Study on Distribution of Micro Nutrients, Electro-chemical behavior and saline soil properties due to heavy irrigation in Bagalkot district, Karnataka state, India.

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ABSTRACT: The electro-chemical behavior, salinity assessment and deficiency of micro-nutrients in soil samples from selected locations of highly irrigated cultivated lands of Bagalkot district have been investigated on the basis of Cation exchange capacity, the levels of Physico- and electro-chemical parameters such as Bulk density, soil texture, and water holding capacity, pH, EC, Sodium and Calcium carbonate. The major nutrients such as OC, available Nitrogen, available Phosphorous and available Potash and the Micro-nutrients such as Iron, Manganese, Zinc, Copper, Boron and Molybdenum were determined by using flame photometer, visible spectrophotometer and Atomic Absorption spectrophotometer followed by so far reported standard methods respectively. The secondary nutrients such as Calcium (%), Magnesium (%) and Sulphate (ppm) were determined by simple titration methods.

Key words: Electro-chemical behavior, soil salinity, plant nutrients, heavy irrigation, cultivated lands, vegetations and plant growth.

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I.   INTRODUCTION:

Salts can come from irrigation water, fertilizers, compost and manure. The potential problem in irrigated soils due to high evaporation rates and low annual rain fall leaving salts to accumulate. The severe accumulation of salts may restrict growth of many vegetables. Even moderate accumulation of salts in soils requires more frequent irrigation. Hence, salts can be leached by slowly applying excess water e.g. 3 inches of water table removes about 50% of the soluble salt and 5 inches removes at 90% soluble salt from soil system. Uses of liming materials such as lime stone, wood ashes and some composts leads to increase the soil pH – value, the use of sulphur more than recommended doses, ammonium and ammonium forming N- fertilizers will decrease in soil pH; in both cases the soils and sediments put into the deficiency in micro-nutrients.

II.   MATERIALS AND METHODS:

Soil samples were collected by scrapping using a pre-cleaned and acid washed plastic scales and immediately kept in clean polythene bags. 5 grams of soil sample were taken into 150 ml conical flasks separately, 50 ml of 0.1 M HCl was added and flasks were kept on shaker for one hour. The content were filtered into 50 ml standard flask and made up to mark with 0.1 M HCl for determination of micro-nutrients using Atomic Absorption Spectrophotometer (AAS).

The dried samples (50 mg) were digested in 2 ml of Nitric acid (70%) Merck, in a block thermostat at $80^{o}C$ for 3 to 4 hours until the solutions were clear [6-7]. The extracted soil solutions than made up to 25 ml with double distilled water in 25 ml volumetric flask separately, the micro-nutrients (trace elements) were analyzed in all samples by using AAS. The soils were analyzed for physicochemical parameters using respective instruments, Secondary and Major nutrients were analyzed according to the standard procedures by using Nitrogen analyzer and Flame photometer respectively, the values obtained were within 5 – 10% range from the reference values.

All the reagents used were of analytic grade, Deionized water (18 mega ohm resistivity) prepared from Millipore mili-Q water purification system, USA was use throughout. Hydrochloric acid (Merck) 40% ultra pure were used to carry the experiments [8].

III.   RESULTS AND DISCUSSION:

Quality of soil samples were investigated seasonally from the selected locations of Bagalkot district. The district is composed with six taluks (Jamkhandi, Mudhol, Bilagi, Bagalkot, Badami and Hunagund). The research work was under taken to know the salinity condition in soil samples and micro-nutrients status in them. All the values were recorded in Tables 1 to 6 and the recorded values were compared with WHO, ISI and Bureau of standards. The figures I to VI reveal the comparative study of Major-nutrients in the Soil samples of cultivated lands of various regions of Bagalkot district.

