Int.J.Curr.Microbiol.App.Sci (2018) Special Issue-7: 3825-3836

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 Special Issue-7 pp. 3825-3836
Journal homepage: http://www.ijcmas.com

Original Research Article

Evaluation of Soil Fertility Status of Rajiv Gandhi South Campus (Banaras Hindu University), Mirzapur, Uttar Pradesh by Using GIS

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Keywords

Vindhyan, Soil, Fertility, Macro-Micronutrients, GPS, GIS

A B S T R A C T

The experiment was conducted at Agricultural Farm of Rajiv Gandhi South Campus (Banaras Hindu University), Barkachha, Mirzapur, Uttar Pradesh, India located in central Vindhyan plateau region during the pre-monsoon season of 2014-2015. The topography of agricultural farm is undulating and surface is rough. It has an area of 2663 acre. The entire soil sampling area was divided into 52 grids and 260 soil samples were collected from the study area. Surface soil samples were collected to a depth of 0-15cm and was labelled with its particular geolocation for site specific nutrient information by using GARMIN- GPS device. Collected soil samples were analyzed for pH, EC, organic carbon (OC), nitrogen, phosphorus, potassium, sulphur, magnesium, iron, copper, zinc and manganese. Results obtained from 260 soil samples, analysis showed the pH ranged from 5.9 to 6.5 with mean of 6.14 slightly acidic in nature, E.C. (dS m^{-1}) ranged from 0.25-0.76 with mean of 0.53, OC ranged from 0.26-0.75 % and available nitrogen, phosphorus, potassium and sulphur were ranged from 160-241.5, 8.24-11.79, 70.1-128.25 and 6.7-10.25 kg ha^{-1}, respectively. In terms of micronutrients, available Fe, Mn, Cu, and Zn were ranged from 19.2 - 38.12, 2.31 - 6.94, 0.67 - 0.98 and 0.23 - 0.9 mg kg^{-1}, respectively.

Introduction

The increasing demand of food grain has forced farmers to use high doses of chemical fertilizers. Imbalanced use of chemical fertilizers is a serious threat to sustainable agricultural production system. Soil test-based fertilizer recommendation and management is an effective tool for increasing productivity of agricultural soils (Srinivasarao *et al.*, 2010; Sahrawat *et al.*, 2010). Soil test-based fertility management is an effective tool for increasing productivity of agricultural soils that have high degree of spatial variability resulting from the combined effects of physical, chemical or biological processes (Goovaerts, 1998). Major constraints impede wide scale adoption of soil testing in most of the developing countries. In India, these include the prevalence of small holding systems of farming as well as lack of infrastructural facilities for extensive soil testing (Sen *et al.,* 2008). Under this context, Geographic Information System (GIS)-based soil fertility mapping has appeared as a promising alternative. Use of such maps as a decision support tool for nutrient management will not only be helpful for adopting a rational approach compared to farmer's practices or blanket use of state recommended fertilization but will also reduce the necessity for elaborate plot-by-plot soil testing activities. However, information pertaining to such use of GIS-based fertility maps are meager in India (Sen and Majumdar, 2006; Sen *et al.,* 2008). Therefore, generation of information on land qualities, through survey of land resources like climate, water, geology, landforms, soils, land uses etc. and use of this data in agricultural development planning could augment judicious application of inputs such as chemical fertilizers and better land use options will lead to optimal utilization of land resources and maintenance of soil health. Soil fertility is an aspect of the soil-plant relationship. Fertility status of the soils is primarily and importantly dependent upon both the macro and micronutrient reserve of that soil. Continued removal of nutrients by crops, with little or no replacement will increase the nutrient stress in plants and ultimately lowers the soil productivity. The fertility status of the soils mainly depends on the nature of vegetation, climate, topography, texture of soil and decomposition rate of organic matter. The total geographical area of Uttar Pradesh is 29.44 million hectare. The cultivable area is 24170403 hectare (82.1 % of total geographical area) and the net area sown is 16573478 hectare (68.5% of cultivable area) (GOI, 2014). However, recent reports suggest a declining trend in production of rice and wheat in South Asia (Ladha *et al.,* 2003) which is mainly attributed to deficiency of micronutrients in soil. Soil quality is usually defined in terms of soil productivity, and specifically in regard to soil's capacity to sustain and nurture plant growth (Cater *et al.,* 1997). The primary reason for initiating soil survey was for the evaluation of soil productivity, which involves a blend of qualitative and quantitative rating models (Huddleston, 1984). While efforts to define and quantify soil productivity are not new, establishing a consensus with regard to a set of standard conditions (soil properties) to be used for evaluation of productivity of soils remains difficult (Karlen and Stott, 1994). Such databases can be analyzed in a computerized geographic information system (GIS) to develop broad regional assessment of inherent soil quality and land- scape quality (Petersen *et al.*, 1995). Intensively cultivated soils are being depleted with available nutrients especially secondary and micronutrients. Soil testing provides information regarding nutrient availability in soils which forms the basis for the fertilizer recommendations for maximizing crop yields (Doneriya *et al.,* 2013). Therefore, assessment of fertility status of soils that are being intensively cultivated with high yielding crops needs to be carried out. Soil testing is usually followed by collecting composite soil samples in the fields without geographic reference. The results of such soil testing are not useful for site specific recommendations and subsequent monitoring. Soil available nutrients status of an area using Global Positioning System (GPS) and Geographical information system (GIS) will help in formulating site specific balanced fertilizer recommendation and to understand the status of soil fertility spatially.

