J. Farm Sci., 30(1): (61-66) 2017

Fertility status of soil along the water course of selected distributory-4 of Shahapur branch canal of UKP command area

CHANDRAGOUDA GIRIGOUDAR, H. V. RUDRAMURTHY, N. L. RAJESH

Department of Soil Science and Agricultural Chemistry, College of Agriculture, Raichur
University of Agricultural Sciences, Raichur, Karnataka, India
E-mail: girigoudar1991@gmail.com

(Received: May, 2016 ; Accepted: March, 2017)

Abstract: Available nitrogen content was comparatively more in surface soils than in sub surface soils all along the water course of distributory-4. Available phosphorous status in soils at the tail reach was comparatively more than that of head reach. Irrespective of surface and sub surface soils available potassium status was medium and was comparatively low in sub surface than in surface soils. However increasing trend of potassium from head to tail via middle reach along the water course was observed. Available sulphur status was medium in surface and low in sub surface soils all along the water course. Available nitrogen, phosphorous, potassium and sulphur were strongly correlated with organic carbon (0.950, 0.989, 0.986 and 0.989), CEC (-0.838, -0.925, -0.970 and 0.948) and dehydrogenase activity (0.934, 0.979, 0.980 and 0.982). Higher concentration of DTPA extractable micronutrients namely, Fe, Cu and Zn in surface than in sub surface soils was observed all along the water course. However fertility status of soils along the water course was low with respect to both available N and P, medium with respect to available K, S, Fe and Zn while high with respect to available Cu and Mn.

Keywords: Available nutrients, Dehydrogenase activity, Micronutrients, Organic carbon

Introduction

Fertile soil and irrigation are the two key factors for well flourished civilization and Mohenjo-Daro and Harappa in the Indus valley is the evident for it. At global level 20 per cent of total cultivated land is under irrigation and its contribution to the total food production of the world is 40 per cent and on an average crop yield from irrigated land is two times more than that of rain fed. Thus irrigation continues to play an important role in contributing to the food and fibre production and is one of the vital factors to achieve food sufficiency at global level and India is also not exceptional for it.

Success of green revolution in India is mainly attributed to high yielding varieties accompanied by chemical fertilizers and irrigation. However the success did not last long due to improper management of agricultural inputs and natural resources. Excessive use of chemicals and water for irrigation accompanied by excessive tillage, neglecting both organic manures and balanced integrated plant nutrition lead to deterioration of physical, chemical and biological properties and processes of soil which in turn decreased soil fertility and thereby drastic reduction in productive capacity of soils in command areas. Thus present investigation on assessing the soil fertility status of red soils along the water course of selected laterals and distributory-4 of Shahapur branch canal in UKP command area of Yadgir was carried out to delineate the study area into different management units and to prepare thematic maps with respect to available nutrient status based on soil test values.

Material and methods

The area selected for the present study includes Shahapur and Shorapur taluks of Yadgir district and lies between North latitude $16^0\ 36'\ 58.40''$ to $16^0\ 74'11.63''$ and East longitude $76^0\ 38'\ 04.99''$ to $76^0\ 97'\ 31.66''$ along the water course of Shahapur branch canal of UKP command area (Fig. 1). The study area is characterised by semi arid climate where annual rainfall is 872.02 mm and is mean of ten years. Nearly 74, 16 and 8 % of mean annual rainfall is received during south-west monsoon, north-east monsoon and summer seasons respectively. The minimum temperature is recorded during December (15.68°C) and maximum in May (40.33°C). The maximum temperature remains between 29.91°C to 35.33°C from June to December. The mean relative humidity for forenoon and afternoon is 65.94 and 49.10 %, respectively. The mean monthly relative humidity is the highest in the month of September (81.33 %) and the lowest in March (46.84 %). The red soil area under paddy land use along the water course of distributory-4, the head reach of SBC was selected for the study and distributory-4 was divided into head, middle and tail sections. From each section of the distributory-4, one lateral was selected. Again each of these laterals was divided into head, middle and tail sections. Composite soil samples, one from each depth (0-20 and 20-40 cm) were drawn from head, middle and tail reaches of each lateral and thus 18 soil samples were collected from the fields along the water course at the head reach of SBC and geographical position of the sampling spots were recorded using GPS. Collected soil samples were air dried in shade, ground in wooden pestle and mortar, passed through 2.00 mm sieve and the mineral matter left on the sieve was washed, dried, weighed and expressed as percent gravels content of total soil. Processed soil samples were analysed for particle size classes, bulk density, available water, soil reaction organic carbon and dehydrogenase activity following standard procedures and however soil samples were analysed for dehydrogenase activity within ten days from date of sampling.

