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Assessment of physico-chemical properties of soil in Gwalior region

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Abstract
Soil is most important component of our planet. Soil puts food on our plates, purifies our water, protects us against flooding and combats drought. So soil health is a priority for good crop production. For this purpose surface soil sample were collected from 120 locations. Analysis of various soil parameter (Bulk density, porosity, textural class, Ph, EC, OC) have been done using standard method were adopted. The bulk density of Gwalior district varied from 1.21- 1.42 (mg m^{-3}) with the mean value of 1.32 (mg m^{-3}). The porosity of soil ranged from 43.33-57.39% with a mean value of 49.34%. The sand content in 120 soil samples ranged from 43.10 to 58.55 percent, with a mean value of 51.76 percent. The silt percent ranges from 7.1-22.08% with a mean of 15.17%. The clay particle range was 26.85 to 40.30 percent with a mean of 33.24%. Among these three soil particles silt content showed highest variability followed by sand and minimum in case of clay content. The soils of the study area are clay in texture. The pH of Gwalior district varied from 6.40- 8.40 with the mean value of 7.63. The Electrical conductivity of soil water suspension ranged from 0.15-0.72 dSm^{-1} with a mean value of 0.45 dS m^{-1} emphasizing the fact that these soils are in safe limit of EC. The variation in organic carbon content in this soil was from 0.21-0.77% with a mean value of 0.43%. In general, the organic carbon status of Gwalior district soils was low to medium.

Keywords: Bulk density, porosity, pH, EC and Organic carbon

Introduction
One of the key elements affecting crop production is soil fertility. For the purpose of identifying obstacles to crop production for sustained productivity and aiding Agrotechnology transfer programmes, a clear understanding of the condition of soil fertility is essential. One of the most significant barriers to increasing agricultural productivity has been identified as the deteriorating soil fertility brought on by unbalanced fertilizer use. In order to evaluate the fertility state of the soils in a given area or region and to limit the disproportionate and out-of-balance use of fertilizer, which can lower the efficiency of other inputs, soil characterization is a crucial component of sustainable agriculture production. To ascertain the nature and extent of their toxicities or deficiencies and to develop strategies for their improvement to increase crop productivity, information on the status of macro- and micronutrients for various soil types, districts, and regions, as well as for the entire country, is extremely important. To understand the causes of the lack of accessible nutrients in soil, physico-chemical characteristics must be studied in connection to both macro- and micronutrient availability. To comprehend the intrinsic ability of soil to give these nutrients to plants, to achieve balanced nutrition, and to increase soil fertility on a long-term basis, it is crucial to analyze the status of macro- and micronutrients and their interactions with soil features.

Madhya Pradesh is bestowed with diverse soil, water, climate and agro-biodiversity. Gird zone falls under central highlands. Most of the terrain is flat without any mountains or hills in the zone except at the end of Aravali ranges of Rajasthan. In Madhya Pradesh, ravines lie along the rivers chambal, Sindh, Betwa, Kunwari, and other tributaries of river Yamuna. These are mainly north flowering peninsular rivers in the state. Out of estimated 20.6 lakh ha area under ravines in India, about 6.83 lakh ha is in Madhya Pradesh.

The soils of Gird zone of Madhya Pradesh (MP) have alluvial, medium black soils and ravine land (Singh *et al*., 2014a) [13]. Existence of extensive ravines in Bhind and Morena districts is a great problem to the human beings. These ravines are formed due to erosion alluvial soils.

The soil, water, climate, and agro-biodiversity of Madhya Pradesh are all different. Central highlands include the gird zone. Along the Chambal, Sindh, Betwa, Kunwari, and other Yamuna tributaries in Madhya Pradesh are ravines. In the state, these are primarily north-flowering peninsular rivers. About 6.83 lakh hectares of India's estimated 20.6 lakh ha of ravine-covered land are in Madhya Pradesh. The soils of Madhya Pradesh's (MP) Gird zone are alluvial, medium-black, and feature ravine land (Singh *et al*., 2014a) [13]. The presence of large ravines in the Bhind and Morena areas poses a serious difficulty for people. Alluvial soils that are subject to erosion create these ravines.

Materials and Methods

The present investigation was carried out during the year 2020-2021 in the Department of Soil Science & Agricultural Chemistry, School of Agriculture, ITM University, Gwalior. Soil of experimental site was analyzed for the physico-chemical properties like pH, Electrical conductivity, organic carbon The data on various soil analysis were subjected to statistical analysis by adopting appropriate method of analysis of variance.

