STUDY OF PHYSICOCHEMICAL PROPERTIES OF SOILFROM SUNFLOWERCROP FIELDSIN DAVANGERE DISTRICT, KARNATAKA

[1]Shaila M & [2]Nafeesa Begum

[1]Research Scholar, Department of Botany and Seed Technology, Sahyadri Science College, Shivamogga
E-mail: shailamresearchscholar95@gmail.com
[2]Chairman & Research Guide, Department of Botany and Seed Technology,
Sahyadri Science College, Shivamogga
E-mail: nafeesabegum30@gmail.com

Abstract

Sunflower (*Helianthus annuus* L.)Isthe fourth oil crop in grain production and the fifth in cultivated area in the world. The crop has most important agronomic characteristics, such as resistance to drought and cold, with wide adaptability to different soil and climatic conditions. In the present study the physicochemical assessment of soil samples were collected randomly from Sunflower crop fields of Davangere region was carried out. The physicochemical analysis of soil is based on the various parameters such as Soil texture, Soil moisture, p^H, Moisture content, Electrical conductivity, Micro and macro nutrients in the soil were analysed. Six soil samples were collected from the different places of all the taluks of Davangere district results shows that, the values of p^H range from 6.89 to 7.88, while the organic carbon present in the soil range from 0.012 to 0.501 mS/cm, Macronutrients N, P & K present in the range from 154.80-309.60 kg per hectare, 51.34-100.03 kg per hectare and 123.65-512.06 kg per hectare respectively and the micronutrients (Cu, Zn, Fe and Mn) are present in the soil sample range from 0.30-2.40 PPM, 0.50-1.70 PPM, 0.84-24.50 PPM & available 10.72-35.38 PPM respectively. p^H was found to vary from neutrality to slightly alkaline. The values of EC indicated that all samples of the soils are non-saline. The soil studies can be considered as good sources of essential nutrients and this information will help farmers to solve the problems related to soil nutrients and amount of which fertilizers to be used to increase the yield of Sunflower crop.

Key words: Sunflower, Soil sample, Physicochemical, Micronutrients, Macronutrients

Introduction

Soil is a thin layer on the surface of earth and it constitutes the minerals, organic matter gases, decaying plant and animal matter etc. Soil play a crucial role in delivering a variety of ecosystem it also act as a medium that can supports plant growthand it modulates water, nutrients and pollutant transport (Vaneet Kumar *et.al.,*2016). At microscopic level it performs the ecological important function is that help in sustaining a diverse and dynamic microbial activity. Soil characterization is to evaluate the fertility status of the soils of an area or region is an important aspect in context of sustainable agricultural production. The Productivity of agricultural soil depends largely on its physicochemical properties. The soil condition is important because it is a universal medium for plant growth, which supplies essential nutrients to the plants. The several elements known to be essential for plant growth, macronutrients (N, P, and K) and micronutrients (Zn, Fe, Cu, Mn) are important soil elements that control the soil fertility(Srinivasanand Poongothai2013).

Sunflower (*Helianthus annuus* L.) is a photosensitive crop and is therefore grown in Kharif, Rabi and spring seasons. Rabi season is recommended for cultivation of sunflower. Kharif season is may not be suitable for its cultivation because grain filling/harvesting will coincide with heavy rainfall. The crop requires a cool climate during germination and warm climate during flowering stages. The seedlings tolerate frost and drought. It can tolerate temperature.It requires an annual rainfall of 500 – 1000 mm.Sunflower can be grown on a wide range of soils and tolerates a moderate p^H range and some salinity. It thrives best on deep loam soils with good drainage and irrigation facilities. The optimum range of soil pH for this crop is 6.5 to 8.5. Sunflower is a major source of vegetable oil in India and the world. India is a leading producer of this oil-seed crop. The sunflower oil that is manufactured from sunflower seeds is widely used in India for cooking purposes.The productivity of sunflower in terms of seed yield, oil and protein output varies widely depending on multifarious factors such as agro climatic condition of the locality, inappropriate choice of cultivar, land preparation, timely sowing, moisture deficit situation, nutrient imbalance, degraded status of growing medium especially soil, lack of improved agronomic crop management practices, varying planting pattern, etc. Insufficient and/or imbalanced fertilization including micronutrients has been identified as one of the critical situation in oilseed productivity. Sustainable production of sunflower requires efficient use of inputs maintaining optimum yield and input use efficiency under resource constraint situations. Soils deficient in micronutrients are not capable of nourishing crop plant successfully and therefore low yield and quality of crops are obtained (Abbas, 2013).Zn is an essential plant nutrient element plays significant role in RNA and

protein synthesis in plants. Zinc deficiency reduces net photosynthesis, inter nodal length of stem, increasing chlorosis and necrotic spots in the leaves and severely reduce yield (Alloway, 2008). Boron deficiency is the second most dominant problem, which is involved in the reduction of sunflower production (Tahir et al., 2014).

The study of soil physicochemical parameters is an important for Crop growth and soil management. The Physicochemical properties such as Soil texture, Soil moisture, p^H, Moisture content, Electrical conductivity, Micro and macro nutrients in the soil were analysed. The investigation is undertaken because Davangere is comprises different agro climatic zone and it is the most agreeable and healthy climatic condition for growing the crops. In Davangere region now a day, large number of fertilizers are used instead of manures due to this the crop productivity increases speedily but the quality of the soil decreases. So it is essential to analyse the physicochemical characteristics of soil because as with the increasing use of chemical fertilizer to the soil. Therefore, the present study was under taken to know the physicochemical parameters of soilSunflower crop fieldin Davangere region and an attempt was also made to compare nutrient contents of the soils with other soil properties.

