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Physico-chemical parameters and elemental analysis of the soils of sunflower *(Helianthus annus. L)* growing field with different manure treatment

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ABSTRACT

In this study, an attempt has been made to find any possible variation in Physico-Chemical parameters of the soils collected from various sunflower fields (sandy loam & red soil) with root rot diseases in three different manure treatments viz; control (T1), chemical fertilizer (T2) and organic manure (T3). Also the concentrations of four important trace elements viz., Fe, Zn, Mn and Cu are estimated using Atomic Absorption Spectrometer (AAS). The results of the Physico-Chemical parameters, the concentrations of trace elements and their results are discussed.

Key words: Sunflower, Physio-Chemical Parameters, AAS, Red and Sandy Soils

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INTRODUCTION

The modern concept, the soil quality is the ability to sustain plant and animal productivity, to increase water and air quality and to contribute plant and animal health [1-2] although all Physico-Chemical properties are involved in soil functioning, bio chemical properties tend to react most rapidly to get change in the external environment [3-4].

Sunflower is one of the most important sources of high quality edible oil. It has been identified to be a potential oilseed crop [5] *Macrophomina phaseolina* (Tassi) Goid, is an important root pathogen and causes dry root rot, stalk rot or charcoal rot of over 500 plant species including sunflower [6-7]. Various diseases management methods have been implemented to combact and eradicate pathogenic fungi; these include cultural, regulatory, and biological methods [8]. Nitrogen, phosphorous and potassium ratio is an important indicator in crop production that identifies balanced or unbalanced fertilization. Application of NPK fertilizer above or below the optimum level adversely affects the growth and yield. Hence, balanced fertilizer applications are important for high crop yield and consequently more oil yield [9]. Organic manures can be used to promote the healthy population of beneficial organisms in the soil [10], hence the present study has been taken up to determine and to compare various Physico-Chemical parameters and some major trace elements with respect to the three different manure treatments soil from sunflower field.

MATERIALS AND METHODS

The soil samples are collected from different (sandy loam & red soil) sunflower fields with three different manure treatments viz; (control (T1), chemical fertilizer (T2) and organic manure (T3)). Representative composite soil samples are taken from the study area up to 15 cm depth as per standard procedure of IARI (Indian agricultural research institute) New Delhi [11]. The locations of sampling sites are randomized to avoid biasing in results. The collected sample after coning, quartering and sieving are used for further spectral investigations. The Physico-Chemical parameters of soil, like p^H, EC, available N, Available P, available k and organic carbon are determined by standard methods [12]. The soil samples are digested with tri-acid mixture using 10:4 nitric acid and perchloric acid. The soil samples are subjected to chemical analysis for the estimating Fe, Mn, Cu and Zn through atomic absorption spectrometer [13]. This analysis has been carried out in soil testing laboratory, Perambalur, Tamilnadu, India.

RESULTS AND DISCUSSION

From the Table 1, p^H value and its ranges from 7.42 to 8.27 in both soils. The p^H soils are found to be alkaline and weakly alkaline.

Table1. p^H Value of two different soils

Varieties	Red Soil			Sandy Soil		
	T1	T2	T3	T1	T2	T3
Co-4	8.10	8.00	7.42	8.23	8.18	7.91
Co-5	8.06	8.01	7.90	8.27	8.13	8.05
HyCo2	8.18	7.95	7.91	8.06	7.98	7.87
TCSH-1	8.15	7.85	7.35	8.08	7.98	7.75
Co-3	8.10	7.98	7.30	8.20	8.10	7.85

If EC values exceeded this recommended values, the germination of almost all groups would be seriously affected resulting much reduced yield [14]. Tariq Aziz have reported, addition of organic manure in soil, get no change in the electrical conductivity [15]. From the table 2, The EC value is measured for all treatments soil and its value ranges from 0.01 dsm^{-1} to 0.05 dsm^{-1} in bots soils. All the soil samples values are within the prescribed limit.

