SOME PHYSICAL PROPERTIES OF REDDISH BROWN EARTH SOIL.

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The quantification of physical parameters of soil is important to intensify Agriculture.

This study was done at Thambuttegama. This location is in Mahaweli Project System H (DL_1 Agro-Ecological zone) The aim was to evaluate the physical soil fertility factors.

The results show that the soil physical factors at different places of a catena varies (significantly) according to the depth of the soil, and its drainage condition.

No physical factor functions independently. They depend on one another. Correlations were observed among different physical parameters in their behaviour.

This study indicated that soil physical parameters influence soil physical fertility factors such as soil moisture availability, soil aeration and soil mechanical impedence.

Introduction:

The increasing demand for food, and the limited availability of cultivable land, creates a need to increase production per unit of cultivable land.

The majority of the lands available for arable annual cropping are within the dry zone of Sri Lanka. Reddish Brown Earth soil is the dominant great soil group in the dry zone (Moor man and Panabokke, 1961). It occupies 3.6 million of acres. Over 2/3 of the total paddy lands of the country are found in the group of Reddish Brown Earth soils. Also these soils compose a major component of the soils in the Mahaweli diversion (Multipurpose) Project.

Intensification of crop production can be achieved by improving and maintaining the soil fertility. Therefore the study of soil fertility of Reddish Brown Earth in the dry zone must be given priority.

Soil physical characteristics play a major role in determining the status of soil physical fertility factors, and also is useful in addressing irrigation and soil erosion problems. The important physical characteristics are soil texture, structure, porosity, Bulk density, Soil consistency and soil strength. These physical attributes influence plant growth through their effects on soil moisture availability soil aeration, soil temperature and mechanical impedence.

Therefore to improve productivity of a soil suitable physical characteristics in the soil must be developed. Better understanding of those characteristics help the agriculturists to develop the physical status of soil, that help good plant growth.

The objective of this investigation was:

1. to study the soil physical characteristics in three drainage associates of Reddish Brown Earth soils and,
2. to evaluate the effects of these parameters on soil physical fertility factors such as soil aeration, soil moisture content and soil mechanical impedence.

Mataerials and Methods:

Location

The site selected for this Study was Thambuttegama, 16 miles south of Anuradhapura within the H area of Mahaweli development project, (DL_1 Agro-Ecological zone).

Topography

Topography at the site is undulating to rolling. The study area consisted of a catenary unit having three drainage classes:-

1. The well drained (W.D.) class located at the upper aspects of the catena,
2. The imperfectly drained (I.D) class located at the middle aspects of the catena, and
3. The poorly drained (P.D.) category occupied tahe lower aspects of the catena as shown in the Figure 1.

Table 1. **SOME PHYSICAL CHARACTERISTICS OF SOILS FROM A CATENA OF REDDISH BROWN EARTHS.**

Drainage member	Horizon	Land slope %	Soil Depth (cm)	Percentage of Sand	Silt	Clay	Organic matter.	Texture	Time taken for dispersion
W.D.	A	1.5-2.0	0-15	83.45	8.50	8.04	1.47	LS*	12 hours
	B_2		15-75	67.96	10.50	21.54	0.87	SCL*	90 seconds
	B gravel		75-175	65.76	10.70	23.54	0.08	SCL	15 secpmds
	C		175	90.36	3.40	6.24	0.02	Sandy	5 seconds
I.D	A	1.0-1.5	0.25	81.62	6.10	12.28	1.16	SL*	10 hours
	B_2		25-75	71.48	5.50	23.04	0.32	SCL	45 seconds
	B gravel		75-175	70.18	5.80	24.02	0.08	SCL	20 seconds
	C		175	-	-	-	-	-	-
P.D.	A	0.5-1.0	0-30	78.46	4.00	17.54	1.86	SL	13 hours
	B_2		30.105	76.36	4.10	19.54	0.59	SCL	45 seconds
	B gravel		105-175	66.08	10.44	22.88	0.04	SCL	10 seconds
	C		175	-	-	-	-	-	-

* **LS = Loamy sand SL = Sandy Loam SCL = Sandy clay loam.**

Measurements:

The following laboratory and field measurements were carried out for the samples from each horizon of each drainage class.

Laboratory Measurmeents:

Parameter

1. Soil Texture

   Mechanical analysis was done according to the Hydrometer method (Bouyoucous, 1951) for the particles 2 mm in diameter. Three replicates were used for each horizon

2. Organic matter

   Walkley and Black (1934) method. Three replicates per horizon were tested.

3. Plasticity Index:

   Determination of plasticity limit and liquid limit according to the Black et al (1965) method. Three samples for each horizon.