Materials and Methods

Study Area

Davangeredistrict is an agricultural and food treasury of Karnataka state located in central part of Northern Karnataka. It is the heart of Karnataka. Total area of district is 54, 98,397 sq.km. It lies in 13^0 45'00" N and 14^0 50'00"N latitude and 75^0 30'00" E and 76^0 30'00" E longitude.The district is subsidiaries categorized as 6 talukasViz.,,Davangere, Harihara, Honnali, Nyamti, Channagiri and Jagaluru. The district occupies the total geographical area 5913.4 sq.km. In this district consist of different types of soil Black & Red soil, Red Sandy soil mixed with clay soil and patches of black soil and Black Cotton soil. It consist of hot humid monsoon type of climate, the annual rainfall is 637mm and the temperatures ranges from 43^0C, depending upon the climatic season.

Sample Collection:

In Sunflower crop field, soil samples were collected from six taluks of Davangere district. In each taluk of Sunflower crop field. Soil samples from the Sunflower field were randomly sampled and bulked together to form a composite sample. Soil samples were collected by using spade and then dig a "V" shaped furrow to a depth of (6 inches) and then cut a uniform slice and collected the bottom in the depth of 22 cm of the soil place in a bucket. Similarly, collected soil samples at all 4-5 spots in Sunflower crop field. Thecollected soil samples by following quartering technique reduce the bulk of soil samples. Spread the sample on clean polythene sheet in circular manner after thoroughly mixing. Break the clods and remove the roots pebbles and then divide the soil into four quarters, reject the two opposite quarters and mix the remaining two quarters and spread in a circular manner again. Repeat this procedure until desired sample size of 500g of soil is left. Then the soil put in to a clean zip locked plastic bags with proper labelling and transported through the laboratory. The collected soil samples along with locations are showed in table-1.

Table – 1

Collection of soil samples from Sunflower crop at six taluks of Davangere region

Sl.no	Sample No.	Taluk	Location
1	**Sample-1**	**Jagaluru**	Hiremallanahole
2	**Sample-2**	**Davangere**	Aluru
3	**Sample-3**	**Harihara**	Ramatheertha
4	**Sample-4**	**Honnali**	Masadi
5	**Sample-5**	**Nyamti**	Surahonne
6	**Sample-6**	**Chennagiri**	Hireganguru

Sample Preparation

The collected soil samples were taken to the laboratory and air dried by placing soil on filter paper on a steel mesh. Stones and other debris were removed from the soil samples. The samples were ground, passed through 2-mm sieve and stored in new clean polythene bags until further analysis.

Physicochemical Parameter analysis of soil samples:

Physicochemical parameters such as Soil texture, Soil moisture, p^H, Electrical conductivity, Total organic carbon, total nitrogen, phosphorus, potassium, copper, zinc, iron and manganese were analysed.

Soil Texture:

The soil texture was determined by Field method (Feel method). Sand, silt and clay are the primary particles comprising the soil solids. These aregenerally clustered together as secondary particles. The relative proportion of size groups of sand, silt and clay in a soil called as soil texture. These primary soil particles are measuring their proportions were analysed by International pipette method.

Soil Colour:

Soil colour was identified by Visual methods.

Soil moisture:

Soil moisture content was determined by oven drying method. 20g of composite soil sample was taken. The samples were oven dried at 105^0C for 24 hrs. Dry weight was taken till it showed its constant weight. The loss in weight correspondence to the amount of water present in the soil sample. The formula below was used to calculate the percentage of moisture content in each of the soil samples (Wodaje Addis et.al.,2014).

$$\text{Moisture content (MC) (\%)} = \frac{\text{Loss in weight on drying (g)}}{\text{Initial sample weight}} \times 100$$

p^H

The p^H of the soil sample was measured in water suspension (1:2:5) as described by (Jackson, 1967). Air dried soil of 20 g was taken in a beaker and to this 50 ml of water was added. The mixture was stirred with glass rod for 10 min and was allowed to stand for 30 min. The p^Hmeter was calibrated using standard buffer solution of p^H 4.0, 7.0 and 10.0. Then electrode of the p^H meter was inserted in to the supernatant solution and the p^H reading was taken.

Electrical Conductivity

The electrical conductivity (EC) of the soil samples was determined as described by (Jackson, 1967). Air dried soil of 20 g was taken in a beaker and to this 50 ml of water was added. The mixture was stirred with glass rod for 10 min and was allowed to stand for 30 minutes without any disturbances. The soil was allowed to settle down and the EC value was measured inserting electrical conductivity meter in to the supernatant solution and the reading was recorded in units of Millisiemens per meter (mS/m).

Total Organic Carbon

Soil organic content was detected by using of commercially available kit. One gram of soil was taken and 10 ml of chemical solution A & B were added. After mixing gently they were allowed to stand for 10-15 min & filtered through a given filter paper in the kit. Compare the colour of the clean filtrate with the given colour chart from the kit. The organic content of soil was assigned value of most matching colour on the given standard chart.

Available Nitrogen (N)

The available nitrogen content of the soil was estimated by alkaline potassium permanganate method (Subbaiah and Asija, 1956). 20 gm of the soil sample was weighed and transferred into 1 lit distillation flask followed by the addition of 10m1 of 0.32 % potassium permanganate, 10m1 of 2.5% sodium hydroxide, 10m1 of distilled water and immediately fitted up in the distillation apparatus. 25m1 of 0.02 N sulphuric acid was pipetted into a 250 ml beaker, and one or two drops of methyl red indicator added through the end of the delivery tube dipped in it. The contents of the flask were digested and distilled to collect about 30 ml of the distillate into the known excess of 0.02 N sulphuric acid. The excess of the acid was titrated against 0.02N potassium hydroxide till the pink colour changed into the light yellow. Then from the volume of 0.02N sulphuric acid actually consumed by ammonia, the percentage of nitrogen present in the given soil sample was calculated.

