

Determine the physico-chemical properties of the Surface Soil of Ashoknagar District of Madhya Pradesh

ABSTRACT

The present study was carried out during the year 2017 in the Department of Soil Science & Agricultural Chemistry, College of Agriculture, Gwalior. Looking at the crop production and soil related constraints in different village of Ashoknagar District of Madhya Pradesh we found it important to characterize the soils of the village. For this purpose, one hundred twenty-five GPS-based surface soil samples (0-15 cm) were collected from five blocks (Mungaoli, Chanderi, Ishagarh, Ashoknagar and Sadora) of Ashoknagar district from April to May 2017. Soils were studied for their physical and chemical characteristics - status of sand, silt, clay percent varied from 36.6-56.7, 3.9-38 and 25.2-42.4, with the mean value of 47.5, 17.2 or 35.1, respectively and soil pH, EC, OC, Calcium carbonate, total Nitrogen or available sulphur were observed in the range of 7.2-8.6, 0.32 - 0.62 dSm⁻¹, 2.14 - 7.06 gkg⁻¹, 0.5 - 3.5 % 0.01-0.24 % and 4.36 - 40.25 mg kg⁻¹ under different villages of the investigated area with the average value of 8.0, 0.45 dSm⁻¹, 4.35 gkg⁻¹, 1.7% and 0.11 %, 14.68 mg kg⁻¹ respectively. The availability of sulphur increased with an increase in organic carbon and clay content in the soil.

KEYWORDS: Total Nitrogen, calcium carbonate, organic carbon, clay content.

INTRODUCTION

Presently, the foremost challenge confronting Indian agriculture lies in the imperative to enhance both food production and productivity while ensuring the sustainability of agriculture as a whole. Several issues act as constraints on these objectives, raising significant concerns about national food security. These challenges encompass the deterioration of soil fertility, escalating production costs, and a limited diversity of production systems. The pressing need for improved crop productivity has become more critical than ever due to the escalating population and the resulting pressures from competing demands for land. This has led to a reduction in the land-man ratio, significantly diminishing the average size of farm land. Consequently, there is a heightened risk of soil fertility depletion through continuous or intensive cropping, coupled with imbalanced fertilization practices. Plants necessitate nutrients in adequate and proper proportions for optimal growth, constituting a pivotal element in determining soil productivity. Effectively managing the fertility of Indian soils requires its augmentation. Soil fertility, in this context, refers to the intrinsic capacity of soil to provide essential nutrients at a high level, supporting the production of sufficient food to feed the burgeoning population.

Prudent soil fertility management necessitates the careful identification of existing nutrient deficiencies and monitoring changes in soil fertility to predict potential deficiencies. Addressing these deficiencies requires the implementation of sound and proven practices encompassing

nutrients, water, crops, and energy in soil management. This approach is essential to sustain food production at a satisfactory level, ensuring continued high productivity in the future.

Thus, the management of soil fertility, particularly in terms of nutrient management at an optimum level, stands out as a crucial factor in achieving both high and sustainable productivity. Soil test-based fertility management is an effective tool for increasing productivity of agricultural soils that have high degree of spatial variability resulting from the combined effects of physical, chemical or biological processes (Goovaerts,1998).

The increased production per unit area of cereals, pulses and oilseeds crops led to more removal of nutrients and their deficiency of nutrients. The information on micro nutrients and sulphur status in district is inadequate and hence an attempt has been made for the delineation of these nutrients.

MATERIALS AND METHODS

The study was carried out during 2016-17 in the Department of Soil Science, College of Agriculture, Gwalior (M.P.).

(a) Location and extent: Ashoknagar is located in the northern part of Madhya Pradesh, between the rivers Sindh and the Betwa. It comes under the northern part of the Malwa plateau, though the main part of its district lies in the Bundelkhand Plateau. The Coordinates of the district are 24°34' 48" N and 77°43' 48"E with an average elevation of 507 meters (1640 ft) above sea level.

