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Micro Nutrient Evaluation in Soils of Jhabua District of Madhya Pradesh

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ABSTRACT

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 chemical properties of sampled vertisols and associated soils of Ralyawan village of Jhabua district of western Madhya Pradesh. Results showed that the Soils of Ralyawan village in Jhabua district of Madhya Pradesh were available sulphur varied from 8.77 to 29.7 kg ha^{-1} with a mean value of 18.3 kg ha^{-1}.The 76.36% village soil samples under the study were classified as low fertility class, 23.63% as medium fertility class and available iron varied from 2.36 to 10.9 mg kg^{-1} with a mean value of 5.91 mg kg^{-1}. The status of available manganese and Copper varied from 1.34 to 4.02 mg kg^{-1} and 0.08 to 0.89 mg kg^{-1}with a mean value of 2.7 and 0.37 mg kg^{-1}, respectively. Similarly, the status of available zinc varied from 0.2 to 1.94 mg kg^{-1} with a mean value of 0.645 mgkg^{-1}.

Key word: *Sulphur, iron, manganese, zinc, copper nutrient index, and soil*

INTRODUCTION

Micronutrient deficiency in Indian soils has emerged as one of the major constraints to crop productivity. While zinc, iron, boron and manganese deficient areas are vast, copper deficiency has also been observed in many districts of the country. The problem has been compounded by soil acidity affecting large area in eastern and southern states and soil alkalinity commonly observed in north-western states as crops grown on such soils encounter nutritional disorders and toxicities. Soil fertility is a dynamic natural property and it can change under the influence of natural and human induced factors. Soil fertility is one of the major constraints in achieving high productivity goals. In both rain-fed and irrigated systems, nutrient replenishment through fertilizers and manures remains far below the crop removal, thus causing mining of native reserves over the years. Micronutrients, comprising Sulphur, iron, manganese, zinc and copper though required by plants in much smaller amounts, yet are as essential for them as the major nutrients. Despite that, little attention has been paid to employ the soil testing for assessing the micronutrient status of soils and determining soils requirement for micronutrient fertilizers for growing crops.

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This study presents the soil spatial variability maps for soil micronutrient sulphur, iron, manganese, zinc and copper status of Ralyawan village of Jhabua district of western Madhya Pradesh soils. Respectively Chouhan *et al*[2]., and Singh *et al*[8]., observed a similar trend of nutrient status in study area soils.

METHOD AND MATERIALS

The experiment was conducted during *kharif* seasons of 2014-15 under All India Coordinated Research Project for Dry land Agriculture at College of Agriculture, Indore Madhya Pradesh. Jhabua is situated at an altitude of 428 meters above the mean sea level with latitude of $21^0$30'-$22^0$55'N and longitude of 73^o30'-$75^0$01'E and Ralyawan is located in Jhabua district lying between 21^o30'N latitude and 73^o30'E longitude. Soil samples (0-15 cm) at random were collected during May 2014 in the help of soil augar. Processed soil samples were analysed for nutrient availability by following standard analytical techniques. Total 250 soil samples covering all soil types. These samples were analyzed for micronutrient sulphur, iron, manganese, zinc and copper. Available sulphur was determined by Chesnin and Yien[1]. Available micronutrients Zn, Cu, Fe and Mn were extracted by Lindsay and Norvell[3], 1978 and concentrations were analysed by atomic absorption spectrophotometer. General statistics was calculated by Pearson correlation and one-way analysis of variance using SPSS Software 16.0.

RESULT AND DISCUSSION

Available micronutrients status of soils of Ralyawan village:

Available sulphur status of the soils of Ralyawan village:

The area under medium and low category for sulphur was 175 ha and 17 .81 ha out of 180.57 ha total area of the village, respectively. In general, out of 250 samples, 76.36 % fall under low status and 23 .63% samples were categorized under medium S status. In this way, almost all the soil samples tested were found to be deficient in S. Low and medium level of available sulphur was recorded due to lack of sulphur addition and continuous removal of S by crops. Similar results were also reported by Chouhan *et al*[2]., in the soils of dewas District in Madhya Pradesh and Singh *et al*[8]., in garhwal region of western Himalayas. The available S content (Table 1) of the soils of Ralyawan village ranged from 8.77 to 29.7 kg ha^{-1} with an average value of 18.3 kg ha^{-1}. Considering the soil test rating for available S (< 20 $kgha^{-1}$ as low, 20-40 $kgha^{-1}$ as medium and >40 $kgha^{-1}$ as high in the status of S) the soils of Ralyawan fall under low and medium status in available S content. In general, out of 250 samples, 75.2 % samples fall under low status and 24.8% samples were medium in S status. The general statistics calculated from 250 soil samples revealed that the available – S content ranged from 8.77 to 29.7 kg ha^{-1} with a mean value of 18.3 kg ha^{-1}, standard deviation 3.33kgha-1 and Coefficient of Variation (CV) 18.21%.

