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Morphological and physical characterization of the dominant soil type under potato cultivation in Hassan district

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Abstract

Hassan district in Karnataka has the largest area and higher potato production in the state and contributes about 40.88 per cent of total production followed by Kolar district. Compared to other states the productivity is very poor in Karnataka. Through extensive traverse of potato growing areas of the district and soil pedons excavated at six representative sites and sampled horizon-wise; Madalapura, Kalenahalli, Chigatihalli, Gonisomanahalli, Hongere and Sidlahsahalli villages. At each site soil morphology and soil physical properties was studied by exposing soil profile to depth of 1.5 meter, or less in shallow soils. The physiography of all the sites selected were nearly level land with 1-3% slope and relief of 50-150 m. Major land use pattern of the sites were potato, potato followed by maize or ragi. The parent material of the sites was granite gneiss. Four of the soils pedons keyed out to Alfisol order and two Inceptisol order.

Keywords: Crop production, soil morphology, physical properties, soil pedons, horizon

Introduction

Potato is reported to have originated in Andean region of high hills of South America and brought to India first by the Portuguese in the 17th century. Among the major potato growing countries of the world, China ranks first in area followed by the Russian federation, India, Ukraine, USA, Germany and Poland. India ranks third in area in the world. The present area under potato in India is about 1.9 million hectares. India produces a total of about 45 million tonnes of potatoes every year and ranks fifth in production after China, Russian federation, Poland and Ukraine. The productivity of potato in India is about 23.68 tonnes per hectare. In European and American countries the productivity is about 40-50 tonnes per hectare (FAO, 2012) [2]. Potato can be grown in alluvial, hill, black, red and laterite soils having pH in the range of 5.5-8.0 (Pandey, 2007) [5].

In Karnataka, potato is grown in an area of 40,700 hectares, with an annual production of 5.39 lakh tonnes (Anon, 2014) [1]. As compared to other states the productivity is very poor as the climate is not so favourable for growing potato. Hence, Studies on soil morphology and physical properties of soil under potato cultivation is very important to improve soil properties under prevailing climatic conditions to increase potato production. Suvana (2012) reported that surface soil of Hassan district was sandy loam in nature with 17.3 per cent clay, subsoil horizon was sandy clay loam with clay content of 28.5 per cent. Keeping in view these facts the present study was carried out in potato growing areas of Hassan district Karnataka with the objective to characterize the dominant soil type based on morphological and physical properties under potato cultivation in Hassan district.

Material and Methods

Study area

Hassan district is situated at southern part of the state, the district comes under 4 Agro climatic zones namely, Central dry zone, Southern dry zone, Southern transitional zone and Hilly zone. According to delineation of NARP zones in the state Arasikere taluk comes under Central dry zone, Channarayapatna taluk comes under Southern dry zone, Holenarsipur, Arkalgud, Alur and Belur comes under Southern transitional zone where as Sakleshpur taluk comes under Hilly zone. Major areas growing potato comes under Hassan, Channarayapattana, Belur and Holenarasipura taluks of Hassan district.

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The sites for sampling were chosen on the basis of soil suitability for potato cultivation, microclimate, degree of erosion, away from field boundaries, roads and rivers. The sites selected were representative of the area. A pit of 1.5m x 1.5m x 2m dimension was excavated at each site of soil profile study. The soil profile was oriented in such a manner that a face was well lighted. Side to be examined was made even and different horizons were demarcated based on variability in colour, texture and structure. The details like depth, colour, texture, structure, and consistency were studied and recorded in the standard form for soil profile description. The field descriptions of features were using the standard notations and abbreviations used for the purpose (Soil survey staff, 1999) [3].

Soil Sampling

Soil sample from each horizon of the profile was collected in polythene bags, labeled properly and transported to laboratory for processing and analysis. Samples for determination of bulk density were collected using a metallic core of known volume which was driven into each horizon. The cutting edge of the core was pressed into the soil and driven in using a wooden hammer and then carefully removed to gather a known volume of soil sample. Duplicate core samples were collected from each horizon of the pedon. The protruding soil on either end of the core was removed.