Particle size analysis, bulk density and available water of soil was determined using International pipette, core sampler

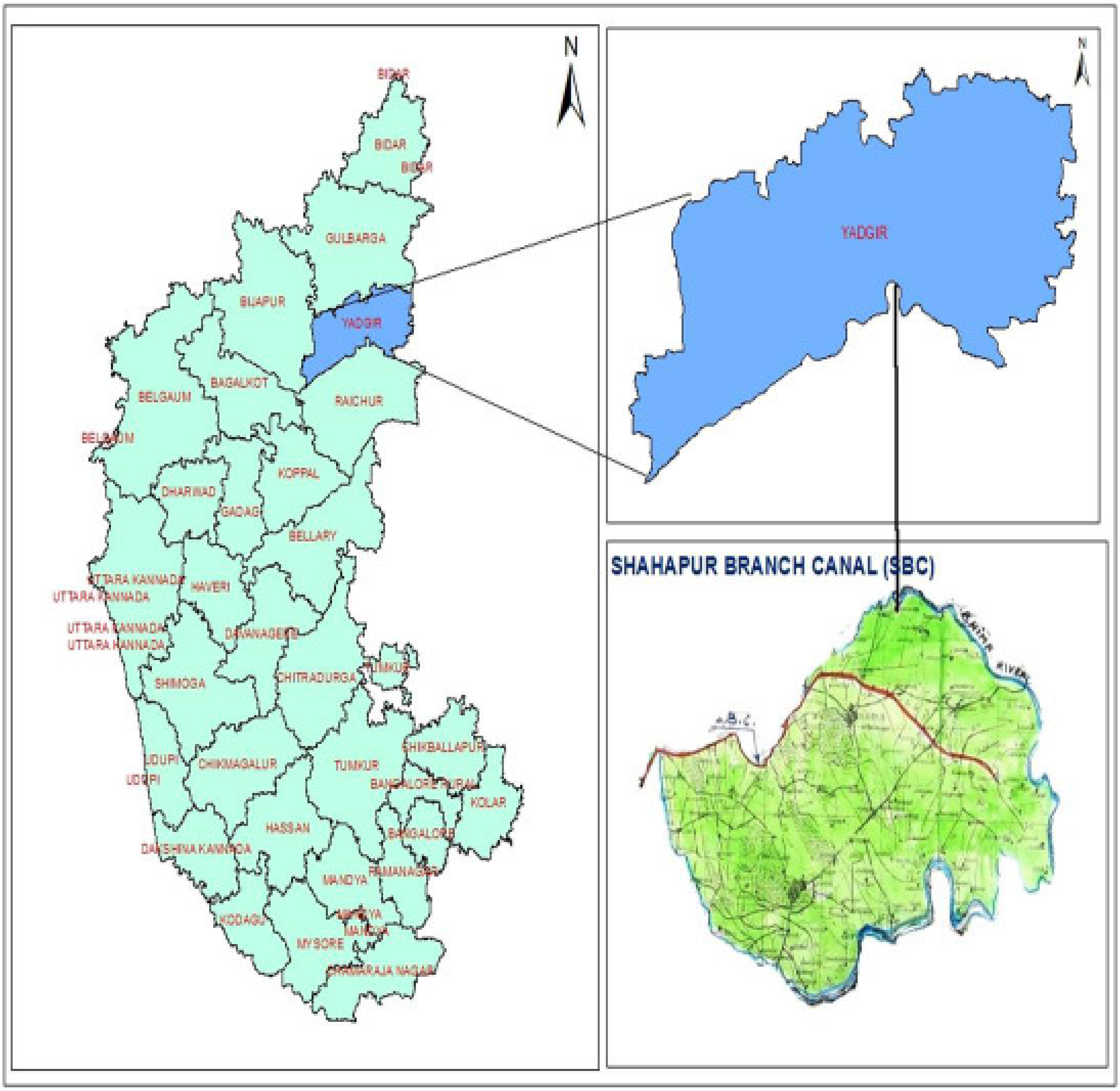

Fig. 1. Location map of SBC of UKP command area selected for study

and pressure plate apparatus as per the procedure outlined by Piper (1966), Black (1965) and Richard's (1954) respectively.

