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A STUDY ON SEASONAL VARIATIONS OF PHYSICO-CHEMICAL CHARACTERISTICS OF SOIL SAMPLES WITH CHEMICAL FERTILIZER RESIDUES UNDER DIFFERENT CROPPING PATTERNS

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ABSTRACT

The physico-chemical characteristics of soil samples from agricultural fields of Hunsur taluk were analyzed for seasonal variations. The seasonal variations of main soil characteristics were studied under different cropping pattern in the agricultural lands of Hunsur taluk. The soil samples were collected during rainy, winter and summer seasons from 15 different agricultural lands and were analyzed for different physico–chemical characteristics and chemical fertilizer residues. From the study, it was concluded that, in all the soil samples, urea and DAP residues were detected. The pH of soil samples were found to be neutral to alkaline in nature and the ions like calcium, magnesium, sodium and potassium were found to vary during all the seasons. Most of the ionic content was found to be decrease during winter season. The total nitrogen and ammoniacal-nitrogen content were found to be higher in all the seasons.

Key Words: Urea, DAP, Soil Characteristics, Cropping pattern.

I. INTRODUCTION

Soil properties play a major role in assessing nutritional status of agricultural lands for cultivation of different crops with different cropping patterns (Bharathi Sharma et.al., 2013). The soil characteristics mainly depend on various factors such as, climatic conditions of place and land forms and other factors such as, total ionic contents in the soil (Granados et.al., 2006). Among the various parameters, total ionic content of soil has greater influence on soil geochemistry and distribution of vegetation of a particular place. The continuous application of nutrients in the form of chemical fertilizers helps to improve the nutritional status of deficient soils (Haynes et.al., 1998). The monitoring of soil characteristics is essential in order to know the information about the nutritional status of soil during cropping season and harvesting period, which helps to manage soil health as well as production of crops. Since there are disadvantages associated with use of chemical fertilizers, the complete soil analysis during and after harvesting the crops help for the complete soil fertility management for increasing the crop yield as a part of soil fertility management (Vinod Dubey et.al., 2012). Hence, the present study has been under taken to assess the nutritional status of agricultural soil samples of Hunsur taluk with respect to seasonal variations of different agricultural lands and cropping pattern.

II. MATERIALS AND METHODS:

Study area

Hunsur Taluk is one of the seven taluks in the district. Hunsur is located at 12.31°N 76.29°E. It has an average elevation of 792 metres (2598 feet). The river Lakshmana Tirtha flows though the town. It is bounded in the north by K.R.Nagara taluk, in the south by H.D.Kote taluk, in the east by Srirangapatna & Mysore taluk and in the west by Periyapatna taluk & Kodagu district. Red soil, gravelly soil, Black soil and Clay soil are found in Hunsur taluk. Actual rainfall of Hunsur taluk was 742.9 mm. The total geographical area is about 98194 ha out of which 64870 ha of land is used for agricultural purpose. The agricultural lands cover most of the area. The main cropping season is from September to January. During this period, Paddy and vegetables are grown. These crops mainly depend on borewell, river and channel water sources, used for irrigation throughout all the seasons. The second cropping season is from February to May. Tobacco, maize, turmeric, vegetables, cotton, banana, green leafy vegetables are grown. These crops are mainly dependent on channel water. Tobacco and maize are the major crop grown in majority of the area throughout the year. The most commonly used fertilizers are urea and diammonium phosphate during farming season. The amount of chemical fertilizers used varies within the study area, depending on the type of crop and the actual rate of application varies, depending on the farmer's practice which may exceed the prescribed rate.

Collection of the soil samples:

15 soil samples were collected from selected agricultural areas from different farm lands during rainy, winter and summer seasons respectively(From 2011-2013). From each of the farm lands, composite soil samples were collected along with one sample from non-agricultural land. The soil samples were collected at 0-15 cm depth, air dried, ground and sieved through 2 mm sieve and stored in polythene bags until analysis. The physico-chemical analysis was carried out as per standard methodology of Arun Kumar Saha (2008), GKVK manual (1999).

