EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 8
Issue: 4
46-54
Year: 2021

APPRAISAL OF TDS AND pH OF THE TURAG RIVER WATER OF BANGLADESH FOR EVERY MONTH OF THE YEAR OF 2019

Farha Matin Juliana[1], Md. Sumsuzzaman[2], Abu Nayem[2], Dipok Roy Dwip[2], Mohammod Johirul Islam[3], Aradhan Sarkar[4] and Mohammad Asaduzzaman[2]*

[1]Department of Biochemistry and Molecular Biology, Jahangirnagar University, Savar, Dhaka, Bangladesh.
[2]Department of Biochemistry, Primeasia University, Banani, Dhaka, Bangladesh.
[3]Department of Biochemistry and Molecular Biology, Mawlana Bhashani Science and Technology University, Santosh, Tangail, Bangladesh.
[4]Department of Biotechnology and Genetic Engineering, Noakhali Science and Technology University, Noakhali, Bangladesh.

***Corresponding Author: Mohammad Asaduzzaman**
Department of Biochemistry, Primeasia University, Banani, Dhaka, Bangladesh.

Article Received on 27/01/2021 **Article Revised on 16/02/2021** **Article Accepted on 08/03/2021**

ABSTRACT
The Turag River is very important to Bangladesh's economic development, and residents use this waterway for a variety of purposes, such as fishing, watering, drinking and other work sessions. In any case, the waterway has been contaminated with unreasonable modern man-made practices. We evaluated TDS and pH to discover the aquatic properties of the Turag River. The water quality values obtained for river water are compared to the parameters of agricultural water quality standards. The TDS parameter exceeded the guideline value for January, February, March and April 2019. The pH of the river water sample did not exceed the standard value in any month of 2019.

KEYWORDS: Turag River, TDS, pH and 2019.

1.1 INTRODUCTION

Water is a prerequisite for carrying out all biological, industrial, urban, agricultural and household activities. It's hard to imagine a day without water. Unfortunately, useful water sources are polluted daily due to natural and human activities. Pollution of surface water (rivers, lakes and ponds), land and sea water is a threat to human and animal life. Water is generally regarded as a recyclable resource, but it must be properly managed to protect the resource as it is very susceptible to pollution due to industrial growth, urbanization and human activity caused by overcrowding.[1,2]

Bangladesh is surrounded by several rivers and is often called "Land of Rivers". The river is considered an elevator to this country. According to the US Library of Congress, Bangladesh's rivers flow at about 140,000 cubic meters per second during the annual rainy season and fall to 7,000 cubic meters per second during the dry season.[3]

Irrigation farming depends on the proper supply of available water quality. Water quality issues are often overlooked because a quality water source is adequate and easily accessible. This situation is currently changing in many areas. The intensive use of almost all quality materials means that new irrigation projects and older projects looking for new or additional sources will have to rely on smaller, lower quality and less undesirable sources. To avoid problems caused by the use of these poor water sources, careful planning is required to make the most of the available water quality.[3]

Conceptually, water quality refers to the characteristics of a water supply that affect its suitability for a particular application. How well water meets consumer needs is determined by certain physical, chemical and biological properties. Personal preferences such as taste are also a simple measure of acceptance. For example, if two drinking water of the same quality are available, people may prefer one source over the other. When evaluating irrigation water, the focus is on the chemical and physical properties of the water, other factors are considered to be of little importance.[3]

Some applications have different quality requirements, and are considered more acceptable (better quality) if the water supply provides better results or causes less problems than the alternative water supply. For example, quality river water that can be successfully used for irrigation may not be acceptable for urban use because it contains sediment without treatment for sediment removal. Likewise, melt water of good quality for urban use may be too corrosive for use in untreated industrial applications to reduce the likelihood of corrosion.[3]

