Journal of Clinical Chemistry and Laboratory Medicine

OPEN ACCESS Freely available online

Book review

Analytical Reagents Catalogue for Soil and Plant Analysis

Yohannes Habteyesus Yitagesu*

Department of Analytical Chemistry, Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia

ABSTRACT

Soil and plant analysis is an initial and a key points to which know what the soil currently have sufficient or deficient nutrients. To recommend the required level of nutrients in to the soil either in the form of inorganic or organic fertilizations, it has to be determined first the amount of macro and micronutrients. Different analytical procedures can be used to determine the physical, chemical and biological parameters of the soil. Based on the amount of nutrients and extraction methods can possible to interpret and put recommendation in order to fulfill the required nutrient levels. The available forms of nutrients in soil can a positive coloration to plant nutrition and crop productivity.

Keywords: Soil; Plant; Catalog

INTRODUCTION

The accuracy of laboratory data directly related with the performance of technicians, the precision of the instrument, purity of laboratory reagents and chemicals. Depending on the purpose and the nature of parameters selective methods and techniques can applied to quantify the level of minerals [1]. The purity of chemicals also significant roles in raw data of soil and plant tests. There are different grades of chemicals available designed for different tests and specific purpose of the test [2].

In Ethiopia there are few soil and plant analysis laboratories even their scope of tests limited for major physic-chemical parameters. The demands of soil and plant laboratories from agricultural sectors, researchers, students and investors totally incomparable to the available laboratories [3]. Many universities and private sectors wants to build such like testing laboratories but needs strong guidance and consultation to fulfill what facilities and reagents required [4]. This soil and plant analytical catalogue therefore aimed to answer what chemicals with the required purity which needs to analyze the physic-chemical tests are listed in short and brief way [5].

DESCRIPTION AND BRIEFING

The description and briefing is described in Figure 1.

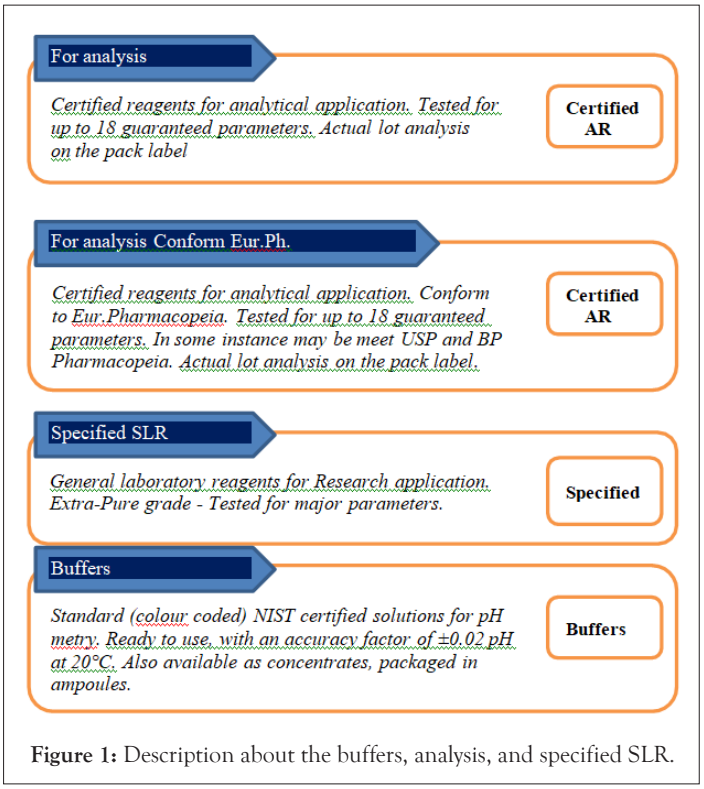


Figure 1: Description about the buffers, analysis, and specified SLR.

Correspondence to: Yitagesu YH, Department of Analytical Chemistry, Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia, Tel: +0911475074; E-mail: yhabteyesus@yahoo.com

Received: August 20, 2020; **Accepted:** September 03, 2020; **Published:** September 10, 2020

Citation: Yitagesu YH (2020) Analytical Reagents Catalogue for Soil and Plant Analysis. J Clin Chem Lab Med. 4.149. DOI: 10.35248/clinical-chemistry-laboratory-medicine.20.4.149

Concentration of solution

Percent Composition (by mass): Can consider percent by mass (or weight percent) in two ways:

- The parts of solute per 100 parts of solution.
- The fraction of a solute in a solution multiplied by 100 [6].