Preparation of soil samples

Soil samples upon arrival at the laboratory were air dried under shade. These were ground in a wooden mortar with a wooden pestle and then passed through a 2 mm sieve to separate the coarse fragments. The fine earth was stored in polythene bags for analytical purpose.

Methods of soil analysis

Particle size analysis

Particle size analysis was done by International pipette method as described by Piper (1942). Air dry soil (<2 mm) was treated with hydrogen peroxide for destroying organic matter. The treated soil was dispersed using ultrasound sonicator with the addition of sodium hexa met aphosphate as a dispersing agent. The dispersed solution was passed through 300 mesh sieve to separate sand particles. The suspension obtained after sieving was analysed for silt and clay.

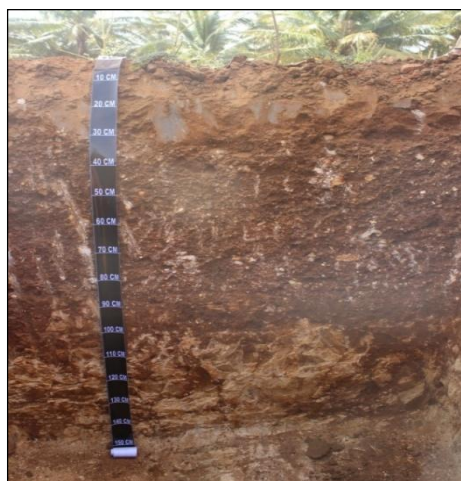


Plate 1: Depth wise soil of pedon 1, Madalapura village, Channarayapatna taluk, Hassan district under potato cultivation



Plate 2: Depth wise soil of pedon 2, Kalenahalli village, Holenarashipura taluk, Hassan district under potato cultivation



Plate 3: Depth wise soil of pedon 3, Gonisomenahalli village, Belur taluk, Hassan district under potato cultivation



Plate 4: Depth wise soil of pedon 4, Chigatihalli village, Hassan taluk, Hassan district under potato cultivation



Plate 5: Depth wise soil of pedon 5, Hongere village, Hassan taluk, Hassan district under potato cultivation



Plate 6: Depth wise soil of pedon 6, Sidlahosalli village, Hassan taluk, Hassan district under potato cultivation

Results

This section presents the results of investigation with respect to morphological characteristics of pedons studied, physical and chemical properties of the soil samples collected horizon wise and from farmers fields under potato cultivation.

Soil Morphology

Pedon 1: Madalapura (Channarayapatna taluk)

This site represents an area experiencing sub-humid climate. The average annual rainfall is 1031 mm. Soil moisture is adequate to support annual crop production for 180 to 210 days. The site for soil profile study was located on nearly level land with 1-3 per cent slope with elevation of 885 above mean sea level. Surface features indicated moderate erosion with slow run off. The soil developed from weathered granite was well drained. The soil profile was excavated to a depth of 100 cm. The 14 cm thick Ap horizon was dusky red (7.5YR 4/3), sandy loam in texture with weak, medium, sub-angular blocky structure. Moist consistency of soil was friable and

wet, slightly hard, slightly sticky and slightly plastic. The horizon had many very fine roots. The morphology of subsequent horizons that merged smoothly into subsurface horizons are described in the table 2.

Pedon 2: Kalenahalli (Holenarshipura taluk)

This site too has sub humid climate. The site for soil profile study was located on nearly level land with 1-3 per cent slope with elevation of 882 above mean sea level. Surface features indicated moderate erosion with slow run off. The soil developed from weathered granite was well drained (Table 1).

Pedon 3: Gonisomenahalli (Belur taluk)

The climate Gonisomenahalli is similar to other sites. The site for soil profile study was located on nearly level land with 1-3 per cent slope with elevation of 887 above mean sea level. Surface features indicated moderate erosion with slow run off. The soil developed from weathered granite was well drained. The soil profile was excavated to a depth of 33 cm only as the soil development was restricted. The 18 cm thick Ap horizon was dark reddish brown (10YR 3/2). The horizon merged into the subsoil horizon smoothly. The under lying material was partially weathered rock. The subsoil B horizons were designated as Bw with depth interval of 18-33 cm. The Bw horizon was dark greyish brown in colour (10YR 3/2) and other detailing is made in the table 2.