Available Phosphorus (P205):

Available phosphorus was estimated by Olsen's method (Olsen, *et al.,* 1954). About 5g of soil was weighed and transferred to a 250 nil conical flask and 100 ml of 0.5 M sodium bicarbonate (pH 8.5) was added, followed by one teaspoonful of carbon black, shaken for 30 min. and filtered through Whatman No. 40 filter paper. 10 ml of the filtrate was pipetted out into a 50 ml volumetric flask and a drop of Para nitrophenol indicator was added and the pH was adjusted to 3.0 with 4 N Hydrochloric acids. Then 0.25 ml (5 drops) of 0.1 N chlorostannous acid solution was added followed by immediate shaking and the volume was made up. The standard curve was

prepared with the same quantity of sodium bicarbonate included. The colour intensitywas nearly constant between 4-20 min and was read photometrically after 5 min with a 660 light red filter in Klettesummerson calorimeter. The quantity of phosphorus was calculated as Kg per hectare of the soil.

Available Potassium (K20):

The flame photometric method (Jackson, 1958) was employed to estimate available K of samples. 5g of air dried sample was taken in 150m1 Erlenmeyer flask and 25 ml of 1 N ammonium acetate was added to the flask. The contents were shaken for 5 minutes on a mechanical shaker and filtered immediately through a dry Whatsman No.1 filter paper. 5m1 of filtrate diluted with 25 ml with distilled water. Atomized the above diluted extract to flame photometer to note the reading and the quantity of potassium was calculated as Kg per hectare of the soil.

Available Micronutrients:

The micronutrients are essential for plant growth the available micronutrients are Fe, Mn, Cu and Zn in soil samples were determined by atomic absorption Spectrophotometry using extractant DTPA solution (0.005M DTPA + 0.01 M CaCl2 + 0.1 M triethanolamine, p^H 7.3) as outlined by Lindsay and Norvell (1978). The concentration of micronutrients in the extract was determined by atomic absorption spectrophotometer.

Results and Discussion:

The results of the determination of physicochemical parameters of the soils are shown in Table 2 and 3.The selected soil physical characteristics for representative data were presented in Table 2. In the study area, soil colour patterns showed great variability. It changes the soil colour from region to region is different. The soil colour patterns are two regions which show the blackish brown, two regions are black and another two regions are different soil colours. According to Alemo (2019), dark brown surface of soil colour could be attributed to a relatively high content of organic matter of the surface horizons. Sand, silt and clay are the primary particles comprising the soil solids. Sand content is varied between 20% (Sample 1,2 & 6), Sample 3 is 45% , Sample 4 is 40% and Sample 5 is 60% (Fig:1). Silt and Clay content also varied from region to region. According to Boul*et al*(2003), the accumulation of clay in the soil surface could be due to the insitu synthesis of secondary clays and weathering of primary minerals.

The selected soil chemical characteristics for representative data were presented in Table 3. According to Churchman et al. (1983), these values reveals the absence of calcium carbonate in the study area, where values $p^H$is less than 6.5 are generally considered as non-calcareous.

Moisture Content (%)

The moisture content (MC) which is directly proportional to the water holding capacity of the soil ranged from 6.12 to 12.73 % (Table3). Soil collected from Nyamti region has relatively higher moisture content than the other studied sites.

p^H

Soil p^H is a measure of hydrogen ion activity in the solution. It express the acidity and alkalinity of the soil and is a primary factor in plant growth. It is a very important property of soil as it determines the availability of nutrients, microbial activity and physical condition of soil. Soil p^H values in the six areas ranges from 6.89to 7.88 (Table 3) and it also representing the data in (Fig: 3), the lower $p^H$was observed in Chennagiri region and higher p^H in 7.88 Harihara region soil sample.All the soil samples are normal range and it is suitable for sunflower crop growing. According to Odoemelan and Ajunwa (2008) the application of bio solids such as animal manure and compost on acid soils increases the soil p^H appreciably.

Electrical Conductivity (mS/cm)

Electrical conductivity (EC) expresses ion contents of solution which determine the current carrying capacity thus giving a clear idea of the soluble salts present in the soil. Electrical conductivity value ranges from 0.012 to 0.501 mS/cm (Table 3). The electrical conductivity of Honnali region is high as compared to the other sites which may due to excess use of fertilizer like P and K. Electrical conductivity is used to estimate the soluble salt concentrations in soil and is commonly used as salinity (Wodaje, 2014). The difference in the electrical conductivity values could be attributed to differences in the soluble salt content of the soils.

Organic Carbon (%)

Organic carbon is the index for nitrogen content in the soil. The source of organic carbon in the cultivated Sunflower crop field soil included crop residue, animal manure, green manure and organic fertilizer etc. (Borkar 2015). Organic carbon values ranges from 0.42% to 2.10%. Organic carbon of Nyamti (Sample 5) region is high as compared to Sample 1,2,3,4 & 6.