You need two pieces of information to calculate the percent by mass of a solute in a solution, shown in Figure 2:-

- The mass of the solute in the solution.
- The mass of the solution

$$\text{Mass percentage} = \frac{\text{solute mass}}{\text{Solution mass}} * 100$$

Figure 2: Equation to calculate percent by mass.

$$\text{Molarity(M)} = \frac{\text{moles of solute}}{\text{volume of solution (L)}}$$

Figure 3: Formula to calculate Molarity.

Molality: Molality, m, tells us the number of moles of solute dissolved in exactly one kilogram of solvent [7]. You need two pieces of information to calculate the molality of a solute in a solution, shown in Figure 4:-

- The moles of solute present in the solution.
- The mass of solvent (in kilograms) in the solution.

$$\text{Molality(m)} = \frac{\text{Moles of solute}}{\text{Mass of solvent (Kg)}}$$

Figure 4: Formula to calculate Molality.

The Table 1, shows the units for reporting concentration and the Table 2 shows the fundamental SI units.

Table 1: Units for reporting concentration.

Common units for reporting concentration		
Name	**Units**	**Sign**
Molarity	Moles solute/liters solution	m
Formality	Number fws solute/liters solution	f
Normality	Number ews solute/liters solution	n
Molality	Moles solute/kg solvent	m
Weigh %	gm solute/100 gm solution	%w/w
Volume %	ml solute/100 ml solution	%v/v
Weight-to-volume %	gm solute/100 ml solution	%w/v
Parts per million	gm solute/106 g solution	ppm
Parts per billion	gm solute/109 g solution	ppb
fw: formula weight		ew: equivalent weight

Table 2: Fundamental SI units of measurements.

Fundamental SI Units		
Measurement	**Unit**	**Symbol**
mass	kilogram	kg
volume	liter	l
distance	meter	m
temperature	kelvin	K
time	second	s
current	ampere	A
amount of substance	mole	mol

Laboratory safety

A safe working in a chemical laboratory needs special care in using and handling of chemicals and reagents. For chemical operations, the release of gases and fumes in some specific analytical operation are controlled through a fume hood or trapped in acidic/alkaline solutions and washed through flowing water. Also, some chemical reactions during the process of analysis, if not handled well, may cause an explosion [8,9]. Analytical processes normally carried out at room temperature can be affected by differences in temperature so that an analysis performed in a "cold" room can give a different result to one performed in a "hot" room. Many chemicals are affected by the temperature and humidity conditions under which they are stored, particularly if these conditions fluctuate [10,11]. The air temperature of the laboratory and working rooms should ideally be maintained at a constant level (usually between 20 and 25°C). Humidity should be kept at about 50% [12].

Health, safety and regulatory information

The health safety and other regulatory information are depicted in the form of Figures 5-12.

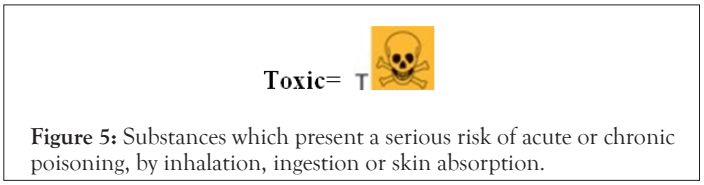


Figure 5: Substances which present a serious risk of acute or chronic poisoning, by inhalation, ingestion or skin absorption.

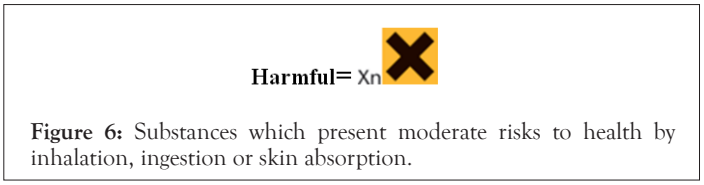


Figure 6: Substances which present moderate risks to health by inhalation, ingestion or skin absorption.

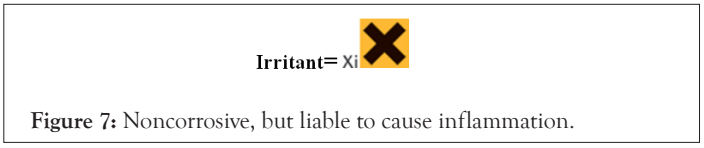


Figure 7: Noncorrosive, but liable to cause inflammation.

