Analysis and Interpretation of Somatogenic Variations of Soil

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ABSTRACT
Physico-chemical properties are very important**.** Physico-chemical properties are also called somatogenic properties. Physico-chemical properties plays pivotal role for progressive farmers in production of desired results. Soil is related with its properties. Specific surface, density, size analysis, heating of wet soil, viscosity, thixotropy, plasticity, soil strength, shear strength, soil puddling, colour, soil organic matter, soil colloids, soil pH, soil acidity, soil alkanities, soil enzymes, soil bacteria, soil fungi, soil texture, soil consistency, void ratio, degree of saturation, air filled porosity, total porosity, particle size distribution, soil structure management, soil compaction, soil crusting, swelling, soil tilth and tillage, soil water, total soil water potential, gravitational potential, pressure potential, matric potential, pneumatic potential, osmotic potential, water capacity, hydraulic conductivity, hydraulic fluidity, evaporation, solute transport, soil air, soil aeration, thermal properties of soil, soil rheology, micronutrients and macronutrients. The author has focused the effect of some parameters and depicted through graphs although the somatogenic deta have been tabulated properly.

Keywords: Somatogenic, physico-chemical, porosity, pH, soil texture, moisture content

INTRODUCTION

In agriculture soil has its own importance. Agriculture sector is the key sector of Indian economy. Soil has several properties i.e. physico-chemical, electrical and geographical. The somatogenic variation helps in desired production. Soil plays a pivotal role in agriculture. Recently it has been seen that majorityof sectors affected from Covid-19, but remarkably agriculture sector has not affected. Soil hasphysical,chemical,geographicalaswellaselectricalproperties.Inthestudyofsoilcharacteristics physico-chemical properties havevery significant role.So in this paper ourmain focus is to estimate the physico-chemical properties. Physico-chemical properties act as abridge regarding crop production. Physical properties comprise colour, bulk density, particledensity, porosity, water holding capacity, moisture content, texture, wilting point, field capacity,transition point, temperature, colour etc. Especially chemical properties of soil comprise pH, electrical conductivity, organic carbon and nutrients. Physical and chemical properties vary due to different region.In this paper it has been focused on study and analysis of somatogenic variation in material under testing. Somatogenic variation exhibits as a bridge in between crop production and progressive farmers. Several properties of soil have been already discussed in different chapters, but some properties are benchmark for studies such as electrical conductivity, textual analysis, porosity, moisture content, temperature, bulk density, soil colour, soil consistency, soil plasticity etc. Without somatogenic study it cannot be imagine to achieve desired results. A researcher is focused throughout the research, to achieve desired output.Nitrogen, phosphorus, potassium, calcium, magnesium etc. are the main macronutrients in the soil. Macronutrients are present is substantial amount compared to micronutrients which are present in trace amounts. Micronutrients include copper, zinc, iron, cobalt, boron, manganese, molybdenum. Both macronutrients and micronutrients are present in soil but quantities of these nutrients depend on the soil type. For healthy soil and healthy plant growth micronutrient and macronutrients are required in appropriate quantities. Electrical conductivity is the measurement of the capacity of soil to conduct electrical current through it. Electrical conductivity measurement is quick, reliable, simple and inexpensive way to predict soil fertility and health. Electrical conductivity shows the availability of soil nutrients. More is the clay and organic particles i e. the negatively charged ions/anions more will be the electrical conductivity and more the positively charged

ions/cat-ions will be held in the soil. Too high value of electrical conductivity indicates large amount of positively charged minerals like Sodium and Magnesium, which is dangerous to soil health. Too low value of electrical conductivity indicates low amount of nutrients/minerals. Electrical conductivity of soil is influenced by various soil properties and mostly it is influenced by salinity, texture and moisture. With the rise in salinity, salts in soil increases so electrical conductivity increases soil with electrical conductivity greater than 1600 mS/m is saline soil, electrical conductivity between 0 to 200 mS/m is non-saline soils. Water is good conductor of electricity and water is also a good soluble of minerals hence with rice in moisture conductivity electrical conductivity increases soil texture influences electrical conductivity set has electrical conductivity of 1 to 10 mS/m, silt has electrical conductivity between 8 to 800 mS/m, clay has electrical conductivity between 20 to 800 mS/m. So the electrical conductivity value can be used to estimate the texture of the soil. The physico-chemical properties have been analysed as well as

Theoretical Consideration

Wilting Point

Wilting point is defined as the minimum amount of soil moisture that plant need so that they do not wilt. Below the wilting point a plant wilt and will not be able to recover back. At wilting point soil is not able to supply the amount of water required by the plant. Soil may contain a large amount of water but is not able to give it to plant as this water is held tightly by clay and other constituent's particles of soils.

Wilting point= 0.06774 - 0.000674x(percentage of sand) + 0.0478 x (percentage of clay)

Wilting point is further divided into two categories permanent wilting point and temporary wilting point. Permanent wilting point is defined as lower limit of water content in the soil that plants need to not wilt. Permanent wilting point happens when the rate of transpiration is above the rate of water supply. This critical limit of moisture content is known as transition point. Temporary wilting point occurs during hot season when rate of water supply to plant is below the rate of transpiration. In permanent wilting point plant wilts but in temporary wilting point on plant regains it life on increasing water supply to soil. Then lower limit of water supply for permanent wilting point is known as transition point (W_t).