Pedon 4: Chigatihalli (Hassan taluk)

The soil profile was excavated to a depth of 194 cm. The 18 cm thick Ap horizon was dark reddish brown (5YR 3/3), sandy clay loam with moderate, medium, sub-angular blocky structure. Moist consistency of soil was friable and wet, sticky and plastic. Horizon had fine common roots. The subsoil B horizons were designated as B1, Bt21, Bt22, Bt23, Bt23 and B3 with depth interval of 18-32, 32-65, 65-104, 104-128, 128-166 and 166-194 cm respectively. The horizon merged into the sub horizon smoothly. The morphological descriptions of the horizons are given in table 2.

Pedon 5: Hongere (Hassan taluk)

The soil profile in Hongere was excavated to depth of 86 cm (Table 1). The lowest layer was (56-86 cm). The 22 cm thick Ap horizon was dark brown (10YR 3/3), sandy clay loam in texture containing 31 per cent of fine gravels with moderate medium sub-angular blocky structure. Moist consistency of soil was hard friable and wet slightly sticky and slightly plastic. The horizon had common very fine roots. The horizon merged into the subsoil horizon smoothly. The subsoil B horizons were designated as Bw and BC with depth interval of 22-56 and 56-86 respectively. The horizon merged into the sub soil horizon smoothly and are described in the table 2.

Pedon 6: Sidlahosalli (Hassan taluk)

The soil profile was excavated to a depth of 164 cm. The 14 cm thick Ap horizon was dark brown (10YR 3/3), sandy clay loam in texture containing 1 percent gravel with moderate, medium sub-angular blocky structure. Moist consistency of soil was friable and wet, sticky and plastic. The horizon had common fine roots. The horizon merged into the subsoil horizon smoothly and are explained in the table 2.

Table 1: Soil morphological characteristics of pedons in the sites soil suitable for potato cultivation in Hassan district

Site	Village	Taluk	Soil Classification	Physiography	Elevation (m above MSL)	Ground water table (m)	Slope (%)	Relief (m)	Erosion	Drainage	Land use	Parent material
Pedon 1	Madalapura	Channarayapatna	Fine, mixed, isohyperthermic, Typic Haplustalfs	Nearly level land	885	>50	1-3	50-150	moderately eroded	Well drained with rapid permeability	Potato followed by maize	Granite gneiss
Pedon 2	Kalanahalli	Holenarashipura	Fine, loamy, mixed, isohyperthermic, Typic Haplustalfs	Nearly level land	882	>50	1-3	50-150	moderately eroded	Well drained with rapid permeability	Potato followed by Ragi	Granite gneiss
Pedon 3	Gonisomenahalli	Belur	Loamy, mixed, isohyperthermic, Lithric Haplustepts	Nearly level land	887	>50	1-3	50-150	moderately eroded	Well drained with rapid permeability	Potato followed by Ragi	Granite gneiss
Pedon 4	Chigatihalli	Hassan	Fine, mixed, isohyperthermic, Typic Haplustalfs	Nearly level land	984	>50	1-3	150-300	moderately eroded	Well drained with rapid permeability	Potato	Granite gneiss
Pedon 5	Hongere	Hassan	Clayey skeletal, mixed isohyperthermic, Typic, Dystrustepts	Nearly level land	954	>50	1-3	50-150	moderately eroded	Well drained with rapid permeability	Potato followed by Ragi	Granite gneiss
Pedon 6	Sidlahosalli	Hassan	Fine, mixed, isohyperthermic Typic Haplustalfs	Nearly level land	911	>50	1-3	50-150	moderately eroded	Well drained with rapid permeability	Potato followed by Ragi	Granite gneiss