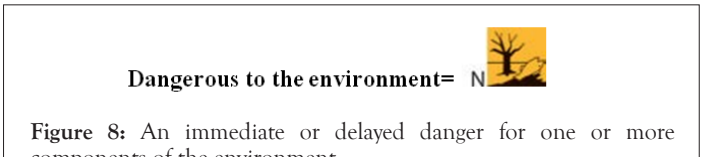


Figure 8: An immediate or delayed danger for one or more components of the environment.

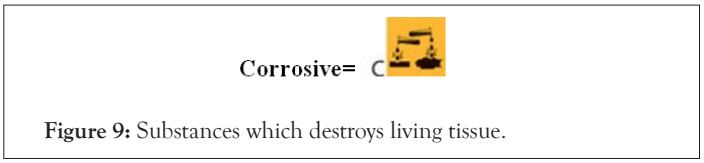


Figure 9: Substances which destroys living tissue.

Figure 10: Substances which may explode under the effect of flame or heat or which are more sensitive to shock.

Figure 11: May catch fire rapidly in contact with air at ambient temperature without application of energy, are gaseous and flammable in air at normal pressure.

Figure 12: Which give rise to highly exothermic reactions in contact with other substances, particularly flammable substances.

Chemicals handling

• Use fume hoods when handling concentrated acids, bases or other hazardous chemicals.

• Do not pipette by mouth; always use a suction bulb.

• When diluting, always add acid to water, not water to acid.

• Some metal salts are extremely toxic and may be fatal if swallowed. Wash hands thoroughly after handling such salts or indeed any chemical regardless of toxicity. Chemical spills should be cleaned promptly and all waste bins emptied regularly.

• All reagent bottles should be clearly labeled and must include information on any particular hazard. This applies particularly to poisonous, corrosive, and inflammable substances.

• For the preparation of reagents, only distilled water (DI) is used. Note that volatile acids, ammonia, nitrite, chlorine and carbon dioxide have to be removed by means of a column containing resin (deionizer) which will exchange the charged ions, is needed.

Following are the chemicals and their respective quantitative proportions, shown in Figures 13-28.

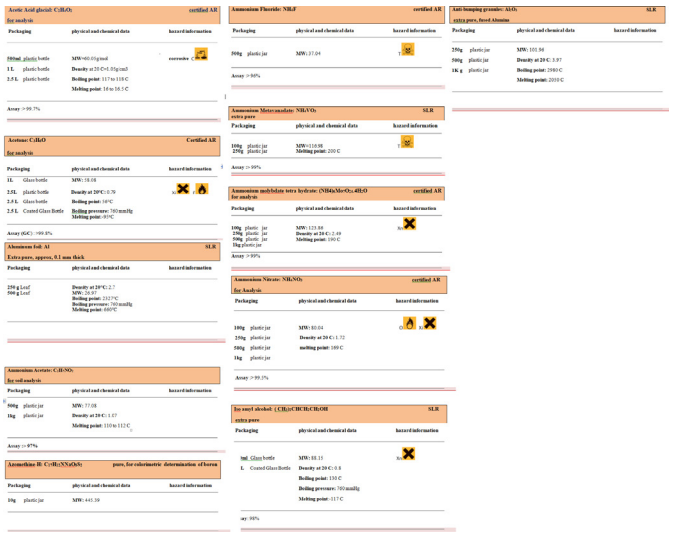


Figure 13: It consist of chemicals starting with alphabet 'A'.

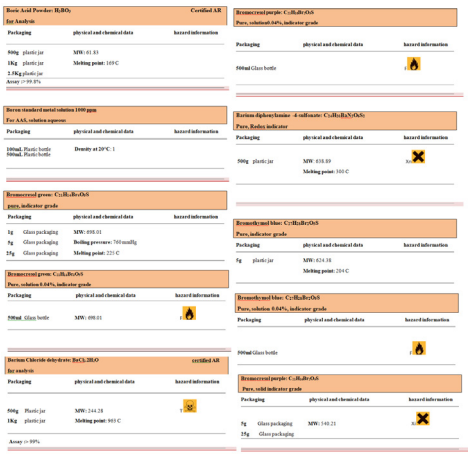


Figure 14: It consist of chemicals starting with alphabet 'B'.