Fig 1: Location map of study area

Study Area

Gwalior district is one of the 52 districts of Madhya Pradesh state in central India and East longitude′21° and 26′43° Gwalior District lies between North latitude 25 of Madhya Pradesh. The district is bounded by Bhind and Morena in ′39° and 78′40°77 the North, Datia in the East and Shivpuri in the southern direction. There are 3 Tehsils and 4 Blocks in the district. The block headquarters are Ghatigaon, Morar, Dabra and Bhitarwar and the total population of the district is 2032036 (As per census 2011). Gwalior district falls under Ganga basin, Yamuna Sub Basin, Sind and Kunwari Minor basin. The district is at the center of the Gird region. The district has an area of 4,560 km2, and a population 2,032,036 (2011 census), a 25% increase from the 2001 census. The district comprises 4 tehsils: Gwalior (formerly, Gird), Bhitarwar, Dabra (formerly, Pichore), and Chinour. There are also 4 community development blocks: Ghatigaon (Barai), Morar, Dabra, and Bhitarwar. There are 655 revenue villages in the district, of which 618 are inhabited.

Results and Discussion

Bulk density (mg m^{-3}): The average two year bulk density(mg m^{-3}) of soil ranges from 1.21- 1.42 mg m^{-3} with a mean value of 1.32 mg m^{-3}, standard deviation 0.05 and CV% 3.84.Similar trend was also noticed by Yadav *et al.* (2018) [18].

Soil texture of soil: Soil texture analysis of two year was carried out to determine the relative percentage of sand, silt and clay in 120 surface soil samples collected from Gwalior district. On the basis of texture, it is found that most of the soils of Gwalior district are clayey in texture having lot of variability in the relative percentage of sand, silt and clay.

Table 1: Bulk density (2 year) range of soils in Gwalior district

Bulk density (mg m^{-3})	
General statistics	
Range	1.21- 1.42
Mean	1.32
SD	0.05
CV (%)	3.84

The data presented in revealed that the sand content in 120 soil samples ranged from 43.1 to 58.55 per cent, with a mean value of 51.76 percenthavingstandarddeviation3.37and 6.52per cent coefficient of variation. The silt per cent range from 7.1 to 22.08per cent with a mean of 15.17%, standard deviation 3.57 and CV % 23.52. The clay particle was range in between 26.85 0to 40.3per cent with a mean of 33.24%, standard deviation of 3.44andCV of 10.34per cent. The silt content of these three soil particles varied the most, followed by the sand content and clay content, respectively. The silt content of these three soil particles varied the most, followed by the sand content and clay content, respectively. These results are consistent with Murthy *et al.,* (1972) [7] research. The deposition of finer fractions was the primary source of this textural variance. Similar results reported Meena *et al.,* (2006) [6], the variances in physiographic are primarily to blame for the texture variety. These findings are in agreement with those of Nayak *et al*., (2002) [8]. According to the USDA textural triangle, all of the soil samples have clayey textures after a review of the data on particle size distribution in soils. In the majority of the soils, the clay and silt composition varied with depth. The study's findings about the rise in clay content in black soil pedons might be explained by a number of mechanisms, such as illuviation of the finer fraction to the lower depth (Dasog, 1975 and Krishnamurthy and Govindarajan, 1977) [3, 4]. In the deteriorated Vertisols of the Purna valley in Maharashtra, Balpande *et al.,* (1996) [2] and Parvatappa (1981) [9] also noted a similar tendency in the Vertisols of the Upper Krishna Command Area of Karnataka. Generally sand content was lower than silt in all samples.

Table 2: Soil texture of soils in Gwalior district

Soil texture			
General statistics			
Parameters	**Sand (%)**	**Silt (%)**	**Clay (%)**
Range	43.1- 58.55	7.1- 22.08	26.85- 40.3
Mean	51.76	15.17	33.24
SD	3.37	3.57	3.44
CV (%)	6.52	23.52	10.34

Porosity (%)

Porosity (%) of soil ranges from 43.33 to 57.39 (%) with a mean value of 49.34 (%), standard deviation 3.14 and CV% 6.36. Similar trend was also noticed by Yadav *et al.* (2018) [18].

Table 3: Porosity (%) of soils in Gwalior district

General statistics	
Range	43.33- 57.39
Mean	49.34
SD	3.14
CV (%)	6.36

Chemical Properties

Soil Reaction (pH)

The pH of soils of Gwalior district ranges from 6.40- 8.40 with a mean value of 7.63, standard deviation 0.33 and coefficient of variation 4.37%. Out of 120 soil samples 46 soil samples were neutral in pH and 73 samples were slightly alkaline.