(b) Soils: Soils of the investigated area are generally variable in colour, depending on the timing period and sources of the irrigation system. In this region, the main classes of soil are black, brown and bhakti (stony) soil. The volcanic, clay-like soil of the region owes its black colour to the high iron content of the basalt from which it is formed. The soil requires less irrigation because of its high capacity for moisture retention. The other two soil types are lighter and have a higher proportion of sand.

(c) Collection and preparation of soil samples: For the present study, 125 surface (0- 15 cm) soil samples (GPS based, detail given in tables) collected from cultivar's fields of five blocks (namely; Mungaoli, Chanderi, Ishagarh, Ashoknagar and Sadora) of Ashoknagar district. The representative soil samples were collected with the help of soil auger. The soil samples were put in the polythene bags properly, labelled and carried to the laboratory. After collection, the samples were brought to the Soil Science Laboratory, College of Agriculture, Gwalior and samples were air dried, crushed and sieved through a 2 mm plastic sieve.

(d). Soil analysis:

List 1. Determination method of Soil constituents

S.No.	Soil constituents	Method of determination
1.	Mechanical composition Sand (%) Silt (%) Clay (%)	Bouyoucous Hydrometer method (Piper, 1950)
2.	Soil pH (1:2 soil- water ratio)	pH meter (Jackson, 1973)
3.	Electrical conductivity (ds/m)	Conductivity meter at 25°C (Jackson, 1967)
4.	Organic carbon (g/kg)	Walkley and Black method (1934)
5.	Total nitrogen (%)	sulfuric salicylic acid modification method (Chapman and Pratt, 1961).
6.	Calcium carbonate CaCO ₃ (%)	Titration method Piper (1950).
7.	Available Sulphur (mgkg ⁻¹)	Turbidity metric method (Bardsley and Lancaster 1965)

RESULTS AND DISCUSSION

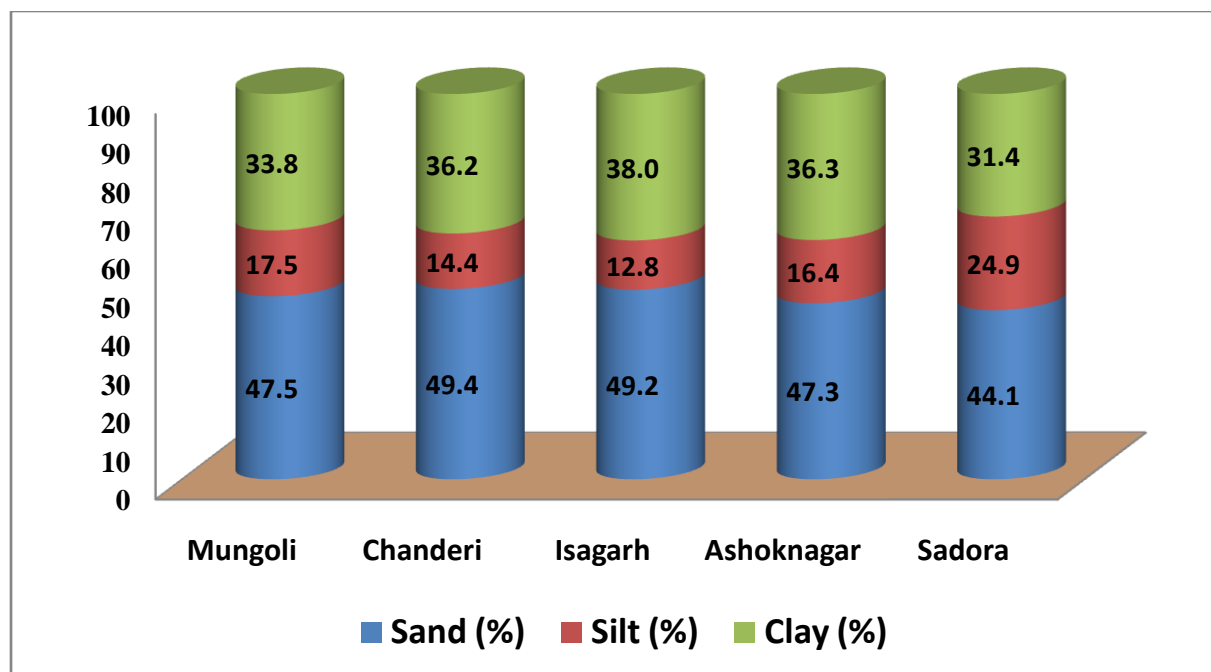
Physical and chemical characteristics of soils:

Mechanical composition of soils

Mechanical composition (sand, silt and clay) of soils of different blocks of Ashoknagar district are presented in (Fig-1).

In the study area of Ashoknagar district sand, silt and clay percent varied from 36.6-56.7, 3.9-38 and 25.2-42.4, with the mean value of 47.5, 17.2 and 35.1, respectively (Fig 1). However, maximum average content of sand (49.4%), silt (24.9%) and clay (38.0%) were observed recorded in Chanderi, Sadora, Isagarh block, respectively, whereas minimum content of sand (44.1%), silt (12.8%) and clay (31.4%) were observed in Sadora, Isagarh and Sadora block, respectively. Similar result recorded by (Santra et al., 2008)

Fig. 1: Mechanical composition of soils in different blocks of Ashoknagar district



Soil pH:

Soil pH of studied area was found in the range of 7.2 - 8.6 under different villages with the average value of 8.0 (Table 1). However, pH value in different villages of Mungaoli, Chanderi, Isagarh, Ashoknagar, and Sadora block varied from 7.2 – 8.6, 7.2 – 8.6, 7.5 – 8.4, 7.6 – 8.5, and 7.3 – 8.4 with an average value of 8.0, 8.0, 8.0, 8.1 and 7.9 respectively. Maximum average value of soil pH (8.1) was observed in Ashoknagar block whereas minimum value (7.9) noted in Sadora block of Ashoknagar district. Higher pH (>8.5) in some of the samples of Ashoknagar district indicate towards the fact that the soils are infested with alkalinity. Similar, result were recorded (Ravikumar and Somashekar, 2013, Shukla et al., 2016 and Subhash et al., 2017) indicating the existence of a variety of soils that are slightly natural to slightly alkaline nature.

Electrical conductivity (dSm^{-1}):

Value of electrical conductivity in Ashoknagar district varied from 0.32 - 0.62 with the average value of 0.45dSm^{-1} (Table 1). However, EC value in different villages of Mungaoli, Chanderi, Isagarh, Ashoknagar, and Sadora block varied from 0.32 - 0.61, 0.37- 0.56, 0.38–0.62, 0.38- 0.61 and 0.38 - 0.59 dSm^{-1} , with an average value of 0.44, 0.45, 0.45, 0.44, and 0.45dSm^{-1} respectively.

Highest value of electrical conductivity (0.62dSm^{-1}) was observed in Korwas village of Isagarh block whereas minimum value (0.32dSm^{-1}) was found in Shyampur village of Mungaoli block of Ashoknagar district. similar findings were reported Bharteey et al., (2017).

Table 1: Soil pH and EC in various villages of different blocks of Ashoknagar district

