World Journal of Pharmaceutical and Life Sciences
WJPLS
www.wjpls.org
SJIF Impact Factor: 6.129

ASSESSMENT OF SOIL AND IRRIGATION WATER QUALITY FOR HIGHER CROP PRODUCTIVITY OF RESEARCH FARM OF ALLAHABAD SCHOOL OF AGRICULTURE SHIATS-DU ALLAHABAD (U.P.) INDIA

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Article Received on 12/04/2022 **Article Revised on 01/05/2022** **Article Accepted on 21/05/2022**

ABSTRACT

A study was conducted on the quality of irrigation water and soil (Ganga, Yamuna, Sangam, Research farm of Horticulture and Tube well No 5 of SHIATS-DU, Allahabad), the physical, chemical properties of the soil and water. A split plot experiment with five main Sites with three replication were designed and executed in Ganga, Yamuna, Sangam and research Farm. soil samples were collected from depth of 0-15, 15-30, and 30-45 cm were analyzed for, Soil pore space(%), bulk density(gcm^{-3}), particle density(gcm^{-3}), moisture(%), soil texture(Sandy loam), and EC(dSm^{-1}), pH(1:2 W/V), Total Nitrogen, Phosphorous, Potassium, Zinc, Sulphur, and Magnesium were found to be significantly greater with surface Soil (0-15).The pH, EC, DO,BOD, TDS, BO, Turbidity, Hardness, Na and Cl of first and second soil layers irrigation with wastewater were higher as compared with Ganga, Yamuna, Sangam and SHIATS-DU, Allahabad research farm. The soil EC, Na and Cl content increased with increasing the depth of the soil layer. The fluctuations in nitrogen concentration were opposite to the fluctuation in Cl concentration as the nitrogen content of the soil decreased with increasing the soil depth.

KEYWORDS: irrigation water quality, pH, EC, DO, BOD, TDS, BO, Tutbidity, Hardness, soil physical and chemical properties etc.

INTRODUCTION

Agricultural sustainability depends to a large extent upon maintenance or enhancement of soil health or quality. Soil quality is conceptualized as the major linkage between the strategies of conservation management practices and achievement of major goals of sustainable agriculture (Andrews, 2004). The quality & health of soils not only determine agricultural sustainability but also environmental quality & the plant, animal & human health.

Thus the land care & soil quality management assume great significance for ensuring agricultural sustainability which is inevitable to feed the burgeoning population.

Soil Health Indicators

There are two ways in which the concept of soil health (or the closely related concept of soil quality) has been considered, which can be termed either 'reductionist' or 'integrated'. The former is based on estimation of soil condition using a set of independent indicators of specific soil properties—physical, chemical and biological. The alternative, integrated, approach makes the assumption that the health of a soil is more than simply the sum of the contributions from a set of specific components. It recognizes the possibility that there are emergent properties resulting from the interaction between different processes and properties. This approach has been much discussed and well reviewed **(Doran *et al.* 1994; Doran & Jones 1996; Van-Camp *et al.* 2004).** The quality of soil is rather dynamic and can affect the sustainability and productivity of land use. It is the end product of soil derivative or conserving processes and is controlled by chemical, physical, and biological components of a soil and their interactions (**Papendick and Parr, 1992**). Indicators, however, will vary according to the location, and the level of sophistication at which measurements are likely to be made (**Riley, 2001**).

MATERIALS AND METHODS

This experiment was conducted during 2012-14 on research farms of Allahabad school of Agriculture (Research farm- Soil Science, Agronomy, Horticulture,

