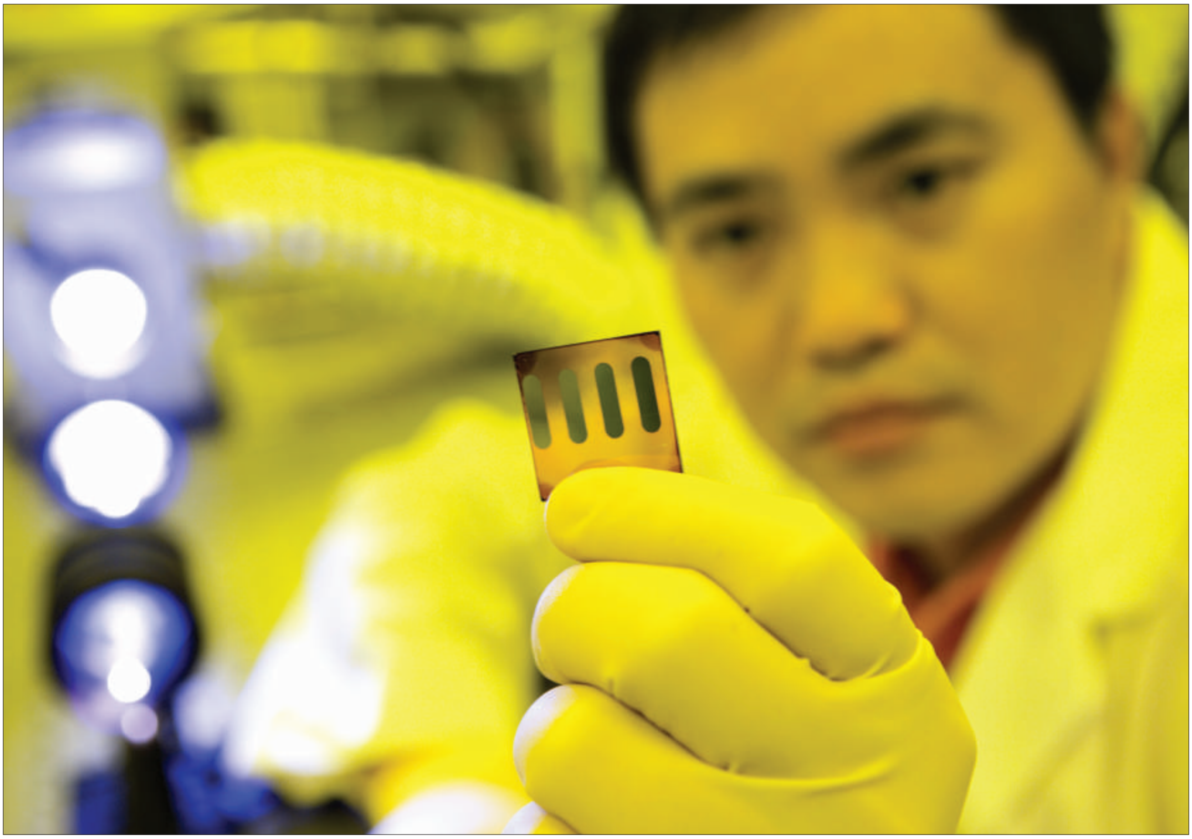

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Research Article
Analysis of Edaphic Factors in Few Villages of Mysuru District

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Abstract
Background and Objective: Soil is highly erratic. Mineral, organic matter, water and air are the four main ingredients that are consistent with all types of soil. The present investigation records the findings of soil parameters. Soils and the functions vary greatly from one location to another as a result of many factors. **Materials and Methods:** The present investigation records the findings of soil fertility by the Jar test method, analysis of soil pH, soil moisture, soil texture and soil temperature and also determines the water holding capacity of soil samples collected from different villages of Mysuru districts. The selected villages are Bhugathagalli, Banagahalli, Halaga Hai Hundi, Kokkarae Hundi, Sugganahalli, Marse, KM Hundi, Byathahalli, Sindhuvalli and Chikkakanya. A field survey was carried out on Jan-2019 for the collection of soil samples. **Results:** Findings of soil fertility by the Jar test method, based on that Sugganahalli and Chikkakanya (0.9 cm) rank first. Highest pH recorded in Byathahalli (6.5). The highest moisture content recorded in Bhugathagalli (1.6 g). Among the ten village soil samples, analysis of water holding capacity in each soil reveals that Sugganahalli and Byathahalli (32 mL of water holding) show the highest water holding capacity. **Conclusion:** Based on the overall analysis it is very clearly shown that in all soil types macronutrients are sufficiently present or overdose in a few villages but the crops suffer from inorganic salt contents like phosphate and nitrate.