The ideal situation would be to select multiple consumables, but usually only one. In this case, the quality of the available sources should be evaluated in terms of their suitability for their intended use. Much of the experience with different qualities of water comes from closely observing and studying problems that arise after use. The causal relationship between the water component and the observed problem assesses the degree of acceptance quality. With many experience reports and well-balanced solutions, some ingredients are becoming indicators of quality problems. Then these functions are combined into the suitability for using the instructions. Each new set of guidelines is based on the previous set to improve the predictive function. Many tutorials have emerged covering many types of use.[3]

The Turag River is one of the upper tributaries of Buriganga, a large river in Bangladesh. Turag comes from the Bangshi River, an important tributary of the Dhaleshwari River and passes through Gazipur to join Buriganga at Mirpur in the Dhaka region.[4]

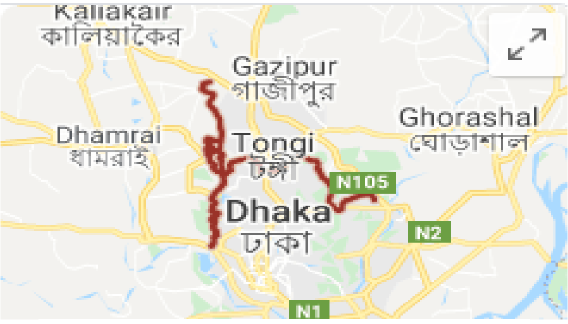

Figure 1: Turag river (red line in the map).

Turag is used for a variety of purposes and has a significant impact on economic, ecological, agricultural and industrial growth in cities and countries. The Turag River emerges from the Bangshi River, an important tributary of the Dhaleshwari River, flows through Gazipur and joins Buriganga at Mirpur, Dhaka. Most of the industries on the riverside are developing rapidly.

Wastewater, agricultural runoff and river treatment from nearby factories and municipalities without proper treatment increases river water pollution.[5]

The amount of water decreases during the dry season and worsens during the rainy season. People living around the river rely on the water of the Turag river in a variety of ways, such as home, fishing, drinking and agricultural needs. For this reason, it is important to manage the water quality of the Turag river. Therefore, the purpose of this study was to evaluate the water quality of the Turag river by measuring the TDS and pH parameters.

1.2 Water Quality Problems[6]

The water used for irrigation can vary greatly in quality depending on the type and amount of dissolved salt. Salinity is relatively small in irrigation water, but found in significant amounts. It is caused by the dissolution or weathering of rocks and soil, including the dissolution of lime, gypsum and other slowly dissolving soil minerals. This salt is carried by the water to the point where it is used. During irrigation, salt is taken with the water and remains in the soil when the water evaporates or is used for crops.

The suitability of irrigation water depends not only on its salt content, but also on its type. As the total salt content increases, a variety of soil and planting problems may arise, and certain treatment methods may be required to maintain acceptable yields. The quality or suitability of water is assessed as a measure of the potential difficulty of problems that may arise during long-term use.

The resulting problem differs from nature and quality and depends on the soil, climate and crops, and the skills and knowledge of the water users. As a result, there are no set limits on water quality. Rather, their suitability for use is determined by the conditions of use, which affect the accumulation of water compounds that can limit crop yields. Frequently occurring soil problems used as the basis for water quality assessment are related to salinity, water penetration, toxicity, and a variety of other problems.[6]

1.3 Water Quality Guidelines[7]

Recommendations for the assessment of water quality for irrigation are given in Table 1. It describes the long-term impact of water quality on crop production, soil health, and agricultural management and is presented in the same format as the 1976 edition, but has been updated to include: Latest Findings. University of California 1974 Consultant Committee Water Quality Handbook, written in collaboration with the American Salt Institute.

This guide is practical in nature and has been used successfully in general irrigation farming to assess the common components of surface, groundwater, drainage, wastewater and wastewater. This is based on some assumptions immediately following the table. These assumptions should be clearly understood, but not strict assumptions. If the actual conditions of use differ significantly from those planned, an adapted set of alternative guidelines can be developed.