Plant Protection, Genetic and Plant Breeding, Agro-Forestry and Commercial Farm) Sam Higginbottom Institute of Agriculture Technology & Sciences. Deemed-to-be-University, Allahabad. The right bank of the Yamuna and about 6 km. away from Allahabad railway station. It is positioned at 25! 57°N Latitude and 81! 5°E latitude and about 98 meter about sea level. The soil (Sandy loam) was neutral in reaction, low in available N, medium in available P_2O_5 and high in available K_2O content. The experiment was soil survey, mapping and analysis of physic-chemical properties of soil, of different depth 0-15, 15-30 and 30-45cm respectively. Physical properties- soil colour(In Dry and Wet condition),Soil Texture (sand, silt and Clay %),Pore Space(%),Particle Density(gcm^{-3}),Bulk Density (gcm^{-3}), Water holding capacity (%), Specific Gravity and Moisture (%). Chemical properties –Soil pH (1:2 W/V), EC ($dS\ m^{-1}$), Organic Carbon (%), Organic Matter (%), Available Nitrogen ($kgha^{-1}$), Available Phosphorous ($kgha^{-1}$), Available Potassium ($kgha^{-1}$),Total Sulphur in Soil (ppm) and Total Zinc in soil (ppm). Micronutrients in Soil- Total Iron in Soil (ppm), Manganese in soil (ppm), and Total Cupper in Soil (ppm).

Water

Water sampling and analysis of Physico-chemical and Biological Properties of water, of different Ghats, Site and Distance (km) respectively. Physical Properties- Turbidity (NTU). Chemical Properties- pH , EC (μSm^{-1}), Temperature (°C), Total Dissolved Solids (mg^{-1}), Total Alkalinity (mg^{-1}), Chloride (mg^{-1}), Hardness (mg^{-1}), Calcium (mg^{-1}), Magnesium (mg^{-1}), Dissolved Oxygen (mg^{-1}), Chemical Oxygen Demand (mg^{-1}), Biochemical Oxygen Demand (mg^{-1}).

Map of SHIATS-DU, Allahabad

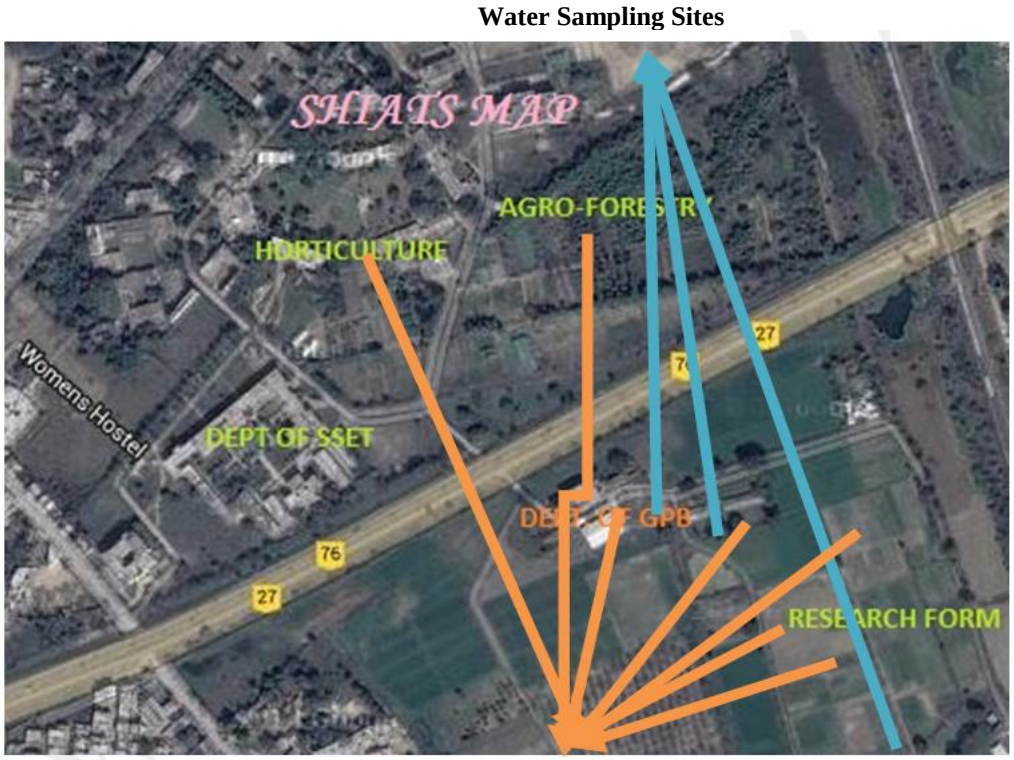


Fig 1: Map of Sam Higginbottom Institute of Agriculture, Technology & Sciences (Formerly- Allahabad Agricultural Institute) Deemed-to-be University Allahabad- 211007 (U.P), India.