Wt=0.070+ 0.0047 x Field Capacity

or

Wt= 0.49 x Wilting point + 0.165

Moisture Content

Moisture content or water content or soil moisture content refers to the amount of water contained in the soil. This water is present in between the pore spaces of soil aggregates. These vacant spaces are occupied either by air or water. Soil is said to be completely dry if pore spaces is filled with only air and no water. Soil is said to be saturated if the pore spaces is filled with water soil texture and soil structure affects the moisture content i.e. the influence organic content, clay mineral, particle size, void rate and most importantly on ground water condition. Hence the moisture content of soil is an indicator of degree of saturation of soil and his expressed in the percentage of water present in soil mass to its weight.

$$\text{Moisture content} = \frac{\text{water present in soil}}{\text{weight of soil}} X\ 100\%$$

This is generally obtained for the soil at a depth of one meter below the Earth's surface. It is important to know soil moisture content because water helps in chemical and biological activities of soil, soil formation i.e. weathering and depends on water it help in temperature regulation of soil, it helps plants as carrier of food nutrients for photosynthesis thus overall influencing plant form production and productivity as described by **Gavrilescu Maria (2021)**. Soil moisture content is function of time and place as moisture content can be different at same place for different time and seasons. It can be different for different places.

Soil Temperature

Soil temperature is one of the very important physical property. It is measure of internal energy or heat of the soil. Farmer waits for temperature to go above certain threshold value to plant crops so that seeds will germinate. Soil temperature affects the chemical and biological activities of soil. It also influence the electrical properties of soil. Various factor influences soil temperature, soil colour, soil water content, organic matter, latitude, topography and most important is the amount of solar radiation received.

Table 1: Effect of Electrical conductivity on soil health

Sl. no.	Value of E.C.	Effect
1	<1(dS/cm)	It is normal soil
2	1-2(dS/cm)	Critical for germination
3	2-3(dS/cm)	Critical for soil sensitive crops growth
4	>3(dS/cm)	It is severely injurious to crops

Table 2: List of essential plant nutrients and their primary form

Essential plant elements		**Symbol**	**Primaryform**
Non mineral elements:			
	Carbon	C	$CO_2(g)$
	Hydrogen	H	$H_2O(I),H^+$
	Oxygen	O	$H_2O(I),O_2(g)$
Mineral elements			
Primary macronutrients	Nitrogen	N	NH^{4+}, NO^{3-}
	Phosphorus	P	HPO_4^{2-},H_2PO^{4-}
	Potassium	K	K^+
Secondary Macronutrients	Calcium	Ca	Ca^{2+}
	Magnesium	Mg	Mg^{2+}
	Sulfur	S	SO_4^{2-}
Micronutrients	Iron	Fe	Fe^{3+},Fe^{2+}
	Magnesium	Mn	Mn^{2+}
	Zinc	Zn	Zn^{2+}
	Copper	Cu	Cu^{2+}
	Boron	B	$B(OH)_3$
	Molybdenum	Mo	MoO_4^{2-}
	Chlorine	Cl	Cl^-
	Nickel	Ni	Ni^{2+}

Observation Table and Graphs of Soil Sample

Observed value of chemical properties and nutrients for all soil samples are as follows:

Table 3: Observed values of chemical properties for CVRU Campus, Kota, Bilaspur (sample1)

Sl.No.	Parameter	Observed value	Unit	Observation	Normalvalue
1	pH	5.9		Slightly acidic	7,Neutral
2	EC	0.05	dS/m		0-2dS/m
3	OC	0.53	%	Medium	0.50-0.75%
4	N	201	Kg./ha	Low	280-560 Kg./ha
5	P	15.59	Kg./ha	Medium	12.5-25Kg./ha
6	K	260	Kg./ha	Medium	135-335Kg./ha
7	S	21.28	ppm	High	>10 ppm
8	Zn	0.46	ppm	Deficient	>0.60 ppm
9	B	0.32	ppm	Deficient	>0.50 ppm
10	Fe	28.38	ppm	Sufficient	>4.5 ppm
11	Mn	22.86	ppm	Sufficient	>3.5 ppm
12	Cu	2.14	ppm	Sufficient	>0.20 ppm

Table 4: Observed values of chemical properties for Niyanar, Bastar (sample 2)

Sl.No.	Parameter	Observed value	Unit	Observation	Normal value
1	pH	6.4		Slightly acidic	7,Neutral
2	EC	0.08	dS/m		0-2dS/m
3	OC	0.58	%	Medium	0.50-0.75%
4	N	251	Kg./ha	Low	280-560 Kg./ha
5	P	7.02	Kg./ha	Low	12.5-25Kg./ha
6	K	289	Kg./ha	Medium	135-335Kg./ha
7	S	22.68	ppm	High	>10 ppm
8	Zn	0.44	ppm	Deficient	>0.60 ppm
9	B	0.42	ppm	Deficient	>0.50 ppm
10	Fe	44.20	ppm	Sufficient	>4.5 ppm
11	Mn	41.26	ppm	Sufficient	>3.5 ppm
12	Cu	2.58	ppm	Sufficient	>0.20 ppm

Table 5: Observed values of chemical properties for Patan, Durg (sample3)

