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Research Paper

Soil Bulk Density As Related to Texture, Organic Matter Content And Porosity In Kandi Soils of District Kupwara (Kashmir Valley), India

Geography

KEYWORDS : Bulk Density; Texture; Organic Matter; Kandi; Kupwara.

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ABSTRACT

Bulk density is a basic soil property that dependents on soil texture, the densities of soil mineral (sand, silt, and clay) and organic matter particles, as well as their packing arrangement. The present study is an attempt to examine the relationship between bulk density, texture (sand content), organic matter content and porosity in the soils of Kandi area of Kupwara (Kashmir valley), India. Five surface soil samples were collected on altitudinal basis from different locations of the study area at a depth of 20-35 cms. Soil bulk density showed negative relationships with total organic matter content and porosity except with sand content (S).

INTRODUCTION

Bulk density is affected by factors such as water, aeration status, root penetrate, clay content, texture, land use and management, therefore it is a very important soil parameter (Sakin, 2012). It is influenced by the amount of organic matter in soils, their texture, constituent minerals and porosity. Knowledge of soil bulk density is essential for soil management, and information about it is important in soil compaction as well as in the planning of modern farming techniques (Chaudhari*et al.*, 2013). Bulk density values are required to calculate soil porosity which is the amount pore space in the soil (Blake and Hartge, 1986). Total porosity can be calculated by using bulk density and particle density of soil (Hillel, 1982). Soil organic matter plays a key role in nutrient cycling and can help improve soil structure.

STUDY AREA

The Kashmir Valley is a longitudinal depression which forms the interior part of the Jammu and Kashmir. It lies between 33$^{025'}$ to 34 050'N latitude & 740 to 75050'E longitude and is roughly 135 km long and 114 km wide enclosing an area of about 15853 sq.km. The average altitude of the Valley is about 1800 m while some peaks exceed the height of 4000 m from mean sea level (Kaul, 1985).Kandi refers to an area which is upland or submontane having scarcity of water, undulating topography, steep and irregular slopes, erodible and low water retentive soils with terrain dissected by numerous gullies. These are mostly found on the west side of the valley covering mountain foothills and sloping Karewas (Fig. 1)where there is undulating topography with scarcity of water and irrigation facilities.

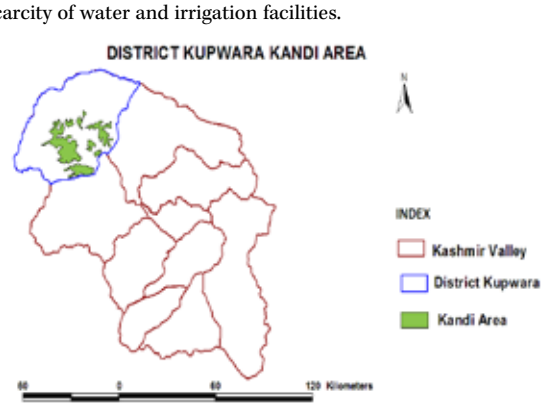


Fig. 1: District KupwaraKandi Area

Sources: generated from SOI toposheets 1971and IRS-1C LISS Satellite image, 2010.

METHODOLGY

The aim of this study was to determine bulk density of soil samples and its relationship with the soil particle distribution, organic matter and porosity of soil in Kandi areas of district Kupwara, Kashmir valley (India). Soil samples were collected from five (5) different locations at the depth of 20-35cm (Fig. 2) in zigzag pattern across the required areas. The proposed samples were analyzed for physico-chemical properties using standard procedures and are represented in Table 1.

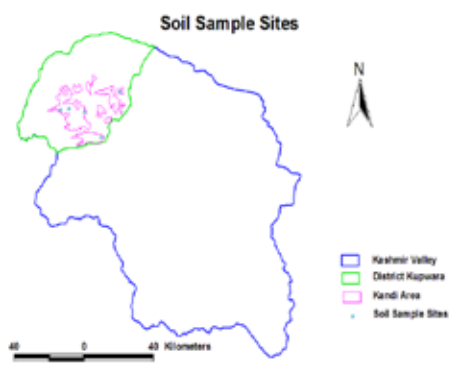


Fig. 2: Soil Sample Sites
Source: generated from SOI toposheets

Organic Matter (OM) was obtained from estimated organic carbon (OC) using the conventional conversion (Brady, 1984)

OM = 1.72 × OC

The soil bulk density was selected as dependent variables to determine statistical relationships of soil texture, organic matter content and porosity with soil bulk density. Bulk density is closely related to the soil porosity through the following relationship (Morgan, 2005)

n = 1 - (db / dp)

Where, n = porosity ; db = bulk density and dp = particle density

Statistical analysis

The relationship between different soil parameters and nutrient content of soils were determined using correlation coefficient "r ".

$$r = n\sum xy - (\sum x)(\sum y)/n(\sum x2) - (\sum x)2\, n(\sum y2) - (\sum y)2$$

Where n is the number of pairs of data (x, y).

Simple Correlation Coefficients (r) between soil parameters and bulk density are listed in Table 2.

