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NA Khadse
Ms.C (SSAC) Department Of Soil Science & Agricultural Chemistry College of Agriculture Nagpur (MH), India

VP Babhulkar
Ms.C (SSAC) Department Of Soil Science & Agricultural Chemistry College of Agriculture Nagpur (MH), India

Sharad Pophle
Ms.C (SSAC) Department Of Soil Science & Agricultural Chemistry College of Agriculture Nagpur (MH), India

Correspondence
NA Khadse
Ms.C (SSAC) Department Of Soil Science & Agricultural Chemistry College of Agriculture Nagpur (MH), India

Physico-Chemical properties under soybean growing area of Nagpur District

NA Khadse, VP Babhulkar and Sharad Pophle

Abstract
The study on nutrient status in relation to soil properties for growing soybean was under taken at HingnaTahsil of Nagpur district, Maharashtra during the year 2014-2015. Five farms at distinct location growing soybean were selected for soil profile study. The soils of study area having colour ranging from very dark gray (10YR 3/ 1M) to yellowish brown colour (10 YR 4/4). Structure was granular to sub angular blocky in surface and sub angular blocky structure in sub surface horizons. Sand, silt, clay content in the soils varied from 4.7 to 12.8, 24.6 to 36.6, 51.9 to 68.6% respectively. Bulk density varied from 1.38 to 1.63 Mg m^{-3}. The saturated hydraulic conductivity ranged from 1.73 to 2.38 cm hr^{-1}. The soils reaction was neutral to slightly acidic (6.26 to 7.65) The WHC range from 47.4 to 63.9 organic carbon values decreases with depth and ranged from 0.231 to 0.684 g kg^{-1}. The pH found Increasing with depth ranging from 7.65 to 8.50. The Electrical conductivity (EC) ranged from 0.16 to 0.34dSm^{-1}.The available major nutrient content in soils were available Nitrogen ranged from 140 to 244 kg ha^{-1},available Phosphorus ranged from 2.21 to 8.16 kg ha^{-1} and available Potassium ranged from 219 to 422 kg ha^{-1}. As regards with available Sulphur status it varied from 3.03 to 8.73 kg ha^{-1}.The Ca^{2+} and Mg^{2+} of soils were varied from Ca^{2+} 21.7 to 45.6 C mol (p+) kg^{-1} and Mg^{2+} 9.2 to 19.1 C mol (p+) kg^{-1}.The DTPA extractable micronutrient status in soils were, Fe content varies from 6.1 to 8.7 mg kg^{-1}, Mn content varies from 3.41 to 5.02 mg kg^{-1}, Zn content varies from 0.36 to 0.58 mg kg^{-1}, and Cu content varies from 0.59 to 2.94 mg kg^{-1}. In correlation studies between physico-chemical properties of soils and soybean yield were evaluated to know the relationship and found that soybean yield is adversely affected because of soil higher pH and EC however, yield positively influenced by all major and micro nutrients. The physical properties like clay and BD are responsible for reducing the yield however, saturated hydraulic conductivity and water holding capacity can increase the yield.In correlation studies of various soil major and micro with physical, chemical properties.

Keywords: Physico-Chemical, soybean growing, Sand, silt, clay

Introduction
India is situated in between 8^0 and 37^0 N latitudes and 9^0 and 97^0 E latitudes. India has geographical area of 329 mha. Some other soils like Inceptisol, Entisol, Vertisols (black cotton soil) are predominant in, the north central Western parts and central parts of Deccan trap, where, coal bearing gondwana formation and basaltic rock found. The soil of India also called Black cotton or regur soil constitute an important soil group and cover about one third of the deccan peninsula extending for about 72million ha bet latitudes 15^0 to 26^0 north and longitudes 73^0 to 83^0 east.The name of Vertisols is derived from Latin "vertere" meaning to invert. In Maharashtra, it is grown over an area of 32.130 lakh ha with total production of 39.950 lakh tones with average productivity of 1243 kg ha^{-1}. In Vidharbha, area covered under soybean is 13.28 lakh ha which 63.15 per cent of Maharashtra is. The annual soybean production in Vidharbha is 10.05 lakh tones which is 55.49 per cent of Maharashtra, with an average productivity of 791 kg ha^{-1} and in Vidharbha area is 5.33 lakh ha. With production 5.577LMT with average productivity 1046 kg ha. (Anonymous, 2012).