Sl.No.	Parameter	Observed value	Unit	Observation	Normal value
1	pH	7.8		Slightly alkaline	7,Neutral
2	EC	0.17	dS/m		0-2dS/m
3	OC	0.56	%	Medium	0.50-0.75%
4	N	213	Kg./ha	Low	280-560 Kg./ha
5	P	9.63	Kg./ha	Low	12.5-25Kg./ha
6	K	455	Kg./ha	High	135-335Kg./ha
7	S	33.60	Ppm	High	>10 ppm
8	Zn	0.58	Ppm	Deficient	>0.60 ppm
9	B	0.51	Ppm	Sufficient	>0.50 ppm
10	Fe	18.44	Ppm	Sufficient	>4.5 ppm
11	Mn	14.84	Ppm	Sufficient	>3.5 ppm
12	Cu	176	Ppm	Sufficient	>0.20 ppm

Table 6: Observed values of chemical properties for Sejbahar, Raipur (sample 4)

Sl.No.	Parameter	Observed value	Unit	Observation	Normal value
1	pH	7.8		Slightly alkaline	7,Neutral
2	EC	0.31	dS/m		0-2dS/m
3	OC	0.49	%	Low	0.50-0.75%
4	N	201	Kg./ha	Low	280-560 Kg./ha
5	P	10.75	Kg./ha	Medium	12.5-25Kg./ha
6	K	431	Kg./ha	High	135-335Kg./ha
7	S	28.56	ppm	High	>10 ppm
8	Zn	0.54	ppm	Deficient	>0.60 ppm
9	B	0.56	ppm	Sufficient	>0.50 ppm
10	Fe	12.78	ppm	Sufficient	>4.5 ppm
11	Mn	9.36	ppm	Sufficient	>3.5 ppm
12	Cu	1.70	ppm	Sufficient	>0.20 ppm

Table 7: Observed values of chemical properties for Bhagwanpur, Ambikapur (sample 5)

Sl.No.	Parameter	Observed value	Unit	Observation	Normal value
1	pH	4.8		Moderate acidic	7,Neutral
2	EC	0.11	dS/m		0-2dS/m
3	OC	0.41	%	Low	0.50-0.75%
4	N	188	Kg./ha	Low	280-560 Kg./ha
5	P	5.60	Kg./ha	Low	12.5-25Kg./ha
6	K	349	Kg./ha	High	135-335Kg./ha
7	S	14.56	ppm	High	>10 ppm
8	Zn	1.36	ppm	Sufficient	>0.60 ppm
9	B	0.21	ppm	Deficient	>0.50 ppm
10	Fe	6.74	ppm	Sufficient	>4.5 ppm
11	Mn	6.82	ppm	Sufficient	>3.5 ppm
12	Cu	3.56	ppm	Sufficient	>0.20 ppm

Estimation of physical properties areas follows: Texture of soil:

Table 8: Represent the textural value of soil samples

Sl.No.	Sample	S and(%)	Silt (%)	Clay (%)	Classification
1.	CVRU Campus (Sample I)	36	38	26	Silty clay loam
2.	Niyanar, Bastar (Sample II)	30	40	30	Silty clay loam
3.	Patan, Durg (Sample III)	22	36	42	Silty clay
4.	Sejbahar, Raipur (Sample IV)	24	32	44	Silty clay
5.	Bhagwanpur (Sample V)	50	28	22	Silty loam

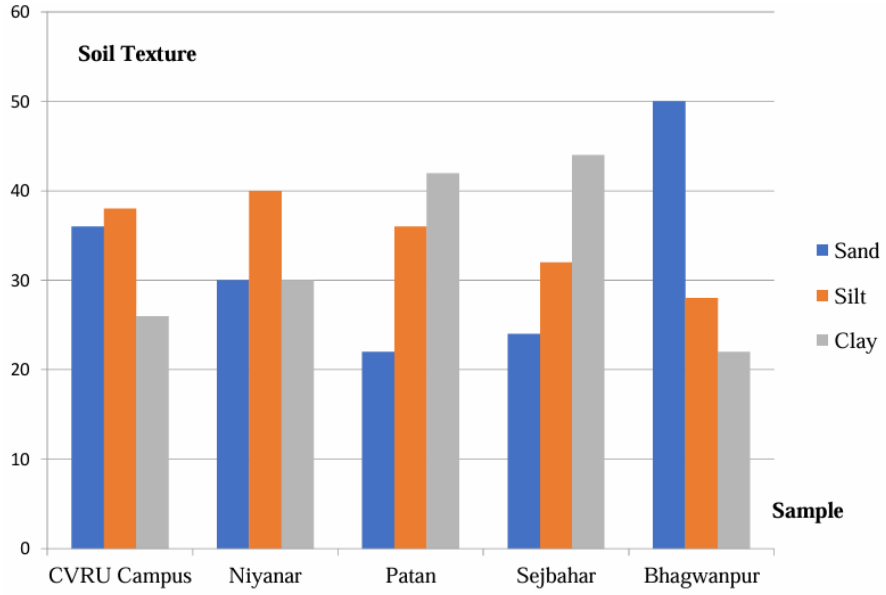

Fig 1: Graphical representation of soil texture.