1.   Soil Salinity Condition of Jamkhandi location during the monitoring period.

Black sandy soil with 53% water holding capacity. Sodium, calcium and magnesium salts found to be more which indicates the wood ashes applied to the soil. The organic carbon

found to be in higher range. Available nitrogen & % of total nitrogen content in the soil samples found quit normal, indicates the regular and proper doses of nitrogenous containing fertilizers were used during agriculture activities. Available P deficiency was noticed in the samples. Hence crops are prone to iron chlorosis and soil phosphorus is excess due to the lack of fertilization. Available K found lower limit in soil to enrich the soils with K, suitable and in proper proportions fertilizers are needed regularly. Available sulphur in the form of S04 in soils found very irregular in the soil samples lower in few spots and higher few soils. Micronutrients: iron, manganese found to be within the legal requirement in spots S1 and S2 and deficiency in spots S3 and S4. Boron, molybdenum, zinc and copper found in legal limits.

Salinity Conditions: high soil salinity reduces crop yields in the long run. The soil salinity measured and justified by the EC values, if the EC value is more than 4 or above, the soil possess severe accumulation of salts may restrict the growth of plants and vegetations. The soil in the present location is less than 1.

2.   Soil Salinity Condition of Mudhol location during the monitoring period.

Sandy mixed red clay soil, having 56% water holding capacity. Organic carbon found to be in higher range. Available nitrogen was found to be lower at spots S2 and S4 and Total nitrogen percentage found to be in the normal range. Nitrogen containing fertilizers should be essential for sensitive crops. Available P found above the normal range, indicates that during the agricultural activities soils were mixed with the DAP regularly. Available K also noticed higher than the prescribed limits in three spots, whereas at spot S3 K level in normal range. Available Sulphur in the form of Sulphate found in the normal range and the soils were highly alkaline in nature with normal electrical conductivity. Micro-Nutrients: Iron just below the normal range, Manganese, Zinc and Born recorded with lower concentration in all the selected spots of soil samples, whereas Copper concentration and Molybdenum was in normal range.

Salinity Conditions: high soil salinity reduces crop yields. The soil salinity depends on the EC values, if the EC value is more than 4 or above, the soil possess severe accumulation of

salts may restrict the growth of plants and vegetations. The soil in the present location is found more than 4 ds /m.

3. Soil Salinity Condition of Bilagi location during the monitoring period.

Black clay with good water holding capacity. The organic carbon in the soil samples were normal to medium, indicates that the organic manures used regularly during agriculture practices. A pH = 8.59 probably create severe micronutrient deficiency (Fe, Mn) and (Ca, Mg) result in a general yellowing and poor growth. If the pH of soils can be lowered simply by using fertilizers containing Ammonium Nitrate, Ammonium Sulphates, Urea, Sulphur and Ammonium Sulphate (10 pounds of sulphur per acre as a plant nutrient).Available nitrogen is slightly higher than the prescribed levels, total nitrogen in the soil samples were found to be slightly higher levels. Available phosphorus found in deficient level it is required to enrich the P content by using suitable fertilizer like DAP and others. Available potassium in the soil samples were found to be in lower levels, Available sulphur in the form sulphate lower levels, gypsum, zinc sulphate and borax should be used as fertilizer. Micronutrient: Zinc found normal at spots S1 and S4, lower at spots S2 and S3, Manganese and Boron found deficient, copper is found higher, whereas Iron, Copper and Molybdenum found normal.

Salinity Conditions: high soil salinity reduces crop yields in the long run. The soil salinity is justified by the EC values, if the EC value is more than 4 or above, the soil possess severe accumulation of salts may restrict the growth of plants and vegetations. The soil in the present location is less than 1.

4. Soil Salinity Condition of Bandai location during the monitoring period.

Red clay soil with 57% water holding capacity and 1.13g/cc bulk density. The organic carbon found to be in higher range. Available nitrogen and Total nitrogen among the selected soil samples found to be higher values than prescribed limit indicates the uses organic manures regularly during agriculture activities. Available P and Available sulphur in the form of sulphate was found to be in the normal range but Available K found deficient in the soil samples. Micronutrient: iron and manganese in ppm levels found to be lower than the prescribed limit. Boron, Copper, Zinc and Molybdenum found in normal range.

Salinity Conditions: high soil salinity reduces crop yields in the long run. The soil salinity is measured by the EC values, if the EC value is more than 4 or above, the soil possess severe accumulation of salts may restrict the growth of plants and vegetations. The soil in the present location is less than 1.