Table 2: Horizon wise soil description of sampling sites soil suitable for potato cultivation in Hassan district**Pedon 1: Madalapura**

Horizon	Depth (cm)	Soil characteristics
Ap	0-14	Dusky red (7.5YR 4/3) sandy loam; weak, medium, sub-angularblockystructure; slightly hard, friable, slightly sticky and slightly plastic consistency; many very fine roots;45 per cent fine gravel; clear smooth boundary.
Bt21	14-39	Reddish brown (7.5YR 3/3) sandy clay loam; moderatemedium sub-angularblockystructure; hard, friable, sticky and plastic consistency; fine common roots; very fine many pores; 43 per cent fine gravel; gradual smooth boundary.
Bt22	39-51	Dark reddish brown (5YR3/3) sandy clay; moderate medium sub-angular blocky structure; hard; friable, sticky and plastic consistency; few fine roots; fine few pores; thick, patchy clay films on ped faces; gradual smooth boundary.
Bt23	51-80	Dark reddish brown (5YR 3/3) sandy clay; moderate, medium, sub-angular blocky structure; hard, friable, sticky and plastic consistency; fine few roots; fine many pores; thick, patchy clay films on ped face; clear smooth boundary.
B3	80-100	Dark reddish brown (5YR 3/4) sandy clay loam; moderate, medium, sub-angularblockystructure; slightly hard, friable, sticky and plastic consistency; fine few roots; fine many pores; thick, patchy clay films on ped faces; clear smooth boundary.

Pedon 2: Kalenahalli

Horizon	Depth (cm)	Soil characteristics
Ap	0-20	Dark brown (7.5YR 4/4) sandy clay loam; weak, medium, sub-angularblockystructure; friable, non-sticky and non-plastic consistency; very fine roots;1per cent fine gravel; clear smooth boundary.
B1	20-39	Dusky red (7.5YR 4/3) sandy clay loam; moderate medium sub-angularblockystructure; friable, slightly sticky and slightly plastic consistency; very fine roots; fine common pores; 1 per cent fine gravel; gradual smooth boundary.
B2	39-80	Dusky red (7.5YR4/3) sandyclay; moderatemedium sub-angular blocky structure; firm, sticky and plastic consistency; very fine roots; fine few pores; 66 per cent fine gravel; gradual smooth boundary.
C	80-106	Weathered rock

Pedon 3: Gonisomenahalli

Horizon	Depth (cm)	Soil characteristics
Ap	0-18	Dark reddish brown (10YR 3/2) sandy clay; moderate, medium, sub-angularblockystructure; slightly hard, friable, slightly sticky and slightly plastic consistency; fine common roots;15 per cent fine gravel; clear smooth boundary.
Bw	18-33	Dark grayish brown (10YR 3/2) sandy clay ; moderatemedium sub-angularblockystructure; firm, slightly sticky and plastic consistency; very fine few roots; fine many pores; 10per cent fine gravel; gradual smooth boundary.

Pedon 4: Chigatihalli

Horizon	Depth (cm)	Soil characteristics
Ap	0-18	Dark reddish brown (5YR 3/3) sandy clay loam; moderate, medium, sub-angularblockystructure; hard, friable, sticky and plastic consistency; fine common roots; 3 per cent gravel; clear smooth boundary.
B1	18-32	Dark reddish brown (5YR 3/3) sandy clay loam; moderatemedium sub-angularblockystructure; very hard, slightly sticky and