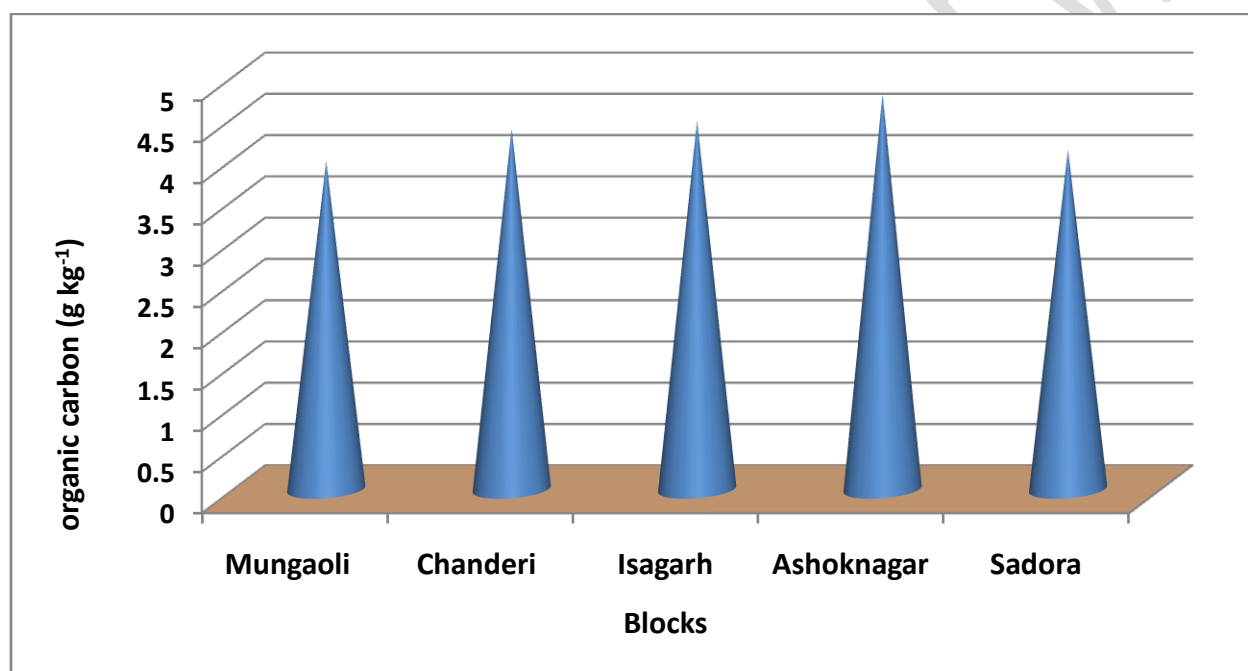
S. No.	Block	Village name	pH		EC	
			Range	Mean	Range	Mean
1.	Mungaoli (25)	Aathaikheda	7.9 – 8.3	8.1	0.39 – 0.51	0.47
		Bilakhedi	8.0 – 8.6	8.2	0.37 – 0.51	0.44
		Mudrakhana	7.6 – 8.1	8.0	0.38 – 0.48	0.41
		Chamrai	7.9 – 8.2	8.0	0.39 - 0.61	0.49
		Shyampur	7.2 – 8.4	7.8	0.32 – 0.50	0.41
		Overall Block	7.2 - 8.6	8.0	0.32 – 0.61	0.44
2.	Chanderi (25)	Barodiya	7.2 – 8.6	7.8	0.37 – 0.43	0.41
		Sangampur	7.8 - 8.6	8.2	0.39 – 0.53	0.46
		Tarai	7.9 – 8.3	8.1	0.41 – 0.53	0.45
		Mohalichak	7.6 – 8.4	8.0	0.38 – 0.56	0.46
		Salona	7.2 - 8.4	7.9	0.38 - 0.50	0.44
		Overall Block	7.2 – 8.6	8.0	0.37 – 0.56	0.45
3.	Isagarh (25)	Korwas	7.8 – 8.4	8.1	0.41 – 0.62	0.46
		Kotharkhedi	7.9 – 8.3	8.1	0.39 – 0.49	0.43
		Vijayapura	8.0 – 8.4	8.1	0.39 – 0.52	0.45
		Pachlana	7.5 – 8.2	7.9	0.38 – 0.47	0.43
		Bamnawar	7.6 – 7.9	7.8	0.43 – 0.61	0.50
		Overall Block	7.5 – 8.4	8.0	0.38 – 0.62	0.45
4.	Ashoknagar (25)	Mau	8.0 – 8.3	8.1	0.42 – 0.46	0.44
		Banyga	8.0 - 8.2	8.1	0.38 – 0.51	0.45
		Diyadhari	8.0 – 8.4	8.1	0.38 – 0.45	0.41
		Ratikheda	7.6 – 8.5	8.0	0.39 – 0.53	0.45
		Ashoknagar	7.8 – 8.4	8.1	0.39 – 0.61	0.45
		Overall Block	7.6 – 8.5	8.1	0.38 – 0.61	0.44
5.	Sadora (25)	Kherai	7.7 – 8.4	8.0	0.42 – 0.59	0.47
		Bamuraia	7.3 – 8.1	7.8	0.38 – 0.52	0.44
		Parwai	7.6 – 8.3	8.0	0.39 – 0.47	0.43
		Gugor	7.4 – 8.2	7.9	0.41 – 0.46	0.44
		Bagulya	7.6 – 8.3	7.9	0.43 – 0.52	0.46
		Overall Block	7.3 – 8.4	7.9	0.38-0.59	0.45
Whole district			7.2- 8.6	8.0	0.32-0.62	0.45