5. Soil Salinity Condition of Bagalkot location during the monitoring period.

Black-clay (sandy) alkaline soil with 58% water holding capacity, Organic carbon in all the spots found to be higher in range. Available Nitrogen in soils was found to be lower in level, the neutral fertilizers like Urea should be used for growth and yield of plants and crops. CAN- can be used to increase the availability of micro-nutrients in the soil. Total Nitrogen found higher-limits. Available Phosphorous in the soil samples found to be deficiency, suitable fertilizer should be used to enrich the nutrient. Available Potassium in soil samples found normal except for the spot S1, salts of Na and K are called high salts, the high salts will kill the plants and crops if they found higher limit. Available Sulphur in the form of Sulphate found deficiency, to enrich this nutrient it should be mixed suitably with any one of the fertilizer during cultivation. Micro-Nutrients: the situation could create a very high soil pH more than 8.0 due to the use of lime, basic slag, wood ashes make the soil with great mulch and it create the severe micro nutrient deficiency. The micro nutrients in soil such as Fe, Mn found in lower level. Boron and Molybdenum found in normal level where as Zinc and Copper found in higher levels.

Salinity Conditions: high soil salinity reduces crop yields in the long run. The soil salinity measured and justified by the EC values, if the EC value is more than 4 or above, the soil possess severe accumulation of salts may restrict the growth of plants and vegetations. The soil in the present location is less than 1.

6. Soil Salinity Condition of Hunagund location during the monitoring period.

Percentage of organic carbon in the selected soils samples of the spots found to be more soil is black and red mixed clay with medium fertile. Available nitrogen was found to be normal at two spots and slightly higher at two spots S1 and S4.Total nitrogen % in the soil samples found to be more than normal levels, such soil do not cause any deleterious effect on crops. Available P in the three sampling spots are very less in content, Used DAP fertilizer were

washed from the soil by regular rains. Available K found in medium level of all the soil samples. Available S in the form of SO4 was in normal . Micronutrients: Iron in ppm levels found to be deficient, Mn in ppm level was found maximum quantity. Zinc in ppm legal level, copper in ppm legal level and Molybdenum in all selected spots were in normal range, whereas Boron was found to be in lower range except for the spot S3.

Salinity Conditions: high soil salinity reduces crop yields in the long run. The soil salinity is depended upon by the EC values, if the EC value is more than 4 or above, the soil possess severe accumulation of salts may restrict the growth of plants and vegetations. The soil in the present location is less than 1.

Information and Suggestion Recommendations: The following fertilizers should be used for sensitive crops and sugar cane crop in Kg per hector and kg per acre.

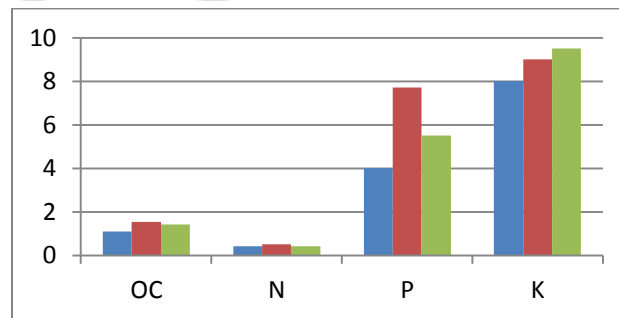| Sensitive crops				sugar cane crop		
Urea	58 kg/ha	23kg/acre		Urea	210kg/ha	84kg/acre
DAP	95kg/ha	38kg/acre		DAP	160kg/ha	64kg/acre
Potash	18kg/ha	7kg/acre		Potash	150kg/ha	60kg/acre
Gypsum	160kg/ha	64 kg/acre		Gypsum	190kg/ha	76kg/acre
Org.Manure	100 kw/ha	40 kw/acre		Org.Manure	150kw/ha	60 kw/acre

