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Studies on Early Germination of Gum Arabic (*Acacia senegal)* Tree Species Using Different Water Qualities

Umar M. R[1], Delanice S. K[2], Bode A. S[3]
[1,2]Modibbo Adama University Yola, Adamawa State, Nigeria
[3]Adamawa State University Mubi, Nigeria
Umar.mr@gmail.com

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Abstract

This study was carried out to access different water qualities on germination of *Acacia senegal* seeds in other to determine conditions that promote successful germination. Water quality use was (Borehole, River and Well water). Laboratory analysis on water quality was conducted. Different parameters on growth of *Acacia senegal* species (height, stem diameter and number of leaves) using borehole, well and river water. Results shows that stem diameter of river water recorded the highest value of (2.38m) while borehole and well water having values of (2.09m) and (0.43m) respectively. The height of river water recorded the highest value (30.08m) in parameters of Acacia species while lowest values was found in borehole and well water (28.31m) and (28.81m). Number of leaves gave the highest value of (184.93) and lowest in borehole and well water with values (142.6) and (158.0). All parameters measured highest in week 8 while lowest in week 1. Water quality test also reveals that Cl, Mg and Na show low results in the quality test for water. The result for the water quality test for pH, EC, Ca, Mg, Na, CO_3, HCO_3 and Cl showed no significant ($p<0.05$) between the pH of the borehole, well and river (6.66, 6.31 and 6.23) respectively also Cl recorded highest in well water 21.63, lowest in

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borehole and river water 19.25 both. Correlation analysis reveals strong positive linear relationships in stem, height and number of leaves in the different types of water (river, well and borehole) with values (0.996, 0.994 and 0.995) respectively. It is concluded that that river water boosts the germination rates of *Acacia senegal* seeds due salinity content in the study area. Further research can be geared toward using different water quality in determination of the growth parameter for different tree species.

Keywords: *Acacia senegal*, Early Germination, Water Quality

INTRODUCTION

Water is the most common substance found on earth. Water is an inorganic compound with the chemical formula H_2O. It plays a vital role in various sectors, including agriculture, industry, and domestic use. However, the quality of water is equally important as its availability. Water quality refers to the physical, chemical, and biological characteristics of water that determine its suitability for specific purposes (American Public Health Association APHA, 2012). Water is the second most important need for life to exist after air. As a result, water quality has been described extensively in the scientific literature (Spellman, 2013).

Water is the second most important need for life to exist after air. As a result, water quality has been described extensively in the scientific literature. The most popular definition of water quality is "it is the physical, chemical, and biological characteristics of water" (Spellman, 2013; Alley, 2007). Water quality is a measure of the condition of water relative to the requirements of one or more biotic species and/or to any human need or purpose (Shah,2017; Tchobanoglousand Schroeder,1985). Poor quality water can be responsible for slow growth, poor aesthetic quality of the crop and, in some cases, can result in the gradual death of the plants. High soluble salts can directly injure roots interfering with the water and nutrient uptake. Salts can accumulate in plant leaf margins, causing burning of the edges. Water with high alkalinity can adversely affect the pH of the growing medium, interfering with nutrient uptake and causing deficiencies which comprise plant health (University of Massachusetts Amherst, 2023).

The quality of water can be influenced by various natural and human activities. Natural processes such as weathering, erosion, and microbial activities can affect water quality. Additionally, human activities such as industrial discharges, agricultural runoff, and

improper waste management can introduce pollutants into water bodies, leading to water pollution (United Nations Environmental Programme UNEP, 2018). Water pollution poses significant risks to both ecosystem s and human health. Contaminants in water can have detrimental effects on aquatic life, including fish, plants, and other organisms. In addition, when polluted water is used for irrigation or drinking purposes, it can have adverse effects on crop growth and human health, potentially leading to diseases (Bartram and Cairncross, 2010). To ensure the availability of clean and safe water, it is necessary to monitor and manage water quality. This involves regular testing and analysis of water samples to assess its suitability for different uses. Water treatment processes are employed to remove contaminants and improve water quality for specific purposes, such as drinking water treatment plants and wastewater treatment facilities (Crittenden *et al.,* 2012). Understanding water quality is essential for developing effective water management strategies and policies. Integrated water resource management approaches, stakeholder engagement, and water governance play vital roles in ensuring sustainable and equitable water allocation and conservation (Biswas, 2004; Sadoffand and Grey, 2002). Additionally, awareness and education about the importance of water quality are crucial for promoting responsible water use and pollution prevention. Given the significance of water quality in various sectors, including agriculture, it is important to investigate its impact on crop growth and productivity. Assessing how different water qualities affect the early growth stages of crops, such as sunflower and cotton, can provide valuable insights for optimizing irrigation practices and enhancing agricultural sustainability.