Materials and Methods

The experiment was conducted at Agricultural Farm of Rajiv Gandhi South Campus (Banaras Hindu University), Barkachha, Mirzapur located in central Vindhyan plateau region and lies between 25^o002 to 25^o 152 North latitude and 82^o 452 East longitude at an altitude of 146 m above mean sea level. The topography of agricultural farm is undulating and surface is rough it has an area of 2663 acre. The entire soil sampling area was divided into 52 grids and 260 soil samples were collected from study area. Surface soil samples were collected to a depth of 0-15cm in 'V' shape with the help of *khurpi* from different locations of Rajiv Gandhi South Campus. Along with the soil sample collection the GPS coordinates values were noted down for precise location specific soil fertility evaluation. Garmin GPS device was used to locate the geo-referenced points of soil sample collection and latitude and longitude reading were recorded. The five soil sample was mixed thoroughly from each location and about a half kilogram of composite samples was taken for analysis. Collected soil samples were analyzed nitrogen, phosphorus, potassium, sulphur, magnesium, iron, copper, zinc and manganese by following methods (Table 1). All the GIS work is performed in Arc GIS 9.2, Global mapper 13 version and Kriging interpolation technique was utilized.

Results and Discussion

The data shows that the pH of these soils was ranging from 5.9 to 6.5 with average value of 6.14±0.19 and the lowest pH 5.9 was recorded in soils of grid number 15 to 21 while highest pH 6.5 was observed in soils of grid number 44. All the 260 soil samples of 52 grids were slightly acidic in nature ranging from 5.9 to 6.5 (Table 2, 6). The soils of Rajiv Gandhi South Campus, Barkachha were slightly acidic in reaction. In terms of electrical conductivity, results varied from 0.25 to 0.76 dS m^{-1} with an average value of 0.52±0.13 dS m^{-1}. The lowest EC (0.25) was recorded in grid number 01 while, highest EC (0.76) was recorded from grid number 25 (Table 2, 6). The majority of samples were found low to medium in organic carbon ranging from 0.26 – 0.75 % (Table 2, 6) wth a mean value of 0.47±0.12%. Similar results was also observed by Singh and Kumar, 2012; Singh *et al.,* 2017 and Singh *et al.,* 2015 in Mirzapur District.

The available nitrogen content, ranged from 160 to 241.5 kg ha^{-1} with a mean value of 187.81±20.45 kg ha^{-1}. The lowest (160 kg ha^{-1}) nitrogen content was observed in Grid No. 37 and 42 whereas the highest (241.5 kg ha^{-1}) nitrogen content was recorded in Grid No. 50 with S.D. value of ± 20.45 and C.V. value of 9.18%. Soil samples collected from 52 Grids were in low range for available nitrogen (Table 3, 6).

Similar result was also observed by Verma *et al.,* (2005) that the available nitrogen content in soils of Arid Tract of Punjab, India and Singh and Kumar, 2012 in the Mirzapur district. The available phosphorous content varied from 8.24 to11.79 kg ha^{-1} with a mean value of 9.79 ±0.66 kg ha^{-1}. The lowest 8.24 kg ha^{-1} phosphorous content was observed in Grid No 16, while highest 11.79 kg ha^{-1} was recorded in Grid No. 27 followed with S.D. value of ± 0.66 and C.V. value of 14.81%. From 260 soil samples, 62.20% were low and 30.80% were medium in available phosphorus content (Table 3, 6).

