Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

**E-ISSN:** 2278-4136
**P-ISSN:** 2349-8234
www.phytojournal.com
JPP 2020; Sp 9(5): 04-09
Received: 01-06-2020
Accepted: 03-08-2020

**Rakesh Dhakad**
Institute of Agriculture Sciences, SAGE University, Indore, Madhya Pradesh, India

**Pramod Kumar**
Institute of Agriculture Sciences, SAGE University, Indore, Madhya Pradesh, India

**Chandra Kant Sharma**
Institute of Agriculture Sciences, SAGE University, Indore, Madhya Pradesh, India

**Corresponding Author:**
**Rakesh Dhakad**
Institute of Agriculture Sciences, SAGE University, Indore, Madhya Pradesh, India

# Status of soil pH, EC, OC and micronutrients levels in Madhya Pradesh: An overview

**Rakesh Dhakad, Pramod Kumar and Chandra Kant Sharma**

**Abstract**
The soils of Madhya Pradesh are generally poor status of micronutrients nutrients. Prospect for horizontal development on agriculture very diminutive, thus the future food, fodder, fruit, fiber, fuel requirement has to be met through vertical expansion with increasing crops productivity unit$^{-1}$ area of soil. The intensification is results in further whooping of micronutrients nutrients mining from the finite Zn, Fe Cu Mn resources on soil to crop, which may lead to causes as deficiency of all micronutrients to crop besides aggravating that existing ones. That the most important constituents soil in organic matter, an appreciable is amount of organic matter in soil tremendously increase soil fertility. Decay of organic matter release nitrogen, phosphorus and micronutrients nutrients in soil available to wheat crop. Micronutrient deficiencies in soil so that the crop are referred to as 'Hidden Hunger' affects the health, learning ability as well as productivity of crops owing to high rates of illness and disability contributing to vicious nutrients cycle of malnutrition, underdevelopment and poverty.

**Keywords:** Micronutrient, soil, pH, EC, organic carbon

## Introduction
It is estimated on the year 2050, world human population will climb to the 9.7 billion, and India's population is projected to overtake that the China will rise to 1.6 billion, from its current level of 1.2 billion. The skewed use of higher quantity of macro fertilizer it's without application of micronutrients is major concern for achieving the agricultural intensification required to feed on growing world population nutritious food crop production.

The micronutrient deficiency in Madhya Pradesh soil has emerged is one of major micronutrients constraints to crop productivity. While Zn, S and Fe is deficient in soil are vast on Madhya Pradesh, India. The problem has been compounded is soil pH are affecting on large area in Madhya Pradesh, The soil is natural to sligli-alkalinity commonly is observed in Madhya Pradesh. Soil nutrients are a dynamic natural property and it can change under the influence of natural and human induced factors.

The nutrients status in soil is one of the major constraints in achieving high productivity goals. In Madhya Pradesh both rain-fed and irrigated systems, the nutrients replenishment through fertilizers application in soil and organic manures remains for below the crop removal, thus causing mining of native reserves over the years (Patidar *et al.*, 2017) [24].

The organic matter is most important constituents in soil, an appreciable amount of organic matter in soil tremendously increase the soil nutrients. Decay of organic matter is release nitrogen, phosphorus and micronutrients is available form to crop. The availability of plant micronutrients induces better germination of seeds and hence subsequent better growth and stronger root development is crop. The evaluation of soil micronutrients status an area is an important aspect in the context of sustainable crop production (Kavitha C and Sujatha, 2015).

The soils of Madhya Pradesh are generally poor status of micronutrients, the prospect for horizontal development of agriculture is very diminutive and thus the future food, fruit and fiber requirement has to be met through vertical expansion with increasing crop productivity unit$^{-1}$ area of soil. That the intensification is results in further whooping of micronutrients is resources in soil to plant, which may lead to causes is deficiency of all micronutrients to plant besides aggravating that the existing ones (Takkar and Shukla, 2015).

Micronutrient deficiencies in soil so that the plants are referred to as 'Hidden Hunger' affects on plant and human health, learning ability as productivity of crops owing to high rates of illness and disability contributing to vicious nutrient cycle of malnutrition, underdevelopment and poverty of soil. The available plant nutrients role in the growth, development and yield of plant and information on nutritional status of field can go a long way in planning judicious fertilizer and soil management practices to develop the economically viable alternative for the farming community of soil.