Acacia senegal, a species within the Acacia genus, is known for its ecological and economic significance. As a pioneer species, it plays a crucial role in ecosystem restoration and soil stabilization (Smith *et al.,* 2017). The germination process is a critical stage in a plant's life cycle, influencing its establishment and survival (Bewley and Black, 1994). *Acacia senegal* native to Australia, belongs to the Acacia genus, which is renowned for its diversity and ecological importance (Maslin, 2001). The species is recognized for its role as a pioneer plant in disturbed landscapes, aiding in soil stabilization and ecosystem regeneration (Eldridge *et al.,* 2017). Early observations of *Acacia senegal* in the Australian landscape can be traced back to the writings of early explorers and botanists. The species' adaptive traits, including its ability to tolerate challenging conditions, were noted in various botanical records (Cunningham, 1828). Throughout the years, *Acacia senegal* 'spotential for soil improvement and its usefulness in afforestation projects became increasingly recognized.

Its fast growth and nitrogen-fixing abilities contributed to its popularity in land restoration initiatives (Carr, 1995). The species has been evaluated for its potential economic uses. *Acacia senegal* wood has been utilized for timber, and its tannin-rich bark has found applications in leather tanning (Duke *et al.,* 2002).

MATERIALS AND METHODS

The Study Area

The study was carried out in the nursery of the department of Forestry and Wildlife Management. Modibbo Adama University, Yola in Girei local Government Area is located between latitude 9º 18'00"N to 9º 21' 40"N and longitude 12º 28' 30"E to 12º 30' 30"E, while Girei local Government Area is located between latitude 9º 13'N to 9º 37'N and longitude 12º 15'E to 12º 42'E, Fig 1. Adamawa State falls under the Sudan, Southern and Guinea Savannah types of vegetation and it experiences distinct dry and wet season with temperature and humidity varying with seasons. The wet or rainy season lasts from April to November, and is characterized by single maxima in August and September. During this season the moisture laden south west trade wind from the Atlantic Ocean blows over the area. Seventy percent of the total rainfall in the area happens to fall within four months of May-September (Adebayo, 2011).

Data Collection

Data was collected from the seeds of *Acacia senegal* which was planted in the nursery, forty-five (45) poly bags was used for the seeds (15) for each treatment. Measurement of height, Stem diameter and number of leaves was taken on the planted seedlings for two (2) months, measurement was carried out every weekly base within the two (2) months period, watering of the seedlings was done morning and evening which was enable the flow of water in and out of the seeds to enable germination to take place and help in the breakdown to dormancy of the seed coat.

Parameters measured include:

Height, Stem diameter, Number of leaves and Leaf area.

To measure leaf area

A= Length of leaf ×Width of leaf

Pre planting treatment

The seed was put into a rubber bowl and cold water was poured with a boiling point of 85-90^{0}C then cover for 24hours.

Procedure of Water Quality Analysis

(i) Water pH: water pH was determined in 2:0 (Water) suspension using pH meter, value was adjusted at 20 ^{0}C. (LTPSWA, 2009).

(ii) Electrical Conductivity EC:

The Water Electrical conductivity was determined in 2:0 Water suspensions using electrical conductivity meter. (LTPSWA, 2009).

(vi) Exchangeable Cations in Soils

Exchangeable cations Calcium (Ca), Magnesium (Mg) and Sodium (Na) were determined from the water treated with neutral normal ammonium acetate (pH 7.0). Calcium and Magnesium were determined by titration, whereas Na were determined using a flame photometer (LTPSWA,2009).

Laboratory Testing Procedure for Soil and Water Analysis (LTPSWA, 2009)

Determination of Ca, Mg, K and Na in Water

The Calcium (Ca) and Magnesium (Mg) content in the water will be determined titre-metrically in the laboratory using Atomic Absorption Spectrophotometer where Sodium (Na) content of the water will be determined via flame photometer as reported by Bower and Wilcox (1965), IITA (1984) and Jaiswal (2003).