Experimental work:

The soil samples were analyzed for various physico-chemical parameters. The soil moisture content was assessed by gravimetric method. The bulk density and particle density were determined by core sampler method and volumetric flask method. The urea residues were quantified by reaction of urea with diacetylmonoxime under acidic condition using spectrophotometer. The diammonium phosphate residues were calculated by using amount of phosphate (taking difference between agricultural and non-agricultural soil samples) present in soil samples, considering the molecular weight of DAP and weight of phosphate group of DAP. The soil pH was measured in 1:5 soil/water suspensions using the glass electrode pH meter. The electrical conductivity of the soil extract was determined by using conductivity meter. The organic carbon was determined by using potassium dichromate wet oxidation method. The total nitrogen was determined by Kjeldhal distillation method, while the phosphate was determined by o-dianisidine molybdate method. The sodium and potassium concentrations were determined by flame photometry. Estimation of calcium and magnesium was done by EDTA titration method and the ammoniacal nitrogen by Nessler's reagent method.

Table-1: Sampling points with sampling codes, crop types and types of fertilizers applied for agricultural lands of Hunsur taluk

Sl No	Sampling stations of soil /water	Types of crops cultivated	Types of fertilizers used	Water source	Quantity of	
					urea applied	DAP applied
1	Dharmapura	Cotton, Turmeric	Urea, DAP	Bore well water	100 kg/ha	50 kg/ha
2	Karimuddanahalli	Coconut, Turmeric	Urea, DAP, Organic manure	Bore well water	100 kg/ha	50 kg/ha
3	Ballenahalli	Mango	Urea, DAP, Organic manure	Bore well water	100 kg/ha	50 kg/ha
4	Hralahalli	Turmeric, Coconut	Urea, DAP, Organic manure	Bore well water	100 kg/ha	50 kg/ha
5	Thattekere	Turmeric, Banana	Urea, DAP, Organic manure	Bore well water	100 kg/ha	50 kg/ha
6	Nadappanahalli	Maize, Tobacco	Urea, DAP, Organic manure	Bore well water	100 kg/ha	50 kg/ha
7	Halepura	Maize, Turmeric, Tobacco	Urea, DAP, Organic manure	Bore well water	100 kg/ha	50 kg/ha
8	Gagenahalli	Maize, Turmeric, Tobacco	Urea, DAP, Organic manure	Bore well water	100 kg/ha	50 kg/ha
9	Hallikere	Maize, Banana	Urea, DAP	Bore well water	100 kg/ha	50 kg/ha
10	Gohalli	Maize, Banana, Ginger	Urea, DAP, Organic manure	Bore well water	100 kg/ha	50 kg/ha
11	Asvalu	Paddy	Urea, DAP	Channel water	100 kg/ha	50 kg/ha
12	Kuttavadi	Coconut, Turmeric	Urea, DAP, Organic manure	Channel water	100 kg/ha	50 kg/ha
13	Varanchi	Turmeric, Banana	Urea, DAP, Organic manure	Channel water	100 kg/ha	50 kg/ha
14	Ummathur	Aracanut, Banana	Urea, DAP, Organic manure	Channel water	100 kg/ha	50 kg/ha
15	Uddurkaval	Paddy	Urea, DAP	Channel water	100 kg/ha	50 kg/ha

III. RESULTS AND DISCUSSIONS:

Table -2: Seasonal variations of chemical fertilizer residues and physico-chemical characteristics of soil samples of Hunsur taluk