Methodology
the present investigation, the work was carried out at HingnaTahsil of Nagpur district, during the year 2014-2015.Total five soil profiles were selected on the basis of visual observations from HingnaTahsil area, And their analysis for physico-chemical properties Particle size distribution of soil samples was determined by International pipette method as described by Black (1965) Bulk density was determined by the core method (Yaloon, 1957). Maximum water holding capacity by (Piper 1966). saturated hydraulic conductivity was measured using constant head method of Richards (1954).Soil reaction was determined soil/water ratio(1:2.5) described by Richards (1954) while electrical conductivity using electro conductivity meter Richards (1954).Organic carbon was estimated by Walkley and Black1934)Available Nitrogen

was determined by Subbaiah and Asija (1956). available phosphorus was estimated calorimetrically as per the method given by Jackson (1973).while Available potassium by Jackson (1973) Cation Exchange Capacity was estimated by ammonium acetate method given by Jackson (1967)

Result and Discussion

Table 1: Particle size of soil particles at various depth

Depth (cm)	Horizon	Size class and particle diamete(mm)			BD ($Mg\ m^{-3}$)	SHC ($cm\ hr^{-1}$)	WHC (%)
		Sand (2.0 -0.05)	Silt (0.05 -0.002)	Clay (<0.002)			
		% of less than 2mm					
Pedon 1							
0-30	Ap	10.6	36.6	52.8	1.44	2.29	48.5
30-55	Bw	9.4	35.7	54.9	1.46	1.96	51.7
55-82	Bss	8.2	33.4	58.4	1.51	1.86	53.5
82^{+}	Bc	6.6	31.3	62.1	1.54	1.75	58.3
Pedon 2							
0-20	Ap	12.2	35.9	51.9	1.41	2.38	47.4
20-42	Bw	9.8	33.8	56.4	1.54	2.06	51.3
42-62	Bss1	8.9	32.4	58.7	1.55	1.90	54.5
62-82	Bss2	8.2	32.6	59.2	1.56	1.82	56.5
100^{+}	Bss3	7.6	30.1	62.3	1.59	1.76	59.1
Pedon 3							
0-35	Ap	9.1	32.2	58.7	1.40	2.24	52.2
35-60	Bw	8.1	31.8	60.1	1.47	1.84	55.8
60-100	Bss1	6.8	29.3	63.9	1.56	1.82	60.2
100^{+}	Bss3	4.7	27.9	67.4	1.63	1.79	63.8
Pedon 4							
0-22	Ap	12.8	34.3	52.9	1.43	2.38	47.9
22-44	Bw	11.3	33.6	55.1	1.52	2.05	52.8
44-100	Bss1	9.2	30.2	58.6	1.54	1.98	54.7
100^{+}	Bss2	8.3	29.8	61.9	1.56	1.81	57.6
Pedon 5							
0-26	Ap	11.2	32.2	56.6	1.38	2.28	49.8
26-44	Bw	9.7	30.6	59.7	1.42	2.12	55.4
44-88	Bss1	8.2	29.2	62.6	1.44	1.89	58.4
88^{+}	Bss2	6.8	24.6	68.6	1.52	1.73	63.9