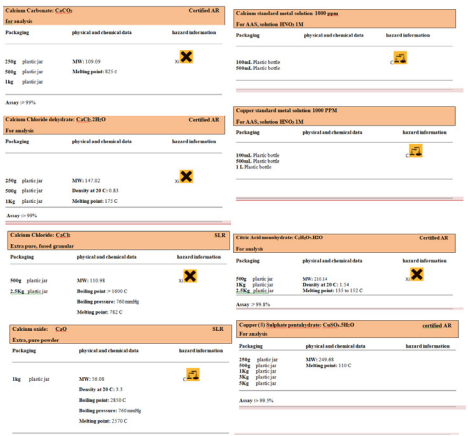


Figure 15: It consist of chemicals starting with alphabet 'C'.

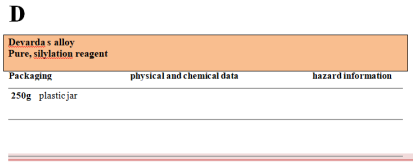


Figure 16: It consist of chemicals starting with alphabet 'D'.

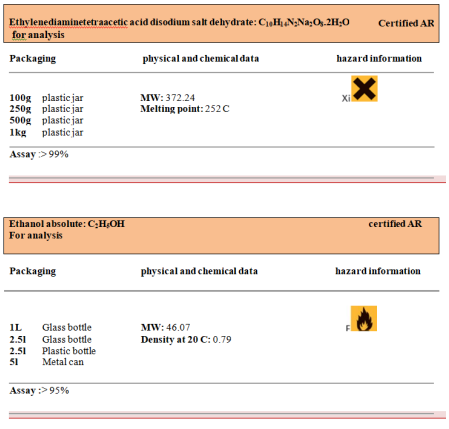
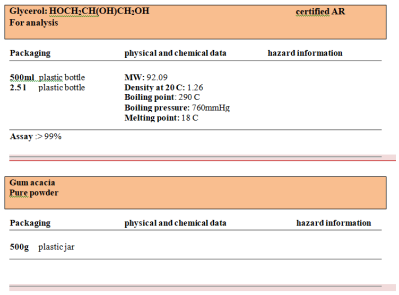


Figure 17: It consist of chemicals starting with alphabet 'E'.



Glycerol: $HOCH_2CH(OH)CH_2OH$ certified AR
For analysis

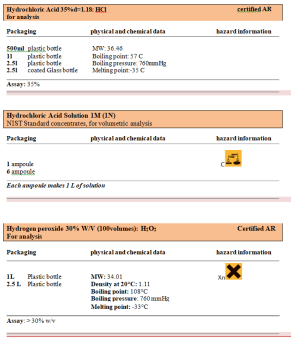
Packaging	physical and chemical data	hazard information
500ml plastic bottle **2.5 l** plastic bottle	**MW:** 92.09 **Density at 20 C:** 1.26 **Boiling point**: 290 C **Boiling pressure:** 760mmHg **Melting point:** 18 C	

Assay :> 99%

Gum acacia
Pure powder

Packaging	physical and chemical data	hazard information
500g plastic jar		

Figure 18: It consist of chemicals starting with alphabet 'G'.



Hydrochloric Acid 35%-d=1.18: HCl certified AR
for analysis

Packaging	physical and chemical data	hazard information
500ml plastic bottle **1l** plastic bottle **2.5l** plastic bottle **2.5l** coated Glass bottle	MW: 36.46 Boiling point: 57 C Boiling pressure: 760mmHg Melting point:-35 C	

Assay: 35%

Hydrochloric Acid Solution 1M (1N)
NIST Standard concentrates, for volumetric analysis

Packaging	physical and chemical data	hazard information
1 ampoule **6** ampoule		

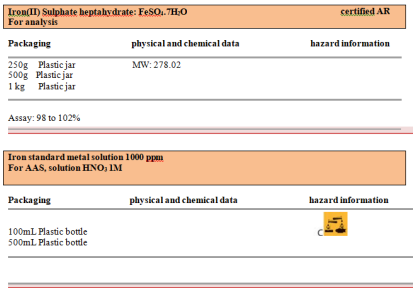
Each ampoule makes 1 L of solution

Hydrogen peroxide 30% W/V (100volumes): H_2O_2 Certified AR
For analysis

Packaging	physical and chemical data	hazard information
1L Plastic bottle **2.5 L** Plastic bottle	**MW:** 34.01 **Density at 20°C:** 1.11 **Boiling point:** 108°C **Boiling pressure:** 760 mmHg **Melting point:** -33°C	

Assay: > 30% w/v

Figure 19: It consist of chemicals starting with alphabet 'H'.



