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Analysis and Interpretation of the Dielectric Properties of Vegetable - based Soil of Bilaspur in Bilaspur, Chhattisgarh: An Experimental Study

Pandey Priyanka[1], Shrivastava A. K.[2]

[1]Dr. C. V. Raman University, Kota, Bilaspur, Chhattisgarh, India
Email: *priyankamishrabsp26[at]gmail.com*

[2]Dr. C. V. Raman University, Kota, Bilaspur, Chhattisgarh, India
Corresponding Author Email: *drakshrivastava01[at]gmail.com*

Abstract: ***Soils are complex mixture of minerals, air, organic matter, and countless organisms. The properties of soil such as physical properties, chemical properties, geographical properties are really important in production of vegetables. Moisture content is a crucial parameter for the production of vegetable. For geometric upgradation requires estimating and understanding various parameters, such as soil texture, particle density, bulk density, porosity, moisture content etc. Permittivity or dielectric constant is a function of electrical parameter of surface constituents. The properties of dielectric material influence its quality to absorb energy of microwave. Dielectric property critically affects the scattering the microwave energy. Remote sensing technique is widely used in agronomy and agriculture. Soil fertility and fertilizer are very importance for productive of vegetables. There are so many factors which affect the production, such as nutrients, soil plants relationship, acidity and alkalinity, nitrogen, phosphorus, potassium, sulphur, calcium, magnesium, iron, zinc, copper, manganese, boron, chlorine, molybdenum, nickel, etc. Soil characterization of a region is an important aspect in relation to sustainable vegetable productions. The Moisture content in the soil has effect on the Dielectric constant of the soil. The Dielectric constant depends upon the percentage of moisture content in the soil. Humid climates sufficient for growing of vegetables crops. Optimum vegetables can produce in well - drained sandy loam soil.***

Keywords: Moisture content, Permittivity, Dielectric constant, Vegetable - based soil

1. Dielectric Properties of Soil

Dielectric properties are important characteristics of material; it depend on the activity of permanent dipole, ionic conduction and degree of dipole alignment when the time varying electric field is applied. Dielectric constant shows the ability of the material to store electrical energy. The soil characterization of region play important role in sustainable farming. There is lots of parameters that affect the farming production. It has been observed that sand, silt, clay, electrical conductivity, bulk density, porosity, pH, macronutrients, moisture content, affected the dielectric constant of soil. Although it has been seen experimentally in my research work.

2. Analysis of effect of moisture content on dielectric properties of soil

The table below represent the real and imaginary part of dielectric constant at different moisture level (0%, 10%, 20%, 30%, 40%). Moisture content of soil is an important parameter that influences the properties of soil.

Table 1: Dielectric constant and dielectric loss at moisture level (0%, 10%, 20%, 30%, 40%)

S. NO.	Sample	Real part of dielectric constant Ɛ′					Imaginary part of dielectric constant Ɛ''				
		Dry soil (0%)	10%	20%	30%	40%	Dry soil (0%)	10%	20%	30%	40%
01.	S_1/Mangla, Bilaspur	3.13	6.92	11.19	16.89	26.29	0.23	0.28	0.40	1.19	1.47

Table 2: Different chemical properties of samples of Bilaspur

S. NO.	Parameter	Sample1.1	Sample1.2	Sample1.3	Sample1.4	unit	Normal value
01.	pH	2.0	6.8	7.4	7.1		Range 5.5 - 8.5
02.	EC	0.40	0.30	0.40	0.30	dS/m	Range <1
03.	OC	0.15	0.75	0.75	0.15	%	Range 0.50 - 0.75
04.	N	125	150	200	125	Kg/ha	Range 280 - 560
05.	P	10.75	6.27	8.06	9.86	Kg/ha	Range 10 - 25
06.	K	313	347	604	280	Kg/ha	Range 120 - 280
07.	S	10	8.75	10.00	8.75	ppm	Range >10
08.	Zn	2.77	2.69	2.98	1.01	ppm	Range>0.6
09.	B	6.00	5.00	4.00	6.00	ppm	Range>0.5
10.	Fe	18.17	41.49	38.18	37.18	ppm	Range>4.5
11.	Mn	12.25	17.81	13.38	12.27	ppm	Range>2
12.	Cu	4.41	2.06	3.12	2.14	ppm	Range>0.2

