	3.064	3.761
100 mg B/L	1.536	3.814	2.278	3.594	2.863	3.777
10 mg/L SO4	1.807	4.197	2.391	2.991	2.499	3.787
250 mg/L SO4	0.59	3.605	3.015	3.093	3.02	3.383
1000 mg/L SO4	-0.198	3.232	3.033	3.17	3.084	3.218
2500 mg/L SO4	0.309	2.945	2.636	2.839	2.723	2.906
5000 mg/L SO4	0.795	3.076	2.281	2.453	2.292	2.838
0.8 meq/L	1.236	3.369	2.133	2.588	2.158	3.181
4.2 meq/L	0.71	2.836	2.127	2.388	2.131	2.738
19.8 meq/L	0.148	2.398	2.25	2.326	2.262	2.387
51.1 meq/L	0.331	2.638	2.307	2.525	2.41	2.587
103.2 meq/L	0.211	2.022	1.811	1.895	1.826	1.985

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	-0.569	1.486	0.249	0.438	0.964	0.804
100 mg B/L	-1.722	2.926	0.321	0.159	0.801	0.104
10 mg/L SO4	0.733	-1.416	0.243	0.462	0.929	0.587
250 mg/L SO4	1.682	2.722	0.308	0.197	0.796	0.095
1000 mg/L SO4	-0.913	-0.376	0.229	0.525	0.931	0.602
2500 mg/L SO4	-0.988	1.24	0.236	0.495	0.952	0.727
5000 mg/L SO4	1.209	0.536	0.26	0.389	0.864	0.274
0.8 meq/L	0.311	-4.169	0.287	0.274	0.866	0.283
4.2 meq/L	0.253	-4.553	0.297	0.236	0.843	0.204
19.8 meq/L	-0.0217	-5.094	0.261	0.382	0.869	0.292
51.1 meq/L	-1.07	2.034	0.292	0.254	0.926	0.569
103.2 meq/L	0.378	-3.056	0.247	0.446	0.93	0.593

Column	Sum	Sum of Squares
HS-1	13.65	47.421
100 mg B/L	13.28	45.615
10 mg/L SO4	12.57	41.524
250 mg/L SO4	12.807	41.232
1000 mg/L SO4	12.604	39.739
2500 mg/L SO4	11.258	31.739
5000 mg/L SO4	10.262	26.736
0.8 meq/L	10.679	29.629
4.2 meq/L	9.738	24.095
19.8 meq/L	9.299	21.634
51.1 meq/L	9.996	25.036
103.2 meq/L	7.622	14.554

One Way Analysis of Variance

Data source: SD 21 Shoot Length in 00325_SD 21_101613

Normality Test (Shapiro-Wilk) Passed (P = 0.256)

Equal Variance Test: Failed (P < 0.050)

Test execution ended by user request, ANOVA on Ranks begun

Kruskal-Wallis One Way Analysis of Variance on Ranks

Data source: SD 21 Shoot Length in 00325_SD 21_101613

Group	N	Missing	Median	0.2500	0.7500
HS-1	4	0	3.464	2.891	3.882
100 mg B/L	4	0	3.594	2.570	3.7960
10 mg/L SO4	4	0	2.991	2.445	3.992
250 mg/L SO4	4	0	3.093	3.018	3.494
1000 mg/L SO4	4	0	3.170	3.058	3.225
2500 mg/L SO4	4	0	2.839	2.679	2.925
5000 mg/L SO4	4	0	2.453	2.286	2.957
0.8 meq/L	4	0	2.588	2.146	3.275
4.2 meq/L	4	0	2.388	2.129	2.787
19.8 meq/L	4	0	2.326	2.256	2.393
51.1 meq/L	4	0	2.525	2.359	2.613
103.2 meq/L	4	0	1.895	1.818	2.004

H = 28.888 with 11 degrees of freedom. (P = 0.002)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.002)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

Multiple Comparisons versus Control Group (Dunn's Method) :

Comparison	Diff of Ranks	Q	P<0.05
103.2 meq/L vs HS-1	36.500	3.687	Yes
19.8 meq/L vs HS-1	26.250	2.652	No
4.2 meq/L vs HS-1	23.250	2.349	Do Not Test
51.1 meq/L vs HS-1	20.500	2.071	Do Not Test
5000 mg/L SO4 vs HS-1	19.250	1.945	Do Not Test
0.8 meq/L vs HS-1	18.250	1.844	Do Not Test
2500 mg/L SO4 vs HS-1	12.750	1.288	Do Not Test
10 mg/L SO4 vs HS-1	7.750	0.783	Do Not Test
1000 mg/L SO4 vs HS-1	3.250	0.328	Do Not Test
250 mg/L SO4 vs HS-1	3.250	0.328	Do Not Test
100 mg B/L vs HS-1	3.000	0.303	Do Not Test

Descriptive Statistics:

Data source: SD 21 Root Length in 00325_SD 21_101613

Column	Size	Missing	Mean	Std Dev	Std. Error	C.I. of Mean
HS-1	4	0	4.495	0.763	0.382	1.215
100 mg B/L	4	0	2.069	0.076	0.038	0.121
10 mg/L SO4	4	0	5.436	0.399	0.200	0.635
250 mg/L SO4	4	0	5.037	0.459	0.230	0.731
1000 mg/L SO4	4	0	4.556	0.184	0.092	0.293
2500 mg/L SO4	4	0	3.984	0.436	0.218	0.693
5000 mg/L SO4	4	0	2.565	0.370	0.185	0.589
0.8 meq/L	4	0	5.170	1.104	0.552	1.757
4.2 meq/L	4	0	3.780	0.493	0.246	0.784
19.8 meq/L	4	0	3.230	0.673	0.336	1.070
51.1 meq/L	4	0	3.679	0.577	0.289	0.919
103.2 meq/L	4	0	2.862	0.402	0.201	0.640

Column	Range	Max	Min	Median	25%	75%
HS-1	1.599	4.953	3.354	4.837	4.081	4.909
100 mg B/L	0.163	2.122	1.959	2.098	2.019	2.119
10 mg/L SO4	0.862	5.962	5.099	5.341	5.126	5.745
250 mg/L SO4	0.997	5.674	4.677	4.899	4.701	5.373
1000 mg/L SO4	0.450	4.787	4.336	4.550	4.441	4.671
2500 mg/L SO4	0.930	4.429	3.499	4.003	3.621	4.346
5000 mg/L SO4	0.795	3.076	2.281	2.453	2.292	2.838
0.8 meq/L	2.437	6.139	3.702	5.421	4.327	6.013
4.2 meq/L	1.176	4.367	3.191	3.780	3.418	4.142
19.8 meq/L	1.424	3.857	2.433	3.315	2.676	3.785
51.1 meq/L	1.255	4.149	2.894	3.837	3.246	4.112
103.2 meq/L	0.931	3.241	2.311	2.947	2.576	3.147

Column	Skewness	Kurtosis	K-S Dist.	K-S Prob.	SWilk W	SWilk Prob
HS-1	-1.964	3.883	0.409	0.018	0.703	0.013
100 mg B/L	-1.658	2.633	0.304	0.213	0.810	0.121
10 mg/L SO4	0.898	-0.935	0.260	0.386	0.897	0.418
250 mg/L SO4	1.244	0.746	0.251	0.426	0.871	0.301
1000 mg/L SO4	0.183	1.505	0.252	0.424	0.953	0.733
2500 mg/L SO4	-0.140	-3.864	0.239	0.480	0.926	0.569
5000 mg/L SO4	1.209	0.536	0.260	0.389	0.864	0.274
0.8 meq/L	-0.942	-0.488	0.242	0.467	0.916	0.515
4.2 meq/L	-0.005	0.055	0.142	0.705	1.000	1.000
19.8 meq/L	-0.390	-3.390	0.263	0.374	0.909	0.475
51.1 meq/L	-1.102	0.084	0.254	0.416	0.887	0.368
103.2 meq/L	-1.082	1.081	0.230	0.521	0.939	0.650

Column	Sum	Sum of Squares
HS-1	17.981	82.577
100 mg B/L	8.277	17.144
10 mg/L SO4	21.743	118.667
250 mg/L SO4	20.148	102.116
1000 mg/L SO4	18.224	83.126
2500 mg/L SO4	15.934	64.043
5000 mg/L SO4	10.262	26.736
0.8 meq/L	20.682	110.589
4.2 meq/L	15.118	57.870
19.8 meq/L	12.921	43.094
51.1 meq/L	14.717	55.148
103.2 meq/L	11.447	33.242

One Way Analysis of Variance

Data source: SD 21 Root Length in 00325_SD 21_101613

Normality Test (Shapiro-Wilk) Passed (P = 0.219)

Equal Variance Test: Passed (P = 0.205)

Group Name	N	Missing	Mean	Std Dev	SEM
HS-1	4	0	4.495	0.763	0.382
100 mg B/L	4	0	2.069	0.076	0.038
10 mg/L SO4	4	0	5.436	0.399	0.200
250 mg/L SO4	4	0	5.037	0.459	0.230
1000 mg/L SO4	4	0	4.556	0.184	0.092
2500 mg/L SO4	4	0	3.984	0.436	0.218
5000 mg/L SO4	4	0	2.565	0.370	0.185
0.8 meq/L	4	0	5.170	1.104	0.552
4.2 meq/L	4	0	3.780	0.493	0.246
19.8 meq/L	4	0	3.230	0.673	0.336
51.1 meq/L	4	0	3.679	0.577	0.289
103.2 meq/L	4	0	2.862	0.402	0.201

Source of Variation	DF	SS	MS	F	P
Between Groups	11	51.116	4.647	14.954	<0.001
Residual	36	11.187	0.311		
Total	47	62.303			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 1.000

Multiple Comparisons versus Control Group (Bonferroni t-test):

Comparisons for factor:

Comparison	Diff of Means	t	P	P<0.050
HS-1 vs. 100 mg B/L	2.426	6.155	<0.001	Yes
HS-1 vs. 5000 mg/L SO4	1.930	4.896	<0.001	Yes
HS-1 vs. 103.2 meq/L	1.634	4.144	0.002	Yes
HS-1 vs. 19.8 meq/L	1.265	3.209	0.031	Yes
HS-1 vs. 10 mg/L SO4	0.940	2.386	0.247	No
HS-1 vs. 51.1 meq/L	0.816	2.070	0.502	Do Not Test
HS-1 vs. 4.2 meq/L	0.716	1.816	0.855	Do Not Test
HS-1 vs. 0.8 meq/L	0.675	1.713	1.000	Do Not Test
HS-1 vs. 250 mg/L SO4	0.542	1.374	1.000	Do Not Test
HS-1 vs. 2500 mg/L SO4	0.512	1.298	1.000	Do Not Test
HS-1 vs. 1000 mg/L SO4	0.061	0.154	1.000	Do Not Test

Appendix D. Electronic Raw Data

Study Day	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
0	HS-1 (1:4)-A	22.5	-	12.3	0	7.1	7.3	59.1	528
	HS-1 (1:4)-B	22.5	-	12.5	0	7.0	7.0	61.4	530
	HS-1 (1:4)-C	22.5	-	12.4	0	7.0	7.3	58.7	523
	HS-1 (1:4)-D	22.5	-	12.4	0	7.0	7.4	51.1	530
1	HS-1 (1:4)-A	22.9	22.8	12.6	0				
	HS-1 (1:4)-B	22.9	22.7	12.5	0				
	HS-1 (1:4)-C	22.7	22.6	12.5	0				
	HS-1 (1:4)-D	22.8	22.7	12.7	0				
2	HS-1 (1:4)-A	22.4	22.5	12.6	0				
	HS-1 (1:4)-B	22.5	22.5	12.5	0				
	HS-1 (1:4)-C	22.6	22.6	12.7	0				
	HS-1 (1:4)-D	22.5	22.5	12.7	0				
3	HS-1 (1:4)-A	22.7	22.7	12.7	0				
	HS-1 (1:4)-B	22.8	22.7	12.7	0				
	HS-1 (1:4)-C	22.7	22.5	12.6	0				
	HS-1 (1:4)-D	22.6	22.7	12.7	0				
4	HS-1 (1:4)-A	22.7	22.6	12.6	0				
	HS-1 (1:4)-B	22.8	22.3	12.5	0				
	HS-1 (1:4)-C	22.7	22.7	12.6	0				
	HS-1 (1:4)-D	22.5	22.7	12.7	0				
5	HS-1 (1:4)-A	22.6	22.6	12.7	0	7.1	7.2	61.2	532
	HS-1 (1:4)-B	22.6	22.6	12.6	0	7.0	7.1	63.5	541
	HS-1 (1:4)-C	22.7	22.6	12.6	0				
	HS-1 (1:4)-D	22.7	22.6	12.6	0				
6	HS-1 (1:4)-A	22.7	22.6	12.7	0				
	HS-1 (1:4)-B	22.5	22.5	12.6	0				
	HS-1 (1:4)-C	22.6	22.7	12.6	0				
	HS-1 (1:4)-D	22.6	22.6	12.6	0				
7	HS-1 (1:4)-A	22.5	22.7	12.7	0				
	HS-1 (1:4)-B	22.7	22.6	12.7	0				
	HS-1 (1:4)-C	22.6	22.7	12.6	0	7.0	7.3	61.2	541
	HS-1 (1:4)-D	22.6	22.7	12.6	0				
8	HS-1 (1:4)-A	22.7	22.7	12.7	0				
	HS-1 (1:4)-B	22.6	22.5	12.7	0				
	HS-1 (1:4)-C	22.6	22.8	12.5	0				
	HS-1 (1:4)-D	22.6	22.7	12.5	0				
9	HS-1 (1:4)-A	22.8	22.6	12.7	0				
	HS-1 (1:4)-B	22.6	22.8	12.8	0				
	HS-1 (1:4)-C	22.8	22.7	12.7	0				
	HS-1 (1:4)-D	22.9	22.7	12.8	0				
10	HS-1 (1:4)-A	22.8	22.7	12.8	4250				
	HS-1 (1:4)-B	22.8	22.7	12.8	4296				
	HS-1 (1:4)-C	22.7	22.8	12.7	4296				
	HS-1 (1:4)-D	22.8	22.7	12.9	4312	7.0	7.1	60.7	555
11	HS-1 (1:4)-A	22.8	22.6	12.6	4312	6.9	7.1	60.4	549
	HS-1 (1:4)-B	22.9	22.8	12.8	4274				
	HS-1 (1:4)-C	22.8	22.8	12.7	4261				
	HS-1 (1:4)-D	22.8	22.9	12.8	4280				

Study Day	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
12	HS-1 (1:4)-A	22.8	22.7	12.5	5710				
	HS-1 (1:4)-B	22.7	22.5	12.7	5710				
	HS-1 (1:4)-C	22.7	22.6	12.6	4690				
	HS-1 (1:4)-D	22.7	22.6	12.7	4690				
13	HS-1 (1:4)-A	22.6	22.5	12.7	5320				
	HS-1 (1:4)-B	22.7	22.5	12.7	5320				
	HS-1 (1:4)-C	22.7	22.7	12.5	5150				
	HS-1 (1:4)-D	22.8	22.7	12.6	5150				
14	HS-1 (1:4)-A	22.8	22.7	12.8	4780				
	HS-1 (1:4)-B	22.8	22.5	12.7	4780				
	HS-1 (1:4)-C	22.8	22.7	12.8	5670				
	HS-1 (1:4)-D	22.8	22.8	12.8	5670				
15	HS-1 (1:4)-A	25.3	22.3	12.6	4220				
	HS-1 (1:4)-B	25.3	22.7	12.8	4170				
	HS-1 (1:4)-C	24.2	22.4	12.7	4390				
	HS-1 (1:4)-D	24.2	22.8	12.9	4810				
16	HS-1 (1:4)-A	23.8	22.6	12.9	4270				
	HS-1 (1:4)-B	23.8	22.1	12.9	4520	7.1	5.7	58.3	643
	HS-1 (1:4)-C	23.4	22.4	12.8	4940				
	HS-1 (1:4)-D	23.4	22.4	12.8	5200				
17	HS-1 (1:4)-A	24.1	22.1	12.7	4360				
	HS-1 (1:4)-B	24.1	22.2	12.8	4360				
	HS-1 (1:4)-C	23.7	22.6	12.8	5020	6.8	6.8	58.4	663
	HS-1 (1:4)-D	23.7	22.8	12.9	5020				
18	HS-1 (1:4)-A	22.8	23.0	12.6	4870				
	HS-1 (1:4)-B	22.8	22.5	12.8	4870				
	HS-1 (1:4)-C	22.8	22.9	12.9	5370				
	HS-1 (1:4)-D	22.8	22.6	12.7	5370				
19	HS-1 (1:4)-A	24.1	23.0	12.8	5060				
	HS-1 (1:4)-B	24.1	22.9	12.7	4160				
	HS-1 (1:4)-C	23.7	22.9	12.5	4870				
	HS-1 (1:4)-D	23.7	23.0	12.7	4870	6.9	5.5	60.2	643
20	HS-1 (1:4)-A	24.8	22.6	12.7	4563				
	HS-1 (1:4)-B	24.2	22.5	1.7	4358				
	HS-1 (1:4)-C	23.2	22.6	12.7	4392				
	HS-1 (1:4)-D	22.7	22.9	12.6	4816				
21	HS-1 (1:4)-A	22.7	22.8	12.7	4836	7.0	6.8	61.4	656
	HS-1 (1:4)-B	22.9	22.6	12.9	4789				
	HS-1 (1:4)-C	22.8	22.6	12.6	4782				
	HS-1 (1:4)-D	22.4	22.6	12.8	4265				

Study Day	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
0	100 mg/L BA -A	22.4	-	12.4	0	7.0	7.3	58.3	593
	100 mg/L BA -B	22.4	-	12.4	0	6.8	7.2	69.8	588
	100 mg/L BA -C	22.4	-	12.5	0	6.9	7.2	59.2	586
	100 mg/L BA -D	22.4	-	12.5	0	6.8	7.3	62.6	591
1	100 mg/L BA -A	22.9	22.7	12.6	0				
	100 mg/L BA -B	22.8	22.7	12.5	0				
	100 mg/L BA -C	22.7	22.7	12.6	0				
	100 mg/L BA -D	22.7	22.6	12.6	0				
2	100 mg/L BA -A	22.4	22.6	12.7	0				
	100 mg/L BA -B	22.4	22.6	12.6	0				
	100 mg/L BA -C	22.6	22.5	12.5	0				
	100 mg/L BA -D	22.5	22.5	12.7	0				
3	100 mg/L BA -A	22.8	22.6	12.7	0				
	100 mg/L BA -B	22.7	22.8	12.7	0				
	100 mg/L BA -C	22.5	22.6	12.6	0				
	100 mg/L BA -D	22.7	22.6	12.6	0				
4	100 mg/L BA -A	22.7	22.7	12.5	0				
	100 mg/L BA -B	22.8	22.6	12.7	0				
	100 mg/L BA -C	22.6	22.6	12.7	0				
	100 mg/L BA -D	22.6	22.7	12.7	0				
5	100 mg/L BA -A	22.7	22.5	12.6	0	7.1	7.1	60.9	593
	100 mg/L BA -B	22.6	22.7	12.6	0	7.0	7.1	70.2	602
	100 mg/L BA -C	22.5	22.6	12.7	0				
	100 mg/L BA -D	22.6	22.7	12.7	0				
6	100 mg/L BA -A	22.6	22.5	12.6	0				
	100 mg/L BA -B	22.6	22.6	12.5	0				
	100 mg/L BA -C	22.6	22.5	12.7	0				
	100 mg/L BA -D	22.7	22.6	12.7	0				
7	100 mg/L BA -A	22.6	22.6	12.7	0				
	100 mg/L BA -B	22.7	22.7	12.7	0				
	100 mg/L BA -C	22.6	22.7	12.7	0	7.0	7.2	58.3	602
	100 mg/L BA -D	22.7	22.6	12.7	0				
8	100 mg/L BA -A	22.8	22.8	12.6	0				
	100 mg/L BA -B	22.7	22.6	12.7	0				
	100 mg/L BA -C	22.7	22.7	12.6	0				
	100 mg/L BA -D	22.7	22.6	12.5	0				
9	100 mg/L BA -A	22.7	22.7	12.6	0				
	100 mg/L BA -B	22.7	22.7	12.7	0				
	100 mg/L BA -C	22.6	22.7	12.6	0				
	100 mg/L BA -D	22.8	22.8	12.7	0				
10	100 mg/L BA -A	22.7	22.8	12.7	4260				
	100 mg/L BA -B	22.6	22.7	12.9	4304				
	100 mg/L BA -C	22.8	22.7	12.6	4238				
	100 mg/L BA -D	22.6	22.6	12.7	4308	7.0	7.0	62.5	610
11	100 mg/L BA -A	22.7	22.6	12.5	4294	6.9	7.0	49.8	606
	100 mg/L BA -B	22.7	22.7	12.9	4282				
	100 mg/L BA -C	22.6	22.7	12.6	4272				
	100 mg/L BA -D	22.9	22.7	12.8	4269				