Iron(II) Sulphate heptahydrate: $FeSO_4.7H_2O$ certified AR
For analysis

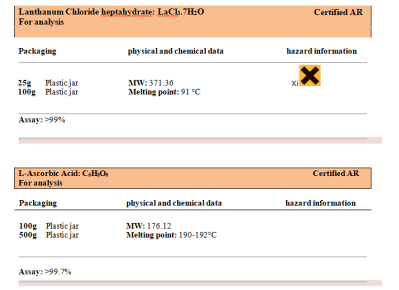
Packaging	physical and chemical data	hazard information
250g Plastic jar 500g Plastic jar 1 kg Plastic jar	MW: 278.02	

Assay: 98 to 102%

Iron standard metal solution 1000 ppm
For AAS, solution HNO_3 1M

Packaging	physical and chemical data	hazard information
100mL Plastic bottle 500mL Plastic bottle		

Figure 20: It consist of chemicals starting with alphabet 'I'.



Lanthanum Chloride heptahydrate: $LaCl_3.7H_2O$ Certified AR
For analysis

Packaging	physical and chemical data	hazard information
25g Plastic jar **100g** Plastic jar	**MW:** 371.36 **Melting point:** 91 °C	

Assay: >99%

L-Ascorbic Acid: $C_6H_8O_6$ Certified AR
For analysis

Packaging	physical and chemical data	hazard information
100g Plastic jar **500g** Plastic jar	**MW:** 176.12 **Melting point:** 190-192°C	

Assay: >99.7%

Figure 21: It consist of chemicals starting with alphabet 'L'.

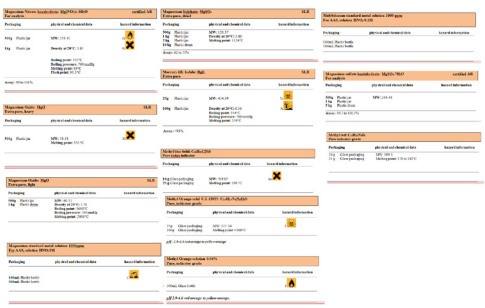
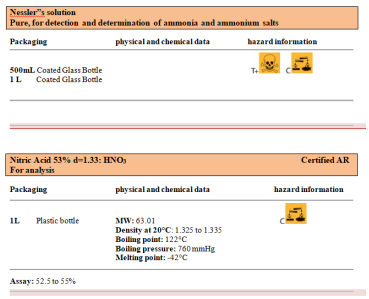


Figure 22: It consist of chemicals starting with alphabet 'M'.



Nessler's solution
Pure, for detection and determination of ammonia and ammonium salts

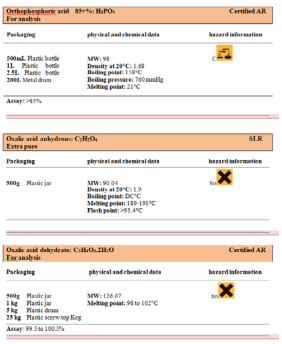
Packaging	physical and chemical data	hazard information
500mL Coated Glass Bottle **1 L** Coated Glass Bottle		

Nitric Acid 53% d=1.33: HNO_3 Certified AR
For analysis

Packaging	physical and chemical data	hazard information
1L Plastic bottle	**MW:** 63.01 **Density at 20°C:** 1.325 to 1.335 **Boiling point:** 122°C **Boiling pressure:** 760 mmHg **Melting point:** -42°C	

Assay: 52.5 to 55%

Figure 23: It consist of chemicals starting with alphabet 'N'.



Orthophosphoric acid 85+%: H_3PO_4 Certified AR
For analysis

Packaging	physical and chemical data	hazard information
500mL Plastic bottle **1L** Plastic bottle **2.5L** Plastic bottle **200L** Metal drum	**MW:** 98 **Density at 20°C:** 1.68 **Boiling point:** 158°C **Boiling pressure:** 760 mmHg **Melting point:** 21°C	

Assay: >85%

Oxalic acid anhydrous: $C_2H_2O_4$ SLR
Extra pure

Packaging	physical and chemical data	hazard information
500g Plastic jar	MW: 90.04 Density at 20°C: 1.9 Boiling point: DC°C Melting point: 189-191°C Flash point: >93.4°C	

Oxalic acid dehydrate: $C_2H_2O_4.2H_2O$ Certified AR
For analysis

Packaging	physical and chemical data	hazard information
500g Plastic jar 1 kg Plastic jar 5 kg Plastic drum 25 kg Plastic screw top Keg	MW: 126.07 **Melting point:** 98 to 102°C	

Assay: 99.5 to 100.5%

Figure 24: It consist of chemicals starting with alphabet 'O'.