Table.1 Procedure followed for physico-chemical analysis of soil

Properties	Method applied	Reference
pH	Glass electrode pH meter	Jackson (1973)
EC (dS m^{-1})	Electrical conductivity meter	Jackson (1973)
Organic carbon (%)	Wet oxidation method	Walkey and Black (1934)
Available Nitrogen (kg ha^{-1})	Alkaline $KMnO_4$ method	Subbiah and Asija (1956)
Available Phosphorus (kg ha^{-1})	Bray's method / Olsen's method	Bray and Kurtz (1945) Olsen *et al.,* (1954)
Exchangeable Potassium (kg ha^{-1})	Ammonium Acetate method	Hanyway and Heidal (1952)
Available Sulphur (kgha^{-1})	Calcium chloride method	Chesnin and Yien (1950)
Cationic Micronutrient Zn, Fe, Cu and Mn (mg kg^{-1})	DTPA solution by Atomic Absorption Spectrophotometer	Lindsay and Norvell (1978)

Table.2 Status of Physico-chemical properties of Rajiv Gandhi South Campus, Barkachha

Parameters	**Number of soil samples**	**Range**	**Mean**	**S.D.**	**C.V. (%)**
pH (1:2.5, soil water suspension)	260	5.9 - 6.5	6.14	±0.19	32.75
E.C.(dS m^{-1})	260	0.25 - 0.76	0.53	±0.13	4.03
O.C. (%)	260	0.26 – 0.75	0.47	±0.12	4.17

Table.3 Status of available Macro-nutrient in Soils of Rajiv Gandhi South Campus, Barkachha

Soil characteristics	**Range**	**Mean**	**S.D**	**C.V. (%)**
Available N (kg ha^{-1})	160 - 241.5	187.81	±20.45	9.18
Available P (kg ha^{-1})	8.24 -11.79	9.79	±0.66	14.81
Exchangeable K (kg ha^{-1})	70.1 - 128.25	88.94	±14.50	6.13
Available S (kg ha^{-1})	6.7 - 10.25	8.35	±0.79	10.53

Table.4 Status of available Micro-nutrient in Soils of Rajiv Gandhi South Campus, Barkachha

Soil characteristics	Range	Mean	S.D.	C.V.
Available Fe (mg kg^{-1})	19.2 - 38.12	26.61	±4.78	5.56
Available Mn (mg kg^{-1})	2.31 - 6.94	5.17	±1.24	4.16
Available Cu (mg kg^{-1})	0.67 - 0.98	0.85	±0.08	9.95
Available Zn (mg kg^{-1})	0.23 - 0.9	0.49	±0.15	3.29

Table.5 Correlation between Physico-chemical properties and Available Nutrients in the Soil of Rajiv Gandhi South Campus:

	*p*H	EC	OC	N	P	K	S	Zn	Fe	Cu	Mn
*p*H	1										
EC	0.164**	1									
OC	0.365**	0.006	1								
N	0.306**	0.088	0.513**	1							
P	0.408**	0.272**	0.550**	0.354**	1						
K	0.368**	0.379**	0.589**	0.525**	0.458**	1					
S	0.256**	0.667**	0.014	0.256**	0.134*	0.454**	1				
Zn	0.02	0.401**	0.033	0.224**	-0.080	0.295**	0.665**	1			
Fe	-0.37**	0.019	-0.47**	-0.193**	-0.365**	-0.123*	0.254**	0.041	1		
Cu	-0.129*	0.419**	0.114	0.263**	0.012	0.416**	0.650**	0.624**	0.286**	1	
Mn	-0.106	-0.22**	0.418**	0.364**	0.057	0.086	-0.152*	0.201**	-0.364**	0.196**	1

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Table.6 Soil fertility status of Rajiv Gandhi South Campus, Barkachha, Mirzapur.