Spatial distribution of available–S in the village soils: Spatial variability map of Av-S of the village soils is presented in map 1. To prepare the S variability map soils were divided in to ten categories (Table 2). The spatial variability map of available-S of Ralyawan village (map 1) show that in the whole village the Av-S content varies from < 12 - 28 kg ha^{-1}.

Available Zn status of the soils of Ralyawan village:

In Ralyawan soils the available zinc was to be deficient in the entire study are except in about 51% samples (229 ha) out of 361.26 ha total area of the village was deficient. Since, the soils are alkaline and rich in CaCO3, zinc may be precipitated as hydroxides and carbonates under alkali pH range. Therefore, their solubility and mobility may be decreased. In well drained aerated calcareous soils zinc exists in oxidized state and their availability becomes low. The results are in conformity with the finding of Sharma and Chaudhari[6] in soils of Solan district in North-West Himalayas and also similar findings by Rajeswar *et al*[5]. In soils of Garikapadu of

Krishna district of Andhra Pradesh and similar result were also reported by Singh *et al*[7]., in the soils of Ghazipur district of Uttar Pradesh. The available Zn content (Table 3) of the soils of Ralyawan village ranged from 0.2 – 1.94 mgkg^{-1} with an average value of 0.58 mgkg^{-1}. Considering the soil test rating for available Zn (< 0.6 mgkg^{-1}as deficient, 0.6- 1.2 mgkg^{-1} as sufficient and >1.2 mgkg^{-1} as high in the status of Zn) the soils of Ralyawan fall under deficient, sufficient and high status in available Zn content. In general out of 250 samples, 51.87% samples fall under deficient status, 44.95% samples were sufficient in Zn status and 3.17% samples were high in Zn status. The general statistics calculated from 250 soil samples revealed that the available – Zn content ranged from 0.2-1.94 mgkg^{-1} with a mean value of 0.58 mgkg^{-1}, standard deviation 0.22 mgkg^{-1} and Coefficient of Variation (CV) 37.28%.

Spatial distribution of available–Zn in the village soils: Spatial variability map of Av-Zn of the village soils is presented in map 2. To prepare the Zn variability map soils were divided in to eight categories (Table 4) The spatial variability map of available-Zn of Ralyawan village (map 2) showed that in the whole village the Av-Zn content varies from 0.2-1.94 mgkg^{-1}.

Available Fe status of the soils of Ralyawan village:

Ralyawan villege soils fall under deficient 8.35 % (12.44 ha) out of 168 ha total area of the village and sufficient category 84.72% (1 ha) from the Fe status. In study soils, Majority of the soils were not deficient in Fe as the amount of iron required by crops is being released by iron bearing minerals in these soils. The soil pH had reverse effect on the availability of Fe content in soil. Low Fe content may be due to precipitation of Fe2+ by CaCO3 and decrease the availability. Similar results were also observed by Sharma *et al*[6]., in Rajgarh and Narsinghgarh tehsil of M.P. The available iron in surface soils has no regular pattern of distribution as reported by Nayak *et al*[4]. This type of variation may be due to the soil management practices and cropping pattern adopted by different farmers. The available Fe content (Table 5) of the soils of Ralyawan village ranged from 2.36– 10.94 mgkg^{-1} with an average value of 5.91 mgkg^{-1}. Considering the soil test rating for available Fe (< 4.5 mgkg^{-1}as deficient, 4.5 – 9.0 mgkg^{-1} as sufficient and >9 mgkg^{-1} as high in the status of Fe) the soils of Ralyawan fall under deficient, sufficient and high status in available Fe content. In general, out of 250 samples, 8.35% samples fall under deficient status, 84.72% samples were sufficient in Fe status and 6.91% samples were high in Fe status. The general statistics calculated from 250 soil samples revealed that the available – Fe content ranged from 2.36 – 10.90 mgkg^{-1} with a mean value of 5.91 mgkg^{-1}, standard deviation 1.27 mgkg^{-1} and Coefficient of Variation (CV) 21.46%.