Organic Carbon :

Status of organic carbon understudied area was in the range of 2.14 - 7.06gkg⁻¹under different villages with the average value of 4.35g kg⁻¹(Fig.2). However, organic carbon status in different villages of Mungaoli, Chanderi, Isagarh, Ashoknagar, and Sadorablock varied from 2.58 – 6.19, 2.14 – 6.15, 2.88 – 5.85, 3.48 – 5.88 and 2.25 – 7.06 g kg⁻¹, with an average value of 3.98, 4.37, 4.47, 4.79 and 4.12 g kg⁻¹, respectively.

Maximum average organic carbon content (4.79g kg⁻¹) was obtained in Ashoknagar whereas minimum value (3.98g kg⁻¹) in Mungaoli block of Ashoknagar district. Similar results were also reported by Das et al., (2000) and Setia and Sharma, (2004).

Fig. 2: Status of organic carbon (g kg⁻¹) in different blocks of Ashoknagar district



Calcium carbonate:

Calcium carbonate of studied area of Ashoknagar district was found in the range of 0.5 – 3.5 % under different villages with an average value of 1.7% (Table 2). However, calcium carbonate status in different villages of Mungaoli, Chanderi, Isagarh, Ashoknagar, and Sadora block varied from 0.5 – 2.5, 0.5 – 3.5, 0.5 – 2.5, 0.5 – 3.0 and 0.5 – 2.5 %, with a mean value of 1.6, 1.8, 1.8, 1.9 and 1.7 % respectively. Highest content of calcium carbonate (3.5%) was noted in Barodiya village of Chanderi block of Ashoknagar district. Similar result has been recorded by Sharma et al. (2003).

Total Nitrogen (%):

Status of Total Nitrogen under study area of Ashoknagar district was observed in the range of 0.01-0.24 % under different villages with an average value of 0.11 % (Table 2). However, total N status in different villages of Mungaoli, Chanderi, Isagarh, Ashoknagar and Sdora block varied from 0.03-0.24, 0.06-0.14, 0.01-0.16, 0.04-0.24 and 0.05-0.19% with an average value of 0.10, 0.10, 0.10, 0.12 and 0.10 % respectively.