Sr. No	pH	EC (dSm^{-1})	OC (%)	N (Kg ha^{-1})	P (Kg ha^{-1})	K (Kg ha^{-1})	S (ppm)	Zn (ppm)	Fe (ppm)	Cu (ppm)	Mn (ppm)
Grid 1	6.1	0.28	0.54	166.5	9.66	80.65	6.95	0.24	29.4	0.76	4.21
Grid 2	6.1	0.25	0.47	165	9.7	83.21	6.7	0.23	29.7	0.76	4.21
Grid 3	6.1	0.26	0.53	189.5	9.57	79.5	6.95	0.27	29.2	0.73	5.19
Grid 4	6	0.36	0.48	198	9.62	82.35	7.21	0.24	24.8	0.67	5.76
Grid 5	6	0.37	0.57	188.5	9.96	83	7.01	0.31	24.2	0.67	5.64
Grid 6	6.3	0.34	0.58	190	8.94	79.6	7.12	0.23	24.5	0.72	5.69
Grid 7	6.2	0.48	0.6	192.5	10.23	85.65	7.07	0.34	21.7	0.77	5.63
Grid 8	6.3	0.44	0.58	198.5	10.36	85.69	7.19	0.31	21.3	0.74	5.61
Grid 9	6.3	0.4	0.58	207	10.35	98.54	7.34	0.39	21.6	0.76	6.49
Grid 10	6.1	0.38	0.51	203.5	10.12	84.21	7.47	0.23	29.3	0.89	5.61
Grid 11	6.3	0.39	0.47	197	10.24	90.6	8.39	0.4	21.6	0.86	5.86
Grid 12	6.3	0.4	0.53	210.3	9.36	94.58	8.4	0.9	22.5	0.88	6.06
Grid 13	6.3	0.44	0.42	207.4	9.49	97.64	8.43	0.76	22.1	0.86	5.12
Grid 14	6.2	0.41	0.48	165.5	8.42	79.9	8.3	0.81	29.9	0.91	6.94
Grid 15	5.9	0.4	0.36	178.3	8.46	79.8	8.25	0.61	21.8	0.89	6.87
Grid 16	5.9	0.46	0.42	177	8.24	79.21	8.2	0.54	30.2	0.92	6.47
Grid 17	5.9	0.46	0.42	182.6	8.79	80.9	8.29	0.54	30.2	0.92	6.47
Grid 18	5.9	0.46	0.42	189.7	10.21	79.25	8.36	0.54	30.2	0.92	6.47

Grid 19	5.9	0.46	0.42	182.3	9.91	80.1	8.31	0.54	30.2	0.92	6.47
Grid 20	5.9	0.46	0.42	178.6	9.95	80.5	8.32	0.54	30.2	0.92	6.47
Grid 21	5.9	0.68	0.57	186.7	9.27	80	8.34	0.69	24.8	0.87	6.51
Grid 22	6.2	0.56	0.6	174.6	10.72	81.2	8.67	0.64	24.8	0.91	6.48
Grid 23	6.2	0.59	0.68	198.4	10.66	98.65	8.72	0.56	19.2	0.97	5.68
Grid 24	6.2	0.63	0.76	219.8	10.96	128.25	8.6	0.51	19.5	0.97	5.66
Grid 25	6.4	0.76	0.68	211	10.74	127	8.6	0.6	19.9	0.96	6.01
Grid 26	6.2	0.72	0.62	236.5	10.43	118.6	8.97	0.63	23.7	0.87	5.86
Grid 27	6.4	0.75	0.65	206.2	11.79	127	9.01	0.57	23.2	0.84	6.13
Grid 28	6.4	0.49	0.47	199.2	9.36	95.25	8.89	0.46	22.7	0.88	5.37
Grid 29	6.4	0.7	0.44	203.4	9.49	82.45	8.8	0.53	23.3	0.79	5.34
Grid 30	6.4	0.62	0.54	206.4	10.59	83.29	9.2	0.61	23.1	0.79	6.17
Grid 31	6.4	0.53	0.55	205.5	10.5	83	9	0.54	19.9	0.81	5.91
Grid 32	6.4	0.5	0.62	205.2	10.7	92.15	8.98	0.54	19.9	0.8	5.36
Grid 33	5.9	0.65	0.4	178.6	9.3	80.1	8.3	0.54	19.9	0.92	6.61
Grid 34	5.9	0.7	0.41	186.7	9.67	80.5	8.3	0.43	32.4	0.92	6.61
Grid 35	5.9	0.52	0.41	182.3	9.79	86.29	8	0.45	29.8	0.9	6.54
Grid 36	6	0.53	0.27	160.5	9.66	79.21	8.21	0.43	29.4	0.79	2.67
Grid 37	6	0.49	0.3	160	9.54	80	8.02	0.43	29.4	0.74	2.96
Grid 38	6	0.6	0.27	161.2	9.6	79.65	8.45	0.43	29.4	0.78	2.31
Grid 39	6	0.64	0.29	160.7	9.28	70.1	8.3	0.59	27.6	0.79	4.12
Grid 40	6	0.62	0.29	161.8	9.76	70.5	8.21	0.43	27.9	0.77	3.86
Grid 41	6.4	0.6	0.27	161.2	9.67	79.65	8.3	0.46	27.1	0.78	3.71
Grid 42	6.4	0.73	0.3	160	9.71	80.1	8.02	0.31	27.7	0.77	3.47
Grid 43	5.9	0.59	0.48	176.5	9.37	80	8.1	0.59	27.1	0.83	3.52
Grid 44	6.5	0.64	0.54	169.5	9.58	87.68	8.7	0.34	23.6	0.83	3.58
Grid 45	6.3	0.59	0.5	164.3	9.79	83.49	9.3	0.46	27.1	0.81	3.69
Grid 46	6.3	0.63	0.53	164.8	10.71	83.16	9.21	0.59	29.5	0.96	3.72
Grid 47	5.9	0.73	0.51	167	9.67	96.35	8.37	0.54	24.2	0.93	3.79
Grid 48	6.2	0.59	0.33	207.6	9.12	91.48	9.17	0.63	36.4	0.97	3.93
Grid 49	6.2	0.63	0.39	225.4	9.98	89.17	9.3	0.61	34.7	0.98	3.78
Grid 50	6.1	0.65	0.49	241.5	9.52	97.48	10.09	0.59	38.12	0.98	3.89
Grid 51	6.1	0.64	0.54	178.2	9.69	126.32	10.25	0.68	37.4	0.97	4.12
Grid 52	6.3	0.64	0.5	182.5	9.43	119.84	9.96	0.61	33.8	0.95	4.81
Mean	6.15	0.54	0.48	187.90	9.80	88.90	8.39	0.50	26.50	0.85	5.20
SD	±0.19	±0.13	±0.12	±20.57	±0.67	±14.55	±0.78	±0.15	±4.86	±0.09	±1.25
CV %	32.17	4.18	4.11	9.14	14.66	6.11	10.77	3.39	5.45	9.95	4.15

