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Research article

EVALUATION OF BULK DENSITY IN ORGANIC AND LATERITIC SOIL FORMATION INFLUENCED BY VARIATION OF SATURATION AND POROSITY IN DELTAIC ENVIRONMENT, RIVERS STATE OF NIGERIA

Eluozo, S. N.

Subaka Nigeria Limited, Port Harcourt, Rivers State of Nigeria
Director and Principal Consultant, Civil and Environmental Engineering Research and Development
E-mail: Soloeluozo2013@hotmail.com
E-mail: solomoneluozo2000@yahoo.com

Abstract

Evaluation of bulk density in organic and lateritic soil formation influenced by variation of saturation and porosity in deltaic environment has been assessed. The study was to determine the effect of bulk density at every condition of soil use in the study location. The study expressed an increase in bulk densities thus on the process where constant trend of densities between three thousand and five thousand millimeter were observed. Constant depositions of bulk density were found in the lateritic soil horizon, Bulk density in a soil is a measurement of the total volume of both the particles and pore space within a sample.. Loamy soils, a mixture of sand, silt and clay have moderate bulk densities between that of sands and clays. The addition of organic matter to a soil is typically a low percentage that does not significantly influence the measurement of bulk density. Soil scientists use one of several methods to determine the bulk density of a sample including the clod method, core method, excavation method or the radiation method, which always involve determining the mass and volume of the sample since the sand develop higher densities than clay. The rate of bulk densities in lateritic soil implies that there is a noticeable deposition of clay content in the lateritic soil, there rate of this clay content explain the reason why the lateritic soil are not good enough for our sub base material in road construction.

Keywords: organic and lateritic soil; clay; Nigeria; Soil

1. Introduction

Soil is composed of three major components: soil particles, air, and water. The fractions of water and air are contained in the voids between soil particles. The ratio of the volume of pores (voids) to the total (bulk) volume of a soil is the ***porosity*** (N). One way to determine porosity is to measure the volume of a soil that is composed of soil particles and the fraction made up of the pores. The porosity may also be determined using the soil ***bulk density*** (Db). Bulk density is the density of the undisturbed (bulk) soil. Proper characterization of soil bulk density is essential for an accurate interpretation of chemical and microbiological parameters in the field. Reluctance to report soil analyses on a volumetric basis is usually related to requirements of additional time and specialized equipment for determination of soil bulk density. Proper characterization of the soil physical environment is important to denning and interpreting microbiological, chemical, and crop growth processes in the field. Measurement of soil bulk density enables calculation of volumetric soil water content from gravimetric contents, calculation of soil porosity when particle density is known, and expression of soil analysis results on a volumetric basis. Soil bulk density is defined as the ratio of oven-dried mass weight to its bulk volume depends on the soil particles densities such as sand, silt, clay and organic matter and their packing arrangement. Bulk density values are required for converting gravimetric soil water content to volumetric and to calculate soil porosity which is the amount pore space in the soil [Blake and Hartge, 1986]. Researchers often need a bulk density value to use in models, characterize field conditions, or convert to volumetric measurements [Reinsch and Grossman, 1995]. Soil bulk density is a basic soil property influenced by some soil physical and chemical properties. Bulk density is a dynamic property that varies with the structural condition of the soil. This condition can be altered by cultivation, trampling by animals, agricultural machinery, weather, i.e. raindrop impact [Arshad et al., 1996, Akin and. Özdemir, 2003].]. Knowledge of soil bulk density is essential for soil management, and information on the soil bulk density of soils is important in soil compaction and structure degradation as well as in the planning of modern farming techniques. If both, bulk density and particle density are known, the total porosity can be calculated by using these values [Hillel, 1982]. Soil bulk density should be used as an indicator of soil quality parameter. Akgül and Özdemir [1996] studies on relationships between soil bulk density and some soil properties explained that these constants can be estimated by means of developed regression models. A unit increases in organic matter and clay content caused a relatively larger decrease in soil bulk density. A soil system can be thought as a network of soil properties. Path analysis may be used to investigate the relationships among these soil properties. The path diagram gives a picture of network of relations among the characters, as quantitative evaluation is possible from the data (Wright, 1968). The objective of this study was to determine relationships between soil particle size distribution and organic matter content and soil bulk density by using path analysis. [Akin and. Özdemir, 2003].