Key words: Doctor kit, edaphic factors, field survey, soil, villages

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The soil is the unconsolidated outer layer of the Earth's scab. The soil appears in a variety of forms. It has different textures, colour, structure and nutrient content. Although soil is highly erratic, there are four main ingredients that are consistent with all types of soil. They are mineral, organic matter, water and air[1]. Soils within an ecosystem vary greatly from one location to another as a result of many factors, due to differences in climate, the animal and plant life living on them, the soil parent material and the age of the soil[2].

The soil is not a renewable resource, it will take several years to replace[1]. A laboratory test of soil samples reveals important information about the soil nutrient level. A good lab test gives you the results for all types of soil nutrients like nitrogen, phosphorus and potassium, sulphur, calcium, magnesium, iron, copper, zinc and others. A quality test will give us information regarding the soil pH level, whether it is particularly acidic or alkali. The intention of soil tests is used to measure soil nutrients that are expected to become available to plants. They do not measure the total amounts of nutrients in the soil. Most of the soil test values do not vary greatly from year to year. However, environmental conditions cause fluctuations in measurements such as pH and nitrate-nitrogen. Drastic changes in test values may indicate an unrepresentative soil sample or due to errors occur during laboratory analysis[3]. Soil testing includes three-steps, the first step is the collection of a representative soil sample from each field, secondly, proper analysis of that soil sample to realize the levels of available nutrients and use of the results to determine optimum fertilizer rates[4]. Soil testing is an important diagnostic tool for determining the nutrient needs of plants and for environmental assessments to the farmers. Some soils are naturally deficient in plant nutrients for various reasons and some other soils had sufficient levels of nutrients in the past, but removal with crop harvest unscientifically by farmers has depleted the reserves[5].

The present investigation records the findings of soil fertility by the Jar test method, analysis of soil pH, soil moisture, soil texture, soil temperature, macro and micro-nutrients of soil and determines the water holding capacity of soil samples collected from different villages of Mysuru districts. The selected villages are Bhugathagalli, Banagahalli, Halaga Hai Hundi, Kokkarae Hundi, Sugganahalli, Marse, KM Hundi, Byathahalli, Sindhuvalli and Chikkakanya.

MATERIALS AND METHODS

The study was carried out at Post Graduate Department of Botany, JSS College, Ooty road, Mysuru, Karnataka from Dec, 2018 to May, 2019.

Soil sample collection: The latitude of Mysuru, Karnataka, India is 12.311827 and the longitude is 76.652985. Mysuru, Karnataka, with the GPS coordinates of 12°18'42.5772''N and 76°39'10.7460''E. Collect the appropriate number of samples one unit at a time. Take all soil samples randomly infield in a zig-zag pattern before that scrape away any surface residues and mix the sample to break up the soil aggregates. After collecting all subsamples, stir your composite and spread out the sample on a plastic or plywood.

Sample handling: After the collection of soil samples, it is subjected to air-dry. Breaking up any clumps and spreading the soil in a layer about 0.25 inch deep. When the soil samples are dry, again mix the soil thoroughly, breaking up any large clumps. Then take a few grams of well-mixed soil from the sample for further analysis.

Jar test for soil fertility analysis: Take a sample of soil and fill the jar and water until the jar is nearly full, leaving about ½" of air space at the top. Screw on the lid and shake it vigorously for a minute, until all the soil particles are broken down into suspension in the water.