Soil reaction was determined potentiometrically in 1:2.5 soil water suspension (Jackson, 1973). Organic carbon content of soil was determined by Walkley and Black's wet oxidation method (1934). Exchangeable potassium extracted by neutral normal ammonium acetate and was estimated flame photometrically (Jackson, 1973). Available nitrogen content of soil was determined by alkaline potassium permanganate method (Subbaiah and Asija, 1956). Available phosphorus in soil was extracted by Olsen's extractant $NaHCO_3$ (Jackson, 1973) and phosphorus content was estimated spectrophotometrically. Available sulphur in the soil was extracted by 0.15% calcium chloride (Jackson, 1973) and sulphur content was estimated turbidometrically. Available micronutrients *viz.,* Fe, Mn, Cu and Zn present in soil were extracted by Diethylene triamine penta acetic acid (Lindsay and Norwell, 1978) and the content of the same was read in AAS.

Dehydrogenase activity of soil was determined as per the procedure outlined by Casida *et al.* (1964). Soil with Triphenyl tetrazolium chloride (TTC) was incubated for specific period and then shaken with methanol. The intensity of red colour developed due to the formation of Triphenyl formazon (TPF) was measured at 485 nm in spectrophotometer. Available nutrients were subjected to Pearson's correlation with soil properties to know the impact of soil properties on available nutrients status as the soil properties are influenced by continuous irrigation and land use for more than 30 years.

Result and discussion

Soil texture (Table 1) was slightly gravelly sandy loam in surface and gravelly sandy loam in sub surface soils all along the water course. Soil bulk density (Table 2) was comparatively more in sub surface (1.61 Mg/m^{-3}) than in surface soils (1.52 Mg/m^{-3}) all along the water course. Available water content of soils increased with depth all along the water course and from head to tail reaches via middle reach of distributory-4. Irrespective of head, middle and tail reaches of water course along the laterals of distributory-4, sub surface soils recorded the highest pH (6.77 to 6.92) as compared to surface soils (6.57 to 6.71) and however soils were neither saline nor sodic as the pH of soils was in between 6.5 to 7.5. Electrical conductivity of soils was less than 4 dS m^{-1} along the water course in both surface and sub surface of distributory-4 and thus soils were non saline. Organic matter content was comparatively more in surface (6.66 to 7.15 g/kg) than in sub surface (3.79 to 4.09 g/kg) soils of distributory-4 and however fertility status of soils with respect to organic matter was medium in surface and low in sub surface soils. Dehydrogenase activity also followed the trend of organic carbon with depth as well as along the water course.

Available Nitrogen (N): In general available nitrogen content in soils all along the water course was low (Table 3) and this could be attributed to rapid oxidation of organic matter as climate is tropical. Comparatively more available nitrogen in surface soils (152.76 to 162.59 kg/ha) than in sub surface soils (123.82 to 136.39 kg/ha) at head, middle and tail reaches of distributory-4 and this could be attributed to both low organic carbon content and low activity of dehydrogenase at subsurface as compared to surface soils and it was further supported by the strong correlation of available nitrogen with both organic carbon (0.950) and dehydrogenase activity (0.934). However available nitrogen content all along the water course was almost same as present land use all along water course of distributory-4 was paddy. Tukura *et al.* (2013) also observed lower content of available nitrogen in soils at head reach of the water course as compared to that of tail reach and Biju Joseph (1994) opined that total nitrogen of soils dependents on temperature, rainfall and altitude.

Available Phosphorous (P_2O_5): Comparatively more available phosphorous (Table 3) in soils at the tail reach of surface (19.1 to 20.74 Kg/ha) and sub surface (14.32 to 15.81 kg/ha) soils and as compared that of head reach

Table 1. Particle size distribution in fine earth and whole soil (%) along the water course of diostributory-4

