



## Status of Zinc Availability in Jhum Fields under Rainfed Condition in Zunheboto District of Nagaland

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### *Author's contribution*

*The sole author designed, analysed, interpreted and prepared the manuscript.*

### *Article Information*

DOI: 10.9734/IJPSS/2020/v32i2030399

#### Editor(s):

(1) Dr. Hon H. Ho, State University of New York, USA.

#### Reviewers:

(1) Sajad Hussain, Sichuan Agricultural University, China.

(2) Moraru Paula Ioana, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/65403>

**Short Communication**

**Received 25 October 2020**  
**Accepted 30 December 2020**  
**Published 31 December 2020**

### **ABSTRACT**

The Zinc deficiency in the soil is spreading worldwide. It can lead to decrease in soil fertility, crop yield and productivity. It is an essential micronutrient required for plants and an important dietary nutrient for the wellbeing of human beings and animals. In Nagaland, its deficiency is slowly increasing and several factors such as shifting cultivation which is also known as slash and burn, forest fire, leaching and runoff and nutrient exhaustion in the soil by the crop may be attributing to its deficiency in the soil. As Zinc deficiency is rapidly increasing all over, a soil survey on zinc availability was conducted in 83 jhum fields under rainfed condition covering 7 villages of Zunheboto district of Nagaland during 2016-17. The soil samples were collected from the field using GPS and were analysed using standard procedure. It was observed that the Zinc deficiency ranged from 0.26 to 0.55 mg kg<sup>-1</sup> which indicated that its deficiency is found widespread in this part of the region. Zinc being an important micronutrient for growth and yield of crops, timely nutrient management through balanced fertilization will enhance soil fertility and crop productivity.

*Keywords: Jhum field; Nagaland; soil fertility; zinc.*

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## 1. INTRODUCTION

Zinc is an important micronutrient for plant growth and nutrition. Its deficiency is about 36.5% in Indian soil. This micronutrient is required in small amounts but in inadequate conditions, it will cause physiological stress in plants [1]. The available Zinc is also low in about 30% of the cultivated soils in the world (FAO) and its deficiency is found all over the world. It is considered the fourth most yield limiting nutrient for crops in India. Zinc deficiency is likely to increase from 49 to 63% in Indian soils by 2025 [2].

It plays an important role for various enzymatic actions required for protein synthesis, nitrogen metabolism and energy transfer in animals as well as human beings too. There are about 3 billion people around the world suffering from zinc deficiency [3, 4]. This condition is prevalent in areas where people are constantly depending on a particular cereal diet. The recommended daily intake of 15 mg Zinc per day is required for overall growth and immune systems in humans. Deficiency of zinc leads to memory loss, hair and skin problems, weakness in body muscles, infertility, stunted brain development of the fetus and congenital diseases.

In plants with zinc deficiency, protein, carbohydrate and chlorophyll formation is significantly reduced. Zinc deficiency in plants causes stunted growth, chlorosis, spikelet sterility, water uptake and transport in plants [5]. It plays a key role in the production of growth hormone auxin [6].

The micronutrient deficiencies are prevalent in the Northeast region of India and it varies from one location to another due to varying climatic conditions, topography and soils [7,8,9]. It is also relevant that the crop production in this region is lacking behind with the rest of the other region which may be due to micronutrient deficiency and acidity in soil. Wang et al., 2015 [10,11] also reported that soil pH and nutrient leaching are major limiting factors that affect yield. The yield decline in an intensified cropping system is mainly due to micronutrient deficiencies [12]. The Zinc deficiency problem has been rapidly increasing due to lack of knowledge on Zinc responsiveness and use of highly zinc susceptible crop variety.

The deficiency of Zinc in Nagaland is also increased by 4.62 % [13]. There are several factors causing zinc deficiency in these areas

such as shifting cultivation, excessive leaching [14], run off and forest fire that leads to decline in fertility of topsoil (FAO) which may contribute to the zinc deficiency in this region. The continuous removal of the nutrient by the crop without replenishing it also leads to zinc deficiency. However, there is limited information on micronutrients and its availability in this part of the region [15]. Therefore further research is needed to understand the cause of its deficiency.

Keeping the limitation of Zinc availability in mind, this soil survey was conducted in 83 jhum fields covering 7 villages under zunheboto district of Nagaland.

## 2. MATERIALS AND METHODS

The climatic condition of the soil surveyed areas varies from subtropical to temperate climate with temperature falling between 8 – 32 °C and annual mean rainfall of 200 mm [16]. The soil order falls under inceptisols and ultisols. The soil type ranges from sandy loam to clay loam (Table. 1). The acidity of soil ranged from strongly acidic to slightly acidic with low to medium organic carbon, low available phosphorus, medium in available nitrogen and potassium. Altogether 83 soil samples were analysed using GPS. The soil samples were collected from a 15cm depth during the year 2016-17. The soils were turned into powder form and then sieved. The soil pH was measured using the procedure given by Jackson [17]. Soil organic carbon (OC) was estimated using potassium dichromate and sulphuric acid [17]. Soil texture was estimated using a hydrometer method. Available nitrogen (N) was measured using KMnO<sub>4</sub> by distillation method [18]. Available phosphorus (P) was extracted by Bray and Kurtz No.1 extractant which was determined spectrophotometrically [17].