Allow the suspended soil to settle for about a minute in a jar and place a mark on the side of the jar. It indicates sand layer and comprised primarily of sand and larger particles. Set the jar aside and wait approximately an hour, being careful not to mix the sand layer that has already settled. Now, place a mark on the side of the jar at the top and consider it as the silt layer. Again, place the jar aside for a full day, being careful not to shake or mix the layers that have settled out. After 24 h place a mark on the side of the jar at the top of the final layer and consider it as a clay layer. The percentage of each layer clearly indicates what kind of soil (Table 1).

Soil pH measuring by pH meter (method 1): Weigh 5 g of sieved, air-dried soil into a paper cup. Add 5 mL of distilled water to the sample. Stir vigorously for 15 sec and let stand for 30 min. Place electrodes in the slurry and read the pH immediately. Ensure that the electrode tips are in the slurry and not in the overlying solution. For the $CaCl_2$ pH measurement, add 1 drop of 1.0 M $CaCl_2$ solution to the

Table 1: Type of soil composition determined by the jar method

Soil types	Composition	Nature of soil
Sandy soils	80-100% sand, 0-10% silt, 0-10% clay by volume	Sandy soils are light and typically very free draining, usually holding water very poorly due to very low organic content
Loam soils	25-50% sand, 30-50% silt, 10-30% clay by volume	Loam soils are somewhat heavier than sandy soils, but also tend to be fairly free draining, again, due to typically low organic content
Clay soils	0-45% sand, 0-45% silt, 50-100% clay by volume	Clay soils are not typically free draining and water tends to take a long time to infiltrate, when wet, such soils tend to allow virtually all water to run-off, clay soils tend to be heavy and difficult to work when dry

Table 2: Standard chart for analysis of soil texture

Texture	Length of ribbon (mm)	Soil properties and management implications
Sandy	<15	Little resistance of root growth High infiltration rate Low plant available water
Loam	25	Root growth not restricted Moderately susceptible to mechanical compaction Moderate plant available water Low to the moderate infiltration rate
Clay	50-75	Root growth frequently restricted Moderately to highly susceptible to mechanical composition Same restriction on water movement leading to periodic water logging Moderate to high plant available water

previous sample. Alternatively, prepare a sample as was done previously, using 0.01M $CaCl_2$ instead of water. Stir vigorously and let stand for 30 min, stirring occasionally. Read the pH as in pH meter.

Soil pH measuring by soil doctor kit tablet (method 2)

Preparation of soil sample extracts solutions: Mix soil with distilled water in a 1:2 ratio (i.e., one cup of soil with 2 cup water and mix it thoroughly). Wait for 10-30 min for settling the soil in the bottom and clear water separation (wait at least water soil extract should be clear in case of not clear up to 30 min please try to filter by normal filter paper).

Analysis of pH: Open soil doctor kit-pH capsule carefully. Put the chemical inside the test tube and transfer 4.0 mL clear soil extract with a dropper. Cap it and mix gently until the chemical is dissolved. Wait for 5 min for colour appearance. Match colour reaction with pH colour chart RF# 1006 pH on the bottle to know the acidity/alkalinity of the soil sample.

Soil moisture: Mix the collected soil samples in a clean beaker. Weigh a dry crucible (initial weight) and note down its weight (X_1 g), put about 10 g of the soil sample in a weighed crucible and weigh again (X_2 g). Heat the crucible along with the soil sample in an oven at 105-110°C till it becomes completely dry. Allow to cool and weigh it again and note down its weight (X_3 g). Soil moisture will be calculated by using the following equation:

$$\text{Weight of the wet samples} = X_2 - X_1 = W_1$$

$$\text{Weight of the dry soil sample} = X_3 - X_1 = W_2$$

$$\text{Loss in weight} = W_1 - W_2$$

Soil texture: Soil texture refers to the proportion of sand, silt and clay-sized particles that make up the mineral frictions of the soil (Table 2).