RESULT AND DISCUSSION

Properties of Soil

The soil colour (dry method) of soil varied from light yellowish brown, olive yellow, pale olive, pale yellow, light olive brown, yellowish brown, dark brown, pale brown and dark yellowish brown. The soil color (Wet method) of soil varied from olive brown, olive, olive yellow, dark brown and dark yellowish brown. The sand, silt and clay percentage varied from sand – 50-65 %, silt – 20-33 % and clay – 15-20 %. The textural class identified was sandy loam soil. The Pore Space (%) ranged from 50.00 to 69.00 percent and in each department soil pore space % decreases with the increasing soil depth. The highest pore space % was found in Horticulture department at 0-15 cm depth. Bulk Density was varied from 1.11 to 1.34 g cm^{-1}. The Particle Density varied from 2.48 to 2.87 g cm^{-1}. The soil Moisture (%) ranged from 10.37 to 24.69 percent. The moisture percent was found high in Plant Protection department at 15-30 cm depth. Specific Gravity ranged from 1.96 to 2.75.The Water Holding Capacity (%) ranged from 52.91 to 81.25 percent. Department of Plant Protection holds the water best at 81.25 %. The pH value ranged from 7.27 to 7.74 pH. The alkalinity of Agro-

forestry department is high at 7.74 pH. The Electrical Conductivity ranged from 0.02 to 0.07 dSm^{-1}. The soil is found to be non-saline. The value of Total Organic Carbon (%) varied from 0.17 to 0.89 %. Organic carbon content was found low in Plant protection and Agro-forestry but medium in the remaining department. The value of Total Organic Matter (%) varied from 0.30 to 1.53 %. Available Nitrogen content of soil ranged from 154.04 to 276.04 kg ha^{-1}. Nitrogen content is low in the entire department except in Agro-forestry it was found medium. Available Phosphorous content of soil ranged from 10.05 to 19.64 kg ha^{-1}. Phosphorous content was found low in the entire department. Available Potassium content of soil ranged from 98.00 to 254.39 kg ha^{-1}. The value of Total Sulphur in soil varied from 14.76 to 20.17 ppm. The value of Total Zinc in soil varied from 0.76 to 1.36 ppm. The value of Total Iron in Soil varied from 6.30 to 12.50 ppm, the value of Total Manganese in Soil varied from 6.30 to 17.18 ppm, the value of Total Cupper in Soil varied from 0.76 to 1.20 ppm.

Table: 1.Soil Physico-Chemical Properties of different depths of Soil Science research farm Allahabad School of Agriculture, SHIATS-DU Allahabad.

Soil Properties	0-15 cm (soil depth)	15-30 cm (soil depth)	30-45 cm (soil depth)	Result
Soil Colour (Dry)	2.5 Y, 6/4 Light Yellowish Brown	2.5 Y, 6/6 olive Yellow	5 Y ,6/3 Pale olive	
Soil Colour (Wet)	2.5 Y, 4/4 olive Brown	2.5 Y, 4/4 olive Yellow	5 Y ,5/6 Olive	
Soil Texture	Sand- 55%, silt- 30 % , clay- 15 % Sandy Loam	Sand- 58%, silt- 26 % , clay- 16 % Sandy Loam	Sand- 50%, silt- 33 % , clay- 17 % Sandy Loam	
Soil pore Space (%)	56.00	52.00	51.50	S
Bulk Density (gcm^{-3})	1.25	1.25	1.17	S
Pd(gcm^{-3})	2.75	2.70	2.55	S
Moisture (%)	22.54	19.58	19.66	S
Specific Gravity	2.25	2.75	2.34	S
Water Holding Capacity (%)	62.50	68.75	52.91	S
Soil pH (1:2 W/V)	7.42	7.52	7.51	S
Soil CE (dS m^{-1})	0.06	0.05	0..05	S
Organic Carbon (%)	0.48	0.35	0.36	S
Organic Matter (%)	0.83	0.60	0.42	S
Available Nitrogen (kg ha^{-1})	226.74	226.67	196.37	S
Available Phosphorus (kg ha^{-1})	17.82	17.34	16.93	S
Available Potassium (kg ha^{-1})	210	180	160	S
Total Sulphur (ppm)	17.86	16.40	15.32	S
Total Zinc (ppm)	0.90	0.84	0.70	S
Total Iron (ppm)	8.60	10.64	10.30	S
Manganese (ppm)	6.30	8.40	6.30	S
Total Cupper (ppm)	1.10	0.90	0.76	S

