ISSN:0976-4933
Journal of Progressive Science
A Peer-reviewed Research Journal
Vol.14, No.01&02, pp 100-109 (2023)

Suitability assessment of available sulphur in soil by use of different extractant reagents under pigeon pea grown soils of Ballia district of Uttar Pradesh

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Abstract

An experiment was carried out in 2017 for evaluation of extracting reagents for available sulphur in surface soil (0-15 cm) in pigeon pea grown soil of different village of Ballia to assess the suitability extracting reagents for available sulphur (SO_4) in the collected soil samples (0-15 cm) from seventeen blocks (Bairiya, Bansdih, Belhari, Beruarbari, Chilkahar, Dubhad, Garwar, Hanumangang, Maniyar, Murlichhapra, Nagra, Navanagar, Pandah, Rasra, Revati, Siar and Sohaon) of 85 villages of Ballia district of pulses (Pigeon Pea) grown field. The different extracting reagents were used as available-S (0.15 percent $CaCl_2$ extractable), KCl extractable-S, 0.5 M $NaHCO_3$ extractable-S, HCl extractable-S, Morgan's reagent extractable-S. among the extracting reagents 0.15 % $CaCl_2$ extractant was appeared to suitable with different village's soil.

Keywords- Extracting reagents, villages, surface soil, pigeon pea land use soil

Introduction

Distribution of different forms of sulphur and their interrelationship with soil physical, chemical and biological properties determine the sulphur supplying capacity of soil by influencing its release and dynamics in soil. Availability of sulphur from organic sulphur to reserves in soils depends on its mineralization and immobilisation through microbial activity. Elemental sulphur, sulphide-sulphur and other sulphur compounds can be oxidised in the soil purely by chemical means but these are usually much slower and therefore, less important than microbial oxidation which depends on interaction of microbial activities in soil, nature of sulphur source and sulphur transformation. Sulphur, in soil is found as sulphate ions in solutions, adsorbed sulphate on exchange, organically bound ester sulphate–S and organic S-complexes. As comes in soluble form, subsequent retention and build-up of sulphate-S fluctuate with leaching in the soil, removal by plants. Several soil related factors influence the availability of sulphur and hence the status of different forms of sulphur in soil varies widely with soil types (Tomar *et al.*1995). Hence, the present study was carried out an experiment by collection of surface soil sample to find out the suitable extractant for available sulphur for pigeon pea growing soil in Ballia district.

Materials and method

The study area Ballia district is situated in the eastern most part of Uttar Pradesh lies between 25°3" and 26°11" N latitude and 89°38" and 84°39" E longitudes is situated at an altitude of 59 to 64 m above mean sea level and almost in Indo-Gangetic soil belt in the semi-arid zone. The mean annual rainfall ranges from 950-1150 mm and normally confined during May-July. Normally the maximum temperature ranges from 30.2˚C to 45.3˚C to 28.1˚C there is a gradual increase in temperature up to April and decrease from June to January. Ballia is occupying an irregular wedge shape tract in interfluvial region of reverse Ganga and Ghaghara which is a part of central Ganga plain physio – graphically the area can be divided into units i.e. central uplands region and low land tract along river Ganga and Ghaghara. About 72% is net sown area, 14.36% under land utilized other than agriculture, 7.94% current and other follow, 0.4% cultivable west land and 1.94% only under orchand, tree and shrubs with least forest. Total net sown area covers 74.99 %, 83.33 % and 3.0% in kharif, rabi and zaid crop respectively with 79.58 present irrigated area. The productivity of this area is also affected adversely due to floods affection as agro-climatic condition some large area of the district is under wheat followed by paddy, lentil, potato, pigeon, chick pea, sugarcane and maize, area is covered under oil seed and pulses also. The cropping intensity of the district is only 160.6 percent need affection to increase. Under the study 85 composite surface soil samples (0-15 cm) were collected from 17 blocks (Bairiya, Bansdih, Belahari, Beruarbari, Chilkahar, Dubahad, Garwar, Hanumangang, Maniyar, Murlichhapra, Nagra, Navanagar, Pandah, Rasara, Reoti, Siar and Sohaon) by chosen five village in each block of Ballia district. Soil sampling was done from five village by five points of each village of pulses (Pigeon pea (Arhar) grown field after harvesting. After collection of samples were made composite sample from five points of each five village. Soil samples were processed, air dried, powdered and sieved through 2 mm brass sieve and stored separately in polythene bag for physico-chemical and chemical analyses. The collected surface soil samples from different village was analyses for percent sand, silt, clay, soil pH, EC, Organic carbon, Available-S (0.15 percent $CaCl_2$ extractable- Williams and Steinberg (1969), KCl extractable S- Bloem *et al*. (2002), 0.5 M $NaHCO_3$ extractable S- Kilmer and Nearpaoo (1996) and Singh and Srivastava (1993), HCl extractable S- Little *et al*. (1958), Morgan's reagent extractable S - Chesnin and Yien (1951) by using standard method described by different authors.