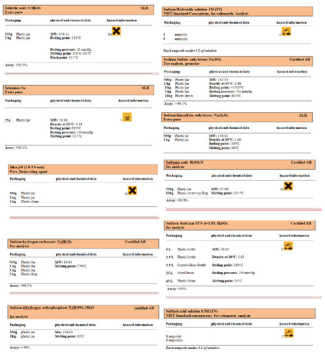
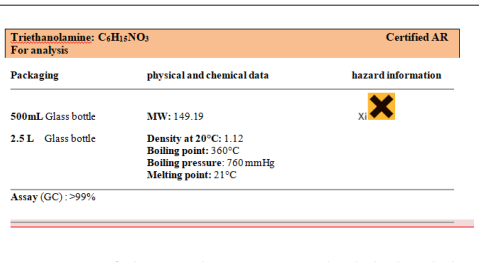


Figure 26: It consist of chemicals starting with alphabet 'S'.

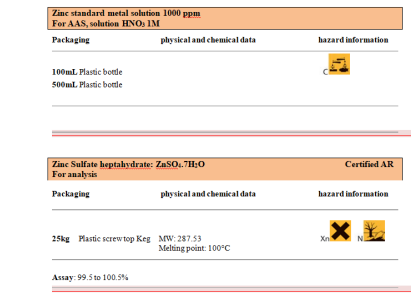


Triethanolamine: $C_6H_{15}NO_3$ Certified AR
For analysis

Packaging	physical and chemical data	hazard information
500mL Glass bottle **2.5 L** Glass bottle	**MW:** 149.19 **Density at 20°C:** 1.12 **Boiling point:** 360°C **Boiling pressure**: 760 mmHg **Melting point:** 21°C	

Assay (GC) : >99%

Figure 27: It consist of chemicals starting with alphabet 'T'.



Zinc standard metal solution 1000 ppm
For AAS, solution HNO_3 1M

Packaging	physical and chemical data	hazard information
100mL Plastic bottle **500mL** Plastic bottle		

Zinc Sulfate heptahydrate: $ZnSO_4.7H_2O$ Certified AR
For analysis

Packaging	physical and chemical data	hazard information
25kg Plastic screw top Keg	MW: 287.53 Melting point: 100°C	

Assay: 99.5 to 100.5%

Figure 28: It consist of chemicals starting with alphabet 'Z'.

The chemicals pH range and color changes are described in Table 3.

Table 3: pH indicator of the chemicals.

pH indicator			
Designation	**pH range**	**Color change**	**Pack size**
Alizarin	11.0-13.0	Pink to violet	10 g
Alizarin red S, C.I.58005	4.0-6.0	Yellow to orange-red	25 g
	3.6-5.2	Yellow to blue	1 g
Bromocresol green	3.6-5.2	Yellow to blue	5 g
	3.6-5.2	Yellow to blue	25 g
	5.2-6.8	Yellow to violet	5 g
Bromocresol purple	5.2-6.8	Yellow to violet	25 g
	2.8-4.6	Yellow to blue-violet	5 g
Bromophenol blue	2.8-4.6	Yellow to blue-violet	25 g
Congo red	3.0-5.0	Violet to red-orange	25 g
Cresol red	0.2-1.8	Red to yellow	5 g
Full range indicator, pH range 1-13	1.0-13.0	Color chart on bottle	100 mL
	1.0-13.0	Color chart on bottle	500 mL
Litmus	5.0-8.0	Red to blue	25 g
	2.9-4.6	Orange red to orange yellow	25 g
Methyl orange solid C.I. 13025	2.9-4.6	Orange red to orange yellow	100 g
	4.2-6.3	Red to yellow	10 g
Methyl red spirit soluble C.I. 13020	4.2-6.3	Red to yellow	25 g
	4.2-6.3	Red to yellow	5 g
Methyl red solid water soluble	4.2-6.3	Red to yellow	100 g
	0.1-3.2	Yellow to violet	10 g
Methyl violet solid (crystal violet) C.I. 42555	0.1-3.2	Yellow to violet	25 g
p-Naphtholbenzein	8.5-9.8	Yellow to green	25 g
Neutral red C.I 50040	6.8-8.0	Red to yellow-orange	5 g
Thymol blue	1.2-2.8	Red to yellow	5 g
	9.3-10.5	Colorless to blue	5 g
Thymolphthalein solid	9.3-10.5	Colorless to blue	25 g
Titan yellow C.I. 19540	12.0-13.0	Yellow to red	25 g
	4.0-10.0	Color chart on bottle	2.5 L
Universal indicator, pH range 4-10	4.0-10.0	Color chart on bottle	100 mL
	4.0-10.0	Color chart on bottle	500 mL