2. Material and method

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Samples of five v surface soils (0-20 cm depth) were taken from grassland in Samsun district in Port Harcourt. This area has a organic and lateritic soil. Annual mean of precipitation is 670.4 mm and mean temperature is 24. 0C [Anonymous, 2002]. Standard experiments were Bulk soil samples were air dried and then crushed to pass through a 2 mm sieve. Soil organic matter content was measured by a modified Walkley-Black method (Nelson and Sommers, 1982); soil particle size distribution was determined by the hydrometer method [Gee and Bauder, 1979]; lime content was measured by Scheibler Calcimeter [Soil Survey Staff, 1993]; soil pH was measured by using a 1:2.5 (w/v) soil-water ratio by pH-meter with glass electrode (Black, 1965). Bulk density was determined by means of the clod method [Blake and Hartge, 1986, Akin and. Özdemir, 2003].

3. Results and Discussion

Various sample interpretation from the field were thoroughly analyzed the results are presented in table and figures stated below.

Table 4.1: bulk density of soil at different depths

Depth mm	Bulk Density /1000kg
200	2.2
400	2.42
600	2.48
800	2.55
1200	2.62
1400	2.7
1600	2.74
1800	2.74
2000	2.74
2500	2.74
3000	2.74
4000	2.74
5000	2.74

Table 4.2: bulk density of soil at different depths

Depth mm	Bulk Density /1000kg
200	2.28
400	2.45
600	2.46
800	2.52
1200	2.6
1400	2.7

1600	**2.73**
1800	**2.74**
2000	**2.73**
2500	**2.74**
3000	**2.75**
4000	**2.75**
5000	**2.75**

Table 4.3: bulk density of soil at different depths

Depth mm	**Bulk Density /1000KG**
200	**2.3**
400	**2.44**
600	**2.48**
800	**2.57**
1200	**2.6**
1400	**2.68**
1600	**2.72**
1800	**2.75**
2000	**2.74**
2500	**2.75**
3000	**2.76**
4000	**2.75**
5000	**2.75**

Table 4.4: bulk density of soil at different depths

Depth mm	**Bulk Density /1000kg**
200	**2.15**
400	**2.28**
600	**2.32**
800	**2.45**
1200	**2.5**
1400	**2.61**
1600	**2.67**
1800	**2.74**
2000	**2.75**
2500	**2.75**
3000	**2.74**
4000	**2.75**

5000	**2.75**

Table 4.5: bulk density of soil at different depths

Depth mm	Bulk Density /1000kg
200	1.18
400	1.29
600	2.3
800	2.36
1200	2.45
1400	2.52
1600	2.62
1800	2.63
2000	2.74
2500	2.75
3000	2.74
4000	2.74
5000	2.74