Table 2. EC Value of two different soils

Varieties	Red Soil (dsm^{-1})			Sandy Soil (dsm^{-1})		
	T1	T2	T3	T1	T2	T3
Co-4	0.02	0.02	0.03	0.04	0.05	0.05
Co-5	0.01	0.02	0.03	0.02	0.03	0.03
HyCo2	0.01	0.01	0.01	0.02	0.03	0.04
TCSH-1	0.01	0.03	0.02	0.03	0.03	0.04
Co-3	0.02	0.02	0.03	0.02	0.03	0.04

Table 3. OC Value of two different soils

Varieties	Red Soil (%)			Sandy Soil (%)		
	T1	T2	T3	T1	T2	T3
Co-4	0.36	0.43	0.54	0.42	0.43	0.59
Co-5	0.36	0.40	0.42	0.54	0.56	0.59
HyCo2	0.45	0.51	0.51	0.26	0.43	0.51
TCSH-1	0.35	0.45	0.52	0.36	0.41	0.51
Co-3	0.47	0.51	0.56	0.41	0.45	0.49

From the above table (3) shows the value of organic carbon, its varies from 0.36 % to 0.59 % for both soils. Generally, the higher amount of organic carbon found in soil, the level of sunflower biomass, leaf and seed production will be increased. But in both soils higher values in treatment T3 when compare to other treatments.

Table 4. Potassium (K) Value of two different soils

Varieties	Red Soil (kg/ha)			Sandy Soil (kg/ha)		
	T1	T2	T3	T1	T2	T3
	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD
Co-4	27.748±0.328	38.606±0.830	75.523±0.530	23.283±0.863	42.961±0.685	50.530±0.612
Co-5	45.119±0.088	54.779±0.583	73.253±1.123	44.828±0.573	54.579±0.497	62.514±0.635
HyCo2	42.805±0.401	45.132±0.341	54.787±0.502	35.800±0.490	52.884±0.282	60.496±0.658
TCSH-1	42.796±0.524	52.515±0.559	62.216±0.831	37.259±1.840	52.596±0.423	61.630±0.631
Co-3	45.789±0.327	55.925±0.875	65.507±0.565	39.761±3.884	51.179±0.985	61.745±0.623

Potassium is an essential nutrient; it has an important role in the growth of plants, the synthesis of amino acids and proteins. T3 and T2 all treatments the K values are greater than the control (T1), and it is predicted to be more disease resistant. Table 4 indicates the potassium content in all treatments shows a variation of 27.74 kg/ha to 75.52 kg/ha (Red soil) and 23.28 kg/ha to 62.51 kg/ha (sandy loam soil). The concentration of K in T3 treatment is found to be greater than that of the T1 and T2 treatments. The increases in k concentration because of added organic matter may be attributed to k concentration of organic matter and improved root growth [15].

Table 5. Nitrogen (N) Value of two different soils

Varieties	Red Soil (kg/ha)			Sandy Soil (kg/ha)		
	T1	T2	T3	T1	T2	T3
	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD
Co-4	66.370±0652	62.184±1.025	56.475±0.493	69.703±0.467	62.766±0.219	59.563±0.581
Co-5	60.277±0.779	56.251±0.307	52.765±0.326	68.558±0.422	60.441±0.377	58.303±0.330
HyCo2	66.170±0.587	63.287±0.509	60.009±0.357	66.034±0.100	59.982±0.336	50.752±0.659
TCSH-1	60.613±0.547	56.018±0.152	52.880±0.196	68.080±0.135	61.576±0.354	58.629±0.409
Co-3	64.880±0.415	57.673±0.583	51.271±0.366	66.537±0.510	61.032±0.048	57.552±0.509

Nitrogen is the first element to be specifically recognized as necessary for plant growth [16]. The table 5 shows a variation from 56.01 kg/ha to 66.37 kg/ha and 50.75 kg/ha to 69.70 kg/ha of red and sandy sunflower growing soil respectively. Nitrogen content is lower in the treatments of T3 (manure) and T2 (chemical fertilizer) than T1 (control). The similar results have been reported by Felay Narajothy [17].

