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DTPA – Extractable Micronutrients and Fertility Status Of Soil in Shirpur Tahasil Region.

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Abstract : Soil survey was carried out during 2009 in Shirpur Tahasil Region. Great revolution has greatly increased the food crop production in Shirpur Tahasil but continuous cultivation of high yielding crop varieties have led to depletion of native micronutrients and soil fertility. There were 30 samples collected and analyzed for the basic soil parameters p^H,E.C,O.C,$CaCO_3$. The available micronutrients Fe, Mn, Cu, Zn were investigated by using Atomic Absorption Spectrophotometer[1] (ECIL, AAS - 4129). The availability of micronutrients and their relationship with soil properties were also studied.
Key Words- Diethylene tetramine penta acetic acid (DTPA), triethanolamine(TEA),Micronutrients.

INTRODUCTION

Investigation of micronutrients in soils mostly carried out to explain crop failures and to determine the effect on plant growth of elements, other than those already recognized as essential. Soil fertility is one of the important factor controlling yields of the crops. Because of imbalanced and inadequate fertilizers use coupled with low efficiency of other inputs, the production efficiency of chemical fertilizers nutrients has declined tremendously under intensive agriculture in recent years[2]. Introduction of high yielding varieties in Indian Agriculture forced the farmers to use high dose of NPK along with micronutrients fertilizers. This caused declined in the level of some micronutrients in the soil at which productivity of crops cannot be sustained. The deficiencies of micronutrients have become major restrictions to productivity, stability and sustainability of soils[3].Nutrients strength and their relationship with soil properties affect the soil health.

Micronutrients play of vital role in maintaining soil health and also productivity of crops.[4] These are needed in very small amounts. The soil must supply micronutrients for desired growth of plants and synthesis of human food. The present study was taken up to evaluate the availability of Fe, Mn, Cu & Zn in soil sample of Shirpur Tahasil.

MATERIALS AND METHODS

The study area Shirpur Tahasil covering an area of 1106 sq. km. It lies between $19^0 2'$ to $22^0 03'$ north attitude, $74^0 10'$ to $75^0 11'$ east longitude. Shirpur Tahasil is situated in Khandesh region of Maharashtra state.[5] It is northern most Tahasil of

Dhule district and bordering with Madhaya Pradesh state to it's north.

Shirpur Tahasil is located in Tapi Basin. Tapi river flows westwards in the south part of Tahasil and receives tributaries from north mainly Aner, Arunawati, Kordi, Nandi, etc. Tapi river deposited alluvial soil along with it's borders. The climate of Tahasil is whole dry except during south west monsoon season. Tahasil falls under assured rain fall zone with 700 to 900 mm rainfall and 75% rainfall received in the Tahasil which is useful for Kharif crops.

The processed soil samples were analyzed for the basic soil parameters p^H, E.C. O.C. $CaCO_3$. The available fraction of Fe, Mn, Cu And Zn were extracted with DTPA – TEA buffer (0.005 M DTPA+ 0.01 M $CaC1_2$ + 0.1 M TEA).[6] as per method and conc. of Fe, Mn, Cu & Zn in the DTPA extracts was determined in an Atomic Absorption Spectrophotometer. The relationship between various soil properties and micronutrients distribution was established by using simple calculations and backward analysis

Diethelene teteamine penta acetic acid method which is found useful for separating soils into deficient and sufficient categories for micronutrients using AAS. Chelating agent offer great promise for assessing readily available micronutrients cation in the soil.[7] These agents combine with free metal ions in solution to form suitable complexes. DTPA offers a most favorable combination of stability constants for the simultaneous complexing of Fe, Mn, Cu & Zn.[8]

Table 1: Soil Properties and DTPA Extractable Micronutrient Status of Soil.

Sr.	p^H	E.C. mmhos/ cm	O.C. %	$CaCO_3$ %	Fe mg/kg	Mn mg/kg	Cu mg/kg	Zn mg/kg
1	6.05	1.14	0.90	0.5	14.8	2.81	3.0	0.61
2	6.98	1.40	1.25	1.25	14.8	2.1	3.2	0.58
3	7.51	1.02	0.62	1.0	14.7	1.8	3.0	1.3
4	7.73	1.14	0.93	3.75	14.3	1.2	3.1	0.53
5	7.81	4.59	0.82	3.75	14.6	2.4	2.8	0.68
6	7.96	0.73	0.16	4.75	14.1	2.7	2.4	0.62
7	8.02	1.10	0.71	2.75	11.8	2.7	3.5	0.55
8	8.4	0.10	0.82	1.96	9.5	1.7	2.5	0.53

Table 2 : Range and Mean Values of Micronutrients of Analyzed Soil.

Available Micronutrient	Range mg/Kg	Mean mg/Kg	Limiting value mg/kg	Deficient %	Marginal %	Sufficient %
Fe	9.5 – 14.8	13.57	4.5	Nil	Nil	100
Mn	1.2 – 2.81	2.24	2.0	20	20	60%
Cu	2.4- 3.2	3.2	0.2	Nil	Nil	100%
Zn	0.53 – 1.3	0.62	0.6	50	37.5	12.5

Table 3: The Relationship between Soil Properties and Micronutrient content in the soils determined using correlation Coefficient.