Table 9: Represent the field capacity, wilting point and transition point

Sl.No.	Sample no.	Field capacity	Wilting point	Transition point
1.	CVRU Campus (SampleI)	23.26	0.1688	0.2478
2.	Niyanar, Bastar (SampleII)	25.40	0.19194	0.2590
3.	Patan, Durg (SampleIII)	29.72	0.25442	0.2896
4.	Sejbahar, Raipur (SampleIV)	29.74	0.2627	0.2937
5.	Bhagwanpur (SampleV)	19.44	0.1409	0.2340

Geographical Location: Latitude, altitude , longitude and average rainfall are four main important parameters of a geographical location. These parameters play an important role in soil qualityand hence in soil fertility.

Table 10: Geographical location of soil samples sites

Sl.No.	Collection place	Latitude	Longitude	Distance from research centre
S1	CVRU Campus (Sample I)	22283228^0	82.00847	1.3 Km
S2	Niyanar, Bastar (Sample II)	19.047278^0	82.031695^0	441Km
S3	Patan, Durg (Sample III)	21.194077^0	81.566633^0	155Km
S4	Sejbahar, Raipur (Sample IV)	21.162522^0	81.681533^0	154Km
S5	Bhagwanpur (Sample V)	23.148114^0	83.158823^0	217Km

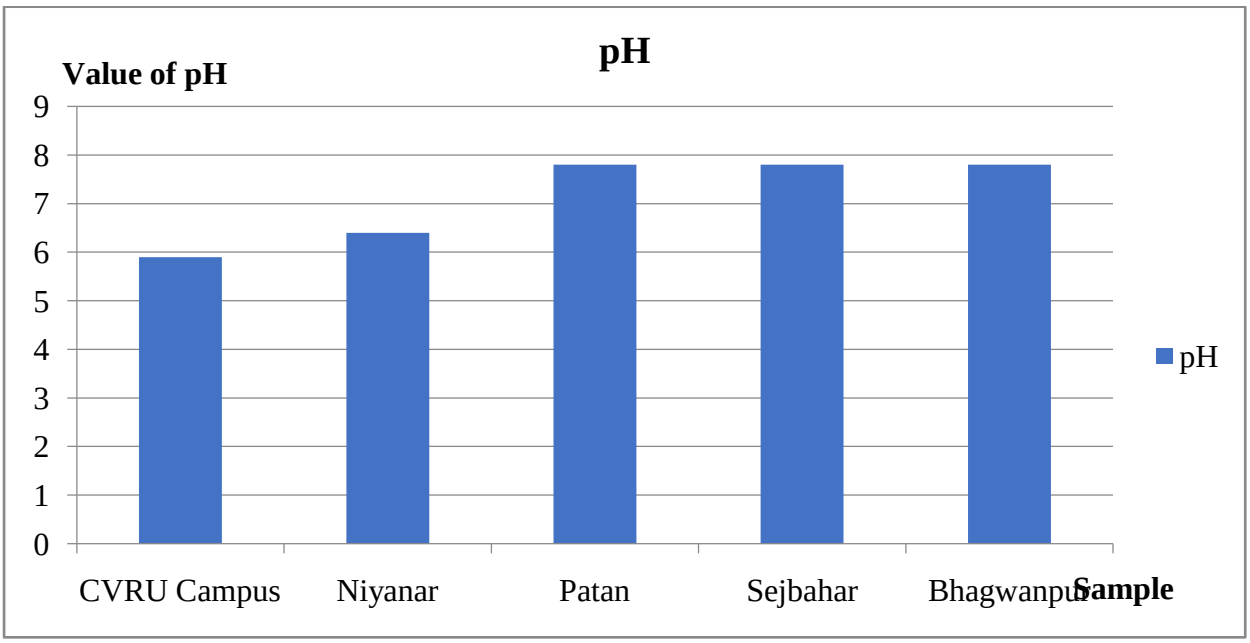

Fig 2: Graphical representation of pH.