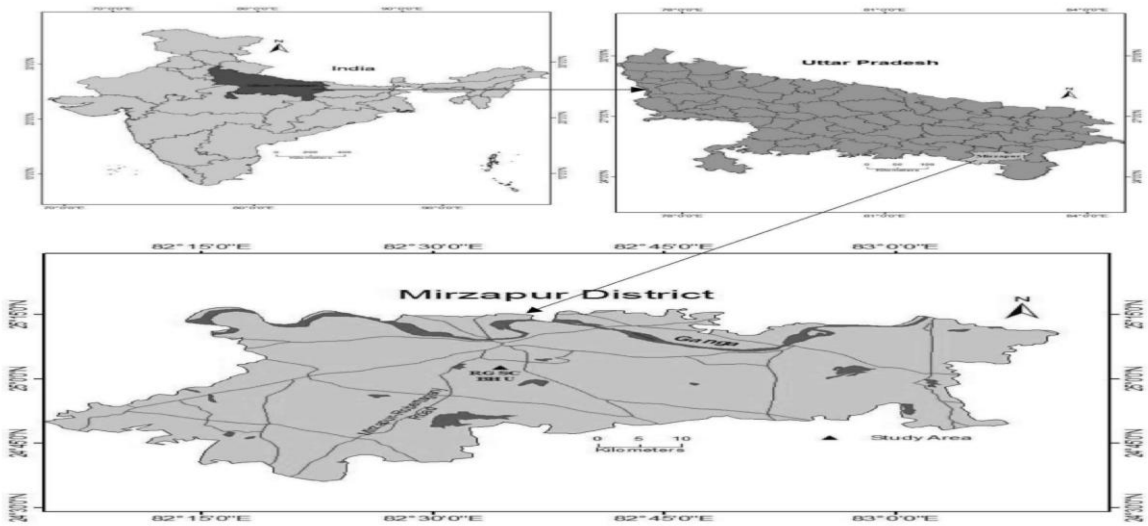

Fig.1 Location of Rajiv Gandhi South Campus, Barkachha, Mirzapur, Uttar Pradesh

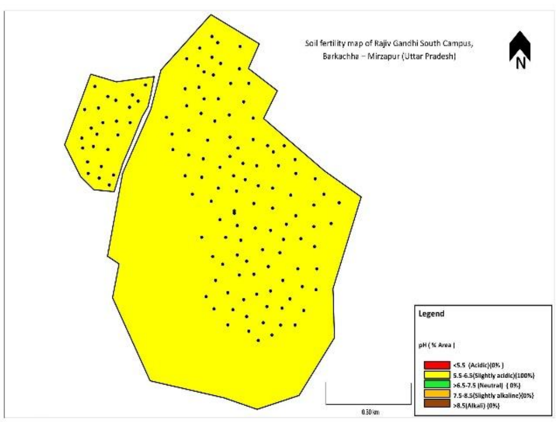

Fig.2 GIS based map of RGSC for pH

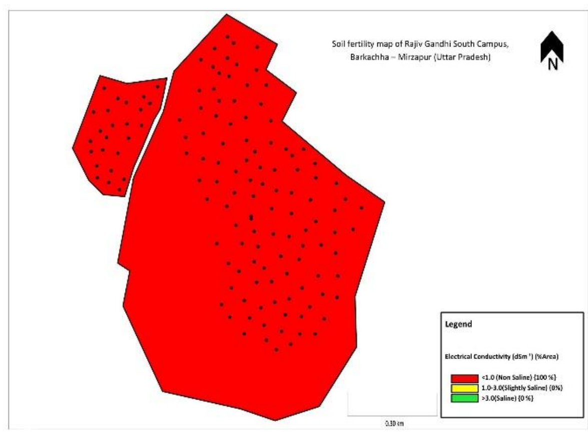

Fig.3 GIS based map of RGSC for EC.(dS m^{-1})