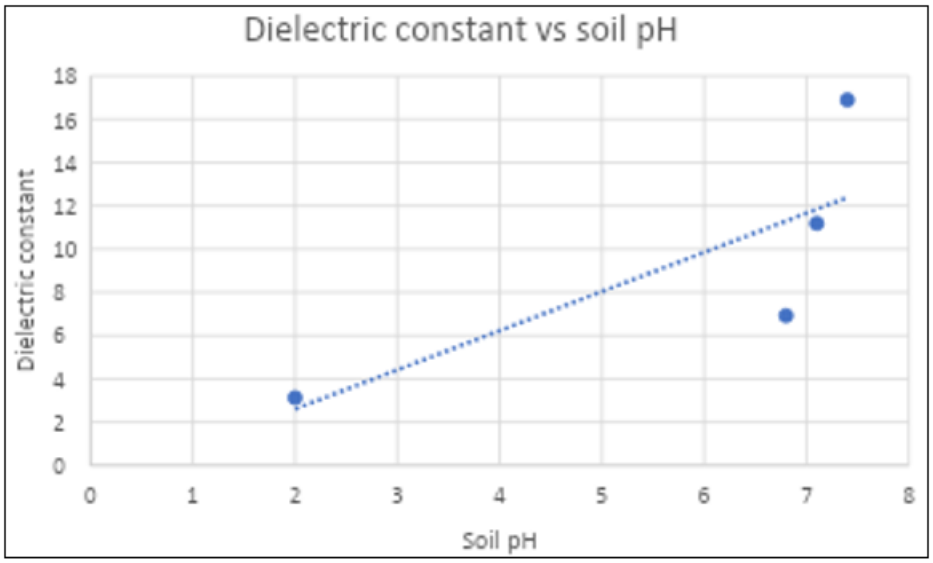

Figure 1: Variation of dielectric constant ∈ ′with pH value of soil samples of Bilaspur

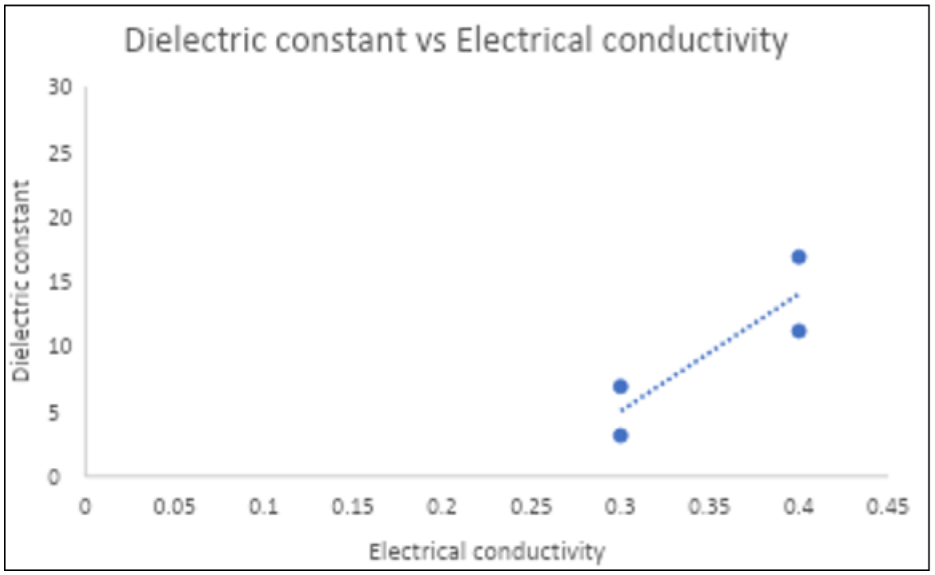

Figure 2: Variation of dielectric constant ∈ ′with electrical conductivity of soil samples of Bilaspur