Macronutrients (N, P & K)

Macronutrients are the main soil nutrients for normal germination, growth and maturity of plants. The availability of nitrogen depends on thevarying degree of soil microbial decomposition (Gairola and Soni, 2010). Nitrogen, Phosphorus and potassium content varies from 154.80-309.60 kg per hectare, 51.34-100.03 kg per hectare and 123.65-512.06 kg per hectare respectively indicating its sufficient amount of macronutrients in Davangere region but the Sample 2 & 3 Nitrogen is lowest as compared to Sample 1, 4,5 & 6. Phosphorus is lowest in sample 3 & 4 as compared to sample 1,2,4,5 & 6. Potassium is lowest in sample 1,2,3& 4 as compared to sample 5 & 6. These variations are shown in Fig: 6, 7 & 8. Application of macronutrients is necessary for maintaining a balance between the other plant nutrients and ensuring the normal growth of the Sunflower crop. Low Nitrogen status in the soils could be due to low amount of organic carbon in the soil. Since most of the Nitrogen found in organic form, therefore, this relationship was observed (Table 3). According to Elseret.al., (2007) Phosphorus act as a limiting or co-limiting factor of ecosystem productivity and low P availability can constrain N2 fixation.

Micronutrients (Cu, Zn, Fe &Mn)

Micronutrients are growing importance in crop nutrition because of increased demand from higher yielding crops are and intensive cropping, continued expansion of cropping and forestry on marginal land with low inherent levels of micronutrients, increased use of high analysis fertilizers containing low levels of micronutrient and decreased use of manures, composts and crop residues in some parts of the world (Manjushree *et.al.,* 2018). Cu, Zn, Fe Mn nutrients are varied from region to region. Copper, Zinc, Iron and Manganese are essential trace element. The available Copper in the studied soils varied from 0.30-2.40 PPM, the available Zinc is varied from 0.50-1.70 PPM, available Iron is varied from 0.84-24.50 PPM & available Manganese is varied from 10.72-35.38 PPM. According to Aravind Kumar (2010) the application of Zn or Fe also caused significant yield increase over control due to improvement in growth and yield attributes. Manganese functions primarily as part of enzyme systems in plants. It activates several metabolic reactions and plays a direct role in photosynthesis. Manganese accelerates germination and maturity while increasing the availability of Phosphorus and calcium.

The variations are observed in available micronutrients among the collected soil sample in Sunflower crop field are might be the result of variable intensity of different pedogenic processes taking place during soil development. Decomposition of organic material release micronutrient and also reduces p^H locally which assists in mineral solubility. Further availability of metal ions (Zn, Cu, Fe and Mn) increases as the organic matter provides chelating agent for complexion of

these micronutrients. Thus management of carbon stocks (FYM, night soil, organic residues, etc.) will improve their availability to the Sunflower crop.

Table: 2

Physical parameter analysis of soil sample:

Sample No.	Name	Soil Type	Soil Colour	Soil Texture		
				Sand%	Clay%	Silt%
Sample-1	Jagaluru	Silt clay loam	Reddish Brown	20	18	62
Sample-2	Davangere	Loam	Light Brown	20	20	60
Sample-3	Harihara	Clay loam	Black	45	22	33
Sample-4	Honnali	Silt clay loam	Brownish Black	40	16	44
Sample-5	Nyamti	Sandy loam	Black	60	40	40
Sample-6	Chennagiri	Clay loam	Brownish Black	20	60	20

Table: 3

Chemical Parameter Analysis of Soil Samples:

Sl. No	Region	Moisture Content (%)	P^H	EC (dS/m^{-1})	OC (%)	N kg/hac	P kg/hac	K kg/hac	Cu PPM	Zn PPM	Fe PPM	Mn PPM
1	**Jagaluru**	6.18	7.72	0.453	0.60	258.00	100.03	162.62	1.92	1.18	0.84	19.40
2	**Davangere**	6.12	7.58	0.456	0.42	154.80	81.44	186.82	1.46	1.70	1.68	18.86
3	**Harihara**	12.19	7.88	0.390	0.66	154.80	51.34	159.94	1.20	0.50	1.10	10.72
4	**Honnali**	7.88	7.31	0.501	0.78	206.40	56.66	123.65	2.40	0.52	1.10	28.64
5	**Nyamti**	12.73	7.78	0.012	2.10	258.00	81.44	512.06	1.96	0.86	1.84	19.76
6	**Chennagiri**	6.79	6.89	0.466	0.90	309.60	99.15	247.30	0.30	1.24	24.50	35.38

Conclusion

The physicochemical characteristics of soil in Sunflower crop field of Davangere district were analysed. The results indicate that the soil p^H is neutral to slightly alkaline and it is one of the major factors affecting mobility/solubility of metals in soil environment. EC values of the Sunflower field soils were non-saline. The Physicochemical assessment of soil is important to agricultural chemists for plant growth and soil management. These studies give information about the nature of soil, nutrient status of soil; according to this information farmer arrange the amount of which fertilizers and nutrients needed to soil for increase the percentage yield of crops. It is concluded thatphysicochemical studies of soil in six taluks of Davangere region shows that different concentration of various parameters at different sites at Davangere district. This may be due to the excess use of chemical fertilizer which may affect the microbial activity in the soil resulting effect on the crop fertility of the soil.