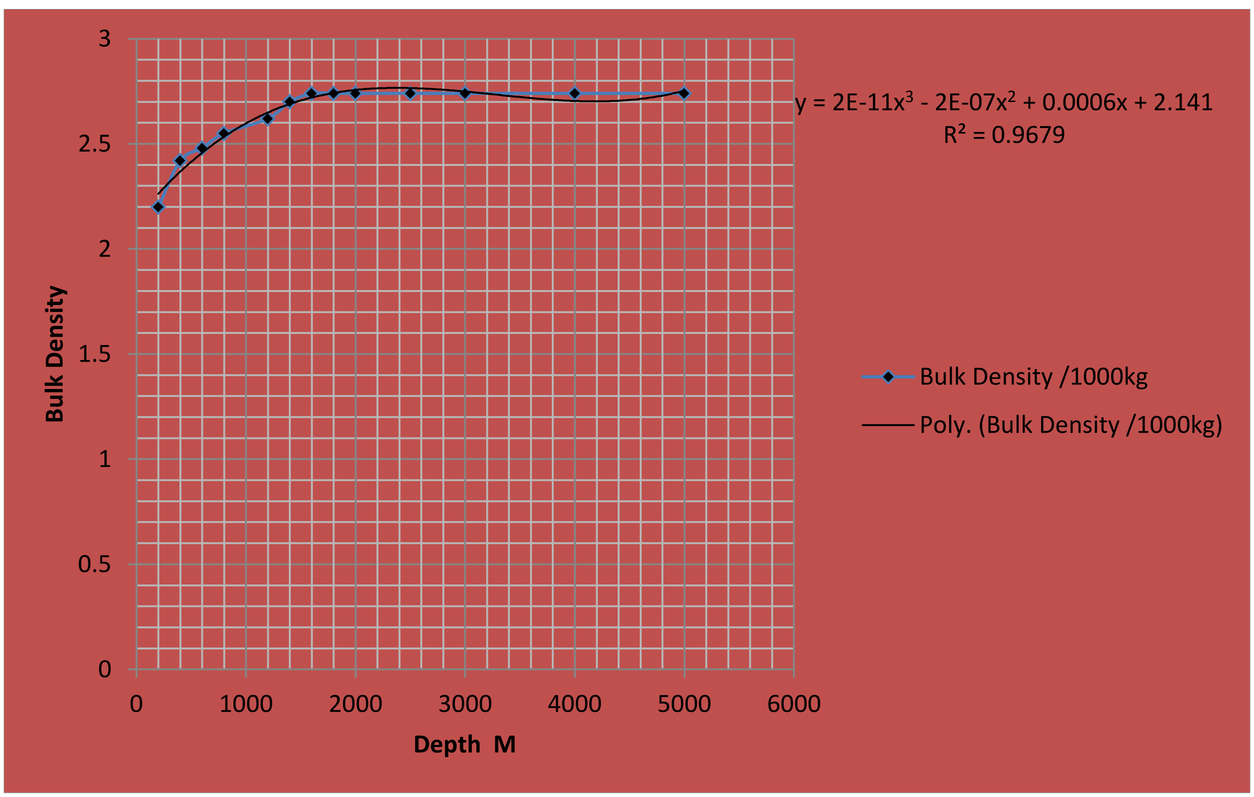

Figure 1: bulk density of soil at different depths

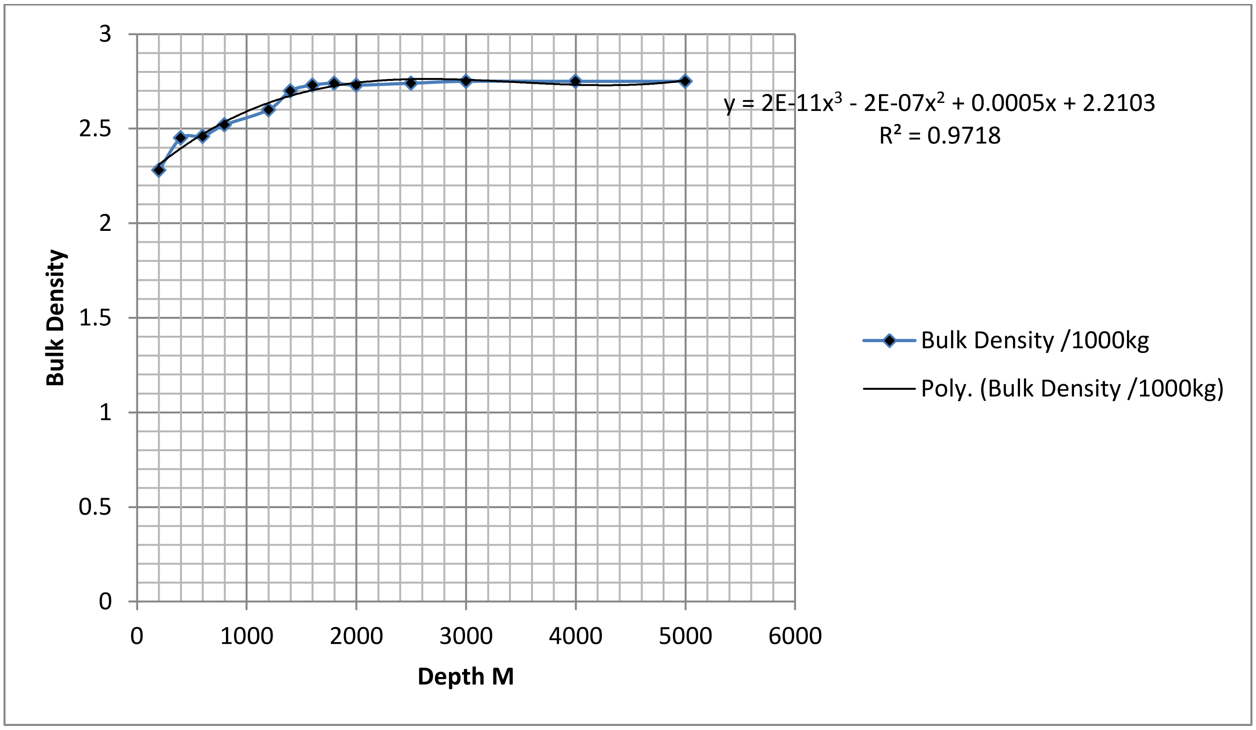

Figure 2: Bulk density of soil at different depths

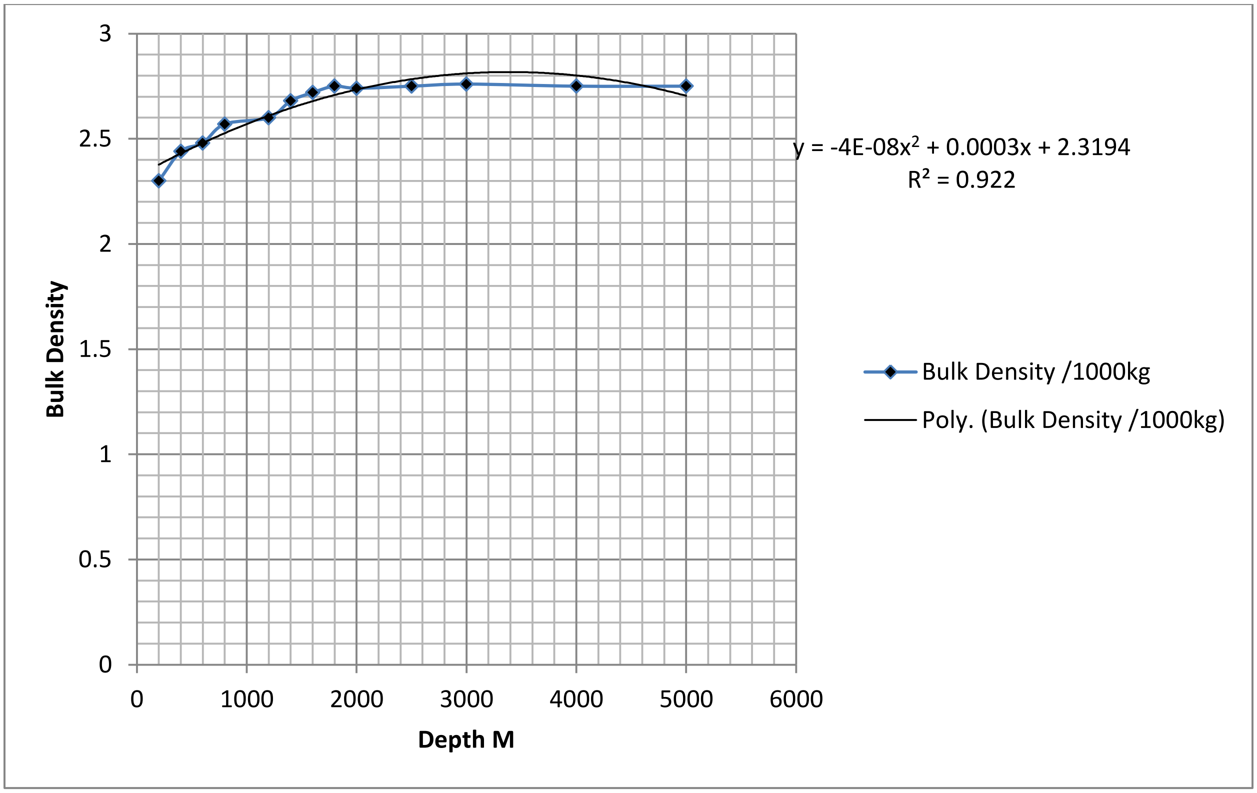

Figure 3: Bulk density of soil at different depths

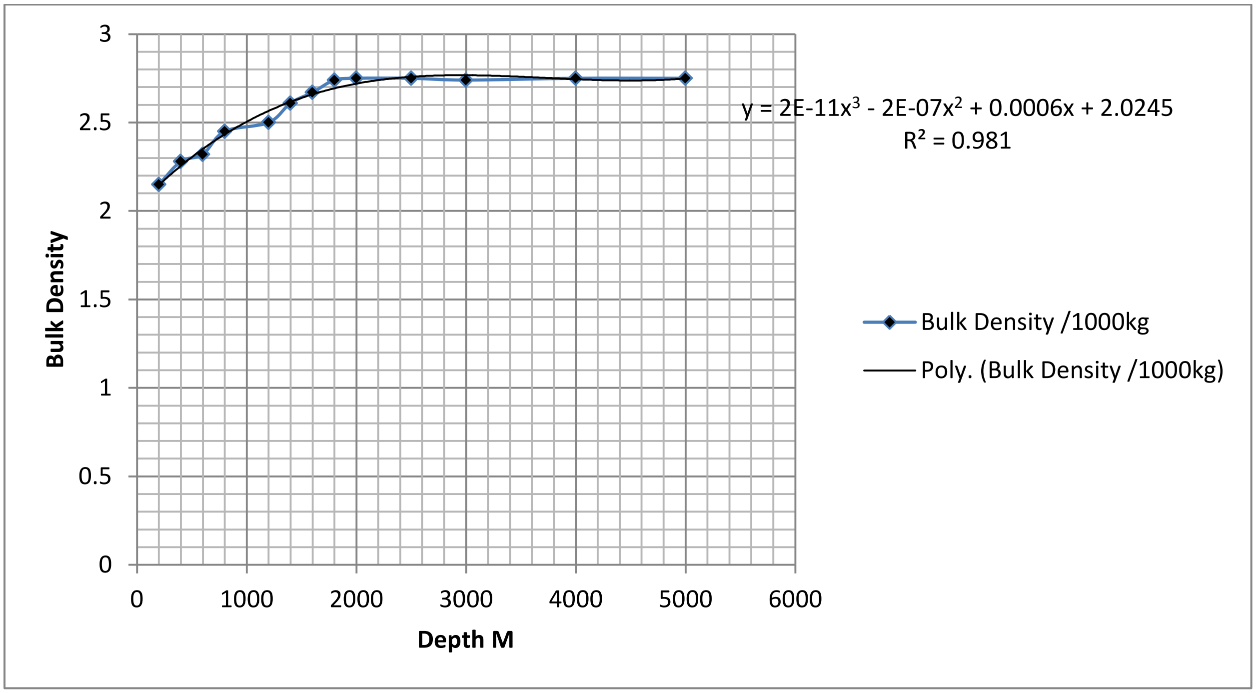

Figure 4: Bulk density of soil at different depths

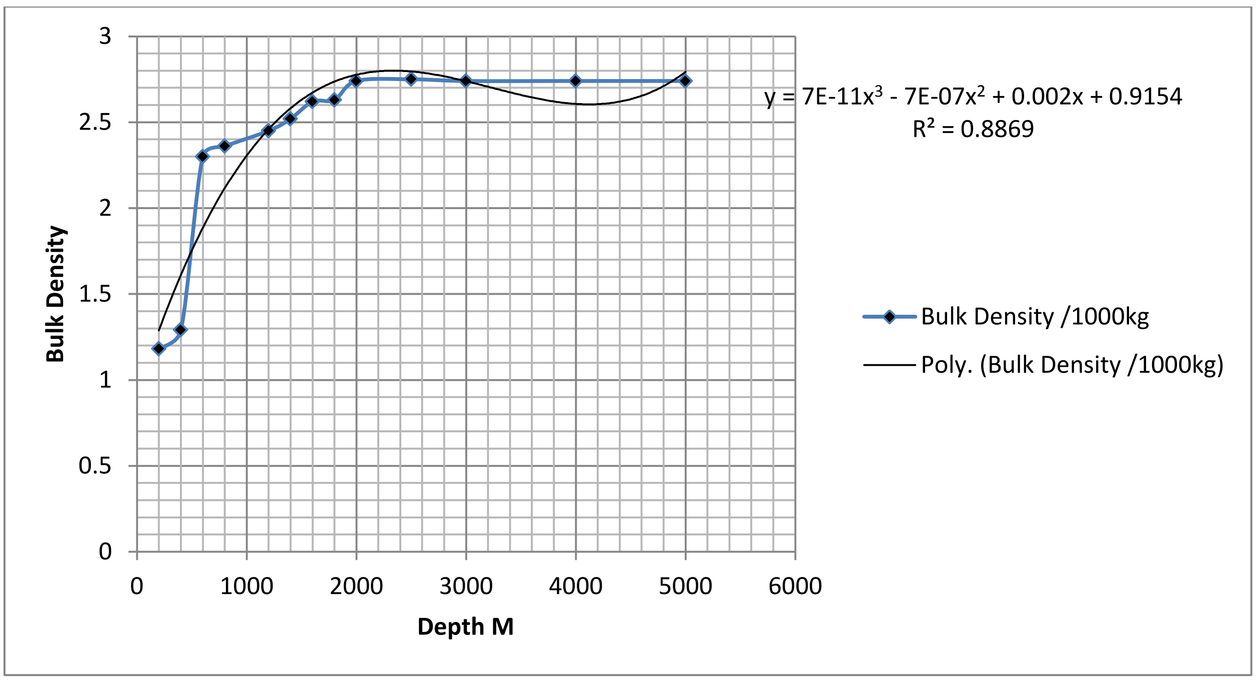

Figure 5: Bulk density of soil at different depths

Figure one to five show that the trend increased to two hundred mm, slight variations of four hundred to three thousand millimeters