The role of micronutrient in balanced plant nutrition is well established. However, exploitive nature of modern agriculture on soil involving use of high analysis N,P,K fertilizer coupled with less use of organic manures with micronutrients and not use of recycling crop residues as important factor contributing towards accelerated exhaustive of soil.

The trace elements are found sparingly in most of the soils and their availability to plant is very low. Consequently, even though their removal by plants is a very small quantity of plant nutrients, the cumulative effect rapidly reduce the large quantity of micronutrients, originally present in soils.

The factors can be affecting of availability of micronutrients to crops. The most important include nature of parent material, soil pH and organic matter in soil with drainage, interactions to plant nutrients.

**Status of soil pH, EC and Organic carbon in soils of Madhya Pradesh**

Rathore *et al.,* (1990) [26] studied on some mixed red and black soils of Tikamgarh district and reported that available manganese and iron is negative and significant relationship to soil pH. Pandey *et al.,* (2002) [22] studied the availability of phosphate and sulphur in Inceptisols of central (UP) India and reported that the available sulphur had significant positive correlation with pH in typic Ustifluents (r= 0.521) Aquic Haplustalfs (r= 0.77) typic Haplquepts (r= 0.331). Rashid *et al.,* (2008) [25] reported that the soil pH and EC is varied from is 7.681 to 8.61 and 1.695 to 6.92 $dSm^{-1}$, respectively in Peshawar district. All soils are moderate to the strongly calcareous with <1.01% organic matter in 12.02% samples. Kumar *et al.,* (2011) [13] repotted that Fe is positive correlation with organic carbon but negative of correlation with pH, Mn is also followed by Fe with OC, EC and pH, Zn with EC & positive relationship with pH & OC with positive of correlation. Zn showed negative correlation with OC and positive correlation with EC & pH.

Sharma *et al.,* (2013) [30] reported that the status of pH, EC & OC in the soils of Assam, India were 4.96, 43.18 $dSm^{-1}$ and 1.11% is respectively. Nath *et al.,* (2014) [20] reported that the pH, EC of soil and total OC, varied from 4.69-5.58, 0.09-0.42 $dSm^{-1}$ and 1.87-3.198% of the material, respectively in field of the Shivanagar district (Assam). Hailu *et al.,* (2015) [7] reported that the soils of central highlands of Ethiopia are clayey in neutral to slightly alkaline (pH 7.20-7.90) and their OC (1.61-3.22%) content in low to medium. Behera *et al.,* (2016) [3] reported that the soils of South Goa and North Goa were acidic to neutral in reaction. Other soil is EC, OC and $CaCO_3$ varied widely in both the soil layers in soil properties. Khadka *et al.,* (2016) [11] observed that the soil was grayish brown in color and sub-angular blocky in structure of soil. The soil was acidic in pH (5.6 ± 0.15), OC (1.35 ± 0.071%). To improve the potentiality of maize, rice etc. for studied area, future research strategy should be made based on its agricultural research station, Belachapi, Dhanusha, Nepal in soil nutrients status.

Jatav *et al.,* (2017) [9] repotted that the collected from rice based cropping zone of Rewa district in Madhya Pradesh using Geo Positioning System (GPS). The mean value of pH, electrical conductivity (EC), organic carbon and $CaCO_3$ in soil were 7.45, 021 $dSm^{-1}$, 5.03 g $kg^{-1}$ and 2.83 g $kg^{-1}$, respectively. Sulphur as found to be positively correlation and statistically not-significant with pH and positively and significant correlation with organic carbon. The results of study indicated that 45.10% sulphur deficiency is the major disorder in mixed red and black soils of Madhya Pradesh, India.

Patidar *et al.,* (2017) [24] repotted that the results that soils of Ralyawan village in Jhabua district of Madhya Pradesh was soil pH of varied from 7 to 8 with the mean value of 7.5. The electrical conductivity of soil water suspension ranged from 0.17 to 0.86 $dSm^{-1}$ with mean value of 0.37 $dSm^{-1}$. The variation organic carbon in soil was from 0.23% to 0.80% with a mean value of 0.53%. In general on Ralyawan village was low to medium of organic carbon status in soil. Pathak *et al.,* (2017) Soil nutients refers to the inherent capacity of a soil to supply essential nutrients to plants in adequate micronutrients are important soil elements to control soil fertility. Keeping in view of Gwalior district. Under these, soils of Morar and Ghatigoan blocks belong to Inceptisol and Dabra and Bhitarwar blocks belong to Vertisols, Soils were studied for their status of different available all plant nutrient.