Seasons	Urea	DAP	MC	BD	PD	P	pH	EC	Ca^{2+}	Mg^{2+}	OC	TN	Na^{+}	K^{+}	PO_4^{3-}	NH_4^{+}-N
R12011	**8.70**	18.9	**35.2**	1.23	2.56	50.98	**7.44**	0.345	5.39	**4.26**	1.34	**2024.8**	114.1	**72.53**	**11.66**	5.74
R22012	**8.91**	25.3	**41.9**	1.27	2.57	50.38	**7.42**	0.409	6.22	**3.27**	1.37	**1298.9**	111.6	**68.66**	**9.06**	4.46
R32013	**7.54**	24.8	**45.9**	1.27	2.52	48.56	**7.33**	0.448	6.44	**6.44**	1.38	**1000**	100.9	**63.33**	**9.00**	4.63
W12011	6.96	**23.6**	26.7	**1.26**	**2.58**	50.27	7.20	0.397	**6.23**	4.30	**1.44**	1660.6	138.3	64.6	11.79	11.50
W22012	5.45	**26.3**	33.9	**1.27**	**2.57**	45.96	7.27	0.417	**6.52**	3.36	**1.32**	917	128.3	60.33	7.83	7.83
W32013	4.36	**27.2**	34.9	**1.31**	**2.61**	48.13	7.30	0.484	**6.76**	3.71	**1.36**	755.6	114.9	62.26	8.68	8.5
S12011	6.08	28.2	27.3	1.12	2.53	**52.04**	7.35	**0.418**	5.39	4.34	1.16	1276.7	**146.5**	58.6	11.63	**11.63**
S22012	6.08	20.1	27.6	1.15	2.59	**50.76**	7.29	**0.487**	5.62	3.46	1.13	793.2	**124.2**	64.53	10.61	**10.61**
S32013	3.20	18.9	21.8	1.10	2.57	**52.86**	7.22	**0.517**	5.14	2.93	1.15	652.7	**120.9**	61	9.82	**9.82**
NAS	-	-	**12.36**	**1.08**	**5.0**	**78.4**	**7.4**	**0.18**	**15.3**	**8.1**	**1.52**	**136.2**	**51.7**	**33.1**	**9.1**	**1.79**
SQS	-	-	-	**1-1.65**	**2-2.65**	**30-55**	**6.5-7.5**	**0-2**	**10-30**	**5-10**	**0.50-0.75**	**200-500**	-	**50-125**	**5-10**	-
UNITS	**ppm**	**ppm**	**%**	**mg/m^3**	**mg/m^3**	**%**	-	**dS/m**	**Meq/l**	**Meq/l**	**%**	**Kg/ha**	**Kg/ha**	**Kg/ha**	**ppm**	**ppm**

DAP- Diammonium phosphate, MC- Moisture content, BD-Bulk density, PD –Particle density, P – Porosity, EC-Electrical conductivity, Ca^{2+}- Calcium, Mg^{2+}- Magnesium, OC-Organic carbon, TN-Total Nitrogen, Na^{+}-Sodium, K^{+}- Potassium, PO_4^{3-}- phosphate. NH_4^{+}-N - Ammoniacal nitrogen.

NAS-Non agricultural soil sample, SQS-Soil quality standards.

From the seasonal quantification analysis of chemical fertilizer residues and physico-chemical characterization of soil samples of Hunsur taluk (Table-2.), following observations were made. During the present investigation, from the study area 15 soil samples were collected over a period of 2011-2013 from different agricultural lands. From the seasonal analysis during 2011-2013, following observations were made from the experimental results with respect to different seasons

Urea: A variations in urea residues were observed throughout the study period. The urea content was 8.91ppm (2012) in rainy season, 6.96 ppm (2011) in winter season and 6.08 ppm (2011) in summer season. The present study shows, a gradual reduction in urea residues from rainy to summer season. Many research on urea reveals that, the variations in urea residues mainly depends on soil pH, temperature, moisture content, organic carbon, quantity of urea applied which varies with respect to seasons (Bremner and Mulvaney, 1978).

Diammonium phosphate residues: The DAP content in soil samples was 25.3 ppm (2012) in rainy season, 27.20 ppm (2013) in winter season and 28.2 ppm (2011) in summer season. Highest concentration was reported during summer season. High concentration of DAP residues indicate that, the quantity of fertilizer applied to the soil has not been completely utilized by the crops.