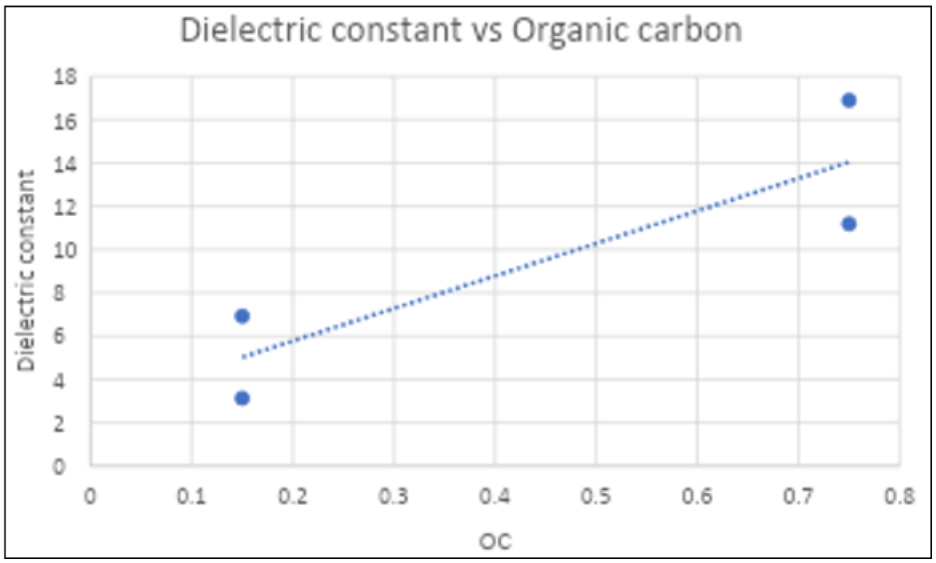

Figure 3: Variation of dielectric constant ∈ ′with OC of soil samples of Bilaspur.

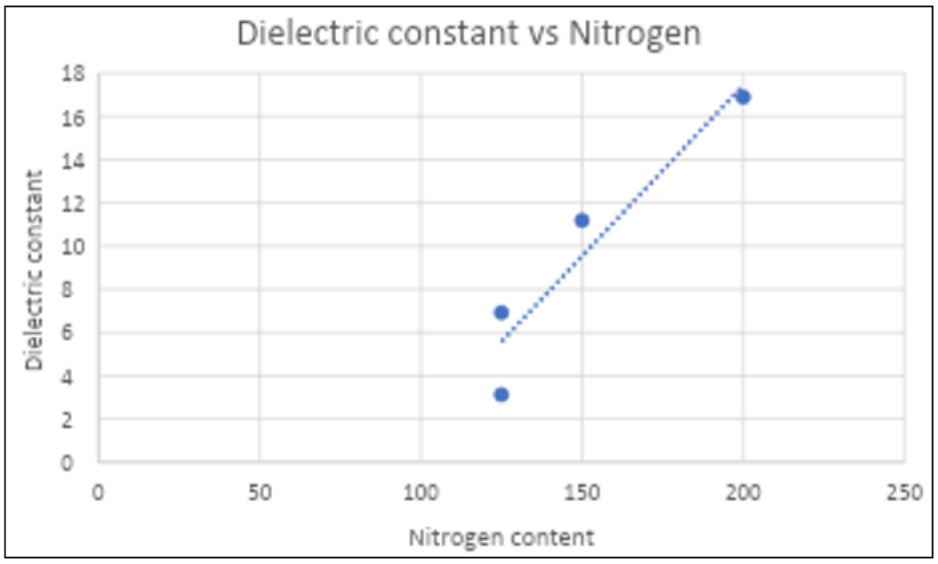

Figure 4: Variation of dielectric constant ∈ ′with Nitrogen content of soil samples of Bilaspur