Results and discussion

Mechanical composition

The per cent value of sand, silt and clay was measured at all blocks in 0-15 cm depth (table-1). Soil texture of surface soil at all blocks were ranged with mean value are presented in table - 1. The percentage of sand, silt and clay in different block soils of Arahar growing area varied from block. Dubahar 19.09 to 32.77 % sand, 10.61 to 26.25 % silt and 41.73 to 68.79 % clay, Sohaon 17.56 to 41.79 % sand, 13.19 to 30.39 % silt and 33.79 to 57.82 % clay, Rasara 11.22 to 32.14 % sand, 11.19 to 19.29 % silt and 42.49 to 59.12 % clay, Pandah 11.26 to 39.41 % sand, 11.56 to 29.11 % silt and 46.16 to 59.22 % clay, Navanagar 21.24 to

39.92 % sand, 12.14 to 27.24 % silt and 33.49 to 49.57 % clay, Siar 10.26 to 21.05 % sand, 12.62 to 42.16 % silt and 40.56 to 72.79 % clay, Nagara 21.44 to 29.56 % sand, 13.24 to 26.39 % silt and 49.57 to 56.72 % clay, Hanumanganj 26.11 to 39.66 % sand, 10.60 to 19.57 % silt and 39.51 to 56.32 % clay, Bansdih 10.12 to 33.46 % sand, 14.16 to 19.63 % silt and 33.44 to 70.56 % clay, Garwar 13.11 to 44.11 % sand, 11.09 to 27.11 % silt and 40.82 to 57.56 % clay, Chilkahar 11.92 to 42.19 % sand, 10.52 to 16.32 % silt, and 42.51 to 77.89 % clay, Reoti 13.39 to 36.42 % sand, 11.19 to 30.05 % silt and 42.36 to 70.56 % clay, Bairia 16.47 to 40.59 % sand, 10.19 to 30.52 % silt and 42.02 to 56.04 % clay, Belahari 11.26 to 26.17 % sand, 14.12 to 36.57 % silt and 44.19 to 70.21 % clay, Maniyar 12.11 to 24.13 % sand, 12.64 to 56.24 % silt and 15.27 to 74.11 % clay, Beruarbari 14.61 to 28.17 % sand, 10.21 to 24.49 % silt and 49.27 to 71.29 % clay and Murlichhapara 11.69 to 39.44 % sand, 11.59 to 20.56 % silt and 41.59 to 56.24 % clay respectively, according the textural class of these soils varied from loamy sand to clay loam (Hegde *et al.,* 2007). Irrespective of the land use systems soil texture was finer in the surface horizons and this might be due to the pedogenic process *viz.,* clay illuviation.