4. Bulk Density:

   Undisturbed core samples were used to determine bulk density. Three samples were used per horizon.

5. Porosity

   Bulk density and particle density were estimated to determine total porosity.

6. Aggregate stability

   Seives of 2000 m and 250 m aperture diameter used for both dry and wet seiving tests to determine Wet and Dry aggregate stability. Two tests for each horizon.

7. Dispersion rate of Aggregates

   Emerson's (1954) method was used to estimate the dispersion rate of aggregates. Three tests per horizon.

Field Measurements

1. Soil strength

   This attribute was estimated in the field (in-situ) using a recording type penetrometer having a cone of 8 mm diameter. 10 tests for each drainage category were made. Tests were conducted at comparable moisture contents.

2. Infiltration Rate

   Infiltration tests were conducted using double ring infiltrometers of Eijkelkamp type. Duplicate runs were carried out per drainage associate.

RESULTS AND DISCUSSION

Land slope and depth of soil horizon.

Land slope and depth of different soil horizons of the three drainage associates are shown in Table 1. According to these results a correlation was observed between the land slope and the thickness of A-horizon. Variation of depth in A horizon among different drainage categories is probably caused by continuous soil erosion. The well drained soil has the highest erodibility because this soil is always at upper aspects of catena with the highest land slope. Soil erosion may be the reason for the lowest thickness of A horizon of this drainage group. The lowest soil erodibility is exhibited by the poorly drained group which is located at lower aspects with the lowest land slope, where the eroded material from upper and middle aspects of the catena is deposited. Therefore this drainage member possessed the highest depth of A horizon while the imperfectly drained class exhibited the moderate depth of A horizon.

Soil texture

Soil textural data (for the three drainage classes are in Table I. Texture of the A horizon seems to exhibit desirable conditions (for better plant growth) such as good moisture holding capacity, better aeration and sufficient voids for better root growth. The B horizon due to the increased amount of clay, may have greater water holding capacity, but soil aeration is likely to be poor and as well as increased the mechanical impedence.

A correlation was seen between the land slope and the soil textural data. The variation of clay content along the surface horizons is probably due to migration of clay particles. Due to the small particle size, the clay particles are carried further down along the slope and deposited at lower aspects of the catena.

Organic matter content:

Soil organic matter contents of all the three drainage classes are shown in Table I. These data indicate that the organic matter content decreases with the depth of the horizon. Ill drained condition of the soils at lower apsects of catena, decreases soil aeration leading to restricted organic matter decomposition. Therefore this soil (P.D) contains higher amounts of organic matter due to the accumulation.

Dispersion rate of aggregates

Results of the Emerson's dispersion rating tests are also shown in Table 1. Surface soils always possess higher stabilities than that of subsurface soils.

Good relationships can be seen between the organic matter contents and the dispersion rate of aggregates. The highest organic matter content and the lowest dispersion rate could be observed in the A horizon of the poorly drained class. Organic matter content of the imperfectly drained surface soil is lower than that of similar horizon of well and poorly drained groups. The dispersion rate of soils at imperfectly drained A horizon is higher than that of the well and poorly drained A horizon soils. Thus the poorly drained surface soil possess the highestaggregate stability while the well drained surface soil have moderate aggregate stability and the imperfectly drained surface soil, had the lowest aggregate stability.

With increasing depth of soil, the clay content too increases while the organic matter content decreases. Dispersion rate also increases with the depth of all three drainage classes. By increasing the cohesion between soil particles, both decomposed and undecomposed ortanic materials contribute to stabilized soil structure. There-fore where the amount of soil organic matter is high, the cohesion forces are also high. As such even when this soil is wetted, the surface tension forces are not strong enough to slake aggregates. Therefore, soils with high organic matter, show higher aggregate stabilities In the sub-surface horizons the organic matter percentages are low while the clay percentages are high Bonding by clay is not so strong as those due to organic matter. Therefore, aggregate stability in subsurface horizons is lower.

Stability of aggregates of different sizes.

According to the dry seiving data in Table 2, the aggregates between 250 m and 2000 m diameter possessed higher stabilties compared to the aggregates in the range of 2000 m and 250 m diameter. It is also observed that in all the drainage members the A - horizon have higher weight propotions of particles above 250 m. This indirectly shows that A - horizon contains higher amounts of stronger aggregates than the B - horizon. B - gravel horizons are not compared (for the same effect) as it was observed to contain relatively high percentage of gravel.