RESULTS AND DISCUSSION

The sand, silt and clay of collected samples ranges 55.33%–68.96%, 12% - 33% and 10% – 18 % respectively and these soils were categorized loamy sand and sandy loam due to high percentage of sand and silt. Out of 5 soil samples 1 fall in loamy sand and 4 in sandy loam categories as given in Table 1 below.

Table 1 Texture, Textural class, Organic carbon, Organic matter, Bulk density and Porosity of soil samples

Sample No.	Texture (%)				Textural class	Organic Carbon	Organic matter	Bulk density	Porosity
	Coarse sand	sand	Silt	Clay		(%)	(%)	db(gm/cm^3)	100-(db/dp*100)
1.	1.04	68.96	12	18	Loamy sand	0.49	0.84	1.46	43.85
2.	0.10	57.9	28	14	Sandy loam	0.56	0.97	1.34	48.26
3.	1.5	58.5	30	10	Sandy loam	0.59	1.02	1.32	42.86
4.	0.56	59.44	24	16	Sandy loam	0.42	0.72	1.33	45.71
5.	1.7	55.3	33	10	Sandy loam	0.78	1.64	1.24	51.18

Effect of sand content on soil bulk density was found to be higher than that of the other soil properties. A significant positive correlation of bulk density was observed with sand content (r = 0.65) (Fig. 3). The bulk density indirectly provides a measure of the soil porosity. Soil porosity is the ratio of the volume of soil pores to the total soil volume. Thus the bulk density of a soil is inversely related to the porosity. Also a strong negative correlation (r = - 0.79) was found between porosity and bulk density of soil samples (Fig. 4).

Fig. 3

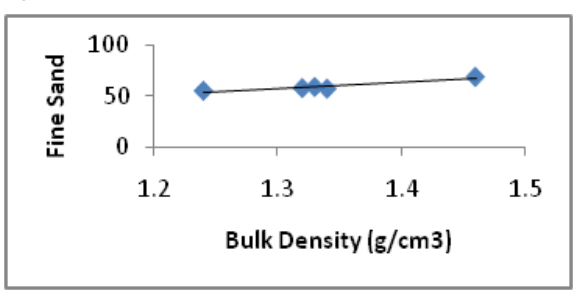
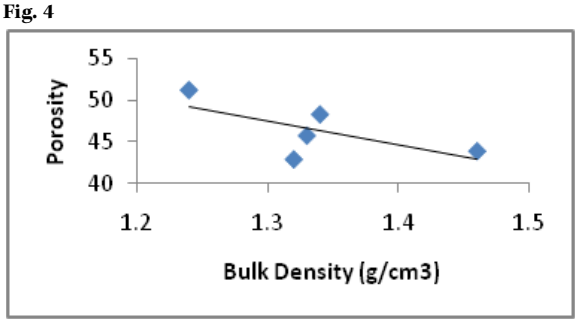


Fig. 4



There was a significant positive correlation of bulk density with sand content (0.65) and a strong negative correlation with porosity (-0.79) and organic matter (-0.87) as shown in Table 2 given below. Many researchers (Askin, 2003; Morisada et al., 2004; Sakin, 2012) obtained the relationship between organic matter and bulk density of soils and showed strong correlation between them. E. Sakin (2011) determined the strongest correlation between bulk densities and organic matter among the data attained from the analysis results. Soil bulk density decreases with increasing organic carbon concentration (Bauer and Black, 1992). Bulk density tends to decrease as soil organic matter concentration increases (Curtis and Post, 1964). We obtained similar results with strong negative correlation (r = - 0.87) between organic matter and bulk density of soil samples (Fig. 5).

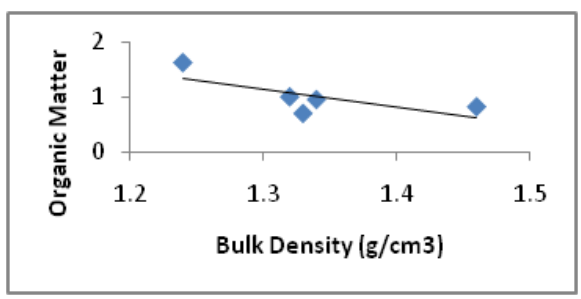


Fig. 5

Table 2 Correlation coefficient and Level of significance among some soil properties

Soil related properties	Correlation Coefficient (r)	Level of Significance
Bulk density – Sand %	0.65	Significant positive
Bulk density – Organic matter	-0.87	Strong negative
Bulk density – Porosity	-0.79	Strong negative

CONCLUSIONS

Following conclusions can be drawn for Kandi soils in Kashmir Valley-

So far as the Kandi areas of Kupwara (Kashmir), India are concerned, the soils were found to be less productive and fertile. There was a direct relationship ofbulk density with sand content and an indirect relationship with clay contentwhich means more sand andless clay content in soil more is bulk density and vice-versa. As the bulk density of soil is higher the porosity is lower and subsequently water holding capacity of soil is also low. It also affects root growth as well as other soil properties.There was a high degree reverse correlation between organic matter and bulk density of soil. Organic matter makes its greatest contribution to soil productivity. It provides nutrients to the soil, improves its water holding capacity, and helps the soil to maintain good tilth and thereby better aeration for germinating seeds and plant root development. All the soil samples were having low organic matter content which means lower nutrient status, lower water holding capacity and thus low soil productivity as well.

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