Available potassium (K) was extracted by neutral normal ammonium acetate using flame photometer. The available Zinc in the soil was determined with 0.005 M DTPA extractant using the atomic absorption spectrophotometer given by Lindsay and Norvell [19].

## 3. RESULTS AND DISCUSSION

Zinc deficiency was found in all the 7 villages. Its deficiency ranges from 0.26 to 0.55 mg kg<sup>-1</sup> in the jhum fields (Table 2). The highest Zinc deficiency was seen in Aotsakili followed by

**Table 1. Characteristics of soil and climate of the survey sites**

<b>Village</b>	<b>No. of field samples</b>	<b>Location</b>	<b>Soil order</b>	<b>Mean annual rainfall (cm)</b>	<b>Temperature</b>	<b>Soil texture</b>
Sumi Settsu	13	26°15'44"N 94°28'88"E 26°15'42"N 94°28'85"E 26°15'54"N 94°28'75"E 26°15'44"N 94°28'67"E	Inceptisol	200	8-32	Sandy loam
Zaphumi	10	26°13'54"N 94°27'55"E 26°13'57"N 94°28'03"E 26°13'53"N 94°27'35"E 26°13'50"N 94°27'09"E	Inceptisol	200	8-32	Sandy loam
Lumami	10	26°13'54"N 94°27'55"E 26°13'57"N 94°28'03"E 26°13'53"N 94°27'35"E 26°13'50"N 94°27'09"E	Inceptisol	200	8-32	Sandy loam
Alaphumi	14	26°11'795"N 94°27'80"E 26°11'71"N 94°27'89"E 26°11'92"N 94°27'79"E 26°11'85"N 94°27'71"E	Inceptisol	200	8-32	Sandy loam

<b>Village</b>	<b>No. of field samples</b>	<b>Location</b>	<b>Soil order</b>	<b>Mean annual rainfall (cm)</b>	<b>Temperature</b>	<b>Soil texture</b>
Aotsakili	16	26°05'37"N 94°30'55"E 26°05'23"N 94°31'09"E 26°05'46"N 94°31'27"E 26°05'54"N 94°31'08"E	Ultisol	200	8- 32	Clay loam
Lumithsami	9	26°11'39"N 94°29'52"E 26°11'23"N 94°30'06"E 26°11'38"N 94°30'22"E 26°11'56"N 94°30'21"E	Inceptisol	200	8-32	Sandy loam
Litta New	11	26°15'53"N 94°37'98"E 26°15'36"N 94°37'87"E 26°15'23"N 94°38'05"E 26°15'26"N 94°38'20"E	Inceptisol	200	8- 32	Sandy loam

**Table 2. Status of zinc availability in different Jhum fields under Zunheboto district**

Location	Soil pH	Organic carbon	Zn (mg kg <sup>-1</sup> )
Sumi Settsu	6.0	1.26	0.45
Zaphumi	6.0	0.69	0.52
Lumami	5.7	0.97	0.30
Alaphumi	6.0	1.39	0.55
Aotsakili	5.5	0.63	0.26
Lumithsami	5.9	0.94	0.29
Litta New	5.7	0.93	0.32
Mean	5.8	0.97	0.38
Range	0.5	0.76	0.29
S.D±	0.2	0.28	0.10

Lumithsami village. Even though the rate of deficiency of Zinc differs from one location to another, however from the soil samples that were analysed, it showed that Zinc deficiency is spread over a large part of this location. Several factors may be responsible for causing Zinc deficiency such as traditional practice of shifting cultivation has lead to gradual decrease in the soil bases and further decline in soil fertility. The heavy rainfall in this region is also another factor that leads to loss of nutrients due to leaching and runoff causing micronutrient deficiency. The total Zinc status is low in sandy, highly leached and weathered acidic soil [1]. These may be the reason for Zinc deficiency in the surveyed area as the soil is acidic in reaction with soil pH ranging from 5.5 to 6.0. The soil available Zinc varies from 0.26 to 0.55 mg kg<sup>-1</sup> with an average content of 0.38±0.10 mg kg<sup>-1</sup>. These may be due to leaching out of the water soluble Zinc from the acidic upland soils. Similar finding was reported by Kumar et al. [20] due to heavy precipitation in the acidic uplands. The lowest soil available Zinc of 0.26 mg kg<sup>-1</sup> was found at OC 0.63%. Zinc deficiency is also observed in areas with low organic carbon content as the Zinc availability may also be decreased due to low soil organic carbon content in the rainfed region [21, 22].

Continuous cropping with Zinc requiring crop also leads to depletion of soil available Zinc, if the nutrient source is not applied in the soil. In India, the loss of yield due to lack of Zinc fertilizer application is about 10% as reported by Shukla ET [23]. It is a major productivity constraint faced in the rainfed farming areas [24,25].

#### 4. CONCLUSION

From the survey conducted, it was observed that Zinc deficiency in soil increases with low pH and

organic carbon. Its deficiency is widely found all over in all types of soils. Zinc deficiency is expected to increase 63% by 2025 [26]. It is an essential micronutrient for a multiple range of crops. Therefore correcting this nutrient deficiency will be an important measure to enhance the soil health and crop productivity in the jhum upland fields of the Zunheboto district of Nagaland.

#### COMPETING INTERESTS

Author has declared that no competing interests exist.

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