Wet seiving data are also shown in Table 2. Only the gravel particles remained on the seive (size 2000 m diameter size have no stability to wet seiving. But considerable amounts of aggregate having size 2000-250 m show stability to wet seiving. Further the stability of 2000-250 m size aggregates to wet seiving was higher thant that of the B - horizon.

Soil consistency

Soil consistency data are shown in Table 2. Always the plasticity index of subsurface soils are higher than surface soils. Further plasticity index of the poorly drained A horizon soils were higher than that of well and imperfectly drained A - horizon soils. According to these data it could be expressed that, the poorly drained group surface soils' workability is lower than that of well and imperfectly drained categories.

A correlation between soil textural values and consistency values were seen. As subsurface (B-horizon) soils had relatively high amounts of clay, their liquid limits are higher than the soils from A horizon. This leads to increased plasticity index of subsurface soils. The relatively high plasticity index of subsurface soils. The relatively high plasticity index of poorly drained surface soil is probably caused by tahe presence of relatively higher clay amounts.

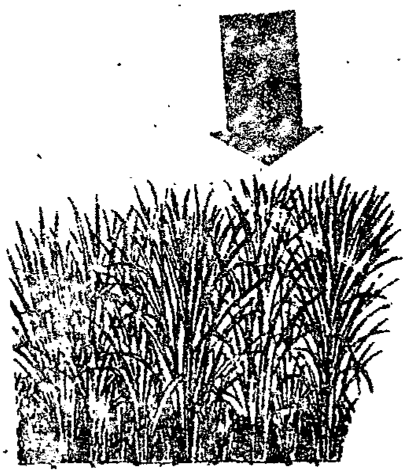
Table 2. CONSISTENCY AND AGGRIGATE STABILITY LEVELS OF SOILS FROM A CATENA OF REDDISH BROWN EARTH.

Drainage Class	Horizon	Liquid limit %	Plastic limit %	Plasticity index	Dry Sieving Results 2000 m %	Dry Sieving Results 2000-250 m %	Dry Sieving Results 250 m %	Wet Seiving Results 2000 m %	Wet Seiving Results 2000-250 m %	Wet Seiving Results 250 m %
W.D	A	18.31	14.00	4.31	41.43	42.90	15.97	7.90	32.04	60.06
	B_2	25.00	16.74	8.26	38.90	39.21	22.49	7.20	29.60	63.20
	B gravel	23.00	15.90	7.10	25.25	35.50	39.25	34.52	8.88	56.60
I.D.	A	17.80	15.70	2.10	17.18	64.36	19.50	4.00	47.44	48.56
	B_2	21.00	16.90	4.10	14.87	56.70	29.13	2.88	39.60	57.52
	B gravel	22.40	14.90	7.50	37.28	40.50	22.22	11.92	33.72	54.36
P.D.	A	30.76	17.80	12.96	19.92	59.73	20.35	2.32	43.37	54.31
	B_2	25.70	20.28	5.42	19.72	54.85	25.43	4.24	43.24	52.52
	B gravel	25.06	17.27	7.79	28.98	42.64	28.38	25.55	30.27	44.18

W.D. = The well drained class located at the upper aspects of the catena.

I.D. = The imperfectly drained class located at the middle aspects of the catena.

P.D. = The poorly drained category located at the lower aspects of the catena.



Soil Bulk density

Table 3 exhibits the bulk density status of different soil horizons. Always subsurface soils have higher bulk densities. And the poorly drained surface soils show relatively higher bulk density than shown by surface soils of other drainage classes.

There is a distinct relationship between soil texture and bulk density in all three drainage classes. Soil texural data Table 1 correlates with the bulk density data in Table 3. TAh soils that had relatively higher percentages of clay also had relatively higher bulk density values. That is probably because of reduced porosity due to clogging of soil pores by clay particles. This may be the reason for relatively higher bulk densities of soil in the subsurface horizons.

Further the surface soils in the lower aspects contained relatively higher percentages of clay. These higher clay amounts while reducing the soil porosity increases the soil bulk density. Relatively low clay percentages, as well as, low bulk density values are exhibited in the surface soils at upper and middle aspects of the catena.

A relationship was seen between the organic matter content and the bulk density and porosity levels of soil. In soil layers where organic matter content is high, the bulk density is low. Mainly in the A - horizon a significant accumulation of organic matter was observed. It promotes good soil structure. This results in an increase in porosity and also reduction in soil bulk density.

Also the regular loosening of the surface soil layer by cultivation brings about a significant reduction of the bulk density of the layer of soil at the surface.

Presence of high plasticity index values is a characteristic feature of soils which have high bulk density values. High bulk density is mainly due to high amount of clay. This high amount of (sticky) clay also causes increased soil plasticity index.