Study Day	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
12	100 mg/L BA -A	22.6	22.7	12.7	5600				
	100 mg/L BA -B	22.6	22.8	12.5	5600				
	100 mg/L BA -C	22.7	22.6	12.8	5660				
	100 mg/L BA -D	22.7	22.6	12.7	5660				
13	100 mg/L BA -A	22.6	22.7	12.7	5550				
	100 mg/L BA -B	22.7	22.6	12.7	5550				
	100 mg/L BA -C	22.6	22.7	12.6	4930				
	100 mg/L BA -D	22.6	22.6	12.6	4930				
14	100 mg/L BA -A	22.6	22.8	12.8	5950				
	100 mg/L BA -B	22.6	22.8	12.7	5950				
	100 mg/L BA -C	22.8	22.6	12.8	5470				
	100 mg/L BA -D	22.8	22.7	12.6	5470				
15	100 mg/L BA -A	23.9	22.1	12.5	4500				
	100 mg/L BA -B	23.9	22.4	12.7	4870				
	100 mg/L BA -C	24.3	22.3	12.8	4310				
	100 mg/L BA -D	24.3	23.0	12.8	5120				
16	100 mg/L BA -A	23.4	22.4	12.8	4980				
	100 mg/L BA -B	23.4	22.6	12.8	5210	6.9	5.6	59.2	628
	100 mg/L BA -C	22.9	22.3	12.8	5400				
	100 mg/L BA -D	22.9	22.4	12.7	5450				
17	100 mg/L BA -A	24.1	22.9	12.8	5350				
	100 mg/L BA -B	24.1	22.2	12.8	4360				
	100 mg/L BA -C	22.6	22.4	12.8	5360	6.7	6.7	57.2	649
	100 mg/L BA -D	22.6	22.7	12.9	5360				
18	100 mg/L BA -A	22.8	22.5	12.7	5420				
	100 mg/L BA -B	22.8	23.2	12.9	5420				
	100 mg/L BA -C	22.4	22.7	12.8	5360				
	100 mg/L BA -D	22.4	23.0	12.7	5360				
19	100 mg/L BA -A	24.6	23.0	12.7	4130				
	100 mg/L BA -B	24.6	22.8	12.6	5310				
	100 mg/L BA -C	23.1	22.8	12.6	4960				
	100 mg/L BA -D	23.1	22.8	12.8	4960	6.9	5.5	58.1	648
20	100 mg/L BA -A	24.8	22.8	12.6	4628				
	100 mg/L BA -B	24.1	22.6	12.7	4270				
	100 mg/L BA -C	23.5	22.7	12.8	4485				
	100 mg/L BA -D	22.8	22.7	12.7	4929				
21	100 mg/L BA -A	22.8	22.6	12.8	4928	6.9	6.3	58.1	649
	100 mg/L BA -B	22.8	22.7	12.9	4886				
	100 mg/L BA -C	22.6	22.7	12.7	4936				
	100 mg/L BA -D	22.7	22.7	12.9	4871				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
0	9/4/2013	10 mgL SO4 -A	22.5	-	12.3	0	6.9	7.5	57.2	512
		10 mgL SO4 -B	22.5	-	12.4	0	7.0	7.0	61.1	523
		10 mgL SO4 -C	22.5	-	12.4	0	7.0	7.2	56.9	508
		10 mgL SO4 -D	22.5	-	12.4	0	7.0	7.1	65.3	516
1	9/5/2013	10 mgL SO4 -A	22.8	22.7	12.7	0				
		10 mgL SO4 -B	22.9	22.8	12.6	0				
		10 mgL SO4 -C	22.7	22.7	12.6	0				
		10 mgL SO4 -D	22.8	22.7	12.7	0				
2	9/6/2013	10 mgL SO4 -A	22.4	22.6	12.6	0				
		10 mgL SO4 -B	22.4	22.5	12.6	0				
		10 mgL SO4 -C	22.5	22.5	12.6	0				
		10 mgL SO4 -D	22.5	22.5	12.6	0				
3	9/7/2013	10 mgL SO4 -A	22.5	22.5	12.6	0				
		10 mgL SO4 -B	22.5	22.6	12.7	0				
		10 mgL SO4 -C	22.5	22.6	12.7	0				
		10 mgL SO4 -D	22.6	22.6	12.7	0				
4	9/8/2013	10 mgL SO4 -A	22.6	22.5	12.7	0				
		10 mgL SO4 -B	22.7	22.7	12.6	0				
		10 mgL SO4 -C	22.7	22.6	12.7	0				
		10 mgL SO4 -D	22.6	22.6	12.6	0				
5	9/9/2013	10 mgL SO4 -A	22.6	22.7	12.6	0	7.0	7.1	58.4	521
		10 mgL SO4 -B	22.7	22.5	12.5	0	6.9	7.0	70.5	539
		10 mgL SO4 -C	22.4	22.7	12.7	0				
		10 mgL SO4 -D	22.7	22.7	12.6	0				
6	9/10/2013	10 mgL SO4 -A	22.5	22.6	12.6	0				
		10 mgL SO4 -B	22.7	22.6	12.6	0				
		10 mgL SO4 -C	22.7	22.5	12.5	0				
		10 mgL SO4 -D	22.8	22.6	12.7	0				
7	9/11/2013	10 mgL SO4 -A	22.5	22.6	12.6	0				
		10 mgL SO4 -B	22.6	22.7	12.8	0				
		10 mgL SO4 -C	22.7	22.6	12.7	0	7.1	7.2	55.4	540
		10 mgL SO4 -D	22.6	22.7	12.7	0				
8	9/12/2013	10 mgL SO4 -A	22.5	22.7	12.7	0				
		10 mgL SO4 -B	22.8	22.7	12.6	0				
		10 mgL SO4 -C	22.7	22.7	12.6	0				
		10 mgL SO4 -D	22.6	22.7	12.6	0				
9	9/13/2013	10 mgL SO4 -A	22.7	22.6	12.7	0				
		10 mgL SO4 -B	22.8	22.8	12.8	0				
		10 mgL SO4 -C	22.7	22.8	12.7	0				
		10 mgL SO4 -D	22.7	22.8	12.8	0				
10	9/14/2013	10 mgL SO4 -A	22.8	22.6	12.8	4238				
		10 mgL SO4 -B	22.8	22.8	12.8	4288				
		10 mgL SO4 -C	22.9	22.8	12.8	4251				
		10 mgL SO4 -D	22.7	22.6	12.8	4294	7.0	7.0	63.4	552
11	9/15/2013	10 mgL SO4 -A	22.6	22.5	12.6	4289	7.0	7.0	50.3	546
		10 mgL SO4 -B	22.8	22.6	12.7	4350				
		10 mgL SO4 -C	22.9	22.7	12.5	4285				
		10 mgL SO4 -D	22.7	22.8	12.8	4321				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
12	9/16/2013	10 mgL SO4 -A	22.8	22.7	12.6	5820				
		10 mgL SO4 -B	22.7	22.8	12.6	5820				
		10 mgL SO4 -C	22.8	22.6	12.7	5210				
		10 mgL SO4 -D	22.6	22.8	12.8	5210				
13	9/17/2013	10 mgL SO4 -A	22.7	22.7	12.6	5680				
		10 mgL SO4 -B	22.6	22.8	12.5	5680				
		10 mgL SO4 -C	22.5	22.8	17.8	4820				
		10 mgL SO4 -D	22.7	22.7	12.8	4870				
14	9/18/2013	10 mgL SO4 -A	22.7	22.8	12.8	4610				
		10 mgL SO4 -B	22.7	22.6	12.6	4610				
		10 mgL SO4 -C	22.5	22.6	12.5	4300				
		10 mgL SO4 -D	22.8	22.6	12.6	4300				
15	9/19/2013	10 mgL SO4 -A	23.8	22.3	12.7	4180				
		10 mgL SO4 -B	23.8	23.0	12.9	4020				
		10 mgL SO4 -C	23.1	21.6	12.6	4150				
		10 mgL SO4 -D	23.1	22.1	12.8	4110				
16	9/20/2013	10 mgL SO4 -A	23.3	21.8	12.8	4170				
		10 mgL SO4 -B	23.3	22.2	12.8	4040	7.0	5.6	60.1	539
		10 mgL SO4 -C	23.1	22.3	12.8	4010				
		10 mgL SO4 -D	22.9	22.4	12.7	5450				
17	9/21/2013	10 mgL SO4 -A	23.7	22.2	12.8	4520				
		10 mgL SO4 -B	23.7	22.3	12.7	4520				
		10 mgL SO4 -C	21.3	21.6	12.7	4850	6.7	6.9	59.6	631
		10 mgL SO4 -D	21.3	21.7	12.8	4850				
18	9/22/2013	10 mgL SO4 -A	22.3	22.5	12.8	4130				
		10 mgL SO4 -B	22.3	22.3	12.8	4130				
		10 mgL SO4 -C	22.3	22.6	12.8	5140				
		10 mgL SO4 -D	22.3	21.9	12.9	5140				
19	9/23/2013	10 mgL SO4 -A	23.1	22.9	12.5	5630				
		10 mgL SO4 -B	23.1	22.8	12.8	4720				
		10 mgL SO4 -C	23.1	22.7	12.8	4620				
		10 mgL SO4 -D	23.1	22.6	12.6	4170	6.6	5.5	59.2	632
20	9/24/2013	10 mgL SO4 -A	24.6	22.9	12.6	4374				
		10 mgL SO4 -B	24.0	22.7	12.8	4588				
		10 mgL SO4 -C	23.4	22.6	12.6	4716				
		10 mgL SO4 -D	22.9	22.8	12.8	4763				
21	9/25/2013	10 mgL SO4 -A	22.7	22.7	12.7	4614	6.9	6.4	59.8	638
		10 mgL SO4 -B	22.5	22.8	12.6	4929				
		10 mgL SO4 -C	22.7	22.8	12.5	4583				
		10 mgL SO4 -D	22.6	22.8	12.8	4919				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
0	9/4/2013	250 mgL SO4 -A	22.6	-	12.5	0	7.0	7.2	50.1	1741
		250 mgL SO4 -B	22.6	-	12.5	0	7.0	6.9	57.3	1693
		250 mgL SO4 -C	22.6	-	12.5	0	7.0	7.2	57.4	1623
		250 mgL SO4 -D	22.6	-	12.5	0	7.1	7.2	55.7	1713
1	9/5/2013	250 mgL SO4 -A	22.8	22.7	12.7	0				
		250 mgL SO4 -B	22.8	22.7	12.6	0				
		250 mgL SO4 -C	22.8	22.7	12.6	0				
		250 mgL SO4 -D	22.6	22.5	12.6	0				
2	9/6/2013	250 mgL SO4 -A	22.5	22.5	12.6	0				
		250 mgL SO4 -B	22.4	22.5	12.7	0				
		250 mgL SO4 -C	22.5	22.6	12.7	0				
		250 mgL SO4 -D	22.6	22.6	12.6	0				
3	9/7/2013	250 mgL SO4 -A	22.6	22.4	12.7	0				
		250 mgL SO4 -B	22.7	22.5	12.6	0				
		250 mgL SO4 -C	22.6	22.6	12.6	0				
		250 mgL SO4 -D	22.7	22.7	12.5	0				
4	9/8/2013	250 mgL SO4 -A	22.6	22.6	12.7	0				
		250 mgL SO4 -B	22.6	22.7	12.6	0				
		250 mgL SO4 -C	22.6	22.6	12.6	0				
		250 mgL SO4 -D	22.6	22.6	12.6	0				
5	9/9/2013	250 mgL SO4 -A	22.7	22.7	12.7	0	7.0	7.0	60.1	1732
		250 mgL SO4 -B	22.7	22.6	12.6	0	6.9	7.0	69.8	1725
		250 mgL SO4 -C	22.6	22.7	12.6	0				
		250 mgL SO4 -D	22.5	22.6	12.7	0				
6	9/10/2013	250 mgL SO4 -A	22.7	22.6	12.5	0				
		250 mgL SO4 -B	22.7	22.7	12.6	0				
		250 mgL SO4 -C	22.6	22.6	12.6	0				
		250 mgL SO4 -D	22.6	22.7	12.6	0				
7	9/11/2013	250 mgL SO4 -A	22.6	22.7	12.7	0				
		250 mgL SO4 -B	22.6	22.5	12.7	0				
		250 mgL SO4 -C	22.7	22.6	12.5	0	7.0	7.1	56.1	1767
		250 mgL SO4 -D	22.7	22.6	12.6	0				
8	9/12/2013	250 mgL SO4 -A	22.6	22.7	12.7	0				
		250 mgL SO4 -B	22.7	22.7	12.7	0				
		250 mgL SO4 -C	22.7	22.5	12.7	0				
		250 mgL SO4 -D	22.7	22.5	12.6	0				
9	9/13/2013	250 mgL SO4 -A	22.8	22.5	12.6	0				
		250 mgL SO4 -B	22.8	22.7	12.7	0				
		250 mgL SO4 -C	22.8	22.9	12.8	0				
		250 mgL SO4 -D	22.6	22.7	12.3	0				
10	9/14/2013	250 mgL SO4 -A	22.7	22.7	12.8	4255				
		250 mgL SO4 -B	22.9	22.7	12.7	4259				
		250 mgL SO4 -C	22.7	22.8	12.6	4274				
		250 mgL SO4 -D	22.8	22.7	12.7	4286	6.9	6.9	61	1694
11	9/15/2013	250 mgL SO4 -A	22.8	22.7	12.5	4311	7.0	7.0	52.5	1708
		250 mgL SO4 -B	22.9	22.5	12.8	4340				
		250 mgL SO4 -C	22.7	22.8	12.6	4270				
		250 mgL SO4 -D	22.6	22.8	12.7	4099				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
12	9/16/2013	250 mgL SO4 -A	22.7	22.6	12.8	5960				
		250 mgL SO4 -B	22.8	22.5	12.8	5960				
		250 mgL SO4 -C	22.5	22.7	12.7	5330				
		250 mgL SO4 -D	22.8	22.5	12.6	5330				
13	9/17/2013	250 mgL SO4 -A	22.8	22.6	12.8	4940				
		250 mgL SO4 -B	22.5	22.6	12.7	4940				
		250 mgL SO4 -C	22.7	22.6	12.7	5610				
		250 mgL SO4 -D	22.7	22.7	12.7	5610				
14	9/18/2013	250 mgL SO4 -A	22.8	22.8	12.8	5560				
		250 mgL SO4 -B	22.8	22.8	12.6	5560				
		250 mgL SO4 -C	22.8	22.8	12.8	5460				
		250 mgL SO4 -D	22.5	22.8	12.5	5460				
15	9/19/2013	250 mgL SO4 -A	23.4	22.4	12.7	4980				
		250 mgL SO4 -B	23.4	21.6	12.8	4380				
		250 mgL SO4 -C	23.2	22.4	12.7	4600				
		250 mgL SO4 -D	23.2	21.9	12.7	5790				
16	9/20/2013	250 mgL SO4 -A	22.7	22.7	12.7	5450				
		250 mgL SO4 -B	22.7	22.6	12.8	4360	6.7	6.0	62.3	1743
		250 mgL SO4 -C	22.6	22.6	12.7	5400				
		250 mgL SO4 -D	22.6	22.6	12.8	4180				
17	9/21/2013	250 mgL SO4 -A	22.9	22.2	12.7	5950				
		250 mgL SO4 -B	22.9	22.1	12.6	5950				
		250 mgL SO4 -C	21.4	21.6	12.7	5500	6.8	7.0	58.9	1768
		250 mgL SO4 -D	21.4	21.4	12.8	5500				
18	9/22/2013	250 mgL SO4 -A	22.2	22.4	12.8	5330				
		250 mgL SO4 -B	22.2	22.4	12.8	5330				
		250 mgL SO4 -C	22.3	22.4	12.7	5900				
		250 mgL SO4 -D	22.3	22.4	12.8	5900				
19	9/23/2013	250 mgL SO4 -A	23.2	22.8	12.6	5420				
		250 mgL SO4 -B	23.2	22.4	12.7	4810				
		250 mgL SO4 -C	22.6	22.7	12.6	5100				
		250 mgL SO4 -D	22.6	22.5	12.8	4730	6.6	6.2	57.1	1784
20	9/24/2013	250 mgL SO4 -A	24.6	22.8	12.5	4581				
		250 mgL SO4 -B	24.3	22.7	12.6	4723				
		250 mgL SO4 -C	23.6	22.7	12.9	4552				
		250 mgL SO4 -D	23.3	22.7	12.9	4819				
21	9/25/2013	250 mgL SO4 -A	22.6	22.7	12.5	4583	6.8	6.2	51.4	1780
		250 mgL SO4 -B	22.6	22.9	12.7	4685				
		250 mgL SO4 -C	22.8	22.7	12.7	4691				
		250 mgL SO4 -D	22.8	22.5	12.6	4821				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
0	9/4/2013	1000 mgL SO4-A	22.5	-	12.4	0	7.0	7.3	54.5	2740
		1000 mgL SO4-B	22.5	-	12.5	0	7.0	6.9	58.9	2753
		1000 mgL SO4-C	22.5	-	12.5	0	7.0	7.2	51.5	2732
		1000 mgL SO4-D	22.5	-	12.6	0	7.0	7.0	51.3	2759
1	9/5/2013	1000 mgL SO4-A	22.8	22.8	12.6	0				
		1000 mgL SO4-B	22.8	22.7	12.7	0				
		1000 mgL SO4-C	22.7	22.7	12.5	0				
		1000 mgL SO4-D	22.7	22.6	12.8	0				
2	9/6/2013	1000 mgL SO4-A	22.4	22.4	12.6	0				
		1000 mgL SO4-B	22.5	22.6	12.5	0				
		1000 mgL SO4-C	22.6	22.6	12.7	0				
		1000 mgL SO4-D	22.6	22.6	12.7	0				
3	9/7/2013	1000 mgL SO4-A	22.7	22.6	12.6	0				
		1000 mgL SO4-B	22.8	22.8	12.6	0				
		1000 mgL SO4-C	22.7	22.6	12.6	0				
		1000 mgL SO4-D	22.8	22.6	12.6	0				
4	9/8/2013	1000 mgL SO4-A	22.5	22.6	12.6	0				
		1000 mgL SO4-B	22.7	22.8	12.7	0				
		1000 mgL SO4-C	22.6	22.7	12.7	0				
		1000 mgL SO4-D	22.7	22.8	12.7	0				
5	9/9/2013	1000 mgL SO4-A	22.7	22.6	12.6	0	7.0	7.1	57.3	2759
		1000 mgL SO4-B	22.6	22.7	12.6	0	7.0	7.1	71.3	2736
		1000 mgL SO4-C	22.6	22.6	12.6	0				
		1000 mgL SO4-D	22.6	22.6	12.6	0				
6	9/10/2013	1000 mgL SO4-A	22.6	22.7	12.6	0				
		1000 mgL SO4-B	22.6	22.6	12.6	0				
		1000 mgL SO4-C	22.7	22.6	12.6	0				
		1000 mgL SO4-D	22.5	22.7	12.7	0				
7	9/11/2013	1000 mgL SO4-A	22.7	22.5	12.7	0				
		1000 mgL SO4-B	22.7	22.6	12.7	0				
		1000 mgL SO4-C	22.6	22.7	12.7	0	7.0	7.0	53.9	2773
		1000 mgL SO4-D	22.6	22.5	12.7	0				
8	9/12/2013	1000 mgL SO4-A	22.7	22.6	12.7	0				
		1000 mgL SO4-B	22.6	22.8	12.6	0				
		1000 mgL SO4-C	22.7	22.6	12.7	0				
		1000 mgL SO4-D	22.6	22.6	12.6	0				
9	9/13/2013	1000 mgL SO4-A	22.7	22.8	12.8	0				
		1000 mgL SO4-B	22.7	22.8	12.8	0				
		1000 mgL SO4-C	22.6	22.7	12.6	0				
		1000 mgL SO4-D	22.8	22.9	12.8	0				
10	9/14/2013	1000 mgL SO4-A	22.9	22.8	12.7	4380				
		1000 mgL SO4-B	22.8	22.9	12.8	4302				
		1000 mgL SO4-C	22.5	22.7	12.6	4241				
		1000 mgL SO4-D	22.8	22.5	12.9	4290	6.9	7.1	59.6	2793
11	9/15/2013	1000 mgL SO4-A	22.9	22.8	12.7	4308	6.9	6.9	55.6	2780
		1000 mgL SO4-B	22.8	22.9	12.9	4330				
		1000 mgL SO4-C	22.8	22.8	12.6	4255				
		1000 mgL SO4-D	22.8	22.7	12.8	4283				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
12	9/16/2013	1000 mgL SO4-A	22.7	22.5	12.7	5430				
		1000 mgL SO4-B	22.6	22.6	12.7	5430				
		1000 mgL SO4-C	22.6	22.8	12.6	5470				
		1000 mgL SO4-D	22.6	22.7	12.8	5470				
13	9/17/2013	1000 mgL SO4-A	22.7	22.8	12.7	5310				
		1000 mgL SO4-B	22.8	22.6	12.6	5310				
		1000 mgL SO4-C	22.7	22.9	12.7	5580				
		1000 mgL SO4-D	22.5	22.8	12.6	5580				
14	9/18/2013	1000 mgL SO4-A	22.6	22.7	12.7	4690				
		1000 mgL SO4-B	22.6	22.6	12.8	4690				
		1000 mgL SO4-C	22.6	22.8	12.8	5630				
		1000 mgL SO4-D	22.8	22.7	12.5	5630				
15	9/19/2013	1000 mgL SO4-A	23.9	22.8	12.8	4370				
		1000 mgL SO4-B	23.9	21.5	12.8	4210				
		1000 mgL SO4-C	23.3	21.9	12.8	4500				
		1000 mgL SO4-D	23.3	21.8	12.5	4370				
16	9/20/2013	1000 mgL SO4-A	22.9	22.8	12.7	4180				
		1000 mgL SO4-B	22.9	22.8	12.9	4010	6.5	5.6	57.6	2841
		1000 mgL SO4-C	23.4	22.4	12.6	4340				
		1000 mgL SO4-D	23.4	22.2	12.8	5060				
17	9/21/2013	1000 mgL SO4-A	23.0	22.1	12.7	4980				
		1000 mgL SO4-B	23.0	22.1	12.8	4980				
		1000 mgL SO4-C	21.3	21.7	12.8	5530	6.8	6.8	59.1	2875
		1000 mgL SO4-D	21.3	21.6	12.7	5830				
18	9/22/2013	1000 mgL SO4-A	22.6	22.4	12.7	4580				
		1000 mgL SO4-B	22.6	22.4	12.7	4580				
		1000 mgL SO4-C	22.7	22.6	12.8	5780				
		1000 mgL SO4-D	22.7	22.3	12.7	5780				
19	9/23/2013	1000 mgL SO4-A	22.6	23.0	12.7	5710				
		1000 mgL SO4-B	22.6	22.3	12.7	4990				
		1000 mgL SO4-C	22.4	22.6	12.8	5030				
		1000 mgL SO4-D	22.4	22.5	12.6	4520	6.2	5.6	56.5	2904
20	9/24/2013	1000 mgL SO4-A	24.5	22.6	12.7	4368				
		1000 mgL SO4-B	24.2	22.8	12.7	4819				
		1000 mgL SO4-C	23.4	22.5	12.7	4819				
		1000 mgL SO4-D	23.8	22.8	12.5	4512				
21	9/25/2013	1000 mgL SO4-A	22.7	22.5	12.4	4929	6.8	6.2	61.6	2916
		1000 mgL SO4-B	22.7	22.8	12.7	4781				
		1000 mgL SO4-C	22.6	22.8	12.6	4833				
		1000 mgL SO4-D	22.7	22.7	12.7	4586				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
0	9/4/2013	2500 mgL SO4-A	22.5	-	12.5	0	7.0	7.2	55.6	4236
		2500 mgL SO4-B	22.5	-	12.5	0	6.9	6.9	51.4	4248
		2500 mgL SO4-C	22.5	-	12.5	0	7.0	7.0	60.9	4212
		2500 mgL SO4-D	22.5	-	12.6	0	7.0	6.9	48.9	4275
1	9/5/2013	2500 mgL SO4-A	22.9	22.7	12.7	0				
		2500 mgL SO4-B	22.9	22.6	12.7	0				
		2500 mgL SO4-C	22.8	22.8	12.5	0				
		2500 mgL SO4-D	22.7	22.6	12.7	0				
2	9/6/2013	2500 mgL SO4-A	22.5	22.5	12.5	0				
		2500 mgL SO4-B	22.4	22.5	12.6	0				
		2500 mgL SO4-C	22.6	22.5	12.7	0				
		2500 mgL SO4-D	22.6	22.5	12.7	0				
3	9/7/2013	2500 mgL SO4-A	22.7	22.6	12.6	0				
		2500 mgL SO4-B	22.7	22.6	12.5	0				
		2500 mgL SO4-C	22.7	22.5	12.7	0				
		2500 mgL SO4-D	22.7	22.6	12.6	0				
4	9/8/2013	2500 mgL SO4-A	22.6	22.5	12.7	0				
		2500 mgL SO4-B	22.8	22.7	12.7	0				
		2500 mgL SO4-C	22.6	22.7	12.7	0				
		2500 mgL SO4-D	22.6	22.7	12.7	0				
5	9/9/2013	2500 mgL SO4-A	22.6	22.7	12.6	0	7.1	7.1	55.6	4228
		2500 mgL SO4-B	22.7	22.6	12.6	0	7.0	7.1	70.1	4210
		2500 mgL SO4-C	22.6	22.6	12.5	0				
		2500 mgL SO4-D	22.7	22.7	12.7	0				
6	9/10/2013	2500 mgL SO4-A	22.8	22.7	12.7	0				
		2500 mgL SO4-B	22.6	22.7	12.6	0				
		2500 mgL SO4-C	22.7	22.7	12.7	0				
		2500 mgL SO4-D	22.7	22.7	12.5	0				
7	9/11/2013	2500 mgL SO4-A	22.6	22.6	12.7	0				
		2500 mgL SO4-B	22.8	22.7	12.6	0				
		2500 mgL SO4-C	22.6	22.6	12.6	0	6.9	7.1	67.2	4270
		2500 mgL SO4-D	22.7	22.6	12.7	0				
8	9/12/2013	2500 mgL SO4-A	22.7	22.7	12.6	0				
		2500 mgL SO4-B	22.7	22.6	12.6	0				
		2500 mgL SO4-C	22.6	22.7	12.6	0				
		2500 mgL SO4-D	22.7	22.7	12.7	0				
9	9/13/2013	2500 mgL SO4-A	22.7	22.7	12.7	0				
		2500 mgL SO4-B	22.6	22.7	12.8	0				
		2500 mgL SO4-C	22.7	22.5	12.5	0				
		2500 mgL SO4-D	22.7	22.6	12.7	0				
10	9/14/2013	2500 mgL SO4-A	22.8	22.7	12.8	4270				
		2500 mgL SO4-B	22.6	22.8	12.7	4285				
		2500 mgL SO4-C	22.6	22.7	12.7	4279				
		2500 mgL SO4-D	22.7	22.6	12.8	4298	6.8	7.2	55.2	4288
11	9/15/2013	2500 mgL SO4-A	22.8	22.7	12.7	4279	6.9	6.9	50.9	4266
		2500 mgL SO4-B	22.8	22.8	12.7	4331				
		2500 mgL SO4-C	22.9	22.7	12.7	4267				
		2500 mgL SO4-D	22.7	22.8	12.6	4219				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
12	9/16/2013	2500 mgL SO4-A	22.6	22.8	12.7	5520				
		2500 mgL SO4-B	22.6	22.7	12.7	5520				
		2500 mgL SO4-C	22.6	22.7	12.7	4980				
		2500 mgL SO4-D	22.7	22.6	12.7	4980				
13	9/17/2013	2500 mgL SO4-A	22.5	22.6	12.6	5170				
		2500 mgL SO4-B	22.7	22.7	12.8	5170				
		2500 mgL SO4-C	22.8	22.5	12.6	5320				
		2500 mgL SO4-D	22.6	22.7	12.5	5320				
14	9/18/2013	2500 mgL SO4-A	22.8	22.7	12.5	5350				
		2500 mgL SO4-B	22.8	22.8	12.8	5350				
		2500 mgL SO4-C	22.8	22.6	12.7	5580				
		2500 mgL SO4-D	22.6	22.8	12.8	5580				
15	9/19/2013	2500 mgL SO4-A	23.2	21.9	12.6	4080				
		2500 mgL SO4-B	23.2	22.3	12.7	4470				
		2500 mgL SO4-C	23.4	22.4	12.7	5550				
		2500 mgL SO4-D	23.4	22.9	12.6	5350				
16	9/20/2013	2500 mgL SO4-A	23.4	22.1	12.8	4020				
		2500 mgL SO4-B	23.4	21.8	12.9	4120	6.4	5.7	59.4	4752
		2500 mgL SO4-C	23.1	22.4	12.7	4770				
		2500 mgL SO4-D	23.1	22.4	12.7	5120				
17	9/21/2013	2500 mgL SO4-A	22.9	22.0	12.8	4950				
		2500 mgL SO4-B	22.9	22.4	12.8	4950				
		2500 mgL SO4-C	21.5	22.1	12.8	5600	6.6	6.5	60.3	4802
		2500 mgL SO4-D	21.5	21.7	12.7	5600				
18	9/22/2013	2500 mgL SO4-A	22.1	22.3	12.8	4790				
		2500 mgL SO4-B	22.1	22.3	12.7	4790				
		2500 mgL SO4-C	22.5	23.0	12.8	5560				
		2500 mgL SO4-D	22.5	22.8	12.7	5560				
19	9/23/2013	2500 mgL SO4-A	22.8	22.9	12.8	5320				
		2500 mgL SO4-B	22.8	22.3	12.8	4630				
		2500 mgL SO4-C	22.6	23.0	12.6	4760				
		2500 mgL SO4-D	22.6	22.3	12.8	4600	6.2	5.7	55.3	4823
20	9/24/2013	2500 mgL SO4-A	24.4	22.7	12.5	4472				
		2500 mgL SO4-B	24.1	22.8	12.8	4924				
		2500 mgL SO4-C	22.9	22.5	12.8	4710				
		2500 mgL SO4-D	23.9	22.7	12.6	4728				
21	9/25/2013	2500 mgL SO4-A	22.8	22.6	12.6	4968	6.6	6.0	65.8	4884
		2500 mgL SO4-B	22.8	22.7	12.8	4928				
		2500 mgL SO4-C	22.7	22.7	12.7	4915				
		2500 mgL SO4-D	22.8	22.8	12.7	4842				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
0	9/4/2013	5000 mgL SO4-A	22.6	-	12.4	0	6.9	7.2	51.9	8351
		5000 mgL SO4-B	22.6	-	12.6	0	6.9	7.0	57.6	8364
		5000 mgL SO4-C	22.6	-	12.5	0	6.9	7.1	65.8	8341
		5000 mgL SO4-D	22.6	-	12.6	0	6.9	7.0	60.1	8369
1	9/5/2013	5000 mgL SO4-A	22.9	22.6	12.5	0				
		5000 mgL SO4-B	22.8	22.7	12.6	0				
		5000 mgL SO4-C	22.6	22.7	12.6	0				
		5000 mgL SO4-D	22.8	22.6	12.7	0				
2	9/6/2013	5000 mgL SO4-A	22.4	22.6	12.5	0				
		5000 mgL SO4-B	22.5	22.4	12.6	0				
		5000 mgL SO4-C	22.5	22.6	12.6	0				
		5000 mgL SO4-D	22.5	22.5	12.5	0				
3	9/7/2013	5000 mgL SO4-A	22.7	22.7	12.7	0				
		5000 mgL SO4-B	22.6	22.7	12.6	0				
		5000 mgL SO4-C	22.6	22.6	12.6	0				
		5000 mgL SO4-D	22.6	22.7	12.7	0				
4	9/8/2013	5000 mgL SO4-A	22.5	22.7	12.7	0				
		5000 mgL SO4-B	22.5	22.6	12.7	0				
		5000 mgL SO4-C	22.6	22.5	12.6	0				
		5000 mgL SO4-D	22.6	22.6	12.6	0				
5	9/9/2013	5000 mgL SO4-A	22.7	22.7	12.7	0	7.0	7.0	57.4	8372
		5000 mgL SO4-B	22.6	22.5	12.7	0	6.9	7.0	69.4	8356
		5000 mgL SO4-C	22.7	22.6	12.6	0				
		5000 mgL SO4-D	22.7	22.8	12.8	0				
6	9/10/2013	5000 mgL SO4-A	22.7	22.6	12.6	0				
		5000 mgL SO4-B	22.7	22.5	12.5	0				
		5000 mgL SO4-C	22.6	22.6	12.6	0				
		5000 mgL SO4-D	22.6	22.6	12.6	0				
7	9/11/2013	5000 mgL SO4-A	22.6	22.6	12.7	0				
		5000 mgL SO4-B	22.7	22.5	12.6	0				
		5000 mgL SO4-C	22.7	22.6	12.7	0	6.9	6.9	60.9	8390
		5000 mgL SO4-D	22.6	22.6	12.6	0				
8	9/12/2013	5000 mgL SO4-A	22.8	22.7	12.7	0				
		5000 mgL SO4-B	22.8	22.6	12.6	0				
		5000 mgL SO4-C	22.7	22.7	12.6	0				
		5000 mgL SO4-D	22.6	22.7	12.7	0				
9	9/13/2013	5000 mgL SO4-A	22.7	22.6	12.6	0				
		5000 mgL SO4-B	22.7	22.6	12.6	0				
		5000 mgL SO4-C	22.8	22.8	12.7	0				
		5000 mgL SO4-D	22.6	22.7	12.8	0				
10	9/14/2013	5000 mgL SO4-A	22.7	22.8	12.9	4275				
		5000 mgL SO4-B	22.7	22.8	12.8	4291				
		5000 mgL SO4-C	22.8	22.9	12.9	4294				
		5000 mgL SO4-D	22.9	22.8	12.7	4312	6.8	7.0	60.8	8402
11	9/15/2013	5000 mgL SO4-A	22.7	22.8	12.8	4285	6.8	6.9	49.8	8398
		5000 mgL SO4-B	22.7	22.8	12.8	4286				
		5000 mgL SO4-C	22.5	22.6	12.7	4273				
		5000 mgL SO4-D	22.6	22.9	12.7	4271				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
12	9/16/2013	5000 mgL SO4-A	22.8	22.6	12.5	5690				
		5000 mgL SO4-B	22.6	22.7	12.7	5690				
		5000 mgL SO4-C	22.8	22.7	12.6	4710				
		5000 mgL SO4-D	22.8	22.7	12.7	4710				
13	9/17/2013	5000 mgL SO4-A	22.6	22.7	12.7	5610				
		5000 mgL SO4-B	22.7	22.8	12.6	5610				
		5000 mgL SO4-C	22.6	22.7	12.8	4990				
		5000 mgL SO4-D	22.8	22.5	12.7	4990				
14	9/18/2013	5000 mgL SO4-A	22.6	22.8	12.7	5650				
		5000 mgL SO4-B	22.6	22.6	12.6	5650				
		5000 mgL SO4-C	22.6	22.8	12.6	5850				
		5000 mgL SO4-D	22.8	22.8	12.8	5850				
15	9/19/2013	5000 mgL SO4-A	23.6	22.8	12.8	4740				
		5000 mgL SO4-B	23.6	22.4	12.9	4880				
		5000 mgL SO4-C	23.1	22.8	12.7	4490				
		5000 mgL SO4-D	23.1	22.9	12.6	4920				
16	9/20/2013	5000 mgL SO4-A	22.6	22.9	12.8	5100				
		5000 mgL SO4-B	22.6	22.7	12.8	5130	6.5	5.6	58.2	8746
		5000 mgL SO4-C	22.9	22.8	12.7	4110				
		5000 mgL SO4-D	22.9	22.7	12.7	4320				
17	9/21/2013	5000 mgL SO4-A	22.9	22.8	12.8	5680				
		5000 mgL SO4-B	22.9	22.3	12.9	5680				
		5000 mgL SO4-C	21.8	22.2	12.7	4570	6.6	7.0	62.3	8812
		5000 mgL SO4-D	21.8	21.9	12.8	4570				
18	9/22/2013	5000 mgL SO4-A	22.9	22.8	12.8	5580				
		5000 mgL SO4-B	22.9	22.6	12.8	5580				
		5000 mgL SO4-C	23.0	22.5	12.8	5380				
		5000 mgL SO4-D	23.0	22.3	12.8	5380				
19	9/23/2013	5000 mgL SO4-A	22.3	22.3	12.5	5010				
		5000 mgL SO4-B	22.3	22.1	12.6	4170				
		5000 mgL SO4-C	22.7	22.0	12.6	4210				
		5000 mgL SO4-D	22.7	22.1	12.8	4700	6.4	5.5	59.8	8801
20	9/24/2013	5000 mgL SO4-A	24.6	22.8	12.6	4581				
		5000 mgL SO4-B	24.2	22.7	12.6	4629				
		5000 mgL SO4-C	22.8	22.6	12.6	4623				
		5000 mgL SO4-D	24.1	22.8	12.6	4832				
21	9/25/2013	5000 mgL SO4-A	22.8	22.8	12.7	4584	6.5	6.0	67.3	8886
		5000 mgL SO4-B	22.9	22.6	12.8	4446				
		5000 mgL SO4-C	22.5	22.6	12.8	4612				
		5000 mgL SO4-D	22.7	22.6	12.9	4935				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
0	9/4/2013	0.8 meqL-A	22.7	-	12.4	0	7.0	7.0	53.8	642
		0.8 meqL-B	22.7	-	12.7	0	7.0	7.0	58.9	651
		0.8 meqL-C	22.7	-	12.4	0	7.0	7.0	51.3	675
		0.8 meqL-D	22.7	-	12.5	0	7.0	7.0	55.8	669
1	9/5/2013	0.8 meqL-A	22.9	22.7	12.6	0				
		0.8 meqL-B	22.8	22.8	12.6	0				
		0.8 meqL-C	22.7	22.6	12.6	0				
		0.8 meqL-D	22.7	22.7	12.8	0				
2	9/6/2013	0.8 meqL-A	22.5	22.5	12.5	0				
		0.8 meqL-B	22.56	22.5	12.6	0				
		0.8 meqL-C	22.5	22.6	12.6	0				
		0.8 meqL-D	22.7	22.6	12.6	0				
3	9/7/2013	0.8 meqL-A	22.6	22.6	12.5	0				
		0.8 meqL-B	22.7	22.7	12.8	0				
		0.8 meqL-C	22.5	22.7	12.6	0				
		0.8 meqL-D	22.7	22.6	12.7	0				
4	9/8/2013	0.8 meqL-A	22.5	22.6	12.6	0				
		0.8 meqL-B	22.6	22.7	12.7	0				
		0.8 meqL-C	22.7	22.6	12.6	0				
		0.8 meqL-D	22.7	22.5	12.7	0				
5	9/9/2013	0.8 meqL-A	22.7	22.6	12.7	0	6.9	7.2	51.3	691
		0.8 meqL-B	22.7	22.6	12.7	0	6.9	7.0	65.2	659
		0.8 meqL-C	22.6	22.5	12.5	0				
		0.8 meqL-D	22.6	22.7	12.8	0				
6	9/10/2013	0.8 meqL-A	22.6	22.5	12.5	0				
		0.8 meqL-B	22.7	22.6	12.5	0				
		0.8 meqL-C	22.5	22.6	12.6	0				
		0.8 meqL-D	22.7	22.6	12.7	0				
7	9/11/2013	0.8 meqL-A	22.6	22.7	12.6	0				
		0.8 meqL-B	22.6	22.6	12.7	0				
		0.8 meqL-C	22.6	22.7	12.7	0	6.9	7.0	58.7	702
		0.8 meqL-D	22.7	22.7	12.7	0				
8	9/12/2013	0.8 meqL-A	22.6	22.7	12.6	0				
		0.8 meqL-B	22.7	22.5	12.7	0				
		0.8 meqL-C	22.7	22.5	12.5	0				
		0.8 meqL-D	22.7	22.6	12.8	0				
9	9/13/2013	0.8 meqL-A	22.8	22.7	12.8	0				
		0.8 meqL-B	22.6	22.8	12.7	0				
		0.8 meqL-C	22.9	22.7	12.8	0				
		0.8 meqL-D	22.8	22.7	12.7	0				
10	9/14/2013	0.8 meqL-A	22.8	22.6	12.7	4194				
		0.8 meqL-B	22.6	22.7	12.7	4219				
		0.8 meqL-C	22.9	22.8	12.7	4265				
		0.8 meqL-D	22.8	22.9	12.6	4309	7.1	6.9	63.7	709
11	9/15/2013	0.8 meqL-A	22.6	22.7	12.7	4290	6.9	6.8	46.1	702
		0.8 meqL-B	22.7	22.7	12.7	4290				
		0.8 meqL-C	22.3	22.9	12.8	4316				
		0.8 meqL-D	22.8	22.7	12.6	4256				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
12	9/16/2013	0.8 meqL-A	22.8	22.7	12.7	5710				
		0.8 meqL-B	22.6	22.6	12.7	5710				
		0.8 meqL-C	22.7	22.6	12.8	5630				
		0.8 meqL-D	22.6	22.7	12.7	5630				
13	9/17/2013	0.8 meqL-A	22.7	22.6	12.7	5540				
		0.8 meqL-B	22.6	22.7	12.8	5540				
		0.8 meqL-C	22.7	22.7	12.5	5110				
		0.8 meqL-D	22.6	22.6	12.7	5110				
14	9/18/2013	0.8 meqL-A	22.6	22.6	12.6	5140				
		0.8 meqL-B	22.6	22.7	12.6	5140				
		0.8 meqL-C	22.6	22.6	12.7	4380				
		0.8 meqL-D	22.6	22.5	12.8	4380				
15	9/19/2013	0.8 meqL-A	22.3	21.3	12.7	4010				
		0.8 meqL-B	22.3	21.4	12.8	4130				
		0.8 meqL-C	22.3	21.2	12.6	4100				
		0.8 meqL-D	22.4	21.3	12.7	4030				
16	9/20/2013	0.8 meqL-A	22.9	22.2	12.7	4030				
		0.8 meqL-B	22.4	21.8	12.7	5340	6.6	5.9	60.1	723
		0.8 meqL-C	22.9	22.6	12.9	4930				
		0.8 meqL-D	22.9	22.5	12.8	4010				
17	9/21/2013	0.8 meqL-A	22.7	21.5	12.7	4080				
		0.8 meqL-B	22.7	21.9	12.7	4080				
		0.8 meqL-C	22.7	21.0	12.7	4090	6.7	7.0	61.8	745
		0.8 meqL-D	22.7	21.0	12.7	4090				
18	9/22/2013	0.8 meqL-A	22.1	22.3	12.7	5140				
		0.8 meqL-B	22.1	22.9	12.8	5140				
		0.8 meqL-C	22.1	22.8	12.7	5140				
		0.8 meqL-D	22.1	22.3	12.8	5140				
19	9/23/2013	0.8 meqL-A	22	21.9	12.6	4030				
		0.8 meqL-B	22.0	22.2	12.5	5320				
		0.8 meqL-C	22	22.6	12.6	4910				
		0.8 meqL-D	22	22.1	12.8	4030	6.4	5.9	51.4	756
20	9/24/2013	0.8 meqL-A	24.6	22.9	12.7	4619				
		0.8 meqL-B	24.3	22.7	12.8	4843				
		0.8 meqL-C	23.5	22.8	12.8	4295				
		0.8 meqL-D	24.3	22.6	12.7	4921				
21	9/25/2013	0.8 meqL-A	22.7	22.7	12.7	4619	6.6	6.7	69.1	763
		0.8 meqL-B	22.7	22.5	12.9	4592				
		0.8 meqL-C	22.6	22.8	12.7	4821				
		0.8 meqL-D	22.8	22.7	12.8	4510				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
0	9/4/2013	4.2 meq/L-A	22.7	-	12.5	0	7.1	6.9	55.1	1872
		4.2 meq/L-B	22.7	-	12.7	0	7.0	7.0	54.2	1879
		4.2 meq/L-C	22.7	-	12.5	0	7.1	7.3	50.8	1882
		4.2 meq/L-D	22.7	-	12.5	0	7.1	7.3	57.2	1902
1	9/5/2013	4.2 meq/L-A	22.8	22.7	12.6	0				
		4.2 meq/L-B	22.8	22.8	12.7	0				
		4.2 meq/L-C	22.7	22.6	12.7	0				
		4.2 meq/L-D	22.8	22.7	12.7	0				
2	9/6/2013	4.2 meq/L-A	22.4	22.5	12.6	0				
		4.2 meq/L-B	22.4	22.6	12.7	0				
		4.2 meq/L-C	22.6	22.5	12.5	0				
		4.2 meq/L-D	22.6	22.5	12.6	0				
3	9/7/2013	4.2 meq/L-A	22.6	22.5	12.6	0				
		4.2 meq/L-B	22.7	22.6	12.7	0				
		4.2 meq/L-C	22.6	22.6	12.6	0				
		4.2 meq/L-D	22.7	22.6	12.6	0				
4	9/8/2013	4.2 meq/L-A	22.6	22.6	12.6	0				
		4.2 meq/L-B	22.7	22.6	12.6	0				
		4.2 meq/L-C	22.7	22.7	12.7	0				
		4.2 meq/L-D	22.5	22.6	12.6	0				
5	9/9/2013	4.2 meq/L-A	22.6	22.7	12.6	0	6.9	7.1	58.7	1899
		4.2 meq/L-B	22.6	22.6	12.6	0	6.9	6.8	67.3	1858
		4.2 meq/L-C	22.8	22.5	12.5	0				
		4.2 meq/L-D	22.7	22.8	12.7	0				
6	9/10/2013	4.2 meq/L-A	22.7	22.6	12.6	0				
		4.2 meq/L-B	22.6	22.6	12.6	0				
		4.2 meq/L-C	22.6	22.5	12.7	0				
		4.2 meq/L-D	22.7	22.7	12.6	0				
7	9/11/2013	4.2 meq/L-A	22.7	22.6	12.6	0				
		4.2 meq/L-B	22.6	22.6	12.6	0				
		4.2 meq/L-C	22.6	22.6	12.6	0	7.0	7.1	59.2	1912
		4.2 meq/L-D	22.6	22.6	12.7	0				
8	9/12/2013	4.2 meq/L-A	22.7	22.8	12.5	0				
		4.2 meq/L-B	22.6	22.6	12.7	0				
		4.2 meq/L-C	22.6	22.6	12.6	0				
		4.2 meq/L-D	22.6	22.7	12.8	0				
9	9/13/2013	4.2 meq/L-A	22.7	22.8	12.8	0				
		4.2 meq/L-B	22.8	22.6	12.7	0				
		4.2 meq/L-C	22.7	22.8	12.7	0				
		4.2 meq/L-D	22.9	22.8	12.8	0				
10	9/14/2013	4.2 meq/L-A	22.9	22.8	12.8	4260				
		4.2 meq/L-B	22.8	22.9	12.9	4310				
		4.2 meq/L-C	22.7	22.6	12.6	4248				
		4.2 meq/L-D	22.9	22.5	12.5	4279	7.1	6.8	60.6	1962
11	9/15/2013	4.2 meq/L-A	22.5	22.8	12.6	4278	6.9	6.9	47.9	1954
		4.2 meq/L-B	22.8	22.8	12.8	4274				
		4.2 meq/L-C	22.5	22.8	12.7	4312				
		4.2 meq/L-D	22.9	22.8	12.7	4263				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
12	9/16/2013	4.2 meq/L-A	22.5	22.6	12.8	5770				
		4.2 meq/L-B	22.7	22.8	12.6	5770				
		4.2 meq/L-C	22.7	22.6	12.5	5240				
		4.2 meq/L-D	22.7	22.8	12.6	5240				
13	9/17/2013	4.2 meq/L-A	22.8	22.6	12.6	5420				
		4.2 meq/L-B	22.8	22.7	12.7	5420				
		4.2 meq/L-C	22.6	22.8	12.7	5730				
		4.2 meq/L-D	22.6	22.7	12.6	5730				
14	9/18/2013	4.2 meq/L-A	22.8	22.8	12.8	4180				
		4.2 meq/L-B	22.8	22.8	12.5	4180				
		4.2 meq/L-C	22.8	22.6	12.6	5730				
		4.2 meq/L-D	22.8	22.5	12.5	5730				
15	9/19/2013	4.2 meq/L-A	22.4	21.1	12.9	4090				
		4.2 meq/L-B	22.4	20.7	12.8	4920				
		4.2 meq/L-C	22.4	20.9	12.6	4720				
		4.2 meq/L-D	22.3	20.7	12.7	4210				
16	9/20/2013	4.2 meq/L-A	23.4	22.6	12.7	4100				
		4.2 meq/L-B	23.4	22.5	12.7	5080	6.6	5.6	63.5	2052
		4.2 meq/L-C	23.4	22.3	12.8	5630				
		4.2 meq/L-D	23.4	22.4	12.8	4030				
17	9/21/2013	4.2 meq/L-A	22.7	21.5	12.8	5140				
		4.2 meq/L-B	22.7	21.9	12.8	5140				
		4.2 meq/L-C	22.7	21.0	12.7	5140	6.6	7.1	70.1	2083
		4.2 meq/L-D	22.7	20.9	12.8	5140				
18	9/22/2013	4.2 meq/L-A	22.3	21.8	12.8	4860				
		4.2 meq/L-B	22.3	12.8	12.7	4860				
		4.2 meq/L-C	22.3	22.3	12.7	4860				
		4.2 meq/L-D	22.3	21.4	12.7	4860				
19	9/23/2013	4.2 meq/L-A	22.2	22.9	12.7	4040				
		4.2 meq/L-B	22.2	22.4	12.6	5410				
		4.2 meq/L-C	22.2	23.0	12.8	5100				
		4.2 meq/L-D	22.2	22.4	12.6	4100	6.3	5.6	53.6	2116
20	9/24/2013	4.2 meq/L-A	24.6	22.8	12.8	4472				
		4.2 meq/L-B	24.2	22.8	12.8	4551				
		4.2 meq/L-C	22.8	22.7	12.9	4388				
		4.2 meq/L-D	23.7	22.5	12.5	4763				
21	9/25/2013	4.2 meq/L-A	22.5	22.5	12.8	4728	6.7	6.6	60.6	2110
		4.2 meq/L-B	22.8	22.8	12.9	4685				
		4.2 meq/L-C	22.7	22.7	12.9	4683				
		4.2 meq/L-D	22.7	22.8	12.7	4756				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
0	9/4/2013	19.8 meq/L -A	22.6	-	12.4	0	7.0	7.0	57.9	2836
		19.8 meq/L -B	22.6	-	12.5	0	7.0	6.9	61.5	2847
		19.8 meq/L -C	22.6	-	12.6	0	7.0	7.2	52.6	2849
		19.8 meq/L -D	22.6	-	12.6	0	7.0	7.2	59.1	2873
1	9/5/2013	19.8 meq/L -A	22.9	22.7	12.5	0				
		19.8 meq/L -B	22.9	22.7	12.7	0				
		19.8 meq/L -C	22.7	22.7	12.7	0				
		19.8 meq/L -D	22.7	22.6	12.8	0				
2	9/6/2013	19.8 meq/L -A	22.4	22.4	12.6	0				
		19.8 meq/L -B	22.4	22.6	12.5	0				
		19.8 meq/L -C	22.5	22.6	12.6	0				
		19.8 meq/L -D	22.6	22.6	12.5	0				
3	9/7/2013	19.8 meq/L -A	22.7	22.7	12.6	0				
		19.8 meq/L -B	22.7	22.5	12.7	0				
		19.8 meq/L -C	22.6	22.6	12.7	0				
		19.8 meq/L -D	22.7	22.7	12.6	0				
4	9/8/2013	19.8 meq/L -A	22.5	22.7	12.7	0				
		19.8 meq/L -B	22.7	22.6	12.6	0				
		19.8 meq/L -C	22.6	22.7	12.7	0				
		19.8 meq/L -D	22.5	22.7	12.5	0				
5	9/9/2013	19.8 meq/L -A	22.7	22.6	12.6	0	6.9	7.0	59.2	2865
		19.8 meq/L -B	22.6	22.7	12.6	0	7.0	7.0	68.1	2853
		19.8 meq/L -C	22.7	22.6	12.6	0				
		19.8 meq/L -D	22.6	22.6	12.7	0				
6	9/10/2013	19.8 meq/L -A	22.7	22.7	12.5	0				
		19.8 meq/L -B	22.6	22.7	12.6	0				
		19.8 meq/L -C	22.5	22.7	12.7	0				
		19.8 meq/L -D	22.6	22.6	12.6	0				
7	9/11/2013	19.8 meq/L -A	22.6	22.7	12.6	0				
		19.8 meq/L -B	22.6	22.7	12.6	0				
		19.8 meq/L -C	22.7	22.7	12.5	0	7.0	7.0	60.3	2874
		19.8 meq/L -D	22.7	22.7	12.6	0				
8	9/12/2013	19.8 meq/L -A	22.7	22.6	12.6	0				
		19.8 meq/L -B	22.8	22.7	12.7	0				
		19.8 meq/L -C	22.5	22.5	12.6	0				
		19.8 meq/L -D	22.7	22.7	12.9	0				
9	9/13/2013	19.8 meq/L -A	22.8	22.7	12.7	0				
		19.8 meq/L -B	22.7	22.7	12.8	0				
		19.8 meq/L -C	22.7	22.8	12.8	0				
		19.8 meq/L -D	22.7	22.8	12.7	0				
10	9/14/2013	19.8 meq/L -A	22.7	22.8	12.7	4284				
		19.8 meq/L -B	22.7	22.8	12.7	4276				
		19.8 meq/L -C	22.8	22.7	12.8	4256				
		19.8 meq/L -D	22.8	22.8	12.6	4284	7.2	6.5	57.2	2883
11	9/15/2013	19.8 meq/L -A	22.7	22.6	12.7	4296	6.8	7.0	46.3	2851
		19.8 meq/L -B	22.9	22.9	12.9	4280				
		19.8 meq/L -C	22.7	22.8	12.7	4301				
		19.8 meq/L -D	22.7	22.7	12.5	4316				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
12	9/16/2013	19.8 meq/L -A	22.6	22.6	12.6	4830				
		19.8 meq/L -B	22.8	22.6	12.8	4830				
		19.8 meq/L -C	22.7	22.8	12.7	5540				
		19.8 meq/L -D	22.6	22.5	12.5	5540				
13	9/17/2013	19.8 meq/L -A	22.7	22.7	12.5	5860				
		19.8 meq/L -B	22.6	22.6	12.5	5860				
		19.8 meq/L -C	22.6	22.6	12.6	5690				
		19.8 meq/L -D	22.7	22.6	12.7	5690				
14	9/18/2013	19.8 meq/L -A	22.8	22.5	12.6	4110				
		19.8 meq/L -B	22.8	22.5	12.6	4110				
		19.8 meq/L -C	22.8	22.8	12.8	4480				
		19.8 meq/L -D	22.8	22.5	12.6	4950				
15	9/19/2013	19.8 meq/L -A	22.3	20.4	12.7	4150				
		19.8 meq/L -B	22.3	21.1	12.7	4600				
		19.8 meq/L -C	22.3	21.3	12.7	4170				
		19.8 meq/L -D	22.3	20.6	12.8	4080				
16	9/20/2013	19.8 meq/L -A	22.8	22.2	12.8	4020				
		19.8 meq/L -B	22.8	22.4	12.9	5020	6.8	5.8	62.3	2987
		19.8 meq/L -C	22.8	22.3	12.8	4260				
		19.8 meq/L -D	22.8	22.0	12.9	4000				
17	9/21/2013	19.8 meq/L -A	22.1	21.3	12.8	4870				
		19.8 meq/L -B	22.1	21.8	12.8	4870				
		19.8 meq/L -C	22.1	21.0	12.7	4870	6.8	6.8	67.2	3013
		19.8 meq/L -D	22.1	20.6	12.7	4870				
18	9/22/2013	19.8 meq/L -A	21.8	21.9	12.8	4380				
		19.8 meq/L -B	21.8	21.9	12.7	4380				
		19.8 meq/L -C	21.8	21.6	12.7	4380				
		19.8 meq/L -D	21.8	21.6	12.6	4380				
19	9/23/2013	19.8 meq/L -A	22.3	22.3	12.7	4120				
		19.8 meq/L -B	22.3	21.5	12.7	5430				
		19.8 meq/L -C	22.3	21.8	12.6	5010				
		19.8 meq/L -D	22.3	21.3	12.8	4010	6.1	5.4	57.2	3019
20	9/24/2013	19.8 meq/L -A	24.8	22.7	12.7	4583				
		19.8 meq/L -B	24.0	22.8	12.7	4372				
		19.8 meq/L -C	22.7	22.8	12.9	4472				
		19.8 meq/L -D	24.1	22.6	12.4	4512				
21	9/25/2013	19.8 meq/L -A	23.0	22.6	12.9	4899	6.8	6.4	68.4	3032
		19.8 meq/L -B	22.7	22.7	12.7	4723				
		19.8 meq/L -C	22.8	22.8	12.6	4819				
		19.8 meq/L -D	22.8	22.7	12.5	4892				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (μ s/cm)
0	9/4/2013	51.1 meq/L -A	22.7	-	12.5	0	7.0	7.1	40.8	4189
		51.1 meq/L -B	22.7	-	12.6	0	7.0	6.9	683	4196
		51.1 meq/L -C	22.7	-	12.6	0	7.0	7.3	55.8	4132
		51.1 meq/L -D	22.7	-	12.6	0	6.9	7.0	60.7	4098
1	9/5/2013	51.1 meq/L -A	22.8	22.8	12.5	0				
		51.1 meq/L -B	22.8	22.7	12.6	0				
		51.1 meq/L -C	22.7	22.7	12.6	0				
		51.1 meq/L -D	22.8	22.7	12.6	0				
2	9/6/2013	51.1 meq/L -A	22.5	22.5	12.6	0				
		51.1 meq/L -B	22.5	22.6	12.6	0				
		51.1 meq/L -C	22.5	22.6	12.6	0				
		51.1 meq/L -D	22.6	22.5	12.7	0				
3	9/7/2013	51.1 meq/L -A	22.7	22.7	12.7	0				
		51.1 meq/L -B	22.7	22.5	12.6	0				
		51.1 meq/L -C	22.6	22.7	12.7	0				
		51.1 meq/L -D	22.8	22.5	12.7	0				
4	9/8/2013	51.1 meq/L -A	22.7	22.7	12.7	0				
		51.1 meq/L -B	22.8	22.7	12.6	0				
		51.1 meq/L -C	22.6	22.6	12.6	0				
		51.1 meq/L -D	22.6	22.6	12.6	0				
5	9/9/2013	51.1 meq/L -A	22.6	22.7	12.7	0	6.8	7.1	61.4	4150
		51.1 meq/L -B	22.7	22.7	12.7	0	6.9	7.0	60.5	4138
		51.1 meq/L -C	22.6	22.7	12.5	0				
		51.1 meq/L -D	22.5	22.6	12.6	0				
6	9/10/2013	51.1 meq/L -A	22.6	22.6	12.5	0				
		51.1 meq/L -B	22.5	22.6	12.5	0				
		51.1 meq/L -C	22.6	22.7	12.5	0				
		51.1 meq/L -D	22.6	22.6	12.7	0				
7	9/11/2013	51.1 meq/L -A	22.7	22.6	12.5	0				
		51.1 meq/L -B	22.6	22.6	12.7	0				
		51.1 meq/L -C	22.6	22.6	12.7	0	6.9	7.0	62.4	4181
		51.1 meq/L -D	22.6	22.6	12.6	0				
8	9/12/2013	51.1 meq/L -A	22.8	22.6	12.6	0				
		51.1 meq/L -B	22.7	22.7	12.6	0				
		51.1 meq/L -C	22.6	22.6	12.6	0				
		51.1 meq/L -D	22.6	22.6	12.8	0				
9	9/13/2013	51.1 meq/L -A	22.7	22.8	12.6	0				
		51.1 meq/L -B	22.6	22.8	12.9	0				
		51.1 meq/L -C	22.8	22.7	12.7	0				
		51.1 meq/L -D	22.8	22.7	12.7	0				
10	9/14/2013	51.1 meq/L -A	22.8	22.7	12.8	4290				
		51.1 meq/L -B	22.8	22.7	12.8	4283				
		51.1 meq/L -C	22.9	22.8	12.7	4279				
		51.1 meq/L -D	22.7	22.9	12.6	4292	7.0	6.7	59	4204
11	9/15/2013	51.1 meq/L -A	22.7	22.5	12.5	4312	6.8	7.0	48.1	4180
		51.1 meq/L -B	22.8	22.8	12.8	4316				
		51.1 meq/L -C	22.8	22.7	12.8	4288				
		51.1 meq/L -D	22.6	22.8	12.6	4244				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
12	9/16/2013	51.1 meq/L -A	22.7	22.7	12.6	4930				
		51.1 meq/L -B	22.7	22.6	12.7	4950				
		51.1 meq/L -C	22.6	22.6	12.6	5670				
		51.1 meq/L -D	22.6	22.7	12.6	5670				
13	9/17/2013	51.1 meq/L -A	22.7	22.8	12.7	4950				
		51.1 meq/L -B	22.7	22.8	12.7	4950				
		51.1 meq/L -C	22.7	22.6	12.7	5400				
		51.1 meq/L -D	22.5	22.6	12.7	5400				
14	9/18/2013	51.1 meq/L -A	22.8	22.6	12.5	5290				
		51.1 meq/L -B	22.8	22.8	12.8	5290				
		51.1 meq/L -C	22.8	22.8	12.8	4480				
		51.1 meq/L -D	22.8	22.8	12.5	4480				
15	9/19/2013	51.1 meq/L -A	21.9	21.3	12.7	4060				
		51.1 meq/L -B	21.9	21.9	12.8	4620				
		51.1 meq/L -C	21.9	21.7	12.8	4510				
		51.1 meq/L -D	21.9	21.3	12.8	4150				
16	9/20/2013	51.1 meq/L -A	23.5	22.4	12.8	4010				
		51.1 meq/L -B	23.5	22.3	12.9	4500	6.7	5.8	59.2	4293
		51.1 meq/L -C	23.5	22.6	12.7	5420				
		51.1 meq/L -D	23.5	22.7	12.8	4020				
17	9/21/2013	51.1 meq/L -A	22.1	22.0	12.7	4260				
		51.1 meq/L -B	22.1	21.8	12.7	4260				
		51.1 meq/L -C	22.1	21.8	12.8	4260	6.7	6.9	69.3	4364
		51.1 meq/L -D	22.1	21.5	12.7	4260				
18	9/22/2013	51.1 meq/L -A	22.5	22.6	12.7	5130				
		51.1 meq/L -B	22.5	22.3	12.9	5130				
		51.1 meq/L -C	22.3	22.1	12.8	5130				
		51.1 meq/L -D	22.3	21.8	12.8	5130				
19	9/23/2013	51.1 meq/L -A	22.8	21.4	12.6	4010				
		51.1 meq/L -B	22.8	22.3	12.8	5140				
		51.1 meq/L -C	22.8	22.0	12.8	4900				
		51.1 meq/L -D	22.8	22.1	12.6	4040	6.1	5.5	58.9	4388
20	9/24/2013	51.1 meq/L -A	24.6	22.6	12.7	4912				
		51.1 meq/L -B	24.1	22.7	12.5	4480				
		51.1 meq/L -C	22.4	22.6	12.8	4582				
		51.1 meq/L -D	24.0	22.7	12.6	4633				
21	9/25/2013	51.1 meq/L -A	22.8	22.8	12.7	4718	6.8	6.4	67.2	4396
		51.1 meq/L -B	22.7	22.7	12.8	4885				
		51.1 meq/L -C	22.6	22.6	12.7	4916				
		51.1 meq/L -D	22.6	22.8	12.7	4667				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
0	9/4/2013	103.2 meq/L -A	22.6	-	12.5	0	7.0	7.0	43.9	8365
		103.2 meq/L -B	22.6	-	12.5	0	6.9	6.8	625	8374
		103.2 meq/L -C	22.6	-	12.6	0	6.9	7.2	54.7	8352
		103.2 meq/L -D	22.6	-	12.6	0	6.9	7.4	60.1	8326
1	9/5/2013	103.2 meq/L -A	22.8	22.6	12.6	0				
		103.2 meq/L -B	22.9	22.7	12.6	0				
		103.2 meq/L -C	22.7	22.6	12.6	0				
		103.2 meq/L -D	22.7	22.7	12.7	0				
2	9/6/2013	103.2 meq/L -A	22.4	22.6	12.7	0				
		103.2 meq/L -B	22.4	22.5	12.6	0				
		103.2 meq/L -C	22.6	22.5	12.5	0				
		103.2 meq/L -D	22.5	22.6	12.6	0				
3	9/7/2013	103.2 meq/L -A	22.6	22.6	12.6	0				
		103.2 meq/L -B	22.6	22.6	12.6	0				
		103.2 meq/L -C	22.7	22.6	12.6	0				
		103.2 meq/L -D	22.4	22.6	12.7	0				
4	9/8/2013	103.2 meq/L -A	22.6	22.7	12.6	0				
		103.2 meq/L -B	22.7	22.8	12.7	0				
		103.2 meq/L -C	22.6	22.7	12.6	0				
		103.2 meq/L -D	22.6	22.7	12.6	0				
5	9/9/2013	103.2 meq/L -A	22.7	22.6	12.7	0	6.8	7.2	60.8	8379
		103.2 meq/L -B	22.6	22.7	12.6	0	6.8	6.9	67.3	8351
		103.2 meq/L -C	22.5	22.5	12.6	0				
		103.2 meq/L -D	22.6	22.7	12.7	0				
6	9/10/2013	103.2 meq/L -A	22.5	22.5	12.6	0				
		103.2 meq/L -B	22.6	22.7	12.6	0				
		103.2 meq/L -C	22.7	22.7	12.6	0				
		103.2 meq/L -D	22.7	22.7	12.5	0				
7	9/11/2013	103.2 meq/L -A	22.6	22.5	12.6	0				
		103.2 meq/L -B	22.7	22.7	12.6	0				
		103.2 meq/L -C	22.7	22.6	12.6	0	6.9	6.8	65.2	8395
		103.2 meq/L -D	22.6	22.7	12.6	0				
8	9/12/2013	103.2 meq/L -A	22.8	22.7	12.7	0				
		103.2 meq/L -B	22.6	22.6	12.6	0				
		103.2 meq/L -C	22.6	22.7	12.7	0				
		103.2 meq/L -D	22.7	22.7	12.7	0				
9	9/13/2013	103.2 meq/L -A	22.7	22.7	12.7	0				
		103.2 meq/L -B	22.7	22.9	12.9	0				
		103.2 meq/L -C	22.8	22.8	12.8	0				
		103.2 meq/L -D	22.9	22.8	12.8	0				
10	9/14/2013	103.2 meq/L -A	22.7	22.8	12.7	4266				
		103.2 meq/L -B	22.9	22.7	12.9	4251				
		103.2 meq/L -C	22.7	22.6	12.7	4288				
		103.2 meq/L -D	22.6	22.7	12.6	4298	7.0	6.9	49.8	8432
11	9/15/2013	103.2 meq/L -A	22.8	22.7	12.6	4316	6.8	6.9	49.8	8412
		103.2 meq/L -B	22.7	22.8	12.9	4312				
		103.2 meq/L -C	22.7	22.8	12.7	4291				
		103.2 meq/L -D	22.5	22.7	12.5	4256				