Soil pH - Soil pH (table-1) of different Arhar growing area of Dubhad block was ranged 7.74 to 7.90, Sohaon 6.4 to 6.51, Rasara 7.75 to 8.27, Pandah 7.5 to 7.9, Navanagar 7.51 to 7.91, Siar 7.7 to 7.80, Nagara 7.03 to 7.85, Hanumanganj 8.1 to 8.25, Banshdih 7.43 to 7.90, Garwar 7.02 to 7.35, Chilkahar 7.8 to 9.6, Reoti 6.0 to 6.50, Bairia 7.1 to 7.50, Belahari 8.1 to 8.4, Maniyar 7.2 to 7.31, Beruarbari 7.5 to 7.95 and block Murlichhapra ranged from 7.69 to 7.91. The range of pH value to word saline for surface soil (0-15 cm) were found in all Arhar grown area. The pH range were found higher alkalinity at surface (0 -15) layer of cultivated soil due to presence of alkaline salts and present material resulted in higher P adsorption (Trivedi *et al.*1998)). The higher biological activities might be responsible for decrease pH range on surface soil. The pH value showed in variation of different village which has attributed to the dominance of natural soluble salt (Aggarwal and Nayar, 1998). It was also observed that the surface of normal soil had higher pH values as compared to black soil of Sohaon block. It might be due to leaching of bases from upper layer to lower layer where they have retained by clay particles or as a result of chemical precipitation. Among the different location soils. The marked differences of pH value from location to another was due to both season crop raising and farmer's using imbalance chemical fertilizers, pesticide and cultural practices.

Electrical conductivity of soil (EC)

Soil EC (table-1) from all Arhar growing area of cultivated land depending on soil condition. Soils under study ranged from 0.990 dSm^{-1} to 1.004 dSm^{-1} indicated no wide variation among the blocks. A relative lower EC (0.993 dSm^{-1}) value in Siar block as compared to Navanagar block soils 1.004 dSm^{-1} were observed. There was no difference at others blocks. Which might be due to lateral movement of water from the construction of earthen bund on ground (Gautam *et al.*, 2013) level. Electrical conductivity varied between 0.990 and 1.009 dSm^{-1} characteristic of the normal black alluviat soil.

Organic carbon (%)- Organic carbon content (table-1) from different blocks soil of pigeon pea growing soil *viz*. Dubahar 0.28 to 0.52 %, Sohaon 0.6 to 0.97 %, Rasara 0.29 to 0.82 %, Pandah 0.26 to 0.87 %, Nawanagar 0.24 to 0.85 %, Siar 0.25 to 0.85 %, Nagara 0.43 to 0.76 %, Hanumanganj 0.37 to 0.84 %, Bansdih 0.30 to 0.74 %, Garwar 0.24 to 0.60 %, Chilkahar 0.24 to 0.79 %, Reoti 0.25 to 0.80 %, Bairia 0.24 to 0.84 %, Belahari 0.27 to 0.73 %, Maniar 0.24 to 0.81 %, Beruarbari 0.71 to 0.79 % and Murlichhapra block 0.27 to 0.89 % . Content in composite surface soil of seventeen block of Ballia district was fairly

medium to higher range in all village due to pedogenic process and accumulation organic matter in the surface of soils (Kushwaha *et al*. 2021). Differences in organic carbon content of the soil of different block has high rate of possible CO_2 evolution leads to low organic carbon content (Jat and Yadav, 2006) in soil. Value ranged between 0.24 to 0.89 % of targeted village might be due to different land use system and physiographic situation.

Table- 1 Soil physical and chemical properties of different Blocks of Ballia district