Highest content of total N (0.24%) was noted in Mudrakhana and Diyadhari villages of Mungaoli and Ashoknagar block of Ashoknagar district. Similar result has been recorded by Paul and Mukopadhyay (2014)

Table 2: Status of CaCO₃ (%) and Total N(%) in soils of different blocks of Ashoknagar district

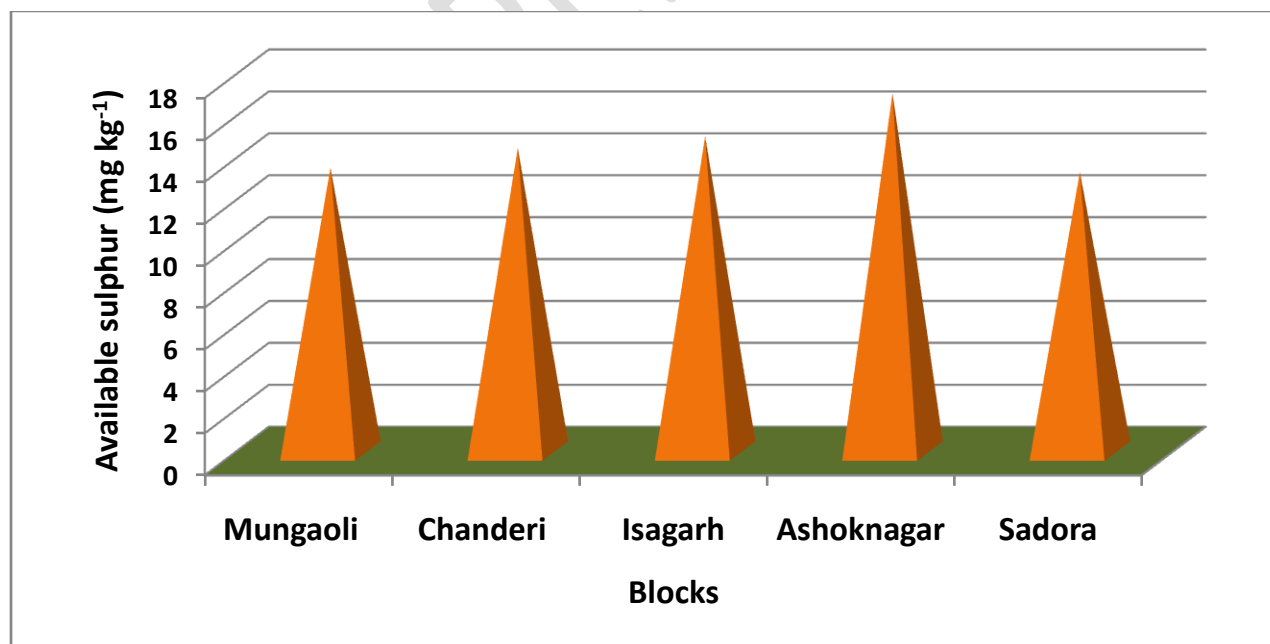
S. No.	Block	Village name	CaCO ₃ (%)		Total N (%)	
			Range	Mean	Range	Mean
1.	Mungaoli (25)	Aathaikheda	1.5 – 2.5	2.1	0.08-0.16	0.10
		Bilakhedi	1.5 – 2.5	2.0	0.03-0.13	0.07
		Mudrakhana	1.0 – 1.5	1.2	0.10-0.24	0.16
		Chamrai	0.5 – 1.5	1.2	0.09-0.22	0.14
		Shyampur	0.5 – 2.5	1.6	0.08-0.18	0.12
		Overall Block	0.5 – 2.5	1.6	0.03-0.24	0.10
2.	Chanderi (25)	Barodiya	0.5 – 3.5	1.7	0.08-0.14	0.11
		Sangampur	1.5 – 2.5	1.8	0.06-0.13	0.07
		Tarai	1.5 - 2.5	1.9	0.09-0.12	0.10
		Mohalichak	1.0 – 2.5	1.9	0.07-0.13	0.09
		Salona	0.5 - 2.5	1.8	0.08-0.14	0.11
		Overall Block	0.5 – 3.5	1.8	0.06-0.14	0.10
3.	Isagarh (25)	Korwas	1.5 – 2.5	1.8	0.12-0.16	0.14
		Kotharkhedi	1.0 – 2.5	1.7	0.07-0.16	0.10
		Vijaypura	1.5 – 2.5	2.0	0.04-0.12	0.08
		Pachlana	0.5 – 2.5	1.6	0.01-0.12	0.05
		Bamnawar	1.5 – 2.0	1.7	0.08-0.16	0.11
		Overall Block	0.5 – 2.5	1.8	0.01-0.16	0.10
4.	Ashoknagar (25)	Mau	2.0 – 2.5	2.3	0.05-0.19	0.12
		Banyga	1.5 – 2.0	1.8	0.08-0.19	0.11
		Diyadhari	1.5 – 3.0	2.1	0.05-0.24	0.14
		Ratikheda	0.5 – 2.5	1.8	0.04-0.10	0.08
		Ashoknagar	1.0 – 2.5	1.7	0.06-0.20	0.12
		Overall Block	0.5 – 3.0	1.9	0.04-0.24	0.12