In general, no soil or pruning problems will occur and will not be recognized when using water values lower than those specified as "no consumption limit". Due to low-to-medium restrictions, a gradual increase in crop selection and management options is required to achieve full harvest potential. On the other hand, when using water above the specified limit values, water users must have problems with soil and crops or reduce yields, as well as problems with crop management specifically designed to cope with poor water quality. It is the high level of conductivity required for acceptable production. If the water quality value is close to or greater than the value specified in the strict limiting category, a series of experimental agricultural studies are recommended before using water in major projects to determine the agricultural economy and pruning method to implement.

As with many other agricultural interpretation tools, Table 1 is a management tool designed to help consumers such as water quality authorities, project planners, farmers, researchers and experienced professionals better understand the impact of water quality on health and soil yields. Understanding this, consumers should be able to adjust their controls to better use poor quality water. However, users of Table 1 should be careful to draw unjustified conclusions based solely on laboratory results and interpretation of recommendations. This is because it must be related to the site conditions and must be verified, verified and tested by field test or experience.

Recommendations are the first step to highlighting water quality constraints, but they are not enough. We also need a way to overcome or correct it. So, the following sections introduce management alternatives and give some examples explaining how the guidelines can be used.

These guidelines do not evaluate the effects of unusual or special water components that are sometimes found in wastewater, such as pesticides and organic matter. However, suggested limits for trace element concentrations for general irrigation water are given in section 5.5. Since irrigation water sources are often the source of drinking water for livestock, restrictions on mineralization and the inclusion of trace elements in drinking water for livestock are given in section 6.

Dealing with drinking water standards is beyond the scope of this publication, but it still needs to be considered when designing an irrigation schedule. This is important because irrigation water sources are widely used as drinking water for humans. For more information, contact the World Health Organization (WHO) or your local healthcare organization.

The laboratory determinations and calculations required to use the instructions are shown in Table 2 and Figure 1 along with the symbols used. Analytical procedures for laboratory decisions are presented in several publications. You should use the method that best suits your available equipment, budget, and sample size. Analysis accuracy within ±5% is considered adequate.

Table 1: Guidelines For Interpretations of Water Quality For Irrigation.[1]

Potential Irrigation Problem				Units	Degree of Restriction on Use		
					None	Slight to Moderate	Severe
Salinity *(affects crop water availability)*[2]							
	EC_w			dS/m	< 0.7	0.7 – 3.0	> 3.0
	(or)						
	Total Dissolved Solids (TDS)			mg/l	< 450	450 – 2000	> 2000
Infiltration *(affects infiltration rate of water into the soil. Evaluate using EC_w and SAR together)*[3]							
SAR	= 0 – 3	**and EC_w**	=		> 0.7	0.7 – 0.2	< 0.2
	= 3 – 6		=		> 1.2	1.2 – 0.3	< 0.3
	= 6 – 12		=		> 1.9	1.9 – 0.5	< 0.5
	= 12 – 20		=		> 2.9	2.9 – 1.3	< 1.3
	= 20 – 40		=		> 5.0	5.0 – 2.9	< 2.9
Specific Ion Toxicity *(affects sensitive crops)*							
	Sodium (Na)[4]						
	surface irrigation			SAR	< 3	3 – 9	> 9
	sprinkler irrigation			me/l	< 3	> 3	
	Chloride (Cl)[4]						
	surface irrigation			me/l	< 4	4 – 10	> 10
	sprinkler irrigation			me/l	< 3	> 3	
	Boron (B)[5]			mg/l	< 0.7	0.7 – 3.0	> 3.0
Miscellaneous Effects *(affects susceptible crops)*							
	Nitrogen (NO_3 - N)[6]			mg/l	< 5	5 – 30	> 30
	Bicarbonate (HCO_3)						
	(overhead sprinkling only)			me/l	< 1.5	1.5 – 8.5	> 8.5
	pH				**Normal Range 6.5 – 8.4**		