Spatial distribution of available–Fe in the village soils: Spatial variability map of Av-Fe of the village soils is presented in map13 . To prepare the Fe variability map soils were divided in to eightt categories (Table 6). The spatial variability map of available-Fe of Ralyawan village (map3) showed that in the whole village the Av-Fe content varies from 2.5-10 mgkg^{-1}.

Available Cu status of the soils of Ralyawan village:

Major portion of the study area 56% (31.33 ha)out of 180.57 ha total area of the village was under sufficient rating for available copper status and some area was under deficient for available copper (3 ha) Singh *et al*[9]., reported that available copper content in Madhya Pradesh soils ranged from 0.08 to 1.18 ppm. The available Cu content (Table 7) of the soils of Ralyawan village ranged from 0.08-0.89 mgkg^{-1} with an average value of 0.37 mgkg^{-1}. Considering the soil test rating for available Cu (< 0.20 mgkg^{-1}as deficient, 0.20-0.40 mgkg^{-1} as sufficient and >0.40 mgkg^{-1} as high in the status of Cu) the soils of Ralyawan fall under deficient, sufficient and high status in available Cu content. In general out of 250 samples, 1.15% samples fall under deficient status, 56.77% samples were sufficient in Cu status and 42.07% samples were high in Cu

status. The general statistics calculated from 250 soil samples revealed that the available – Cu content ranged from 0.08-0.89 $mgkg^{-1}$ with a mean value of 0.407 $mgkg^{-1}$, standard deviation 0.12$mgkg^{-1}$ and Coefficient of Variation (CV) 31.71%.

Spatial distribution of available–Cu in the village soils: Spatial variability map of Av-Cu of the village soils is presented in map 4. To prepare the Cu variability map soils were divided into eight categories (Table 8). The spatial variability map of available-Cu of Ralyawan village (map 4) showed that in the whole village the Av-Cu content varies from < 0.20 – 0.50 $mgkg^{-1}$.

Available Mn status of the soils of Ralyawan village:

The available Mn content (Table 9) of the soils of Ralyawan village ranged from 1.34-4.02 $mgkg^{-1}$ with an average value of 2.7 $mgkg^{-1}$. Considering the soil test rating for available Mn (< 3.5 $mgkg^{-1}$as deficient, 3.5 – 7.0 $mgkg^{-1}$ as sufficient and >7 $mgkg^{-1}$ as high in the status of Mn) the soils of Ralyawan fall under deficient and sufficient status in available Mn content. In general out of 250 samples, 83.28% samples fall under deficient status and 16.71% samples were sufficient in Mn status. The general statistics calculated from 250 soil samples revealed that the available – Mn content ranged from 1.34-4.02 $mgkg^{-1}$ with a mean value of 2.7 $mgkg^{-1}$, standard deviation 0.43 $mgkg^{-1}$ and Coefficient of Variation (CV) 15.83%. Similar findings were also reported by Singh *et al*., in the soils of District Ghazipur, Uttar Pradesh.

Spatial distribution of available–Mn in the village soils: Spatial variability map of Av-Mn of the village soils is presented in map 5. To prepare the Mn variability map soils were divided in to six categories (Table 10) The spatial variability map of available-Mn of Ralyawan village (map 5) showed that in the whole village the Av-Mn content varies from 1.34-4.02 $mgkg^{-1}$.

Table 1: Distribution of available sulphur status in the soils of Ralyawan village

Available-S (kg ha^{-1})	No. of Samples	% Samples
Low(<20)	188	75.2
Medium (20-40)	62	24.8
High (>40)	NIL	NIL
General statistics:		
Range ($kgha^{-1}$)	8.77-29.7	
Mean ($kgha^{-1}$)	18.3	
Standard deviation ($kgha^{-1}$)	3.33	
Coefficient of variation (%)	18.21	

Table 2: Different S availability classes of the soils of Ralyawan village.