		slightly plastic consistency; fine common roots; fine common pores; thick, patchy clay films on ped faces; 3 per cent gravel; gradual smooth boundary.
Bt21	32-65	Dark reddish brown (5YR3/4) clay; moderate medium sub-angular blocky structure; friable, sticky and plastic consistency; very fine few roots; fine common pores; thick, patchy clay films on ped faces; 1 per cent gravel; gradual smooth boundary.
Bt22	65-104	Dark reddish brown (5YR 3/4) clay; moderate, medium, sub-angular blocky structure; friable, sticky and plastic consistency; very fine few roots; fine common pores; thick, patchy clay films on ped faces; 1 per cent gravel; clear smooth boundary.
Bt23	104-128	Dark reddish brown (2.5YR 3/4) clay; moderate, medium, sub-angular blocky structure; friable, sticky and plastic consistency; very fine few roots; fine common pores; thick, patchy clay films on ped faces; 10 per cent gravel; clear smooth boundary.
Bt24	128-166	Dark reddish brown (2.5YR 3/4) clay; moderate, medium, sub-angular blocky structure; firm, sticky and plastic consistency; fine few pores; thin, patchy clay films on ped faces; 4 per cent gravel; clear smooth boundary.
B3	166-194	Red (2.5YR 3/6) clay; moderate, medium, sub-angular blocky structure; firm, sticky and plastic consistency; very fine few pores; 1 per cent gravel; clear smooth boundary.

Pedon 5: Hongere

Horizon	Depth (cm)	Soil characteristics
Ap	0-22	Dark brown (10YR 3/3) sandy clay loam; moderate, medium, sub-angular blocky structure; hard, friable, slightly sticky and slightly plastic consistency; very fine common roots; 31 per cent fine gravel; clear smooth boundary.
B2t	22-56	Dark brown (7.5YR 3/2) sandy clay; moderate medium sub-angular blocky structure; hard, firm, very sticky and plastic consistency; very fine common roots; fine common pores; thin, patchy clay films on ped faces; 57 per cent fine gravel; gradual smooth boundary.
BC	56-86	Reddish brown (5YR4/3) sandy clay; moderate medium sub-angular blocky structure; firm, very sticky and plastic consistency; very fine few roots; fine common pores; thin, patchy clay films on ped faces; 30 per cent fine gravel; gradual smooth boundary.

Pedon 6: Sidlahosalli

Horizon	Depth (cm)	Soil characteristics
Ap	0-14	Dark brown (10YR 3/3) sandy clay loam; moderate, medium, sub-angular blocky structure; hard, friable, sticky and plastic consistency; fine common roots; 1 per cent gravel; strongly acid; clear smooth boundary.
Bt21	14-34	Dark brown (10YR 3/3) sandy clay; strong medium sub-angular blocky structure; firm and very sticky, plastic consistency; fine few roots; coarse common pores; thin, patchy clay films on ped faces; 2 per cent gravel; gradual smooth boundary.
Bt22	34-54	Dark brown (10YR4/3) sandy clay; moderate medium sub-angular blocky structure; friable, very sticky and plastic consistency; very fine few roots; fine common pores; thin, patchy clay films on ped faces; 2 per cent gravel; gradual smooth boundary.
Bt23	54-69	Reddish brown (5YR 4/4) sandy clay; moderate, medium, sub-angular blocky structure; friable, very sticky and plastic consistency; very fine common pores; 2 per cent fine gravel; clear smooth boundary.
Bt24	69-100	Yellowish red (5YR 4/6) sandy clay; moderate, medium, sub-angular blocky structure; friable, very sticky and plastic consistency; very fine common pores; clear smooth boundary.
Bc1	100-129	Yellowish red (5YR 4/6) sandy clay loam; moderate, medium, sub-angular blocky structure; friable, sticky and plastic consistency; fine many pores; 45 per cent gravel; clear smooth boundary.
Bc2	129-164	Yellowish red (5YR 4/6) sandy clay; moderate, medium, sub-angular blocky structure; sticky and plastic consistency; 10 per cent gravel; clear smooth boundary.

Physical Properties**Pedon 1: Madalapura (Channarayapatna taluk)**

Texture of surface soil was sandy loam with 16.53 per cent clay. The clay content increased abruptly into the immediate subsoil horizon, 33.42 per cent and thereafter ranged from 31.88-50.93 per cent (Table 3).

Pedon 2: Kalenahalli (Holenarshipura taluk)

Texture of surface soil was sandy clay loam with 22.20 per cent clay. The clay content slightly increased into the immediate subsoil horizon 23.17 per cent. In the B2 horizon clay increased substantially with 31.82 per cent. Bulk density in the surface soil horizon was 1.52 Mg m⁻³ and in subsoil horizons, it ranged from 1.32 to 1.49 Mg m⁻³.