[1] Adapted from University of California Committee of Consultants 1974.
[2] ECw means electrical conductivity, a measure of the water salinity, reported in deciSiemens per metre at 25°C (dS/m) or in units millimhos per centimetre (mmho/cm). Both are equivalent. TDS means total dissolved solids, reported in milligrams per litre (mg/l).
[3] SAR means sodium adsorption ratio. SAR is sometimes reported by the symbol RNa. See Figure1 for the SAR calculation procedure. At a given SAR, infiltration rate increases as watersalinity increases. Evaluate the potential infiltration problem by SAR as modified by ECw. Adapted from Rhoades 1977, and Oster and Schroer 1979.
[4] For surface irrigation, most tree crops and woody plants are sensitive to sodium and chloride; use the values shown. With overhead sprinkler irrigation and low humidity (< 30 percent), sodium and chloride may be absorbed through the leaves of sensitive crops.
[5] For boron tolerances, see Tables 1 and 2.
[6] NO_3 -N means nitrate nitrogen reported in terms of elemental nitrogen (NH_4 -N and Organic-N should be included when wastewater is being tested).

Table 2: Laboratory Determinations Needed To Evaluate Common Irrigation Water Quality Problems.

Water parameter	Symbol	Unit[1]	Usual range in irrigation water	
SALINITY				
Salt Content				
Electrical Conductivity	EC_w	dS/m	0 – 3	dS/m
(or)				
Total Dissolved Solids (TDS)s	TDS	mg/l	0 – 2000	mg/l
Cations and Anions				
Calcium	Ca^{++}	me/l	0 – 20	me/l
Magnesium	Mg^{++}	me/l	0 – 5	me/l
Sodium	Na^{+}	me/l	0 – 40	me/l
Carbonate	CO_3^{--}	me/l	0 – .1	me/l
Bicarbonate	HCO_3^{-}	me/l	0 – 10	me/l
Chloride	Cl^{-}	me/l	0 – 30	me/l
Sulphate	SO_4^{--}	me/l	0 – 20	me/l
NUTRIENTS[2]				
Nitrate-Nitrogen	NO_3-N	mg/l	0 – 10	mg/l
Ammonium-Nitrogen	NH_4-N	mg/l	0 – 5	mg/l
Phosphate-Phosphorus	PO_4-P	mg/l	0 – 2	mg/l
Potassium	K^{+}	mg/l	0 – 2	mg/l
MISCELLANEOUS				
Boron	B	mg/l	0 – 2	mg/l
Acid/Basicity	pH	1–14	6.0 – 8.5	
Sodium Adsorption Ratio[3]	SAR	(me/l)[1], [2]	0 – 15	

[1]dS/m = deciSiemen/metre in S.I. units (equivalent to 1 mmho/cm = 1 millimmho/centi-metre) mg/l = milligram per litre ≃ parts per million (ppm). me/l = milliequivalent per litre (mg/l ÷ equivalent weight = me/l); in SI units, 1 me/l= 1 millimol/litre adjusted for electron charge.
[2] NO_3 -N means the laboratory will analyse for NO_3 but will report the NO_3 in terms of chemically equivalent nitrogen. Similarly, for NH_4-N, the laboratory will analyse for NH_4 but report in terms of chemically equivalent elemental nitrogen. The total nitrogen available to the plant will be the sum of the equivalent elemental nitrogen. The same reporting method is used for phosphorus.
[3] SAR is calculated from the Na, Ca and Mg reported in me/l

1.4 The Effect of Total Dissolved Solids[8]

Interpretation of water quality for irrigation purposes is crop-specific. Crops differ in their salt tolerance and respond differently to the quality of water with which they are irrigated. Use the following information as a guideline to determine if a possible problem exists. The primary items of interest in your water analysis are total salts (Total Dissolved Solids), Sodium, Chloride and Sodium Adsorption Ratio (a calculation using the ratio of calcium plus magnesium to sodium). These are the main items that determine the suitability of water for irrigation. As noted above, different crops have different tolerance of salts. The following table lists the salt tolerance of some of the major crops in Oklahoma and Texas.

Table 3: Relative Tolerance of Crops to Salt.