Lohiya *et al.,* (2018) [17] repotted that the concluded from the above results on soils Golpura village in Dhar district of Madhya Pradesh were characterized under neutral to alkaline in soil reaction (pH) and less than one $dSm^{-1}$ soluble salt (EC) comes under safe limit for soils. The organic carbon level exhibited low to medium status and positively significant correlation is exhibited amongst OC. The study of concluded that, soils of Golpura village in Malwa Plateau Agro climatic western zone of Madhya Pradesh are low in soil available organic matter content, Soil organic carbon, are important soil nutrients constraints indicating their immediate attention for sustained crop production.

Emmanuel *et al.,* (2018) [6] to study were carried out to assess the soil reaction (pH), Electrical Conductivity (EC) and organic carbon in soil. The soil samples were slightly acidic with a pH mean of 6.26. The textural class of the soil samples varied from sandy loam to loamy and with sand ranging from 75.30-80.30%, silt 7.00-11.30% and clay 12.30-13.30%. The soil organic corbon and organic matter were recorded low and moderate in locations. The sustainable crop production, good soil management practice such as crop rotation, addition of quality crop residue, Organic Manure (OM) and application of organic fertilizer is recommended dose.

Kutubuddin Beg and Ravi Chaurey (2018) [15] repotted that the study on area comes under Vindhyan hill range covering Rewa and Bhander soil and located in North-East part of Madhya Pradesh. It stretches between 800 38’ 41.143” and 810 12’ 55.097” E and 240 37’ 47.994” and 240 55’ 36.438” N. The pH values of soils in study area varied from slight alkaline to strongly alkaline (5.32 to 8.59) and Results shows that the deficiency of Nitrogen (N), Boron (B) and Zinc (Zn).

Lohiya *et al.,* (2018) [17] repotted that the soil reaction (pH) and electrical conductivity (EC) and organic carbon in different soil samples of the study area the characterized under neutral to alkaline in soil reaction (pH) and less than one d $Sm^{-1}$ soluble salt content (EC) comes under safe limit for all soils it can be concluded that, soils of Golpura village in Malwa Plateau Agro climatic zone of western Madhya Pradesh are low in soil available organic matter content.

Yadav *et al.,* (2019) [25] repotted that the present study was focused on assessing of soils in Alirajpur district of Madhya Pradesh using geo-statistical approach. 272 GPS based surface (0-15 cm) soil samples were collected from six blocks (Alirajpur, Bhabra, Jobat, Kathiwara, Sondwa, and Udaigarh) of Alirajpur district after harvest of crops during rabi season 2016-17. Soils samples were processed and analyzed in the laboratory using standard procedures for results revealed that pH, EC and OC of soils collected across different blocks of

Alirajpur district varied from 4.70 to 8.40, 0.03 to 0.90 $dSm^{-1}$ and 0.47 to 12.92 g $kg^{-1}$ soil, respectively.

**Status of available micronutrients in soils of Madhya Pradesh.**

Nayak *et al.*, (2000) [21] studied the status of available micronutrient in alluvial soils of. The available zinc, copper iron and manganese content of surface soils ranged from 0.2 to 1.12, 0.5 to 3.57, 7.0 to 73.6 and 2.70 to 53.8 mg $kg^{-1}$, respectively. Considering 0.5, 0.2, 4.5 and 2.0 mg $kg^{-1}$ as the threshold value of available Zn, Cu, Fe and Mn. All the soils are quite in Cu, Fe and Mn. Surface soils of most the profile are deficient or marginally adequate in available micronutients.

Sharma *et al.*, (2001) [31] repotted that the Zn deficiency is maximum in Gird Zone (86.3%) followed Satpura Hills (6R.6), Bundelkhand Zone (65.0%) and Chhattisgarh Plain (63.0%). About 23.7% soils of Satpura plateau, 19.6% of Jhabua Hills, 16.7% of Central Narmada Valley, 7.2% of Vindhy' a plateau, 4 9% of Bundelkhand zone, 4.5% of Nimar valley were found to be deficient in Fe. Git Zone showed Mn deficiency to the extent of 12.8%. Available Cu was found sufficient in. Other zones indicated Zn deficiency below 60 % and the minimum being in Satpura Plateau (19.5%). Manganese deficiency in plants was found to the extent of 54.3% in the Gird zone.