Pedon 3: Gonisomenahalli (Belur taluk)

Texture of surface soil was sandy clay loam with 23 per cent gravel. The clay content increased abruptly into the immediate subsoil horizon 38.00%.

Pedon 4: Chigatihalli (Hassan taluk)

Texture of surface soil was sandy clay loam with 33.70 per cent clay. The clay content decreased abruptly into the

immediate subsoil horizon 28.35 per cent and thereafter increased and ranged from 54.00-67.12 per cent. The textural class (USDA) sandy clay loam was observed in surface Ap horizon and B1 horizon and clay in Bt21, Bt22, Bt23, Bt24, and B4 horizons; Bulk density in the surface horizon was 1.31 Mg m⁻³ and increased abruptly into the immediate to 1.56 and thereafter from 1.43 to 1.60 Mg m⁻³, in further subsoil horizons (Table 3).

Pedon 5: Hongere (Hassan taluk)

Texture of surface soil was sandy clay loam with 21 per cent clay. The clay content increased abruptly into the immediate subsoil horizon to 43.17 per cent. The gravel content was 31 per cent in surface soil and the textural class (USDA) sandy clay loam was observed in surface Ap horizon.

Pedon 6: Sidlahosalli (Hassan)

Texture of surface soil was sandy clay with 40 per cent clay, the clay content increased abruptly into the subsoil horizon down to Bt24. The textural class (USDA) sandy clay was observed in surface Ap, Bt21, Bt22, Bt23, Bt24, BC2 and sandy clay loam was observed in BC1.

Table 3: Horizon wise physical properties of soil profile sampled at soil suitable for potato cultivation in Hassan district

Depth (cm)	Horizon	Size class and particle diameter (mm)							Gravel % volume	Texture (USDA)
		Sands					Total			
		V. coarse (2.0-1.0)	Coarse (1.0-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	V. fine (0.1-0.05)	Sand (2.0-0.05)	Silt (0.05-0.002)		
% of <2 mm										

Pedon 1: Madalapura (Channarayapatna taluk)

0-14	Ap	3.18	5.45	14.48	28.95	22.07	74.13	9.34	16.53	45	Sl
14-39	Bt21	2.99	5.66	12.87	23.79	19.67	64.98	1.60	33.42	43	Scl
39-51	Bt22	6.31	5.29	10.89	15.87	11.60	49.95	5.01	45.04	-	Sc
51-80	Bt23	8.05	8.96	9.06	11.33	9.06	46.47	2.60	50.93	-	Sc
80-100	B3	5.54	7.60	10.68	19.30	17.56	60.68	7.44	31.88	-	Scl

Pedon 2: Kallenahalli (Holenarasipura taluk)

0-20	Ap	1.89	7.68	13.96	24.63	25.02	73.18	4.62	22.20	1.00	Scl
20-39	B1	2.57	9.15	12.95	18.71	17.06	60.44	16.39	23.17	1.00	Scl
39-80	B2	5.49	8.80	11.80	15.73	13.87	55.70	6.78	37.52	66.0	Sc

Pedon 3: Gonisomenahalli (Belur)

0-18	Ap	3.89	10.02	14.83	18.81	18.71	66.26	11.25	22.49	15.00	scl
18-33	Bw	2.79	7.03	3.10	25.65	17.99	56.58	5.37	38.05	10.00	sc

Pedon 4: Chigatihalli (Hassan taluk)

0-18	Ap	5.44	8.06	13.24	21.06	18.20	66.01	0.29	33.70	03	scl
18-32	B1	4.02	8.77	11.87	19.30	14.55	58.51	13.13	28.35	03	scl
32-65	Bt21	3.26	5.94	8.70	14.74	11.46	44.10	1.60	54.30	01	c
65-104	Bt22	3.92	5.01	6.68	13.22	9.17	38.00	0.50	61.50	01	c
104-128	Bt23	9.85	4.15	6.64	11.62	8.61	40.87	2.00	54.00	10	c
128-166	Bt24	6.61	3.10	4.65	8.57	7.44	30.37	2.50	67.12	04	c
166-194	B3	4.54	2.37	3.30	6.70	8.04	24.95	12.21	62.83	01	c