Study Day	Study Date	Tank ID (Rep-Treatment #)	Water Bath (C)	AM Temp (C)	PM Temp (C)	Light Intensity (Lux)	pH (su)	D.O. (mg/L)	ORP	Cond. (µs/cm)
12	9/16/2013	103.2 meq/L -A	22.7	22.7	12.7	5500				
		103.2 meq/L -B	22.5	22.7	13.6	5500				
		103.2 meq/L -C	22.6	22.7	12.7	5130				
		103.2 meq/L -D	22.7	22.7	12.8	5130				
13	9/17/2013	103.2 meq/L -A	22.6	22.6	12.7	5290				
		103.2 meq/L -B	22.6	22.7	12.7	5290				
		103.2 meq/L -C	22.8	22.7	12.7	5270				
		103.2 meq/L -D	22.6	22.7	12.5	5270				
14	9/18/2013	103.2 meq/L -A	22.8	22.7	12.8	4360				
		103.2 meq/L -B	22.8	22.7	12.8	4360				
		103.2 meq/L -C	22.8	22.8	12.6	5190				
		103.2 meq/L -D	22.8	22.5	12.8	5190				
15	9/19/2013	103.2 meq/L -A	21.7	21.0	12.7	4050				
		103.2 meq/L -B	21.7	21.7	12.8	4610				
		103.2 meq/L -C	21.7	21.3	12.8	4720				
		103.2 meq/L -D	21.7	21.9	12.7	4040				
16	9/20/2013	103.2 meq/L -A	22.4	22.6	12.8	4590				
		103.2 meq/L -B	22.4	22.1	12.9	5190	6.8	5.8	61.4	8651
		103.2 meq/L -C	22.4	22.6	12.8	4390				
		103.2 meq/L -D	22.4	22.2	12.7	4010				
17	9/21/2013	103.2 meq/L -A	22.3	21.8	12.7	5580				
		103.2 meq/L -B	22.3	21.7	12.7	5580				
		103.2 meq/L -C	22.3	21.5	12.8	5580	6.6	6.8	58.6	8816
		103.2 meq/L -D	22.3	21.6	12.8	5580				
18	9/22/2013	103.2 meq/L -A	22.7	22.1	12.7	5680				
		103.2 meq/L -B	22.7	22.4	12.8	5680				
		103.2 meq/L -C	22.7	22.1	12.8	5680				
		103.2 meq/L -D	22.7	22.2	12.8	5680				
19	9/23/2013	103.2 meq/L -A	21.0	22.0	12.7	4110				
		103.2 meq/L -B	21.0	21.5	12.8	5160				
		103.2 meq/L -C	21.0	21.0	12.6	5150				
		103.2 meq/L -D	21.0	20.2	12.8	4500	6.4	5.7	63.2	8859
20	9/24/2013	103.2 meq/L -A	24.6	22.8	12.6	4642				
		103.2 meq/L -B	24.2	22.6	12.7	4965				
		103.2 meq/L -C	22.6	22.8	12.7	4751				
		103.2 meq/L -D	23.7	22.8	12.7	4718				
21	9/25/2013	103.2 meq/L -A	22.8	22.7	12.8	4584	6.5	6.5	68.9	8902
		103.2 meq/L -B	22.8	22.6	12.7	4919				
		103.2 meq/L -C	22.5	22.7	12.6	4748				
		103.2 meq/L -D	22.7	22.6	12.8	4831				