observed, this is are where linear depositions found between four hundred and five thousand mm, this is observed between lateritic soil found to develop constant degree of bulk density as expressed in the figures, this condition implies the rate of porosity decrease as it definitely influences constant deposition in the study area, the condition of porosity reflect the depositions of soil bulk density in the study location. Moreso, the most direct effect of soil compaction is an increase in bulk density of soil. Bulk density is the mass of given-dry soil in a standard volume, often given as grains per cubic centimeter (g/cm^3). Optimum bulk densities for soil depend on the soil texture. Whenever the bulk density exceeds a certain level, root growth is restricted. A note of caution must be made here in respect to the effects of tillage on bulk density. No-till soil often has a higher bulk density than recently tilled soils porosity. Due to the increase in bulk density, the porosity of soil decrease, large pores (called micropores), essential for water and air movement in soil are primarily affected by soil compaction. Soil hydraulic properties like the retention capacity and hydraulic as well as gas conductivity have agronomical and ecological implications. Drainage, evaporation and water-uptake by roots are just few examples where the knowledge about the rate of water flow through the soil plays an important role. The relive proportion of the three phases (water, gas and solid) of the soil is influenced by properties like texture, structure, biological activity, weather and soil management in terms of porous media, it can be characterized in their volume and can be expressed great relevance to understand process related to water, air and heat transport in soil.