Table 6. Phosphorus (P) Value of two different soils

Varieties	Red Soil (kg/ha)			Sandy Soil (kg/ha)		
	T1	T2	T3	T1	T2	T3
	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD
Co-4	92.237±0.292	144.322±0.209	147.218±0.089	95.415±0.268	128.521±0.265	142.535±0.410
Co-5	123.732±0.453	150.991±0.033	183.321±0.218	124.271±0.366	142.535±0.443	147.743±0.191
HyCo2	111.640±0.558	155.334±0.186	168.603±0.413	107.585±0.076	118.587±0.305	186.618±0.241
TCSH-1	124.690±0.472	152.717±0.291	184.731±0.236	120.343±0.191	143.336±0.210	159.266±0.336
Co-3	114.566±0.308	156.274±0.663	170.010±0.318	123.255±0.429	151.839±0.988	181.570±0.159

Nutrient management is the key factor increasing the sunflower production. The starvation of phosphorus retards the growth of sunflower at every stage. Application of phosphorus (P) is necessary for maintaining a balance between the other plant nutrients and ensuring the normal growth of the crop. Therefore an attempt is made to review the effect arid sources of P on growth, yield, nutrient uptake and oil content of sunflower [18]. Table 6 shows the value of phosphorus in different treatment and its ranges from 92.23kg/ha to 186.61 kg/ha.

Iron is essential for chlorophyll and protein formation, photosynthesis, electron transfer oxidation and reduction of nitrates and sulphates and other enzyme activities [19]. Iron (Fe) is one of the most common nutrients plant growth and development because it exists in low-soluble form that is hardly available for plants [20]. The iron content of the soil in all treatments, table 7 shows a variation from 1.38 ppm to 3.54 ppm and 2.75ppm to 8.26 ppm of red and sandy sunflower growing soil respectively. The iron content in T1 treatment is higher while compare with T2 and T3 treatments.

Table 7. Iron (Fe) Content of two different sunflower growing soils

Varieties	Red Soil (kg/ha)			Sandy Soil (kg/ha)		
	T1	T2	T3	T1	T2	T3
	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD
Co-4	3.547±0.039	2.159±0.041	1.558±0.044	8.263±0.046	4.537±0.053	3.797±0.006
Co-5	2.801±0.048	1.493±0.026	1.426±0.052	4.281±0.068	3.867±0.024	2.755±0.035
HyCo2	1.477±0.042	1.461±0.039	1.387±0.011	4.868±0.041	4.009±0.017	3.704±0.041
TCSH-1	3.244±0.027	2.163±0.055	1.468±0.019	5.873±0.024	3.797±0.051	2.820±0.023
Co-3	2.715±0.230	1.962±0.019	1.454±0.047	5.484±0.129	4.142±0.050	3.484±0.032

Table 8. Zinc (Zn) Content of two different sunflower growing soils

Varieties	Red Soil (kg/ha)			Sandy Soil (kg/ha)		
	T1	T2	T3	T1	T2	T3
	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD
Co-4	3.996±0.016	5.754±0.040	7.585±0.015	2.370±0.022	2.875±0.039	3.627±0.031
Co-5	1.583±0.012	1.761±0.045	2.000±0.054	2.259±0.016	3.057±0.024	3.370±0.035
HyCo2	1.692±0.011	1.792±0.010	2.475±0.048	3.643±0.044	4.660±0.052	6.762±0.008
TCSH-1	1.966±0.057	2.472±0.024	4.168±0.019	3.778±0.024	4.588±0.016	6.669±0.022
Co-3	2.124±0.024	3.162±0.011	4.478±0.025	2.872±0.021	3.479±0.016	5.383±0.012

Zinc deficient plants are sensitive to pathogenic fungal root diseases [21-22]. Improvement of Zn nutritional status of plants reduces the exudation of such compounds from roots and increases resistance to fungal root diseases. The zinc concentration ranged from 1.58 ppm to 7.58 ppm (Red soil) and 2.25 ppm to 6.76 ppm (sandy loam soil). The Zn content of T3 treatment is higher compared toT1 and T2 treatments of sunflower growing soil.