Study Day	Treatment	Rep	Hardness (mg/L)	Alkalinity (mg/L)	Res. Oxid. (mg/L)	NH ₃ -N (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)
0	HS-1 (1:4)	A	116	16	<0.01	7.64	65	4.92
0	HS-1 (1:4)	B	112	18	<0.01	7.44	66	4.80
21	HS-1 (1:4)	C	160	20	<0.01	7.83	67	4.83
21	HS-1 (1:4)	D	196	20	<0.01	7.29	68	4.26
0	100 mg/L BA	A	140	14	<0.01	7.20	65	5.04
0	100 mg/L BA	B	114	16	<0.01	7.38	65	5.12
21	100 mg/L BA	C	160	20	<0.01	7.35	69	4.61
21	100 mg/L BA	D	192	20	<0.01	7.51	56	4.75

Study Day	Treatment	Rep	Hardness (mg/L)	Alkalinity (mg/L)	Res. Oxid. (mg/L)	NH ₃ -N (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)
0	10 mg/L SO ₄ ²⁻	A	120	12	<0.01	7.12	59	5.08
0	10 mg/L SO ₄ ²⁻	B	122	12	<0.01	7.62	60	5.06
21	10 mg/L SO ₄ ²⁻	C	188	8	<0.01	7.28	59	4.92
21	10 mg/L SO ₄ ²⁻	D	208	8	<0.01	7.79	59	4.88
0	250 mg/L SO ₄ ²⁻	A	146	12	<0.01	7.48	69	4.78
0	250 mg/L SO ₄ ²⁻	B	196	10	<0.01	7.18	69	4.92
21	250 mg/L SO ₄ ²⁻	C	320	6	<0.01	7.04	57	4.61
21	250 mg/L SO ₄ ²⁻	D	328	6	<0.01	7.32	52	4.93
0	1000 mg/L SO ₄ ²⁻	A	426	12	<0.01	7.66	62	4.54
0	1000 mg/L SO ₄ ²⁻	B	440	10	<0.01	7.40	62	4.76
21	1000 mg/L SO ₄ ²⁻	C	708	4	<0.01	7.51	54	4.39
21	1000 mg/L SO ₄ ²⁻	D	780	6	<0.01	7.51	50	4.66
0	2500 mg/L SO ₄ ²⁻	A	892	10	<0.01	6.96	59	4.68
0	2500 mg/L SO ₄ ²⁻	B	888	10	<0.01	6.82	60	5.08
21	2500 mg/L SO ₄ ²⁻	C	1680	8	<0.01	7.08	61	4.56
21	2500 mg/L SO ₄ ²⁻	D	1930	12	<0.01	7.08	65	5.08
0	5000 mg/L SO ₄ ²⁻	A	1590	8	<0.01	7.54	60	4.84
0	5000 mg/L SO ₄ ²⁻	B	1680	8	<0.01	6.96	60	4.80
21	5000 mg/L SO ₄ ²⁻	C	2730	14	<0.01	7.39	65	4.09
21	5000 mg/L SO ₄ ²⁻	D	2960	18	<0.01	7.12	67	4.91

Study Day	Treatment	Rep	Hardness (mg/L)	Alkalinity (mg/L)	Res. Oxid. (mg/L)	NH ₃ -N (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)
0	0.8 meq/L	A	180	12	<0.01	7.66	57	5.10
0	0.8 meq/L	B	156	10	<0.01	6.96	57	4.58
21	0.8 meq/L	C	400	8	<0.01	7.82	56	5.02
21	0.8 meq/L	D	300	10	<0.01	7.03	53	4.56
0	4.2 meq/L	A	280	6	<0.01	6.90	55	4.98
0	4.2 meq/L	B	280	8	<0.01	7.18	54	4.88
21	4.2 meq/L	C	530	8	<0.01	7.36	59	5.08
21	4.2 meq/L	D	550	12	<0.01	6.99	58	4.39
0	19.8 meq/L	A	372	6	<0.01	7.12	62	4.78
0	19.8 meq/L	B	384	8	<0.01	7.26	60	5.16
21	19.8 meq/L	C	660	8	<0.01	7.21	53	4.92
21	19.8 meq/L	D	740	10	<0.01	7.31	49	4.56
0	51.1 meq/L	A	510	6	<0.01	7.36	59	4.82
0	51.1 meq/L	B	480	6	<0.01	7.40	59	4.78
21	51.1 meq/L	C	1120	10	<0.01	7.38	58	4.88
21	51.1 meq/L	D	1070	6	<0.01	7.52	60	4.88
0	103.2 meq/L	A	900	6	<0.01	6.88	49	4.64
0	103.2 meq/L	B	900	6	<0.01	7.12	49	4.86
21	103.2 meq/L	C	1860	4	<0.01	7.04	64	4.71
21	103.2 meq/L	D	2210	6	<0.01	7.28	62	4.32

Study Day	Treatment	Rep	Sulfate (mg/L)
0	HS-1 (1:4)	A	48
0	HS-1 (1:4)	B	50
10	HS-1 (1:4)	C	50
10	HS-1 (1:4)	D	52
21	HS-1 (1:4)	A	54
21	HS-1 (1:4)	B	56
0	100 mg/L BA	A	52
0	100 mg/L BA	B	54
10	100 mg/L BA	C	54
10	100 mg/L BA	D	52
21	100 mg/L BA	A	52
21	100 mg/L BA	B	52

Study Day	Treatment	Rep	Sulfate (mg/L)
0	10 mg/L SO ₄ ²⁻	A	12
0	10 mg/L SO ₄ ²⁻	B	12
10	10 mg/L SO ₄ ²⁻	C	14
10	10 mg/L SO ₄ ²⁻	D	12
21	10 mg/L SO ₄ ²⁻	A	12
21	10 mg/L SO ₄ ²⁻	B	14
0	250 mg/L SO ₄ ²⁻	A	230
0	250 mg/L SO ₄ ²⁻	B	240
10	250 mg/L SO ₄ ²⁻	C	234
10	250 mg/L SO ₄ ²⁻	D	235
21	250 mg/L SO ₄ ²⁻	A	240
21	250 mg/L SO ₄ ²⁻	B	256
0	1000 mg/L SO ₄ ²⁻	A	1050
0	1000 mg/L SO ₄ ²⁻	B	1080
10	1000 mg/L SO ₄ ²⁻	C	1030
10	1000 mg/L SO ₄ ²⁻	D	1042
21	1000 mg/L SO ₄ ²⁻	A	1024
21	1000 mg/L SO ₄ ²⁻	B	1038
0	2500 mg/L SO ₄ ²⁻	A	2530
0	2500 mg/L SO ₄ ²⁻	B	2510
10	2500 mg/L SO ₄ ²⁻	C	2570
10	2500 mg/L SO ₄ ²⁻	D	2592
21	2500 mg/L SO ₄ ²⁻	A	2524
21	2500 mg/L SO ₄ ²⁻	B	2546
0	5000 mg/L SO ₄ ²⁻	A	4900
0	5000 mg/L SO ₄ ²⁻	B	5010
10	5000 mg/L SO ₄ ²⁻	C	4952
10	5000 mg/L SO ₄ ²⁻	D	4985
21	5000 mg/L SO ₄ ²⁻	A	5012
21	5000 mg/L SO ₄ ²⁻	B	5022

Study Day	Treatment	Rep	Sulfate (mg/L)
0	0.8 meq/L	A	54
0	0.8 meq/L	B	48
10	0.8 meq/L	C	50
10	0.8 meq/L	D	56
21	0.8 meq/L	A	52
21	0.8 meq/L	B	56
0	4.2 meq/L	A	52
0	4.2 meq/L	B	52
10	4.2 meq/L	C	48
10	4.2 meq/L	D	50
21	4.2 meq/L	A	54
21	4.2 meq/L	B	46
0	19.8 meq/L	A	50
0	19.8 meq/L	B	54
10	19.8 meq/L	C	46
10	19.8 meq/L	D	46
21	19.8 meq/L	A	56
21	19.8 meq/L	B	48
0	51.1 meq/L	A	56
0	51.1 meq/L	B	50
10	51.1 meq/L	C	52
10	51.1 meq/L	D	52
21	51.1 meq/L	A	56
21	51.1 meq/L	B	56
0	103.2 meq/L	A	54
0	103.2 meq/L	B	54
10	103.2 meq/L	C	46
10	103.2 meq/L	D	54
21	103.2 meq/L	A	54
21	103.2 meq/L	B	54