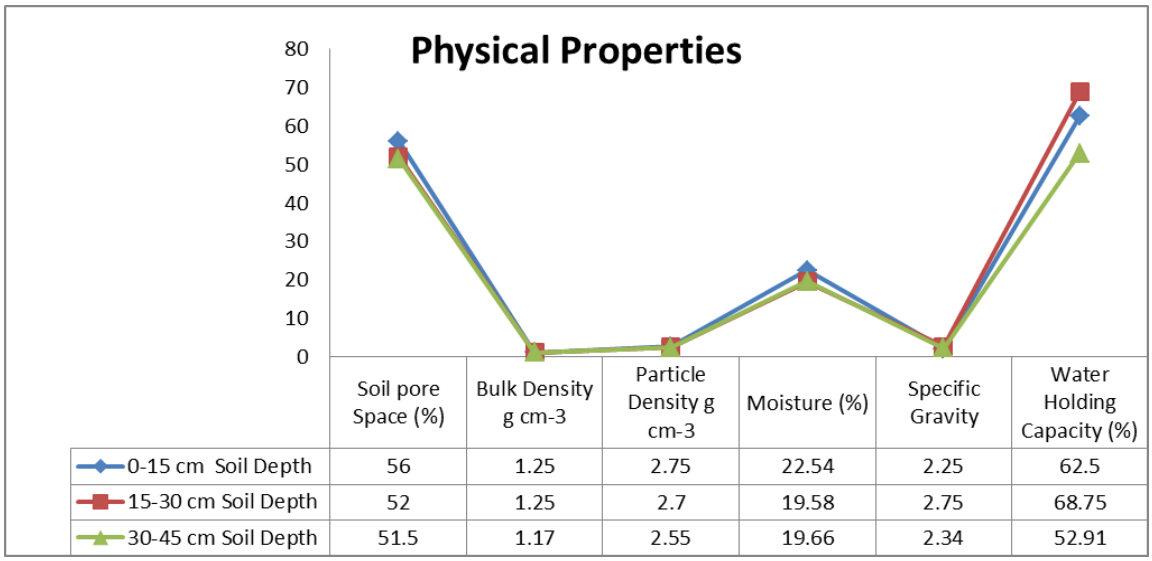


Fig 2: Soil Physical Properties of different department of Allahabad School of Agriculture of SHIATS-DU, Allahabad, of different depth (0-15, 15-30 and 30-45 cm) respectively, 2014.