Figure I. Major Nutrients in Soil samples of Jamkhandi Region of Bagalkot District:
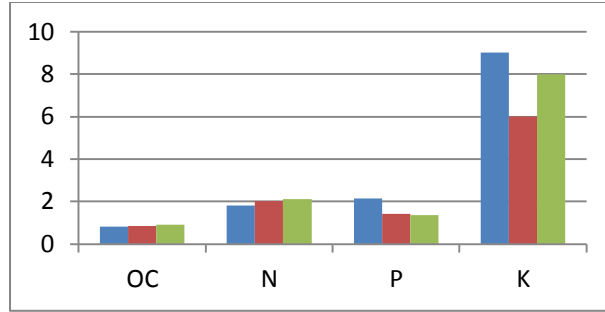
Figure II. Major Nutrients in Soil samples of Mudhol Region of Bagalkot District:
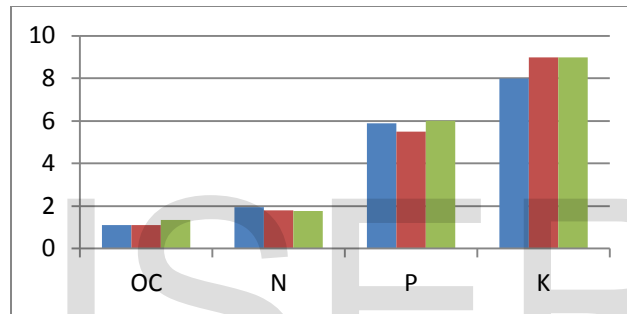
Figure III. Major Nutrients in Soil samples of Balagi Region of Bagalkot District:
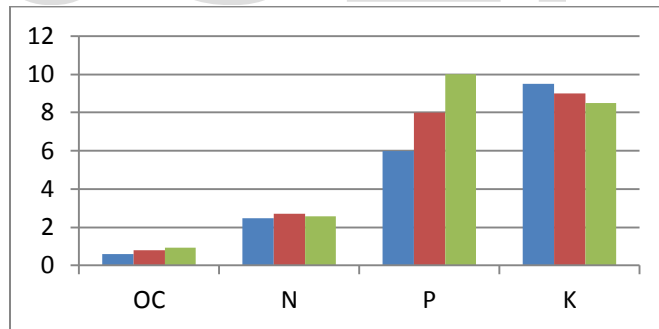
Figure IV. Major Nutrients in Soil samples of Bagalkot Region of Bagalkot District:
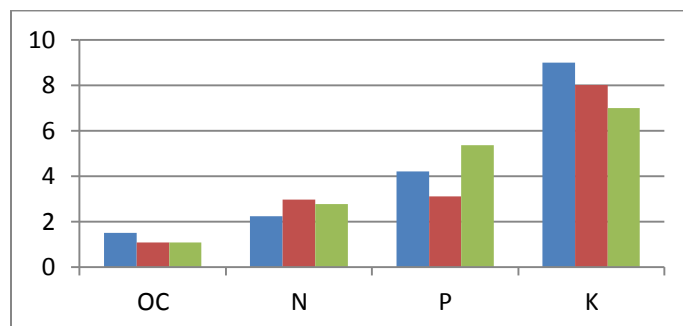
Figure V. Major Nutrients in Soil samples of Badami Region of Bagalkot District:
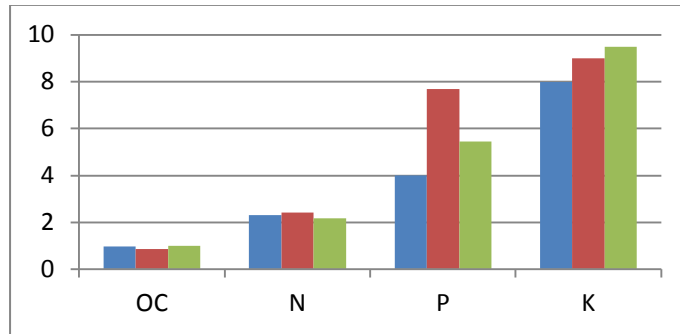
Figure VI. Major Nutrients in Soil samples of Hunagund Region of Bagalkot District:

TABLE 1

SOIL ANALYSIS
Soil analysis of Report of Jamkhandi locations of Bagalkot District:
Village: Hire Padasalagi,   Analysis Date: 02.08.2015
During: Pre- Monsoon 2015.

