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The co-relationship between iron and zinc and their importance as micronutrients in the agricultural land of Baliapur region, Dhanbad, Jharkhand

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Abstract

Through the quality of agricultural land is judge by macronutrient availability, micronutrient play and important role too. The primary focus of this research work is on iron and zinc, two very crucial micronutrients. Their deficiency in the soil leads to their lack in crops like wheat is falling because of insufficient presence of Zn and Fe in the agricultural soil. Nearly all living things require iron for survival metabolic activities, including respiration, photosynthesis and DNA synthesis. It also supports the physiological characteristics of plants. In crops like wheat, lower zinc content in soil yields less grain and lower quality nutrients. Since deficient Zn causes in plants, symptoms initially show up on immature leaves. Wheat with minor deficiencies is characterised by light green to white chlorotic and necrotic streaks that appear on each side of the leaf midrib. the corelation between Zn and Fe is negative. The goal of this study work is to emphasize the significance of this parameter in crop production, which might benefit the general public on both a social and economic level.

Keywords: Micronutrient, iron, zinc and corelationship

Introduction

The easiest way to determine the quality of soil is to look at its nutrients. Soil is infertile without them because it contains two different types of nutrients: macronutrients (such as nitrogen, phosphorous, sulphur, and potassium) and micronutrients (such as iron, zinc, boron, copper, etc.). This study primarily looks at two micronutrients, such zinc and iron. The development, yields, and growth of crops are all influenced by these two factors. Organic matter in soil is increased by zinc stain, possibly as a result of organic acids. Lateritic and red soils have low zinc contents. Clay and zinc are positively correlated. (C P Nisab. *et al*. 2019) [9]. The fourth most significant component is zinc deficiency, which results in micronutrient deficiencies that exacerbate malnutrition in rural areas. Zinc solubility in soil is influenced by the iron, aluminium, manganese, and other element oxide matrix, among other elements (W Zhang., *et al*., 2021) [2] (Ganeshamurthy., *et al*., 2019) [7] Zn affects human nutrition as well as the development and function of plants, as plants make up a large portion of diets. Growing knowledge about the effects of zinc on living things has led to the development of zinc-efficient crop types that can withstand low zinc stress in soil. A thorough grasp of the cellular processes, genes, and plant Zn efficiency techniques can open doors for enhancing agricultural sustainability, enhancing human nutrition, and lowering the need for synthetic fertilisers. Zn effectiveness might therefore improve agricultural yield and nutritional quality for the 21st-century population that is expected to grow. (Gokhan Hacisalihoglu 2020) [6]. Zinc uptake in plant will increase with increase pH value more than 7 but in soil it will decrease while increase pH. (Loneragan, J. F., *et al*. 1993) [15].

Advantage and Disadvantage of Zinc

Advantage

- Boosting the synthesis of cytochrome p450, controlling auxin hormone, repairing photosystem II, and stabilising CO_2 throughout the mesophyll biosynthesis process. (Hamzah Saleem, *et al*. 2022) [1].

- Essential elements of an enzyme's membrane stability that protect it against abiotic stress. (Hamzah Saleem, *et al*. 2022) [1].

Disadvantage
Reduced photosynthetic rate, nutrients imbalance, and membrane deterioration were caused by necrosis and curled leaf excursions. (Hamzah Saleem, *et al*. 2022) [1].

Deficiency of Zinc
Reduced nutrition intake, yellowing of the leaves, stunted development, and altered protein metabolism. Zn levels drop as a result of symptoms such interveinal yellowing, stunting, and leaf deformation brought on by a rise in pH. (Hamzah Saleem, *et al*. 2022) [1].

Iron is the second most common metal in earth crust. Ferric oxide (Fe_2O_3), often known as hematite, is the most prevalent form of iron in soils. It is incredibly insoluble and gives the soil a red tint. Typically, the oxide form is hydrated. The concentration of Fe in solution and its availability to plants are regulated by the phosphate, hydroxide, and oxide forms in aerobic soils (Pandorf, M., *et al*., 2018) [11]. Nearly every type of soil contains an abundance of iron, which plants may absorb in a variety of way $Fe3^+$ is reduced to $Fe2^+$ in strategy-I to make it accessible for plants. Meanwhile, chelation of iron is the basis of strategy-II for their absorption. Paddy, rice and other crops have embraced a multifaceted approached that includes distinct phases for both strategies I and II. Numerous studies have previously been conducted to comprehend the molecular foundation regarding the procurement, transportation, and storage of iron in Arabidopsis thaliana, but there are still a lot of unanswered questions regarding strategy-II to the degree that this information may be applied to other species. (Akbar, F., *et al*. 2020) [5]. It is challenging for Fe-ions to translocate into plant roots because ionic forms of iron are highly reactive and poorly soluble. Regarding the iron transport in plant is accomplished by forming associations with mugineic acid (MA), nicotinamine (NA), citrate, and phenolic compounds in order to prevent precipitation and toxicity (Kobayashi, T., & Nishizawa, N. K. 2012.) [13]. Given the severity of Fe-toxicity issues in tropical rice-based systems and the dearth of broadly accepted solutions, it is imperative that crop adaptation mechanisms be aligned with site-specific factors related to Fe toxicity. In cases where adaptation is not sufficient, site-specific appropriate agronomic management practises should be specifically targeted. It is also necessary to comprehend the genetic diversity and how adaptation mechanisms work in order to successfully target crops to precisely specified settings (the degree, timing, and duration of Fe-toxic stress). After that, the mechanisms and processes will be looked at, tracking the flow of Fe_2^+ from the rhizosphere to the leaf cells Mathias Beckar *et al*. 2005).