Physical Parameter Analysis of Sunflower crop field soil sample from various locations of Davangeredistrict

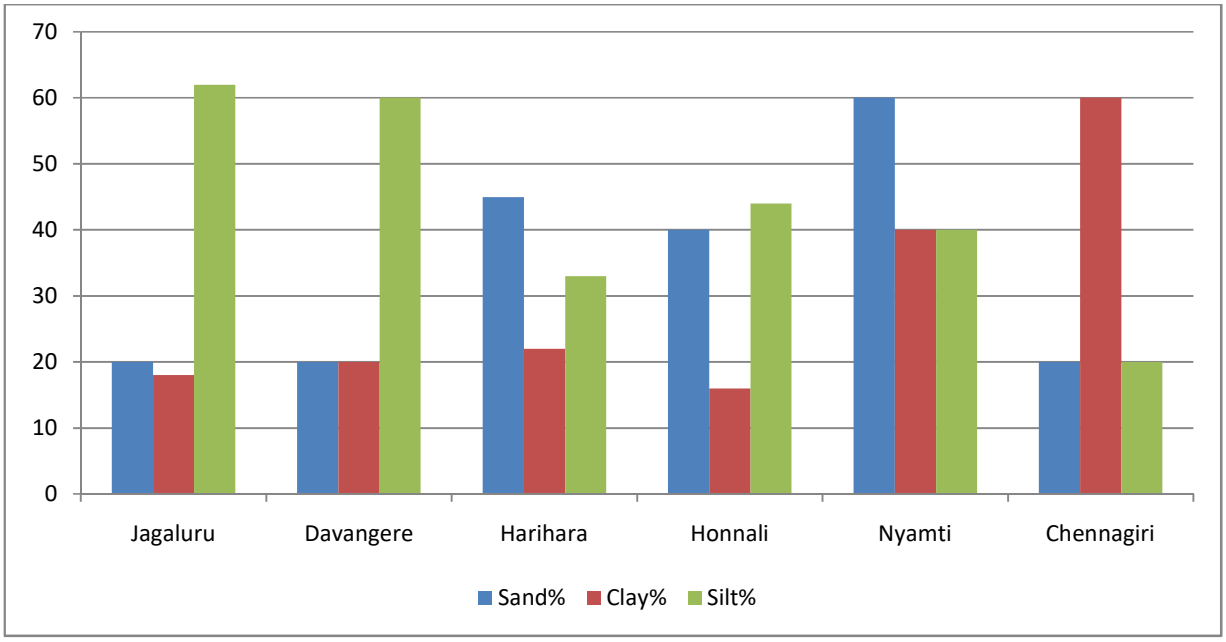


Fig: 1

Chemical Parameter Analysis of Sunflower crop field soil sample from various locations of Davangeredistrict

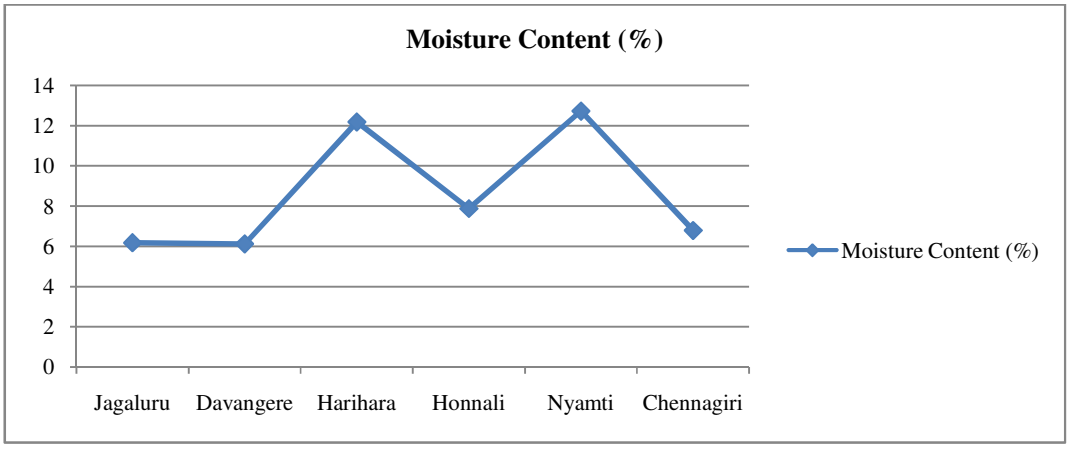


Fig: 2

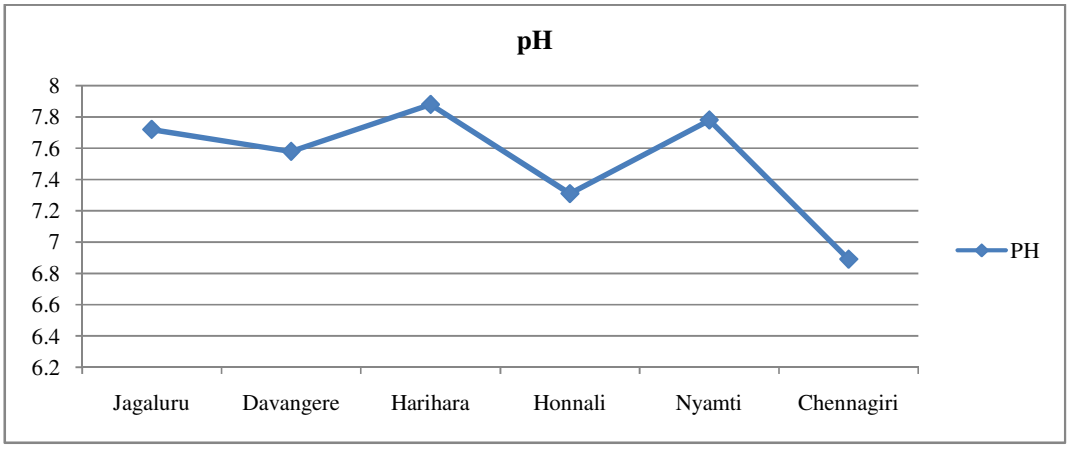
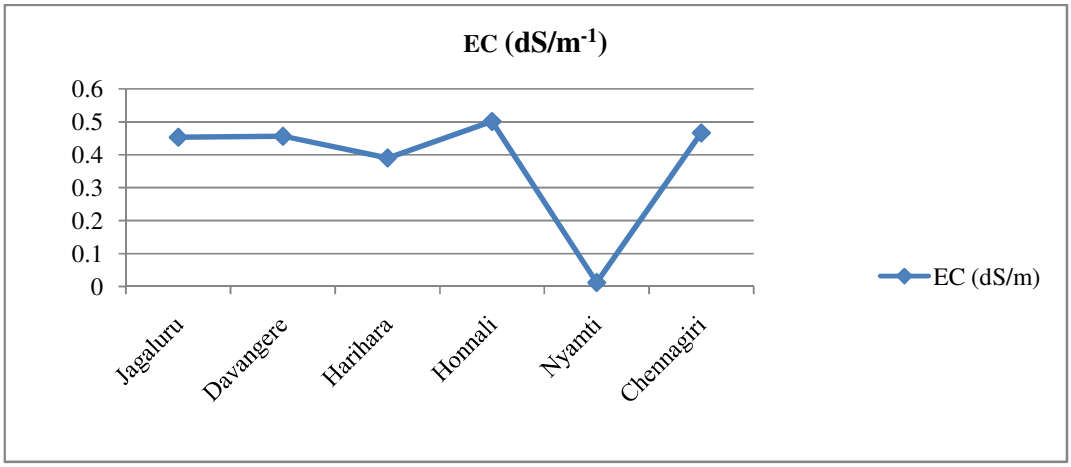