Particle size class	Distributory-4Laterals	Water course sections/reaches											
		Head				Middle				Tail			
		Coordinates		Soil depth (cm)		Coordinates		Soil depth (cm)		Coordinates		Soil depth (cm)	
		Latitude	Longitude	0-20	20-40	Latitude	Longitude	0-20	20-40	Latitude	Longitude	0-20	20-40
		Lateral-3				Lateral-7				Lateral-10			
Gravels	Head	16^{0}36'58.40''	76^{0}38'04.99''	12.96	16.20	16^{0}36'52.09''	76^{0}39'07.10''	12.84	16.10	16^{0}36'31.42''	76^{0}40'17.17''	12.74	15.94
	Middle	16^{0}36'57.76''	76^{0}38'09.02''	12.88	16.06	16^{0}36'57.75''	76^{0}39'03.70''	12.75	15.97	16^{0}36'27.91''	76^{0}40.12.81''	12.61	15.85
	Tail	16^{0}36'58.15''	76^{0}38'11.48''	12.70	15.92	16^{0}36'58.09''	76^{0}38'57.53''	12.62	15.84	16^{0}36'31.76''	76^{0}40'09.82''	12.59	15.80
	Mean		12.85	16.06		12.74	15.97		12.65	15.87			
Sand	Head	16^{0}36'58.40''	76^{0}38'04.99''	69.42	64.99	16^{0}36'52.09''	76^{0}39'07.10''	69.12	64.67	16^{0}36'31.42''	76^{0}40'17.17''	68.91	64.39
	Middle	16^{0}36'57.76''	76^{0}38'09.02''	69.14	64.57	16^{0}36'57.75''	76^{0}39'03.70''	68.72	64.45	16^{0}36'27.91''	76^{0}40.12.81''	68.54	63.99
	Tail	16^{0}36'58.15''	76^{0}38'11.48''	68.83	64.26	16^{0}36'58.09''	76^{0}38'57.53''	68.32	64.15	16^{0}36'31.76''	76^{0}40'09.82''	68.13	63.49
	Mean		69.13	64.61		68.72	64.42		68.52	63.96			
Silt	Head	16^{0}36'58.40''	76^{0}38'04.99''	15.19	15.50	16^{0}36'52.09''	76^{0}39'07.10''	15.34	15.65	16^{0}36'31.42''	76^{0}40'17.17''	15.55	15.77
	Middle	16^{0}36'57.76''	76^{0}38'09.02''	15.43	15.53	16^{0}36'57.75''	76^{0}39'03.70''	15.61	15.68	16^{0}36'27.91''	76^{0}40.12.81''	15.73	15.91
	Tail	16^{0}36'58.15''	76^{0}38'11.48''	15.58	15.55	16^{0}36'58.09''	76^{0}38'57.53''	15.74	15.72	16^{0}36'31.76''	76^{0}40'09.82''	15.93	16.23
	Mean		15.40	15.56		15.56	15.69		15.74	15.94			
Clay	Head	16^{0}36'58.40''	76^{0}38'04.99''	15.39	19.42	16^{0}36'52.09''	76^{0}39'07.10''	15.54	19.61	16^{0}36'31.42''	76^{0}40'17.17''	15.55	19.94
	Middle	16^{0}36'57.76''	76^{0}38'09.02''	15.43	19.72	16^{0}36'57.75''	76^{0}39'03.70''	15.67	19.87	16^{0}36'27.91''	76^{0}40.12.81''	15.73	20.10
	Tail	16^{0}36'58.15''	76^{0}38'11.48''	15.58	19.96	16^{0}36'58.09''	76^{0}38'57.53''	15.94	20.13	16^{0}36'31.76''	76^{0}40'09.82''	15.94	20.28
	Mean		15.47	19.70		15.72	19.87		15.74	20.10			
Soil texture	Head	16^{0}36'58.40''	76^{0}38'04.99''	sgsl	gsl	16^{0}36'52.09''	76^{0}39'07.10''	sgsl	gsl	16^{0}36'31.42''	76^{0}40'17.17''	sgsl	gsl
	Middle	16^{0}36'57.76''	76^{0}38'09.02''	sgsl	gsl	16^{0}36'57.75''	76^{0}39'03.70''	sgsl	gsl	16^{0}36'27.91''	76^{0}40.12.81''	sgsl	gsl
	Tail	16^{0}36'58.15''	76^{0}38'11.48''	sgsl	gsl	16^{0}36'58.09''	76^{0}38'57.53''	sgsl	gsl	16^{0}36'31.76''	76^{0}40'09.82''	sgsl	gsl

surface (18.27 to 19.58 kg/ha) and sub surface (13.33 to 14.81 kg/ha) soils of distributory-4. could be attributed to transportation of phosphorous along with finer soil particles through water erosion from head to tail reach against slope gradient and lower available phosphorous at sub surface as compared to that of surface could be attributed to immobile nature of P_2O_5. Similar kind of observations was reported by Tukura *et al.* (2013).

Available Potassium (K_2O): Irrespective of surface and sub surface soils available potassium status was medium (Table 3) and was comparatively less in sub surface (147.75 to 150.13 kg/ha) than in surface soils (213.64 to 221.60 kg/ha) as potassium is less mobile in soil. However increasing trend of potassium from head to tail *via* middle reach along the water course of distributory-4 could be attributed to the transportation of potassium along with water from head to tail reach against the slope gradient and accumulation of same in soils at tail reach. Similar kind of observations was reported by Finck and Venkateswarlu, (1982).