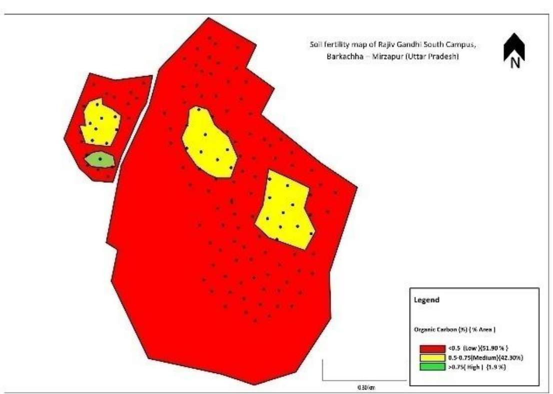

Fig.4 GIS based map of RGSC for OC (%)

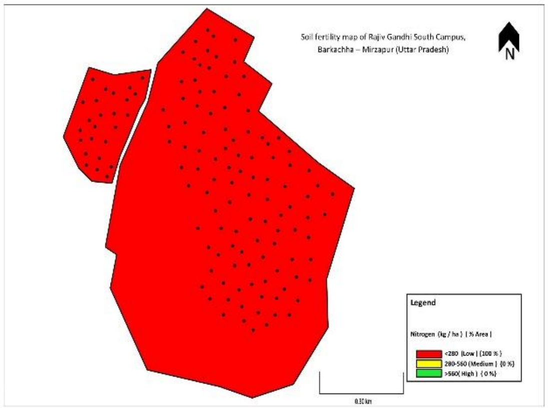

Fig.5 GIS based map of RGSC for N Kg ha^{-1}

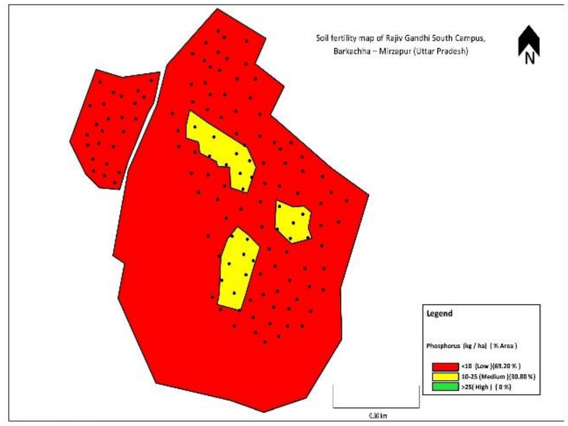

Fig.6 GIS based map of RGSC for P Kg ha^{-1}

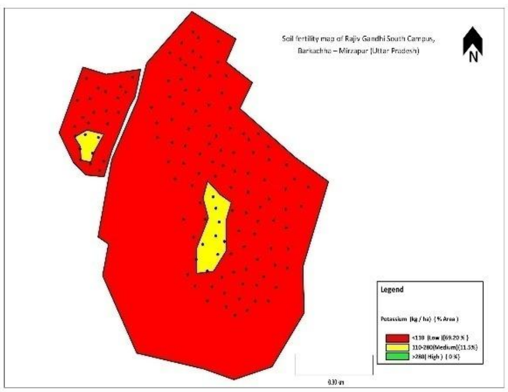

Fig.7 GIS based map of RGSC for K Kg ha^{-1}

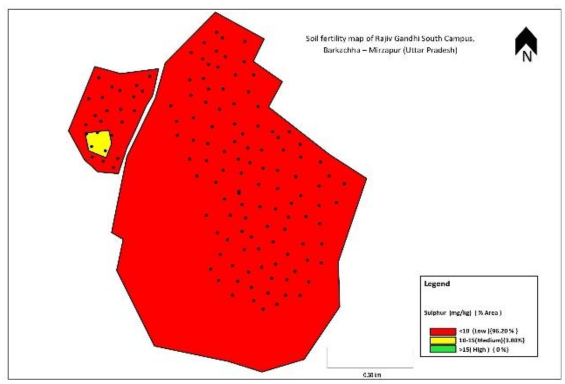

Fig.8 GIS based map of RGSC for S Kg ha^{-1}

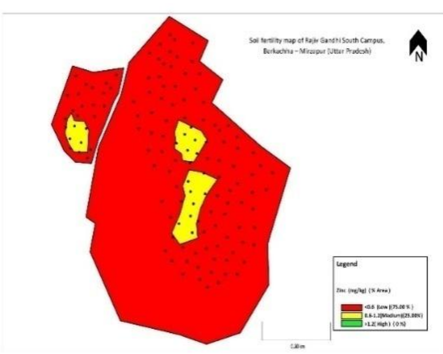

Fig.9 GIS based map of RGSC for Zn (mg kg^{-1})

Fig.10 GIS based map of RGSC for Fe (mg kg^{-1})

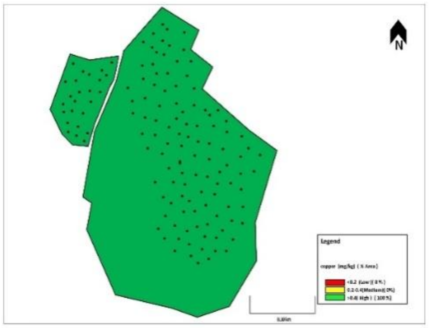

Fig.11 GIS based map of RGSC for Cu (mg kg^{-1})

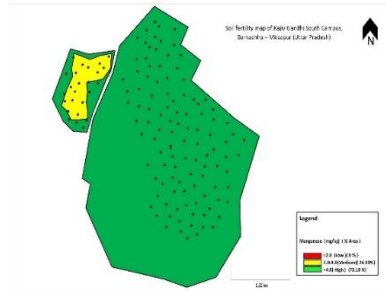

Fig.12 GIS based map of RGSC for Mn (mg kg^{-1})

The potassium content in these soils was ranged from 70.1 to 128.25 kg ha^{-1} with a mean value of 88.94±14.50 kg ha^{-1}. The lowest value (70.10 kg ha^{-1}) was recorded in soils of Grid No. 39 while highest value (128.25 kg ha^{-1}) of K content was recorded in Grid No. 24 with S.D. value ±14.50 and C.V. value of 6.13 %. From 260 Soil samples, 88.50% samples were found low and 11.50% samples were medium in K content (Table 3, 6). The available sulphur content in soils was ranging from 6.7 to 10.25 kg ha^{-1} with an average value of 8.35±0.79 kg ha^{-1}. The lowest (6.7 kg ha^{-1}) value was recorded in soil of Grid No. 2 while higher value 10.25 kg ha^{-1} of S content was recorded in Grid No. 51 with S.D. value of ±0.79 and C.V. value 10.53 %. 96.20 % of soils samples were found low and 3.80 % samples were found medium in sulphur content (Table 3, 6). The finding of N, P, K and S are in agreement with the similar results reported by Singh and Kumar, 2012; Singh *et al.,* 2017 and Singh *et al.,* 2015 in soil of Mirzapur district of Uttar Pradesh.