Block	Village	pH	E.C. (dSm^{-1})	Organic Carbon (%)	Sand (%)	Silt (%)	Clay (%)
Dubahar	Basarsand	7.8	1.00	0.28	32.77	9.79	47.44
	Milki	7.9	1.00	0.23	28.10	19.00	52.90
	Dubahar	7.7	1.00	0.33	27.11	26.78	46.11
	Dharmipur	7.8	1.00	0.52	19.09	20.12	60.79
	Byasi	7.7	0.99	0.37	26.11	29.16	41.73
Sohaon	Narahi	6.9	0.09	0.60	23.46	33.19	43.35
	Narayanpura	6.9	0.99	0.44	24.75	19.21	56.04
	Sarya	6.9	0.99	0.38	17.69	24.49	57.82
	Sarai Kota	6.8	0.99	0.77	41.79	24.42	33.79
	Sohaon	6.9	0.99	0.59	21.72	31.16	47.12
Rasara	Basanahi	8.1	0.99	0.32	32.14	15.11	52.75
	Jam	8.1	0.99	0.69	19.56	21.32	59.12
	Sultanipur	7.8	0.99	0.82	34.00	3.51	42.49
	Siswar	7.7	0.99	0.81	25.22	28.02	46.76
	Kharasara	8.2	0.99	0.29	27.56	25.15	47.29
Pandah	Ratasi	7.5	1.00	0.24	21.62	23.00	55.38
	Kuwaridai	7.9	0.99	0.26	38.27	11.44	50.29
	Tenuhi	7.7	0.99	0.60	27.49	26.35	46.16
	Pandah	7.8	0.99	0.82	12.26	29.11	58.63
	Dhaneja	7.8	1.00	0.87	20.25	21.13	58.62
Nawanagar	Arajipur	7.5	1.00	0.30	21.24	29.19	49.57
	Chakusman	7.5	0.99	0.62	34.96	24.92	40.12
	Sonpurwa	7.5	0.99	0.85	32.43	27.25	40.32
	Baghudi	7.9	1.00	0.72	27.16	23.12	49.72
	Bagara	7.5	1.00	0.24	17.62	26.76	55.62
Siyar	Awaya	7.6	0.99	0.25	17.50	22.24	60.26
	Bhuari	7.6	0.99	0.85	22.76	21.56	55.68
	Masaon	7.5	0.99	0.56	21.05	20.53	58.42
	Bithua	7.7	0.99	0.79	19.26	21.46	59.28
	Chandadih	7.8	0.99	0.79	17.28	42.16	40.56
Nagara	Beerpura	7.6	0.99	0.60	26.44	23.99	49.57
	Sarai	7.8	0.99	0.76	29.21	18.29	52.50
	Pahesar	7.8	0.99	0.59	27.44	19.56	53.00
	Pakadih	7.3	0.99	0.77	29.04	21.24	49.72
	Pakadi	7.5	0.99	0.43	21.44	27.39	51.17
Hanumanganj	Pauharipur	8.2	1.00	0.66	31.11	24.37	44.52
	Indarpur	8.1	0.99	0.37	36.76	19.55	43.69

	Pandeypur	8.4	0.99	0.70	34.66	13.02	52.32
	Nidharia	8.2	1.00	0.81	26.00	22.20	51.80
	Thamhanpura	8.2	0.99	0.84	34.59	23.00	42.41
Bansdih	Bakwa	7.4	1.00	0.30	27.34	17.16	55.50
	Darao	7.9	1.00	0.39	24.99	24.52	50.49
	Narla	7.5	0.99	0.73	33.46	18.10	48.44
	Beur	7.5	1.00	0.74	20.97	19.56	59.47
	Manuli	7.6	1.00	0.57	20.12	30.02	49.86
Garwar	Trikalpur	7.2	0.99	0.24	44.11	15.66	40.23
	Govindpur	7.2	1.00	0.28	29.26	27.11	43.63
	Babhanauli	7.3	0.99	0.25	26.39	26.05	47.56
	Garwar	7.3	0.99	0.24	21.11	25.68	53.21
	Akoni	7.5	1.00	0.60	30.15	27.29	42.56
Chilkahar	Kureji	7.8	0.99	0.28	26.41	30.03	43.56
	Narao	7.9	0.99	0.24	19.57	23.32	57.11
	Veerpur	7.8	0.99	0.26	42.19	15.37	42.44
	Pipara	8.3	0.99	0.24	21.92	21.02	57.06
	Budhau	8.6	0.99	0.79	23.57	20.30	56.13
Reoti	Bindaha	6.9	1.00	0.80	23.39	26.32	50.29
	Bisauli	6.8	1.00	0.79	23.26	25.43	51.31
	ChakMiran	6.8	1.00	0.26	36.42	16.19	47.39
	Hasanpura	6.9	1.00	0.25	24.72	30.05	45.23
	Reoti	6.7	1.00	0.49	30.14	29.50	40.36
Bairia	Gopal Nagar	7.2	0.99	0.55	27.46	30.52	42.02
	Adhisijhua	7.2	0.99	0.72	34.11	21.62	44.27
	Bairia	7.3	0.99	0.84	28.21	27.61	44.18
	Chakia	7.1	0.99	0.27	37.56	24.00	38.44
	Siwaal	7.5	0.99	0.24	40.59	20.19	39.22
Belahari	Bigahi	8.2	0.99	0.27	26.67	29.14	44.19
	Varuna	8.4	0.99	0.42	21.26	28.53	50.21
	Puras	8.2	0.99	0.70	13.42	36.46	50.12
	Parasia	8.3	0.99	0.69	22.39	22.82	54.79
	Rehuan	8.1	1.00	0.73	26.17	21.24	52.59
Maniyar	Baragaon	7.5	1.00	0.80	25.44	29.00	45.56
	Jigani	7.2	1.00	0.73	25.26	47.64	27.10
	Lohata	7.3	0.99	0.25	17.26	55.74	27.00
	Chakia	7.3	0.99	0.24	24.13	28.44	47.63
	Maniar	7.2	0.99	0.81	36.17	29.19	34.64
Beruarbari	Dhanidhara	7.9	0.99	0.79	24.16	29.42	46.42
	Beruarbari	7.5	0.99	0.71	28.17	24.49	47.34
	Middha	7.5	0.99	0.57	21.22	31.24	47.54
	Kurthia	7.5	0.99	0.75	25.13	24.21	50.66
	Karmar	7.5	0.99	0.74	24.61	24.10	51.29
Murlichhapra	Suryabhanpur	7.6	0.99	0.40	26.69	28.16	43.15
	Murarpatti	7.9	0.99	0.56	27.76	30.65	41.59
	Lalganj	7.8	0.99	0.80	39.44	12.59	47.97
	Semaria	7.8	0.09	0.27	26.56	27.69	45.75

