Original Research Article

Assessment of Physical properties of soil from different villages of Karnal district, Haryana

ABSTRACT

An appraisement of physical properties of soil from different villages of 'Karnal District' an allied area of Haryana was carried out in 2022-2023. The prime objectives of this study were to carry out the survey, collection of information of sampling sites and analysis of physical properties of soil and macro-micro nutrient status and its relation to various chemical properties of soil. For assessment, nine sampling sites were selected. Soil samples were collected with respect of depth of 0-15, 15-30, and 30-45 cm and the physical properties of soil were analyzed. The result indicated that soil of Kalampura, Dabri and Pundrak villages are sandy loam in texture, has good water holding capacity and percentage pore space and optimum bulk density and particle density and good overall physical condition.

Keywords: Physical properties, analysis, texture, bulk density, particle density.

1. Introduction

Soil is a complex and dynamic natural resource that plays a critical role in supporting life on Earth. It is composed of a mixture of minerals, organic matter, water, air, and a diverse array of microorganisms (Brady and Weil, 2016). It is the product of biochemical weathering of the parent material and its formation is influenced by the soil formation factors like climate, organism, parent material, relief, and time (Belwal and Mehta, 2014). An independent body in nature with a singular morphology from the surface to the parent materials is expressed by the sample profile (Tan, 1995). Soil properties can be broadly categorized into physical and chemical parameters. The physical properties include bulk density (Mg m^{-3}), particle density (Mg m^{-3}), pore pace (%), water holding capacity (%), and soil texture. The chemical properties consist of pH, electrical conductivity, percentage organic carbon, available nitrogen, available phosphorus, available potassium, exchangeable calcium, magnesium, and available zinc. Understanding these properties is critical for effective soil management and sustainable productivity. Physical properties play an important role in determining soil's suitability for agriculture. The supporting capability, movement, retention and availability of water and nutrients to plants, ease in penetration of roots and flow of heat and air are directly associated with physical properties of the soil. Physical properties also influence the chemical and biological properties. Chemical properties of soil include the following aspects; inorganic matters of soil, organic matters in soil, colloidal properties of soil particles and soil reactions and buffering action in acidic soils and basic soils. The chemical side of a soil is extremely important of course and is about the correct balance of the available nutrients in the soil (Das *et al*., 2020).

Soil testing refers to the qualitative analysis of soils and is well recognized as a scientific means for quick characterization of the inherent fertility status of soils (Meena *et al.*, 2018). Soil test-based fertility management is an efficient tool for increasing the productivity of agricultural soils that have a high degree of spatial variability resulting from the combined effects of physical, chemical, or biological processes (Majumdar *et al.,* 2015). The fertility and health of soil form the foundation for the healthy existence of flora, fauna, and humans.

Materials and Methods

Location:

Karnal district in Haryana is located on the map with the GPS coordinates of 29º25'05"N latitude and 76º27'40"E longitude with an elevation of 240m above the sea level.

Soil and Climate:

Karnal district lies in the Eastern Haryana plain which has Gangetic type, sub-tropical continental monsoon climate with mean annual rainfall of 842 mm. A lot of rain falls in the months: July, August and September with July being the wettest month. Climatic conditions are usually suitable for the normal cultivation of paddy, maize, jute, wheat, barley and other crops. The district is divided into three sub-micro regions based on soil and topography namely: Assandh Plain, Karnal Bhangar and Yamuna Khadar. Soil in Karnal is formed almost entirely of alluvium and the textural class is loamy sand to sandy loam on the surface and sandy loam to clay loam in the sub surface.

Sampling and Analysis

The soil sample collection is from 3 villages of Karnal district in the state of Haryana each selecting 3 farmers. Samples were collected randomly from a site of each village using soil khurpi by composite sampling method at a depth of 0-15, 15-30 and 30-45 cm**.**

After sampling, the samples were air dried in shade and then these samples were processed for various physical and chemical tests.

The data hence recorded during the course of investigation was subjected to statistical analysis by Completely Randomized Design (CRD) as per the method of "Analysis of Variance" (ANOVA) technique.