Example; light soil refers to soil high in sand relative to clay, while heavy soils are made up largely of clay. For determination of soil texture:

- Take about 2 teaspoon of the soil sample in one hand and add water drop by drop, while working the soil until it reaches a sticky consistency
- Squeeze the wetted soil between thumb and forefinger to form a flat ribbon
- Determine the textural based on the length of the ribbon that can be formed without breaking

Soil temperature:

- Dig a hole up to desired depth in a soil sample with the help of an iron rod. Insert an ordinary thermometer into the hole and keep it for about 15 min and then note down the temperature
- Use specially designed soil thermometer for this purpose. The soil thermometer consists of a mercury bulb

protected by a steel cone. The bulb is attached to one end of the vertical tube and a dial with deflections needle on the other end. The bulb with steel cone is directly pushed into the soil and the temperature is recorded by taking the reading

Water holding capacity of soil: Weigh 50 g of soil sample and taken in three different funnels placed with filter paper (one for clay, one for sandy and one for loamy soil). The funnel was kept over the measuring cylinder and add 50 mL of water to each funnel. Drop by drop water is flowing through the funnel and stored in a measuring cylinder. After the stop of water flows in the funnel, measure the collected water in a measuring cylinder. The time is taken and the volume of the water collected was noted down.

Test for nitrogen, phosphorous, potassium

Preparation of soil sample extracts solutions: Mix the soil with distilled water with a 1:2 ratio in volume (i.e., one cup of soil with 2 cup water) and mix it thoroughly). Wait 10-30 min for settling the soil in the bottom and clear water separation (wait at least water soil extract should be clear in case of not clear up to 30 min please try to filter by normal filter paper).

Estimation of N, P and K: Open soil Doctor-N capsule carefully. Put the chemical inside the test tube and transfer 4 mL clear soil extract with a dropper. Cap it and mix gently until the chemical is dissolved. Wait 20 min for the colour to develop. Compare the colour of the solution to the Nitrogen colour chart RF# 1006N for nitrogen, RF# 1006P for phosphorous (For both N and P, 40, 30, 20, 10 and 0-5 kg/acre) and RF# 1006K for Potassium (150, 100, 50, 25 and 0-5 kg/acre) on the bottle to know the status in the sample of the field.

Test for carbonate, nitrate and inorganic salt in the soil sample

Test for carbonate: Test a small amount of soil sample in a test tube. Add a little of Conc. HCl and observe. The mixture shows effervescence including the presence of carbonate in the soil.

Test for nitrate: Prepare a suspension of soil in water in the ratio of 1.5 in a test tube. Shake the mixture and allow it to settle down. Add a few drops of 0.2% diphenylamine (prepared in conc. H_2SO_4) and observe. The change in color. the blue color develops which shows the presence of nitrate

Test for inorganic salt: Prepare water extract of the soil for testing the presence of inorganic salts. Take about 200 g of soil in a conical flask and add about 500 mL distilled water. Shake well and keep it overnight so that the soluble salts dissolve in water. Pour the clean water in a beaker. It is called a water extract of soil. Test the presence of the following.

Chloride test: Take about 20 mL of water extract in a beaker. Add 10 mL N/10 H_2SO_4 to neutralize carbonate and bicarbonate present in the extract. Now add silver nitrate solution and observe the change. A white precipitate develops which indicates the presence of chloride in the soil.

Sulphate test: Take about 20 mL of water extract in a beaker. Add 2-5 mL of Conc. HCl and boil after boiling, add barium chloride solution and observe. A white precipitate of barium sulphate develops which indicates the presence of sulphate in the soil.

Phosphate: Take about 10 mL of water in a beaker. Add a drop of ammonium molybdate Conc. nitric acid and Ammonium nitrate. Note the change in colour. A yellow colour appears which indicates the presence of phosphate in the soil.

RESULTS AND DISCUSSION

Different types of soil colour exhibited in all villages (Table 3) and it is revealed during the field visits. During field visits, approximately 1.5-2.0 kg of soil samples were collected

Table 3: Test for soil fertility by Jar test methods of different villages of Mysuru districts