Samanta *et al.*, (2002) [27] repotted that status of total and available iron and zinc in soils of West Bengal under continuous cultivation of mulberry. Total Zn and Fe content in the soils varied from 8.0 to 136.0 ug $g^{-1}$ and 0.65 to 8.78 % with a mean values of the 66.1 ug $g^{-1}$ and 4.97%, respectively. Content of both the element were higher in soils of Darjiling district but lower in soil of Coocheber and Birbhum. The available Fe and Zn in soils extracted by DTPA varied from 3.3 to 205.0 ug $g^{-1}$ and 0.2 to 5.2 $ug^{-1}$ respectively.

Bansal *et al.*, (2003) [2] collected surface soil samples numbering 200, 100 and 100 from Ludhiana, Jalander and Sangrur districts of central plain region of Punjab. Samples were analyzed for boron and physical properties. The available boron content varied between 0.22 to 2.16, 0.28 to 1.85 and 0.32 to 2.00 mg $kg^{-1}$, respectively, considering soil containing available boron less 0.5 and.5 to 1.0 mg $kg^{-1}$ in soil low to medium boron supply, respectively

Sharma *et al.*, (2003) [29] studied the status of micronutrients and effect of soils properties in some soil of semi-arid region. Available micronutrients content ranged from 0.1 to 1.7, 0.5 to 3.9, 1.0 to 6.6, 2.7 to 7.2, and 0.2 to 2.0 mg $kg^{-1}$ with mean values of 0.73, 2.11, 4.32, 5.15 and 0.68 mg $kg^{-1}$, respectively. Silt plus clay, EC, pH, organic carbon and calcium carbonate in soil ranged from 7.9 to 21.8 0 percent.11 to 0.52 $dsm^{-1}$, 8.0 to 9.3, 0.08 to 0.31% and 0.1 to 1.2 % with the mean values of 12.9 %, 0.28,$dsm^{-1}$ 8.5, 0.2 and 0.5% respectively. Available Zn, Fe and B were deficient in 46%, 51.5% and 26.5% soil samples respectively, while copper and manganese were adequate in all the soil samples. Multiple correlation analysis indicated that available micronutrients were significantly influenced by soil properties.

Panwar and Totawat (2004) [23] reported that the DTPA-extractable micronutrients content in salt affected soils of sub humid southern plain of Rajasthan, ranged from 0.21 to 0.75, 0.27 to 1.04, 1.13 to 4.28 and 2.76 to 7.79 mg $kg^{-1}$, respectively. Dwivedi *et al.* (2005) [5] analyzed surface soil samples collected from five cultivated fields, each from 96 and 50 villages of Leh and Kargil districts of Ladakh region. The DTPA- exactable Zn, Cu,Fe and Mn were found to range from 0.54 to 33.79, 0.43 to 3.52, 0.06 to 16.3 and 0.20 to 32.17 mg $kg^{-1}$, respectively in soil of Leh districts, while the range of micronutrients was observed from 0.20 to 38.04, 0.50 to 3.41, 0.14 to 5.17 and 0.34 to 4.74 mg $kg^{-1}$, respectively in soils of Kargil district.

Minakshi *et at.*, (2005) [18] studied the spatial distribution on micronutrients on soils of Patiala districts and revealed that DTPA-extractable micronutrients content of soils also exhibited positive and significant correlation with organic carbon. Dhaliwal *et al.*, (2008) [4] studied the profile distribution of chemical, physical and microbial characteristics in four land use system of Sadhikad watershed in sub monotonous tract of Punjab. The available micronutrients content 1.14 mg $kg^{-1}$, 0.48 mg $kg^{-1}$, 9.30 mg $kg^{-1}$ and 84.5 mg $kg^{-1}$ at 0-16 cm and 0.68, 0.26, 7.16 and 10.64 mg $kg^{-1}$ at 16-41 cm depth in cultivated land, 0.96, 0.28, 7.84 and 7.36 mg $kg^{-1}$ at 19-49 cm depth in undisturbed land use system and 0.72, 0.34,7.086 and 8.06 mg $kg^{-1}$ at 0-23 cm depth and 0.38, 0.22, 5.60, 9.86 mg $kg^{-1}$ at 23-44 cm depth in pasture land use system, 1.22, 0.48, 9.38, 10.16 mg $kg^{-1}$ at 0-10 cm and 0.84, 0.22, 8.10 and 9.80 mg $kg^{-1}$ at 10-30 cm depth in forest land use system.