Pedon 5: Hongere (Hassan taluk)

0-22	Ap	9.71	10.43	16.29	21.46	16.18	73.40	5.60	21.00	31.00	scl
22-56	Bw	6.05	8.03	10.11	12.20	9.49	45.88	10.95	43.17	57.00	sc
56-86	BC	8.03	9.38	8.55	11.26	13.35	50.57	12.72	36.70	30.00	sc

Pedon 6: Sidlahosahalli (Hassan Taluk)

0-14	Ap	2.07	6.40	3.90	24.60	13.84	50.80	9.43	39.77	01	Sc
14-34	Bt21	1.85	7.83	5.97	26.74	16.29	58.60	1.20	40.20	02	Sc
34-54	Bt22	1.56	6.54	3.63	29.21	13.29	54.20	3.40	42.39	02	Sc
54-69	Bt23	3.00	3.79	2.38	28.23	12.39	49.79	2.21	48.00	02	Sc
69-100	Bt24	3.43	4.68	3.33	23.36	11.55	46.30	2.70	51.00	-	Sc
100-129	BC1	8.27	6.34	5.42	26.75	13.24	60.00	7.00	33.00	45	Scl
129-164	BC2	8.17	6.00	5.27	28.47	14.38	62.00	2.00	36.00	10	Sc

Soil classification

The soils studied of potato growing areas of Hassan district were classified according to soil taxonomy of USDA (Table 4).

Table 4: Classification of soils of six sites soil suitable for potato cultivation in Hassan district as per soil taxonomy

Site of pedon	Order	Sub order	Great group	Subgroup
Madlapura	Alfisols	Haplustalfs	Typic Haplustalfs	Fine, mixed, isohyperthermic, Typic Haplustalfs.
Kalanahalli	Alfisols	Haplustalfs	Typic Haplustalfs	Fine, loamy, mixed, isohyperthermic, Typic Haplustalfs.
Gonisomenahalli	Inceptisols	Dystrustepts	Lithic Dystrustepts	Loamy, mixed, isohyperthermic, Lithic Dystrustepts.
Chigatihalli	Alfisols	Haplustalfs	Typic Haplustalfs	Fine, mixed, isohyperthermic
Hongere	Inceptisols	Dystrustepts	Typic Dystrustepts	Clayey skeletal, mixed isohyperthermic, Typic Dystrustepts
Sidlahosalli	Alfisols	Haplustalfs	Typic Haplustalfs	Fine, mixed, isohyperthermic

Discussion

In order to assess soil qualities of potato-growing areas of Hassan district, detailed field and laboratory studies were undertaken. Soil samples collected by exposing soil profiles at six representative crop-growing sites were analysed in the laboratory for relevant quality parameters. Besides, large

numbers of composite surface samples were collected from fields of potato crop. Detailed account of materials used, methods employed and results obtained were presented in proceeding chapters. The focus of this chapter is on analysis of the results to bring out the soil related potential and constraints of potato production in the district.

The study area, Hassan district is a part of Karnataka plateau, the southern part of the larger peninsular Indian plateau. The gently sloping to rolling landscape has geologic base of granite gneiss interspersed at places by intrusive. The peneplaned plateau surface has for most part deep soils unless erosion has truncated the solum. The dominated rain fed agricultural land use system in Hassan district are ragi, maize and jowar. Potato, often grown under rain fed conditions, is followed by maize. Rice is the major crop in irrigated lands.

According to agro climatic division of state by NARP, geographical area of Hassan district has 4 agro climatic zones viz. Central dry zone, southern dry zone, southern transitional zone and hilly zone. The length of the growing period is around 6 months in a year, permitting two short duration crops.