Highly Tolerant Very	Moderately Tolerant	Moderately Sensitive	Sensitive
Cotton, wheatgrass Bermuda grass	Wheat, soybeans, sorghum, fescue, broccoli, tomatoes, cucumbers, cantaloupes	Corn, alfalfa, clovers, cowpeas, lettuce, peaches, apples, pears, grapes, blackberries	Field beans, carrots, onions, strawberries,

The following table shows the suitability of water for irrigation based on the total dissolved salt level.

Table 4: Suitability of Water for Irrigation Based on Total Dissolved Salts.

Very Low	Low	Medium	High	Very High
0-300ppm	301-600ppm	601-1000ppm	1001-1500ppm	>1501
Suitable for all crops	Suitable for all except extremely sensitive crops	Suitable for moderately tolerant crops and for moderately sensitive crops if special precautions are taken	Suitable for moderately tolerant and highly tolerant crops	Suitable only for highly tolerant crops and then only with special precautions

These tables do not cover every eventuality. For example, you can use water with high levels of salts on sensitive crops if you apply small amounts very infrequently. Also, you can use high salt water on crops if you get a lot of rainfall to leach the salts away. The tables are a general guideline to use to determine the long term effects of irrigating with water with different levels of salts.

Total Dissolved Solids (TDS)- related to the amount of dissolved salts in the water. Highersalinity results in higher electrical conductivity. As the salt level increases, the plant must expend more energy to take in nutrients dissolved in the water from fertilizer and the soil. Some plantsare very sensitive to salinity, while others can tolerate a wide range. TDS is calculated from the Electrical Conductivity, which is the analytical test used to determine salt concentration.

Sodium-a cation element contained in water. High sodium levels are bad for irrigation waterquality because sodium is a component of a harmful salt and also causes poor physical conditions of soils. It is the main component of soft water.

Potassium-a cation element and one of the fertilizer elements and a component of total salts. Itis not of consequence in irrigation water unless it occurs in extremely high concentrations.

Calcium and Magnesium-cation elements in water that are major components of hard water.

Nitrate-an anion element that can cause problems in high concentration in drinking water, butnot in irrigation water. High nitrates in irrigation water provide nutrients to the crop.

Sulfate-an anion element that can combine with calcium and form gypsum. It can also cause afoul odor and taste if high concentrations exist. It is not usually a major concern in irrigationwater.

Chloride-an anion element that can be very damaging to plants in high concentrations. This isespecially true when it is accompanied by high concentration of sodium.

Carbonate and Bicarbonate-direct measures of the liming potential of the water. For manycrops, use of water with an appreciable liming potential is not of concern and may lower the need for agricultural lime additions. However, some crops such as pecans can be adversely affected as increasing the pH will make micronutrients such as zinc less available.

Boron-an anion element that is usually not a problem in most crops. High concentrations (>1.0 ppm) can cause problems in pecans and peanuts.

1.5 Effects of pH in irrigation water on plant growth and flower quality

Herbaceous peony (*Paeonia lactiflora* Pall.) is an excellent landscape plant because of its great ornamental values. The objective of this study was to determine if plant growth and flower quality of *P. lactiflora* were affected by extreme pH in irrigation water. Compared with the control (pH 7.0), *P. lactiflora* exhibited a decrease in all morphological parameters except leaf number when irrigated with pH 4.0 and 10.0 waters. Physiological indices including chlorophyll a, chlorophyll b, chlorophyll a+b, soluble protein, malondialdehyde (MDA), soluble sugar, hydrogen peroxide (H_2O_2) and free proline were increased in response to irrigation with waters at pH 4.0 and 10.0, while the decline was occurred in chlorophyll a/b. Moreover, activities of three protective enzymes were also decreased in response to pH 4.0 and 10.0 treatments. These results indicated that the growth of *P. lactiflora* was significantly affected by extreme pH in irrigation water, and the most serious stress to *P. lactiflora* was caused under pH 10.0 treatment. Compared with plants irrigated with water at pH 7.0, 26.78% and 27.82% reduction were found in flower diameter and flower fresh weight of plants irrigated with water at pH 4.0. Likely, flower color fade under pH 4.0 treatment was attributed to decreased anthocyanin content and increased pH value of petal, which were coordinately regulated by nine anthocyanin biosynthetic genes and a vacuolar Na+/H+ antiporter1 gene (NHX1), respectively. The results would provide a theoretical guidance for the use of irrigation water in practical production of *P. lactiflora*.[9]

MATERIAL AND METHODS

2.1 Study Setting and Design: The study was conducted in the laboratory of environmental microbiology icddr,b in Dhaka, the capital of Bangladesh. In 2019, three water samples were taken from each three sampling points on the Turag river each month.