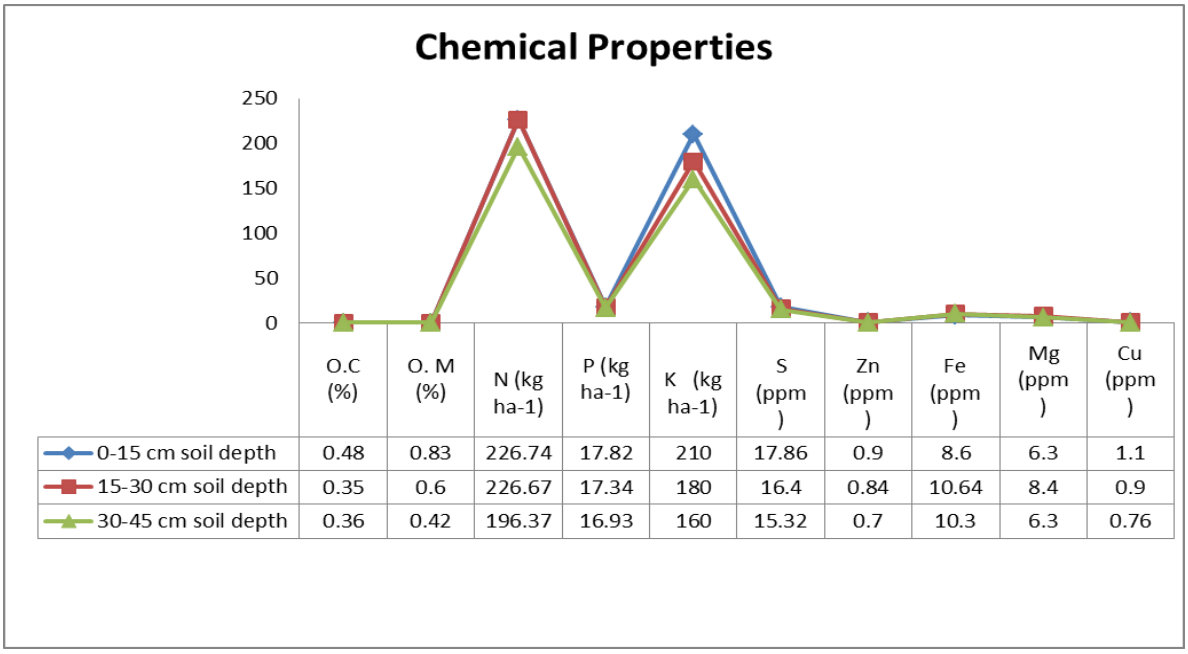


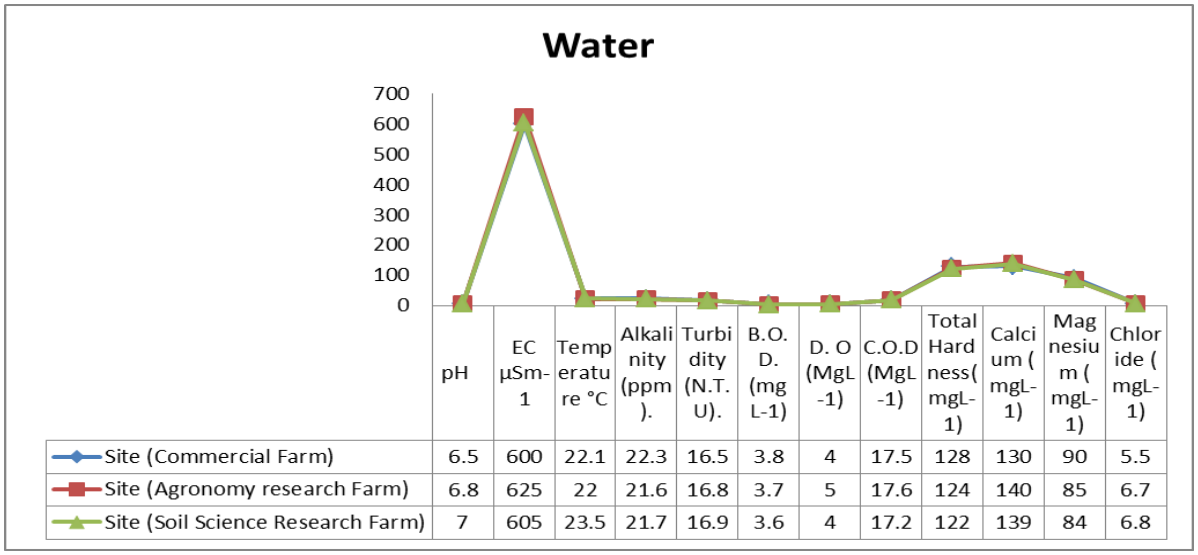
Fig. 3: Soil Chemical Properties of different department of Allahabad School of Agriculture of SHIATS-DU, Allahabad, of different depth (0-15, 15-30 and 30-45 cm) respectively, 2014.