Methods

Analysis of the soil samples were under the methods, the physical parameters include Soil Colour, Soil Texture, Bulk Density, Particle Density, Pore Space and Water Holding Capacity. Soil textural class was determined by using Hydrometer (Bouyoucos, 1927). Bulk density, Particle density, Water holding capacity was determined by using Graduated Measuring Cylinder method (Muthuaval *et al*., 1992).

Result and Discussion

Physical properties

Soil Texture

The sand, silt and clay percentage varied from 62.23-75.16%, 12.94-23.90% and 8.76-16.65% respectively. Similar results were reported by Narwal *et al*. (2006).

Bulk density

The bulk density of different depths varied from 1.18 to 1.32 Mg m^{-3}. Similar results were reported by Singh *et al*., (2016).

Particle density

The range of particle density of different depths of soil varied from 2.39-2.47 Mg m^{-3}. Similar results were reported by Singh *et al*., (2017).

Percent pore space

The maximum percent pore space was found 48.37% and the minimum 44.60%. Similar result was reported by Singh *et al*., (2014).

Water holding capacity

The maximum water retaining capacity 45.2% and minimum of 38.2%.. Similar result was reported by Sharma *et al*., (2016)

Table 1: Bulk density and Particle density (Mg m^{-3}) of soil from different villages of Karnal district at 0-15, 15-30 and 30-45 cm depth

Villages	Bulk Density (Mg m^{-3})		Particle Density (Mg m^{-3})	
	Range	Mean	Range	Mean
Kalampura(V_1)				
F_1	1.23-1.26	1.24	2.373-2.385	2.379
F_2	1.26-1.32	1.29	2.418-2.425	2.421
F_3	1.22-1.29	1.25	2.391-2.405	2.398
Dabri (V_2)				
F_4	1.21-1.28	1.24	2.457-2.469	2.463
F_5	1.18-1.22	1.2	2.383-2.392	2.387
F_6	1.16-1.19	1.17	2.425-2.433	2.429
Pundrak (V_3)				
F_7	1.2-1.24	1.22	2.432-2.440	2.436
F_8	1.19-1.22	1.2	2.403-2.412	2.407
F_9	1.26-1.29	1.27	2.416-2.424	2.420

Table 2: Pore space and Water holding capacity (%) of soil from different villages of Karnal at 0-15, 15-30 and 30-45 cm depth

Villages	Pore Space (%)		Water Holding Capacity (%)	
	Range	Mean	Range	Mean
Kalampura(V_1)				
F_1	43.4-47.1	45.25	39.4-42.2	40.8
F_2	45.2-48.3	46.75	41.5-44.4	42.95
F_3	46.9-49.2	48.05	41.8-45.2	43.5
Dabri (V_2)				
F_4	43.8-45.5	44.65	38.9-41.5	40.2
F_5	44.7-46.9	45.8	39.6-41.9	40.75
F_6	44.4-47.8	46.1	40.2-43.1	41.65
Pundrak (V_3)				
F_7	47.8-49.1	48.45	42.3-44.3	43.3
F_8	43.8-45.4	44.6	38.2-40.8	39.5
F_9	46.4-48.8	47.6	41.5-44.1	42.8

Fig.1: Bulk Density, Particle Density, Pore Space of soil from different villages of Karnal at 0-15, 15-30 and 30-45 cm depth