Procedure for Determination of Carbonate and Bicarbonates

1) Transfer 25 ml of water sample to a 150 ml conical flask. Add 2-3 drops of Phenolphthalein.

2) If pink red colour appears, titrate it against standard H_2SO_4 till colour disappears. The burette reading (volume used) is designated as Y ml.

3) To this colourless solution or in original sample (25 ml) add 2-3 drops of methyl orange. This will develop the yellow colour.

4) Again titrate with standard H_2SO_4 till colour changes from yellow to rosy red. Record the volume of H_2SO_4 as Z ml. This volume corresponds to initial carbonate changed to bicarbonates plus initial bicarbonates present in irrigation water.

5) Run a blank (25 ml distilled water) and subtract from the titre value to avoid error due to any impurity of chemicals.

Bicarbonates (milliequivalents / litre) HCO_3 - (me/L)

$$= \frac{(Z - B) - 2(Y - B) \times \text{Normality of H2SO4} \times 1000}{\text{Sample in ml.}}$$

Here Y is the burette reading (ml of H2SO4) after phenolphthalein is neutralized and Z is the final burette reading (total volume of H2SO4) after methyl orange.

Determination of Chloride

Procedure

1) Transfer 25 ml of water sample to a 150 ml of conical flask.

2) Add 0.01N H2SO4 with methyl orange to neutralize the amount of carbonate and bicarbonate and provide 1 ml in excess.

3) Add 5-6 drops of potassium chromate indicator making it dark yellow.

4) Titrate the contents against 0.02N AgNO3 solution with continuous stirring till the first brick red tinge appears.

Note

The volume of the AgNO3 required (ml.)

5) Run a blank of 25 ml of distilled water and subtract from the titre value to avoid error due to any impurity of chemicals.

6) Determine the normality of AgNO3 by standardizing it against NaCl solution.

Calculation :

Chloride (meq/lit.) =

Where N = Calculated normality of AgNO3,

B = Blank Titre value

Notes :

1) After appearance of white AgCl precipitate, add AgNO3 drop wise to get exact start of red precipitation.

2) Always store silver nitrate in dark amber coloured bottle.

Chloride (meq/lit) = $\frac{(V - B) \times N \times 1000}{\text{sample (ml)}}$

Where N = Calculated normality of $AgNO_3$,

B = Blank Titre value

Notes:

1) After appearance of white AgCl precipitate, add $AgNO_3$ wise to get exact start of red precipitation.
2) Always store silver nitrate in dark amber coloured bottle.

Experimental design

The experiment was arranged in a Completely Randomized

Design (CRD).

Yij=u+Ti+eij

Where U the overall mean

Vij= the jth observation on *Acacia senegal*

Ti- eij (error term)

Data Analysis

The data collected were subjected to analysis of variance (ANOVA) based on a completely randomized design (CRD) using the statistical software SPSS V. 25. The least significant difference (LSD) at the 5% level of significance was used for mean comparison.

RESULTS

Growth Parameters

The results on the effects of different parameters of *Acacia* species seedlings (height, stem diameter and number of leaves and leaf area) using borehole, well and river water.

Stem diameter of *Acacia senegal* seedling

Result obtained in week 1 show that stem diameter of borehole water recorded the highest (0.43cm), followed by stem diameter of river water (0.36cm) while the least recorded (0.36cm) was in stem diameter of well water. Also, in week 2, the highest recorded (0.64cm) was in stem diameter of river water, followed by the stem diameter of well water (0.59cm) while the least recorded (0.49cm) was in the stem diameter of borehole water. In week 3, the highest (0.93cm) stem diameter of well water, was followed by the stem diameter of river water (0.83cm) while the least (0.75cm) was recorded in stem diameter of borehole water. However, there was no significant difference ($p<0.05$) between the stem diameter of river, borehole and well water in weeks 1, 2 and 3. Results obtained from week 4 show the highest recorded value (1.26cm) in stem diameter of well water followed by stem diameter of river water with (1.14cm) and the least (0.99cm) was in stem diameter of borehole water. The result obtained in week 5 indicates highest recorded value (1.57cm) in the stem diameter of well water followed by stem diameter of river water (1.41cm) while the least value (1.21cm) was recorded in stem diameter of borehole water. There was significant difference ($p<0.05$) between the stem diameter of river, borehole and well water at weeks 4 and 5.