Ak porhonor and Agbaire (2009) [1] studies on were collected from 10 locations in Abraka to ascertain the level of total micronutrients. The total micronutrients were determined using atomic absorption spectrophotometer (AAS). Fe has a range between 2214-4820 mg $kg^{-1}$, Cu ranged between 4.00-18.00 mg $kg^{-1}$, Zn ranged between 12.00-44.00 mg $kg^{-1}$, B ranged between 58.00-158.00 mg $kg^{-1}$, and Mn ranged between 4.00-16.00 mg $kg^{-1}$. Soil properties are as follows: pH 4.00-6.90, CEC (c mol $kg^{-1}$) between 0.69-6.94. The parcented organic matter ranged between 0.71-2.46 % with a mean of 1.218%. There is relatively low correlation between soil properties with total micronutrient.

Bali *et al.*, (2010) studies of detailed characterization of soil of Punjab were carried out. The descriptive statistics on soil characteristics indicated that the pH of the soils varied from 6.77 to 9.30 (mean =7.93). The EC ranged from 0.14 to 4.57 dS $m^{-1}$(mean=0.63 dS $m^{-1}$). The organic carbon ranged from 0.0 to 1.55% (0.57%). Calcium carbonate varied from 0.5 to 10.46% (mean =3.94%).The DTPA-Zn ranged from 0.07 to 3.06 mg $kg^{-1}$ (mean =1.10 mg $kg^{-1}$).The GIS aided thematic map indicated that 10% of the total geographical area of Punjab was affected by the Zn deficiency based on the existing critical limits.

Mustapha *et al.*, (2011) [19] this study has been conducted to assess the status and distribution of available zinc (Zn), copper (Cu), iron (Fe) and manganese (Mn) in soil of akko local government area (LGA), Gombe state, Nigeria. Sixty composite soil samples were collected from 0-15 and 15-30 cm depths from 15 purposively selected representative location in the LGA and analyzed in the laboratory using standard procedures. Results obtained showed that the soils were generally clayey to sandy clay soil.

Sharma *et al.*, (2013) [30] repotted that the available micronutrients showed negative correlation with pH, available B content exhibited positive correlation. Zn and B showed positive and significant correlation with organic carbon. Similarly, Zn, Mn and B were found negatively and significant correlation with $CaCO_3$. The results of the study indicated that zinc (Zn: 55.9 %) and iron (Fe: 2.0 %) deficiency are the major disorders in mixed red and black soils of Rewa district of Madhya Pradesh, India.

Singh *et al.*, (2014) [33] repotted that the study of micronutrients on Morena district of Madhya Pradesh. The

DTPA-Fe varies from 0.20 to 9.70 mg $kg^{-1}$ with mean value of 2.90 mg $kg^{-1}$. 54% samples were deficient, 24% marginal and 22% in sufficient. The DTPA-Zn ranged from 0.12 to 1.90 mg $kg^{-1}$ with mean value (0.61 mg $kg^{-1}$. Out of 125 samples, 59% samples were found to be deficient and remaining are sufficient in DTPA-Zn. Available copper content in soil samples varied from 0.02 to 0.82 mg $kg^{-1}$ with mean value of 0.13 mg $kg^{-1}$. About 85% of soil samples were deficient, 13% marginal and 2% high in available Cu and The DTPA-Mn varied from 0.30 to 11.80 mg $kg^{-1}$ with mean value of 2.82 mg $kg^{-1}$. About 24% samples were low and mesium and 52% samples falls under high range.

Singh *et al.,* (2014) [33] Micronutrients status of alluvial and medium black soils and ravenous land, and their correlation studies were carried out for Chambal region of Madhya Pradesh. The alluvial and medium black soils were neutral to alkaline, whereas ravenous land was more or less neutral. In general, soils were low in soluble salts, organic carbon and calcium carbonate content. As regards deficiency of micronutrients, 64.5, 11.7, 14.3 and 14.5% were deficient in micronutrients respectively in alluvial soils; 76.3, 33.3, 8.8, 8.6 and 5.1% were deficient in micronutrients, respectively in medium black soils and 18.4 and 15.8% were deficient in Zn and B, respectively in ravenous land. Available micronutrients were negatively and significantly correlated with pH, whereas Mo showed positive correlation. Available negatively correlated with EC, but positively correlated with Available micronutrients were significantly and positively correlated with organic carbon and silt plus clay content in soil, whereas available micronutrients, were significantly and negatively correlated with $CaCO_3$ content in soil.