Available Sulphur (S): Available sulphur status (Table 3) was medium in surface (10.57 to 10.79 mg/kg) and low in sub surface (8.73 to 8.95 mg/kg) soils of head, middle and tail reaches of distributory-4. Decreasing trend of available sulphur with depth could be attributed to the more of organic matter in surface than in sub surface and however correlation studies indicated positively significant relation between organic matter and available sulphur (0.989). Increasing trend of available sulphur from head to tail reach laterals *via* middle reach could be attributed to transportation as well as seepage of available sulphur along with water from head to tail reach due to differences in elevation and These values are comparable to those reported by Balanagoudar and satyanarayana (1990) in some Vertisols of North Karnataka.

Available micronutrients*:* Comparatively higher concentration of DTPA extractable micronutrients (Table 4) namely, Fe, Cu and Zn in surface (16.11 to 59.64 mg/ kg, 0.91 to 1.48 mg/ kg and 0.82 to 1.84 mg/ kg)

Table 2. Physical and chemical properties of soil along the water course of distributory-4

Chemical quality indicators	Distributory-4 Laterals	Water course sections/reaches											
		Head				Middle				Tail			
		Coordinates		Soil depth (cm)		Coordinates		Soil depth (cm)		Coordinates		Soil depth (cm)	
		Latitude	Longitude	0-20	20-40	Latitude	Longitude	0-20	20-40	Latitude	Longitude	0-20	20-40
		Lateral-3				Lateral-7				Lateral-10			
Bulkdensity (Mg m^{-3})	Head	16^{0}36’58.40”	76^{0}38’04.99”	1.53	1.61	16^{0}36’52.09”	76^{0}39’07.10”	1.53	1.61	16^{0}36’31.42”	76^{0}40’17.17”	1.52	1.60
	Middle	16^{0}36’57.76”	76^{0}38’09.02”	1.53	1.61	16^{0}36’57.75”	76^{0}39’03.70”	1.52	1.61	16^{0}36’27.91”	76^{0}40.12.81”	1.52	1.60
	Tail	16^{0}36’58.15”	76^{0}38’11.48”	1.52	1.60	16^{0}36’58.09”	76^{0}38’57.53”	1.52	1.60	16^{0}36’31.76”	76^{0}40’09.82”	1.51	1.59
	Mean			1.53	1.61			1.52	1.61			1.52	1.60
AW(%)	Head	16^{0}36’58.40”	76^{0}38’04.99”	7.46	8.07	16^{0}36’52.09”	76^{0}39’07.10”	7.64	8.57	16^{0}36’31.42”	76^{0}40’17.17”	7.72	8.73
	Middle	16^{0}36’57.76”	76^{0}38’09.02”	7.64	8.28	16^{0}36’57.75”	76^{0}39’03.70”	7.76	8.70	16^{0}36’27.91”	76^{0}40.12.81”	7.95	8.85
	Tail	16^{0}36’58.15”	76^{0}38’11.48”	7.84	8.46	16^{0}36’58.09”	76^{0}38’57.53”	8.02	8.91	16^{0}36’31.76”	76^{0}40’09.82”	8.15	9.03
	Mean			7.65	8.27			7.81	8.73			7.94	8.87
pH_w(1:2.5)	Head	16^{0}36’58.40”	76^{0}38’04.99”	6.44	6.61	16^{0}36’52.09”	76^{0}39’07.10”	6.57	6.78	16^{0}36’31.42”	76^{0}40’17.17”	6.63	6.85
	Middle	16^{0}36’57.76”	76^{0}38’09.02”	6.48	6.68	16^{0}36’57.75”	76^{0}39’03.70”	6.62	6.81	16^{0}36’27.91”	76^{0}40.12.81”	6.69	6.88
	Tail	16^{0}36’58.15”	76^{0}38’11.48”	6.80	7.03	16^{0}36’58.09”	76^{0}38’57.53”	6.63	6.84	16^{0}36’31.76”	76^{0}40’09.82”	6.80	7.03
	Mean		6.57	6.77		6.61	6.81		6.71	6.92			
CEC{ cmol (P^+) kg^{-1}}	Head	16^{0}36’58.40”	76^{0}38’04.99”	12.24	15.13	16^{0}36’52.09”	76^{0}39’07.10”	12.44	15.36	16^{0}36’31.42”	76^{0}40’17.17”	12.57	15.58
	Middle	16^{0}36’57.76”	76^{0}38’09.02”	12.60	15.50	16^{0}36’57.75”	76^{0}39’03.70”	12.63	15.68	16^{0}36’27.91”	76^{0}40.12.81”	13.01	15.96
	Tail	16^{0}36’58.15”	76^{0}38’11.48”	12.78	15.68	16^{0}36’58.09”	76^{0}38’57.53”	12.83	15.91	16^{0}36’31.76”	76^{0}40’09.82”	13.04	16.00
	Mean			12.54	15.43			12.63	15.65			12.84	15.75
Organic carbon(g kg^{-1})	Head	16^{0}36’58.40”	76^{0}38’04.99”	6.53	3.62	16^{0}36’52.09”	76^{0}39’07.10”	6.92	3.71	16^{0}36’31.42”	76^{0}40’17.17”	6.43	3.90
	Middle	16^{0}36’57.76”	76^{0}38’09.02”	6.53	3.77	16^{0}36’57.75”	76^{0}39’03.70”	7.11	3.93	16^{0}36’27.91”	76^{0}40.12.81”	7.50	4.08
	Tail	16^{0}36’58.15”	76^{0}38’11.48”	6.92	3.97	16^{0}36’58.09”	76^{0}38’57.53”	7.40	4.28	16^{0}36’31.76”	76^{0}40’09.82”	7.50	4.28
	Mean		6.66	3.79		7.14	3.97		7.15	4.09			
Dehydrogenase activity (mg TPF kg^{-1} 24^{-1}hr)	Head	16^{0}36’58.40”	76^{0}38’04.99”	24.48	19.13	16^{0}36’52.09”	76^{0}39’07.10”	24.00	19.43	16^{0}36’31.42”	76^{0}40’17.17”	24.17	18.76
	Middle	16^{0}36’57.76”	76^{0}38’09.02”	23.67	18.74	16^{0}36’57.75”	76^{0}39’03.70”	24.84	19.58	16^{0}36’27.91”	76^{0}40.12.81”	24.75	19.54
	Tail	16^{0}36’58.15”	76^{0}38’11.48”	24.54	20.11	16^{0}36’58.09”	76^{0}38’57.53”	25.29	19.46	16^{0}36’31.76”	76^{0}40’09.82”	26.34	20.65
	Mean		24.23	19.33		24.71	19.49		25.09	19.65			