Results obtained in week 6 showed no significant difference ($p<0.05$) between the stem diameter of river and borehole water. The highest recorded value (1.8cm) was in stem diameter of well water and stem diameter of river water (0.77cm) while the least (1.49cm) was in stem diameter of borehole water. The result obtained in week 7 indicates significant differences ($p<0.05$) between stem diameter of river and borehole water. The highest value (2.15cm) was recorded in stem diameter of well water and the stem diameter of river of water (2.1cm) while the least value (1.78cm) was in stem diameter of borehole water. The values obtained in week 8 were not significantly different ($p<0.05$) between stem diameter of river, borehole and well water. The highest recorded value (2.38cm) was in stem

diameter of river water followed by stem diameter of well water (2.36) while the least recorded value (2.09cm) in stem diameter of borehole water (Table 1).

Table 2 presents the analysis of variance on the effects of growth parameters of Acacia species on stem diameter of river, borehole, and well water at different sampling periods.

Table 1: Stem diameter of *Acacia senegal*

WATER TYPES	WEEKS							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Stem diameter of river water	0.36	0.64	0.83	1.14	1.41	1.77	2.10	2.38
Stem diameter of borehole water	0.43	0.49	0.75	0.99	1.21	1.49	1.78	2.09
Stem diameter of well water	0.32	0.59	0.93	1.26	1.57	1.80	2.15	2.36

Source: Umar, M. R. 2024

Table 2: Analysis of variance for Stem diameter of river, well and borehole water

ANOVA[a]						
Source of variation		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	41.970	3	13.990	1849.905	.000[b]
	Residual	.030	4	.008		
	Total	42.000	7			
a. Dependent Variable: rep						
b. Predictors: (Constant), Stem diameterWell, Stem diameterBorehole, Stem diameterRiver						

Height of *Acacia senegal seedling*

The result of the growth parameter of Acacia species on the height of river, borehole, and well water shows a significant difference at ($p<0.05$) probability level in week 1 shows where the highest value (10.13m) was recorded in the height of river water followed by (8.33m) in the height of well water while the least (5.2m) was in borehole water. At week 2 the result shows no significant differences ($p<0.05$) between the height of

the river, borehole, and well water. The highest recorded (12.21m) water was recorded in the height of river water followed by the height of borehole water (8.61m) while the least (8.61m) was in the height of well water. In week 3 there were no significant differences between the height of the river, borehole, and well water. The highest recorded value (14.49m) was in the height of river water followed by (13.03m) in the height of well water while the least (12.16m) was recorded in the height of borehole water.

Results obtained in week 4, the highest recorded value (16.71m) was in the height of river water followed by (15.99m) in the height of well water while the lowest value (14.86m) was recorded in the height of borehole water. The result from week 5 indicates that the highest value (19.58m) was recorded in the height of river water followed by 19.53 in the height of well water while the lowest value (17.9m) was recorded in the height of borehole water. The highest value (27.12m) was recorded at week 6 in the height of river water followed by (26.12m) in the height of well water while the least (25.17m) was in the height of borehole water. The result of the experiment in week 7 revealed that there were no significant differences between the heights. The highest recorded value (27.12m) in the height of river water followed by (26.12m) in the height of well water while the least (25.17m) was in the height of borehole water. At week 8 the highest value (30.08m) in the height of river water followed by the height of well water (28.81m) while the least (28.31m) was in the height of borehole water. There were no significant differences between the height of the river, borehole, and well water in weeks 3, 4, 5, 6, 7, and 8 (Table 3).

Table 4 presents the analysis of variance on the effects of growth parameters of Acacia species on seedling height of river, borehole, and well water at different sampling periods.