Table 4: NIST buffer pH measurement.

Designation	Pack size	package type
Buffer color coded solution pH 4.00 (phthalate) Red	1 L	Plastic bottle
	2.5 L	Plastic bottle
	5 L	Plastic bottle
	1 L	Plastic bottle
	2.5 L	Plastic bottle
Buffer color coded solution pH 7.00 (phosphate) Yellow	5 L	Plastic bottle
	1 L	Plastic bottle
	2.5 L	Plastic bottle
Buffer color coded solution pH 10.00 (borate) Blue	5 g	5 g
Buffer Capsules for PH measurement, Each Capsule makes up 100 mL of solution		
Buffer capsules pH 4.00		Box of 50 capsules
Buffer capsules pH 7.00		Box of 50 capsules
Buffer capsules pH 9.00	50 PC	Box of 50 capsules
Buffer capsules pH 10.00		Box of 50 capsules

NIST Buffer color coded standard solution for pH measurement. Manufactured to a tolerance of ± 0.02 pH Units at 20°C pH=4.00 and 7.00 buffer solution are stabilized with 10 ppm of Mercury (II) chloride, shown in Table 4.

REFERENCES

1. Analytical Reagents Catalogue Volume I, Fisher Chemical, Part of Thermo Fisher Scientific.
2. Harvey D. Modern Analytical Chemistry.2000.
3. Estefan G, Ryan J. Method of Soil, Plant and Water Analysis. 3rd edn.2013.
4. Abou Seedo K, Abido MS, Salih AA, Abahussain A. Assessing heavy metals accumulation in the leaves and sediments of urban mangroves (Avicennia marina (Forsk.) Vierh.) in Bahrain. Int J Ecol.2017;29.
5. Rehman A, Farooq M, Naveed M, Nawaz A, Shahzad B. Seed priming of Zn with endophytic bacteria improves the productivity and grain biofortification of bread wheat. European J Agronomy.2018;94:98-107.
6. Friis G, Burt JA. Evolution of mangrove research in an extreme environment: Historical trends and future opportunities in Arabia. Ocean Coas Manage.20201;195:105288.
7. Minh TT, Tue NT, Quy TD. Heavy Metal Concentrations in Sediment Cores from Different Mangrove Forests in Da Loc Commune, Hau Loc District, Thanh Hoa Province, Vietnam. VNU J Sci Earth Environ Sci.2018;24;34.
8. Awan ZA, Shoaib A, Khan KA. Crosstalk of Zn in Combination with Other Fertilizers Underpins Interactive Effects and Induces Resistance in Tomato Plant against Early Blight Disease. Plant Pathol J.2019;35:330.
9. Sengupta S, Bhattacharya P, Hazra S. Ensuring nutritional security through zinc biofortification of rice grain in Indian scenario. Int J Consv Sci.2019;7:2129-2144.
10. Machado PP, Steiner F, Zuffo AM, Machado RA. Could the supply of boron and zinc improve resistance of potato to early blight? Potato Res.20181;61:169-1682.
11. Khan KA, Shoaib A, Arshad Awan Z, Basit A, Hussain M. Macrophomina phaseolina alters the biochemical pathway in Vigna radiata chastened by Zn2+ and FYM to improve plant growth. J Plant Inter.20181;13:131-140.
12. Fortes AD, Howard CM, Wood IG, Gutmann MJ. Glycine zinc sulfate pentahydrate: redetermination at 10 K from time-of-flight neutron Laue diffraction. Acta Crystallographica Section E: Crystallogr Comm.20161;72:1438-1445.