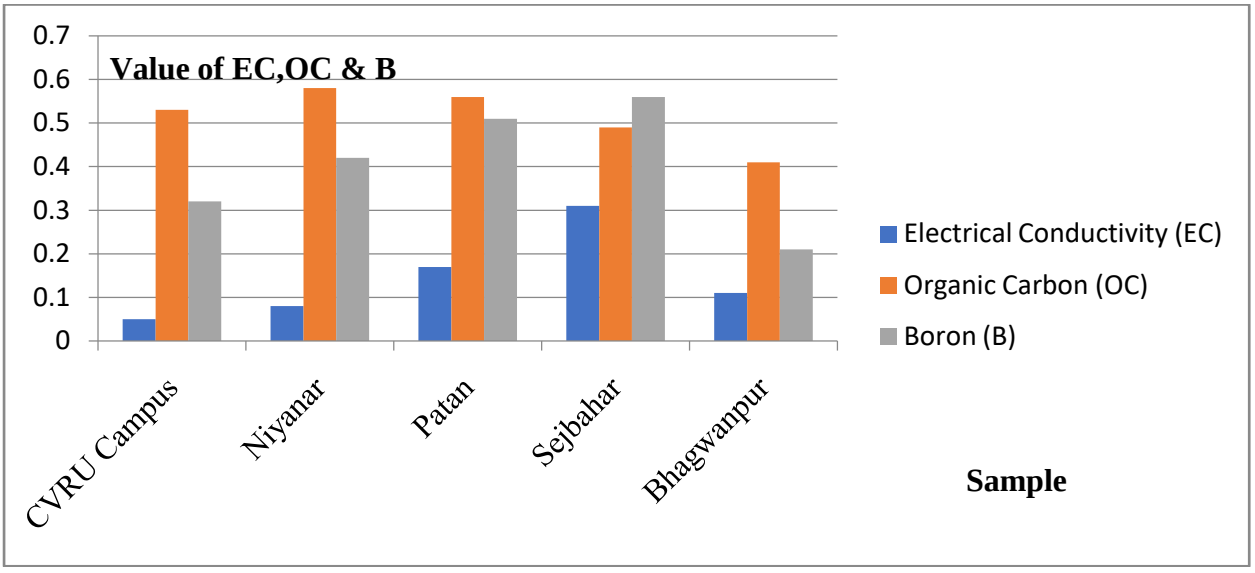

Fig 3: Graphical representation of Electrical Conductivity, Organic Carbon and Boron