Fig: 3



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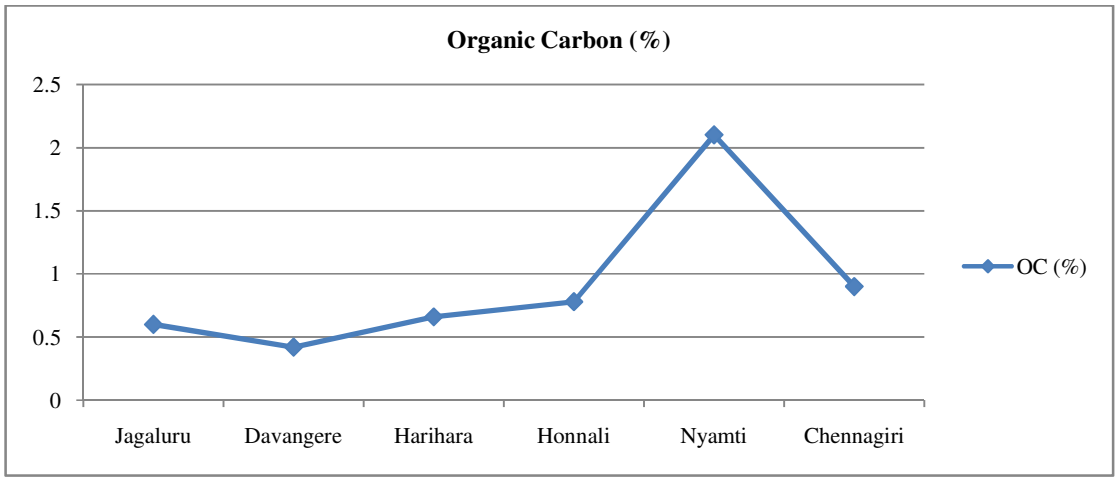


Fig: 5

Macronutrients

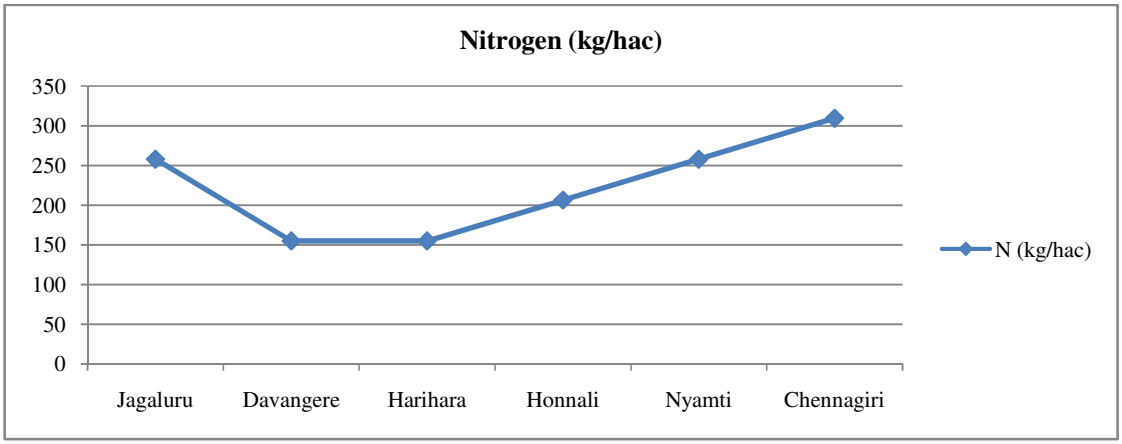
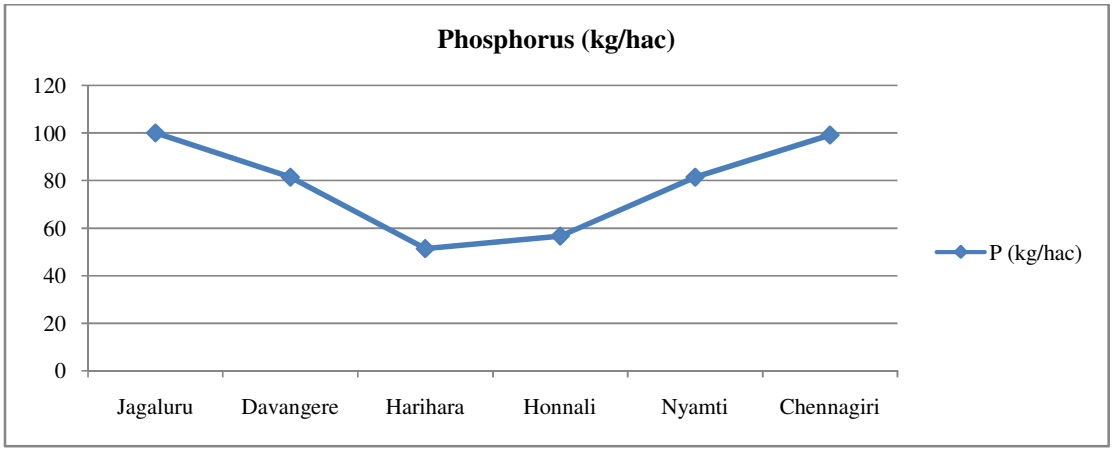