Moisture content: During the present investigation, the moisture content was found to be high in rainy season compared to winter and summer season. In case of non-agricultural soil samples, the moisture content was found to be 12.36 %. The variation in moisture content depends on the amount of pore space present in soil, which is related to soil texture.

Bulk density: Bulk density is defined as the mass of soil material present per unit volume of moist soil under naturally undisturbed conditions. The present study shows variations in bulk density of soil samples. In comparison to seasons, highest concentration was recorded in winter season 1.31mg/m^3 (2013). In case of non-agricultural soil samples, the bulk density was found to be 1.08 mg/m^3. Bulk density is related to total porosity or pore space present in the soil for air and water movement (Mini et al, 2003: Tester, 1993). Lower bulk density implies greater pore space and improved aeration, developing a suitable environment for biological activity (Werner, 1997).

Particle density: Particle density is the density of solid particles in a particular sample. During the present study, the particle density of soil samples in all the seasons ranged from 2 to 2.65 mg/m^3. This indicates the presence of clay and quartz minerals in the soil matrix. High particle density indicates the presence of rich iron in soils ex: ferromagnesian mineral density range from 2.9 to 3.5 mg/m^3 and the density of iron oxides and other heavy minerals can exceed 5-10 mg/$m^{3.}$

Porosity or pore space: Porosity or pore space of a soil is that portion of the total soil volume, which is not occupied by solid particles but occupied by air or water. During present investigation, the porosity value was 50.98% (2011) in rainy season, 50.27% (2011) in winter season and 52.86% (2013) in summer season. In case of non-agricultural land soil samples, the porosity value was found to be 78.4 %. The pore space of a soil varies with respect to soil texture, shape of individual soil particles, organic carbon content and nature of crop soil management.

pH: The present study shows, variations of pH in soil samples. The pH value was found to be 7.44 (2011) in rainy season, 7.30 (2013) in winter season and 7.35(2011) in summer season. For non-

agricultural soil sample, the pH was found to be 7.4. As per the present investigation, Long term fertilizer application of nitrogenous and phosphorous fertilizers results in low soil pH, which confirms the findings of Aref and Wander *et al* (1998). Rainfall also affects soil pH, it decreases during rainy season (De S, 2009) as water passing through the soil leaches basic nutrients such as calcium and magnesium from the soil (Bernstein L. 1975) **.**

Electrical conductivity: Electrical conductivity determines the amount of salts present in soil suspension. During the present investigation, the EC was found to be 0.448 dS/m (2013) in rainy season, 0.484 dS/m (2013) in winter season and 0.517 dS/m (2013) in summer season. For non-agricultural soil sample, the EC was found to be 0.18 dS/m. The value of electrical conductivity was from zero to 2 dS/m, which is safe for all the crops.

Calcium and Magnesium: The calcium content in Hunsur taluk soil samples was 6.44 Meq/l (2013) in rainy season, 6.76 Meq/l (2013), in winter season and 5.62 Meq/l (2012) in summer season. The Magnesium content was 6.44 Meq/l (2013) in rainy season, 4.30 Meq/l (2011) in winter season and 4.34 Meq/l (2011) in summer season. The calcium content were highest in winter season. In comparison with the non-agricultural soil samples, the calcium and magnesium content was found to be very less. Many field trial experiments on urea amended soil shows that, depletion of basic cations, such as calcium, magnesium, sodium, potassium in fertilizer treated plot was observed compared to non fertilizer treated plots. The depletion of these basic cations will accelerate the acidification process in soil which is another reason for decrease in soil pH and confirms the findings of Nel *et al* (1996).

Organic carbon: Organic carbon is an index of soil productivity. During the present investigation, the organic carbon content in Hunsur taluk soil samples was 1.38 % (2013) in rainy season, 1.44% (2011) in winter season and 1.16 % (2011) in summer season. In non-agricultural soil samples, the organic carbon was found to be 1.52 %. For all the soil samples, the organic carbon was found to be higher compared to the normal range. The high organic carbon is due to accumulation of crop residues on soil surface (Ashok, 1998).