Table 3. **SOME PHYSICAL CHARACTERISTICS OF SOILS FROM A CATENA OF REDDISH BROWN EARTH.**

Drainage category	Horizon	Bulk density (grs/cm^3)	Porosity % (volume)	Steady infiltration. cm/hr.	Registeance Kg/cm^2	Moisture * %
Well drained.	A	1.47	44.60	8.0	957.8	7.63
	B_2	1.67	37.00		1235.3	
	B gravel	1.69	36.20		-	-
	C	1.63	38.50		-	-
Imperfectly drained	A	1.31	50.70	14.0	395.5	6.66
	B_2	1.57	40.80		936.8	
	B gravel	1.65	37.70		-	-
Poorly drained	A	1.52	42.70	4.0	1010.2	8.32
	B_2	1.58	40.40		1264.0	
	B gravel	1.62	38.90		-	-

* Moisture content of soil whenthe soil reistence tests were done. The moisture content does not show significant variation among the drainage groups.

Soil strength

The data of soil resistence to penetration tests are shown in Table 3. The sub-surface soils always possessed higher soil strength values than the surface soils. Further the strength of poorly drained group soils was higher than the well and imperfectly drained groups of soils. High soil strength is undesirable for plant growth because it adversly affect root penetration. Therefore better of crop growth could be expected in well and imperfectly drained groups of soils.

The soils having high amounts of clay possess higher mechanical impedence. It is clarified by higher mechanical impedence values in subsurface horizons. The poorly drained surface soils which contain relatively higher amounts of clay, also have higher soil strength values. Thus due to the high soil strength of poorly drained soils they have to be cultivated prior to planting a crop.

The bulk density parameters always correlates with the soil resistence to penetration. In the soils where the bulk density is high, the soil strength also is high. This is probably because of low porosity of such soils.

Infiltration rate

Details of infiltration rating tests are also shown in Table 3. Possessing very low infiltration rates is a common feature of these soils. That is probably because of the presence of compacted B-horizon where soil pores are clogged by illuviated clay particles. The steady infiltration rate of well and imperfectly drained groups is always higher than that of the poorly drained soil group. This type of infiltration rate of both well and imperfectly drained soil groups improves the drainage of these lands. Therefore the suitability of these lands for upland crops is high. However, under the Mahaweli scheme, these lands are at present used for paddy cultivation with supplementary irrigation. The farmers always try to retain some amount of water at the surface of the soil in paddy lands and it is very difficult on these soils due to its high infilitration rate. Therefore it could be concluded that the suitability of these soils for paddy cultivation is low. The low infilitration rate of the poorly drained soils,provide desirable conditions for paddy cultivation.Alternatively the potential of the latter soil group for upland crops are relatively low.

A correlation between steady infiltration rate and the soil texture was observed. The clay content of both well and imperfectly drained surface soils, is relatively lower than that of poorly drained soils. Consequently, a high soil porosity could be expected in soils on the upper and middle aspects of the catena. The infiltration property of the above soils were also observed to be high. The high clay content on the poorly drained group decreases the amount of macro pores and reduces the steady infilitration rate.

A close correlation was observed between the soil bulk density and the steady infilitration rate The imperfectly drained surface, soils which possess the lowest bulk density value exhibited the highest steady infilitration rate. The lowest infiltration was shown by the poorly drained surface soils which also had the highest bulk density.

Results of this investigation show that the physical fertility of soils (on different drainage members of a catena at Thambuttegama withimthe 'H' area of Mahaweli Project zone) differ significantly.

Further this study shows that each physical soil factor completely depends on the other physical factors. This is how they function inthe resultant level of soil fertility.

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The Cultivated Mushrooms

The mature mushrooms consisted of the cap, and and the stalk. The cap is expanded umbrella like structure which is upported by the stalk. In the cultivated mushroom this cap is white. On the under surface of the cap are the gills, atheir folds radiating from the point of attachment of the cap to the stalk. The gills produce spores which,under appropriate conditions, serve as a means of reproduction for the fungus. Many millions of spores, which are purplish black, may be developed by a single mushroom. The gills of the young mushroom are pink, bu the colour darkens and finally turns almost black as the mushroom becomes older.

The young unopened mushroom is as a button. The gills are not visible at this stage, as they are covered by the veil which extends from the edge of the cap to the stem. As growth proceeds, tahe cap expands and the veil is torn, exposing the gills. A remnant of the veils, known as tahe "ring" is left attached to the stem.

Mushrooms do not require sunlight for development They are grown in sheds or houses because tahese permita control of temperture and moisture.

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