Fig: 6



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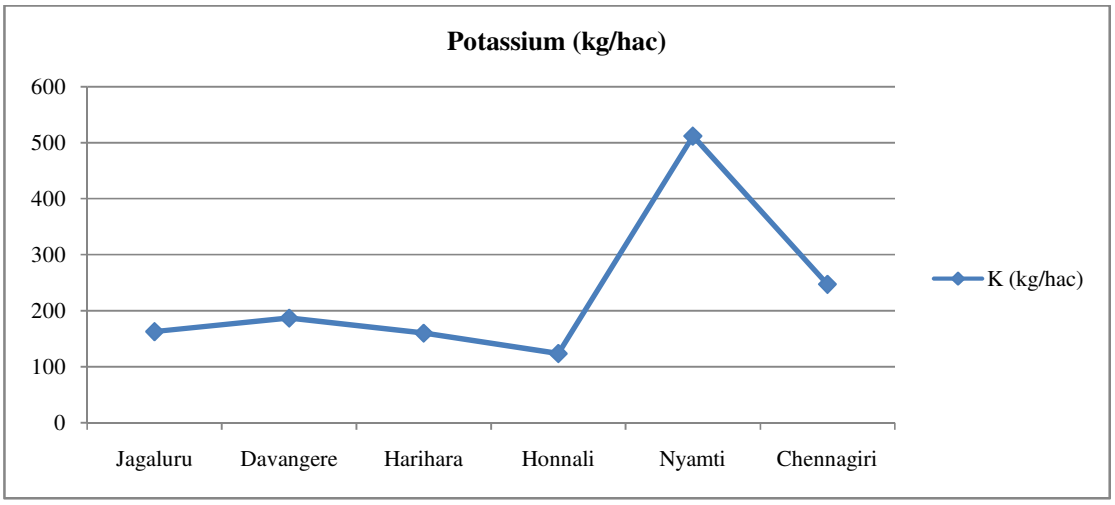