Samples collected from villages	Soil colour	Taken soil (g)	Volume of added water (mL)	Heavier particles (cm)	Lighter particles (cm)	Heavy lighter particles (cm)	Total (cm)
Bhugathagalli	Brown	100	200	2.4	0.2	0.1	2.7
Bonthagahalli	Red	100	200	1.7	0.4	0.2	2.3
Halagana Hundi	Black	100	200	1.5	0.4	0.2	2.1
Kokkarehundi	Brown	100	200	1.6	0.4	0.1	2.1
Sugganahalli	Light red	100	200	1.0	0.5	0.4	1.9
Marse	Red	100	200	1.8	0.3	0.2	2.3
KM Hundi	Brown	100	200	1.5	0.4	0.2	2.1
Byathahalli	Black	100	200	2.9	0.4	0.1	3.4
Sindhuvalli	Red	100	200	1.5	0.3	0.2	2.0
Chikkakanya	Brown	100	200	1.6	0.6	0.3	2.4

in each village and store for further studies. The collected soil samples (100 g) were subjected to fertility analysis by the Jar test method (Table 3). After few hours record the fertility of each soil samples by analyzing different zone of particles like heavy particles, light particles and heavy light particles and the data reveals that more amount of heavy particles recorded from Byathahalli (2.9 cm) and Bhugathagalli (2.4 cm), it is followed by Marse (1.8 cm), Bonthagahalli (1.7 cm), Kokkarehundi and Chikkakanya (1.6 cm). More amounts of lighter particles and heavy lighter particles recorded in soil samples collected from Chikkakanya (0.6 and 0.3 cm, respectively) and Sugganahalli (0.5 and 0.4 cm, respectively). Overall compared to ten villages the total fertility 3.4 cm recorded in Byathahalli followed by 2.7 cm recorded in Bhugathagalli soil sample, 2.4 cm in Chikkakanya village, 2.3 cm in Bonthagahalli village soil sample. But the fertility of the soil was calculated by considering the aggregate of lighter and heavy lighter particles, based on that Sugganahalli and Chikkakanya (0.9 cm) rank first, it is followed by KM Hundi, Halagana Hundi and Bonthagahalli with 0.6 cm of fertility. Bhugathagalli soil sample shows 0.3 cm of total soil fertility and this village is considered as least soil fertility content soils.

Soil organic matter is a sink and source for plant nutrients and is functional in maintaining soil fertility, reducing erosion, influencing aggregation and improving water infiltration and retention[6,7]. Soil tests can be used to estimate the kinds and amounts of soil nutrients available to plants. They also can be used as aids in determining fertilizer needs. Organic matter improves soil quality by improving other properties such as nutrient and water storage, buffering capacity and microbial activity/diversity[8].

In the present investigation, two methods were used to find out the soil pH (Table 4). Highest pH recorded in Byathahalli (6.5) followed by Bhugathagalli (6.4), KM Hundi and Chikkakanya (6.1). Sindhuvalli shows slightly harmful for the crop by showing acidic pH (4.5), in remaining all villages the pH level is moderate. Soil acidity (pH) reflects the hydrogen ion (H^+) activity in the soil solution and defines most chemical and biological activity thresholds. Soil pH is also influenced by the cropping or management system and the use of chemicals. The kind of vegetation, as well as the productivity and health, is highly correlated to the soil pH and the ability of the plant to tolerate acidic or alkaline environments[9].

In case of soil moisture, soil texture and soil temperature, a soil with high clay content may be ideal in a semiarid region where soil moisture retention is beneficial but, in a humid region, the same property might cause poor drainage and limit plant growth. Soil texture has considerable influence on moisture retention and hydraulic conductivity as well as bulk density[8]. Temperature and moisture conditions have considerable influence on mineralization of nutrients such as nitrogen and phosphorus and the emergence or suppression of plant pathogens[10,11]. In the present study, Table 5 and 6 reveals the total moisture content, soil temperature and soil texture. The highest moisture content recorded in Bhugathagalli (1.6 g) and the soil type is sandy. Similarly, Sugganahalli stands second in the moisture content of 1.4 g and the type of soil is loam. Interestingly, Halagana Hundi, Marse, Byathahalli and Chikkakanya show a clay type of soil and it is revealed by soil texture analysis.