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
HS-1 (1:4)	A	1	0.0040	0.0003	0.0020	3.517	2.088	0	1
HS-1 (1:4)	A	2	0.0042	0.0006	0.0014	4.392	1.133	0	1
HS-1 (1:4)	A	3	0.0000	0.0004		0.986	1.976	0	0
HS-1 (1:4)	A	4	0.0042	0.0002	0.0016	5.178	3.487	0	1
HS-1 (1:4)	A	5	0.0036	0.0005	0.0021	4.035	2.795	0	1
HS-1 (1:4)	A	6	0.0035	0.0000	0.0010	3.612	3.150	0	1
HS-1 (1:4)	A	7	0.0052	0.0009	0.0023	5.758	4.505	0	1
HS-1 (1:4)	A	8	0.0049	0.0009	0.0025	4.818	6.558	0	1
HS-1 (1:4)	A	9	0.0035	0.0012	0.0022	2.796	2.689	0	1
HS-1 (1:4)	A	10	0.0025	0.0001	0.0013	4.447	3.086	0	1
HS-1 (1:4)	A	11	0.0033	0.0009	0.0023	5.060	3.416	0	1
HS-1 (1:4)	A	12	0.0022	0.0000	0.0013	3.288	2.401	0	1
HS-1 (1:4)	A	13	0.0024	0.0002		5.718	4.678	0	1
HS-1 (1:4)	A	14	0.0027	0.0002	0.0016	3.547	5.508	0	1
HS-1 (1:4)	A	15	0.0029	0.0003	0.0024	4.899	2.961	0	1
HS-1 (1:4)	A	16	0.0018	0.0001		2.895	1.245	0	1
HS-1 (1:4)	A	17	0.0022	0.0001	0.0005	2.948	1.382	0	1
HS-1 (1:4)	A	18	0.0054	0.0007	0.0052	2.706	4.306	0	1
HS-1 (1:4)	B	1	0.0029	0.0004	0.0010	5.285	1.770	0	1
HS-1 (1:4)	B	2	0.0017	0.0005	0.0020	2.791	3.907	0	1
HS-1 (1:4)	B	3	0.0029	0.0006	0.0027	3.591	2.133	0	1
HS-1 (1:4)	B	4	0.0011	0.0001		2.657	1.631	0	0
HS-1 (1:4)	B	5	0.0029	0.0003	0.0026	3.037	3.092	0	1
HS-1 (1:4)	B	6	0.0026	0.0005	0.0016	2.047	1.788	0	1
HS-1 (1:4)	B	7	0.0039	0.0004	0.0013	3.130	4.873	0	1
HS-1 (1:4)	B	8	0.0023	0.0003	0.0025	3.691	5.298	0	1
HS-1 (1:4)	B	9	0.0039	0.0003	0.0035	5.134	1.891	0	1
HS-1 (1:4)	B	10	0.0038	0.0002	0.0028	5.561	1.261	0	1
HS-1 (1:4)	B	11	0.0026	0.0002	0.0041	5.757	4.153	0	1
HS-1 (1:4)	B	12	0.0016	0.0009	0.0021	3.398	4.720	0	1
HS-1 (1:4)	B	13	0.0028	0.0010	0.0038	3.820	7.747	0	1
HS-1 (1:4)	C	1	0.0019	0.0003	0.0040	3.254	3.893	0	1
HS-1 (1:4)	C	2	0.0022	0.0004	0.0016	4.640	6.011	0	1
HS-1 (1:4)	C	3	0.0024	0.0005	0.0021	2.973	4.052	0	1
HS-1 (1:4)	C	4	0.0033	0.0008	0.0033	4.099	4.117	0	1
HS-1 (1:4)	C	5	0.0016	0.0005	0.0020	2.071	4.815	0	1
HS-1 (1:4)	C	6	0.0024	0.0001	0.0022	4.623	1.855	0	1
HS-1 (1:4)	C	7	0.0017	0.0001	0.0009	3.570	5.259	0	1
HS-1 (1:4)	C	8	0.0029	0.0002	0.0017	4.500	3.472	0	1
HS-1 (1:4)	C	9	0.0018	0.0002	0.0015	2.372	1.743	0	1
HS-1 (1:4)	C	10	0.0008	0.0002		1.756	2.393	0	0
HS-1 (1:4)	C	11	0.0022	0.0006	0.0022	3.740	4.328	0	1
HS-1 (1:4)	C	12	0.0012	0.0001		2.306	4.396	0	0
HS-1 (1:4)	C	13	0.0023	0.0003	0.0029	2.217	3.970	0	1
HS-1 (1:4)	C	14	0.0025	0.0005	0.0028	2.743	4.728	0	1
HS-1 (1:4)	C	15	0.0015	0.0006		2.174	4.206	0	0
HS-1 (1:4)	D	1	0.0008	0.0005		1.002	1.624	0	0
HS-1 (1:4)	D	2	0.0036	0.0006	0.0029	4.419	2.982	0	1
HS-1 (1:4)	D	3	0.0028	0.0001		3.089	3.161	0	0
HS-1 (1:4)	D	4	0.0042	0.0010	0.0014	5.631	6.488	0	1
HS-1 (1:4)	D	5	0.0015	0.0006	0.0022	2.603	5.607	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
HS-1 (1:4)	D	6	0.0027	0.0005	0.0030	4.435	5.833	0	1
HS-1 (1:4)	D	7	0.0024	0.0004	0.0034	3.416	3.711	0	1
HS-1 (1:4)	D	8	0.0020	0.0006	0.0040	4.104	8.473	0	1
HS-1 (1:4)	D	9	0.0073	0.0006	0.0025	8.498	4.431	0	1
HS-1 (1:4)	D	10	0.0036	0.0010	0.0031	7.754	7.829	0	1
HS-1 (1:4)	D	11	0.0033	0.0002	0.0011	5.111	8.675	0	1
HS-1 (1:4)	D	12	0.0003	0.0009		2.651	8.678	0	0
HS-1 (1:4)	D	13	0.0026	0.0008	0.0009	2.362	2.298	0	1
100 mg/L BA	A	1	0.0018	0.0004	0.0004	2.028	0.966	1	1
100 mg/L BA	A	2	0.0021	0.0000	0.0003	2.569	0.520	1	1
100 mg/L BA	A	3	0.0022	0.0003	0.0014	2.880	1.962	1	1
100 mg/L BA	A	4	0.0016	0.0003		1.366	2.432	1	0
100 mg/L BA	A	5	0.0018	0.0000		4.146	0.539	1	0
100 mg/L BA	A	6	0.0024	0.0005		3.587	1.049	1	0
100 mg/L BA	B	1	0.0021	0.0001		2.371	1.582	1	0
100 mg/L BA	B	2	0.0022	0.0001	0.0010	3.698	2.557	0	1
100 mg/L BA	B	3	0.0022	0.0000	0.0010	3.418	3.481	0	1
100 mg/L BA	B	4	0.0005	0.0000		1.429	0.664	1	0
100 mg/L BA	B	5	0.0013	0.0001		2.209	2.860	1	0
100 mg/L BA	C	1	0.0028	0.0002	0.0017	2.986	3.066	1	1
100 mg/L BA	C	2	0.0024	0.0001	0.0004	4.422	0.459	1	1
100 mg/L BA	C	3	0.0020	0.0003	0.0006	3.414	1.964	0	1
100 mg/L BA	C	4	0.0024	0.0000	0.0008	3.795	2.673	0	1
100 mg/L BA	C	5	0.0021	0.0004	0.0012	4.608	3.169	1	1
100 mg/L BA	C	6	0.0015	0.0003	0.0001	3.188	1.819	0	1
100 mg/L BA	C	7	0.0016	0.0003		1.701	0.859	1	0
100 mg/L BA	D	1	0.0008	0.0004		0.760	1.608	1	0
100 mg/L BA	D	2	0.0031	0.0018		2.829	2.644	1	0
100 mg/L BA	D	3	0.0020	0.0005	0.0006	1.278	1.654	0	1
100 mg/L BA	D	4	0.0027	0.0010	0.0016	3.469	2.395	1	1
100 mg/L BA	D	5	0.0020	0.0008	0.0003	4.062	2.547	1	1
100 mg/L BA	D	6	0.0040	0.0002	0.0013	4.347	1.943	0	1
100 mg/L BA	D	7	0.0032	0.0002	0.0021	3.733	2.121	1	1
100 mg/L BA	D	8	0.0007	0.0003		1.955	3.196	0	0
100 mg/L BA	D	9	0.0009	0.0001	0.0000	1.588	1.322	1	1
10 mg/L SO ₄ ²⁻	A	1	0.0024	0.0002	0.0007	2.803	1.355	0	1
10 mg/L SO ₄ ²⁻	A	2	0.0047	0.0002	0.0035	2.508	3.034	0	1
10 mg/L SO ₄ ²⁻	A	3	0.0016	0.0001	0.0023	3.191	1.387	0	1
10 mg/L SO ₄ ²⁻	A	4	0.0035	0.0006	0.0035	5.852	7.597	0	1
10 mg/L SO ₄ ²⁻	A	5	0.0030	0.0006	0.0030	1.590	1.733	0	1
10 mg/L SO ₄ ²⁻	A	6	0.0023	0.0005	0.0006	3.852	6.265	0	1
10 mg/L SO ₄ ²⁻	A	7	0.0028	0.0004	0.0012	6.859	2.540	0	1
10 mg/L SO ₄ ²⁻	A	8	0.0011	0.0005		1.647	1.736	0	0
10 mg/L SO ₄ ²⁻	A	9	0.0010	0.0002	0.0001	3.492	2.827	0	1
10 mg/L SO ₄ ²⁻	A	10	0.0024	0.0002	0.0011	4.561	7.246	0	1
10 mg/L SO ₄ ²⁻	A	11	0.0031	0.0001	0.0014	6.770	2.794	0	1
10 mg/L SO ₄ ²⁻	A	12	0.0026	0.0001	0.0006	4.747	7.337	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
10 mg/L SO ₄ ²⁻	A	13	0.0026	0.0003	0.0002	3.820	4.489	0	1
10 mg/L SO ₄ ²⁻	A	14	0.0005	0.0003		0.597	3.275	0	0
10 mg/L SO ₄ ²⁻	A	15	0.0032	0.0005	0.0022	4.048	4.736	0	1
10 mg/L SO ₄ ²⁻	B	1	0.0009	0.0008		3.052	0.353	0	0
10 mg/L SO ₄ ²⁻	B	2	0.0031	0.0004	0.0022	6.423	5.186	0	1
10 mg/L SO ₄ ²⁻	B	3	0.0026	0.0005	0.0008	4.089	3.433	0	1
10 mg/L SO ₄ ²⁻	B	4	0.0030	0.0009	0.0024	3.824	7.418	0	1
10 mg/L SO ₄ ²⁻	B	5	0.0023	0.0002	0.0011	3.627	2.622	0	1
10 mg/L SO ₄ ²⁻	B	6	0.0025	0.0001	0.0012	4.336	3.561	0	1
10 mg/L SO ₄ ²⁻	B	7	0.0043	0.0001	0.0021	6.204	5.082	0	1
10 mg/L SO ₄ ²⁻	B	8	0.0022	0.0004	0.0019	2.384	1.710	0	1
10 mg/L SO ₄ ²⁻	B	9	0.0030	0.0003	0.0010	3.529	6.130	0	1
10 mg/L SO ₄ ²⁻	B	10	0.0022	0.0001	0.0020	7.120	6.140	0	1
10 mg/L SO ₄ ²⁻	B	11	0.0027	0.0002	0.0021	3.518	2.450	0	1
10 mg/L SO ₄ ²⁻	B	12	0.0040	0.0000	0.0022	6.970	1.062	0	1
10 mg/L SO ₄ ²⁻	B	13	0.0031	0.0004	0.0020	4.663	8.621	0	1
10 mg/L SO ₄ ²⁻	B	14	0.0018	0.0004	0.0018	4.387	6.575	0	1
10 mg/L SO ₄ ²⁻	B	15	0.0035	0.0005	0.0006	4.220	3.297	0	1
10 mg/L SO ₄ ²⁻	B	16	0.0032	0.0005	0.0033	5.184	7.242	0	1
10 mg/L SO ₄ ²⁻	B	17	0.0026	0.0004	0.0023	3.762	4.407	0	1
10 mg/L SO ₄ ²⁻	B	18	0.0097	0.0006	0.0038	2.734	2.431	0	1
10 mg/L SO ₄ ²⁻	B	19	0.0047	0.0006	0.0018	5.100	4.201	0	1
10 mg/L SO ₄ ²⁻	B	20	0.0081	0.0012	0.0005	3.627	2.029	0	1
10 mg/L SO ₄ ²⁻	B	21	0.0032	0.0018	0.0080	2.998	2.421	0	1
10 mg/L SO ₄ ²⁻	B	22	0.0040	0.0006	0.0018	3.113	2.922	0	1
10 mg/L SO ₄ ²⁻	B	23	0.0068	0.0004	0.0063	3.319	2.448	0	1
10 mg/L SO ₄ ²⁻	B	24	0.0018	0.0001	0.0001	3.320	4.165	0	1
10 mg/L SO ₄ ²⁻	C	1	0.0046	0.0004	0.0030	5.349	1.604	0	1
10 mg/L SO ₄ ²⁻	C	2	0.0077	0.0005	0.0032	6.358	4.394	0	1
10 mg/L SO ₄ ²⁻	C	3	0.0003	0.0004	0.0042	6.980	3.054	0	1
10 mg/L SO ₄ ²⁻	C	4	0.0031	0.0007	0.0018	4.666	8.644	0	1
10 mg/L SO ₄ ²⁻	C	5	0.0032	0.0006	0.0058	7.401	4.805	0	1
10 mg/L SO ₄ ²⁻	C	6	0.0044	0.0008	0.0027	6.051	5.747	0	1
10 mg/L SO ₄ ²⁻	C	7	0.0008	0.0003	0.0010	2.503	7.752	0	1
10 mg/L SO ₄ ²⁻	C	8	0.0025	0.0004	0.0030	4.462	1.985	0	1
10 mg/L SO ₄ ²⁻	C	9	0.0001	0.0007	0.0063	2.386	1.083	0	1
10 mg/L SO ₄ ²⁻	C	10	0.0072	0.0009		3.851	1.695	0	0
10 mg/L SO ₄ ²⁻	C	11	0.0032	0.0003	0.0009	3.006	2.653	0	1
10 mg/L SO ₄ ²⁻	C	12	0.0054	0.0000	0.0033	7.511	1.583	0	1
10 mg/L SO ₄ ²⁻	C	13	0.0037	0.0004	0.0015	6.583	6.321	0	1
10 mg/L SO ₄ ²⁻	C	14	0.0024	0.0002	0.0008	3.366	2.165	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
10 mg/L SO ₄ ²⁻	C	15	0.0026	0.0004	0.0007	6.487	5.693	0	1
10 mg/L SO ₄ ²⁻	C	16	0.0019	0.0007		3.109	2.419	0	0
10 mg/L SO ₄ ²⁻	C	17	0.0031	0.0005	0.0029	3.078	6.601	0	1
10 mg/L SO ₄ ²⁻	C	18	0.0021	0.0002	0.0016	3.200	4.452	0	1
10 mg/L SO ₄ ²⁻	C	19	0.0001	0.0001	0.0008	2.678	3.068	0	1
10 mg/L SO ₄ ²⁻	D	1	0.0066	0.0007	0.0015	2.836	2.427	0	1
10 mg/L SO ₄ ²⁻	D	2	0.0046	0.0010	0.0044	4.139	1.342	0	1
10 mg/L SO ₄ ²⁻	D	3	0.0064	0.0011	0.0034	3.972	6.816	0	1
10 mg/L SO ₄ ²⁻	D	4	0.0046	0.0004	0.0019	4.261	6.385	0	1
10 mg/L SO ₄ ²⁻	D	5	0.0088	0.0005	0.0049	6.867	4.136	0	1
10 mg/L SO ₄ ²⁻	D	6	0.0048	0.0008	0.0015	3.189	2.123	0	1
10 mg/L SO ₄ ²⁻	D	7	0.0038	0.0002	0.0063	4.792	4.945	0	1
10 mg/L SO ₄ ²⁻	D	8	0.0012	0.0003	0.0026	1.312	2.591	0	1
250 mg/L SO ₄ ²⁻	A	1	0.0032	0.0009	0.0027	4.499	7.385	0	1
250 mg/L SO ₄ ²⁻	A	2	0.0030	0.0005	0.0015	7.136	2.484	0	1
250 mg/L SO ₄ ²⁻	A	3	0.0027	0.0005	0.0022	4.174	2.875	0	1
250 mg/L SO ₄ ²⁻	A	4	0.0035	0.0010	0.0037	3.914	9.263	0	1
250 mg/L SO ₄ ²⁻	A	5	0.0026	0.0003	0.0017	4.635	5.306	0	1
250 mg/L SO ₄ ²⁻	A	6	0.0026	0.0002	0.0012	3.054	4.095	0	1
250 mg/L SO ₄ ²⁻	A	7	0.0026	0.0002	0.0030	6.723	4.103	0	1
250 mg/L SO ₄ ²⁻	A	8	0.0032	0.0011	0.0025	3.756	2.755	0	1
250 mg/L SO ₄ ²⁻	A	9	0.0049	0.0012	0.0023	4.094	5.663	0	1
250 mg/L SO ₄ ²⁻	A	10	0.0030	0.0009	0.0030	3.403	5.717	0	1
250 mg/L SO ₄ ²⁻	A	11	0.0030	0.0012	0.0051	3.894	7.285	0	1
250 mg/L SO ₄ ²⁻	A	12	0.0521	0.0009	0.0016	3.995	9.417	0	1
250 mg/L SO ₄ ²⁻	A	13	0.0019	0.0003	0.0021	2.992	4.616	0	1
250 mg/L SO ₄ ²⁻	A	14	0.0016	0.0009	0.0015	2.005	4.403	0	1
250 mg/L SO ₄ ²⁻	A	15	0.0017	0.0013	0.0015	2.901	4.915	0	1
250 mg/L SO ₄ ²⁻	A	16	0.0013	0.0002	0.0033	3.148	3.678	0	1
250 mg/L SO ₄ ²⁻	A	17	0.0016	0.0002	0.0018	3.712	4.199	0	1
250 mg/L SO ₄ ²⁻	A	18	0.0046	0.0010	0.0035	2.704	6.366	0	1
250 mg/L SO ₄ ²⁻	A	19	0.0053	0.0009	0.0026	3.560	3.568	0	1
250 mg/L SO ₄ ²⁻	A	20	0.0023	0.0009	0.0009	3.236	4.447	0	1
250 mg/L SO ₄ ²⁻	A	21	0.0021	0.0009	0.0025	2.088	1.412	0	1
250 mg/L SO ₄ ²⁻	A	22	0.0019	0.0002	0.0002	3.370	6.562	0	1
250 mg/L SO ₄ ²⁻	A	23	0.0012	0.0004	0.0019	0.997	1.462	0	1
250 mg/L SO ₄ ²⁻	A	24	0.0058	0.0003		0.419	2.954	0	0
250 mg/L SO ₄ ²⁻	A	25	0.0115	0.0004		1.519	4.069	0	0
250 mg/L SO ₄ ²⁻	B	1	0.0016	0.0007	0.0019	2.685	8.327	0	1
250 mg/L SO ₄ ²⁻	B	2	0.0025	0.0002	0.0037	2.915	2.723	0	1
250 mg/L SO ₄ ²⁻	B	3	0.0019	0.0008	0.0007	2.313	4.503	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
250 mg/L SO ₄ ²⁻	B	4	0.0010	0.0009	0.0020	3.915	5.489	0	1
250 mg/L SO ₄ ²⁻	B	5	0.0023	0.0007	0.0017	3.254	4.219	0	1
250 mg/L SO ₄ ²⁻	B	6	0.0026	0.0007	0.0008	3.806	3.795	0	1
250 mg/L SO ₄ ²⁻	B	7	0.0030	0.0004	0.0035	7.234	2.443	0	1
250 mg/L SO ₄ ²⁻	B	8	0.0027	0.0005	0.0039	3.119	4.922	0	1
250 mg/L SO ₄ ²⁻	B	9	0.0021	0.0011	0.0011	3.711	5.655	0	1
250 mg/L SO ₄ ²⁻	B	10	0.0015	0.0008	0.0023	3.845	6.848	0	1
250 mg/L SO ₄ ²⁻	B	11	0.0027	0.0010	0.0020	5.643	8.763	0	1
250 mg/L SO ₄ ²⁻	B	12	0.0028	0.0009	0.0012	2.919	5.845	0	1
250 mg/L SO ₄ ²⁻	B	13	0.0033	0.0008	0.0041	5.773	7.273	0	1
250 mg/L SO ₄ ²⁻	B	14	0.0023	0.0012	0.0007	3.248	10.826	0	1
250 mg/L SO ₄ ²⁻	B	15	0.0035	0.0010	0.0019	5.445	3.456	0	1
250 mg/L SO ₄ ²⁻	C	1	0.0023	0.0001	0.0024	3.308	1.842	0	1
250 mg/L SO ₄ ²⁻	C	2	0.0023	0.0008	0.0004	4.333	2.934	0	1
250 mg/L SO ₄ ²⁻	C	3	0.0010	0.0004	0.0032	3.863	5.471	0	1
250 mg/L SO ₄ ²⁻	C	4	0.0023	0.0015	0.0008	2.785	1.226	0	1
250 mg/L SO ₄ ²⁻	C	5	0.0020	0.0001	0.0017	3.136	3.836	0	1
250 mg/L SO ₄ ²⁻	C	6	0.0020	0.0009	0.0028	4.481	4.546	0	1
250 mg/L SO ₄ ²⁻	C	7	0.0021	0.0003	0.0023	2.773	3.466	0	1
250 mg/L SO ₄ ²⁻	C	8	0.0019	0.0006		2.743	1.692	0	0
250 mg/L SO ₄ ²⁻	C	9	0.0013	0.0009	0.0019	2.887	3.518	0	1
250 mg/L SO ₄ ²⁻	C	10	0.0020	0.0008	0.0027	5.584	3.723	0	1
250 mg/L SO ₄ ²⁻	C	11	0.0018	0.0001	0.0011	2.445	4.145	0	1
250 mg/L SO ₄ ²⁻	C	12	0.0028	0.0009	0.0029	4.269	4.977	0	1
250 mg/L SO ₄ ²⁻	C	13	0.0027	0.0004	0.0014	4.677	1.717	0	1
250 mg/L SO ₄ ²⁻	C	14	0.0026	0.0008	0.0006	3.599	3.668	0	1
250 mg/L SO ₄ ²⁻	C	15	0.0027	0.0007	0.0025	5.910	1.402	0	1
250 mg/L SO ₄ ²⁻	C	16	0.0011	0.0000		3.909	1.476	0	0
250 mg/L SO ₄ ²⁻	C	17	0.0020	0.0005	0.0022	3.282	4.895	0	1
250 mg/L SO ₄ ²⁻	C	18	0.0007	0.0008	0.0006	3.393	2.337	0	1
250 mg/L SO ₄ ²⁻	C	19	0.0022	0.0007	0.0030	3.446	6.328	0	1
250 mg/L SO ₄ ²⁻	D	1	0.0035	0.0004	0.0048	3.476	3.379	0	1
250 mg/L SO ₄ ²⁻	D	2	0.0015	0.0008	0.0025	2.882	3.708	0	1
250 mg/L SO ₄ ²⁻	D	3	0.0011	0.0005	0.0009	3.248	2.949	0	1
250 mg/L SO ₄ ²⁻	D	4	0.0019	0.0006	0.0027	2.341	4.302	0	1
250 mg/L SO ₄ ²⁻	D	5	0.0037	0.0005	0.0024	3.660	1.398	0	1
250 mg/L SO ₄ ²⁻	D	6	0.0016	0.0010	0.0035	3.269	2.662	0	1
250 mg/L SO ₄ ²⁻	D	7	0.0019	0.0001	0.0048	3.150	2.371	0	1
250 mg/L SO ₄ ²⁻	D	8	0.0011	0.0007	0.0018	2.685	2.712	0	1
250 mg/L SO ₄ ²⁻	D	9	0.0013	0.0005	0.0038	3.259	4.054	0	1
250 mg/L SO ₄ ²⁻	D	10	0.0025	0.0002	0.0036	2.721	3.251	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
250 mg/L SO ₄ ²⁻	D	11	0.0076	0.0051	0.0068	3.802	1.816	0	1
250 mg/L SO ₄ ²⁻	D	12	0.0027	0.0006	0.0020	3.900	3.855	0	1
250 mg/L SO ₄ ²⁻	D	13	0.0019	0.0007	0.0001	3.625	5.614	0	1
250 mg/L SO ₄ ²⁻	D	14	0.0017	0.0002	0.0031	2.925	3.716	0	1
250 mg/L SO ₄ ²⁻	D	15	0.0018	0.0002	0.0023	3.720	1.367	0	1
1000 mg/L SO ₄ ²⁻	A	1	0.0019	0.0000	0.0023	2.967	2.016	0	1
1000 mg/L SO ₄ ²⁻	A	2	0.0022	0.0003	0.0013	3.234	3.746	0	1
1000 mg/L SO ₄ ²⁻	A	3	0.0015	0.0004	0.0020	2.312	4.095	0	1
1000 mg/L SO ₄ ²⁻	A	4	0.0019	0.0002	0.0016	3.149	3.424	0	1
1000 mg/L SO ₄ ²⁻	A	5	0.0024	0.0001	0.0014	3.728	1.581	0	1
1000 mg/L SO ₄ ²⁻	A	6	0.0005	0.0004	0.0015	2.419	2.408	0	1
1000 mg/L SO ₄ ²⁻	A	7	0.0014	0.0009	0.0018	3.600	2.967	0	1
1000 mg/L SO ₄ ²⁻	A	8	0.0037	0.0000	0.0005	5.413	2.899	0	1
1000 mg/L SO ₄ ²⁻	A	9	0.0021	0.0007	0.0008	2.119	2.505	0	1
1000 mg/L SO ₄ ²⁻	A	10	0.0032	0.0018	0.0036	3.388	3.308	0	1
1000 mg/L SO ₄ ²⁻	A	11	0.0017	0.0004	0.0015	3.660	3.561	0	1
1000 mg/L SO ₄ ²⁻	A	12	0.0012	0.0005	0.0055	8.727	0.944	0	1
1000 mg/L SO ₄ ²⁻	A	13	0.0025	0.0001	0.0020	3.300	3.456	0	1
1000 mg/L SO ₄ ²⁻	A	14	0.0026	0.0005	0.0020	3.857	5.212	0	1
1000 mg/L SO ₄ ²⁻	A	15	0.0040	0.0002	0.0022	4.361	2.035	0	1
1000 mg/L SO ₄ ²⁻	A	16	0.0035	0.0002	0.0043	5.477	2.208	0	1
1000 mg/L SO ₄ ²⁻	A	17	0.0021	0.0002	0.0020	2.973	4.848	0	1
1000 mg/L SO ₄ ²⁻	A	18	0.0015	0.0002	0.0000	3.299	2.578	0	1
1000 mg/L SO ₄ ²⁻	A	19	0.0057	0.0029	0.0064	2.934	2.463	0	1
1000 mg/L SO ₄ ²⁻	A	20	0.0022	0.0002	0.0061	3.090	2.583	0	1
1000 mg/L SO ₄ ²⁻	B	1	0.0022	0.0003	0.0010	3.519	1.891	0	1
1000 mg/L SO ₄ ²⁻	B	2	0.0016	0.0008	0.0012	1.627	4.635	0	1
1000 mg/L SO ₄ ²⁻	B	3	0.0030	0.0001	0.0013	2.741	1.496	0	1
1000 mg/L SO ₄ ²⁻	B	4	0.0009	0.0008	0.0015	2.665	3.065	0	1
1000 mg/L SO ₄ ²⁻	B	5	0.0022	0.0005	0.0024	3.369	3.872	0	1
1000 mg/L SO ₄ ²⁻	B	6	0.0011	0.0003		3.164	2.259	0	0
1000 mg/L SO ₄ ²⁻	B	7	0.0012	0.0011	0.0013	1.892	5.303	0	1
1000 mg/L SO ₄ ²⁻	B	8	0.0013	0.0004	0.0021	2.835	4.028	0	1
1000 mg/L SO ₄ ²⁻	B	9	0.0024	0.0005	0.0040	3.817	3.716	0	1
1000 mg/L SO ₄ ²⁻	B	10	0.0029	0.0003	0.0012	3.975	2.965	0	1
1000 mg/L SO ₄ ²⁻	B	11	0.0023	0.0006	0.0025	4.277	5.390	0	1
1000 mg/L SO ₄ ²⁻	B	12	0.0012	0.0003	0.0024	2.407	4.560	0	1
1000 mg/L SO ₄ ²⁻	B	13	0.0019	0.0001	0.0014	4.370	1.274	0	1
1000 mg/L SO ₄ ²⁻	B	14	0.0022	0.0002	0.0025	2.888	4.668	0	1
1000 mg/L SO ₄ ²⁻	C	1	0.0021	0.0005	0.0014	4.919	4.871	0	1
1000 mg/L SO ₄ ²⁻	C	2	0.0031	0.0004	0.0033	3.293	3.825	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
1000 mg/L SO ₄ ²⁻	C	3	0.0010	0.0005		3.032	2.462	0	0
1000 mg/L SO ₄ ²⁻	C	4	0.0015	0.0006	0.0018	2.933	5.029	0	1
1000 mg/L SO ₄ ²⁻	C	5	0.0021	0.0005	0.0036	3.414	4.191	0	1
1000 mg/L SO ₄ ²⁻	C	6	0.0020	0.0003	0.0020	2.926	2.193	0	1
1000 mg/L SO ₄ ²⁻	C	7	0.0030	0.0003		2.387	2.014	0	0
1000 mg/L SO ₄ ²⁻	C	8	0.0024	0.0012	0.0036	3.702	7.709	0	1
1000 mg/L SO ₄ ²⁻	C	9	0.0016	0.0006	0.0018	3.379	5.997	0	1
1000 mg/L SO ₄ ²⁻	C	10	0.0025	0.0006	0.0033	3.569	6.283	0	1
1000 mg/L SO ₄ ²⁻	C	11	0.0017	0.0005	0.0019	3.319	5.675	0	1
1000 mg/L SO ₄ ²⁻	C	12	0.0028	0.0002	0.0039	4.438	5.362	0	1
1000 mg/L SO ₄ ²⁻	C	13	0.0013	0.0002	0.0032	3.573	4.148	0	1
1000 mg/L SO ₄ ²⁻	C	14	0.0023	0.0003	0.0023	2.563	2.127	0	1
1000 mg/L SO ₄ ²⁻	C	15	0.0022	0.0001	0.0018	3.095	2.495	0	1
1000 mg/L SO ₄ ²⁻	C	16	0.0027	0.0003	0.0057	3.165	2.437	0	1
1000 mg/L SO ₄ ²⁻	C	17	0.0021	0.0006	0.0004	3.155	2.580193799	0	1
1000 mg/L SO ₄ ²⁻	D	1	0.0020	0.0002	0.0022	3.100	3.120	0	1
1000 mg/L SO ₄ ²⁻	D	2	0.0021	0.0008	0.0011	3.786	7.205	0	1
1000 mg/L SO ₄ ²⁻	D	3	0.0023	0.0004	0.0010	3.938	4.036	0	1
1000 mg/L SO ₄ ²⁻	D	4	0.0018	0.0005	0.0035	2.831	2.193	0	1
1000 mg/L SO ₄ ²⁻	D	5	0.0031	0.0004	0.0030	4.415	3.193	0	1
1000 mg/L SO ₄ ²⁻	D	6	0.0015	0.0005	0.0025	3.049	3.628	0	1
1000 mg/L SO ₄ ²⁻	D	7	0.0009	0.0014	0.0006	2.671	6.444	0	1
1000 mg/L SO ₄ ²⁻	D	8	0.0026	0.0006	0.0024	1.846	3.305	0	1
1000 mg/L SO ₄ ²⁻	D	9	0.0028	0.0005	0.0017	2.365	2.222	0	1
1000 mg/L SO ₄ ²⁻	D	10	0.0006	0.0004	0.0012	2.236	5.541	0	1
1000 mg/L SO ₄ ²⁻	D	11	0.0025	0.0008	0.0044	3.550	4.424	0	1
1000 mg/L SO ₄ ²⁻	D	12	0.0016	0.0004	0.0002	2.956	3.041	0	1
1000 mg/L SO ₄ ²⁻	D	13	0.0029	0.0013	0.0044	2.896	5.284	0	1
1000 mg/L SO ₄ ²⁻	D	14	0.0021	0.0006	0.0026	2.692	5.252	0	1
1000 mg/L SO ₄ ²⁻	D	15	0.0012	0.0004		2.949	2.226	0	0
1000 mg/L SO ₄ ²⁻	D	16	0.0018	0.0002	0.0013	3.658	2.994	0	1
1000 mg/L SO ₄ ²⁻	D	17	0.0027	0.0004	0.0023	3.738	4.891	0	1
1000 mg/L SO ₄ ²⁻	D	18	0.0021	0.0006	0.0028	3.379	4.153	0	1
1000 mg/L SO ₄ ²⁻	D	19	0.0022	0.0000	0.0002	3.522	1.964	0	1
1000 mg/L SO ₄ ²⁻	D	20	0.0015	0.0002	0.0003	1.957	2.357	0	1
1000 mg/L SO ₄ ²⁻	D	21	0.0017	0.0001	0.0050	3.324	2.336	0	1
1000 mg/L SO ₄ ²⁻	D	22	0.0027	0.0009	0.0036	4.204	11.478	0	1
1000 mg/L SO ₄ ²⁻	D	23	0.0009	0.0002	0.0001	3.040	3.379	0	1
1000 mg/L SO ₄ ²⁻	D	24	0.0019	0.0002		4.119	2.026	0	0
2500 mg/L SO ₄ ²⁻	A	1	0.0021	0.0010	0.0006	5.639	7.824	0	1
2500 mg/L SO ₄ ²⁻	A	2	0.0028	0.0008	0.0005	3.235	3.124	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
2500 mg/L SO ₄ ²⁻	A	3	0.0027	0.0002	0.0014	2.998	0.981	0	1
2500 mg/L SO ₄ ²⁻	A	4	0.0027	0.0006	0.0014	4.542	6.245	0	1
2500 mg/L SO ₄ ²⁻	A	5	0.0026	0.0001	0.0024	3.990	0.893	0	1
2500 mg/L SO ₄ ²⁻	A	6	0.0024	0.0001	0.0003	3.965	3.044	0	1
2500 mg/L SO ₄ ²⁻	A	7	0.0030	0.0002	0.0027	4.154	2.155	0	1
2500 mg/L SO ₄ ²⁻	A	8	0.0011	0.0003	0.0019	1.595	3.818	0	1
2500 mg/L SO ₄ ²⁻	A	9	0.0021	0.0005	0.0010	3.785	4.913	0	1
2500 mg/L SO ₄ ²⁻	A	10	0.0011	0.0006	0.0018	3.062	3.634	0	1
2500 mg/L SO ₄ ²⁻	A	11	0.0019	0.0000	0.0014	2.999	2.379	0	1
2500 mg/L SO ₄ ²⁻	A	12	0.0016	0.0001	0.0033	2.830	2.899	0	1
2500 mg/L SO ₄ ²⁻	A	13	0.0010	0.0000	0.0016	2.746	2.433	0	1
2500 mg/L SO ₄ ²⁻	A	14	0.0024	0.0003	0.0018	3.984	4.065	0	1
2500 mg/L SO ₄ ²⁻	A	15	0.0016	0.0003	0.0029	2.755	4.004	0	1
2500 mg/L SO ₄ ²⁻	A	16	0.0023	0.0001	0.0028	4.566	2.041	0	1
2500 mg/L SO ₄ ²⁻	A	17	0.0013	0.0005	0.0009	2.955	7.047	0	1
2500 mg/L SO ₄ ²⁻	A	18	0.0018	0.0006	0.0019	3.196	6.181	0	1
2500 mg/L SO ₄ ²⁻	A	19	0.0020	0.0001	0.0012	3.088	3.226	0	1
2500 mg/L SO ₄ ²⁻	A	20	0.0016	0.0004	0.0035	2.613	2.678	0	1
2500 mg/L SO ₄ ²⁻	A	21	0.0017	0.0002	0.0027	3.038	3.763	0	1
2500 mg/L SO ₄ ²⁻	A	22	0.0011	0.0001	0.0007	2.362	3.951	0	1
2500 mg/L SO ₄ ²⁻	A	23	0.0013	0.0001	0.0006	2.851	5.651	0	1
2500 mg/L SO ₄ ²⁻	A	24	0.0016	0.0002	0.0005	3.685	3.504	0	1
2500 mg/L SO ₄ ²⁻	A	25	0.0005	0.0001	0.0007	2.000	4.795	0	1
2500 mg/L SO ₄ ²⁻	A	26	0.0025	0.0006	0.0034	4.270	1.966	0	1
2500 mg/L SO ₄ ²⁻	A	27	0.0031	0.0008	0.0006	2.986	4.548	0	1
2500 mg/L SO ₄ ²⁻	B	1	0.0021	0.0010	0.0028	3.517	4.805	0	1
2500 mg/L SO ₄ ²⁻	B	2	0.0025	0.0002	0.0039	3.138	1.774	0	1
2500 mg/L SO ₄ ²⁻	B	3	0.0024	0.0003	0.0027	2.796	2.925	0	1
2500 mg/L SO ₄ ²⁻	B	4	0.0013	0.0004	0.0026	1.924	4.243	0	1
2500 mg/L SO ₄ ²⁻	B	5	0.0023	0.0008	0.0012	3.228	4.156	0	1
2500 mg/L SO ₄ ²⁻	B	6	0.0026	0.0006	0.0027	3.829	5.316	0	1
2500 mg/L SO ₄ ²⁻	B	7	0.0015	0.0003	0.0020	3.264	3.835	0	1
2500 mg/L SO ₄ ²⁻	B	8	0.0020	0.0003	0.0061	2.838	1.107	0	1
2500 mg/L SO ₄ ²⁻	B	9	0.0032	0.0002	0.0036	3.871	2.175	0	1
2500 mg/L SO ₄ ²⁻	B	10	0.0015	0.0004	0.0046	4.379	3.474	0	1
2500 mg/L SO ₄ ²⁻	B	11	0.0023	0.0008	0.0028	4.193	5.855	0	1
2500 mg/L SO ₄ ²⁻	B	12	0.0024	0.0003	0.0022	2.938	2.669	0	1
2500 mg/L SO ₄ ²⁻	B	13	0.0018	0.0014	0.0021	2.081	10.731	0	1
2500 mg/L SO ₄ ²⁻	B	14	0.0011	0.0007	0.0023	2.373	8.178	0	1
2500 mg/L SO ₄ ²⁻	B	15	0.0015	0.0004	0.0014	2.690	2.499	0	1
2500 mg/L SO ₄ ²⁻	B	16	0.0032	0.0005	0.0018	3.480	2.631	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
2500 mg/L SO ₄ ²⁻	B	17	0.0017	0.0003	0.0007	1.540	2.023	0	1
2500 mg/L SO ₄ ²⁻	C	1	0.0018	0.0005	0.0026	2.761	1.717	0	1
2500 mg/L SO ₄ ²⁻	C	2	0.0021	0.0006	0.0036	2.482	2.731	0	1
2500 mg/L SO ₄ ²⁻	C	3	0.0031	0.0007	0.0014	4.353	2.380	0	1
2500 mg/L SO ₄ ²⁻	C	4	0.0021	0.0006	0.0016	1.826	2.730	0	1
2500 mg/L SO ₄ ²⁻	C	5	0.0016	0.0006	0.0025	2.500	3.076	0	1
2500 mg/L SO ₄ ²⁻	C	6	0.0019	0.0012	0.0027	2.510	4.514	0	1
2500 mg/L SO ₄ ²⁻	C	7	0.0017	0.0002	0.0024	3.001	2.222	0	1
2500 mg/L SO ₄ ²⁻	C	8	0.0018	0.0011	0.0020	2.137	2.208	0	1
2500 mg/L SO ₄ ²⁻	C	9	0.0018	0.0003	0.0027	2.922	1.064	0	1
2500 mg/L SO ₄ ²⁻	C	10	0.0018	0.0003	0.0032	3.147	2.196	0	1
2500 mg/L SO ₄ ²⁻	C	11	0.0020	0.0003	0.0038	3.112	1.543	0	1
2500 mg/L SO ₄ ²⁻	C	12	0.0017	0.0002	0.0008	2.344	1.098	0	1
2500 mg/L SO ₄ ²⁻	C	13	0.0015	0.0005	0.0018	3.272	6.394	0	1
2500 mg/L SO ₄ ²⁻	C	14	0.0016	0.0005	0.0018	2.603	2.292	0	1
2500 mg/L SO ₄ ²⁻	C	15	0.0014	0.0003	0.0008	2.376	2.236	0	1
2500 mg/L SO ₄ ²⁻	C	16	0.0016	0.0002	0.0018	1.892	1.663	0	1
2500 mg/L SO ₄ ²⁻	C	17	0.0026	0.0002	0.0014	3.509	1.002	0	1
2500 mg/L SO ₄ ²⁻	D	1	0.0026	0.0005	0.0031	2.651	4.160	0	1
2500 mg/L SO ₄ ²⁻	D	2	0.0024	0.0003	0.0038	3.045	3.196	0	1
2500 mg/L SO ₄ ²⁻	D	3	0.0023	0.0005	0.0019	3.282	3.444	0	1
2500 mg/L SO ₄ ²⁻	D	4	0.0014	0.0008	0.0014	3.106	7.003	0	1
2500 mg/L SO ₄ ²⁻	D	5	0.0009	0.0008	0.0036	2.549	3.311	0	1
2500 mg/L SO ₄ ²⁻	D	6	0.0025	0.0004	0.0020	2.309	1.396	0	1
2500 mg/L SO ₄ ²⁻	D	7	0.0016	0.0007	0.0022	3.139	5.151	0	1
2500 mg/L SO ₄ ²⁻	D	8	0.0015	0.0007	0.0016	2.120	3.315	0	1
2500 mg/L SO ₄ ²⁻	D	9	0.0014	0.0002	0.0005	2.382	2.178	0	1
2500 mg/L SO ₄ ²⁻	D	10	0.0029	0.0004	0.0009	2.295	3.205	0	1
2500 mg/L SO ₄ ²⁻	D	11	0.0019	0.0005	0.0037	2.119	5.404	0	1
2500 mg/L SO ₄ ²⁻	D	12	0.0016	0.0007	0.0028	3.169	7.023	0	1
2500 mg/L SO ₄ ²⁻	D	13	0.0013	0.0002	0.0013	2.380	2.654	0	1
2500 mg/L SO ₄ ²⁻	D	14	0.0015	0.0002	0.0020	2.385	1.079	0	1
2500 mg/L SO ₄ ²⁻	D	15	0.0011	0.0001	0.0015	2.057	1.294	0	1
2500 mg/L SO ₄ ²⁻	D	16	0.0021	0.0001	0.0014	2.994	1.588	0	1
2500 mg/L SO ₄ ²⁻	D	17	0.0022	0.0003	0.0031	2.234	2.117	0	1
2500 mg/L SO ₄ ²⁻	D	18	0.0013	0.0005	0.0007	1.662	3.252	0	1
2500 mg/L SO ₄ ²⁻	D	19	0.0015	0.0003	0.0006	1.773	2.548	0	1
2500 mg/L SO ₄ ²⁻	D	20	0.0025	0.0002		2.673	1.502	0	0
5000 mg/L SO ₄ ²⁻	A	1	0.0040	0.0005	0.0014	3.596	1.137	0	1
5000 mg/L SO ₄ ²⁻	A	2	0.0009	0.0004	0.0026	2.352	1.506	0	1
5000 mg/L SO ₄ ²⁻	A	3	0.0010	0.0002	0.0015	1.969	0.765	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
5000 mg/L SO ₄ ²⁻	A	4	0.0022	0.0013	0.0011	2.995	1.317	1	1
5000 mg/L SO ₄ ²⁻	A	5	0.0023	0.0004	0.0020	2.811	1.458	0	1
5000 mg/L SO ₄ ²⁻	A	6	0.0020	0.0004	0.0012	2.405	1.744	1	1
5000 mg/L SO ₄ ²⁻	A	7	0.0019	0.0002	0.0008	1.377	1.084	0	1
5000 mg/L SO ₄ ²⁻	A	8	0.0023	0.0003	0.0024	2.579	1.644	1	1
5000 mg/L SO ₄ ²⁻	A	9	0.0016	0.0007	0.0012	2.307	2.756	0	1
5000 mg/L SO ₄ ²⁻	A	10	0.0013	0.0003	0.0006	1.876	2.293	1	1
5000 mg/L SO ₄ ²⁻	A	11	0.0011	0.0002	0.0015	1.885	1.713	0	1
5000 mg/L SO ₄ ²⁻	A	12	0.0015	0.0002		0.890	1.499	1	0
5000 mg/L SO ₄ ²⁻	A	13	0.0026	0.0001		2.119	1.319	0	0
5000 mg/L SO ₄ ²⁻	A	14	0.0020	0.0007	0.0009	2.967	2.199	1	1
5000 mg/L SO ₄ ²⁻	A	15	0.0015	0.0004	0.0016	1.811	1.446	0	1
5000 mg/L SO ₄ ²⁻	A	16	0.0016	0.0002		3.167	1.239	0	0
5000 mg/L SO ₄ ²⁻	B	1	0.0020	0.0002	0.0025	1.772	1.417	0	1
5000 mg/L SO ₄ ²⁻	B	2	0.0029	0.0002		1.776	1.357	0	0
5000 mg/L SO ₄ ²⁻	B	3	0.0013	0.0004	0.0003	1.002	0.952	0	1
5000 mg/L SO ₄ ²⁻	B	4	0.0017	0.0010		2.593	1.265	0	0
5000 mg/L SO ₄ ²⁻	B	5	0.0014	0.0006	0.0005	2.279	2.375	1	1
5000 mg/L SO ₄ ²⁻	B	6	0.0014	0.0002	0.0008	1.669	0.427	0	1
5000 mg/L SO ₄ ²⁻	B	7	0.0018	0.0003		2.585	1.557	1	0
5000 mg/L SO ₄ ²⁻	B	8	0.0015	0.0006	0.0011	2.253	4.176	1	1
5000 mg/L SO ₄ ²⁻	B	9	0.0009	0.0002		4.855	1.005	0	0
5000 mg/L SO ₄ ²⁻	B	10	0.0014	0.0007	0.0013	2.268	2.809	1	1
5000 mg/L SO ₄ ²⁻	B	11	0.0015	0.0004	0.0010	1.882	2.444	0	1
5000 mg/L SO ₄ ²⁻	B	12	0.0029	0.0006	0.0023	2.912	3.578	1	1
5000 mg/L SO ₄ ²⁻	B	13	0.0025	0.0007	0.0008	2.201	2.191	0	1
5000 mg/L SO ₄ ²⁻	B	14	0.0026	0.0005	0.0023	2.838	1.936	0	1
5000 mg/L SO ₄ ²⁻	B	15	0.0015	0.0014	0.0022	2.301	9.363	1	1
5000 mg/L SO ₄ ²⁻	B	16	0.0019	0.0004	0.0006	2.452	2.057	0	1
5000 mg/L SO ₄ ²⁻	B	17	0.0016	0.0006	0.0002	1.674	2.145	0	1
5000 mg/L SO ₄ ²⁻	B	18	0.0012	0.0014	0.0015	3.001	5.331	0	1
5000 mg/L SO ₄ ²⁻	B	19	0.0022	0.0002	0.0020	2.725	1.343	0	1
5000 mg/L SO ₄ ²⁻	B	20	0.0015	0.0002	0.0005	1.843	2.476	0	1
5000 mg/L SO ₄ ²⁻	B	21	0.0014	0.0005		1.322	1.716	1	0
5000 mg/L SO ₄ ²⁻	B	22	0.0027	0.0006	0.0012	2.513	3.016	0	1
5000 mg/L SO ₄ ²⁻	B	23	0.0037	0.0006	0.0029	2.872	3.227	0	1
5000 mg/L SO ₄ ²⁻	B	24	0.0018	0.0005	0.0014	2.168	1.155	0	1
5000 mg/L SO ₄ ²⁻	B	25	0.0021	0.0009		1.517	4.455	0	0
5000 mg/L SO ₄ ²⁻	C	1	0.0020	0.0001	0.0011	1.917	1.115	1	1
5000 mg/L SO ₄ ²⁻	C	2	0.0022	0.0004	0.0010	2.447	2.315	0	1
5000 mg/L SO ₄ ²⁻	C	3	0.0015	0.0002	0.0008	1.972	1.029	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
5000 mg/L SO ₄ ²⁻	C	4	0.0011	0.0004	0.0011	2.380	2.204	1	1
5000 mg/L SO ₄ ²⁻	C	5	0.0017	0.0003	0.0020	1.797	2.876	0	1
5000 mg/L SO ₄ ²⁻	C	6	0.0024	0.0007	0.0019	1.671	1.999	0	1
5000 mg/L SO ₄ ²⁻	C	7	0.0022	0.0004	0.0029	2.760	2.303	1	1
5000 mg/L SO ₄ ²⁻	C	8	0.0011	0.0004	0.0027	1.522	1.535	1	1
5000 mg/L SO ₄ ²⁻	C	9	0.0011	0.0002	0.0014	2.825	1.856	1	1
5000 mg/L SO ₄ ²⁻	C	10	0.0018	0.0004	0.0004	1.679	1.554	0	1
5000 mg/L SO ₄ ²⁻	C	11	0.0012	0.0004	0.0014	1.830	1.364	1	1
5000 mg/L SO ₄ ²⁻	C	12	0.0017	0.0005	0.0037	3.025	2.036	1	1
5000 mg/L SO ₄ ²⁻	C	13	0.0024	0.0004	0.0014	2.826	2.249	0	1
5000 mg/L SO ₄ ²⁻	C	14	0.0032	0.0004	0.0010	1.749	1.797	0	1
5000 mg/L SO ₄ ²⁻	C	15	0.0028	0.0005	0.0015	3.009	1.935	0	1
5000 mg/L SO ₄ ²⁻	C	16	0.0026	0.0015	0.0017	1.955	4.003	0	1
5000 mg/L SO ₄ ²⁻	C	17	0.0018	0.0015	0.0014	1.681	0.999	0	1
5000 mg/L SO ₄ ²⁻	C	18	0.0026	0.0005	0.0011	1.940	1.531	0	1
5000 mg/L SO ₄ ²⁻	C	19	0.0018	0.0004	0.0017	2.753	3.344	1	1
5000 mg/L SO ₄ ²⁻	C	20	0.0023	0.0003	0.0020	2.308	1.079	1	1
5000 mg/L SO ₄ ²⁻	C	21	0.0010	0.0006	0.0015	1.860	1.296	0	1
5000 mg/L SO ₄ ²⁻	C	22	0.0006	0.0009		0.590	2.452	1	0
5000 mg/L SO ₄ ²⁻	D	1	0.0015	0.0013	0.0020	2.457	2.533	1	1
5000 mg/L SO ₄ ²⁻	D	2	0.0016	0.0005	0.0018	2.499	2.937	0	1
5000 mg/L SO ₄ ²⁻	D	3	0.0009	0.0003	0.0008	1.234	2.780	0	1
5000 mg/L SO ₄ ²⁻	D	4	0.0017	0.0002	0.0011	2.145	0.833	1	1
5000 mg/L SO ₄ ²⁻	D	5	0.0018	0.0005	0.0016	2.686	2.192	0	1
5000 mg/L SO ₄ ²⁻	D	6	0.0028	0.0005	0.0022	2.745	2.067	0	1
5000 mg/L SO ₄ ²⁻	D	7	0.0022	0.0007	0.0011	2.837	1.937	0	1
5000 mg/L SO ₄ ²⁻	D	8	0.0010	0.0001	0.0011	1.531	1.400	1	1
5000 mg/L SO ₄ ²⁻	D	9	0.0019	0.0003	0.0004	1.946	1.845	0	1
5000 mg/L SO ₄ ²⁻	D	10	0.0006	0.0005	0.0014	2.367	1.325	1	1
5000 mg/L SO ₄ ²⁻	D	11	0.0015	0.0005	0.0019	2.447	1.900	0	1
5000 mg/L SO ₄ ²⁻	D	12	0.0018	0.0004	0.0008	2.322	2.672	0	1
5000 mg/L SO ₄ ²⁻	D	13	0.0022	0.0002	0.0012	2.210	2.126	0	1
5000 mg/L SO ₄ ²⁻	D	14	0.0015	0.0004		4.511	3.209	1	0
5000 mg/L SO ₄ ²⁻	D	15	0.0018	0.0006	0.0023	1.817	3.264	1	1
5000 mg/L SO ₄ ²⁻	D	16	0.0011	0.0004	0.0007	2.378	2.208	1	1
5000 mg/L SO ₄ ²⁻	D	17	0.0020	0.0003	0.0005	1.660	2.337	0	1
5000 mg/L SO ₄ ²⁻	D	18	0.0013	0.0002	0.0012	2.248	1.554	1	1
5000 mg/L SO ₄ ²⁻	D	19	0.0014	0.0004	0.0002	2.641	1.975	0	1
5000 mg/L SO ₄ ²⁻	D	20	0.0011	0.0002	0.0011	1.697	1.812	1	1
5000 mg/L SO ₄ ²⁻	D	21	0.0009	0.0006		1.221	2.762	1	0
5000 mg/L SO ₄ ²⁻	D	22	0.0028	0.0004	0.0007	1.815	3.467	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
0.8 meq/L	A	1	0.0012	0.0004	0.0015	1.929	4.326	0	1
0.8 meq/L	A	2	0.0014	0.0004	0.0043	2.079	3.011	0	1
0.8 meq/L	A	3	0.0012	0.0001	0.0028	2.710	2.806	0	1
0.8 meq/L	A	4	0.0024	0.0002	0.0055	2.856	1.443	0	1
0.8 meq/L	A	5	0.0015	0.0003	0.0042	2.638	3.985	0	1
0.8 meq/L	A	6	0.0019	0.0004	0.0039	2.634	4.518	0	1
0.8 meq/L	A	7	0.0012	0.0009	0.0041	3.031	4.311	0	1
0.8 meq/L	A	8	0.0010	0.0002	0.0009	1.287	2.642	0	1
0.8 meq/L	A	9	0.0007	0.0002	0.0007	1.035	1.756	0	1
0.8 meq/L	A	10	0.0006	0.0004		0.809	2.324	0	0
0.8 meq/L	B	1	0.0021	0.0003	0.0028	3.001	2.668	0	1
0.8 meq/L	B	2	0.0008	0.0001	0.0030	0.839	1.898	0	1
0.8 meq/L	B	3	0.0018	0.0005	0.0046	2.384	4.240	0	1
0.8 meq/L	B	4	0.0007	0.0002	0.0015	2.465	3.083	0	1
0.8 meq/L	B	5	0.0012	0.0002	0.0025	2.707	2.664	0	1
0.8 meq/L	B	6	0.0030	0.0004	0.0036	3.757	2.957	0	1
0.8 meq/L	B	7	0.0022	0.0005	0.0028	2.260	7.411	0	1
0.8 meq/L	B	8	0.0015	0.0005	0.0033	2.084	3.554	0	1
0.8 meq/L	B	9	0.0014	0.0002	0.0046	1.817	2.594	0	1
0.8 meq/L	B	10	0.0014	0.0004	0.0012	3.101	2.780	0	1
0.8 meq/L	B	11	0.0012	0.0003		1.845	1.852	0	0
0.8 meq/L	B	12	0.0009	0.0008	0.0008	0.974	1.964	0	1
0.8 meq/L	B	13	0.0009	0.0004	0.0002	1.459	2.000	0	1
0.8 meq/L	B	14	0.0007	0.0012	0.0028	1.169	2.512	0	1
0.8 meq/L	C	1	0.0018	0.0003		1.682	8.296	0	0
0.8 meq/L	C	2	0.0024	0.0005	0.0028	3.814	4.759	0	1
0.8 meq/L	C	3	0.0022	0.0002	0.0037	2.696	2.210	0	1
0.8 meq/L	C	4	0.0025	0.0004	0.0030	2.760	3.220	0	1
0.8 meq/L	C	5	0.0015	0.0006	0.0033	2.113	3.243	0	1
0.8 meq/L	C	6	0.0007	0.0001	0.0020	1.356	2.482	0	1
0.8 meq/L	C	7	0.0018	0.0001	0.0027	2.748	1.359	0	1
0.8 meq/L	C	8	0.0021	0.0002	0.0015	4.126	1.711	0	1
0.8 meq/L	C	9	0.0013	0.0006	0.0012	1.496	4.936	0	1
0.8 meq/L	C	10	0.0015	0.0001		1.777	0.604	0	0
0.8 meq/L	D	1	0.0014	0.0004	0.0010	2.935	4.312	0	1
0.8 meq/L	D	2	0.0014	0.0003	0.0028	1.733	2.582	0	1
0.8 meq/L	D	3	0.0013	0.0003	0.0009	2.388	3.852	0	1
0.8 meq/L	D	4	0.0011	0.0004	0.0011	3.541	2.745	0	1
0.8 meq/L	D	5	0.0012	0.0007	0.0010	3.236	4.564	0	1
0.8 meq/L	D	6	0.0021	0.0004	0.0022	3.026	6.164	0	1
0.8 meq/L	D	7	0.0013	0.0006	0.0012	1.986	4.518	0	1
0.8 meq/L	D	8	0.0011	0.0006	0.0020	1.986	3.954	0	1
0.8 meq/L	D	9	0.0021	0.0007		2.134	3.738	0	0
4.2 meq/L	A	1	0.0026	0.0005	0.0034	3.154	5.264	0	1
4.2 meq/L	A	2	0.0023	0.0003	0.0034	2.701	5.064	0	1
4.2 meq/L	A	3	0.0021	0.0005	0.0035	3.205	4.703	0	1
4.2 meq/L	A	4	0.0015	0.0002	0.0042	2.176	2.979	0	1
4.2 meq/L	A	5	0.0018	0.0003	0.0017	2.810	5.289	0	1
4.2 meq/L	A	6	0.0019	0.0005	0.0019	1.964	5.338	0	1
4.2 meq/L	A	7	0.0030	0.0005	0.0033	4.066	2.914	0	1
4.2 meq/L	A	8	0.0019	0.0004	0.0025	2.435	6.837	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
4.2 meq/L	B	1	0.0013	0.0003	0.0024	2.115	2.223	0	1
4.2 meq/L	B	2	0.0018	0.0004	0.0030	3.100	1.585	0	1
4.2 meq/L	B	3	0.0015	0.0005	0.0026	2.405	2.802	0	1
4.2 meq/L	B	4	0.0018	0.0005	0.0030	3.318	2.558	0	1
4.2 meq/L	B	5	0.0016	0.0004	0.0010	3.467	8.294	0	1
4.2 meq/L	B	6	0.0026	0.0004	0.0016	2.512	4.334	0	1
4.2 meq/L	B	7	0.0019	0.0004		1.064	6.406	0	0
4.2 meq/L	C	1	0.0019	0.0003	0.0006	2.693	4.138	0	1
4.2 meq/L	C	2	0.0011	0.0002	0.0004	1.886	2.939	0	1
4.2 meq/L	C	3	0.0015	0.0005	0.0022	2.164	7.062	0	1
4.2 meq/L	C	4	0.0034	0.0005	0.0036	4.309	4.261	0	1
4.2 meq/L	C	5	0.0008	0.0003	0.0008	2.059	4.265	0	1
4.2 meq/L	C	6	0.0011	0.0002	0.0003	2.954	3.308	0	1
4.2 meq/L	C	7	0.0014	0.0003	0.0002	2.366	3.065	0	1
4.2 meq/L	C	8	0.0012	0.0005	0.0013	2.600	3.179	0	1
4.2 meq/L	C	9	0.0010	0.0002	0.0003	1.803	2.788	0	1
4.2 meq/L	C	10	0.0015	0.0003	0.0003	2.587	3.618	0	1
4.2 meq/L	C	11	0.0016	0.0005	0.0007	2.127	2.576	0	1
4.2 meq/L	C	12	0.0021	0.0001	0.0018	3.419	2.578	0	1
4.2 meq/L	C	13	0.0019	0.0003	0.0017	2.447	4.186	0	1
4.2 meq/L	D	1	0.0032	0.0011	0.0034	4.638	8.175	0	1
4.2 meq/L	D	2	0.0013	0.0010	0.0040	2.781	6.495	0	1
4.2 meq/L	D	3	0.0014	0.0002	0.0018	3.121	5.259	0	1
4.2 meq/L	D	4	0.0021	0.0001	0.0004	2.219	1.777	0	1
4.2 meq/L	D	5	0.0011	0.0007	0.0027	1.421	8.364	0	1
4.2 meq/L	D	6	0.0030	0.0002	0.0043	3.250	3.284	0	1
4.2 meq/L	D	7	0.0016	0.0002		3.025	2.097	0	0
4.2 meq/L	D	8	0.0014	0.0003	0.0001	2.329	2.643	0	1
19.8 meq/L	A	1	0.0019	0.0004	0.0041	3.404	2.621	0	1
19.8 meq/L	A	2	0.0012	0.0004	0.0035	1.592	2.878	0	1
19.8 meq/L	A	3	0.0012	0.0003	0.0039	1.978	2.592	0	1
19.8 meq/L	A	4	0.0018	0.0011	0.0040	2.494	6.612	0	1
19.8 meq/L	A	5	0.0022	0.0003	0.0017	2.869	2.900	0	1
19.8 meq/L	A	6	0.0019	0.0004	0.0032	2.005	2.129	0	1
19.8 meq/L	A	7	0.0007	0.0009		0.485	6.276	0	0
19.8 meq/L	A	8	0.0012	0.0003	0.0018	1.528	1.492	0	1
19.8 meq/L	A	9	0.0015	0.0003	0.0009	2.267	2.701	0	1
19.8 meq/L	A	10	0.0018	0.0001	0.0035	2.406	1.619	0	1
19.8 meq/L	A	11	0.0018	0.0003	0.0007	1.730	0.970	0	1
19.8 meq/L	A	12	0.0020	0.0004	0.0006	2.473	1.644	0	1
19.8 meq/L	B	1	0.0019	0.0002	0.0022	2.144	1.667	0	1
19.8 meq/L	B	2	0.0009	0.0007		0.169	3.293	0	0
19.8 meq/L	B	3	0.0011	0.0002	0.0033	1.674	1.292	0	1
19.8 meq/L	B	4	0.0013	0.0001	0.0010	2.016	1.165	0	1
19.8 meq/L	B	5	0.0017	0.0003	0.0012	3.262	1.297	0	1
19.8 meq/L	B	6	0.0022	0.0001	0.0009	2.590	1.008	0	1
19.8 meq/L	C	1	0.0019	0.0002	0.0017	2.031	2.632	0	1
19.8 meq/L	C	2	0.0010	0.0003	0.0018	2.656	3.729	0	1
19.8 meq/L	C	3	0.0022	0.0003	0.0029	2.612	2.005	0	1
19.8 meq/L	C	4	0.0017	0.0005	0.0028	3.843	3.564	0	1
19.8 meq/L	C	5	0.0018	0.0009	0.0014	2.055	6.447	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
19.8 meq/L	C	6	0.0006	0.0006	0.0046	4.235	3.987	0	1
19.8 meq/L	C	7	0.0016	0.0005	0.0014	2.038	1.978	0	1
19.8 meq/L	C	8	0.0019	0.0003		1.872	1.001	0	0
19.8 meq/L	C	9	0.0005	0.0003	0.0028	1.966	2.175	0	1
19.8 meq/L	C	10	0.0014	0.0002	0.0011	1.491	2.909	0	1
19.8 meq/L	D	1	0.0016	0.0002	0.0040	2.676	2.243	0	1
19.8 meq/L	D	2	0.0006	0.0003	0.0003	1.950	3.731	0	1
19.8 meq/L	D	3	0.0018	0.0002	0.0014	3.208	3.146	0	1
19.8 meq/L	D	4	0.0013	0.0004	0.0007	1.896	3.796	0	1
19.8 meq/L	D	5	0.0017	0.0004	0.0014	2.638	5.276	0	1
19.8 meq/L	D	6	0.0021	0.0003		2.442	3.155	0	0
19.8 meq/L	D	7	0.0013	0.0008	0.0007	1.396	4.697	0	1
19.8 meq/L	D	8	0.0016	0.0004	0.0014	1.609	4.407	0	1
19.8 meq/L	D	9	0.0017	0.0003	0.0007	2.078	2.332	0	1
19.8 meq/L	D	10	0.0011	0.0005	0.0009	2.031	3.590	0	1
51.1 meq/L	A	1	0.0019	0.0005	0.0033	2.865	3.198	0	1
51.1 meq/L	A	2	0.0011	0.0002	0.0021	2.733	1.176	0	1
51.1 meq/L	A	3	0.0017	0.0006	0.0007	3.027	2.580	0	1
51.1 meq/L	A	4	0.0018	0.0002	0.0008	1.544	1.362	0	1
51.1 meq/L	A	5	0.0014	0.0004	0.0019	2.668	3.275	0	1
51.1 meq/L	A	6	0.0020	0.0003	0.0022	2.986	0.859	0	1
51.1 meq/L	A	7	0.0016	0.0005	0.0012	2.803	2.944	0	1
51.1 meq/L	A	8	0.0018	0.0002	0.0006	2.724	1.534	0	1
51.1 meq/L	A	9	0.0020	0.0004	0.0023	2.104	1.850	0	1
51.1 meq/L	A	10	0.0017	0.0001	0.0012	2.406	1.736	0	1
51.1 meq/L	A	11	0.0021	0.0002	0.0052	2.337	1.747	0	1
51.1 meq/L	A	12	0.0012	0.0002		2.420	2.908	1	0
51.1 meq/L	A	13	0.0023	0.0002	0.0010	2.251	1.768	0	1
51.1 meq/L	A	14	0.0020	0.0003	0.0014	2.862	1.443	0	1
51.1 meq/L	A	15	0.0010	0.0003		1.397	2.216	0	0
51.1 meq/L	A	16	0.0017	0.0001	0.0012	3.547	8.045	0	1
51.1 meq/L	A	17	0.0015	0.0001	0.0017	2.636	1.841	0	1
51.1 meq/L	A	18	0.0022	0.0006	0.0021	2.699	1.636	0	1
51.1 meq/L	A	19	0.0022	0.0003		1.947	1.988	1	0
51.1 meq/L	A	20	0.0012	0.0005	0.0016	2.623	3.400	0	1
51.1 meq/L	A	21	0.0014	0.0004	0.0020	2.435	3.076	0	1
51.1 meq/L	B	1	0.0019	0.0001	0.0027	2.886	1.430	0	1
51.1 meq/L	B	2	0.0011	0.0008	0.0006	2.406	3.744	0	1
51.1 meq/L	B	3	0.0028	0.0002	0.0024	2.586	3.461	0	1
51.1 meq/L	B	4	0.0012	0.0001	0.0033	2.068	2.049	0	1
51.1 meq/L	B	5	0.0015	0.0001	0.0012	3.246	1.629	0	1
51.1 meq/L	B	6	0.0015	0.0003	0.0019	3.453	3.175	0	1
51.1 meq/L	B	7	0.0017	0.0001	0.0017	2.594	3.624	0	1
51.1 meq/L	B	8	0.0021	0.0008	0.0036	2.153	5.442	0	1
51.1 meq/L	B	9	0.0016	0.0006	0.0004	3.080	6.061	0	1
51.1 meq/L	B	10	0.0016	0.0003	0.0030	2.637	5.029	1	1
51.1 meq/L	B	11	0.0013	0.0002	0.0002	2.352	2.240	0	1
51.1 meq/L	B	12	0.0002	0.0004	0.0011	1.091	2.447	0	1
51.1 meq/L	C	1	0.0018	0.0009	0.0018	2.792	5.754	0	1
51.1 meq/L	C	2	0.0020	0.0003	0.0023	2.500	2.825	0	1
51.1 meq/L	C	3	0.0012	0.0006	0.0009	1.756	4.004	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
51.1 meq/L	C	4	0.0020	0.0005	0.0035	2.810	2.589	0	1
51.1 meq/L	C	5	0.0022	0.0005	0.0023	2.336	4.931	0	1
51.1 meq/L	C	6	0.0025	0.0002		6.094	0.654	0	0
51.1 meq/L	C	7	0.0016	0.0006	0.0018	1.799	2.970	0	1
51.1 meq/L	D	1	0.0019	0.0003	0.0042	2.333	3.606	0	1
51.1 meq/L	D	2	0.0017	0.0003	0.0018	2.080	0.852	0	1
51.1 meq/L	D	3	0.0014	0.0004	0.0016	2.679	4.231	0	1
51.1 meq/L	D	4	0.0020	0.0005	0.0027	2.398	3.353	0	1
51.1 meq/L	D	5	0.0022	0.0006	0.0023	2.392	3.324	0	1
51.1 meq/L	D	6	0.0016	0.0005	0.0018	2.345	4.443	0	1
51.1 meq/L	D	7	0.0015	0.0008	0.0034	1.550	4.714	0	1
51.1 meq/L	D	8	0.0014	0.0004		2.367	2.452	0	0
51.1 meq/L	D	9	0.0024	0.0003	0.0002	1.908	2.518	0	1
51.1 meq/L	D	10	0.0012	0.0007	0.0014	1.844	7.374	0	1
51.1 meq/L	D	11	0.0011	0.0006	0.0017	1.314	7.268	0	1
51.1 meq/L	D	12	0.0017	0.0006	0.0016	1.854	2.771	0	1
51.1 meq/L	D	13	0.0017	0.0006	0.0012	3.434	4.453	0	1
51.1 meq/L	D	14	0.0018	0.0006	0.0013	2.699	3.053	0	1
51.1 meq/L	D	15	0.0020	0.0007	0.0007	2.289	3.256	0	1
51.1 meq/L	D	16	0.0016	0.0008		2.487	4.215	1	0
51.1 meq/L	D	17	0.0013	0.0004		2.138	2.289	0	0
51.1 meq/L	D	18	0.0011	0.0004		1.824	2.586	0	0
103.2 meq/L	A	1	0.0013	0.0007	0.0021	1.581	2.945	1	1
103.2 meq/L	A	2	0.0015	0.0005	0.0020	2.252	2.285	0	1
103.2 meq/L	A	3	0.0015	0.0003	0.0027	2.046	1.288	0	1
103.2 meq/L	A	4	0.0013	0.0001	0.0012	1.926	2.264	0	1
103.2 meq/L	A	5	0.0016	0.0001	0.0001	3.109	1.243	0	1
103.2 meq/L	A	6	0.0014	0.0004	0.0022	2.064	1.180	0	1
103.2 meq/L	A	7	0.0010	0.0003	0.0006	2.334	1.837	0	1
103.2 meq/L	A	8	0.0016	0.0004	0.0014	2.014	2.342	1	1
103.2 meq/L	A	9	0.0020	0.0010	0.0016	2.237	2.662	0	1
103.2 meq/L	B	1	0.0021	0.0005	0.0021	2.177	2.207	1	1
103.2 meq/L	B	2	0.0013	0.0004	0.0018	2.186	1.403	0	1
103.2 meq/L	B	3	0.0015	0.0002	0.0014	2.271	2.024	1	1
103.2 meq/L	B	4	0.0018	0.0005	0.0018	2.300	1.520	1	1
103.2 meq/L	B	5	0.0013	0.0001	0.0011	2.651	0.826	0	1
103.2 meq/L	B	6	0.0010	0.0004	0.0006	1.817	1.620	0	1
103.2 meq/L	B	7	0.0008	0.0007	0.0015	1.591	4.652	1	1
103.2 meq/L	B	8	0.0011	0.0001	0.0008	1.909	1.587	1	1
103.2 meq/L	C	1	0.0009	0.0006	0.0016	2.322	2.178	0	1
103.2 meq/L	C	2	0.0012	0.0008	0.0015	1.343	3.159	0	1
103.2 meq/L	C	3	0.0014	0.0004	0.0009	2.017	1.519	0	1
103.2 meq/L	C	4	0.0012	0.0004	0.0018	1.452	1.689	0	1
103.2 meq/L	C	5	0.0013	0.0007	0.0016	2.050	3.632	0	1
103.2 meq/L	C	6	0.0016	0.0005	0.0014	1.859	2.596	1	1
103.2 meq/L	C	7	0.0012	0.0003	0.0016	1.914	1.308	1	1
103.2 meq/L	C	8	0.0005	0.0006	0.0009	1.515	2.101	0	1
103.2 meq/L	C	9	0.0010	0.0003	0.0011	2.107	1.176	0	1
103.2 meq/L	C	10	0.0012	0.0001		2.131	1.056	1	0
103.2 meq/L	C	11	0.0015	0.0004	0.0007	1.196	2.146	0	1
103.2 meq/L	D	1	0.0018	0.0003	0.0013	2.617	1.837	1	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
103.2 meq/L	D	2	0.0019	0.0004	0.0010	2.185	3.670	0	1
103.2 meq/L	D	3	0.0027	0.0005	0.0016	2.395	2.180	1	1
103.2 meq/L	D	4	0.0018	0.0005	0.0014	2.968	2.673	0	1
103.2 meq/L	D	5	0.0009	0.0004	0.0013	1.318	2.509	1	1
103.2 meq/L	D	6	0.0020	0.0003	0.0021	2.425	0.726	0	1
103.2 meq/L	D	7	0.0009	0.0004	0.0013	2.966	2.544	1	1
103.2 meq/L	D	8	0.0005	0.0001	0.0002	1.401	1.191	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
HS-1 (1:4)	A	1	0.0035	0.0007	0.0086	3.219	7.094	0	3
HS-1 (1:4)	A	2	0.0026	0.0005	0.0033	3.156	4.452	0	2
HS-1 (1:4)	A	3	0.0022	0.0011	0.0089	2.731	12.356	0	5
HS-1 (1:4)	A	4	0.0023	0.0004	0.0058	3.193	5.210	0	4
HS-1 (1:4)	A	5	0.0043	0.0001	0.0079	4.328	3.132	0	6
HS-1 (1:4)	A	6	0.0017	0.0008	0.0098	2.971	4.453	0	5
HS-1 (1:4)	A	7	0.0028	0.0004	0.0052	4.060	3.800	0	4
HS-1 (1:4)	A	8	0.0046	0.0005	0.0056	5.597	4.115	0	3
HS-1 (1:4)	A	9	0.0023	0.0001	0.0007	2.188	2.961	0	3
HS-1 (1:4)	A	10	0.0031	0.0001	0.0014	4.513	1.052	0	5
HS-1 (1:4)	A	11	0.0007	0.0002	0.0008	2.737	5.857	0	1
HS-1 (1:4)	B	1	0.0029	0.0005	0.0076	3.024	3.283	0	7
HS-1 (1:4)	B	2	0.0039	0.0004	0.0096	3.776	3.713	0	5
HS-1 (1:4)	B	3	0.0016	0.0008	0.0038	4.044	4.729	0	4
HS-1 (1:4)	B	4	0.0024	0.0005	0.0057	2.479	4.267	0	3
HS-1 (1:4)	B	5	0.0021	0.0010	0.0046	3.159	11.701	0	4
HS-1 (1:4)	B	6	0.0040	0.0014	0.0070	6.376	5.997	0	3
HS-1 (1:4)	B	7	0.0013	0.0005	0.0062	4.935	3.863	0	6
HS-1 (1:4)	B	8	0.0025	0.0009	0.0065	3.597	4.371	0	5
HS-1 (1:4)	B	9	0.0024	0.0001	0.0079	2.890	0.912	0	3
HS-1 (1:4)	B	10	0.0044	0.0005	0.0060	7.175	3.208	0	4
HS-1 (1:4)	B	11	0.0020	0.0006	0.0051	3.980	9.075	0	5
HS-1 (1:4)	B	12	0.0012	0.0006	0.0001	2.611	2.590	0	2
HS-1 (1:4)	C	1	0.0015	0.0004	0.0017	3.982	3.626	0	4
HS-1 (1:4)	C	2	0.0016	0.0006	0.0074	2.705	8.079	0	4
HS-1 (1:4)	C	3	0.0024	0.0004	0.0049	2.803	4.403	0	3
HS-1 (1:4)	C	4	0.0017	0.0007	0.0089	2.470	5.720	0	2
HS-1 (1:4)	C	5	0.0015	0.0004	0.0051	3.027	2.869	0	3
HS-1 (1:4)	C	6	0.0025	0.0005	0.0033	4.945	6.842	0	3
HS-1 (1:4)	C	7	0.0019	0.0003	0.0058	2.894	3.932	0	3
HS-1 (1:4)	C	8	0.0012	0.0005	0.0117	1.026	7.687	0	5
HS-1 (1:4)	C	9	0.0022	0.0005	0.0054	2.596	2.663	0	5
HS-1 (1:4)	C	10	0.0014	0.0015	0.0032	1.833	5.575	0	3
HS-1 (1:4)	C	11	0.0023	0.0002	0.0089	3.005	4.022	0	2
HS-1 (1:4)	C	12	0.0012	0.0002	0.0034	2.524	2.045	0	3
HS-1 (1:4)	C	13	0.0040	0.0011		1.522	5.790	0	0
HS-1 (1:4)	D	1	0.0021	0.0001	-0.0008	4.654	2.193	0	4
HS-1 (1:4)	D	2	0.0014	0.0002	0.0043	3.571	5.979	0	3
HS-1 (1:4)	D	3	0.0020	0.0005	0.0043	2.024	2.467	0	2
HS-1 (1:4)	D	4	0.0038	0.0002	0.0046	3.415	2.325	0	3
HS-1 (1:4)	D	5	0.0023	0.0004	0.0061	3.250	3.704	0	3
HS-1 (1:4)	D	6	0.0032	0.0003	0.0067	6.585	4.534	0	4
HS-1 (1:4)	D	7	0.0020	0.0001	0.0060	2.622	1.726	0	5
HS-1 (1:4)	D	8	0.0019	0.0001	0.0073	2.723	3.033	0	4
HS-1 (1:4)	D	9	0.0016	0.0002	0.0045	2.335	6.035	0	2
HS-1 (1:4)	D	10	0.0014	0.0001	0.0061	2.926	1.538	0	4
100 mg/L BA	A	1	0.0123	0.0003		10.634	3.306	1	0
100 mg/L BA	A	2	0.0009	0.0004	0.0037	1.763	3.011	1	3
100 mg/L BA	A	3	0.0031	0.0002	0.0034	3.427	2.488	1	3
100 mg/L BA	A	4	0.0005	0.0002	0.0011	2.801	0.621	1	2
100 mg/L BA	A	5	0.0010	0.0001		0.446	0.971	1	0