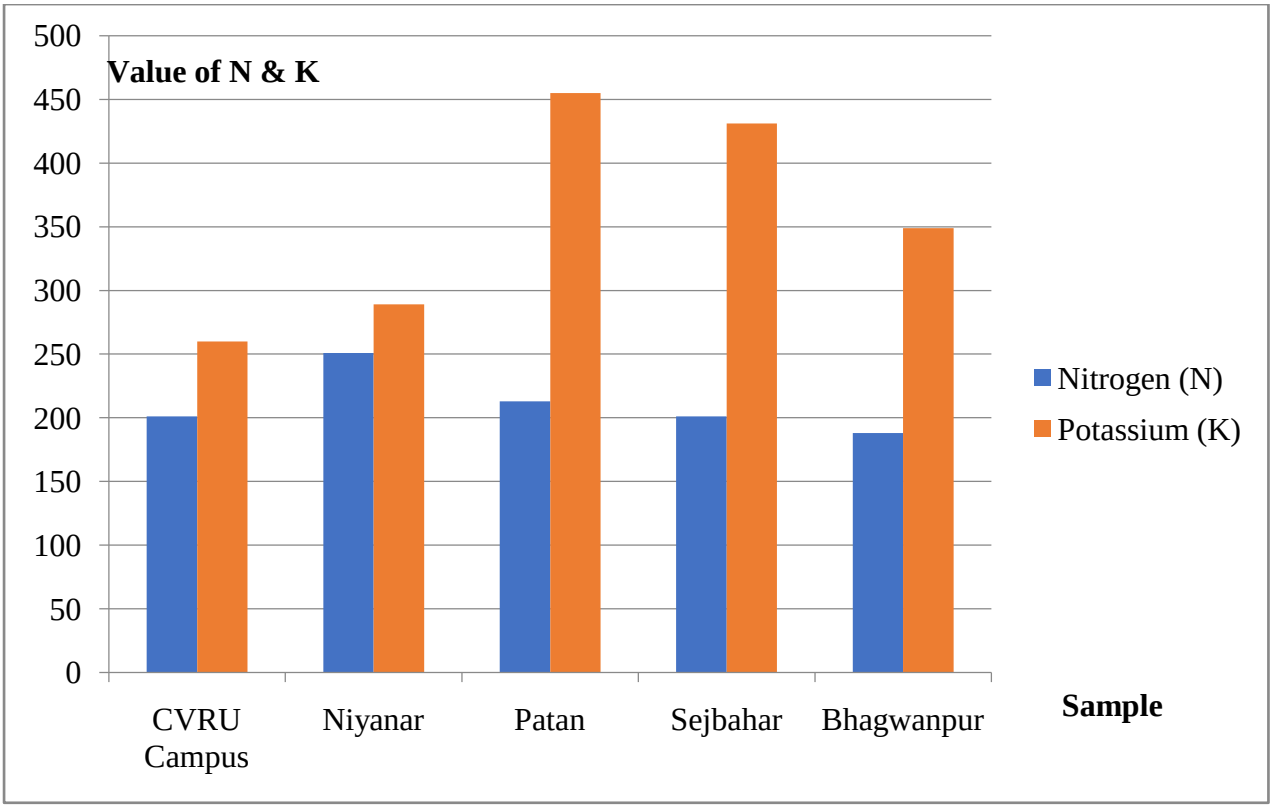

Fig 4: Graphical representation of Nitrogen and Potassium

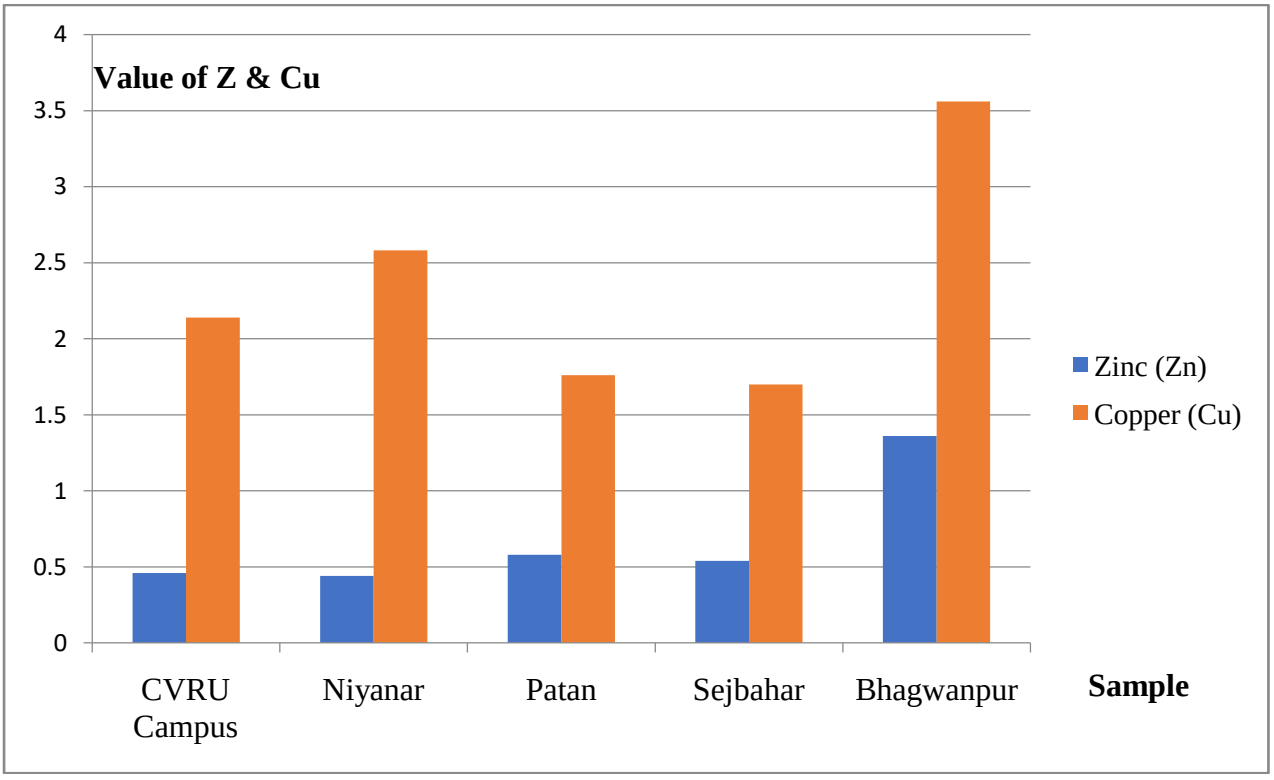

Fig 5: Graphical representation of Zinc and Copper

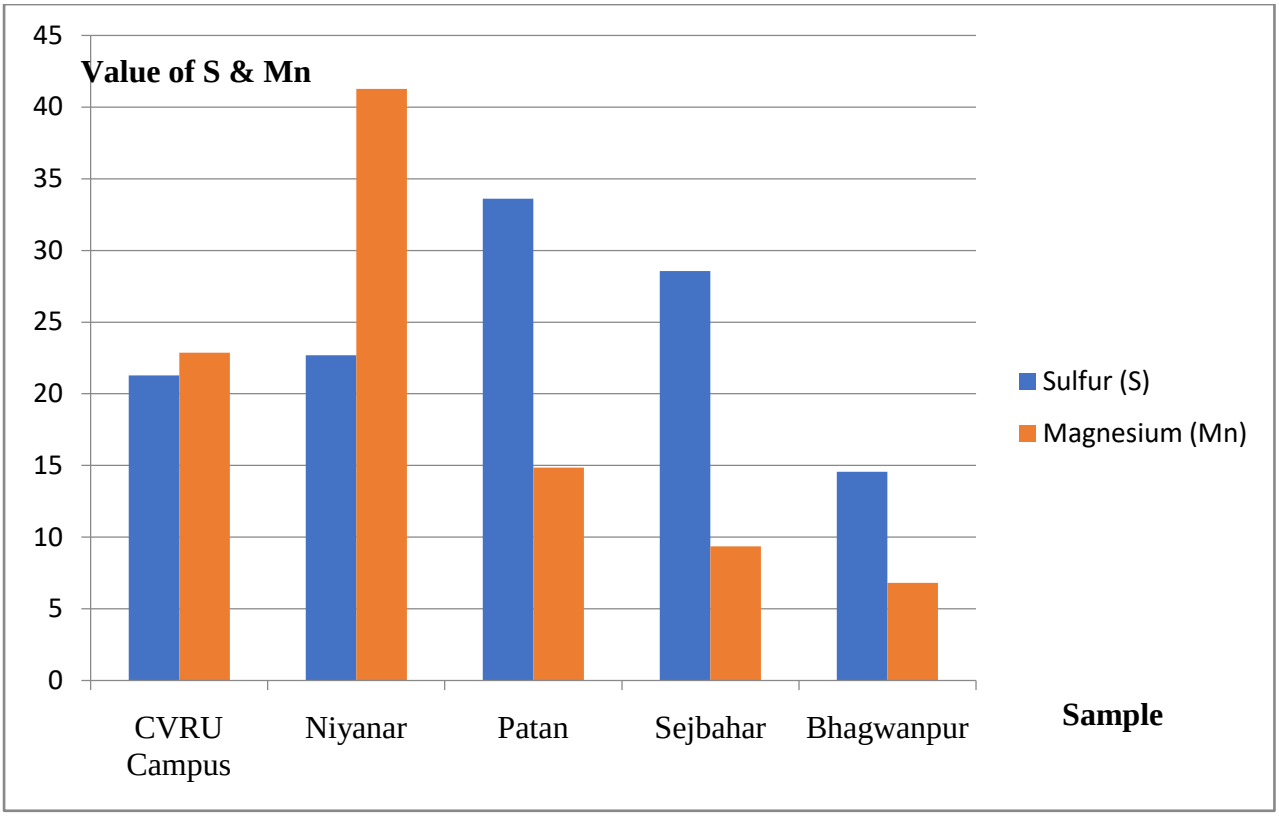

Fig 6: Graphical representation of Sulfur and Magnesium

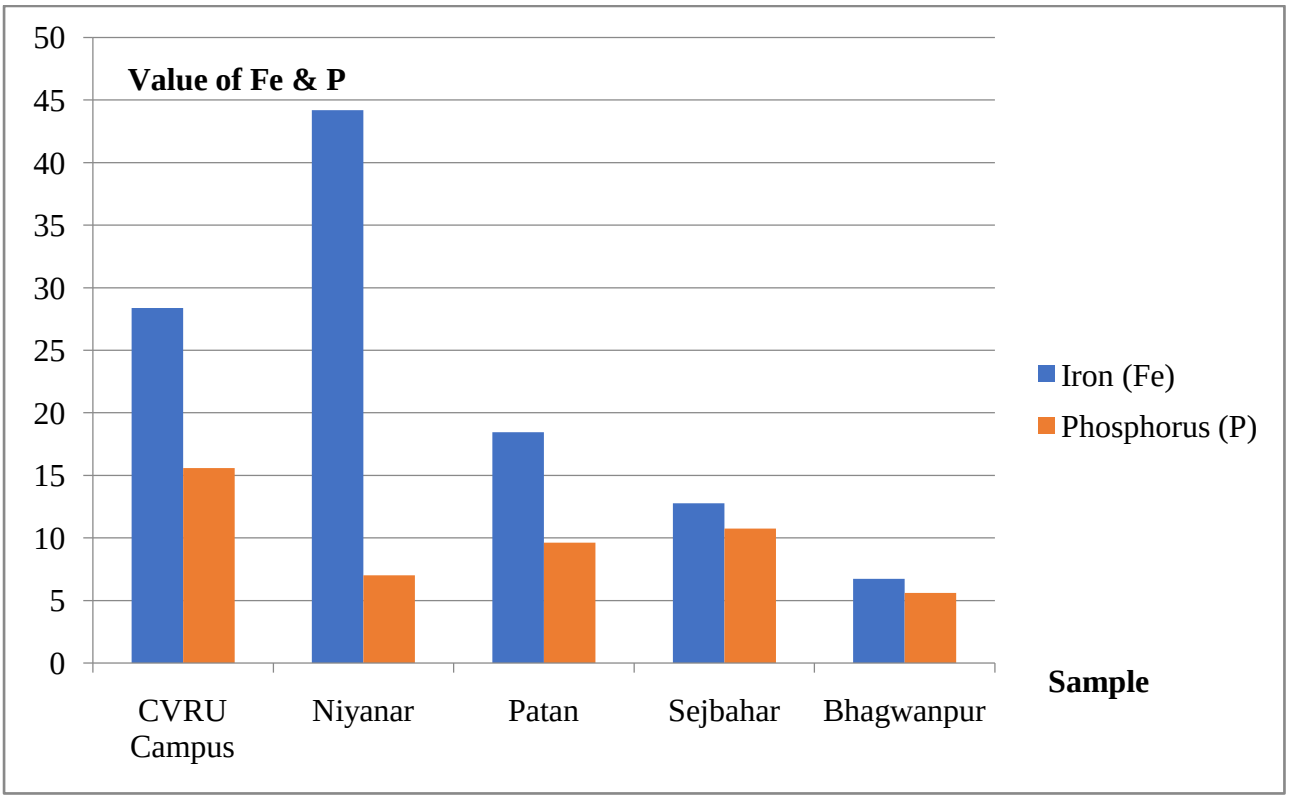

Fig 7: Graphical representation of Iron and Phosphorus

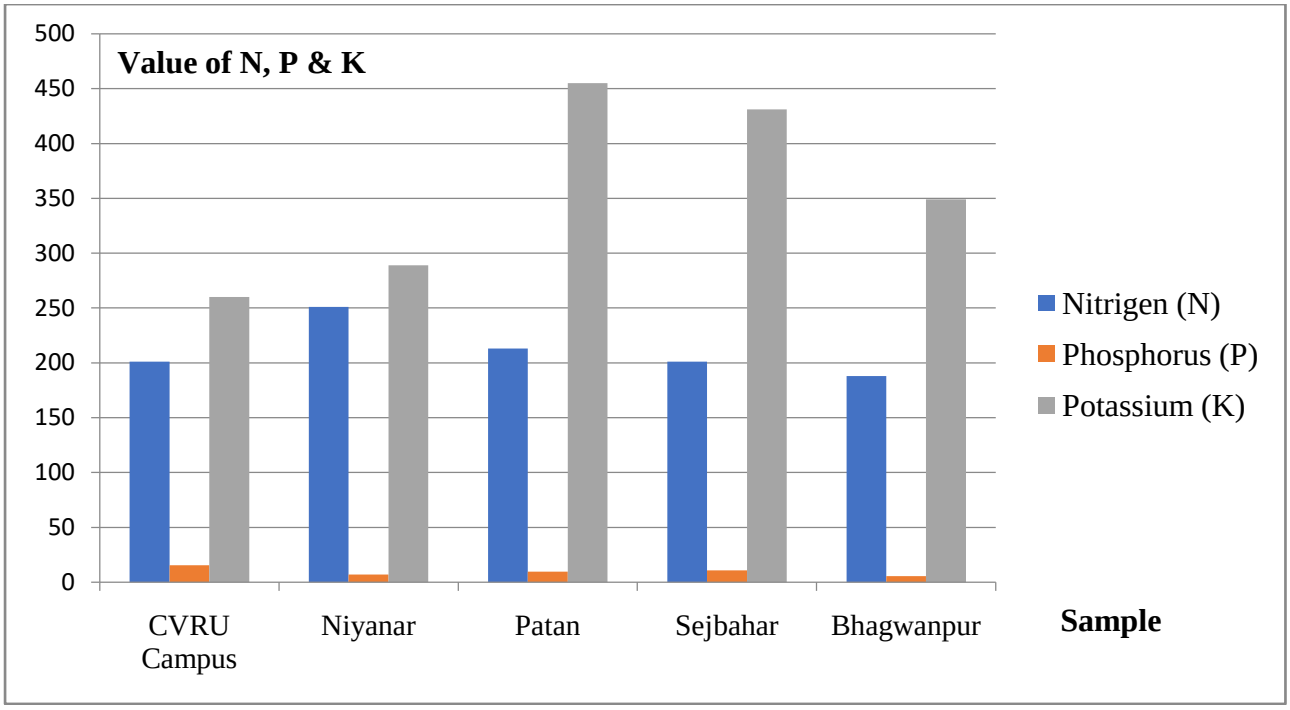

Fig 8: Graphical representation of Nitrogen, Phosphorus and Potassium

The observed values physical properties have been tabulated. Physical properties include texture of soil, field capacity, wilting point and transition point. Total of five samples were taken and all the above mentioned parameters were obtained. It is noted that regarding pH that the numerical value is in between 0 to 14. The indicator of pH value is given below as,
Strongly acidic <4.5
Moderate acidic 4.5 - 5.5
Slightly acidic 5.5-6.5
Neutral acidic 6.5 - 7.5
Slightly alkaline 7.5 - 8.5
Moderate alkaline 8.5 -9.5
Strongly alkaline 9.5
The pH value of Niyanar, Patan and Sejbahar are normal although the pH value of CVRU Campus and Bhagwanpur are low. The observed value of pH is in between 4.8 to 7.8. The observed values of electrical conductivity for all samples i.e CVRU campus, Niyanar, Patan, Sejbahar and Bhagwanpur are in the range of 0.05 to 0.31 and very suitable. The detailed description of electrical conductivity are given below as,

Table 10: Observed value of Electrical Conductivity