Table 3: Seedlings Height of *Acacia senegal*

	WEEKS							
WATER TYPES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Height of river	10.13	12.21	14.49	16.71	19.58	24.02	27.12	30.08
Height of borehole water	5.20	8.61	12.16	14.86	17.90	20.94	25.17	28.31
Height of well water	8.33	10.09	13.03	15.99	19.53	22.97	26.12	28.81

Source: Umar, M. R 2024

Table 5: Analysis of variance for Height of river, well and borehole water

ANOVA[a]						
Source of variation		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	41.967	3	13.989	1678.850	.000[b]
	Residual	.033	4	.008		
	Total	42.000	7			
a. Dependent Variable: rep						
b. Predictors: (Constant), Height Well, Height Borehole, Height River						

Number of leaves of *Acacia senegal* seedling

Results obtained from Table 6 below show growth parameters of acacia species on the number of leaves of river, borehole and well water. The result show that there were no significant differences in the number of leaves from river water, borehole water and well water across the weeks 1, 2, 3, 4, 5, 6, 7, and 8. The highest value (26.47) for the number of leaves recorded was in river water followed by (24.53m) in borehole water and (22.53m) in well water at week 1. The highest number of leaves recorded (49.0) at week 2 was in river water followed by (41.6) in well water and (40.53) was in borehole water. The highest value (72.6) recorded at week 3 was in river water followed by (60.93) in well water and the least (56.53) was recorded in borehole water. At week 4 the highest value (89.53) recorded was in river water followed by (82.47) in borehole water and (79.87) in well water. The result from week 5 reveals that the highest (133.27) number of leaves recorded was in river water followed by (103.4) in borehole water and (101.53) in well water. Week 6 recorded the highest value (152.07) in river of water followed by (127.4) in well water and (118.27) in borehole water. The number of leaves was recorded at week 7 where the highest value was (168.27) from river of water followed by (141.2) in well water and (129.2) as the least in borehole water. In week 8, the highest number (184.93) of leaves recorded was in river water followed by 158 in well water while the least (142.6) was in borehole water (Table 6).

Table 7 presents the analysis of variance on the effects of growth parameters of Acacia species on number of leaves of river, borehole, and well water at different sampling periods.

Table 6: Number of Leaves *Acacia senegal* seedling

	WEEKS							
WATER TYPES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
No. of leaves of river water	26.47	49.00	72.60	89.53	133.27	152.07	168.27	184.93
No leaves of borehole water	24.53	40.53	56.53	82.47	103.4	118.27	129.20	142.60
No leaves of well water	22.53	41.60	60.93	79.87	101.53	127.40	141.20	158.00

Source: Umar, M. R 2024

Table 7: Analysis of variance for leaf number of river, well and borehole water

ANOVA[a]						
Source of variation		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	41.881	3	13.960	470.552	.000[b]
	Residual	.119	4	.030		
	Total	42.000	7			
a. Dependent Variable: rep						
b. Predictors: (Constant), LeafWell, LeafBorehole, LeafRiver						

Water Qualities Test

The result of the experiment on the water test is presented in Table 8 which gives the values of pH, EC, Ca, Mg, Na, CO_3, HCO_3 and Cl. The result of the test shows that there was no significant ($p<0.05$) between the pH of the borehole, well and river water (6.66, 6.31 and 6.23) respectively. The results of the electrical conductivity (EC) indicated no significant difference between the treatments. The higher value (0.80ds/m) was recorded in well water followed by 0.66ds/m in borehole water and the least (0.65ds/m) was in river water. The highest recorded value (5.36cmol/kg) of calcium (Ca) was in river

water while the least (4.11cmol/kg) was in borehole water. The highest (2.84) scenario of magnesium (Mg) was recorded in well water while the lowest (2.46) in borehole water. The highest number (0.565) of sodium (Na) recorded was in borehole water while the least (0.534) was in the river water. The result for the test of CO_3 shows similar values in borehole and well water with (0.40 meq/l) while the least (0.20 meq/l) was in river water. Similarly, the highest recorded value (0.90meq/l) for the test of HCO^{3-} was found in borehole and river water. While the lowest was found in well water (0.70meq/1) Chlorine (Cl) was tested and the highest value (21.63meq/l) was in well water while the least (19.25meq/l) was in borehole and river water.

Table 8: Water Qualities Test

Treatment	pH	EC	Ca	Mg	Na	CO3	HCO3-	Cl
	(1:2)	(dS/m)	cmol/kg			meq/l	meq/l	meq/l
Borehole	6.66	0.66	4.11	2.46	0.565	0.40	0.90	19.252
Well	6.31	0.80	4.32	2.84	0.552	0.40	0.70	21.628
River	6.23	0.65	5.36	2.80	0.534	0.20	0.90	19.252

Source: Laboratory work, 2024

Data analysis

Correlation analysis between stem diameter of borehole, well and river water

Results from Table 9 show the Pearson Correlation Coefficient between the stem diameter of the river, borehole, and well water.