S- availability Class	Available-S , $kgha^{-1}$
I	7.5 to 13
II	>=13 to <16
III	>=16 to <17
IV	>=17 to <18
V	>=18 to <19
VI	>=19 to <20
VII	>=20 to < 21
VIII	>= 21 to >24
IX	>= 24 to >28
X	>= 28 to 30

Table 3: Distribution of available Zinc status in the soils of Ralyawan village

Available-Zn (mg kg^{-1})	No. of Samples	% Samples
Deficient (<0.6)	130	51.87
Sufficient (0.6 – 1.2)	112	44.96
High level (> 1.2)	8	3.17
General statistics:		
Range (mg kg^{-1})	0.2-1.94	
Mean (mg kg^{-1})	0.58	
Standard deviation (mg kg^{-1})	0.22	
Coefficient of variation (%)	37.28	

Table 4: Different Zn availability classes of the soils of Ralyawan village

Zn- availability Class	Available-Zn , $kgha^{-1}$
I	0.2 to 0.34
II	>=0.34 to <0.43
III	>=0.43 to <0.49
IV	>=0.49 to <0.52
V	>=0.52 to <0.58
VI	>=0.58 to <0.67
VII	>=0.67 to < 0.81
VIII	>= 0.81 to 1
Ix	1 to 1.4
X	1.4 to 1.9

Table 5: Distribution of available iron status in the soils of Ralyawan village

Available-Fe (mg kg^{-1})	No. of Samples	% Samples
Deficient <4.5	21	8.35
Sufficient 4.5-9	211	84.72
High level >9	18	6.91
General statistics:		
Range (mg kg^{-1})	2.36-10.9	
Mean (mg kg^{-1})	5.91	
Standard deviation (mg kg^{-1})	1.27	
Coefficient of variation (%)	21.46	

Table 6: Different Fe availability classes of the soils of Ralyawan village

Fe- availability Class	Available-Fe , $kgha^{-1}$
I	2.4- 3.6
II	>3.6 to 4.4
III	>4.4 to < 5.0
IV	>=5.0 to <5.4
V	>=5.4 to <5.7
VI	>=5.7 to <6.1
VII	>=6.1 to <6.6
VIII	>=6.6 – 7.5
IX	>= 7.5 – 8.7
X	>= 8.7 – 10

Table 7: Distribution of available manganese status in the soils of Ralyawan village

Available-Mn (mg kg^{-1})	No. of Samples	% Samples
Deficient <3.5	208	83.28
Sufficient 3.5-7.0	42-	16.71
High level >7.0	-	-
General statistics:		
Range (mg kg^{-1})	1.34-4.02	
Mean (mg kg^{-1})	2.7	
Standard deviation (mg kg^{-1})	0.43	
Coefficient of variation (%)	15.83	

Table 8: Different Mn availability classes of the soils of Ralyawan village

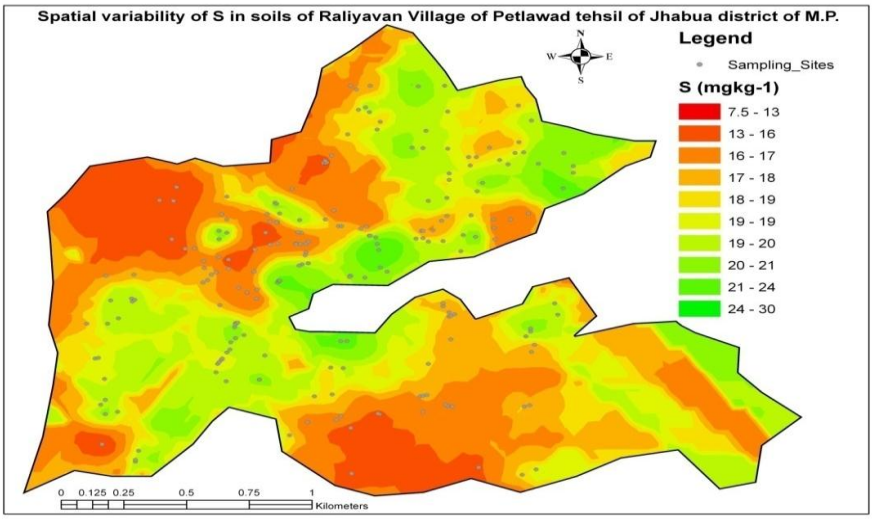
Mn- availability Class	Available-Mn , $kgha^{-1}$
I	1.3 – 1.9
II	>=1.9 to 2.2
III	>=2.2 to <2.5
IV	>=2.5 to <2.6
V	>=2.6 to <2.7
VI	>=2.7 to < 2.8
VII	>=2.8 to 2.9
VIII	>= 2.9 to 3.1
IX	>= 3.1 to 3.5
X	>= 3.5 to 4.0