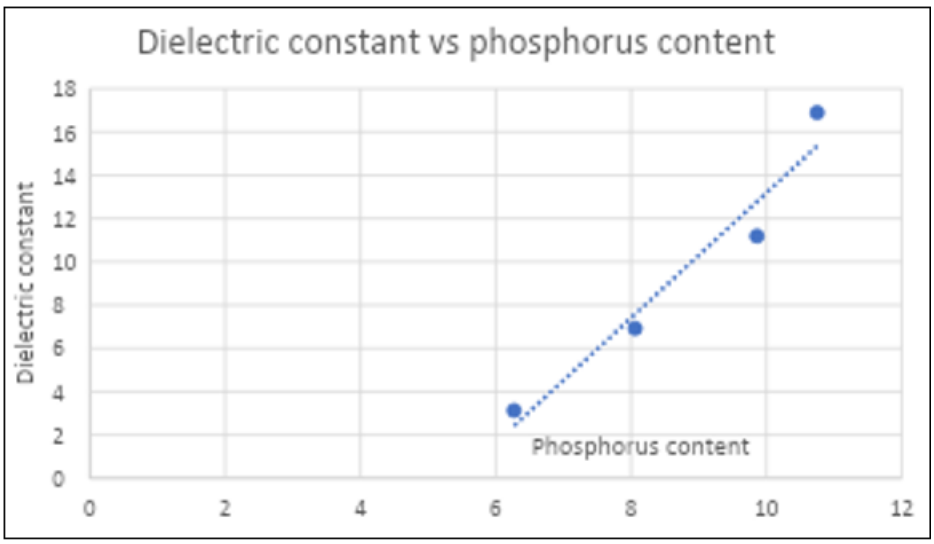

Figure 5: Variation of dielectric constant ∈ ′with phosphorus content of soil samples of Bilaspur

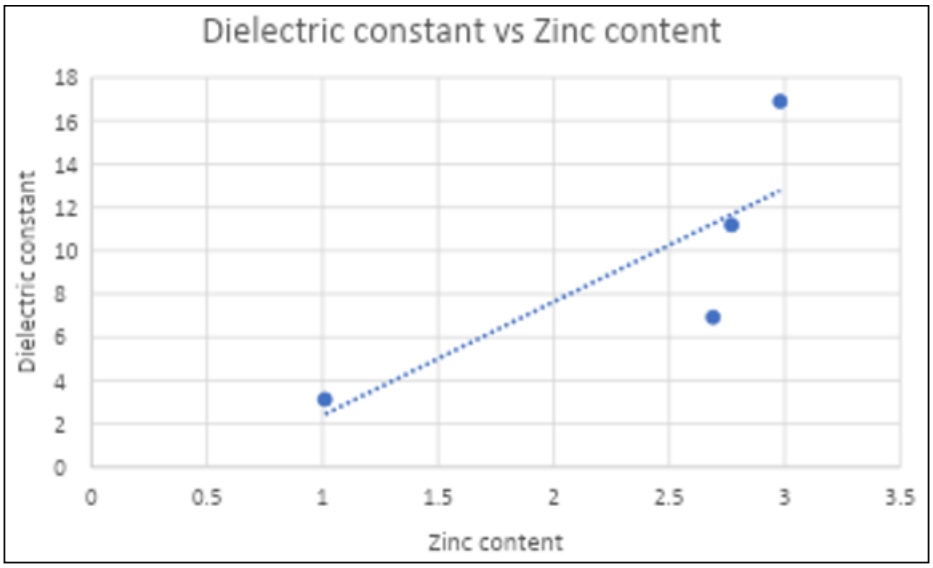

Figure 6: Variation of dielectric constant ∈ ′with Zinc content of soil samples of Bilaspur