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
100 mg/L BA	B	1	0.0026	0.0001	0.0037	3.302	1.547	1	4
100 mg/L BA	B	2	0.0023	0.0002	0.0050	3.428	2.288	1	5
100 mg/L BA	B	3	0.0035	0.0009	0.0063	2.232	3.069	1	5
100 mg/L BA	B	4	0.0045	0.0003	0.0056	5.678	1.534	1	4
100 mg/L BA	B	5	0.0022	0.0002	0.0003	2.596	2.143	1	1
100 mg/L BA	C	1	0.0023	0.0008	0.0031	1.613	0.976	1	4
100 mg/L BA	C	2	0.0025	0.0007	0.0011	4.168	5.287	1	3
100 mg/L BA	C	3	0.0010	0.0001		1.375	1.535	1	0
100 mg/L BA	C	4	0.0017	0.0003	0.0013	1.328	1.053	1	4
100 mg/L BA	C	5	0.0019	0.0002		2.907	1.760	1	0
100 mg/L BA	D	1	0.0029	0.0001	0.0026	5.905	1.872	1	4
100 mg/L BA	D	2	0.0074	0.0009	0.0031	4.996	2.264	1	2
100 mg/L BA	D	3	0.0013	0.0002	0.0035	1.556	2.536	1	5
100 mg/L BA	D	4	0.0028	0.0005	0.0029	3.851	1.858	1	2
100 mg/L BA	D	5	0.0021	0.0001	0.0056	3.559	2.136	1	3
100 mg/L BA	D	6	0.0038	0.0001	0.0007	5.888	1.503	1	3
100 mg/L BA	D	7	0.0020	0.0001	0.0036	1.084	1.515	1	4
100 mg/L BA	D	8	0.0010	0.0002	0.0072	3.087	1.986	1	3
10 mg/L SO ₄ ²⁻	A	1	0.0039	0.0002	0.0075	4.608	2.801	0	2
10 mg/L SO ₄ ²⁻	A	2	0.0022	0.0009	0.0034	5.666	12.908	0	4
10 mg/L SO ₄ ²⁻	A	3	0.0031	0.0007	0.0145	3.342	4.292	0	2
10 mg/L SO ₄ ²⁻	A	4	0.0026	0.0004	0.0098	4.601	5.890	0	4
10 mg/L SO ₄ ²⁻	A	5	0.0019	0.0007	0.0090	4.366	11.487	0	5
10 mg/L SO ₄ ²⁻	A	6	0.0023	0.0004	0.0061	7.379	7.230	0	4
10 mg/L SO ₄ ²⁻	A	7	0.0016	0.0013	0.0064	2.765	3.960	0	5
10 mg/L SO ₄ ²⁻	A	8	0.0019	0.0006	0.0103	3.245	4.942	0	5
10 mg/L SO ₄ ²⁻	A	9	0.0032	0.0006	0.0084	4.127	5.298	0	3
10 mg/L SO ₄ ²⁻	A	10	0.0010	0.0003	0.0076	2.168	5.121	0	6
10 mg/L SO ₄ ²⁻	A	11	0.0039	0.0004	0.0041	3.341	4.636	0	3
10 mg/L SO ₄ ²⁻	A	12	0.0031	0.0004	0.0030	4.762	2.975	0	4
10 mg/L SO ₄ ²⁻	B	1	0.0019	0.0003	0.0101	2.292	2.966	0	4
10 mg/L SO ₄ ²⁻	B	2	0.0019	0.0008	0.0057	3.000	11.065	0	4
10 mg/L SO ₄ ²⁻	B	3	0.0026	0.0006	0.0062	2.290	3.553	0	4
10 mg/L SO ₄ ²⁻	B	4	0.0027	0.0010	0.0087	5.110	6.135	0	4
10 mg/L SO ₄ ²⁻	B	5	0.0033	0.0001	0.0035	3.445	2.594	0	3
10 mg/L SO ₄ ²⁻	B	6	0.0024	0.0012	0.0068	3.528	8.989	0	3
10 mg/L SO ₄ ²⁻	B	7	0.0028	0.0009	0.0056	5.588	4.899	0	3
10 mg/L SO ₄ ²⁻	B	8	0.0026	0.0003	0.0057	1.951	1.541	0	4
10 mg/L SO ₄ ²⁻	B	9	0.0015	0.0005	0.0048	3.177	8.015	0	4
10 mg/L SO ₄ ²⁻	C	1	0.0008	0.0004	0.0102	0.966	5.513	0	4
10 mg/L SO ₄ ²⁻	C	2	0.0029	0.0001	0.0065	4.380	1.993	0	3
10 mg/L SO ₄ ²⁻	C	3	0.0021	0.0009	0.0063	3.569	7.760	0	4
10 mg/L SO ₄ ²⁻	C	4	0.0032	0.0002	0.0106	1.791	4.814	0	5
10 mg/L SO ₄ ²⁻	C	5	0.0033	0.0004	0.0054	2.174	5.600	0	4