Table 2: Chemical analysis data

	Depth (cm)	pH 1:2.5	EC (dSm^{-1})	Org 'C' ($g\ kg^{-1}$)	Aval. N ($kg\ ha^{-1}$)	Aval. P ($kg\ ha^{-1}$)	Aval. K ($kg\ ha^{-1}$)	Aval. S ($kg\ ha^{-1}$)	Ex Ca (cmol $(P^{+})Kg^{-1}$)	Ex Mg (cmol (P^{+}) Kg^{-1})	CEC (cmol (P^{+}) Kg^{-1})
Pedon 1											
Ap	0-30	7.74	0.22	0.641	222	8.16	392	7.39	45.6	19.1	69.2
Bw	30-55	7.82	0.28	0.558	196	6.35	360	5.04	43.3	12.8	61.1
Cr	55-82	7.88	0.30	0.431	183	5.16	352	4.37	41.8	10.9	59.1
Bss1	82^{+}	8.02	0.32	0.292	174	4.10	340	3.03	40.8	10.2	57.4
Pedon 2											
Ap	0-20	7.70	0.20	0.684	206	6.80	396	7.72	40.2	13.2	58.7
Bw	20-42	7.73	0.27	0.603	187	4.21	387	6.81	39.3	12.1	56.5
Bw1	42-62	8.36	0.31	0.460	171	3.90	380	5.28	37.2	11.2	54.8
Bss2	62-82	8.43	0.32	0.352	168	3.76	379	4.68	32.5	10.4	49.2
Bss3	100^{+}	8.50	0.34	0.231	162	3.54	368	3.36	26.3	9.8	41.2
Pedon 3											
Ap	0-35	7.87	0.25	0.668	203	6.41	381	6.10	35.2	17.5	56.8
Bw	35-60	8.18	0.27	0.463	189	5.00	364	4.62	32.1	14.2	49.8
Bss1	60-100	8.30	0.30	0.305	183	4.00	334	4.04	30.2	10.1	45.6
Bss2	100^{+}	8.32	0.34	0.280	178	3.20	310	3.86	28.3	9.2	39.4
Pedon 4											
Ap	0-22	7.65	0.16	0.585	197	8.10	337	8.72	38.5	13.5	55.6
Bw	22-44	7.66	0.19	0.491	181	6.69	272	6.92	36.7	11.2	54.1
Bss1	44-100	7.69	0.22	0.322	161	5.12	268	4.20	32.8	10.8	51.2
Bss2	100^{+}	7.81	0.26	0.282	140	2.21	219	3.12	31.9	9.10	49.7
Pedon 5											
Ap	0-26	7.81	0.24	0.638	244	8.10	422	8.73	30.4	19.1	53.5
Bw1k	26-44	7.92	0.26	0.519	194	7.90	384	6.48	27.1	16.8	49.2
Bw2k	44-88	8.10	0.27	0.468	191	6.10	370	5.36	25.5	14.4	44.8
Bc	88^{+}	8.30	0.30	0.351	185	6.00	335	4.12	21.7	13.7	39.3