2.2 Sampling Site and Collection of Water Samples

Water samples were collected at three sampling points on the Turag river (Figure 2) in 2019. June to September is the wet season, and November to February is the dry season. A plastic bottle with a volume of 500 ml was used for sampling. All samples were collected by sampling, and labeled and stored according to standard procedures to prevent contamination or degradation of the collected water samples.[10]

2.3 pH Measurement

Electrochemical method was used to measure pH of bottled drinking water by using pH meter of Thermoscientific, USA (Model: ThermoscientificTMOrionTM 2-Star pH benchtop).[11]

2.4 TDS Measurement

TDS was measured by using TDS meter of HACH, USA (Model: sensION™+ EC71). This meter measures conductivity, salinity, TDS and temperature. Measurement data can be stored and transferred to a printer or PC. TDS is measured by using electrical conductivity of water. Electrical conductivity of water is directly related to the concentration of dissolved ionized solids in the water. Ions from the dissolved solids in water create the ability for that water to conduct an electric current, which can be measured using a conventional conductivity meter or TDS meter. When correlated with laboratory TDS measurements, conductivity provides an approximate value for the TDS concentration, usually to within ten-percent accuracy.[11]

Figure 2: Water sampling points from Turag River (Sampling point 1, 2 and 3)

3. RESULTS

In Table 5, we observed that the pH values ranged from 6.64 to 7.60. According to recommendations for irrigation water quality, the pH value of the water is between 6.50 and 8.50. The result is between standard specifications. Basically, the pH value is a good indicator of whether the water is hard or soft. Pure water has a pH value of 7. Water with a pH of less than 7 is generally considered acidic, and water with a pH of 7 or higher is considered alkaline. The normal pH range for surface water systems is 6.50 to 8.50 and the pH range for groundwater systems is 6.00 to 8.50. Alkalinity is a measure of a water's ability to withstand changes in pH that can make it more acidic.

Table 5: pH Levels in the Samples.

Sample	Month	Specification	Results	Average
1	January	6.5-8.5	7.29	7.27
2			7.32	
3			7.21	
1	February		7.32	7.43
2			7.60	
3			7.36	
1	March		7.53	7.60
2			7.70	
3			7.56	
1	April		7.28	7.25
2			7.26	
3			7.20	
1	May		7.06	7.05
2			7.11	
3			6.97	
1	June		6.52	6.64
2			6.82	
3			6.59	
1	July		6.97	7.07
2			7.08	
3			7.15	
1	August		6.89	6.89
2			6.99	
3			6.78	
1	September		7.02	7.08
2			7.11	
3			7.10	
1	October		7.21	7.24
2			7.25	
3			7.26	
1	November		7.35	7.40
2			7.41	
3			7.44	
1	December		7.51	7.56
2			7.56	
3			7.62	

In Table 6, TDS values ranged from 121.0 to 1004.2 mg/L. According to the recommendations for irrigation water quality, the TDS for water is in the range of 0-2000mg/l. The result is between specification standards. In fact, the value of TDS is a good indicator of whether water is present or not.

Table 6: TDS Levels in the Samples.