5.	Sadora (25)	Kherai	1.5 – 2.5	1.9	0.08-0.19	0.12
		Bamuria	0.5 – 2.5	1.7	0.07-0.13	0.09
		Parwai	1.5 – 2.5	2.0	0.05-0.14	0.09
		Gugor	1.0 – 2.0	1.5	0.06-0.18	0.11
		Bagulya	1.0 – 2.5	1.5	0.06-0.14	0.09
		Overall Block	0.5 – 2.5	1.7	0.05-0.19	0.10
Whole district			0.5 – 3.5	1.7	0.01-0.24	0.11

Available-S

Status of available -S (mg kg^{-1}) under different villages of Ashoknagar district are presented in Fig.3 It has observed in the range of $4.36 - 40.25 \text{mg kg}^{-1}$ with the mean value of 14.68mg kg^{-1} . However, status of available sulphur in Mungoali, Chanderi, Isagarh, Ashoknagar and Sadora block were $4.36-22.56$, $6.95-24.51$, $6.95-27.44$, $5.27-40.25$ and $4.62-26.55 \text{mg kg}^{-1}$ with an average value of 13.52 , 14.47 , 15.02 , 17.08 , and 13.32mg kg^{-1} , respectively. The average maximum (20.43mg kg^{-1}) and minimum (8.17mg kg^{-1}) values of available-S was noted in Ashoknagar and Shyampur village of Ashoknagar and Mungoali block, respectively. Similar result has been recorded by Ghodke *et al.* (2016)

Fig. 3: Status of available Sulphur (mg kg^{-1}) in different blocks of Ashoknagar district



CONCLUSION:

In conclusion, status of Soil pH in studied area was found in the range of 7.2 - 8.6 under different villages with the average value of 8.0. Value of electrical conductivity in Ashoknagar district varied from 0.32 - 0.62 with the average value of 0.45 dSm⁻¹.

Status of organic carbon under studied area was in the range of 2.14 - 7.06 g kg⁻¹ under different villages with the average value of 4.35 g kg⁻¹. Maximum average organic carbon content (4.79 g kg⁻¹) was obtained in Ashoknagar whereas minimum value (3.98 g kg⁻¹) in Mungaoli block of Ashoknagar district. Calcium carbonate of studied area of Ashoknagar district was found in the range of 0.5 - 3.5 % under different villages with an average value of 1.7%. Status of Total Nitrogen under study area of Ashoknagar district was observed in the range of 0.01-0.24 % under different villages with an average value of 0.11 %. Highest content of total N (0.24%) was noted in Mudra Khana and Diyadhari villages of Mungaoli and Ashoknagar block of Ashoknagar district. Status of available -S (mg kg⁻¹) under different villages of Ashoknagar district. It has observed in the range of 4.36 - 40.25 mg kg⁻¹ with the mean value of 14.68 mg kg⁻¹.

Overall, these findings provide valuable insights into the diverse soil characteristics across different villages in Ashoknagar district, emphasizing the importance of tailored soil test and fertilizer application based on specific soil conditions.

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