Sl.No.	Parameter	UNIT	Spot S1	Spot S2	Spot S3	Spot S4	Legal limit
I	Physical-Parameters						
	Bulk Density	g/cc	1.12	1.14	1.12	1.11	
	Water Holding Capacity	%	52	53	53	52	
	Texture		Sandy	Sandy	Sandy	Black	
II	Chemical Parameters						
	pH		7.56	7.84	7.86	7.78	6.5-7.5
	EC	ds/m	0.68	0.74	0.82	0.69	<1
	Sodium	%	1.21	1.22	1.32	1.29	<0.1
	Calcium Carbonate		Medium	Medium	Medium	Medium	
III	Major Nutrients						

	Organic Carbon	%	1.32	1.89	1.12	1.46	0.5-0.75
	Avail.N	Kg/h	275.3	268.4	291.2	284.3	250-280
	Total N	%	0.089	0.058	0.078	0.069	0.03-0.06
	Available P	Kg/h	11.2	10.3	9.23	9.87	20-60
	Available K	Kg/h	251	246	231	245	250-300
IV	Secondary Nutrients						
	Ca	%	16.2	14.3	15.6	13.4	<1
	Mg	%	1.9	2.0	2.2	2.8	<0.5
	SO4	Ppm	21.2	19.8	18.6	20.1	10-20
V	Micro Nutrients						
	Iron (Fe)	Ppm	4.75	4.98	4.12	3.98	Min.4.50
	Manganese	Ppm	2.12	2.22	2.03	2.09	Min.2.00
	Zinc (Zn)	Ppm	1.01	1.22	1.21	1.29	Min.0.75
	Copper (Cu)	Ppm	1.98	2.01	1.89	2.10	Min.0.60
	Boron	Ppm	0.78	0.68	0.95	0.88	Min.0.50
	Molybdenum	ppm	0.11	0.10	0.09	0.08	0.05-0.2

TABLE 2

SOIL ANALYSIS REPORT
Soil analysis of Report of Mudhol locations of Bagalkot District:
Village: Kajji Doni,   Analysis Date: 16.08.2015
During: Pre- Monsoon 2015.

Sl.No.	Parameter	UNIT	Spot S1	Spot S2	Spot S3	Spot S4	Legal limit
I	Physical-Parameters						
	Bulk Density	g/cc	1.12	1.10	1.12	1.14	
	Water Holding Capacity	%	56	54	56	54	
	Texture		Red-clay	Red-clay	Red-clay	Red-clay	
II	Chemical Parameters						
	pH		8.12	8.24	8.32	8.28	6.5-7.5
	EC	ds/m	4.46	4.52	4.34	4.58	<1
	Sodium	%	0.92	0.81	0.83	0.77	<0.1
	Calcium Carbonate		High	Medium	Medium	Medium	
III	Major Nutrients						

	Organic Carbon	%	0.85	0.87	0.95	0.99	0.5-0.75
	Avail.N	Kg/h	259.3	246.5	278.3	236.9	250-280
	Total N	%	0.036	0.042	0.038	0.051	0.03-0.06
	Available P	Kg/h	66.3	71.2	64.5	66.8	20-60
	Available K	Kg/h	365.3	386.1	298.9	310.5	250-300
IV	Secondary Nutrients						
	Ca	%	21.2	22.8	23.4	20.6	<1
	Mg	%	0.30	0.26	0.28	0.24	<0.5
	SO4	Ppm	18.3	17.3	16.5	16.9	10-20
V	Micro Nutrients						
	Iron (Fe)	Ppm	3.12	3.21	3.56	2.99	Min.4.50
	Manganese	Ppm	1.12	1.32	1.51	1.09	Min.2.00
	Zinc (Zn)	Ppm	0.71	0.72	0.68	0.62	Min.0.75
	Copper (Cu)	Ppm	0.82	0.74	0.68	0.90	Min.0.60
	Boron	Ppm	0.52	0.42	0.39	0.33	Min.0.50
	Molybdenum	ppm	0.11	0.12	0.09	0.08	0.05-0.2

TABLE 3

SOIL ANALYSIS
Soil analysis of Report of Bilagi locations of Bagalkot District:
Village: Chikalagundi,   Analysis Date: 18.08.2015
During: Monsoon 2015.