Sample	Month	Specification (mg/l)	Results	Average
1	January	0.0-2000.0	718.1	777.9
2			814.6	
3			801.6	
1	February		542.1	498.1
2			439.5	
3			512.6	
1	March		645.2	610.9
2			554.9	
3			632.7	
1	April		1114.0	1004.2
2			897.6	
3			1000.9	
1	May		194.0	219.0

2			222.3	
3			240.6	
1	June		209.0	224.8
2			245.6	
3			219.8	
1	July		108.6	121.0
2			112.3	
3			142.2	
1	August		116.5	145.4
2			158.3	
3			161.4	
1	September		321.5	332.6
2			345.2	
3			333.1	
1	October		254.6	284.2
2			287.5	
3			310.5	
1	November		187.5	213.9
2			221.3	
3			225.5	
1	December		232.9	258.4
2			245.3	
3			297.0	

4. DISCUSSION

Water Quality for Crop Production[12]

Irrigation quality is an important aspect of crop production. Water quality is determined by several factors. The most important are alkalinity, pH and soluble salts. However, several other factors must be considered, such as the presence of heavy metals or hard salts such as calcium and magnesium, or sometimes toxic ions, that can clog irrigation systems. To determine this, the water must be tested in a laboratory equipped with agricultural water testing equipment.

Poor quality water can slow growth, reduce aesthetic yields, and increase plant death. Highly soluble salt can directly damage the roots and impede the absorption of water and nutrients. Salt can accumulate on the edges of plant leaves and cause fringe burns. Highly alkaline water can adversely affect the pH of the culture medium, inhibit nutrient absorption, and cause nutrient deficiencies that threaten plant health.

Recycled water, wastewater, or recycled water may have pathogens, soluble salts and traces of organic chemicals present and may need to be reconstituted before use for irrigation.

Water quality should be checked to ensure that it is suitable for plant growth and to reduce the risk of pollutants being released into surface water or groundwater.

pH and Alkalinity[12]

Alkalinity and pH are two important factors that determine the suitability of water for an irrigation system. It measures the pH of water or other liquids by measuring the concentration of hydrogen ions (H+). In our study, we found pH values between 6.64 and 7.60. The irrigation water should generally be between pH 5.0 and 7.0. Water with a pH less than 7.0 is called "acidic" and water with a pH of 7.0 or higher is called "basic". pH 7.0-"neutral". Sometimes the term "alkaline" is used instead of "basic" and often "alkaline" is confused with "alkalinity".

Alkalinity is a measure of the water's ability to neutralize acidity. The alkalinity test measures the content of bicarbonate, carbonate and hydroxide in water. These compounds enter the water from geological substances in the water from which water has been taken, such as limestone and dolomite. Test results are usually expressed as "ppm of calcium carbonate ($CaCO_3$)". The desired irrigation water range is 0 to 100ppm calcium carbonate levels between 30 and 60ppm are considered optimal for most plants.

Irrigation water testing should always include pH and alkalinity testing. Alkalinity was not tested in our experiment. The pH test itself does not show alkalinity. Highly alkaline water (i.e., high levels of bicarbonate or carbonate) often has a pH of 7 or higher, but water with a higher pH is not always highly alkaline. This is important because alkalinity above pH has the most important effect on the fertility and plant nutrition of the culture medium.

Studies on the US Mass Extension of Greenhouse Water show that pH in the 7-8 range is common for most water sources found in Massachusetts. These higher pH levels are generally not an issue as long as the alkalinity is within the acceptable range. High pH/alkaline water is common in Berkshire County and is sometimes found in other parts of the state as well.

Potential adverse effects on nutrition[12]

In most cases irrigation with "high pH" water is not a problem as long as the alkalinity is low. High pH water has little effect on the pH of the culture medium as it has little ability to neutralize acidity.

The main problem is the cause of water at high pH, high alkalinity for irrigation. In Massachusetts, this situation is most common in Berkshire County. One reason is that the pH of the culture medium tends to increase significantly over time. Basically, water acts as a permanent and diluted limestone solution! This increase is so great that the usual lime grade should be reduced by 50%. The problem is most acute when growing plants in small containers, as small amounts of soil are not properly protected from pH changes. As a result, the combination of high pH and high alkalinity is particularly important for cork and plant plates. The deficiency of trace elements such as iron and manganese and an imbalance of calcium (Ca) and magnesium (Mg) may be due to irrigation with highly alkaline water.