Table 3. Distribution of available macro nutrients in soils along the water course of distributory-4

Macro nutrients	Distributory-4 Laterals	Water course sections/reaches											
		Head				Middle				Tail			
		Coordinates		Soil depth (cm)		Coordinates		Soil depth (cm)		Coordinates		Soil depth (cm)	
		Latitude	Longitude	0-20	20-40	Latitude	Longitude	0-20	20-40	Latitude	Longitude	0-20	20-40
		Lateral-3				Lateral-7				Lateral-10			
Available Nitrogen ($kg\ ha^{-1}$)	Head	16^{0}36’58.40’’	76^{0}38’04.99’’	147.47	117.60	16^{0}36’52.09’’	76^{0}39’07.10’’	151.20	123.20	16^{0}36’31.42’’	76^{0}40’17.17’’	158.67	134.40
	Middle	16^{0}36’57.76’’	76^{0}38’09.02’’	154.00	127.87	16^{0}36’57.75’’	76^{0}39’03.70’’	153.07	130.67	16^{0}36’27.91’’	76^{0}40.12.81’’	162.96	136.27
	Tail	16^{0}36’58.15’’	76^{0}38’11.48’’	156.80	126.00	16^{0}36’58.09’’	76^{0}38’57.53’’	156.80	132.53	16^{0}36’31.76’’	76^{0}40’09.82’’	166.13	138.51
	Mean		152.76	123.82		153.69	128.80		162.59	136.39			
Available P_2O_5 ($kg\ ha^{-1}$)	Head	16^{0}36’58.40’’	76^{0}38’04.99’’	18.27	13.33	16^{0}36’52.09’’	76^{0}39’07.10’’	19.75	14.32	16^{0}36’31.42’’	76^{0}40’17.17’’	19.91	14.32
	Middle	16^{0}36’57.76’’	76^{0}38’09.02’’	19.09	14.32	16^{0}36’57.75’’	76^{0}39’03.70’’	20.24	14.81	16^{0}36’27.91’’	76^{0}40.12.81’’	20.24	14.81
	Tail	16^{0}36’58.15’’	76^{0}38’11.48’’	19.58	14.81	16^{0}36’58.09’’	76^{0}38’57.53’’	20.08	14.98	16^{0}36’31.76’’	76^{0}40’09.82’’	20.74	15.31
	Mean		18.98	14.15		20.02	14.70		20.30	14.81			
Available (K_2O) ($kg\ ha^{-1}$)	Head	16^{0}36’58.40’’	76^{0}38’04.99’’	211.32	146.80	16^{0}36’52.09’’	76^{0}39’07.10’’	214.00	146.40	16^{0}36’31.42’’	76^{0}40’17.17’’	220.40	149.20
	Middle	16^{0}36’57.76’’	76^{0}38’09.02’’	213.20	147.20	16^{0}36’57.75’’	76^{0}39’03.70’’	216.00	148.00	16^{0}36’27.91’’	76^{0}40.12.81’’	220.40	149.20
	Tail	16^{0}36’58.15’’	76^{0}38’11.48’’	216.40	149.24	16^{0}36’58.09’’	76^{0}38’57.53’’	218.80	149.20	16^{0}36’31.76’’	76^{0}40’09.82’’	224.00	152.00
	Mean		213.64	147.75		216.27	147.87		221.60	150.13			
Available Sulphur ($mg\ kg^{-1}$)	Head	16^{0}36’58.40’’	76^{0}38’04.99’’	10.39	8.55	16^{0}36’52.09’’	76^{0}39’07.10’’	10.66	8.86	16^{0}36’31.42’’	76^{0}40’17.17’’	10.70	8.82
	Middle	16^{0}36’57.76’’	76^{0}38’09.02’’	10.53	8.68	16^{0}36’57.75’’	76^{0}39’03.70’’	10.88	8.99	16^{0}36’27.91’’	76^{0}40.12.81’’	10.79	8.95
	Tail	16^{0}36’58.15’’	76^{0}38’11.48’’	10.79	8.95	16^{0}36’58.09’’	76^{0}38’57.53’’	10.75	8.95	16^{0}36’31.76’’	76^{0}40’09.82’’	10.88	9.08
	Mean			10.57	8.73			10.76	8.93			10.79	8.95