Table 9: Distribution of available Copper status in the soils of Ralyawan village

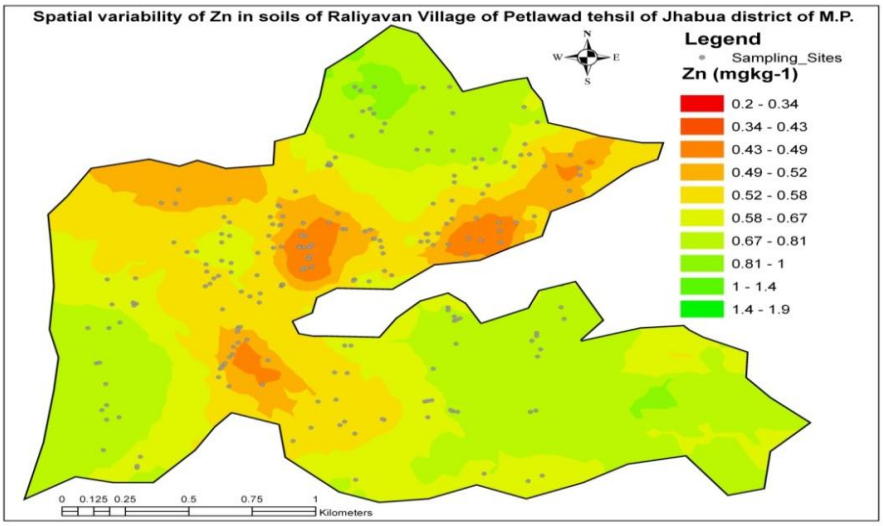
Available-Cu (mg kg^{-1})	No. of Samples	% Samples
Deficient <0.20	3	1.15
Sufficient 0.2- 0.4	142	56.77
High level > 0.40	105	42.07
General statistics:		
Range (mg kg^{-1})	0.08-0.89	
Mean (mg kg^{-1})	0.37	
Standard deviation (mg kg^{-1})	0.12	
Coefficient of variation (%)	31.71	

Table 10: Different copper availability classes of the soils of Ralyawan village

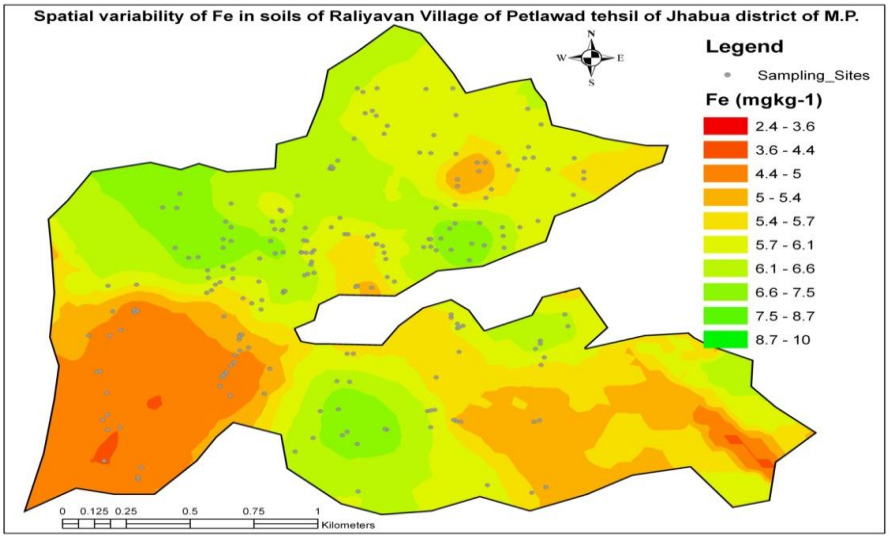
Cu- availability Class	Available-Cu , $kgha^{-1}$
I	0.08 to 0.21
II	>=0.21 to < 0.28
III	>=0.28 to < 0.32
IV	>=0.32 to <0.34
V	>=0.34 to <0.35
VI	>=0.35 to <0.38
VII	>=0.38 to 0.42
VIII	>=0.42 to 0.49
IX	>= 0.49 to 0.61
X	>=0.61 to 0.84