Table 4: pH of soil samples measured by pH meter and using soil doctor kit tablet

Samples	pH meter	Soil doctor kit tablet	Average
Bhugathagalli	6.4	6.5	6.4
Bonthagahalli	5.7	6.0	5.8
Halagana Hundi	5.6	5.5	5.5
Kokkarehundi	5.5	5.0	5.2
Sugganahalli	5.0	5.5	5.2
Marse	6.7	5.5	5.8
KM Hundi	6.2	6.0	6.1
Byathahalli	7.0	6.0	6.5
Sindhuvalli	4.0	5.0	4.5
Chikkakanya	6.3	6.0	6.1

Table 5: Result of soil moisture in all ten villages

Samples	Dry crucible empty X_1 (g)	Crucible+Soil X_2 (g)	Heat crucible and dry X_3 (g)	$W_1 = X_2-X_1$ (g)	$W_2 = X_3-X_1$ (g)	$W = W_2-W_3$ (g)
Bhugathagalli	24.98	36.65	34.99	11.67	10.01	1.60
Bonthagahalli	20.76	31.51	30.78	10.74	10.01	0.70
Halagana Hundi	20.10	28.12	29.12	10.02	09.02	1.00
Kokkarehundi	29.48	39.71	39.51	10.23	10.02	0.20
Sugganahalli	24.52	32.96	33.54	10.44	09.01	1.40
Marse	24.97	34.98	34.84	10.01	9.86	0.14
KM Hundi	20.76	30.77	30.63	10.00	9.86	0.13
Byathahalli	18.09	28.15	27.80	10.05	9.70	0.35
Sindhuvalli	29.47	39.65	39.53	10.18	10.06	0.11
Chikkakanya	22.51	32.65	32.48	10.14	9.96	0.17

Table 6: Soil temperature and soil texture of all ten villages

Samples	Temperature (°C)	Length of ribbon (mm)	Type of soil-based on ribbon length
Bhugathagalli	26	12	Sand
Bonthagahalli	25	17	Loam
Halagana Hundi	28	31	Clay
Kokkarehundi	27	19	Loam
Sugganahalli	26	22	Loam
Marse	29	31	Clay
KM Hundi	29	21	Loam
Byathahalli	27	53	Clay
Sindhuvalli	27	20	Loam
Chikkakanya	28	39	Clay

Table 7: Water holding capacity of collected soil samples

Samples	Soil (g)	Added water (Y_1) (mL)	Collected water (Y_2) (mL)	Final water (Y_2-Y_1) (mL)
Bhugathagalli	50	50	23	27
Bonthagahalli	50	50	28	22
Halagana Hundi	50	50	23	27
Kokkarehundi	50	50	29	21
Sugganahalli	50	50	32	18
Marse	50	50	25	25
KM Hundi	50	50	20	30
Byathahalli	50	50	32	18
Sindhuvalli	50	50	12	38
Chikkakanya	50	50	23	27

Table 8: Inorganic salts analysis of collected soil samples

	Inorganic salts				
Samples	Carbonate	Nitrate	Sulphate	Chloride	Phosphate
Bhugathagalli	+	-	-	-	-
Bonthagahalli	-	-	+	-	-
Halagana Hundi	+	-	-	+	-
Kokkarehundi	-	+	-	-	-
Sugganahalli	+	-	-	-	-
Marse	+	+	+	+	-
KM Hundi	+	-	+	-	+
Byathahalli	+	-	+	-	-
Sindhuvalli	-	+	+	+	-
Chikkakanya	-	-	-	+	-

+: Present, -: Absent

The enhancement in aggregation and porosity of soil contributes to improvements in water holding capacity. Soils were sandy and clayey in nature with low and high water-holding capacity respectively[12,13]. In ten villages soil samples, analysis of water holding capacity in each soil reveals that (Table 7). Sugganahalli and Byathahalli (32 mL of water holding) show the highest water holding capacity and its followed by Kokkarehundi (29 mL) and Bonthagahalli (28 mL).

The other objectives of the investigation were to study the status of inorganic salts and their relationship with various physicochemical properties. The soil properties, particularly soil pH and organic carbon influenced the availability of both macro and micronutrients. Phosphorus is one of the key macronutrient required for plant growth and metabolism than Nitrogen and Potassium. Nazif *et al.*[14] studied the micronutrient status of soils of district Bhimber (Azad Jammu and Kashmir). Similarly, Ravikumar *et al.*[15] reported that the micronutrient status of Malaprabha Right Bank Command of Karnataka. In the present investigation highest nutrient-rich soil were reported from Bhugathagalli (40-N, 15-P, 150-K), Sugganahalli (40-N, 35-P, 100-K), Marse (40-N, 25-P, 50-K) and KM Hundi (40-N, 25-P, 100-K) were reported (Table 6).