	Gopalpur	7.7	0.99	0.89	32.97	23.22	43.81

$CaCl_2$ extractable-S (mg/kg)- $CaCl_2$ extractable – S (table-2) in surface soil of block Dubahar, Sohaon, Rasara, Pandah, Navanagar, Siar, Nagara, Hanumanganj, Bansdih, Garwar, Chilkahar, Reoti, Bairia, Belhari, Maniyar, Beruarbari and Murlichhaprawere observed that 6.5, 4.47, 6.5, 5.6 and 6.09 mg/kg, 5.69, 6.093, 6.906, 5.687 and 6.094 mg/kg, 5.44, 7.54, 7.96, 7.54 and 6.28 mg/kg, 6.63, 5.85, 6.63, 7.41 and 7.02 mg/kg, 5.68, 5.68, 6.093, 6.906 and 8.531 mg/kg, 5.508, 6.78, 7.62, 7.62, and 5.508 mg/kg, 6.63, 5.85, 5.46, 5.85 and 5.85 mg/kg, 5.68, 6.5, 5.68, 5.68 and 6.01 mg/kg, 5.44, 7.95, 6.7, 7.53 and 7.53 mg/kg, 4.74, 6.04, 7.33, 4.74 and 5.6 mg/kg, 7.62, 6.8, 5.6, 5.61 and 6.018 mg/kg, 6.01, 6.82, 6.821, 5.61 and 5.21 mg/kg, 7.24, 6.84, 6.84, 6.037 and 5.63 mg/kg, 6.48, 5.62, 7.35, 7.35 and 6.48 mg/kg, 7.33, 7.33, 6.52, 5.70 and 6.112 mg/kg, 5.96, 6.39, 6.39, 6.82 and 7.67 mg/kg and 4.87, 5.68, 6.093, 5.68 and 5.28 mg/kg Block. Greater amount of $CaCl_2$ extractable –S was found in surface soil of Navanagar block than other block's in resulted from its recycling over the years by plants and subsequent organic matter accumulation. Available sulphur content more or less similar in all development block soils where found in deeper layer there were less than the critical limit (4.75 mg/kg) soil organic matter regulars markedly the content of $SO^{=}_4$-S in alluvial soil. Trivedi *et al*. (1998). The targeted sites were observed negligible amount of use of organic manure and sulphur containing fertilizer has led to low sulphur content in observed area soils (Gautam *et al*.2013).