Property/Micronutrients	Fe	Mn	Cu	Zn
pH	-0.633	-0.321	-0.311	-0.077
E.C.	0.431	0.194	0.070	0.039
O.C	0.078	-0.332	0.528	-0.244
$CaCo_3$	-0.026	0.002	-0.347	-0.341

Correlation coefficient (r) = $\sqrt{}^{SP(xy)}/_{SS(x)SS(y)}$
r =correlation coefficient
$SP_{(xy)}$=Sum of products of xy variables
$SS_{(x)}$=Sum of square of x variable
$SS_{(y)}$=Sum of square of y variable
Where,
x=soil properties and y= micronutrient contents in the soil

RESULT AND DISCUSSION

The range and mean values of analyzed soil are given in the Table 2. On the basis of $CaCO_3$ rating the soils of the Shirpur Tahasil Region are moderately calcareous in nature due to hard water.River water or ground water used in irrigation contains salt. In the absence of sufficient natural drainage as in wateriogged soils and without a proper leaching and drainage program to remove salts, this would lead to a high soil salinity and reduced crop yields in the long run.[8] Low level of $CaCO_3$ enhance soil structure and are generally beneficial for crop production but at higher concentration they may induce iron deficiency and when cemented limit the water storage capacity of soils.[9] All soil sample were moderate in organic carbon. Most of the soil samples were moderately alkaline in nature. Several nutrients are affected by soil pH[10]. On the basis of E.C. limits most of the soils under investigation fall in the category of normal soils. Only few samples showed high value of E.C. These soils are saline hard and less water drainage which are harmful for seed germination. Organic carbon contents in the soil sample were low. The low content is due to poor vegetation and high rate of organic matter decomposition under hyper thermic temperature regime which leads to extremely high oxidizing condition.[11] On the basis of critical limits of available iron, the soil of Shirpur Tahasil were sufficient in available iron and copper (Table 1).

On the basis of critical limits of available Mn 60% of soil samples were found sufficient in Mn and 20% of samples were found marginal in available Mn and 20% of samples were found in deficient.

On the basis of critical limits of available zinc, 50% soil samples were found deficient 37.5% samples were marginal and 12.5% samples were sufficient in available zinc.Extractable Zn declined as the soil was limed from pH 4.3 to5. Zn content of soil depends on the nature of parent material organic matter and pH[12] .

The correlation coefficient[13] between available micronutrient and soil properties shown in table 3.

DTPA Fe in the soil samples varied from 9.5 mg/kg to 14.8 mg/kg with mean value 13.57 mg/kg considering as critical limits. The available Fe showed negative correlation with P^H (r= -0.633)and CaCO3. (r= 0.-0.026) and positive correlation with E.C.(r=0.437) O.C. (r=0.078).

The available Fe decreased significantly with increase in p^H and $CaCO_3$.

DTPA Mn in soil samples varied from 1.2 mg/kg to 3.0 mg/kg with mean value of 2.4 mg/kg considering Mn critical limits for Mn deficiency. The available Mn in these soils are positively correlated with E.C. (r= 0.194) and $CaCO_3$ (r= 0.0029) negatively co-related with P^H (r= -0.321) and O.C.(r=-0.332).

Available Cu content in the soil sample varied from 2.4 mg/kg to 3.5 mg/kg with mean value of 3.2 mg/kg. Copper availability is dependent on soil charactaristics. It increases with increase organic matter but decrease with increase in pH and $CaCO_3$ content of soil. The available Cu is inversely proportional to p^H (r= -0.311) and CaCO3 (r=-0.347) while directly proportional to E.C. (r=0.070) ,O.C. (r= 0.528).

Available Zn in the soil sample varied from 0.53 mg/kg to 1.3 mg/kg with mean value of 0.62 mg/kg. on the basis of critical limit.

The available of Zn increased with increase in E.C. (r= 0.039) where as reduced with increase in pH (r= -0.077), O.C. (r= -0.244) $CaCO_3$ (r= -0.341).

CONCLUSION

The availability of micronutrients increased significantly with the increase in organic matter because organic matter is improving soil aeration and protects the oxidation and precipitation of nutrients into unavailable form and supply soluble chelating agents which increase the solubility of micronutrient contents.

On the other hand its availability was found to be reduced with increase in pH and $CaCO_3$ content of soils and high pH is responsible for its oxidation**.** Thus most readily available for micronutrients into less soluble form after oxidation.Hence the availability of micronutrients is reduced at high pH level. Besides, at high pH micronutrients are also precipitated as insoluble form which reduces its availability.

High soil pH reduces Fe availability while acid soil increase Fe availability[14]. The high pH effect is increased in waterlogged compacted or other poorly aerated soils. Nutrients such as Zn and Fe have limited availability when the soil pH is above 7.5.

Some nutrients become tied up in the soil at certain pH level. By increasing soil pH above 7 favours their conversion to oxides, hydroxides and silicates in which form the activity of all.

Manganese availability is mostly affected by soil pH, organic matter and soil moisture. With pH having the greatest effect, Manganese is most available below pH 5.5. Manganese toxicity in acidic soils can easily be alleviated by liming the soil above pH 6. The ratio of Fe to Mn in most growing medium is maintained between 1.5 and 2.5 to maintain soil fertility. Zinc availability is greatly affected by soil pH. As soil pH increases, Zn availability decreases[15]. The reverse is also true. In one study, extractable Zn declined sharply as the soil was limed from pH 4.3 to 5.0. Liming the soil to pH 6.1 restricted the Zn supply to forage crop severely. Copper availability is reduced at pH 7 and higher and is most available at levels below pH 5. The study among micronutrients, Fe sufficient by 100%, Mn sufficient by 60% Cu sufficient by 100% and Zn sufficient by 12.5% . The studied soils though contained adequate amounts of available micronutrients, some deficient samples also recorded. The result indicated that the soil properties p^H , E.C. O.C. and $CaCO_3$ the main characteristics playing major role in controlling the available of micronutrients.

Among the micronutrients the deficiency of Mn and Zn are of major concern and soils require application of Zn fertilizers to maximize the crop yield.

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