



Analysis of soil physico-chemical properties on sunflower crop fields in Davangere region of Karnataka

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Abstract

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. 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 the rhizosphere soil of Davangere region was carried out. Rhizosphere is a dynamic changing environment that differs from bulk soil both in physical and chemical properties. 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 rhizosphere soil samples 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, 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.

Keywords: macronutrients, micronutrients, physicochemical, rhizosphere, sunflower

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 growth and it modulates water, nutrients and pollutant transport (Vaneet Kumar *et.al.*, 2016). 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 (Srinivasan and Poongothai 2013). 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 p^H 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 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. 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). Rhizosphere is a dynamic changing environment that differs from bulk soil both in physical and chemical properties. In this sense, plant root exudates selectively influence the growth of microorganism that colonize the rhizosphere when altering the chemistry of soil aggregates and currently rhizospheric microbial populations change the composition and quantity of root exudates through their effect on plant nutrition. 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 soil Sunflower crop field in Davangere region and an attempt was also made to compare nutrient contents of the soils with other soil properties.

Materials and Methods

Study area

Davangere district 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° 45'00" N and 14° 50'00" N latitude and 75° 30'00" E and 76° 30'00" E longitude. The district is subsidiaries categorized as 6 taluks Viz., 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°C, 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 rhizosphere region were randomly sampled and bulked together to form a composite sample. Similarly, collected soil samples at all 4-5 spots in the rhizosphere region. The collected soil samples by following quartering technique reduce the bulk of soil samples. 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

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 are generally 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°C 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) ^[19].

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

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^H meter 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 macronutrients (N, P, K): Nitrogen, Phosphorous and Potassium are important soil elements that control its fertility and yields of crops. The available macronutrients (N, P, and K) were analysed by using standard procedures (Jackson 1973).

Available micronutrients (Cu, Zn, Fe, Mn): 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 % (Table 3). 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 6.89 to 7.88 (Table 3) and it also representing the data in (Fig: 1), 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) ^[16] 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) ^[19].

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) ^[4]. Organic

carbon values ranges from 0.42% to 2.10%. Organic carbon of Nyamti (Sample 5) region is high.

Macronutrients (N, P & K)

Macronutrients are the main soil nutrients for normal germination, growth and maturity of plants. The availability of nitrogen depends on the varying 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 3 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 Elser *et al.*, (2007) ^[8] 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) ^[13]. Cu, Zn, Fe and 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) ^[1] 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. 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. Further availability of metal ions (Zn, Cu, Fe and Mn) increases as the organic matter provides chelating agent for complexation 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 (%)	pH	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 analyzed. The results indicate that the soil pH is neutral to slightly alkaline and it is one of the major factors affecting mobility/solubility of metals in soil environment. 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 that physicochemical 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.

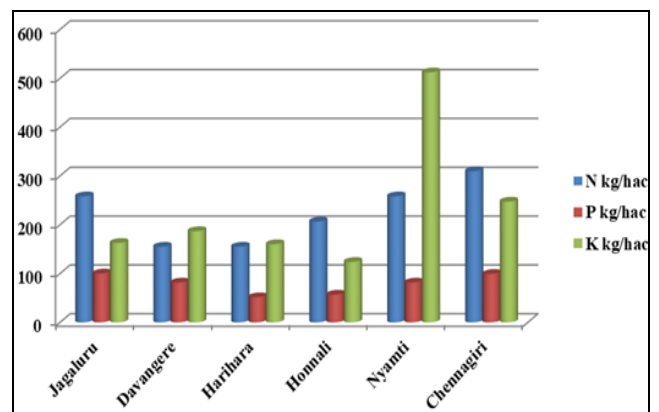


Fig 3: Analysis of macronutrients parameters

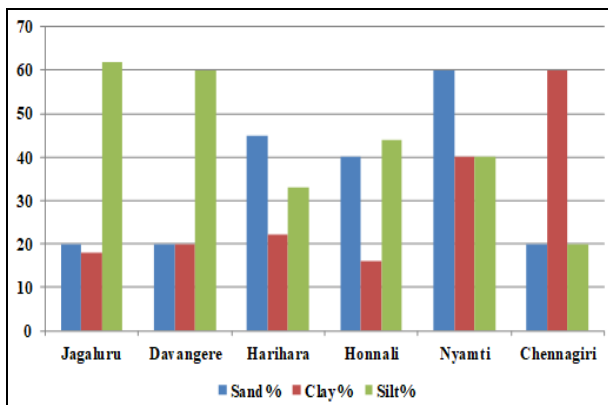


Fig 1: Physical parameter analysis of sunflower crop field soil sample from various locations of davangere district

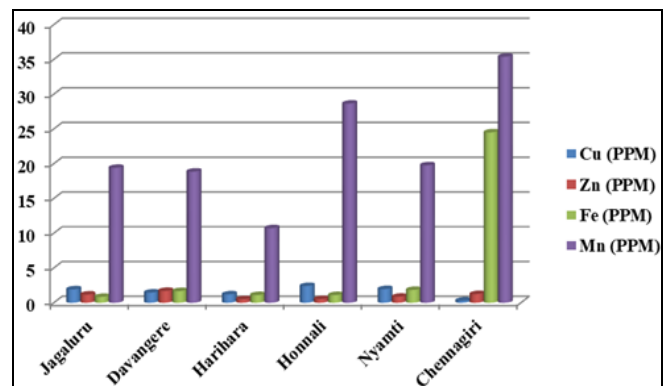


Fig 4: Analysis of micronutrients

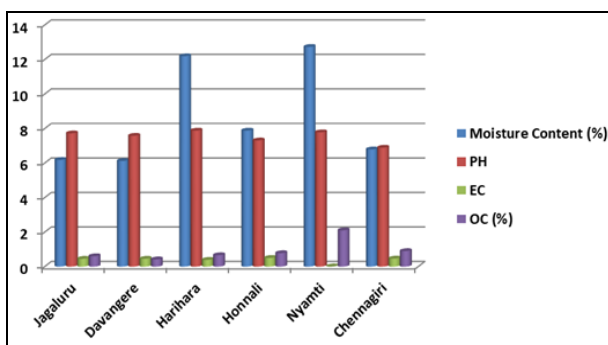


Fig 2: Analysis of soil moisture content, pH ec & oc

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