S.No.	Location	Electrical conductivity (dS/m)
S1	CVRU Campus (SampleI)	0.05
S2	Niyanar, Bastar (SampleII)	0.08
S3	Patan, Durg (SampleIII)	0.17
S4	Sejbahar, Raipur (SampleIV)	0.31
S5	Bhagwanpur (SampleV)	0.11

Firstly the standard value of organic carbon is given as,
Low < 0.5
Medium 0.5 to 0.75
High > 0.75

RESULTS AND DISCUSSION

It has been seen that the value of organic carbon is very suitable for CVRU campus, Niyanar, Patan and Sejbahar but the value organic carbon is very low for Bhagwanpur. Further it has been seen that the value of Phosphorus, Boron and zinc are suitable for CVRU campus, Patan, Bhagwanpur respectively. The value

of sulphur, Iron, Manganese and copper are high whereas the value of nitrogen is low for all samples. It has been observed that the value of Potassium is very high. During textural analysis it has been observed that CVRU Campus and Niyanar are silty clay loam, Patan and Sejbahar is silty clay and Bhagwanpur is silty loam. With the help of agricultural Scientists, it has been received amicable solution which is beneficial for farmers.The analysis of soil properties such as pH, electrical conductivity, and other physical-chemical and geographical characteristics holds great significance. Maintaining a soil pH ranging from 5.5 to 7 is generally recommended for optimal crop growth. Silt loam and loam soils are beneficial as they provide good drainage, promoting healthy plant development. By understanding the relationship between soil properties, nutrients, and the dielectric constant, we can easily interpret and evaluate the soil's characteristics. These physico-chemical parameters are invaluable to researchers in the fields of agriculture, microwave remote sensing, and electrical conductivity. They contribute to the creation of soil health cards, which aid in predicting soil fertility. This information is crucial for progressive farmers, enabling them to implement integrated nutrient management practices to ensure an optimal balance of essential nutrients for plants. Currently, a majority of our land resources are degraded, emphasizing the need to preserve soil health for food security and increased agricultural production.

CONCLUSION

Analysis of pH, electrical conductivity of soil and other physical-chemical and geographical properties are very important. Soil pH of 5.5 to 7 is generally recommended forcrops. Silt loam and loam soil supports healthy growth as they drain quite well. By knowing the correlation of various soil properties and nutrients with dielectric constant,it is easy to understand and analyze the soil nature. All these physico-chemical parameter are very useful for researchers working in the field of agriculture and microwave remote sensing. These parameters are useful to prepare soil health card which may be used to predict soil fertility. These information help to progressive farmer for use integrated nutrient management practice to maintain optimum concentration of all the essential nutrients for plants.

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