Sl.No.	Parameter	UNIT	Spot S1	Spot S2	Spot S3	Spot S4	Legal limit
I	Physical-Parameters						
	Bulk Density	g/cc	1.10	1.12	1.11	1.11	
	Water Holding Capacity	%	54	56	55	56	
	Texture		Black	Black-clay	Black-clay	Black-clay	
II	Chemical Parameters						
	pH		8.23	8.12	8.35	8.14	6.5-7.5
	EC	ds/m	0.24	0.22	0.29	0.26	<1
	Sodium	%	0.12	0.10	0.09	0.08	<0.1
	Calcium		Medium	Medium	Medium	Medium	

			Spot S1	Spot S2	Spot S3	Spot S4	Legal limit
		Carbonate					
III		Major Nutrients					
	Organic Carbon	%	0.72	0.68	0.59	0.74	0.5-0.75
	Avail.N	Kg/h	286.2	278.6	295.3	288.2	250-280
	Total N	%	0.066	0.086	0.075	0.085	0.03-0.06
	Available P	Kg/h	14.2	16.5	18.9	20.1	20-60
	Available K	Kg/h	201	212	234	241	250-300
IV		Secondary Nutrients					
	Ca	%	11.2	12.3	14.3	13.6	<1
	Mg	%	3.3	2.9	3.5	4.0	<0.5
	SO4	Ppm	18.6	16.9	17.8	16.5	10-20
V		Micro Nutrients					
	Iron (Fe)	Ppm	6.82	8.12	7.36	6.89	Min.4.50
	Manganese	Ppm	0.98	0.86	0.99	0.87	Min.2.00
	Zinc (Zn)	Ppm	0.78	0.68	0.67	0.86	Min.0.75
	Copper (Cu)	Ppm	0.72	0.75	0.68	0.87	Min.0.60
	Boron	Ppm	0.38	0.41	0.48	0.46	Min.0.50
	Molybdenum	ppm	0.11	0.09	0.08	0.12	0.05-0.2

TABLE 4

SOIL ANALYSIS REPORT
Soil analysis of Report of Badami locations of Bagalkot District:
Village: Guledagudda,   Analysis Date: 22.08.2015
During: Monsoon 2015.

Sl.No.	Parameter	UNIT	Spot S1	Spot S2	Spot S3	Spot S4	Legal limit
I		Physical-Parameters					
	Bulk Density	g/cc	1.14	1.12	1.13	1.14	
	Water Holding Capacity	%	54	59	56	58	
	Texture		Red-clay	Red-clay	Red-clay	Red-clay	
II		Chemical Parameters					
	pH		7.56	7.42	7.81	7.72	6.5-7.5
	EC	ds/m	0.76	0.81	0.68	0.69	<1
	Sodium	%	0.98	0.89	0.78	0.81	<0.1
	Calcium Carbonate		Low	Low	Medium	Low	

III	Major Nutrients						
	Organic Carbon	%	0.78	0.82	0.86	0.91	0.5-0.75
	Avail.N	Kg/h	352.2	315.6	345.1	367.8	250-280
	Total N	%	0.065	0.071	0.068	0.073	0.03-0.06
	Available P	Kg/h	22.34	24.56	25.34	28.69	20-60
	Available K	Kg/h	152	187	198	213	250-300
IV	**Secondary Nutrients**						
	Ca	%	12.3	11.3	14.6	17.6	<1
	Mg	%	1.84	1.63	1.92	2.01	<0.5
	SO4	Ppm	11.32	12.23	14.32	16.54	10-20
V	Micro Nutrients						
	Iron (Fe)	Ppm	3.12	3.14	3.25	3.46	Min.4.50
	Manganese	Ppm	1.21	1.32	1.08	1.09	Min.2.00
	Zinc (Zn)	Ppm	0.85	0.95	0.88	1.02	Min.0.75
	Copper (Cu)	Ppm	1.10	1.02	1.09	1.08	Min.0.60
	Boron	Ppm	0.62	0.54	0.58	0.71	Min.0.50
	Molybdenum	ppm	0.12	0.14	0.13	0.09	0.05-0.2

TABLE 5

SOIL ANALYSIS
Soil analysis of Report of Bagalkot locations of Bijapur District:
Village: Chikkalagundi,   Analysis Date: 25.08.2015
During: Post- Monsoon 2015.