Properties of Water

Total Hardness of water varied from 156 to 440.16 mg equi. $CaCO_3L^{-1}$ which is considered as hard to very hard. The Turbidity ranges from 1.9 to 12.2 NTU. Temperature of water ranged from 22 to 24.5 ^{0}C where temperature is high in Horticulture Department of SHIATS, Allahabad water. The Electrical Conductivity ranged from 573 to 766 μSm^{-1} .The pH value ranged from 6.50 to 8.34 pH, Total Dissolved Solids ranged from 339 to 456 mgL^{-1},Dissolved Oxygen ranged from 4.00 to 6.7 mg/L^{-1}, Biochemical Oxygen Demand value ranged from 3.0 to 4.5 mgL^{-1}, Chemical Oxygen Demand value ranged from 11.0 to 22.5 mgL^{-1}. The value of Total Alkalinity varied from 21.7 to 27.2 mgL^{-1}, Chloride content ranged from 5.4 to 7.2 mgL^{-1}, Magnesium content ranged from 72 to 154 mgL^{-1} The Calcium content ranged from 104 to 170 $mgL^{-1.}$ The Most Probable Number count was ranged from 1350.07 to 1850.40.

Table 2: Quality of Irrigation Water of different Research Farm of Allahabad School of Agriculture, SHIATS-DU, Allahabad.

Parameter	Site (Commercial Farm)	Site (Agronomy research Farm)	Site (Soil Science Research Farm)	Result
pH	6.50	6.80	7.00	S
EC μSm^{-1}	600	625	605	S
Temperature °C	22.1	22.0	23.5	NS
Alkalinity (ppm).	22.3	21.6	21.7	S
Turbidity (N.T.U).	16.5	16.8	16.9	S
B.O.D. (mg L^{-1})	3.8	3.7	3.6	S
D. O (MgL^{-1})	4.0	5.0	4.0	S
C.O.D (MgL^{-1})	17.5	17.6	17.2	S
Total Hardness(mgL^{-1})	128	124	122	S
Calcium (mgL^{-1})	130	140	139	S
Magnesium (mgL^{-1})	90	85	84	S
Chloride (mgL^{-1})	5.5 5.5	6.7	6.8	S



	pH	EC µSm-1	Temperature °C	Alkalinity (ppm).	Turbidity (N.T.U).	B.O.D. (mg L-1)	D. O (MgL-1)	C.O.D (MgL-1)	Total Hardness(mgL-1)	Calcium (mgL-1)	Magnesium (mgL-1)	Chloride (mgL-1)
Site (Commercial Farm)	6.5	600	22.1	22.3	16.5	3.8	4	17.5	128	130	90	5.5
Site (Agronomy research Farm)	6.8	625	22	21.6	16.8	3.7	5	17.6	124	140	85	6.7
Site (Soil Science Research Farm)	7	605	23.5	21.7	16.9	3.6	4	17.2	122	139	84	6.8

Fig: 3. Water From different Sites (Ganga, Yamuna, Sangam and SHIATS) of Allahabad, Allahabad School of Agriculture.

CONCLUSION

It is concluded that different sites/location have and different nutrient status of soil and water quality. Soils are medium in organic carbon (0.35%) and potassium (160 kg ha^{-1}), low in available nitrogen (196.37 kg ha^{-1}) and phosphorous (16.93 $kgha^{-1}$). Waters are high amount of Biochemical Oxygen Demand (3.8 mg^{-1}) and Chemical Oxygen Demand (17.6 mg^{-1}), medium in Dissolve Oxygen (5.0 mg^{-1}) and Magnesium (90 mg^{-1}).

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