Kumar *et al.,* (2016) repotted that the status of available micronutrient in soils and other soil properties like pH, EC and organic carbon (OC) content were assessed. Results revealed that the soil of study area were neutral to strongly alkaline in reaction and non-saline in nature. Nutrient status regarding to the available micro nutrient in surface (0–15 cm) and subsurface (15–30 cm) depth of soil indicate that soils are general sufficient in available micronutrients in surface soil and subsurface layer of soil. The Nutrient Index (NI) values were available micronutrients was found with organic matter content while significant and negative correlations exist between micronutrients and soil pH.

Patidar *et al.,* (2017) [24] An experiment was conducted during the kharif seasons of 2014-15 under All India Coordinated Research Project for Dry land Agriculture at College of Agriculture, Indore Madhya Pradesh to study the major nutrient and other the pH of varied from 7 to 8 with the mean value of 7.5. The EC of soil water suspension ranged from 0.17 to 0.86 $dSm^{-1}$ with a mean value of 0.37$dSm^{-1}$. The variation in organic carbon content in this soil was from 0.23% to 0.80% with a mean value of 0.53%. In general, the organic carbon status of Ralyawan village soils of was low to medium.

Singh *et al.,* (2017) [32] repotted that the forest soil till it remains in natural state and there is no breaking of land takes place, it tries to retain and check the organic matter content. As long as forest of the study area remains in UN degraded state the average value of micronutrients in encroachment category changes significantly with average value of the study area. When we take combined effect of pH, electrical conductivity and organic carbon on study area it indicates no significant association with respect to various densities of classes. Similarly when we take the combined effect micronutrient on study area these combined parameters do not indicate significant association with respect to various density classes.

Lohiya *et al.,* (2018) [17] repotted that the characterized under neutral to alkaline in soil reaction (pH) and less than one $dSm^{-1}$ soluble salt content (EC) comes under safe limit for all soils. Out of total soil samples were tested high level DTPA-extractable micronutrients deficiency was observed in study area. The organic carbon level exhibited low to medium and positively significant correlation was exhibited amongst OC. From the study, it can be concluded that, soils of Golpura village in Malwa Plateau Agro climatic zone of western Madhya Pradesh are low in soil available organic matter content. Regarding available micronutrients are deficient to sufficient in these soils. Soil organic carbon, available micronutrients are important soil fertility constraints indicating their immediate attention for sustained crop production.

Lohiya *et al.,* (2018) [17] repotted that evaluate the status of micronutrients Vertisols and associated soils, to assess the micronutrients status in sampled soil, to determine the textural class of sampled soils of the village and to quantify the relationship between organic carbon and available N content in soil through correlation. Regarding available micronutrients, zinc, Manganese, copper and iron were deficient to sufficient in these soils. Soil available micronutrients are important soil fertility constraints indicating their immediate attention for sustained crop production. Out of total soil samples were tested high level DTPA-extractable Cu, medium level Fe whereas, Zn and Mn deficiency was observed in study area.

Ingle *et al.,* (2018) a detailed soil survey was undertaken in Bareli watershed in Madhya Pradesh state of India with the aim of evaluating the soil nutrients status. Based soil fertility ratings, pH of soils as neutral to alkaline. Electrical conductivity was normal low (defficient) while iron (Fe), manganese (Mn) and copper (Cu) were high and sufficient to excess were observed as the most important soil nutients constraints that could affect sustainable crop production in the study area.

Subhash *et al.,* (2019) repotted that the Zn, and Fe deficient in 79.54% and 7.92 % soil samples and none of soil samples were found to be deficient in Cu and Mn. Soil pH showed significant and negative correlations with micronutrients. The EC had positive and significant relationship with OC and B with r values of 0.163** and 0.168**, respectively. Geo-statistical suggested that the exponential models best fitted for, Zn while spherical models for micronutrients. The nugget/sill ratios of semivariogram models for micronutrients were moderate. The having value were 0.78, 0.49, 0.44 and 0.41 for Mn, Fe, Zn and Cu, respectively.