TDS measures various salts that have been dissolved in water[13]

These dissolved minerals cannot be removed by traditional filtration, only by membrane, reverse osmosis or distillation. The amount of TDS in the soil or growth medium moves towards the water. If you keep watering the soil with high pH and high TDS water, the plant's root system will eventually become difficult to absorb the many nutrients you add. If the water supply is too acidic (pH too low), it can negatively affect nutrient absorption.

If you start with problematic water, you have to constantly struggle. For example, if you lived in Seattle, Washington, the pH of the incoming water is probably between 7.5 and 7.8. The pH for phytonutrients optimization is optimized to around 6.5, but this range isn't that bad.

The water level in Seattle is also low, with a TDS of around 50ppm. However, if you lived in Las Vegas, Nevada, you will find that the incoming water is very different, with a pH range of 8.0-8.3 and a TDS range of 600-800ppm. This is due to the high mineral content of the water flowing through the Colorado River and the high (primary) pH aspect of that water.

CONCLUSION

Observation was satisfactory regarding pH. Low alkalinity reduces higher pH. We did not observe alkalinity. If we used to measure alkalinity then we could say that due to low alkalinity pH is within the range all the year round. TDS levels were found beyond the range for the first four months of the year.

REFERENCES

1. May J.P., The geometry of iterated loop spaces, Springer, Berlin, Heidelberg, 2006; 271(15).
2. Ouyang Y., Nkedi-Kizza P., Wu Q.T., Shinde D. and Huang C.H., Assessment of seasonal variations in surface water quality, Water Research, 2006; 40(20): 3800-3810.
3. Water quality evaluation. (n.d.). Retrieved February 18, 2021, from http://www.fao.org/3/t0234e/t0234e01.htm
4. Turag river. (2007, April 29). Wikipedia, the free encyclopedia. Retrieved February 18, 2021, from https://en.wikipedia.org/wiki/Turag_River.
5. Meghla N.T., Islam M.S., Ali M.A. and Sultana N., Assessment of physicochemical properties of water from the Turag River in Dhaka City, Bangladesh, Int. J. Curr. Microbiol. App. Sci, 2013; 2(5): 110-122.
6. Water quality for agriculture. (n.d.). Home | Food and Agriculture Organization of the United Nations. https://www.fao.org/3/t0234e/t0234e01.htm#note1.
7. UCCC (University of California Committee of Consultants).: Guidelines for Interpretations of water Quality for Irrigation. Technical Bulletin, University of California Committee of Consultants, California, USA, 1974; 20-28.
8. (n.d.). Noble Research Institute. https://www.noble.org/globalassets/docs/testing-services/irrigation-water-guidelines.pdf.
9. Zhao D, Hao Z, Wang J, Tao J. Effects of pH in irrigation water on plant growth and flower quality in herbaceous peony (Paeonia lactiflora Pall.). Scientia Horticulturae, 2013 May 2; 154: 45-53.
10. Tahmina B, Sujan D, Karabi R, Hena MK, Amin KR, Sharmin S. Assessment of surface water quality of the Turag river in Bangladesh. Res J Chem Environ, 2018 Feb; 22(2): 49-56.
11. Islam R, Faysal SM, Amin R, Juliana FM, Islam MJ, Alam MJ, Hossain MN, Asaduzzaman M. Assessment of pH and total dissolved substances (TDS) in the commercially available bottled drinking water. Iosr Journal of Nursing And Health Science Ver. IX, 2017; 6(5): 35-40.
12. Admin. “Water Quality for Crop Production.” *Center for Agriculture, Food and the Environment*, 19 Apr. 2019, ag.umass.edu/greenhouse-floriculture/greenhouse-best-management-practices-bmp-manual/water-quality-for-crop#:~:text=The%20desirable%20range%20for%20irrigation,considered%20optimum%20for%20most%20plants.
13. “How PH And TDS Levels Affect Plant Water.” *Dutchman's Hydroponics & Garden Supplies*, www.dutchmanhydroponics.com/blogs/gardening/how-ph-and-tds-levels-affect-plant-water.