The first row shows the Pearson correlation coefficient between the stem diameter of the river and borehole water. The coefficient is 0.996, indicating a strong positive linear relationship between these two variances. The second row shows the Pearson correlation coefficient between stem diameter in rivers and well water. The coefficient is 0.994, indicating a strong positive linear relationship between these two variables. The third row shows the Pearson correlation coefficient between stem diameter of the borehole and well water. The coefficient is 0.989, indicating a strong positive linear relationship between these two variables.

The "sig. (2-tailed)" column shows the p-value for each correlation coefficient. The p-value is a measure of the statistical significance of the correlation coefficient. A

p-value of less than 0.05 is considered to be statistically significant. All p-values in this table are less than 0.05, which means that all of the correlations are statistically significant.

The "N" column shows the number of observations used to calculate the correlation coefficient. In this case, there are 8 observations for each correlation coefficient.

Table 9: Correlation analysis between stem diameter of borehole, well and river water

Correlations

		RIVER	BOREHOLE	WELL
River	Pearson Correlation	1	.996**	.994**
	Sig. (2-Tailed)		.000	.000
	N	8	8	8
Borehole	Pearson Correlation	.996**	1	.989**
	Sig. (2-Tailed)	.000		.000
	N	8	8	8
Well	Pearson Correlation	.994**	.989**	1
	Sig. (2-Tailed)	.000	.000	
	N	8	8	8

The correlation coefficient between Height in river, borehole, and well water.

The result in Table 10 below shows the Pearson correlation coefficient between height in river, and well water.

The first row shows the Pearson correlation coefficient between height in river and borehole water. The coefficient is 0.994, indicating a strong positive linear relationship between these two variables. The second row shows the Pearson correlation coefficient between height in the river and well water. The coefficient is 0.997, indicating a strong positive linear relationship between these two variables. The third row shows the Pearson correlation coefficient between height in the borehole and well water. The coefficient is 0.996, indicating a strong positive linear relationship between these two variables.

The "sig. (2-tailed)" column shows the p-value for each correlation coefficient. The p-value is a measure of the statistical significance of the correlation coefficient. A

p-value of less than 0.05 is considered to be statistically significant. As you can see, all of the p-values in this table are less than 0.05, which means that all of the correlations are statistically significant.

The "n" column shows the number of observations used to calculate the correlation coefficient. In this case, there are 8 observations for each correlation coefficient.

Table 10: Correlation coefficient between height in the river, borehole, and well water.

Correlations

		River	Borehole	Well
River	Pearson Correlation	1	.994**	.997**
	Sig. (2-tailed)		.000	.000
	N	8	8	8
Borehole	Pearson Correlation	.994**	1	.996**
	Sig. (2-tailed)	.000		.000
	N	8	8	8
Well	Pearson Correlation	.997**	.996**	1
	Sig. (2-tailed)	.000	.000	
	N	8	8	8

Correlation coefficient between number of leaves in river, borehole, and well water.

The table 11 shows the Pearson correlation coefficient between the number of leaves in river, boreholes, and well water.

The first row shows the Pearson correlation coefficient between the number of leaves in river and borehole water. The coefficient is 0.995, indicating a strong positive linear relationship between these two variables. The second row shows the Pearson correlation coefficient between the number of leaves in river and well water. The coefficient is 0.996, indicating a strong positive linear relationship between these two variables. The third row shows the Pearson correlation coefficient between the number of leaves in the borehole and well water. The coefficient is 0.995, indicating a strong positive linear relationship between these two variables.

The "sig. (2-tailed)" column shows the p-value for each correlation coefficient. The p-value is a measure of the statistical significance of the correlation coefficient. A p-value of less than 0.05 is considered to be statistically significant. As you can see, all of the p-values in this table are less than 0.05, meaning that all correlations are statistically significant.

The "n" column shows the number of observations used to calculate the correlation coefficient. In this case, there are 8 observations for each correlation coefficient.

Table 11. Correlation coefficient between number of Leaves in river, borehole, and well water.