## Conclusion

It is well recognized that micronutrient deficiencies pose a serious concern in sustaining crop productivity, animal and human health on soil of Madhya Pradesh. We have developed micronutrient deficiency maps to affect of relationships between soil micronutrient content, their availability and crop productivity in different soil of Madhya Pradesh. This will improve our understanding on precision management of spatially-variable soil micronutrient availability to the crops. Frequency distribution of micronutrients based on variable critical ratings will provide quantitative support to the decision and policy makers to further improve and the existing agricultural approaches leading to balanced micronutrients nutrition. Fertilization packages with

micronutrient can provide an immediate and effective solution to increase soil and crop productivity and quality of produce without deteriorating the soil health, particularly in the area where severe micronutrient deficiencies have been observed on Madhya Pradesh

**References**


1. Akporhonor, Agbaire PO. Physiochemical properties and micronutrients status of farmland soils in Abraka, Nigeria. African Journal of Pure and Applied Chemistry. 2009; 3(7):131-134.
2. Bansal, Bhatnagar RK, Trivedi SK. Distribution of the OC, S in some profiles of Shivpuri district of M.P. Indian Society of soil science. 2003; 51(1):74-76.
3. Behera, Suresh K, Rao BN, Ramachandrudu K, Harinarayana P. Spatial variability of sometime soil in S, Zn, Fe properties in West coastal area of India having oil palm Plantations of Journal Solid Earth, 2016.
4. Dhaliwal, Sharma BD, Vijay Kumar, Mehra KL. The profile distribution of chemical, physical and microbial characteristics in four land use system. Journal of the Indian Society of Soil Science. 2008; 3(2):316-322.
5. Dwivedi, Sharma VK, Bharadwaj V. Status of available micro-nutrient in the fields of cold or arid region of Ladakh. Journal of the Indian Society of Soil Science. 2005; 53(3):421-423.
6. Emmanuel, Louis Hitler, Akakuru Ozioma Udochukwu, Adeola Oluwakemi Ayoola, Timothy Fidelis Tizhe, Amos Pigweh Isa *et al*. Assessment of Organic Carbon and Available Nitrogen in the Soil of Some Selected Farmlands Located at Modibbo Adama University of Technology, Adamawa State, Nigeria Assessment of Organic Carbon and Available Nitrogen in the Soil of Some Selected Farmlands. 2018; 5(2):2-4.
7. Hailu H, Mamo T, Gebrekidan H, Bekele T. Soil fertility status and wheat crops nutrient content in soil Cropping-Systems of Central High lands of ethiopia agriculture and food security. 2015; 4:19.
8. Ingle SN, MSS Nagaraju, Nisha Sahu, Nirmal Kumar, Pramod Tiwary, Sen TK *et al*. Soil fertility status of micronutrients in Bareli watershed of Seoni district, Madhya Pradesh, India. International Journal of Chemical Studies. 2018; 6(4):1950-1953
9. Jatav RC, Sharma YM, Raghuveer, Shweta Jamra, Vidya Simaiya. Status of Sulphur in soils and plants of mixed red and black soils in Rewa district of Madhya Pradesh, India. International Journal of Chemical Studies. 2017; 5(6):2090-2093.
10. Kavitha C, Sujatha MP. Evaluation of soil fertility status in various agro ecosystems of Thrissur District, Kerala, India. Int. J Agri. and Crop Sci. 8(3):328-338.
11. Khadka D, Lamichhane S, Pant BB. Assessment of soil fertility status as Agriculture Research Station, Nepal, Journal of Maize Research and Development. 2016; 2(1):43-57.
12. Kumar J, Vijay M, Suryanarayan Reddey, Gopala Krishna V. Vertical distribution of micronutrient cation in some propile in Northern Telangana of Andhra radish. Journal of the Indian Society of Soil Science. 1996; 44(2):328-330.
13. Kumar M, Babel AL. Available Micronutrient Status and Their Relationship with Soil Properties of Jhunjhunu Tehsil, District Jhunjhunu, Rajasthan, India. Journal of Agricultural Science. 2011; (2):97-106.
14. Kumar Pramod, Ashok Kumar, Pardeep Kumar, Dhayni BP, Robin Kumar, Ashish Dwivedi. Nutrients Status of Cultivated Soils of Ganga Canal Area of Meerut District of Uttar Pradesh. International Journal of Bio-resource and Stress Management. 2016; 7(4):606-613.
15. Kutubuddin Beg, Ravi Chaurey. Assessment of Soil Fertility and nutrients status of Simrawal and part of Asrawal watershed, Tons sub-Basin, Ganga Basin. International Journal of Advanced Scientific Research and Management. 2018; 3(6):78-85
16. Kuumar R, Hundal HS, Singh K, Singh B. GIS-aided mapping of DTPA extractable zinc and soil characteristics in the state of Punjab. Journal of the Indian society of soil science. 2010; 58(2):180-199.
17. Lohiya, Shila PK, Unni, Sanjay Sharma. Evaluation of Soil Fertility of Golpura Village of Dhar District of Western Madhya Pradesh, India. International Journal of Current Microbiology and Applied Sciences. 2018; 7(4):221-229.
18. Minakshi Tur NS, Sharma PK, Sood AK. Spatial distribution of the micro-nutrients in soils of Patiala district Journal of Indian Society of Soil Science. 2005; 53(3):324-329.
19. Mustapha S, Voneir N, Umar S, Abdulhamid NA. status and distribution of some available micronutrients in the haplic usterts of akko local government area, Gombe state, Nigeria. International Journal of Soil Science, ISSN (1-8):1816-4978, 2011
20. Nath TN. Soil bulk density and its effect on soil texture, OC content and available micro-nutrients of tea cultivated soil in district of Assam, India. International Journal of Development Research. 2014; 4(2):343-346.
21. Nayak DC, Mukhopadhyay S, Government D. Distribution of the some available micro-nutrients in the soils of Arunachal Pradesh in relation to soil characteristics. Journal of the Indian Society of Soil Science. 2000; 48(3):612-614.
22. Pandey SP, Singh RS, Mishra SK. Availability of phosphate and sulphur in Inceptisols of central Utter Pradesh, Journal of the Indian Society of Soil Science. 2002; 48(1):118-121.
23. Panwar NR, Totawat KL. Distribution of micronutrient cation in relation to soil properties of salt affected soils of sub humid plain of Rajasthan. Journal of the Indian Society of Soil Science. 2004; 52(4):290-294.
24. Patidar, Rohit Kumar Patidar, Archana Rajput, Sharma SK, Rahul Thakur. Evaluation of basic properties of soil and major nutrient in soils of jhabua district of madhya Pradesh. International Journal of Agriculture, Environment and Biotechnology Citation IJAEB. 2017; 10(1):45-52.
25. Rashid, Bavalgave VG. Chemical properties and micro-nutrient status of some soils of Latur, M.H. Asian Journal of Soil Science. 2008; 3(2):236-241.
26. Rathore GS, Dubey SB, Khamparia RS, Sharma BL, Gupta GP. Available micronutrient status and suitability of soil test method for Zn in some mixed red and black soils of Madhya Pradesh. JNKVV Res. J. 1990; 24:96-98.
27. Samanta A, Mandal B. Mulberry of the continuous cultivation of Status and available Fe and Zn in the soil. Journal of Indian Society of Soil Science. 2002; 50(1):35-42.
28. Sarmah MC, Phukan JCD. Article Impact of soil fertility silkworm, Antheraea assamensis in potential muga