Table 9. Manganese (Mn) Content of two different sunflower growing soils

Varieties	Red Soil (kg/ha)			Sandy Soil (kg/ha)		
	T1	T2	T3	T1	T2	T3
	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD
Co-4	27.869±0.042	24.862±0.054	23.644±0.044	29.566±0.057	27.390±0.066	26.434±0.062
Co-5	21.873±0.046	18.150±0.018	16.699±0.041	27.352±0.100	25.630±0.044	24.854±0.103
HyCo2	23.144±0.30	18.264±0.039	17.684±0.014	25.289±0.017	22.063±0.054	20.662±0.081
TCSH-1	25.165±0.013	19.587±0.023	17.055±0.012	29.679±0.017	27.251±0.048	25.156±0.050
Co-3	27.676±0.023	24.385±0.006	21.350±0.048	28.582±0.028	26.619±0.067	24.907±0.076

Manganese has oxidation influenced by both chemical and microbiological factors. Its activities has many enzyme reaction involved in the metabolism of organic acids P and N, it is also involved in the photosynthesis and protein synthesis and also, manganese function along with Fe in formation of chlorophyll. Table 9 shows the variation of the manganese content from 27.86 ppm to 17.05 ppm and 29.67 ppm to 20.66 ppm for red and sandy soil. In both soils treatment T3 value are lower compare than treatments T2 and T1.

Table 10. Copper (Cu) Content of two different sunflower growing soils

Varieties	Red Soil (kg/ha)			Sandy Soil (kg/ha)		
	T1	T2	T3	T1	T2	T3
	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD
Co-4	1.074±0.030	1.141±0.047	1.251±0.019	1.116±0.035	1.143±0.012	1.265±0.014
Co-5	1.035±0.019	1.164±0.055	1.485±0.013	0.989±0.008	1.181±0.019	1.755±0.044
HyCo2	1.000±0.023	1.151±0.045	1.277±0.024	0.991±0.001	1.095±0.004	1.691±0.003
TCSH-1	0.475±0.020	0.877±0.016	1.263±0.038	0.841±0.040	1.035±0.019	1.869±0.023
Co-3	0.559±0.025	0.856±0.033	1.269±0.019	0.677±0.017	0.975±0.017	1.578±0.017

Copper is an essential micronutrient for normal plant growth. The copper content of most plant is generally between 2- 20 ppm in the plants. As copper is strongly bound to soils it is very immobile. Roots are frequently higher in copper concentration than other plant tissues [23]. Table 10 shows the value of copper in all treatments ranges from 0.47 ppm to 1.48 ppm (Red soil) and 0.67 ppm to 1.86 ppm (sandy loam soil) for sunflower growing soil. The observation of copper in T3 treatment is higher when compared to T1 and T2treatements.

CONCLUSION

From the Physico-Chemical analysis, electrical conductivity, organic carbon, available P and available K are higher in treatment T3 when compare to treatments T2 and T1, expect available N. From the elemental analysis; the concentration of copper and zinc values are higher in T3 while compare to treatments T2 and T1, but the concentration of iron and manganese are lower in the treatment (T3) compare to other treatments (T2 and T1), in all the five varieties of soil fields. Hence when increases of electrical conductivity , organic carbon, available P, available K, copper and zinc with the reduction of available N , Iron and manganese may be tried to reduce the level of the root rot disease in treatment T3.

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