The study of soils at six sites by exposing soil profile to depth around 1.5 metres from surface for the soil morphological features, physical, chemical and microbiological properties through sampling and analysis helped to understand the qualities of potato growing areas. The salient among them are discussed in the following sections.

Morphological properties

Among the six pedons studied four had deep solum extending beyond 100 cm from surface, one was moderately deep (depth 86 cm) and another shallow (depth 36 cm), though all were located on gently sloping upland; Low lands, susceptible to water logging during monsoon season are seldom to potato production. The shallow solum at one site can be attributed to lack of soil conservation and loss of soil through erosion.

The soil colour on surface and subsoil ranged from dark reddish brown to brown with little exception. The colour is indicative of good drainage of water through the entire solum. The reddish shades can be attributed to the large presence of oxides of iron (Patil and Dasog, 1999) [6].

Surface soil texture was largely sandy clay loam with one exception of sandy loam. At few instances the sandy clay loam texture continued into the immediate subsoil horizon, otherwise sandy clay was the dominant texture of subsoil layers. Clay content of the soil increased into subsoil horizon at all sites. Field evidence of clay illuviation was apparent through presence of clay cutans on ped faces in four soil profiles studied. Particle size distribution of soil, assessed through laboratory analysis of the soil samples, confirmed the clay illuviation. The clay cutans along with laboratory data led to the identification of argillic horizon (Soil Survey Staff 1999) [3] in four profiles studied.

All the soils studied exhibited good structural development throughout the solum. The peds formed by aggregation of primary particles were medium sized, subangular blocky, both in surface and subsoil. The peds were moderately strong in subsoil whereas on the surface they were weak, probably due to constant tillage operation.

The soil consistency when dry was hard and moist friable. Wet consistency was sticky and plastic, especially in subsoil layers with higher content of clay (Mahapatra *et al.* 2000) [4]. Surface gravelliness in significant amounts was uncommon. However, occurrence of gravel or stone layer at some depth was observed in many pedons. This might have been inherited from parent rock layers of very uncontent minerals like quartz. These layers when they occur very near to surface can act as root limiting layers.

Soil classification

The morphological properties of soils and their physical and chemical properties were made to classify the soils according to soil taxonomy (Soil Survey Staff, 1999) [3]. Out of the six soil pedons studied four of them keyed out to Alfisol order and two Inceptisol order. The presence of argillic horizon as evident through the illuvial clay in subsoil enabled assignment of the soils into Alfisol order.

In the field the evidence was clay cutans on pedfaces and depth wise particle sizes distributions, 1.2 times or more clay into subsoil layers. At the suborder level they keyed out to ustalfs due to the prevailing ustic soil moisture regime (a significant dry period in a year). In the absence of any special features at the great group level the soils keyed out to Haplustalfs and at subgroup level to Typic Haplustalfs. The family level classification mainly looks into consideration texture of the control section of family, mineralogy and temperature regime.

Loamy, fine-loamy and fine textured soils were recorded for control section and accordingly assigned for family level classification. CEC/Clay ratio in the range of 0.2 to 0.5 pointed to mixed mineralogy of the soils. Temperature above 22 OC and the difference between mean winter and mean summer temperature not exceeding 5 OC resulted in assignment of isohyperthermic temperature regime.

The soil pedon from Hongere did not found place in Alfisol order since no argillic horizon was apparent instead keyed out to Inceptisol order. The ustic soil moisture regime and base saturation less than 60 per cent in soil layer from 25 to 75 cm resulted in classification of the soil to Dystrustepts at the great group level. In the absence of any special feature deviating from the control concept of great group, at the subgroup level the soils keyed out to Typic Dystrustepts. The soil texture in the control section was clayey-skeletal and the mineralogy was mixed (CEC/Clay 0.49 to 0.59) at the family level the soil classification is clayey-skeletal, mixed, isohyperthermic, Typic Dystrustepts.

The soil pedon studied at Gonisomenahalli had shallow solum (33 cm) and was underlain by roof limiting weathered rock layer: lithic contact. At the family level the soil classification is loamy, mixed, isohyperthermic lithic Haplustupets.

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