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
10 mg/L SO ₄ ²⁻	C	6	0.0009	0.0006	0.0058	1.420	13.415	0	3
10 mg/L SO ₄ ²⁻	C	7	0.0017	0.0004	0.0052	3.594	3.704	0	3
10 mg/L SO ₄ ²⁻	C	8	0.0025	0.0001	0.0030	1.738	1.332	0	3
10 mg/L SO ₄ ²⁻	C	9	0.0015	0.0003	0.0076	2.657	4.082	0	4
10 mg/L SO ₄ ²⁻	C	10	0.0034	0.0006	0.0048	3.745	4.483	0	3
10 mg/L SO ₄ ²⁻	C	11	0.0019	0.0008	0.0040	1.745	5.898	0	3
10 mg/L SO ₄ ²⁻	C	12	0.0020	0.0002	0.0064	3.497	3.246	0	4
10 mg/L SO ₄ ²⁻	D	1	0.0026	0.0008	0.0092	2.777	11.490	0	4
10 mg/L SO ₄ ²⁻	D	2	0.0018	0.0006	0.0123	1.671	4.693	0	5
10 mg/L SO ₄ ²⁻	D	3	0.0013	0.0003	0.0105	1.300	2.245	0	3
10 mg/L SO ₄ ²⁻	D	4	0.0016	0.0004	0.0055	2.909	3.877	0	4
10 mg/L SO ₄ ²⁻	D	5	0.0019	0.0006	0.0084	2.773	5.140	0	4
10 mg/L SO ₄ ²⁻	D	6	0.0017	0.0004	0.0059	2.973	4.508	0	4
10 mg/L SO ₄ ²⁻	D	7	0.0026	0.0006	0.0100	2.616	4.250	0	4
10 mg/L SO ₄ ²⁻	D	8	0.0016	0.0002	0.0077	1.908	3.583	0	5
10 mg/L SO ₄ ²⁻	D	9	0.0012	0.0005	0.0070	2.108	7.062	0	6
10 mg/L SO ₄ ²⁻	D	10	0.0018	0.0007	0.0104	2.576	2.941	0	3
10 mg/L SO ₄ ²⁻	D	11	0.0012	0.0002	0.0008	1.818	3.844	0	3
10 mg/L SO ₄ ²⁻	D	12	0.0017	0.0003	0.0063	3.725	7.865	0	4
10 mg/L SO ₄ ²⁻	D	13	0.0027	0.0004	0.0113	2.525	6.306	0	5
10 mg/L SO ₄ ²⁻	D	14	0.0017	0.0004	0.0079	0.976	5.196	0	4
10 mg/L SO ₄ ²⁻	D	15	0.0016	0.0005	0.0059	2.618	7.174	0	4
10 mg/L SO ₄ ²⁻	D	16	0.0014	0.0005	0.0027	3.354	6.762	0	3
10 mg/L SO ₄ ²⁻	D	17	0.0016	0.0009	0.0058	2.404	7.109	0	4
10 mg/L SO ₄ ²⁻	D	18	0.0036	0.0006	0.0135	3.127	2.689	0	5
10 mg/L SO ₄ ²⁻	D	19	0.0021	0.0010	0.0052	2.130	6.885	0	2
10 mg/L SO ₄ ²⁻	D	20	0.0015	0.0005	0.0051	2.297	3.624	0	4
10 mg/L SO ₄ ²⁻	D	21	0.0015	0.0003	0.0027	2.093	2.811	0	3
10 mg/L SO ₄ ²⁻	D	22	0.0032	0.0002	0.0050	1.920	2.131	0	3
250 mg/L SO ₄ ²⁻	A	1	0.0018	0.0010	0.0089	2.045	5.658	0	5
250 mg/L SO ₄ ²⁻	A	2	0.0026	0.0009	0.0086	3.529	8.267	0	4
250 mg/L SO ₄ ²⁻	A	3	0.0016	0.0007	0.0051	2.471	6.472	0	4
250 mg/L SO ₄ ²⁻	A	4	0.0037	0.0007	0.0121	3.112	4.828	0	4
250 mg/L SO ₄ ²⁻	A	5	0.0023	0.0009	0.0087	2.835	8.196	0	4
250 mg/L SO ₄ ²⁻	A	6	0.0021	0.0004	0.0052	2.441	4.155	0	3
250 mg/L SO ₄ ²⁻	A	7	0.0019	0.0004	0.0027	3.419	3.932	0	2
250 mg/L SO ₄ ²⁻	A	8	0.0028	0.0004	0.0065	2.782	2.741	0	5
250 mg/L SO ₄ ²⁻	A	9	0.0026	0.0004	0.0067	5.345	2.659	0	4
250 mg/L SO ₄ ²⁻	A	10	0.0023	0.0002	0.0085	3.818	1.178	0	4
250 mg/L SO ₄ ²⁻	A	11	0.0016	0.0007	0.0103	1.368	7.706	0	6
250 mg/L SO ₄ ²⁻	B	1	0.0024	0.0001	0.0123	3.179	2.495	0	4

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
250 mg/L SO ₄ ²⁻	B	2	0.0038	0.0002	0.0110	4.150	3.042	0	4
250 mg/L SO ₄ ²⁻	B	3	0.0015	0.0004	0.0014	2.433	2.772	0	2
250 mg/L SO ₄ ²⁻	B	4	0.0025	0.0003	0.0080	3.001	4.009	0	4
250 mg/L SO ₄ ²⁻	B	5	0.0029	0.0007	0.0070	3.984	10.389	0	3
250 mg/L SO ₄ ²⁻	B	6	0.0006	0.0001	0.0020	2.098	3.635	0	3
250 mg/L SO ₄ ²⁻	B	7	0.0020	0.0003	0.0106	3.432	3.788	0	4
250 mg/L SO ₄ ²⁻	B	8	0.0018	0.0008	0.0079	3.006	4.665	0	4
250 mg/L SO ₄ ²⁻	B	9	0.0017	0.0002	0.0046	2.871	5.732	0	3
250 mg/L SO ₄ ²⁻	B	10	0.0015	0.0006	0.0053	3.217	8.837	0	4
250 mg/L SO ₄ ²⁻	B	11	0.0014	0.0001	0.0052	1.908	2.083	0	3
250 mg/L SO ₄ ²⁻	C	1	0.0037	0.0005	0.0070	5.831	5.734	0	3
250 mg/L SO ₄ ²⁻	C	2	0.0015	0.0006	0.0042	2.869	5.290	0	2
250 mg/L SO ₄ ²⁻	C	3	0.0023	0.0003	0.0050	4.147	2.378	0	4
250 mg/L SO ₄ ²⁻	C	4	0.0028	0.0004	0.0088	4.443	4.024	0	4
250 mg/L SO ₄ ²⁻	C	5	0.0028	0.0009	0.0032	1.793	7.111	0	4
250 mg/L SO ₄ ²⁻	C	6	0.0030	0.0006	0.0089	4.384	5.546	0	2
250 mg/L SO ₄ ²⁻	C	7	0.0039	0.0010	0.0016	2.552	4.577	0	5
250 mg/L SO ₄ ²⁻	C	8	0.0024	0.0009	0.0092	3.675	8.185	0	4
250 mg/L SO ₄ ²⁻	C	9	0.0029	0.0016	0.0067	3.369	7.037	0	4
250 mg/L SO ₄ ²⁻	C	10	0.0023	0.0011	0.0072	2.986	6.852	0	7
250 mg/L SO ₄ ²⁻	D	1	0.0015	0.0013	0.0072	1.622	7.628	0	4
250 mg/L SO ₄ ²⁻	D	2	0.0021	0.0006	0.0010	1.706	4.041	0	3
250 mg/L SO ₄ ²⁻	D	3	0.0020	0.0017	0.0081	3.573	12.932	0	6
250 mg/L SO ₄ ²⁻	D	4	0.0020	0.0018	0.0076	1.758	11.182	0	5
250 mg/L SO ₄ ²⁻	D	5	0.0017	0.0007	0.0056	4.007	3.191	0	5
250 mg/L SO ₄ ²⁻	D	6	0.0015	0.0003	0.0086	2.762	3.817	0	4
250 mg/L SO ₄ ²⁻	D	7	0.0019	0.0006	0.0068	2.511	3.651	0	5
250 mg/L SO ₄ ²⁻	D	8	0.0017	0.0006	0.0050	3.295	2.221	0	4
250 mg/L SO ₄ ²⁻	D	9	0.0022	0.0003	0.0055	4.015	5.826	0	4
250 mg/L SO ₄ ²⁻	D	10	0.0019	0.0003	0.0067	2.685	2.996	0	4
250 mg/L SO ₄ ²⁻	D	11	0.0022	0.0010	0.0062	4.810	4.650	0	4
250 mg/L SO ₄ ²⁻	D	12	0.0014	0.0008	0.0081	2.338	6.863	0	6
250 mg/L SO ₄ ²⁻	D	13	0.0026	0.0004	0.0079	3.602	4.537	0	5
250 mg/L SO ₄ ²⁻	D	14	0.0019	0.0004	0.0068	3.272	2.902	0	4
250 mg/L SO ₄ ²⁻	D	15	0.0023	0.0007	0.0105	3.812	3.746	0	4
250 mg/L SO ₄ ²⁻	D	16	0.0024	0.0006	0.0084	2.189	4.422	0	4
250 mg/L SO ₄ ²⁻	D	17	0.0038	0.0002	0.0135	5.329	3.131	0	3
250 mg/L SO ₄ ²⁻	D	18	0.0016	0.0004	0.0053	2.932	2.926	0	4
250 mg/L SO ₄ ²⁻	D	19	0.0038	0.0002	0.0057	4.271	2.431	0	3
250 mg/L SO ₄ ²⁻	D	20	0.0022	0.0004	0.0037	2.692	2.541	0	1
250 mg/L SO ₄ ²⁻	D	21	0.0058	0.0006	0.0125	2.730	4.065	0	3

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
250 mg/L SO ₄ ²⁻	D	22	0.0019	0.0013	0.0081	3.626	4.253	0	4
1000 mg/L SO ₄ ²⁻	A	1	0.0021	0.0006	0.0052	5.454	5.567	0	2
1000 mg/L SO ₄ ²⁻	A	2	0.0020	0.0011	0.0014	3.137	4.006	0	3
1000 mg/L SO ₄ ²⁻	A	3	0.0020	0.0005	0.0067	3.058	4.243	0	4
1000 mg/L SO ₄ ²⁻	A	4	0.0020	0.0011	0.0042	3.105	4.444	0	3
1000 mg/L SO ₄ ²⁻	A	5	0.0029	0.0002	0.0070	2.937	1.510	0	3
1000 mg/L SO ₄ ²⁻	A	6	0.0017	0.0006	0.0071	1.001	1.531	0	3
1000 mg/L SO ₄ ²⁻	A	7	0.0028	0.0009	0.0065	3.144	5.064	0	4
1000 mg/L SO ₄ ²⁻	A	8	0.0029	0.0006	0.0047	2.754	3.515	0	5
1000 mg/L SO ₄ ²⁻	A	9	0.0023	0.0012	0.0063	3.272	5.795	0	4
1000 mg/L SO ₄ ²⁻	A	10	0.0019	0.0006	0.0071	3.328	8.657	0	4
1000 mg/L SO ₄ ²⁻	A	11	0.0033	0.0007	0.0081	4.358	5.773	0	3
1000 mg/L SO ₄ ²⁻	B	1	0.0010	0.0005	0.0101	0.958	3.524	0	4
1000 mg/L SO ₄ ²⁻	B	2	0.0032	0.0007	0.0088	3.791	4.376	0	5
1000 mg/L SO ₄ ²⁻	B	3	0.0010	0.0010	0.0066	1.165	4.664	0	4
1000 mg/L SO ₄ ²⁻	B	4	0.0026	0.0005	0.0034	1.996	3.612	0	4
1000 mg/L SO ₄ ²⁻	B	5	0.0013	0.0003	0.0063	1.786	3.185	0	4
1000 mg/L SO ₄ ²⁻	B	6	0.0015	0.0012	0.0064	1.233	3.807	0	5
1000 mg/L SO ₄ ²⁻	B	7	0.0033	0.0005	0.0039	3.986	3.971	0	2
1000 mg/L SO ₄ ²⁻	B	8	0.0030	0.0034	0.0072	4.073	10.216	0	2
1000 mg/L SO ₄ ²⁻	B	9	0.0025	0.0006	0.0098	3.546	8.085	0	4
1000 mg/L SO ₄ ²⁻	B	10	0.0023	0.0004	0.0036	2.466	3.147	0	3
1000 mg/L SO ₄ ²⁻	B	11	0.0028	0.0010	0.0063	3.745	5.722	0	2
1000 mg/L SO ₄ ²⁻	B	12	0.0023	0.0004	0.0062	5.114	2.771	0	4
1000 mg/L SO ₄ ²⁻	B	13	0.0019	0.0006	0.0068	3.048	2.854	0	3
1000 mg/L SO ₄ ²⁻	B	14	0.0024	0.0016	0.0008	1.690	2.432	0	3
1000 mg/L SO ₄ ²⁻	B	15	0.0026	0.0004	0.0066	3.547	3.427	0	3
1000 mg/L SO ₄ ²⁻	B	16	0.0020	0.0009	0.0084	3.140	4.390	0	4
1000 mg/L SO ₄ ²⁻	B	17	0.0010	0.0004	0.0094	1.110	2.770	0	4
1000 mg/L SO ₄ ²⁻	B	18	0.0038	0.0024	0.0101	5.563	7.748	0	3
1000 mg/L SO ₄ ²⁻	B	19	0.0026	0.0008	0.0084	4.030	4.864	0	4
1000 mg/L SO ₄ ²⁻	B	20	0.0015	0.0010	0.0079	2.662	7.317	0	4
1000 mg/L SO ₄ ²⁻	B	21	0.0022	0.0002	0.0082	3.761	2.447	0	3
1000 mg/L SO ₄ ²⁻	B	22	0.0033	0.0007	0.0097	4.321	4.671	0	4
1000 mg/L SO ₄ ²⁻	C	1	0.0037	0.0006	0.0118	2.999	3.691	0	4
1000 mg/L SO ₄ ²⁻	C	2	0.0021	0.0004	0.0083	2.791	2.259	0	5
1000 mg/L SO ₄ ²⁻	C	3	0.0040	0.0007	0.0098	3.897	6.215	0	4
1000 mg/L SO ₄ ²⁻	C	4	0.0018	0.0004	0.0050	2.819	6.481	0	3
1000 mg/L SO ₄ ²⁻	C	5	0.0037	0.0005	0.0118	3.085	4.815	0	4
1000 mg/L SO ₄ ²⁻	C	6	0.0025	0.0004	0.0066	3.641	1.944	0	3
1000 mg/L SO ₄ ²⁻	C	7	0.0027	0.0005	0.0079	3.938	2.904	0	3

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
1000 mg/L SO ₄ ²⁻	C	8	0.0023	0.0003	0.0058	2.788	3.109	0	4
1000 mg/L SO ₄ ²⁻	C	9	0.0036	0.0008	0.0105	4.667	5.061	0	3
1000 mg/L SO ₄ ²⁻	C	10	0.0032	0.0005	0.0069	2.444	2.557	0	3
1000 mg/L SO ₄ ²⁻	C	11	0.0042	0.0005	0.0095	4.180	6.093	0	5
1000 mg/L SO ₄ ²⁻	C	12	0.0029	0.0015	0.0058	2.373	4.672	0	3
1000 mg/L SO ₄ ²⁻	C	13	0.0027	0.0006	0.0081	5.531	5.977	0	3
1000 mg/L SO ₄ ²⁻	C	14	0.0009	0.0015	0.0036	1.668	5.156	0	3
1000 mg/L SO ₄ ²⁻	C	15	0.0016	0.0007	0.0092	1.253	4.111	0	3
1000 mg/L SO ₄ ²⁻	D	1	0.0025	0.0008	0.0051	1.379	2.154	0	3
1000 mg/L SO ₄ ²⁻	D	2	0.0014	0.0008	0.0063	3.152	9.284	0	3
1000 mg/L SO ₄ ²⁻	D	3	0.0016	0.0005	0.0061	2.991	4.961	0	3
1000 mg/L SO ₄ ²⁻	D	4	0.0024	0.0004	0.0059	4.482	5.325	0	2
1000 mg/L SO ₄ ²⁻	D	5	0.0025	0.0006	0.0047	2.595	2.811	0	3
1000 mg/L SO ₄ ²⁻	D	6	0.0040	0.0007	0.0101	4.258	4.729	0	3
1000 mg/L SO ₄ ²⁻	D	7	0.0017	0.0003	0.0044	1.932	2.481	0	3
1000 mg/L SO ₄ ²⁻	D	8	0.0020	0.0011	0.0093	3.147	2.475	0	4
1000 mg/L SO ₄ ²⁻	D	9	0.0027	0.0009	0.0052	3.119	11.177	0	4
1000 mg/L SO ₄ ²⁻	D	10	0.0020	0.0002	0.0054	2.263	4.101	0	2
1000 mg/L SO ₄ ²⁻	D	11	0.0008	0.0009	0.0039	1.664	4.929	0	2
1000 mg/L SO ₄ ²⁻	D	12	0.0030	0.0007	0.0057	3.272	3.124	0	3
1000 mg/L SO ₄ ²⁻	D	13	0.0025	0.0002	0.0060	4.081	2.243	0	2
1000 mg/L SO ₄ ²⁻	D	14	0.0027	0.0007	0.0082	4.396	5.677	0	3
1000 mg/L SO ₄ ²⁻	D	15	0.0021	0.0004	0.0085	3.379	7.481	0	4
1000 mg/L SO ₄ ²⁻	D	16	0.0017	0.0005	0.0082	3.167	4.649	0	3
1000 mg/L SO ₄ ²⁻	D	17	0.0041	0.0006	0.0074	4.650	4.934	0	3
1000 mg/L SO ₄ ²⁻	D	18	0.0013	0.0004	0.0065	2.035	3.414	0	4
1000 mg/L SO ₄ ²⁻	D	19	0.0017	0.0009	0.0057	2.033	4.582	0	4
1000 mg/L SO ₄ ²⁻	D	20	0.0030	0.0007	0.0085	3.976	4.790	0	4
1000 mg/L SO ₄ ²⁻	D	21	0.0028	0.0005	0.0103	2.187	2.544	0	6
1000 mg/L SO ₄ ²⁻	D	22	0.0021	0.0028	0.0053	4.791	7.443	0	4
2500 mg/L SO ₄ ²⁻	A	1	0.0025	0.0011	0.0063	2.999	3.931	0	3
2500 mg/L SO ₄ ²⁻	A	2	0.0058	0.0005	0.0069	2.585	6.791	0	3
2500 mg/L SO ₄ ²⁻	A	3	0.0031	0.0003	0.0025	2.240	3.741	0	2
2500 mg/L SO ₄ ²⁻	A	4	0.0015	0.0011	0.0058	2.305	4.776	0	5
2500 mg/L SO ₄ ²⁻	A	5	0.0019	0.0001	0.0068	2.622	1.519	0	4
2500 mg/L SO ₄ ²⁻	A	6	0.0010	0.0006	0.0009	2.157	3.407	0	2
2500 mg/L SO ₄ ²⁻	A	7	0.0025	0.0004	0.0075	2.889	1.971	0	4
2500 mg/L SO ₄ ²⁻	A	8	0.0037	0.0004	0.0084	2.634	3.706	0	4
2500 mg/L SO ₄ ²⁻	A	9	0.0033	0.0007	0.0122	3.304	4.791	0	4
2500 mg/L SO ₄ ²⁻	A	10	0.0012	0.0006	0.0023	1.795	5.928	0	1
2500 mg/L SO ₄ ²⁻	A	11	0.0021	0.0008	0.0178	2.910	6.799	0	7

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
2500 mg/L SO ₄ ²⁻	A	12	0.0020	0.0006	0.0053	3.416	4.173	0	2
2500 mg/L SO ₄ ²⁻	A	13	0.0023	0.0005	0.0068	2.981	3.528	0	4
2500 mg/L SO ₄ ²⁻	A	14	0.0021	0.0004	0.0057	4.051	4.116	0	3
2500 mg/L SO ₄ ²⁻	A	15	0.0033	0.0008	0.0034	4.370	3.110	0	2
2500 mg/L SO ₄ ²⁻	A	16	0.0024	0.0011	0.0068	3.224	8.199	0	2
2500 mg/L SO ₄ ²⁻	A	17	0.0011	0.0028	0.0062	3.379	6.034	0	3
2500 mg/L SO ₄ ²⁻	A	18	0.0034	0.0003	0.0160	2.860	3.389	0	4
2500 mg/L SO ₄ ²⁻	A	19	0.0021	0.0010	0.0065	3.101	6.043	0	4
2500 mg/L SO ₄ ²⁻	A	20	0.0020	0.0002	0.0049	1.534	2.636	0	3
2500 mg/L SO ₄ ²⁻	B	1	0.0043	0.0010	0.0061	3.770	3.386	0	2
2500 mg/L SO ₄ ²⁻	B	2	0.0043	0.0014	0.0128	2.333	6.900	0	6
2500 mg/L SO ₄ ²⁻	B	3	0.0008	0.0009	0.0047	1.444	4.538	0	2
2500 mg/L SO ₄ ²⁻	B	4	0.0025	0.0008	0.0052	3.196	3.379	0	3
2500 mg/L SO ₄ ²⁻	B	5	0.0012	0.0005	0.0080	1.683	4.084	0	2
2500 mg/L SO ₄ ²⁻	B	6	0.0026	0.0007	0.0036	2.924	3.878	0	3
2500 mg/L SO ₄ ²⁻	B	7	0.0011	0.0010	0.0052	1.012	2.832	0	3
2500 mg/L SO ₄ ²⁻	B	8	0.0025	0.0008	0.0068	3.398	5.415	0	3
2500 mg/L SO ₄ ²⁻	B	9	0.0021	0.0007	0.0064	2.949	3.803	0	2
2500 mg/L SO ₄ ²⁻	B	10	0.0038	0.0010	0.0032	3.158	7.975	0	3
2500 mg/L SO ₄ ²⁻	B	11	0.0025	0.0005	0.0065	3.731	2.707	0	3
2500 mg/L SO ₄ ²⁻	B	12	0.0029	0.0005	0.0051	4.284	4.732	0	3
2500 mg/L SO ₄ ²⁻	B	13	0.0022	0.0007	0.0099	3.204	2.694	0	3
2500 mg/L SO ₄ ²⁻	B	14	0.0035	0.0009	0.0065	3.054	3.951	0	4
2500 mg/L SO ₄ ²⁻	B	15	0.0045	0.0007	0.0076	4.193	3.880	0	4
2500 mg/L SO ₄ ²⁻	B	16	0.0024	0.0003	0.0085	4.053	3.814	0	4
2500 mg/L SO ₄ ²⁻	B	17	0.0020	0.0006	0.0057	3.429	5.383	0	2
2500 mg/L SO ₄ ²⁻	B	18	0.0029	0.0008	0.0092	3.645	3.710	0	5
2500 mg/L SO ₄ ²⁻	B	19	0.0012	0.0003	0.0042	2.366	2.960	0	3
2500 mg/L SO ₄ ²⁻	B	20	0.0022	0.0013	0.0048	2.193	3.852	0	3
2500 mg/L SO ₄ ²⁻	B	21	0.0012	0.0004	0.0056	1.864	5.027	0	2
2500 mg/L SO ₄ ²⁻	B	22	0.0026	0.0016	0.0066	3.328	4.487	0	3
2500 mg/L SO ₄ ²⁻	B	23	0.0029	0.0014	0.0067	2.881	8.452	0	3
2500 mg/L SO ₄ ²⁻	B	24	0.0025	0.0006	0.0080	3.166	3.485	0	5
2500 mg/L SO ₄ ²⁻	B	25	0.0009	0.0006	0.0029	2.778	2.791	0	3
2500 mg/L SO ₄ ²⁻	B	26	0.0027	0.0005	0.0052	2.523	2.713	0	2
2500 mg/L SO ₄ ²⁻	C	1	0.0038	0.0010	0.0054	3.713	6.873	0	3
2500 mg/L SO ₄ ²⁻	C	2	0.0050	0.0006	0.0072	3.043	5.223	0	3
2500 mg/L SO ₄ ²⁻	C	3	0.0069	0.0006	0.0087	3.168	3.420	0	3
2500 mg/L SO ₄ ²⁻	C	4	0.0034	0.0006	0.0051	3.241	3.151	0	2
2500 mg/L SO ₄ ²⁻	C	5	0.0027	0.0007	0.0068	2.871	5.196	0	4
2500 mg/L SO ₄ ²⁻	C	6	0.0022	0.0003	0.0062	2.363	2.994	0	4

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
2500 mg/L SO ₄ ²⁻	C	7	0.0023	0.0001	0.0092	2.887	2.303	0	4
2500 mg/L SO ₄ ²⁻	C	8	0.0028	0.0004	0.0067	2.898	4.529	0	3
2500 mg/L SO ₄ ²⁻	C	9	0.0032	0.0009	0.0069	2.725	3.961	0	4
2500 mg/L SO ₄ ²⁻	C	10	0.0026	0.0006	0.0088	2.916	2.820	0	4
2500 mg/L SO ₄ ²⁻	C	11	0.0031	0.0005	0.0102	2.587	3.572	0	4
2500 mg/L SO ₄ ²⁻	C	12	0.0028	0.0003	0.0081	2.842	1.969	0	3
2500 mg/L SO ₄ ²⁻	C	13	0.0036	0.0010	0.0073	3.626	8.059	0	3
2500 mg/L SO ₄ ²⁻	C	14	0.0035	0.0003	0.0048	3.144	2.416	0	2
2500 mg/L SO ₄ ²⁻	C	15	0.0068	0.0011	0.0064	2.423	3.655	0	3
2500 mg/L SO ₄ ²⁻	C	16	0.0022	0.0003	0.0085	2.030	1.656	0	3
2500 mg/L SO ₄ ²⁻	C	17	0.0023	0.0006	0.0064	2.423	3.015	0	4
2500 mg/L SO ₄ ²⁻	C	18	0.0023	0.0010	0.0091	1.904	5.719	0	3
2500 mg/L SO ₄ ²⁻	C	19	0.0021	0.0010	0.0066	3.126	4.169	0	3
2500 mg/L SO ₄ ²⁻	C	20	0.0012	0.0009	0.0080	1.938	4.036	0	3
2500 mg/L SO ₄ ²⁻	C	21	0.0036	0.0003	0.0043	4.580	2.020	0	3
2500 mg/L SO ₄ ²⁻	C	22	0.0020	0.0009	0.0099	1.718	3.157	0	3
2500 mg/L SO ₄ ²⁻	C	23	0.0026	0.0003	0.0092	2.341	2.176	0	6
2500 mg/L SO ₄ ²⁻	C	24	0.0038	0.0008	0.0056	2.929	3.751	0	3
2500 mg/L SO ₄ ²⁻	D	1	0.0016	0.0002	0.0057	2.207	2.524	0	3
2500 mg/L SO ₄ ²⁻	D	2	0.0027	0.0005	0.0099	3.220	3.729	0	3
2500 mg/L SO ₄ ²⁻	D	3	0.0016	0.0001	0.0051	2.028	2.617	0	3
2500 mg/L SO ₄ ²⁻	D	4	0.0020	0.0005	0.0058	2.804	3.484	0	4
2500 mg/L SO ₄ ²⁻	D	5	0.0027	0.0005	0.0050	2.603	2.870	0	3
2500 mg/L SO ₄ ²⁻	D	6	0.0019	0.0007	0.0018	2.054	3.082	0	2
2500 mg/L SO ₄ ²⁻	D	7	0.0023	0.0003	0.0056	2.988	4.233	0	3
2500 mg/L SO ₄ ²⁻	D	8	0.0019	0.0010	0.0054	2.486	3.374	0	4
2500 mg/L SO ₄ ²⁻	D	9	0.0037	0.0007	0.0068	2.686	3.457	0	3
2500 mg/L SO ₄ ²⁻	D	10	0.0034	0.0015	0.0083	2.108	6.602	0	4
2500 mg/L SO ₄ ²⁻	D	11	0.0036	0.0008	0.0062	3.647	4.102	0	3
2500 mg/L SO ₄ ²⁻	D	12	0.0010	0.0006	0.0019	0.937	1.591	0	2
2500 mg/L SO ₄ ²⁻	D	13	0.0066	0.0014	0.0052	3.877	3.232	0	1
2500 mg/L SO ₄ ²⁻	D	14	0.0017	0.0005	0.0077	1.463	3.751	0	3
2500 mg/L SO ₄ ²⁻	D	15	0.0020	0.0005	0.0031	3.669	4.194	0	3
2500 mg/L SO ₄ ²⁻	D	16	0.0029	0.0005	0.0045	2.724	4.591	0	2
2500 mg/L SO ₄ ²⁻	D	17	0.0028	0.0003	0.0051	3.037	1.803	0	3
2500 mg/L SO ₄ ²⁻	D	18	0.0025	0.0010	0.0032	2.911	3.746	0	3
5000 mg/L SO ₄ ²⁻	A	1	0.0017	0.0009	0.0037	1.738	2.116	1	1
5000 mg/L SO ₄ ²⁻	A	2	0.0013	0.0003	0.0001	2.370	2.244	1	1
5000 mg/L SO ₄ ²⁻	A	3	0.0026	0.0004	0.0045	1.558	2.396	1	3
5000 mg/L SO ₄ ²⁻	A	4	0.0021	0.0006	0.0024	2.023	1.621	1	2
5000 mg/L SO ₄ ²⁻	A	5	0.0069	0.0008	0.0053	2.370	1.665	1	2