4. Conclusion

The bulk density of soil is an important property, but its significant for a particular soil must be related to texture, change in bulk density affect available water and air capacity and strongly influence permeability, drainage rate, traficability, and penetration by plant roots. It can be changed by cultivation, systems of land use, ameliorative measure such as sub soiling or soil mixing, and by settlement with time. It can be determined relatively simply and is a useful criterion for assessing the effect of different cultivations or rotations on the macro structure of otherwise uniform soil. Assessment of the optimum bulk density for a soil must take account of several considerations. The available water capacity should beat a maximum provided that the air capacity is not less than 10 percent when the soil is at 50mb tension. Bulk density is widely used for converting water or nutrient percentages by height to water or nutrient content by volume. Bulk density express is also commonly used to measure soil compaction. An increase in bulk density if reliable measured indicates that movement of air and water within the soil has been reduced; the soil therefore may be more likely to erode or be less favourable for growth. Soil density is the ratio of the dry solids to bulk volume of soil bulk volume includes the volume of the solids and of the pore space. Soil density is conventionally characterized by bulk density; yet soil density is related to soil resistance, which can be measured with a penetration much more rapid than bulk density can be measured. The increasing bulk density not only induces change in the pore size distribution but also affects the ability of soil to shrink and to conduct water under unsaturated conditions. Greater shrinkage was observed for sample with low bulk density as a consequence of reduction of coarse pore. The water contains different increase with decreasing bulk density.

References

[1] Akgül, M., Özdemir, N. (1996): Regression models for predicting bulk density from measured soil properties. Tr. J. of Agriculture and Forestry, 20:407-413.

[2] Anonymous (2002): Samsun Meteorology Bulletin Reports. Samsun, Turkey.

[3] Arshad, M.A., Lowery, B., Grossman, B. (1996): Physical tests for monitoring soil quality. In: J.W. Doran and A.J. Jones (eds.) Methods for assessing soil quality, Soil Sci. Soc. Am. Spec. Publ. 49:123-142, SSSA, Madison, WI, USA.

[4] Black, C.A. (1965): Methods of Soil Analysis. Part 1, American Society of Agronomy, No 9.

[5] Blake, G.R., Hartge, K.H. (1986): Bulk Density. Methods of Soil Analysis, Part 1, Soil Sci. Soc. Am., 363-376, Madison, WI, USA.

[6] Gee, G.W., Bauder, J.W. (1979): Particle size analysis by hydrometer: A simplified method for routine textural analysis and a sensitivity test of measured parameters. Soil Sci. Soc. Am. J., 43:1004-1007

[7] Nelson, D.W., Sommers, L.E. (1982): Total Carbon, Organic Carbon and Organic Matter. In: A. L. Page(ed.) Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties, Agronomy Monograph No. 9, p. 539-580, ASA Inc., SSSA Inc., Madison, WI, USA.

[8] Wright, S. (1968): Path Analysis: Theory, Evolution and The Genetics of Populations, Volume 1, 299-324, The University of Chicago Press.

[9] Soil Survey Staff, 1993. Soil Survey Manuel. USDA Handbook No.18, Washington, USA.

[10] Reinsch, T.G., Grossman, R.B. (1995): A method to predict bulk density of tilled Ap horizons. Soil & Tillage Research, 34:95-104.

[11] Akin T, Özdemir, N. (2003): Soil bulk density as related to soil particle size distribution and organic matter content Original scientific paper Izvorni znanstveni članak.