Sl. No	Parameter	UNIT	Spot S1	Spot S2	Spot S3	Spot S4	Legal limit
I	Physical-Parameters						
	Bulk Density	g/cc	1.12	1.10	1.09	1.11	
	Water Holding Capacity	%	58	56	57	58	
	Texture		Loam	Sandy	Clay Loam	Clay Loam	
II	Chemical Parameters						
	pH		7.75	8.01	8.42	7.89	6.5-7.5
	EC	ds/m	0.89	0.75	0.45	0.58	<1
	Sodium	%	3.465	4.201	1.865	1.122	<0.1
	Calcium Carbonate		Low	Medium	Low	Medium	

III	Major Nutrients					
	Organic Carbon	%	0.81	0.86	0.92	0.99	0.5-0.75
	Avail.N	Kg/h	182.3	201.3	212.4	198.6	250-280
	Total N	%	0.23	0.28	0.52	0.41	0.03-0.06
	Available P	Kg/h	7.32	11.23	7.56	11.9	20-60
	Available K	Kg/h	312	280	254	298	250-300
IV	Secondary Nutrients					
	Ca	%	0.78	0.81	0.90	0.93	<1
	Mg	%	0.42	0.50	0.44	0.65	<0.5
	SO4	Ppm	5.01	4.98	4.72	2.10	10-20
V	Micro Nutrients					
	Iron (Fe)	Ppm	2.01	1.98	1.53	1.76	Min.4.50
	Manganese	Ppm	0.12	0.82	0.75	0.62	Min.2.00
	Zinc (Zn)	Ppm	3.01	2.36	2.56	2.63	Min.0.75
	Copper (Cu)	Ppm	1.96	1.01	1.68	2.12	Min.0.60
	Boron	Ppm	0.83	0.91	0.68	0.49	Min.0.50
	Molybdenum	ppm	0.08	0.07	0.08	0.06	0.05-0.2

TABLE 6

SOIL ANALYSIS
**Soil analysis of Report of Hunagund locations of Bagalkot District:
Village: Kudalasangum, Analysis Date: 01.09.2015.
During: Post- Monsoon 2015.**

Sl.No.	Parameter	UNIT	Spot S1	Spot S2	Spot S3	Spot S4	Legal limit
I	Physical-Parameters						
	Bulk Density	g/cc	1.10	1.12	1.14	1.14	
	Water Holding Capacity	%	54	56	52	54	
	Texture		Black-Clay	Red-Clay	Black-clay	Red-clay	
II	Chemical Parameters						
	pH		7.81	7.69	7.45	7.65	6.5-7.5
	EC	ds/m	0.51	0.62	0.48	0.42	<1
	Sodium	%	1.40	1.62	1.51	1.51	<0.1
	Calcium		Medium	Medium	Medium	Medium	

	Carbonate						
III	Major Nutrients						
	Organic Carbon	%	1.01	1.10	1.13	1.20	0.5-0.75
	Avail.N	Kg/h	283.2	278.6	264.5	286.2	250-280
	Total N	%	0.080	0.0998	0.0885	0.102	0.03-0.06
	Available P	Kg/h	14.21	13.21	10.56	11.52	20-60
	Available K	Kg/h	256	245	236	264	250-300
IV	Secondary Nutrients						
	Ca	%	22.3	22.6	26.5	29.6	<1
	Mg	%	17.6	18.5	16.9	17.8	<0.5
	SO4	Ppm	12.01	16.32	15.68	18.36	10-20
V	Micro Nutrients						
	Iron (Fe)	Ppm	3.21	3.56	4.02	3.95	Min.4.50
	Manganese	Ppm	6.86	5.68	7.53	6.56	Min.2.00
	Zinc (Zn)	Ppm	3.01	2.86	2.45	2.99	Min.0.75
	Copper (Cu)	Ppm	2.10	2.32	2.41	2.16	Min.0.60
	Boron	Ppm	0.36	0.42	0.65	0.45	Min.0.50
	Molybdenum	ppm	0.10	0.11	0.12	0.09	0.05-0.2

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