The available iron content of these soils was ranged from 19.2 to 38.12 mg kg^{-1} with an average value of 26.61±4.78 mg kg^{-1}. The lowest Iron (19.2 mg kg^{-1}) range was observed in Grid No 23, while highest (38.12 mg kg^{-1}) range was observed in Grid No 50 with S.D. value of ±4.78 and C.V. value of 5.56 % (Table 4, 6). Out of the 52 Grids soil samples, 100% soil samples were found high in iron content. The available Mn content of sampled soils was varied from 2.31 to 6.94 mg kg^{-1} with a mean value of 5.17±1.24 mg kg^{-1}. The lowest (2.31 mg kg^{-1}) value of Mn was recorded in Grid No 38, while highest (6.94 mg kg^{-1}) value of Mn content was observed in Grid No 14 (Table 4, 6). Out of 52 Grids soil samples, 26.90% soil samples were found sufficient, 73.10% soil samples found high in manganese content. The data revealed that the available Zn content in soils of Rajiv Gandhi South Campus, Barkachha was ranged from 0.23 to 0.9 mg kg^{-1} with a mean value of 0.49±0.15 mg kg^{-1} (Table 4, 6). Similar observation were reported by Singh and Kumar, 2012; Singh *et al.,* 2017, Singh *et al.,* 2015 in Mirzapur district and Meena *et al.,* (2006) that the available Zn content in soils of Tonk district, Rajasthan and found that it varied from 0.19 to 1.93 mg kg^{-1}. The lowest (0.23 mg kg^{-1}) Zn content was recorded in Grid No 2, while highest (0.9 mg kg^{-1}) Zn content was observed in soil of Grid No 12 with S.D. value of ±0.15 and C.V. 5.56. Out of 52 Grids soil samples 75% soil samples were found deficient, 25% soil samples were found marginal in Zn content (Table 4, 6). The available Cu content of Rajiv Gandhi South Campus, Barkachha soil were ranged from 0.67 to 0.98 mg kg^{-1} with an average value 0.85 mg kg^{-1}. The result are in conformation with the finding of Pandey *et al.*, (2013) in soils of Dewas district of Madhya Pradesh and Singh and Kumar, 2012; Singh *et al.*, 2017, Singh *et al.*, 2015. The lowest (0.67 mg kg^{-1}) value of Cu content was recorded in Grid No 4, 5 whereas highest (0.98 mg kg^{-1}) value of Cu was recorded in Grid No 49, 50 with S.D. value of ±0.08 and C.V. value of 9.95% (Table 4, 6). Out of 52 Grids, 100% soil samples were found high in Cu content. It has been reported that deficiencies of available major and micronutrients are widespread in soils of Mirzapur districts of eastern Uttar Pradesh (Singh and Kumar, 2012). These finding are in conformation with Singh and Kumar, 2012; Singh *et al.*, 2017, Singh *et al.*, 2015 in Mirzapur district and Kumar and Babel (2010) in district of Jhunjhunu teshsil of Sikar district in Rajasthan.

Correlation between physico-chemical properties and available nutrients

The soil *p*H was found positive correlation with EC (t = 0.164**), organic carbon (t = 0.365**), available nitrogen (t = 0.306**), phosphorus (t = 0.408**), potassium (t = 0.368**), sulphur (t = 0.256**), zinc (t = 0.020**), and at 5% and 1% level of significance the correlation of *p*H is significant with OC, N, P, K, S, Zn in overall sample observation (Table 5). The soil EC is positively correlated with OC (t =.006**), N (t =.088**), P (t =. 272*), K (t =.379**), S (t =.667**), Zn (t =.401**), Fe (t =.019**), Cu (t =.419**) and that is significant at 5% and 1% level of significance in overall sample observation. But in case of Mn (t = -.225**) that is negatively correlated with soil EC and which is not significant (Table 5).The organic carbon was found positive correlation with available N (t =.513**), P (t =.550**), K (t =.589**), S (t =.014**), Zn (t =.033**), Cu (t =.114**), Mn (t =.418**), which is significant at 5% and 1% level of significance. But there was negative correlation between OC and Fe (t = -.479**) found in our sample observation that is non-significant (Table 5).The available nitrogen showed significant and positive relationship with P (t=.354**), K (t=.525**), S (t=.256**), Zn (t=.224**), Cu (t=.263**), Mn (t=.364**) at 5% and 1 % level of significance and in case of Fe (t=-.193**) it showed negative and non-significant relationship (Table 5). The available phosphorus significantly correlated with K (t=.458**), S (t=.134**), Cu (t=.012**), Mn (t=.057**), and Fe (t= -.365**) & Zn (t = -.080**) has negatively non-significant with phosphorus. The exchangeable potassium was found correlation with S (t=.454**), Zn (t=.295**), Cu (t =.416**), Mn (t =.086**) which is positively significant at 5% and 1% level of significance (Table 5). There is negative correlation between K and Fe (t = -.123**), that is not significant relationship among themselves. The available sulphur in the soil show positively significant relationship with Zn (t =.665**), Fe (t =.254**), Cu (t =.650**), but negatively non-significant with Mn (t = -.152**) of our overall sample observation (Table 5).There is positive correlation between Zinc and Fe (t =.041**), Cu(t =.624**) & Mn (t =.201**) found in our overall sample observation and at 1% and 5% level of significance the correlation of Zinc is significant with Fe, Cu and Mn. The available Fe in soil show positively significant relationship with Cu (t =.286**) at 5% and 1% level of significance in our overall sample observation, and showed negatively non-significant relationship with Mn (t= -.364**) (Table 5).The exchangeable Cu in soil was found correlation with Mn (t =.196**) that is positive and at 1% and 5%

level of significance the correlation of Cu is significant with Mn in overall sample observation. Organic carbon, EC has not significant relationship with nitrogen. But there is negative correlation between soil pH and Fe (t = -.370**), Cu (t = -.129**), Mn (t = -.106**) was found in our overall sample observation, which is non-significant at 5% and 1% level of significance in overall sample observation.

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