Table-2 Available sulphur (SO_4) content in surface soil of different bock of Ballia district by using different extractants

Block	Village	Extractants				
		$CaCl_2$	$NaHCO_3$	KCl	HCl	Margan's
Dubahar	Basarsand	6.5	3.75	5.61	3.0	7.5
	Milki	4.47	10.5	6.82	3.75	7.0
	Dubahar	6.5	5.0	4.41	3.25	7.5
	Dharmipur	5.69	7.0	5.22	3.25	7.5
	Byasi	6.09	8.75	6.018	3.75	6.5
Sohaon	Narahi	5.69	6.25	5.44	3.0	8.5
	Narayanpura	6.09	7.0	4.27	2.75	7.5
	Sarya	6.91	5.75	5.05	4.3	7.5
	Sarai Kota	5.69	6.25	4.66	2.75	7.0
	Sohaon	6.09	5.75	6.99	3.25	7.0
Rasara	Basanahi	5.44	7.0	4.93	4.25	7.5
	Jam	7.5	5.0	7.40	3.25	7.0
	Sultanipur	7.96	6.0	11.10	3.75	7.5
	Siswar	7.5	6.5	10.69	4.75	6.5
	Kharasara	6.28	5.5	6.68	4.75	6.5
Pandah	Ratasi	6.63	7.0	4.57	3.25	7.0
	Kuwaridai	5.85	5.5	5.3	3.5	7.0
	Tenuhi	6.63	6.25	4.5	3.25	7.5
	Pandah	7.41	7.0	6.1	3.75	6.0
	Dhaneja	7.02	5.25	7.625	3.75	5.5

Nawanagar	Arajipur	5.68	4.5	7.07	2.75	10.5
	Chakusman	5.68	5.0	5.58	3.25	8.0
	Sonpurwa	6.09	6.25	6.33	2.75	7.5
	Baghudi	6.91	8.75	5.58	2.75	7.0
	Bagara	8.53	7.0	4.09	3.0	7.0
Siyar	Awaya	5.52	5.0	5.58	3.25	6.5
	Bhuari	5.85	6.75	5.06	3.0	7.0
	Masaon	7.62	8.5	7.07	2.75	6.5
	Bithua	7.62	5.5	4.47	3.5	6.0
	Chandadih	5.508	5.5	5.22	3.5	6.0
Nagara	Beerpura	6.63	6.25	4.69	3.25	7.5
	Sarai	5.85	6.75	5.06	3.0	7.0
	Pahesar	5.46	9.25	3.97	3.5	6.0
	Pakdih	5.85	8.75	4.33	3.75	5.5
	Pakadi	5.85	6.75	4.33	3.75	5.5
Hanumanganj	Pauharipur	5.68	4.5	5.43	3.25	7.5
	Indarpur	6.5	3.5	3.98	3.5	9.0
	Pandeypur	5.68	9.0	4.71	3.5	7.0
	Nidharia	5.68	5.0	6.16	2.75	7.0
	Thamhanpura	6.01	3.75	5.43	3.25	6.5
Bansdih	Bakwa	5.44	6.25	3.4	3.0	9.5
	Darao	7.95	8.75	2.15	3.5	6.0
	Narla	6.7	3.75	6.8	3.25	7.0
	Beur	7.53	4.0	8.08	3.0	8.0
	Manuli	7.53	4.0	8.07	3.0	8.0
Garwar	Trikalpur	4.74	6.25	5.95	3.5	9.0
	Govindpur	6.09	3.75	10.6	3.25	7.0
	Babhnauli	7.33	4.5	7.65	3.75	9.0
	Garwar	4.74	3.25	7.65	3.0	8.5
	Akoni	5.61	5.0	4.67	3.0	8.0
Chiklahar	Kureji	7.62	10.0	6.76	3.25	7.0
	Narao	6.82	5.5	6.06	3.25	9.0
	Veerpur	5.61	6.25	7.12	3.5	6.5
	Pipara	5.61	6.25	7.49	2.75	6.5
	Budhau	6.02	5.5	7.12	3.25	6.0
Reoti	Bindaha	6.02	3.25	5.53	3.75	7.5
	Bisauli	6.82	3.75	6.63	3.5	7.0
	ChakMiran	6.82	3.25	4.79	3.75	7.0
	Hasanpura	5.61	4.0	4.79	4.0	8.0
	Reoti	5.21	3.0	5.9	3.75	7.5
Bairia	Gopal Nagar	7.25	3.75	6.88	5.0	7.5
	Adhisijhua	6.84	4.5	5.43	3.75	12.5
	Bairia	6.84	3.5	5.08	3.5	9.5
	Chakia	6.037	4.5	5.43	3.0	9.5
	Siwaal	5.63	4.5	3.98	3.75	10.0