Correlations

		River	Borehole	Well
River	Pearson Correlation	1	.995**	.996**
	Sig. (2-tailed)		.000	.000
	N	8	8	8
Borehole	Pearson Correlation	.995**	1	.995**
	Sig. (2-tailed)	.000		.000
	N	8	8	8
Well	Pearson Correlation	.996**	.995**	1
	Sig. (2-tailed)	.000	.000	
	N	8	8	8

DISCUSSION

Stem diameter: The result of the findings revealed that after sowing, the highest value was found in week 1 in borehole water while the lowest value was in the stem diameter of well water. Also, in week 2, the highest recorded value was in the stem diameter of river water while the least recorded value was in the stem diameter of borehole water. In week 3, the highest recorded in the stem diameter of well water while the least was recorded in the

stem diameter of borehole water. The results show no significant difference ($p<0.05$) between the stem diameter of the river, borehole, and well water in weeks 1, 2, and 3. This study agrees with (Fenner and Thompson, 2005; Matoor *et al.*, 2019) *Acacia nilotica* and *Faidherbia albida* studies.

The result in week 4 shows the highest recorded value in the stem diameter of well water and the least was in the stem diameter of borehole water. The highest recorded value in the stem diameter of well water while the lowest value was recorded in the stem diameter of borehole water. There was a significant difference ($p<0.05$) between the stem diameter of river water, the stem diameter of borehole water, and the stem diameter of well water at weeks 4 and 5. Results from week 6 highest recorded value was in the stem diameter of well water while the least was in the stem diameter of borehole water. The highest value in week 7 was recorded in the stem diameter of well water while the lowest value was in the stem diameter of borehole water. There were significant differences ($p<0.05$) between the stem diameter of river water and the stem diameter of borehole water at weeks 6 and 7. The values recorded at week 8 were not significantly different ($p<0.05$) between the stem diameter of river, borehole, and well water with the highest recorded value in stem diameter of river water while the least recorded value in stem diameter of borehole water. This finding agrees with (Benidire *et al.*, 2015) effects of salt stress on germination and seedling development of *Vicia faba L.*

Seedling height: Results from week 1 show significant differences ($p<0.05$) between the height of the river, borehole and well water respectively. The highest value was recorded at the height of the river while the lowest was in borehole water. Results from weeks 2, 3, 4, 5, 6, 7 and 8 show no significant at ($p<0.05$) between height in river, borehole and well water. The highest growth performance of *Acacia senegal* was recorded in weeks 7 and 8 in the river, borehole and well water. The lowest results were obtained in week 1 within the river, borehole and well water. The low speed of germination of seed in week 1 could be probably due to salinity induced by the Na^+ ions present in this water and its high conductivity. Low pH value and high amount of Chloride in the water quality. They concur with (Rasmata *et al.*, 2019) effect of water quality on the germination of Okra.

Number of leaves: Results from the findings of this study reveal no significant differences in the number of leaves from the river, borehole and well water along weeks 1, 2, 3, 4, 5, 6, 7, and 8. *Acacia senegal* recorded the highest in weeks 7 and 8 in the river and well water

respectively. The lowest value was found in borehole and well water. This study concurs with Matoor *et al.* (2019) who reported that dormancy of seed varies with the degree of seed drying and phase of seed maturity. Therefore, pre-treatment must be adjusted on the base of the status of seed dormancy. Seed dormancy is determined by many endogenous factors so the methods of removing it are different. The moist pre-chilling has been anciently used to break the dormancy (Zohner *et al.,* 2016).

Water Quality: The result of the water quality test is not in line with the study by Nasreldin and Salaheldin (2013) who opined that in the pot experiments, statistical analysis showed significant differences (p>0.05) between EC 10 d sm-1 and EC 0.4d sm-1 and EC 5dsm-1 collectively; likewise, between EC 10d sm-1 and EC 15d sm-1and EC 20d sm-1.

Correlation: Results of correlational analysis shows that p-value is less than 0.05 in river, well and borehole water and shows statistically significant. The results also show strong positive linear relation in stem dimeter, height and number of leaves of *Acacia senegal* species.

CONCLUSION

From the result of the experiment, it is evident that river water gave the highest growth performance of *Acacia senegal* in terms of stem diameter, height and number of leaves at 8 weeks. The salinity content in river water gives high growth yield of tree species.

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