Table 4: Categories of soil reaction (pH) of soils in Gwalior district

Soil pH class	No. of Samples	%Samples
Strongly acid (<5.0)		Nil
Moderately acid (5-6.0)	Nil	Nil
Slightly acid (6.1-6.5)	1	0.83
Neutral (6.6-7.5)	46	38.33
Slightly alkaline (7.6-8.5)	73	60.83
General statistics		
Range	6.40- 8.40	
Mean	7.63	
SD	0.33	
CV (%)	4.37	

This might be explained by the high base status that these horizons have as a result of recycling bases. Singh *et al.,* (2009) [14] made comparable observations in the surface and subsurface soils of the district of Gajipur, Uttar Pradesh. Balpande *et al.,* (1996) [2] found that degraded Vertisols in Purna valley have higher pH levels. It's possible that the increased soil reactivity down the slope is the result of bases draining from higher terrain and depositing themselves at lower elevations (Sitanggang *et al.,* 2006) [15]. While the pH in the C horizon was higher, this contributed to the buildup of bases. Tripathi *et al.,* (2006) [16] obtained results of a similar nature. In addition to Sharma *et al.,* (2015), Shilpa *et al.,* (2007) [12], Singh *et al.,* (2009) [14], and results in soils of M.P. and Maharashtra.

Electrical Conductivity (EC)

Electrical Conductivity (EC) of soil ranges from 0.15-0.72 dSm^{-1} with a mean value of 0.45 dSm^{-1}, standard deviation 0.12 and CV% 27.23. Most of the soil samples were normal in respect of total soluble salt concentration.

Table 5: Categories of Electrical Conductivity (EC) of soils of Gwalior district

EC (dSm^{-1})	No. of Samples	%Samples
<1. 0	Nil	Nil
1.0-2. 0	1	0.83
2. 0 -3. 0	15	12.50
>3.0	104	86.67
General statistics	EC (dSm^{-1})	
Range	0.15-0.72	
Mean	0.45	
SD	0.12	
CV%	27.23	

The electrical conductivity in the tested soils typically increased with depth. Compared to the lower solum, the higher solum had considerably fewer salts. This could be as a result of irrigation causing salts to accumulate at lower depths and leak from the soil surface. The distribution of salts revealed a concentration of salts in the lower solum even at the time when irrigation was first implemented. In the Malaprabha project region, Ved *et al.*, (2008) [17] in soils of the states of Panjab and U.P., Bali *et al.*, (2006) [1] reported results of a similar nature.

Organic Carbon (OC)

The organic carbon content of the soils of Gwalior district ranged from 0.21-0.77% with an average value of 0.43%. Considering the soil test rating for organic carbon (<0.25 as very low, 0.25-0.50 as low; 0.50-0.75 as medium and >0.75 as high in the status of organic carbon) the soils of Gwalior district fall under only two rating classes of OC content. In general out of 120samples, 2.50% samples were categorized under low OC status, 79.17% samples were categorized under low OC status, 16.67% samples under medium OC status and 1.67% samples under high OC status. The general statistics show the standard deviation 0.10 and coefficient of variation (CV %) 27.23 for organic carbon content. Due to minimal inputs of FYM and crop wastes as well as a quick decomposition rate brought on by the high temperature, the soil has low levels of organic carbon.

Table 6: Distribution of organic carbon content in the soils of Gwalior district

Organic carbon (%)	No. of Samples	%Samples
Very Low (<0.25)	3	2.50
Low (0.25-0.50)	95	79.17
Medium (0.50-0.75)	20	16.67
High (>0.75)	2	1.67
General statistics	OC (%)	
Range	0.21-0.77	
Mean	0.43	
SD	0.10	
CV	27.23	

Because of the rapid deterioration and removal of organic matter and the sparse vegetation cover, there is little chance that organic matter will accumulate in the soil. The rate of oxidation of organic matter increased with high soil temperature and good soil aeration, resulting in a decrease in the amount of organic carbon. The quick burning of organic matter caused by the region's high temperatures results in the medium organic carbon level of these soils. Sharma *et al.*, (2008) [10] in the soils of the Amritsar district and Lathwal (2006) [5] in the soil both reported similar findings.

Conclusion

These samples were analyzed for bulk density, porosity, soil texture pH, EC and OC. The bulk density of Gwalior district varied from 1.21- 1.42 (mg m^{-3}) with the mean value of 1.32 (mg m^{-3}). The porosity of soil ranged from 43.33-57.39% with a mean value of 49.34%. The sand content in 120 soil samples ranged from 43.10 to 58.55 percent, with a mean value of 51.76percent. The silt percent ranges from 7.1-22.08% with a mean of 15.17%. The clay particle range was 26.85to40.30percent with a mean of 33.24%. Among these three soil particles silt content showed highest variability followed by sand and minimum in case of clay content. The soils of the study area are clay in texture. The pH of Gwalior district varied from 6.40- 8.40 with the mean value of 7.63. The Electrical conductivity of soil water suspension ranged from 0.15-0.72 $dSm^{-1}$with a mean value of 0.45 dSm^{-1} emphasizing the fact that these soils are in safe limit of EC. The variation in organic carbon content in this soil was from 0.21-0.77% with a mean value of 0.43%. In general, the organic carbon status of Gwalior district soils was low to medium.

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