Belahari	Bigahi	6.48	4.0	5.16	3.75	7.0
	Varuna	5.62	3.75	7.74	3.25	8.0
	Puras	7.35	3.5	9.22	.25	8.0
	Parasia	7.35	4.5	7.74	3.0	8.5
	Rehuan	6.48	5.5	7.37	3.5	8.0
Maniar	Baragaon	7.33	11.0	7.75	4.5	7.0
	Jigani	7.33	5.25	6.97	3.25	8.0
	Lohata	6.52	5.5	8.14	3.75	7.0
	Chakia	5.70	4.5	7.75	3.0	7.5
	Maniar	6.112	6.25	7.36	3.5	7.5
Beruarbari	Dhanidhara	5.96	5.5	5.85	3.25	9.0
	Beruarbari	6.39	4.5	4.29	2.75	9.0
	Middha	6.39	5.0	5.07	3.75	10.5
	Kurthia	6.82	5.0	5.46	3.25	9.5
	Karmar	7.67	6.25	5.07	3.25	10.0
Murlichhapra	Suryabhanpur	4.87	10.0	4.74	3.75	8.0
	Murarpatti	5.68	6.0	4.38	4.0	7.5
	Lalganj	6.09	3.5	4.75	3.75	7.5
	Semaria	5.68	3.25	5.84	3.75	6.0
	Gopalpur	5.28	6.5	4.01	3.5	6.0

$NaHCO_3$ extractable – S (mg/kg)- $NaHCO_3$ extractable-S in surface soil were block Dubahar, Sohaon, Rasara, Pandah, Navanagar, Siar, Nagara, Hanumanganj, Bansdih, Garwar, Chilkahar, Reoyi, Bairia, Belahari, Maniyar, Beruarbari and Murlichhapra were observed of 3.75, 10.5, 5, 7 and 8.75 mg/kg, 6.25, 7, 5.75, 6.25 and 5.75 mg/kg, 7.0, 5, 6, 6.5 and 5.5 mg/kg, 7, 5.5, 6.25, 7 and 5.35 mg/kg, 4.5, 5, 6.25, 8.75 and 7 mg/kg, 5, 4.75, 8.5, 5.5 and 5.5 mg/kg, 6.25, 6.75, 9.25, 8.75 and 6.75 mg/kg, 4.5, 3.5, 9, 5 and 3.75 mg/kg, 6.25, 8.75, 3.75, 4 and 4 mg/kg, 6.25, 3.75, 4.5, 3.25 and 5 mg/kg, 10, 5.5, 6.25, 6.25 5.5 mg/kg, 3.25, 3.75, 3.25, 4 and 3 mg/kg, 3.75, 4.5, 3.5, 4.5 and 5 mg/kg ; 4.0, 3.75, 3.5, 4.5 and 5.5 mg/kg, 11, 5.25, 5.5, 4.5 and 6.25 mg/kg, 5.5, 4.5, 5, 5 and 6.25 mg/kg and 10, 6, 3.5, 3.25 and 6.5mg/kg. So, that greater amount of $NaHCO_3$ extractable-S was found in surface soil of Maniyar block than other blocks has resulted from its recycling over the years by plants and subsequent organic matter decomposition (Adiga and Ananthanarayana, 1996).