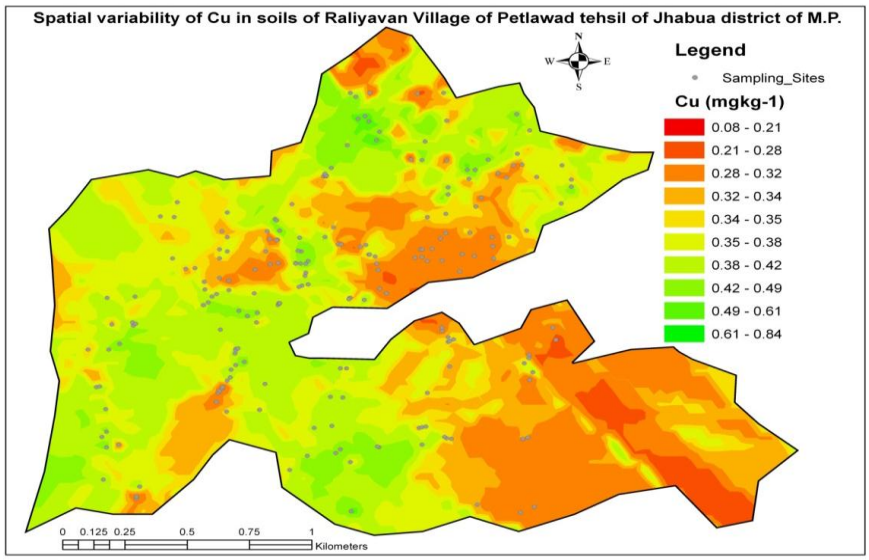
Map 1: Spatial distribution of Av.-S in village Ralyawan



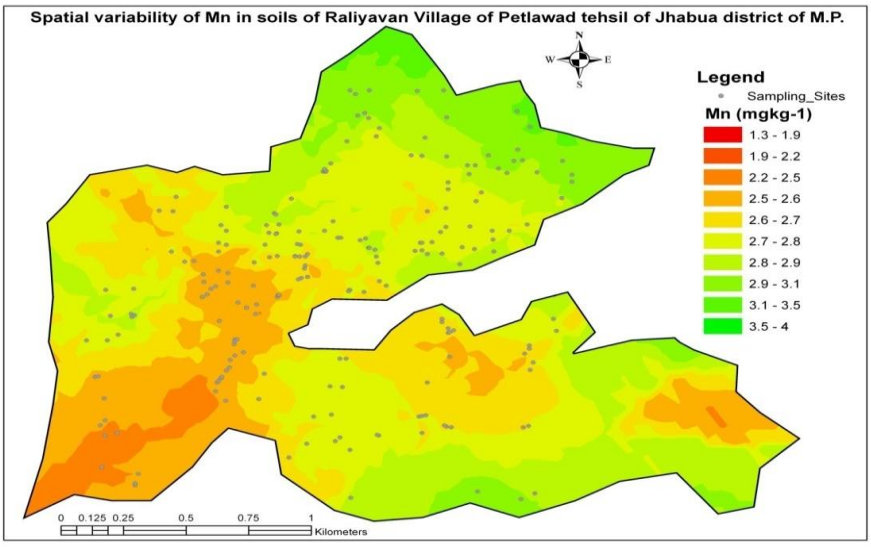
Map 2: Spatial distribution of Av.-Zn in village Ralyawan



Map 3: Spatial distribution of Av.-Fe in village Ralyawan



Map 4: Spatial distribution of Av.-Cu in village Ralyawan



Map 5: Spatial distribution of Av.-Mn in village Ralyawan

CONCLUSION

The Soils of Ralyawan village in Jhabua district of Madhya Pradesh were the status of available sulphur varied from 8.77 to 29.7 kg ha^{-1} with a mean value of 18.3 kg ha^{-1}.The 76.36% village soil samples under the study were classified as low fertility class, 23.63% as medium fertility class. The status of available iron varied from 2.36 to 10.9 mg kg^{-1} with a mean value of 5.91 mg kg^{-1}. The status of available manganese and Copper varied from 1.34 to 4.02 mg kg^{-1} and 0.08 to 0.89 mg $kg^{-1}$with a mean value of 2.7 and 0.37 mg kg^{-1}, respectively. Similarly, the status of available zinc varied from 0.2 to 1.94 mg kg^{-1} with a mean value of 0.645 $mgkg^{-1}$.

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