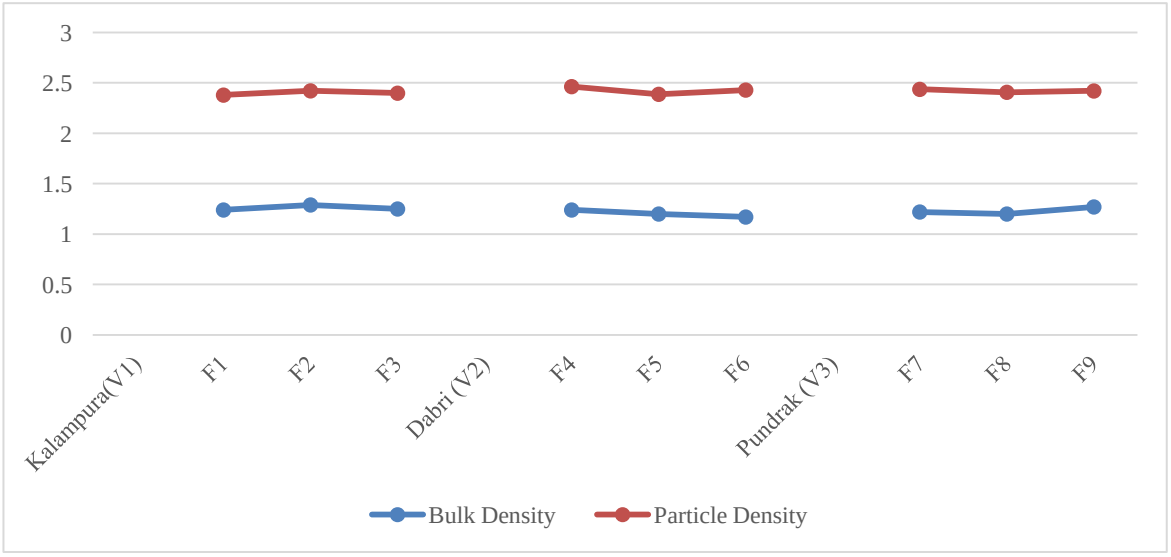
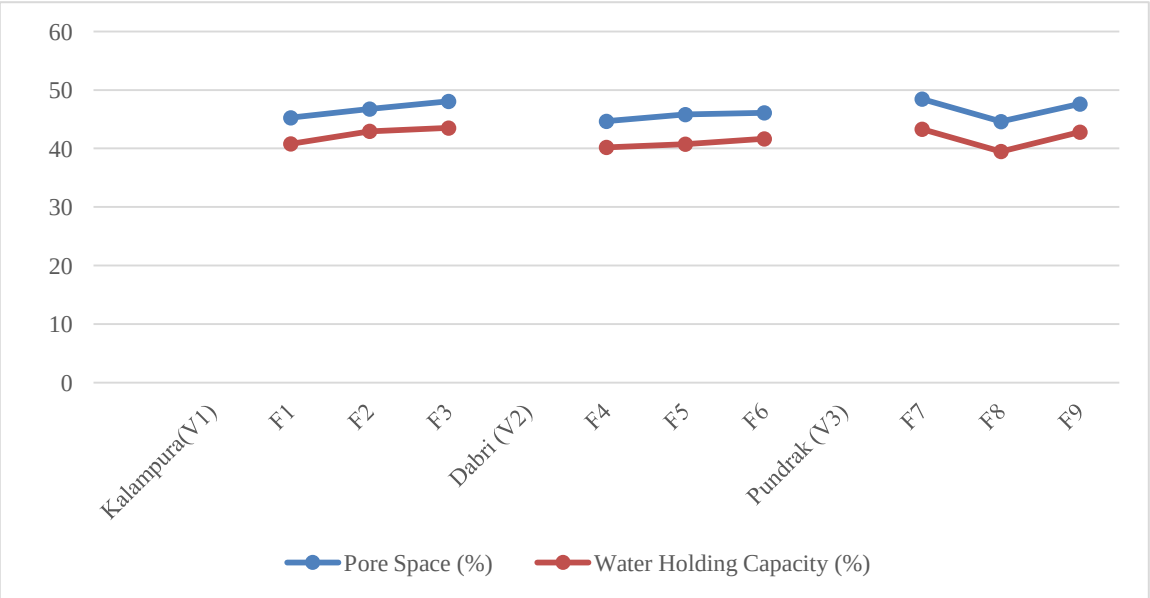


Fig.2: Pore Space (%) and Water Holding Capacity (%) of soil from different villages of Karnal at 0-15, 15-30 and 30-45 cm depth



Conclusion

According to the soil test results of villages of Karnal district of Haryana, it clearly shows that the soil has optimum physical properties namely bulk density, particle density, percent pore space and water holding capacity. It is suggested that still improvement can be done by improving cropping pattern, decomposition of organic waste, mulching, tillage practices and proper irrigation by management practices with knowledge and experience gained through studies and suggest the farmers to achieve quality produce and high yield through Soil Heath Card report as well as practices of soil conservation.

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