The data presented in Table 1. Releaved tha**t** that bulk density values ranged from 1.38 to 1.63 Mg m^{-3}.The highest value (1.63 Mg m^{-3}) of bulk density was observed in Bss3 horizon of pedon 3 and lowest value (1.38 Mg m^{-3}) in Ap horizon of pedon 5.Tandel *et al*, 2009 and Banerjee *et al*, 1986.The Maximum water holding capacity, the highest value (63.9%) of WHC was observed in Bss2 horizon of pedon 5 and lowest value (47.4%) in Ap horizon of pedon 2. (Table no 2) and followed a increasing trend with depth in all the pedons. These soils are highly water retentive. The high values of maximum water holding capacity of these soils are mainly due to high content of smectite clay observed was also reported by Kadu *et al*. (2009).The saturated hydraulic conductivity of soils ranged from 1.73 to 2.38 cm hr^{-1} (Table 1). The minimum value of hydraulic conductivity was recorded in Bss2 horizon of pedon5 and maximum value in Ap horizon of pedon 2 and 4.Hydraulic conductivity of soils generally decreased with depth in all the pedons. Hydraulic conductivity was affected by soil structure, texture, tillage operation and management practices. their silty to due to sandy loam texture and thus soils are classified as moderately well drained by U.S.D.A soil survey manual (Soil survey staff, 1951). pH (Soil Reaction) revealed that the pH of soils of all pedons in a range of 7.65 to 8.50 are neutral to moderately alkaline. The highest value of pH was observed in Bss3 horizon of Pedon 2 and the lowest value in Ap horizon of pedon 4. Generally, in all pedons pH increased with soil depth. Similar to the observations of Prasad *et al.* (1999) and Balagopalan *et al.* (1991).Electrical conductivity revealed that the electrical conductivity of studied soil ranged from 0.16 dSm^{-1} to 0.34 dSm^{-1}. EC less than 2 dSm^{-1} indicates that these soils are free from hazard of soluble salts thus, EC in studied area is in safe limit. The highest value of electrical conductivity was observed in Bss3 horizon of pedon 2 and lowest was observed in Ap horizon of pedon4.The electrical conductivity was reguraly increased with depth in pedon 2 and pedon 3 Similar observations were earlier made by Prasad *et al.* (1999). The surface horizons of all pedons contain organic carbon in a range of 0.231 to 0.684 g kg^{-1}. The Maximum value (0.684 g kg^{-1}) was observed in horizon Ap of pedon 2 and Minimum value (0.231 g kg^{-1}) in horizon Bss3 of pedon 2 on surface layers (Table 2) Organic Carbon was decreased with depth also reported by (Alexander *et al*. 1981, Rahman *et al.* 2012 and Ogundele 2012). Theavailable nitrogen content revealed that the available nitrogen in soils of all the pedons are in range of 140 to 244 Kg ha^{-1} with decreasing trend with depth. The highest value (244 kg ha^{-1}) and lowest value (140 kg ha^{-1}) of maximum available nitrogen was observed in Ap horizon of Pedon 5 and minimum available nitrogen was observed in Bss2 horizon of pedon 4 respectively. Kuldeepsingh and Ahuja, 1990 Mandal *et al.* (1990) and Kaistha *et al.* (1990). Available phosphorus revealed that the available phosphorus in soils of all the pedons are in a range of 2.21 to 8.16 kg ha^{-1} which further decreasing with the increasing depth. The highest value (8.16 kg ha^{-1}) and lowest value (2.21 kg ha^{-1}) of maximum available phosphorus was observed in Ap horizon of Pedon 1 and minimum available phosphorus was observed in Bss2 horizon of pedon 4 respectively results were also reported earlier by NBSS & LUP 1997.availble potassium content in all the pedons are in a range of 219 kg ha^{-1} to 422 kg ha^{-1} and further decreases with the increase in depth. The highest value (422 kg ha^{-1}) and lowest value (219 kg ha^{-1}) of available potassium was observed in Ap horizon of Pedon 5 and Bss2 horizon of pedon4 respectively. As reported earlier by Pal and Mukhopadhyay (1992). sulphur revealed that the sulphur of soils of all pedons content in medium range of 3.03 to 8.73 mg $kg^{-1}$and decreasing with the increasing depth. The higher value (8.73 mg kg^{-1}) and lower value (3.03 mg kg^{-1}) of maximum available sulphur was observed in Ap horizon of Pedon 5 and minimum available sulphur was observed in Bss1 horizon of pedon 1 respectively. Similar results were also reported by Samnidi 2008 and Ravi kumar 1988.it was observed that highest value (45.6 (cmol (P^+) kg^{-1}) of calcium was observed in Ap horizon of pedon 1 while lowest value (21.7 (cmol (P^+) kg^{-1}) in Bc horizon of pedon 5. Similarly, the highest value of magnesium (19.1(cmol (P^+) kg^{-1}) was observed in Ap horizon of pedon 5 and lowest value (9.2 (cmol (P^+) kg^{-1}) in Bss2 horizon of pedon 3.reported by Banerjee *et al.* 1986, Gangopadhay *et al*. (1989).The data on CEC (Table No.2) revealed that values ranged from 39.3 c mol (p+) kg^{-1} to 69.2 c mol (p+) kg^{-1}. The maximum value (69.2 c mol (p+) kg^{-1}) was recorded in Ap horizon of pedon 1 and minimum value (39.3 c mol (p+) kg^{-1}) in Bc horizon of pedon 5.CEC generally decreased with depth as reported by Alexander *et al*., and Jibrin 2012.

Conclusion

Farmers of the Vidharbha region are mainly taking soybean as major crop in *kharif* and follows all the necessary package of practices including organic and inorganic fertilizers. On the basis of analytical data, in respect of the soils having silty, clay texture, lower BD and maximum SHC gives better yield of soybean. The physical properties are affected the nutrient content in the soil. Maximum available major and micro nutrients are found positively correlated with physical properties with soils i.e. Clay, BD, SHC. Therefore it's concluded that the yield of soybean and fertility status are found better in medium to deep soils.

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