Total nitrogen: The total nitrogen content for all the soil samples in all the seasons was found to be higher in range. The total nitrogen content was 2024.8 ka//ha (2011) in rainy season, 1660.6 kg/ha (2011) in winter season and 1276.7 kg/ha (2011) in summer season. Highest values were recorded during rainy and winter season. Similarly, in case of non-agricultural soil, the value was found to be 136.2 kg/ha. Except, non-agricultural soil samples, total nitrogen in all the agricultural soil samples in all the seasons was found to be high, which is due to excessive application of nitrogenous fertilizers and also through leguminous crop rotation (Nel *et al,* 1996), apart from which, soil chemistry greatly varies with seasonal changes, the C or N contents of soil varied seasonally, due to differential microbial activities for decomposing biomass accumulation and thereby nutrient recycling within the soil environment.

Ammoniacal-nitrogen: The ammoniacal-nitrogen content in Hunsur taluk soil samples was 5.74 ppm (2011) in rainy season, 11.50 ppm (2011) in winter season and 11.63 ppm (2011) in summer season. In case of non- agricultural soil samples, the ammoniacal-nitrogen was found to be 1.79 ppm. In comparison with the non-agricultural soil sample, the ammonical-nitrogen content in all the agricultural soil samples were found to be higher, which mainly depends on moisture content and enzymatic activity of soil system which may vary from one place to another with different seasons (Bremner *et al,* 1978).

Sodium and potassium: Sodium and potassium are important basic cations, which are considered as indicators of nutritional imbalance**.** During the present study, the sodium content in Hunsur taluk soil samples was 114.1 kg/ha (2011) in rainy season, 6.76 kg/ha (2013) in winter season and 5.62 kg/ha (2012) in summer season. The potassium content was 72.53 kg/ha (2011) in rainy season, 64.6 kg/ha (2011) in winter season and 58.6 kg/ha (2011) in summer season. In case of non- agricultural soil samples, the sodium and potassium concentrations were found to be 23.1 and 14.8 kg/ha respectively. In comparison with concentrations of non-agricultural soil samples, the sodium and potassium concentrations were found to be high. This confirms the findings of Gurumurthy *et al* (2009) that, his experiments on long term application of different types of chemical fertilizers on soil, resulted in the decline of basic cations.

Phosphate: During the present investigation, the phosphate concentrations of Hunsur taluk soil samples was 11.66 ppm (2011) in rainy season, 11.79 ppm (2011) in winter season and 11.63 ppm (2011) summer season. In non-agricultural soil samples, the phosphate concentration was found to be 9.1 ppm. The high phosphate levels in all the sampling areas were found to be higher than the normal range, which is due to excessive application of phosphate fertilizers. This was confirmed from the report of McCollum (1991), that long term phosphate fertilizer application in excess quantity than the crop requirement, results in a large build up of phosphorous reserves, which may persist for many years.

IV.CONCLUSIONS

From the present study, it confirms that, the application of chemical fertilizers has greater influence on soil under different cropping pattern. Most of the soil samples were found to be neutral to alkaline in nature and the ions like calcium, magnesium, sodium and potassium were found to vary during all the seasons. Most of the ionic content was found to be decrease during winter season. Phosphate level was found to be higher in all the sampling areas, which was due to over-use of phosphate fertilizers. The total nitrogen and ammoniacal-nitrogen content were found to be higher in all the seasons. From the results of seasonal variations of soil characteristics, it was found that, majority of all the cations and anions in soil were found to be higher during monsoon season followed by winter and lesser during summer. The different sources of flooding water and the fertilization habits can be responsible to some extent, for the soil chemical characteristics variability along with seasons. However, it is necessary to apply liming material to reduce the acidifying effect on agricultural lands in order to maintain basic cation levels in soil.

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