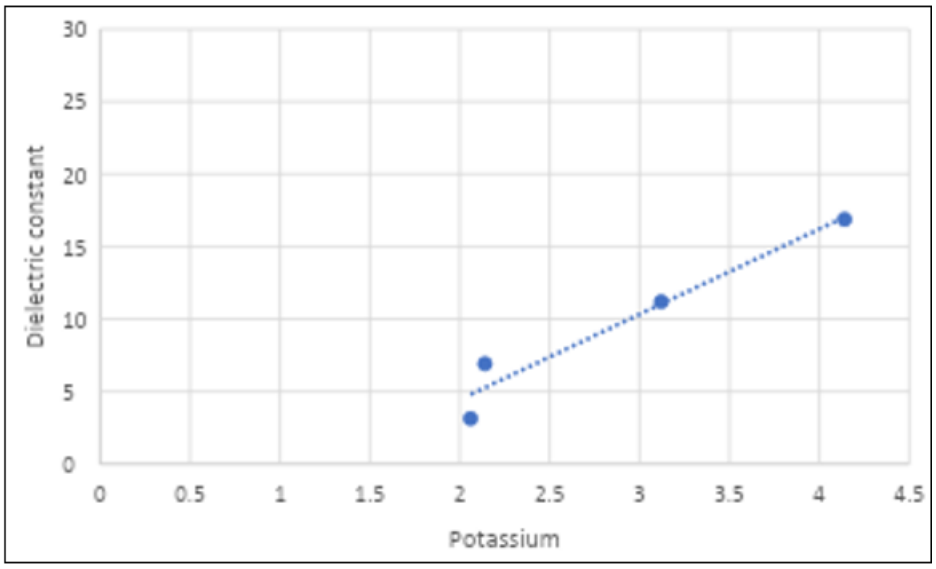

Figure 7: Variation of dielectric constant ∈ ′with potassium content of soil samples of Bilaspur

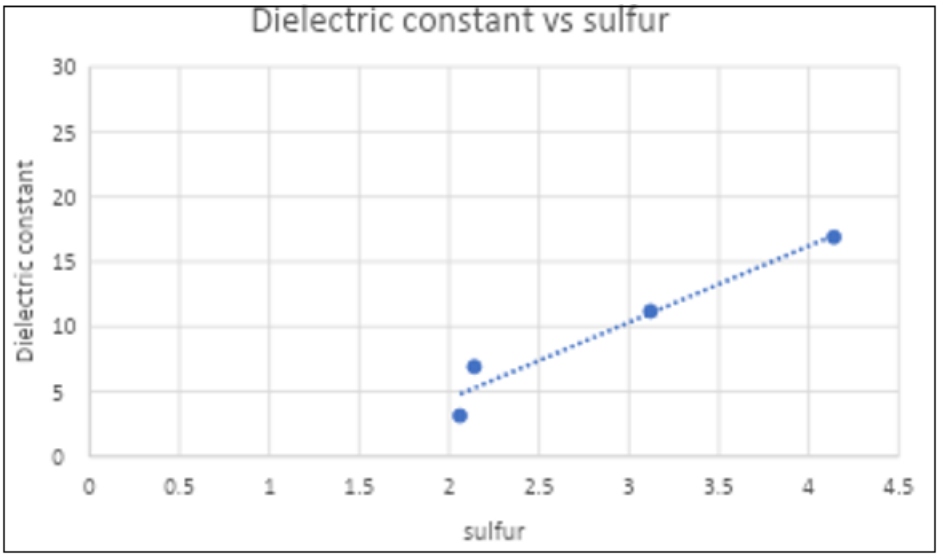

Figure 8: Variation of dielectric constant ∈ ′with sulfur content of soil samples of Bilaspur