Fig: 8

Micronutrients

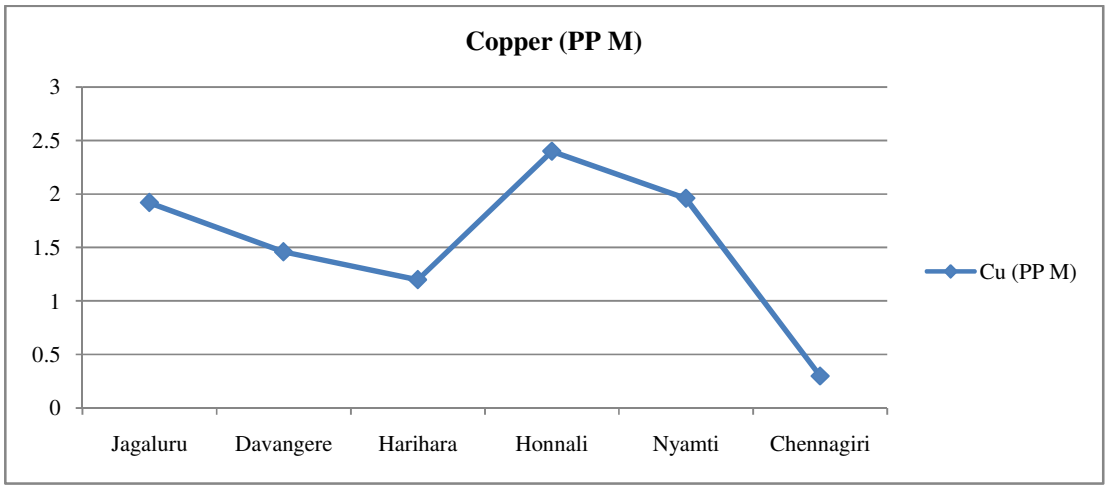

Fig: 9

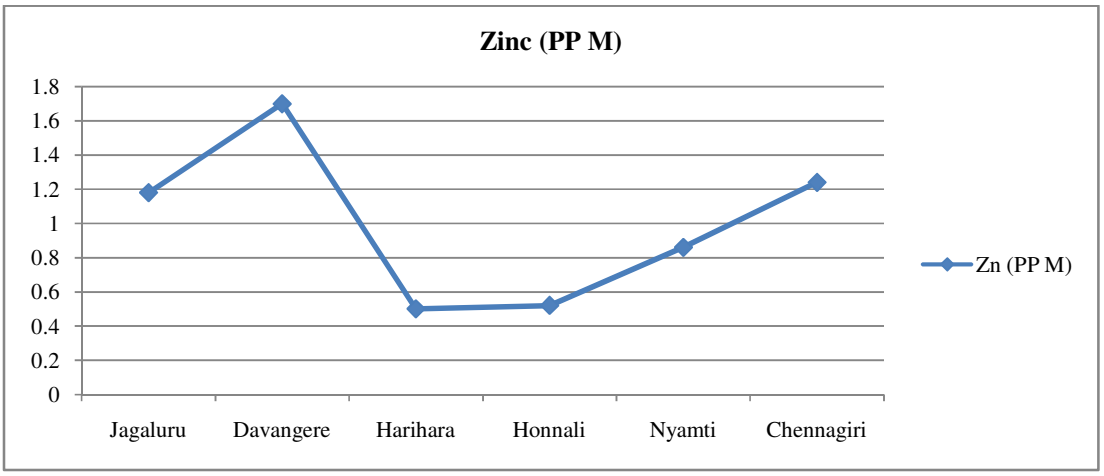

Fig: 10

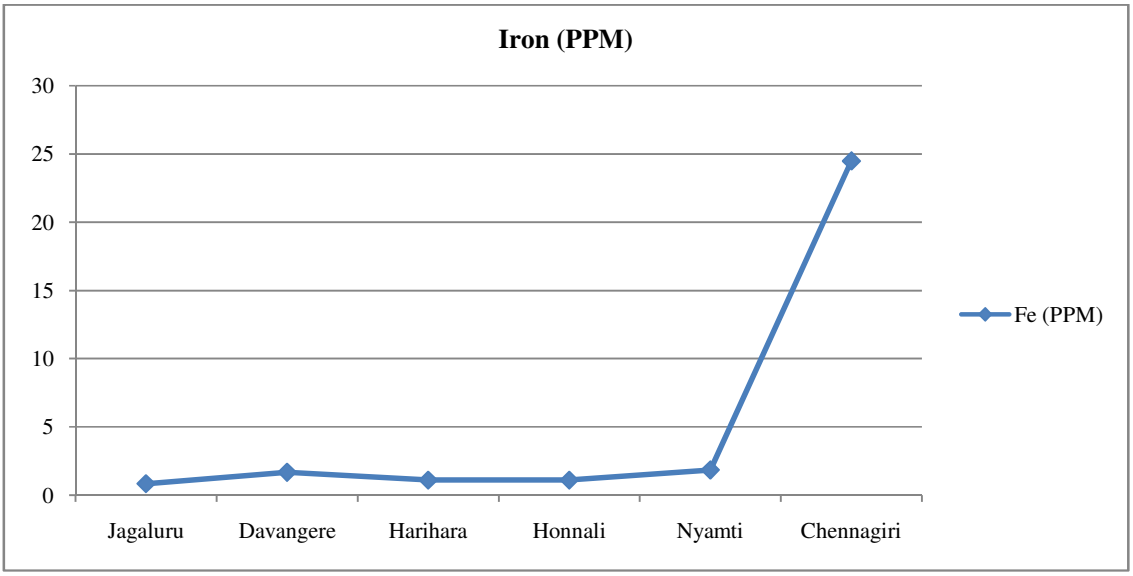
Iron (PPM)
30
25
20
15
10
5
0
Jagaluru
Davangere
Harihara
Honnali
Nyamti
Chennagiri
Fe (PPM)

Fig: 11

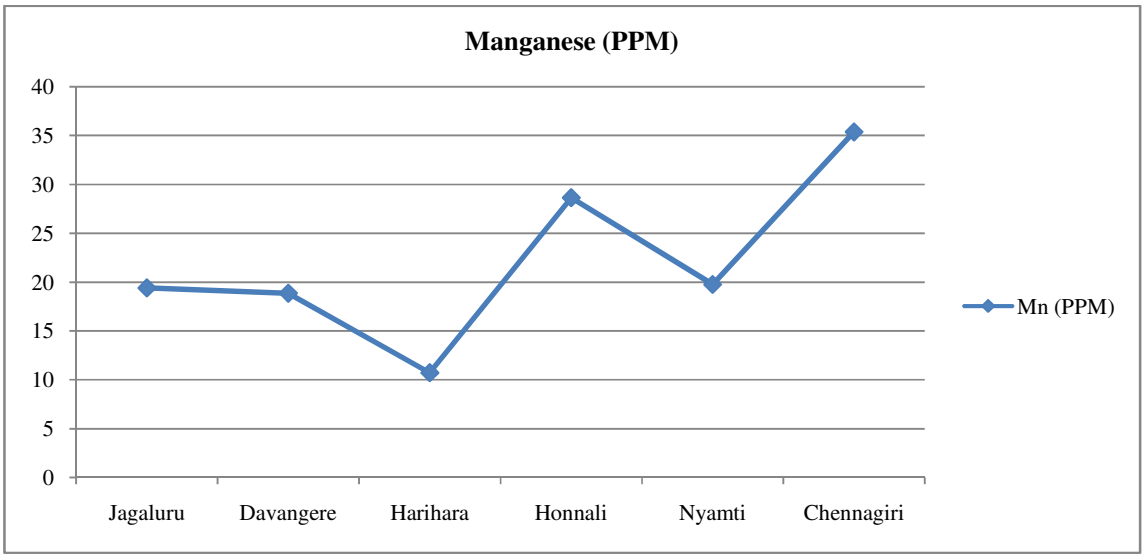
Manganese (PPM)
40
35
30
25
20
15
10
5
0
Jagaluru
Davangere
Harihara
Honnali
Nyamti
Chennagiri
Mn (PPM)

Fig: 12

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