growing areas of Assam, India. International Journal Current Microbial. App. Society. 2013; 2(9):25-38.
29. Sharma RP, Sharma JP. Correlation of studies on DTPA-extractable micro-nutrients soil properties in some fields of in region. Journal Indian Society of Soil Science. 2003; 51:522-527.
30. Sharma YM, Jatav RC, Sharma GD, Risikesh Thakur. Status of Micronutrients in Mixed Red and Black Soils of Rewa District of Madhya Pradesh, India. Asian Journal of Chemistry. 2013; 25(6):3109-3112.
31. Sharma GP, Gupta RS, Kamparia, Sharma YM. micronutrient status in soils and plants of different agro climatic zones of Madhya Pradesh Indian J Agric. Res. 2001; 35(4):243-246,
32. Singh Prachi, Sherendra Sahu, Singh PK, Neeta Singh. Study of Association of Soil Parameters with Various Density Classes of Forests of Mukundpur, Satna, Forest Division and Madhya Pradesh. Journal of Soil Science & Plant Health. 2017; 1(1):2-7
33. Singh YP, Raghubanshi BPS, Tiwari RJ, Motsara S. Distribution of Available Macro and Micronutrients in Soils of Morena District of Madhya Pradesh. Technofame- A Journal of Multidisciplinary Advance Research. 2014; 3(1):01-08.
34. Subhash GS, Tagore PS, Kulhare, Shukla AK. Mapping of Spatial Pattern of Micronutrients in Soils of Harda District of Madhya Pradesh through Geo-statistical Tool in Arc GIS Environment International Journal of Current Microbiology and Applied Sciences. 2019; 8(2):52-63.
35. Yadav Tikam Chand, Rai HK, Tagore GS, Dayanidhi Chaubey, Dhakad R. Assessment of spatial variability in physico- chemical properties of soils in Alirajpur district of Madhya Pradesh using Geo-statistical approach. Journal of Soil and Water Conservation. 2019; 17(4):317-324.