Table 4. Distribution of available micro nutrients in soils ($mg\ kg^{-1}$) along the water course of distributory-4

Micro-nutrients	Distributory-4 laterals	Water course sections/reaches											
		Head				Middle				Tail			
		Coordinates		Soil depth (cm)		Coordinates		Soil depth (cm)		Coordinates		Soil depth (cm)	
		Latitude	Longitude	0-20	20-40	Latitude	Longitude	0-20	20-40	Latitude	Longitude	0-20	20-40
		Lateral-3				Lateral-7				Lateral-10			
Iron	Head	16^{0}36’58.40’’	76^{0}38’04.99’’	25.22	18.52	16^{0}36’52.09’’	76^{0}39’07.10’’	9.51	6.76	16^{0}36’31.42’’	76^{0}40’17.17’’	58.44	28.75
	Middle	16^{0}36’57.76’’	76^{0}38’09.02’’	5.32	4.12	16^{0}36’57.75’’	76^{0}39’03.70’’	40.90	32.34	16^{0}36’27.91’’	76^{0}40.12.81’’	59.35	29.65
	Tail	16^{0}36’58.15’’	76^{0}38’11.48’’	17.78	14.98	16^{0}36’58.09’’	76^{0}38’57.53’’	7.14	5.40	16^{0}36’31.76’’	76^{0}40’09.82’’	61.12	35.10
	Mean		16.11	12.54		19.19	14.83		59.64	31.16			
Manganese	Head	16^{0}36’58.40’’	76^{0}38’04.99’’	5.59	4.64	16^{0}36’52.09’’	76^{0}39’07.10’’	6.82	5.83	16^{0}36’31.42’’	76^{0}40’17.17’’	3.65	2.64
	Middle	16^{0}36’57.76’’	76^{0}38’09.02’’	6.67	5.07	16^{0}36’57.75’’	76^{0}39’03.70’’	4.50	4.03	16^{0}36’27.91’’	76^{0}40.12.81’’	5.16	3.41
	Tail	16^{0}36’58.15’’	76^{0}38’11.48’’	13.79	9.38	16^{0}36’58.09’’	76^{0}38’57.53’’	7.96	6.57	16^{0}36’31.76’’	76^{0}40’09.82’’	9.31	6.59
	Mean		8.68	6.36		6.43	5.48		6.04	4.21			
Copper	Head	16^{0}36’58.40’’	76^{0}38’04.99’’	1.26	1.11	16^{0}36’52.09’’	76^{0}39’07.10’’	1.52	1.21	16^{0}36’31.42’’	76^{0}40’17.17’’	0.77	0.57
	Middle	16^{0}36’57.76’’	76^{0}38’09.02’’	1.37	1.14	16^{0}36’57.75’’	76^{0}39’03.70’’	1.40	1.21	16^{0}36’27.91’’	76^{0}40.12.81’’	1.03	0.92
	Tail	16^{0}36’58.15’’	76^{0}38’11.48’’	1.44	1.22	16^{0}36’58.09’’	76^{0}38’57.53’’	1.53	1.32	16^{0}36’31.76’’	76^{0}40’09.82’’	0.92	0.78
	Mean		1.36	1.16		1.48	1.24		0.91	0.75			
Zinc	Head	16^{0}36’58.40’’	76^{0}38’04.99’’	1.19	0.91	16^{0}36’52.09’’	76^{0}39’07.10’’	0.81	0.65	16^{0}36’31.42’’	76^{0}40’17.17’’	1.57	1.39
	Middle	16^{0}36’57.76’’	76^{0}38’09.02’’	2.09	1.09	16^{0}36’57.75’’	76^{0}39’03.70’’	0.91	0.74	16^{0}36’27.91’’	76^{0}40.12.81’’	1.94	1.66
	Tail	16^{0}36’58.15’’	76^{0}38’11.48’’	1.18	0.59	16^{0}36’58.09’’	76^{0}38’57.53’’	0.74	0.61	16^{0}36’31.76’’	76^{0}40’09.82’’	2.01	1.73
	Mean		1.49	0.86		0.82	0.67		1.84	1.59			