In Table 8, lists out the presence or absence of inorganic salts like sulphate, chloride and phosphate and other salts (Carbonate and nitrate). Among all these carbonate content reported in Bhugathagalli, Halagana Hundi, Marse, KM Hundi, Byathahalli and Sugganahalli soil samples, nitrate content reported only in Kokkarehundi, Marse and Sindhuvalli soil samples and inorganic salts sulphate reported in Bonthagahalli, Marse, KM Hundi, Byathahalli and Sindhuvalli and Chloride reported in Halagana Hundi, Marse, Sindhuvalli and Chikkakanya soil samples. Phosphate is totally absent in all soil samples except KM Hundi village soil sample.

In Table 9, try to analyze the correlation of available nutrients in soil samples of ten villages with the type of crop

Table 9: Co-relation between the standard nutritional requirement of crop and available nutrition in soils of each village

		Nitrogen (kg/acre)		Phosphorous (kg/acre)		Potassium (kg/acre)	
Samples	Type of major crops	Standard requirement*	Present	Standard requirement	Present	Standard requirement	Present
Bhugathagalli	Leafy vegetable and ragi	25-30	40	12-15	15	25-30	150
Bonthagahalli	Ragi, maize	25-30	20	12-15	15	25-30	50
Halagana Hundi	Rice, sugarcane, tomato, cucumber, aster flower	25-30	30	12-15	15	25-30	50
Kokkarehundi	Maize, horse gram, ragi, pigeon pea	25-30	30	12-15	15	25-30	50
Sugganahalli	Rice, ragi, leafy vegetables, aster flower	25-30	40	12-15	35	25-30	100
Marse	Ground nut/ragi/maize/leafy vegetables/vegetables	25-30	40	12-15	25	25-30	50
KM Hundi	Horse gram/ragi	25-30	40	12- 15	25	25-30	100
Byathahalli	Sugarcane/rice	25-30	30	12-15	15	25-30	150
Sindhuvalli	Cotton/garden pea/ground nut	25-30	20	12-15	15	25-30	50
Chikkakanya	Cucumber/lady finger/black gram	25-30	20	12-15	15	25-30	50

*www.fao.org/docrep/pdf/009/a0443e/a0443e04.pdf grown in a particular area. The data show that no deficiency of nutrition occurs (for both N and P) in soil and the availability of potassium is high in these villages. While, nitrogen deficiency occurs in two villages namely Bonthagahalli (20 kg/acre), Sindhuvalli (20 kg/acre) and Chikkakanya (20 kg/acre). No phosphorous deficiency occurs in any villages but Potassium is very high in Bhugathagalli (150 kg/acre), Byathahalli (150 kg/acre), Sugganahalli (100 kg/acre) and KM Hundi (100 kg/acre) compare to normal range.

Based on the overall analysis it is very clearly shown that in all soil types macronutrients are sufficiently present but the crops suffer from inorganic salt contents. Change in edaphic factors greatly influence mycorrhizal diversity. A similar type of work was noticed in the Cauvery basin of Karnataka[16,17].

CONCLUSION

This research work reveals the soil properties of collected soil samples from ten villages of Mysuru district in Karnataka state. The data is useful for farmers to know the content of the soil in their areas and scientist knows about the idea of utilizing the soil doctor kit for the analysis of edaphic factors within a short period of time.

SIGNIFICANCE STATEMENT

This study discovers the different soil parameters in ten villages like soil pH, soil moisture, soil temperature, water holding capacity of the soil, soil nutrients, etc., that can be beneficial for farmers and researchers who involve in agriculture. This study will help the researcher to uncover the critical area of using soil doctor kit method that many researchers were not able to explore. Thus a new theory on the analysis of edaphic factors may be arrived at.

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