KCl extractable-S (mg/kg)- KCl extractable – S in surface soil of Block *viz*. Dubahar, Sohaon, Rasara, Pandah, Navanagar, Siar, Nagara, Hanumanganj, Bansdih, Garwar, Chilkahar, Reoti, Bairia, Belahari, Maniar, Beruarbari and Murlichhaprawere observed of 5.61, 6.82, 4.41, 5.22 and 6.018 mg/kg, 5.44, 4.27, 5.05, 4.66 and 6.99 mg/kg, 4.93, 7.402, 11.10, 10.69 and 6.16 mg/kg, 4.57, 5.34, 4.58, 6.1 and 7.625 mg/kg, 7.077, 5.58, 6.33, 5.58 and 4.09 mg/kg, 5.58, 7.078, 7.078, 4.47 and 5.215 mg/kg, 4.69, 5.058, 3.97, 4.33 and 4.33 mg/kg, 5.43, 3.98, 4.71, 6.16 and 5.43 mg/kg, 3.4, 2.125, 6.8, 8.075 and 5.52 mg/kg, 5.95, 10.63, 7.65, 7.65 and 4.67 mg/kg, 6.76, 6.056, 7.12, 7.481 and 7.125 mg/kg, 5.53, 6.63, 4.79, 4.79 and 5.9 mg/kg, 6.88, 5.43, 5.075, 5.43, 5.43 and 3.98 mg/kg, 5.162, 7.74, 9.22, 7.4 and 7.37 mg/kg, 7.75, 6.97, 8.14, 7.75 and 7.36 mg/kg, 5.85, 4.29, 5.07, 5.46 and 5.07 mg/kg and 4.74, 4.38, 4.745, 5.84 and 4.01 mg/kg. Greater amount of sulphur KCl extractable was found in surface soil of Rasara block than other block's might due to in plants and subsequent organic matter decomposition and pedochemical transformation (Barkotoki and Das, 2008).

HCl extractable-S (mg/kg) - HCl extractable-S was varied with the surface soil upon soil pH and organic materials of soil, among the all blocks of land use system. HCl extractable-S in surface soil of block *viz*. Dubahar 3 to 3.75 mg/kg, Sohaon 2.75 to 4.3 mg/kg, Rasara 3.25 to 4.75 mg/kg, Pandah 3.25 to 3.75 mg/kg, Nawanagar 2.75 to 3 mg/kg, Siar 3.25 to 3.75 mg/kg, Nagara 3 to 3.75 mg/kg, Hanumanganj 2.75 to 3.5 mg/kg, Bansdih 3 to 3.5 mg/kg, Garwar 3 to 3.75 mg/kg, Chilhkar 2.75 to 3.5 mg/kg, Reoti 3.5 to 4 mg/kg, Bairia 3 to 5 mg/kg, Belhari 3 to 3.75 mg/kg, Maniar 3 to 4.5 mg/kg, Beruarbari 2.75 to 3.75 mg/kg and Murlichhapra 3.75 to 4 mg/kg, respectively. So, that greater HCl extractable-S amount was found in Bairia block soil might be due its pedochemical transformation and cultural practise.

Margan's reagent extractable– S (mg/kg)- Margan's reagent extractable - S tables were observed of Block *viz*. Dubhad 6.5 to 7.5 mg/kg, Sohaon 7 to 8.5 mg/kg, Rasara 6.5 to 7.5 mg/kg, Pandah 6 to 7.5 mg/kg, Nawanagar 7 to 10.5 mg/kg, Siar 6 to 6.5 mg/kg, Nagara 5.5 to 7.5 mg/kg, Hanumanganj 7 to 9 mg/kg, Bansdih 6 to 9.5 mg/kg, Garwar 7 to 9 mg/kg, Chilkahar 6 to 9 mg/kg, Reoti 7 to 8 mg/kg, Bairia 7.5 to 12.5 mg/kg, Belhari 7 to 8.5 mg/kg, Maniyar 7 to 8 mg/kg, Beruarbari 9 to 10.5 mg/kg and Murlichhapra 6 to 8 mg/kg. Greater amount of Margan’s reagent extractable-S was found in surface soil of Bairia block than other block's in resulted from its recycling over the years by plants and subsequent organic matter accumulation (Basumatary and Das, 2012).

Conclusion

Physical and chemical properties of soil and different extractents for available sulphur of pigeon pea grown area soil subsequently relation to land use and soil properties. The soil pH, EC, Organic carbon, mechanical composition (sand, silt, clay), sulphur extractents $CaCl_2$, $NaHCO_3$, KCl, HCl, Margan’s reagent have appeared in greater amount were found all blocks observed up to 0-15 cm depth of surface soil. So that 0.15 % $CaCl_2$ extractant was appeared to suitable extractants among the extractants. Since, all forms of sulphur were decreased and increased with different village’s soil.

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Received on 29.09.2023 and accepted on 27.12.2023