than in sub surface (12.54 to 31.16 mg/ kg, 0.75 to 1.24 mg/ kg and 0.67 to 1.59 mg/kg) soils along the water course of distributory-4 where these metallic cations decreased from head to tail reach and this could be attributed to less mobility and chelating of these metallic micro nutrients with organic matter as the organic matter content was more in surface and head reach soils than in sub surface and tail reach soils Correlation coefficient values was positive but non significant for Fe, Cu and Zn (0.371, 0.356 and 0.353 respectively) in relation to organic matter. These findings are in agreement with Ghafoor and Rasool (1999). Distribution of DTPA extractable Mn was same as that of iron copper and zinc with depth and reverse of these metallic cations along the water course.

Conclusion: Primary nutrients nitrogen, phosphorous and potassium as well as the secondary nutrient sulphur showed decreasing trend with depth all along the water course of distributory-4 at head, middle and tail reaches and the content of DTPA extractable micronutrients namely Fe, Mn, Cu and Zn was more in surface than in sub surface and it showed decreasing trend from head to tail reach with exception to that of Mn which showed the trend reverse to that of rest of the micronutrients along the water course. Finally fertility status of both surface and sub surface soils along the water course was low with respect to both N and P, medium with respect to K, Fe and Zn, while high with respect to Cu and Mn. Sulphur status was medium in surface and low in sub surface soils.

References

Balanagoudar, S. R. and Satyanarayana, T., 1990, depth wise distribution of different forms of sulphur in Vertisols and Alfisols. *J. Indian Soc. Soil Sci.,* 38 : 634-640.

Biju Joseph, 1994, Studies on phosphorus in soybean, wheat crop sequence in vertisols. *M. Sc. (Agri.) Thesis,* Univ. Agric. Sci., Dharwad (India).

Black, C. A., 1965, Methods of soil analys*is. Can. J. Soil Sci.,* 62: 595-597.

Casida, L. E., Jr. Klein and Samtora, T., 1964, Soil dehydrogenase activity. *Soil Sci.,*98: 371-376.

Finck, A. and Venkateswarlu, J., 1982, Vertisols and rice soils of the tropics. Paper presented Symposia Papers II 12th Int. Cong. Soil Sci., New Delhi, pp-45-48.

Ghafoor, A. and Rasool, I., 1999, Zinc, Copper, Iron and Manganese in soils and plants at different canal and water course sections in rice- wheat cropping zone. *Int. J. Agri. Biol.,* 1(4): 218-221.

Jakson, M. L., 1973*, Soil Chemical Analysis.* Prentice Hall (India) Pvt. Ltd., New Delhi.

Lindsay, W. L. and Norwell, W. A., 1978, Development of a DTPA soil test for zinc, iron, manganese and copper. *Soil Sci. Soc. Am. J.,* 42: 421-428.

Piper, C. S., 1966, Soil and Plant Analysis, Hans publishers, Bombay, pp. 362.

Richards, L. A., 1954, Diagnosis and Improvement of Saline and Alkali Soils. Agric. Handbook, No. 60, USDA Washington, D. C., pp.166.

Subbaiah, S. V. and Asija, G. L., 1956, A rapid procedure for the estimation of available nitrogen in soils. *Curr. Sci.*, 25: 259-261.

Tukura, B. W., Yahaya Mohammed and Madu, P. C., 2013, Evaluation of physicochemical properties of irrigated soil. *J. Nat. Sci. Res.,* 3(9): 135-139.

Walkley, A. J. and Black, C. A., 1934, Estimation of soil organic carbon by the chromic acid and titration method. *Soil Sci.,* 37: 29-38.