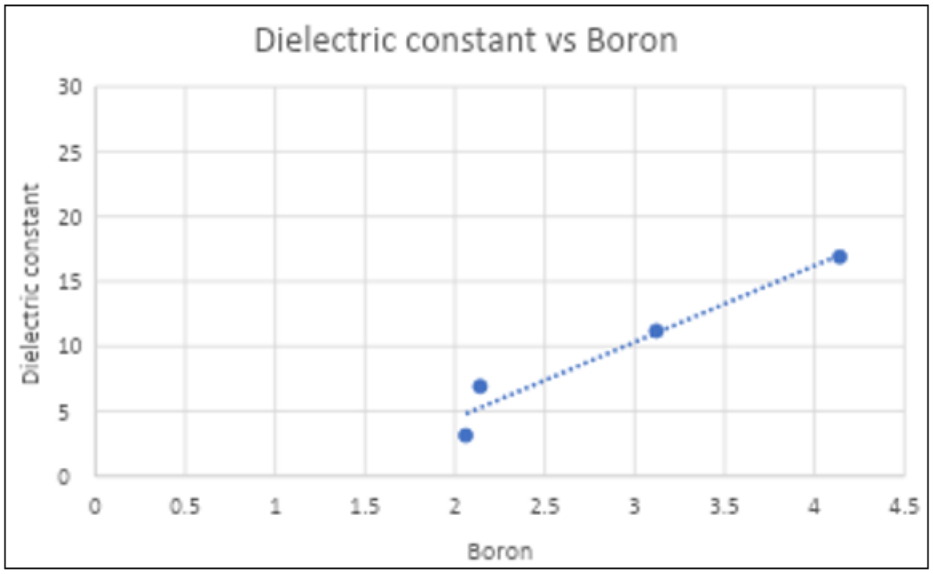

Figure 9: Variation of dielectric constant ∈ ′with Boron content of soil samples of Bilaspur

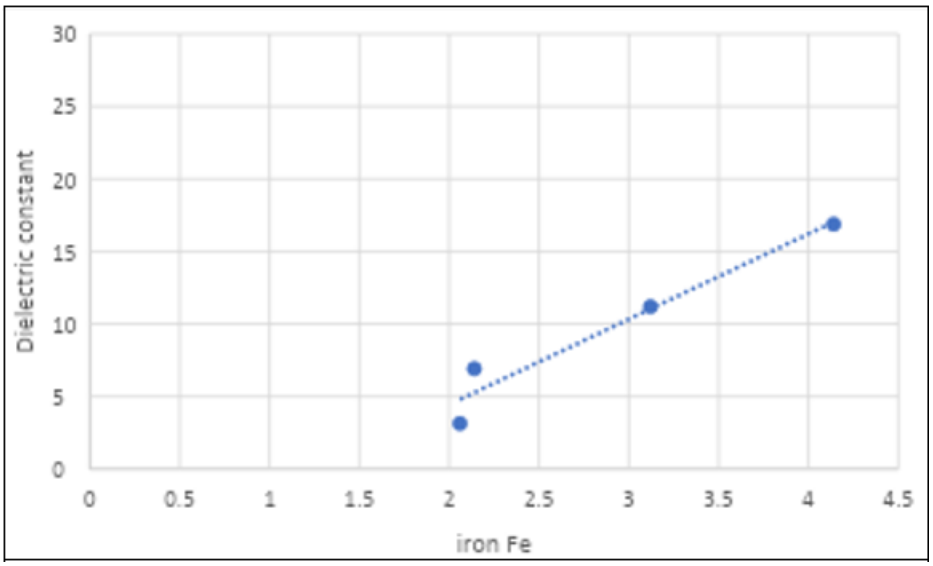

Figure 10: Variation of dielectric constant ∈ ′ with iron content of soil samples of Bilaspur