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
5000 mg/L SO ₄ ²⁻	A	6	0.0030	0.0005	0.0039	1.988	2.962	1	2
5000 mg/L SO ₄ ²⁻	A	7	0.0086	0.0005	0.0051	2.300	1.731	1	2
5000 mg/L SO ₄ ²⁻	A	8	0.0014	0.0008	0.0009	3.140	2.704	1	1
5000 mg/L SO ₄ ²⁻	A	9	0.0086	0.0006	0.0050	2.290	2.260	1	1
5000 mg/L SO ₄ ²⁻	A	10	0.0048	0.0007	0.0076	2.462	2.922	1	4
5000 mg/L SO ₄ ²⁻	A	11	0.0006	0.0010	0.0051	1.181	2.596	0	4
5000 mg/L SO ₄ ²⁻	A	12	0.0017	0.0005	0.0036	1.993	1.135	1	3
5000 mg/L SO ₄ ²⁻	A	13	0.0036	0.0006	0.0039	2.851	3.418	1	2
5000 mg/L SO ₄ ²⁻	A	14	0.0055	0.0008	0.0055	1.979	2.764	1	3
5000 mg/L SO ₄ ²⁻	A	15	0.0019	0.0006	0.0079	2.267	1.390	1	3
5000 mg/L SO ₄ ²⁻	A	16	0.0029	0.0006	0.0074	1.459	3.111	1	4
5000 mg/L SO ₄ ²⁻	A	17	0.0062	0.0008	0.0049	1.838	3.325	1	3
5000 mg/L SO ₄ ²⁻	A	18	0.0030	0.0014	0.0076	1.566	5.110	0	4
5000 mg/L SO ₄ ²⁻	A	19	0.0026	0.0007	0.0062	1.717	2.490	1	3
5000 mg/L SO ₄ ²⁻	A	20	0.0049	0.0007	0.0066	2.168	2.840	1	3
5000 mg/L SO ₄ ²⁻	A	21	0.0028	0.0016	0.0057	2.436	3.823	1	4
5000 mg/L SO ₄ ²⁻	B	1	0.0021	0.0003	0.0063	2.460	1.707	0	4
5000 mg/L SO ₄ ²⁻	B	2	0.0020	0.0006	0.0051	2.699	1.932	1	3
5000 mg/L SO ₄ ²⁻	B	3	0.0010	0.0005	0.0030	2.126	1.616	1	2
5000 mg/L SO ₄ ²⁻	B	4	0.0110	0.0002	0.0035	2.723	1.234	1	2
5000 mg/L SO ₄ ²⁻	B	5	0.0062	0.0009	0.0054	3.411	2.705	1	2
5000 mg/L SO ₄ ²⁻	B	6	0.0038	0.0001	0.0043	1.926	2.479	1	3
5000 mg/L SO ₄ ²⁻	B	7	0.0016	0.0004	0.0027	1.070	3.621	1	2
5000 mg/L SO ₄ ²⁻	B	8	0.0037	0.0006	0.0041	2.088	3.209	1	3
5000 mg/L SO ₄ ²⁻	B	9	0.0012	0.0002	0.0044	2.031	2.616	1	3
5000 mg/L SO ₄ ²⁻	B	10	0.0028	0.0003	0.0020	1.407	2.571	1	2
5000 mg/L SO ₄ ²⁻	B	11	0.0007	0.0003	0.0008	1.324	1.658	1	1
5000 mg/L SO ₄ ²⁻	C	1	0.0075	0.0004		1.369	1.695	1	0
5000 mg/L SO ₄ ²⁻	C	2	0.0046	0.0004		1.742	4.640	1	0
5000 mg/L SO ₄ ²⁻	C	3	0.0022	0.0006	0.0045	2.012	2.518	1	3
5000 mg/L SO ₄ ²⁻	C	4	0.0012	0.0001	0.0035	1.894	0.803	1	1
5000 mg/L SO ₄ ²⁻	C	5	0.0015	0.0003		1.071	0.907	1	0
5000 mg/L SO ₄ ²⁻	C	6	0.0047	0.0005	0.0076	2.767	1.112	1	3
5000 mg/L SO ₄ ²⁻	C	7	0.0071	0.0009	0.0064	1.718	5.258	1	3
5000 mg/L SO ₄ ²⁻	C	8	0.0037	0.0006	0.0069	2.913	2.509	1	3
5000 mg/L SO ₄ ²⁻	C	9	0.0016	0.0001	0.0100	2.414	2.009	1	4
5000 mg/L SO ₄ ²⁻	C	10	0.0017	0.0005	0.0047	3.139	3.163	1	3
5000 mg/L SO ₄ ²⁻	C	11	0.0033	0.0001	0.0071	1.659	1.290	0	3
5000 mg/L SO ₄ ²⁻	C	12	0.0021	0.0002	0.0033	2.592	1.246	1	2
5000 mg/L SO ₄ ²⁻	C	13	0.0023	0.0001	0.0030	2.533	1.328	1	2
5000 mg/L SO ₄ ²⁻	C	14	0.0016	0.0003	0.0023	2.153	2.678	1	3

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
5000 mg/L SO ₄ ²⁻	C	15	0.0034	0.0006	0.0074	1.822	2.629	0	4
5000 mg/L SO ₄ ²⁻	C	16	0.0019	0.0006	0.0034	1.278	2.702	1	3
5000 mg/L SO ₄ ²⁻	D	1	0.0272	0.0004	0.0046	3.156	3.437	1	3
5000 mg/L SO ₄ ²⁻	D	2	0.0022	0.0005	0.0057	2.737	2.084	1	2
5000 mg/L SO ₄ ²⁻	D	3	0.0037	0.0014	0.0052	2.367	6.575	1	3
5000 mg/L SO ₄ ²⁻	D	4	0.0060	0.0003	0.0042	3.321	2.031	1	3
5000 mg/L SO ₄ ²⁻	D	5	0.0026	0.0004	0.0081	1.087	7.241	1	5
5000 mg/L SO ₄ ²⁻	D	6	0.0023	0.0008	0.0056	2.032	3.006	1	3
5000 mg/L SO ₄ ²⁻	D	7	0.0022	0.0005	0.0062	1.041	1.412	1	3
5000 mg/L SO ₄ ²⁻	D	8	0.0011	0.0005	0.0023	1.030	1.987	1	3
5000 mg/L SO ₄ ²⁻	D	9	0.0022	0.0002	0.0047	2.250	1.793	1	3
5000 mg/L SO ₄ ²⁻	D	10	0.0012	0.0005	0.0052	1.493	3.021	0	4
5000 mg/L SO ₄ ²⁻	D	11	0.0057	0.0005	0.0067	1.315	1.933	1	3
5000 mg/L SO ₄ ²⁻	D	12	0.0027	0.0010	0.0100	1.990	4.854	0	4
5000 mg/L SO ₄ ²⁻	D	13	0.0067	0.0006	0.0069	2.650	3.353	1	2
5000 mg/L SO ₄ ²⁻	D	14	0.0016	0.0005	0.0030	1.806	2.204	1	3
5000 mg/L SO ₄ ²⁻	D	15	0.0026	0.0005	0.0025	1.418	2.026	1	3
5000 mg/L SO ₄ ²⁻	D	16	0.0017	0.0007		2.047	2.396	1	0
5000 mg/L SO ₄ ²⁻	D	17	0.0031	0.0022	0.0058	1.639	3.020	1	2
5000 mg/L SO ₄ ²⁻	D	18	0.0045	0.0008	0.0057	1.649	2.987	1	3
0.8 meq/L	A	1	0.0008	0.0002	0.0010	1.973	3.339	0	1
0.8 meq/L	A	2	0.0006	0.0005	0.0090	1.143	6.627	0	5
0.8 meq/L	A	3	0.0012	0.0005	0.0071	2.009	5.166	0	4
0.8 meq/L	A	4	0.0012	0.0010	0.0063	2.417	12.505	0	3
0.8 meq/L	A	5	0.0030	0.0005	0.0080	2.598	5.919	0	3
0.8 meq/L	A	6	0.0014	0.0001	0.0106	2.965	1.730	0	5
0.8 meq/L	A	7	0.0013	0.0017	0.0075	1.826	7.684	0	3
0.8 meq/L	B	1	0.0031	0.0006	0.0074	4.133	5.920	0	4
0.8 meq/L	B	2	0.0007	0.0004	0.0033	1.563	5.852	0	4
0.8 meq/L	B	3	0.0009	0.0006	0.0018	6.845	9.973	0	1
0.8 meq/L	B	4	0.0017	0.0004	0.0076	4.006	4.035	0	2
0.8 meq/L	B	5	0.0021	0.0002	0.0055	3.546	2.670	0	2
0.8 meq/L	B	6	0.0021	0.0005	0.0094	3.132	7.269	0	4
0.8 meq/L	B	7	0.0001	0.0002	0.0010	4.041	4.010	0	3
0.8 meq/L	B	8	0.0015	0.0002	0.0090	2.458	3.433	0	4
0.8 meq/L	B	9	0.0014	0.0004	0.0059	2.936	4.300	0	6
0.8 meq/L	B	10	0.0013	0.0002	0.0063	2.477	1.976	0	5
0.8 meq/L	B	11	0.0011	0.0004	0.0085	1.926	5.047	0	4
0.8 meq/L	C	1	0.0020	0.0003	0.0052	1.738	2.722	0	4
0.8 meq/L	C	2	0.0014	0.0011	0.0084	1.874	7.775	0	3
0.8 meq/L	C	3	0.0016	0.0003	0.0052	2.649	3.220	0	3
0.8 meq/L	C	4	0.0006	0.0007	0.0059	1.531	12.059	0	3
0.8 meq/L	C	5	0.0019	0.0004	0.0137	2.592	4.664	0	5
0.8 meq/L	C	6	0.0012	0.0005	0.0032	1.274	5.140	0	3
0.8 meq/L	C	7	0.0018	0.0001	0.0089	2.712	2.736	0	4
0.8 meq/L	C	8	0.0017	0.0010	0.0092	2.588	8.788	0	4

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
0.8 meq/L	C	9	0.0016	0.0003	0.0069	2.693	5.888	0	3
0.8 meq/L	D	1	0.0019	0.0004	0.0054	2.132	5.302	0	3
0.8 meq/L	D	2	0.0018	0.0005	0.0063	1.468	3.930	0	3
0.8 meq/L	D	3	0.0012	0.0004	0.0054	5.634	4.125	0	4
0.8 meq/L	D	4	0.0012	0.0003	0.0063	1.675	1.931	0	3
0.8 meq/L	D	5	0.0009	0.0006	0.0045	3.831	6.655	0	4
0.8 meq/L	D	6	0.0014	0.0004	0.0049	3.462	3.040	0	3
0.8 meq/L	D	7	0.0020	0.0006	0.0035	3.195	3.322	0	2
0.8 meq/L	D	8	0.0012	0.0001	0.0018	2.550	1.308	0	2
4.2 meq/L	A	1	0.0017	0.0002	0.0069	1.774	4.274	0	4
4.2 meq/L	A	2	0.0024	0.0003	0.0117	3.619	2.564	0	3
4.2 meq/L	A	3	0.0014	0.0007	0.0058	2.827	5.022	0	4
4.2 meq/L	A	4	0.0019	0.0001	0.0064	2.329	2.606	0	5
4.2 meq/L	A	5	0.0015	0.0002	0.0064	2.512	4.106	0	4
4.2 meq/L	A	6	0.0018	0.0002	0.0034	3.357	3.121	0	3
4.2 meq/L	A	7	0.0020	0.0002	0.0076	4.090	4.229	0	3
4.2 meq/L	A	8	0.0013	0.0004	0.0063	2.972	4.241	0	3
4.2 meq/L	A	9	0.0024	0.0004	0.0027	3.362	4.126	0	2
4.2 meq/L	A	10	0.0010	0.0004	0.0096	2.765	4.729	0	3
4.2 meq/L	A	11	0.0010	0.0002	0.0062	3.021	4.303	0	4
4.2 meq/L	A	12	0.0011	0.0002	0.0021	2.190	3.830	0	2
4.2 meq/L	A	13	0.0015	0.0002	0.0057	2.711	3.574	0	4
4.2 meq/L	A	14	0.0027	0.0004	0.0026	2.097	2.310	0	4
4.2 meq/L	A	15	0.0021	0.0001	0.0048	2.916	1.626	0	4
4.2 meq/L	B	1	0.0018	0.0006	0.0036	2.842	4.131	0	2
4.2 meq/L	B	2	0.0005	0.0004	0.0103	2.499	3.751	0	3
4.2 meq/L	B	3	0.0008	0.0004	0.0017	2.302	1.636	0	2
4.2 meq/L	B	4	0.0018	0.0005	0.0055	1.792	2.600	0	1
4.2 meq/L	B	5	0.0014	0.0004	0.0162	3.299	4.530	0	4
4.2 meq/L	B	6	0.0018	0.0015	0.0071	3.061	5.109	0	3
4.2 meq/L	B	7	0.0020	0.0016	0.0189	3.502	1.278	0	3
4.2 meq/L	B	8	0.0009	0.0006	0.0063	2.026	7.537	0	4
4.2 meq/L	B	9	0.0023	0.0019	0.0120	3.054	11.021	0	4
4.2 meq/L	B	10	0.0013	0.0003	0.0031	3.066	3.336	0	2
4.2 meq/L	B	11	0.0015	0.0003	0.0055	2.699	5.114	0	3
4.2 meq/L	B	12	0.0017	0.0003	0.0086	1.532	2.364	0	3
4.2 meq/L	C	1	0.0015	0.0005	0.0064	1.922	4.224	0	3
4.2 meq/L	C	2	0.0020	0.0001	0.0055	1.730	1.724	0	1
4.2 meq/L	C	3	0.0020	0.0004	0.0091	1.803	3.678	0	2
4.2 meq/L	C	4	0.0025	0.0010	0.0109	3.413	4.458	0	4
4.2 meq/L	C	5	0.0014	0.0001	0.0062	2.673	4.361	0	3
4.2 meq/L	C	6	0.0019	0.0004	0.0144	2.995	4.808	0	5
4.2 meq/L	C	7	0.0017	0.0008		1.273	5.186	0	0
4.2 meq/L	C	8	0.0013	0.0001	0.0070	1.203	2.891	0	4
4.2 meq/L	D	1	0.0010	0.0004	0.0022	2.022	4.129	0	2
4.2 meq/L	D	2	0.0032	0.0004	0.0106	1.929	3.031	0	6
4.2 meq/L	D	3	0.0022	0.0006	0.0059	1.294	2.808	0	3
4.2 meq/L	D	4	0.0016	0.0003	0.0079	2.253	2.179	0	3
4.2 meq/L	D	5	0.0016	0.0004	0.0011	2.198	2.560	0	1
4.2 meq/L	D	6	0.0020	0.0014	0.0024	2.924	7.253	0	1
4.2 meq/L	D	7	0.0021	0.0003	0.0066	2.986	1.569	0	3

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
4.2 meq/L	D	8	0.0006	0.0003	0.0068	1.481	1.999	0	2
19.8 meq/L	A	1	0.0013	0.0009	0.0072	2.148	4.954	0	2
19.8 meq/L	A	2	0.0007	0.0009	0.0073	2.557	6.287	0	4
19.8 meq/L	A	3	0.0017	0.0005	0.0127	2.746	3.409	0	3
19.8 meq/L	A	4	0.0013	0.0011	0.0062	2.112	3.449	0	2
19.8 meq/L	A	5	0.0019	0.0007	0.0006	2.075	4.540	0	2
19.8 meq/L	A	6	0.0005	0.0004	0.0060	1.404	3.197	0	3
19.8 meq/L	A	7	0.0009	0.0006	0.0037	1.968	6.411	0	4
19.8 meq/L	A	8	0.0009	0.0004	0.0036	1.794	2.416	0	3
19.8 meq/L	A	9	0.0028	0.0002	0.0087	4.139	1.531	0	3
19.8 meq/L	A	10	0.0009	0.0007	0.0058	1.275	3.694	0	4
19.8 meq/L	A	11	0.0011	0.0002	0.0087	1.456	2.199	0	4
19.8 meq/L	A	12	0.0025	0.0001		3.328	2.459	0	0
19.8 meq/L	B	1	0.0013	0.0002	0.0031	2.084	2.629	0	3
19.8 meq/L	B	2	0.0020	0.0011	0.0061	2.046	0.750	0	3
19.8 meq/L	B	3	0.0033	0.0003	0.0073	3.281	3.767	0	3
19.8 meq/L	B	4	0.0019	0.0004	0.0045	3.013	1.772	0	3
19.8 meq/L	B	5	0.0023	0.0004		2.477	3.642	0	0
19.8 meq/L	B	6	0.0010	0.0003	0.0060	1.512	2.334	0	4
19.8 meq/L	B	7	0.0010	0.0003	0.0068	1.501	3.572	0	4
19.8 meq/L	B	8	0.0034	0.0004	0.0100	3.562	2.246	0	4
19.8 meq/L	B	9	0.0017	0.0003	0.0116	3.344	2.573	0	3
19.8 meq/L	B	10	0.0019	0.0002		2.030	1.103	0	0
19.8 meq/L	B	11	0.0016	0.0004	0.0077	2.689	3.588	0	4
19.8 meq/L	B	12	0.0015	0.0005	0.0078	1.272	1.873	0	5
19.8 meq/L	B	13	0.0015	0.0002	0.0039	1.247	2.274	0	3
19.8 meq/L	B	14	0.0028	0.0004	0.0097	2.582	3.100	0	3
19.8 meq/L	B	15	0.0025	0.0002	0.0081	3.328	1.276	0	4
19.8 meq/L	C	1	0.0019	0.0004	0.0075	2.368	4.492	0	4
19.8 meq/L	C	2	0.0010	0.0002	0.0061	2.420	3.579	0	3
19.8 meq/L	C	3	0.0011	0.0003	0.0040	2.483	4.576	0	1
19.8 meq/L	C	4	0.0025	0.0003	0.0017	0.940	1.481	0	2
19.8 meq/L	C	5	0.0013	0.0005	0.0051	2.691	5.154	0	3
19.8 meq/L	C	6	0.0014	0.0002	0.0067	1.966	3.386	0	4
19.8 meq/L	C	7	0.0015	0.0005	0.0033	2.603	5.407	0	3
19.8 meq/L	C	8	0.0025	0.0002	0.0078	4.569	4.364	0	4
19.8 meq/L	C	9	0.0012	0.0004	0.0046	1.861	3.906	0	4
19.8 meq/L	C	10	0.0014	0.0003	0.0048	1.866	2.225	0	4
19.8 meq/L	D	1	0.0024	0.0001	0.0066	3.528	1.266	0	4
19.8 meq/L	D	2	0.0010	0.0004	0.0052	1.939	2.976	0	3
19.8 meq/L	D	3	0.0031	0.0005	0.0092	2.757	2.532	0	3
19.8 meq/L	D	4	0.0012	0.0002	0.0044	2.001	2.061	0	3
19.8 meq/L	D	5	0.0010	0.0002	0.0020	2.510	1.603	0	1
19.8 meq/L	D	6	0.0008	0.0004	0.0042	1.308	3.269	0	3
19.8 meq/L	D	7	0.0015	0.0006	0.0063	2.412	3.695	0	4
19.8 meq/L	D	8	0.0007	0.0021	0.0030	1.738	5.943	0	4
51.1 meq/L	A	1	0.0030	0.0003	0.0064	3.166	2.587	0	2
51.1 meq/L	A	2	0.0017	0.0005	0.0065	3.234	2.245	0	3
51.1 meq/L	A	3	0.0015	0.0005	0.0056	2.191	2.862	0	2
51.1 meq/L	A	4	0.0025	0.0006	0.0072	2.795	3.828	0	3
51.1 meq/L	A	5	0.0014	0.0003	0.0033	3.255	3.304	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
51.1 meq/L	A	6	0.0020	0.0007	0.0114	1.783	3.616	0	6
51.1 meq/L	A	7	0.0014	0.0008	0.0051	3.123	4.570	0	2
51.1 meq/L	A	8	0.0009	0.0006	0.0013	2.214	4.738	0	4
51.1 meq/L	A	9	0.0014	0.0006	0.0049	2.507	3.769	0	3
51.1 meq/L	A	10	0.0025	0.0005	0.0072	3.232	3.036	0	3
51.1 meq/L	A	11	0.0005	0.0004	0.0057	1.398	2.809	0	4
51.1 meq/L	A	12	0.0011	0.0001	0.0088	2.655	2.702	0	4
51.1 meq/L	A	13	0.0017	0.0002	0.0064	2.264	1.896	0	4
51.1 meq/L	A	14	0.0017	0.0001	0.0071	2.513	1.824	0	3
51.1 meq/L	A	15	0.0007	0.0001	0.0054	1.886	1.080	0	3
51.1 meq/L	A	16	0.0019	0.0001	0.0055	3.196	1.861	0	3
51.1 meq/L	A	17	0.0006	0.0004	0.0041	0.895	2.191	0	3
51.1 meq/L	A	18	0.0018	0.0008	0.0060	2.270	3.428	0	4
51.1 meq/L	A	19	0.0024	0.0002	0.0058	2.978	1.819	0	2
51.1 meq/L	A	20	0.0015	0.0003	0.0046	3.180	3.725	0	3
51.1 meq/L	B	1	0.0014	0.0009	0.0029	2.325	4.245	0	3
51.1 meq/L	B	2	0.0025	0.0004	0.0130	2.748	3.603	0	4
51.1 meq/L	B	3	0.0013	0.0006	0.0064	2.031	4.817	0	4
51.1 meq/L	B	4	0.0018	0.0004	0.0055	2.529	3.129	0	3
51.1 meq/L	B	5	0.0008	0.0001	0.0125	2.404	4.558	0	6
51.1 meq/L	B	6	0.0018	0.0001	0.0048	3.380	2.730	0	3
51.1 meq/L	B	7	0.0021	0.0003	0.0064	2.933	4.281	0	3
51.1 meq/L	B	8	0.0016	0.0005	0.0108	2.391	3.594	0	2
51.1 meq/L	B	9	0.0019	0.0006	0.0087	2.512	6.109	0	4
51.1 meq/L	B	10	0.0031	0.0007	0.0078	2.760	7.122	0	4
51.1 meq/L	B	11	0.0018	0.0004	0.0068	1.614	2.118	0	4
51.1 meq/L	B	12	0.0024	0.0005	0.0047	2.745	3.524	0	3
51.1 meq/L	B	13	0.0014	0.0004	0.0046	2.306	4.108	0	4
51.1 meq/L	C	1	0.0015	0.0004	0.0127	3.489	4.065	0	3
51.1 meq/L	C	2	0.0017	0.0007	0.0064	2.516	6.384	0	4
51.1 meq/L	C	3	0.0027	0.0005	0.0074	2.012	2.140	0	4
51.1 meq/L	C	4		0.0022		2.037	3.031	0	0
51.1 meq/L	C	5	0.0017	0.0005	0.0090	2.851	3.449	0	3
51.1 meq/L	C	6	0.0016	0.0005	0.0066	2.634	3.755	0	3
51.1 meq/L	C	7	0.0047	0.0009	0.0063	2.800	4.348	0	4
51.1 meq/L	C	8	0.0035	0.0005	0.0095	2.535	2.739	0	5
51.1 meq/L	C	9	0.0020	0.0010	0.0078	2.443	3.671	0	3
51.1 meq/L	C	10	0.0027	0.0004	0.0070	3.066	2.401	0	3
51.1 meq/L	D	1	0.0022	0.0005	0.0085	3.660	4.724	0	2
51.1 meq/L	D	2	0.0023	0.0005	0.0073	2.814	6.121	0	3
51.1 meq/L	D	3	0.0020	0.0007	0.0114	2.601	8.614	0	5
51.1 meq/L	D	4	0.0016	0.0002	0.0047	1.966	2.466	0	3
51.1 meq/L	D	5	0.0019	0.0003	0.0103	2.693	4.056	0	3
51.1 meq/L	D	6	0.0007	0.0003	0.0041	1.352	4.257	0	3
51.1 meq/L	D	7	0.0018	0.0001	0.0108	2.602	3.624	0	4
51.1 meq/L	D	8	0.0016	0.0012	0.0077	2.707	6.921	0	4
51.1 meq/L	D	9	0.0064	0.0008	0.0109	2.107	3.250	0	5
51.1 meq/L	D	10	0.0019	0.0009	0.0080	2.779	2.754	0	3
51.1 meq/L	D	11	0.0015	0.0001	0.0025	2.412	2.694	0	3
51.1 meq/L	D	12	0.0021	0.0005	0.0050	2.295	3.062	0	4
51.1 meq/L	D	13	0.0015	0.0003	0.0032	1.926	3.559	0	1

Sample Description	Rep No.	Seed No.	Shoot Wt (g)	Root Wt (g)	Biomass Wt (g)	Shoot Length (cm)	Root Length (cm)	Phytotoxicity (1 or 0)	Free Leaf No.
51.1 meq/L	D	14	0.0017	0.0004	0.0015	1.753	2.101	0	1
51.1 meq/L	D	15	0.0014	0.0004	0.0024	1.851	3.039	0	1
51.1 meq/L	D	16	0.0013	0.0007	0.0085	1.913	4.673	0	3
51.1 meq/L	D	17	0.0017	0.0006	0.0075	2.240	5.141	0	4
51.1 meq/L	D	18	0.0013	0.0001	0.0042	1.858	2.297	0	4
103.2 meq/L	A	1	0.0016	0.0001	0.0076	1.163	1.096	1	4
103.2 meq/L	A	2	0.0018	0.0006	0.0119	1.839	3.559	1	4
103.2 meq/L	A	3	0.0029	0.0029	0.0069	1.928	2.687	1	2
103.2 meq/L	A	4	0.0012	0.0009	0.0173	1.905	3.701	1	2
103.2 meq/L	A	5	0.0015	0.0012	0.0130	2.378	4.861	1	1
103.2 meq/L	A	6	0.0014	0.0006	0.0058	2.104	4.579	1	3
103.2 meq/L	A	7	0.0009	0.0015	0.0053	1.630	2.561	1	3
103.2 meq/L	A	8	0.0017	0.0004	0.0059	1.959	2.896	1	4
103.2 meq/L	A	9	0.0038	0.0004	0.0051	1.478	2.609	1	4
103.2 meq/L	A	10	0.0019	0.0008	0.0128	2.155	4.259	1	4
103.2 meq/L	A	11	0.0032	0.0009	0.0144	1.742	1.657	1	3
103.2 meq/L	A	12	0.0007	0.0013	0.0047	1.808	2.177	1	4
103.2 meq/L	B	1	0.0052	0.0002	0.0471	2.027	1.134	1	3
103.2 meq/L	B	2	0.0007	0.0032	0.0004	0.555	2.666	1	1
103.2 meq/L	B	3	0.0020	0.0008	0.0126	2.376	3.015	1	3
103.2 meq/L	B	4	0.0015	0.0015	0.0095	1.719	1.004	1	2
103.2 meq/L	B	5	0.0030	0.0005	0.0203	2.722	0.699	1	4
103.2 meq/L	B	6	0.0017	0.0009	0.0038	1.456	2.160	1	2
103.2 meq/L	B	7	0.0035	0.0015	0.0107	1.527	4.108	1	3
103.2 meq/L	B	8	0.0035	0.0005	0.0055	3.409	2.824	1	2
103.2 meq/L	B	9	0.0018	0.0007	0.0045	1.982	2.940	1	4
103.2 meq/L	B	10	0.0012	0.0004	0.0041	2.445	2.555	1	3
103.2 meq/L	C	1	0.0070	0.0008	0.0040	3.366	2.869	1	3
103.2 meq/L	C	2	0.0034	0.0014	0.0062	1.651	4.642	1	3
103.2 meq/L	C	3	0.0024	0.0011	0.0026	1.744	3.795	1	3
103.2 meq/L	C	4	0.0033	0.0007	0.0047	1.584	1.683	1	2
103.2 meq/L	C	5	0.0036	0.0010	0.0056	2.910	1.531	1	4
103.2 meq/L	C	6	0.0071	0.0006	0.0073	0.949	1.910	1	2
103.2 meq/L	C	7	0.0039	0.0013	0.0143	1.418	2.745	1	2
103.2 meq/L	C	8	0.0049	0.0034	0.0098	1.971	3.556	1	3
103.2 meq/L	D	1	0.0018	0.0004	0.0059	2.191	1.340	1	3
103.2 meq/L	D	2	0.0021	0.0009	0.0046	2.264	2.584	1	3
103.2 meq/L	D	3	0.0018	0.0005	0.0051	1.533	1.924	1	3
103.2 meq/L	D	4	0.0057	0.0007	0.0109	2.216	4.292	1	3
103.2 meq/L	D	5	0.0033	0.0004	0.0064	2.036	2.557	1	4
103.2 meq/L	D	6	0.0024	0.0012	0.0093	1.159	4.069	1	4
103.2 meq/L	D	7	0.0029	0.0020	0.0043	1.720	5.955	1	2
103.2 meq/L	D	8	0.0005	0.0009	0.0048	1.029	2.578	1	2
103.2 meq/L	D	9	0.0033	0.0007	0.0053	2.324	2.163	1	3
103.2 meq/L	D	10	0.0015	0.0012	0.0043	1.496	5.273	1	2
103.2 meq/L	D	11	0.0039	0.0007	0.0058	1.952	2.919	1	3