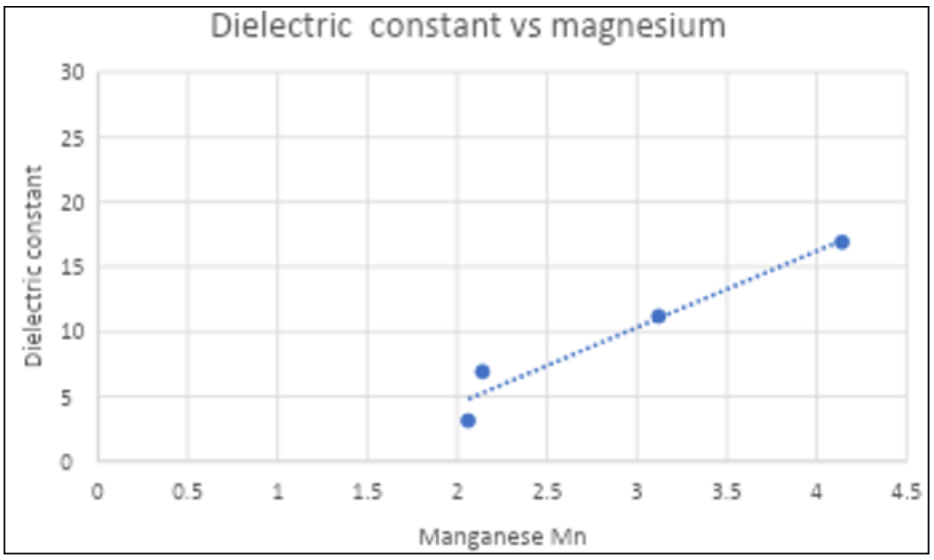

Figure 11: Variation of dielectric constant ∈ ′ with manganese content of soil samples of Bilaspur

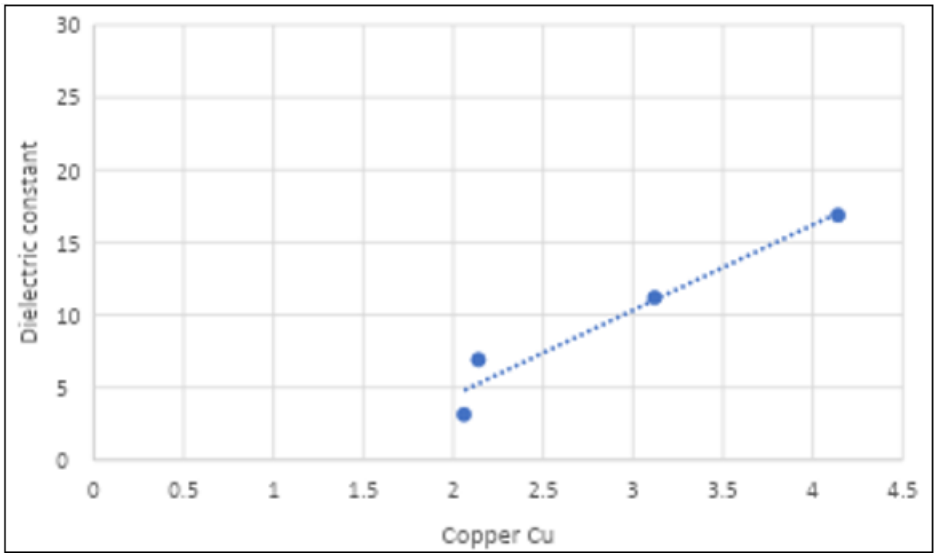

Figure 12: Variation of dielectric constant ∈ ′ with copper content of soil samples of Bilaspur.

3. Analysis and Interpretation

For each samples graphs are plotted that shows the variation of dielectric constant with different pH value, electrical conductivity, organic carbon, and different nutrients. These graphs show the correlation of dielectric constant and dielectric loss with other components. Results are as follows:

- Graph plotted between dielectric constant and pH shows that dielectric constant increases with increasing pH and another graph shows dielectric loss increases with increasing pH. Hence dielectric properties show positive correlation with pH of soil.
- Dielectric constant also linearly increases with electrical conductivity (EC).
- There is very positive change in dielectric constant with respect to Potassium (K), Sulfur (S), Zinc (Zn) component.
- There are so many parameters viz physical and chemical parameters that affect the microwave dielectric behaviour of vegetable - based soil. All concerned testing have been performed in different laboratory where required data had been obtained.

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