Study Area
The Dhanbad district's soil is primarily composed of leftover rock. The majority of lateritic soil types are created by lower godwana rock and the Archean metamorphic complex as a result of high temperatures and significant rains (DEIAA, Dhanbad). Just Five samples were gathered from the Baliapur agricultural Dhanbad District's different locations. The purpose of the sample collection is to analyse the relationship between Zinc and Iron.

Sampling process
Based on observation, the land was divided into many homogeneous portions from which soil samples were taken. Clear the upper part of every sampling area of any trash. Utilising the auger set to plough mode, extract a sample at a depth of 15 cm in a V-shaped pattern from the middle of the sampling plots and every half-inch from each of the four conners. At one sampling location, we collect five samples from the plot, split it into four parts, and take one quarter of the samples for analysis to determine the state of the soil quality (Nivedha., *et al*. 2019) [10]. We then thoroughly mix the samples to make a circle.

Methodology
Analysis of sample was Completed by Mida Parikshak.

Result
The Zinc value of a particular sample ranges from log 0.7708 to 0.8524. The Iron value in log between 0.4698 to 0.4983. The data indicate significant negative relationship between then. The value of zinc in analysed sample are rich whereas concentration of iron are low. (Srivastava, A. K., *et al*. 2019) [8].

Table 1: Iron value in log and derived value of Zinc given below:

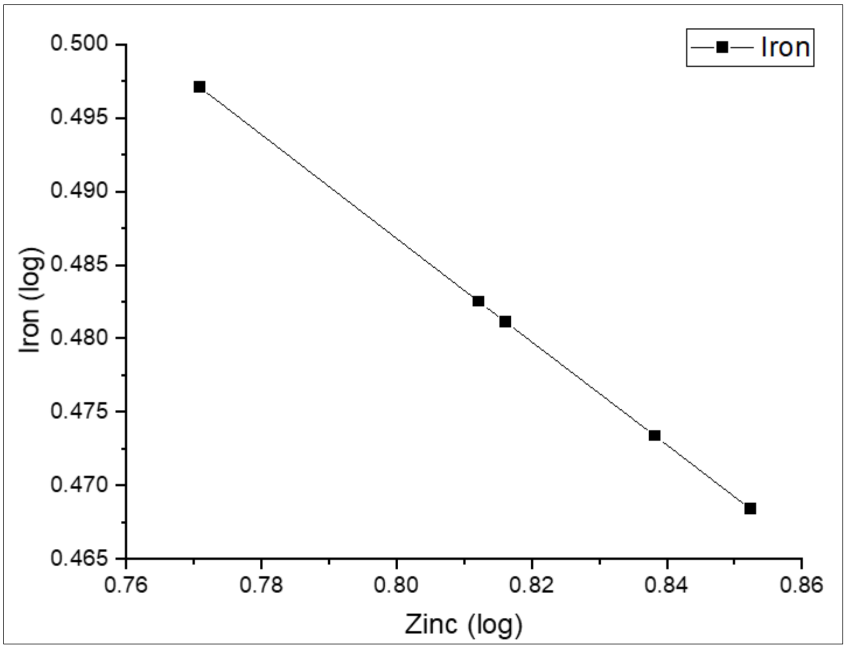
S. No	Zinc (x)	Iron (Y)
1.	0.8524	0.4684
2.	0.8382	0.4734
3.	0.8162	0.4811
4.	0.8122	0.4858
5.	0.7708	0.4971

Table 2: Range of Nutrient (Srivastava, A. K., *et al*. 2019) [8]

Nutrient (unit)	Low	Medium	High
Zinc (mg kg^{-1})	(<0.5-1)	(1.0-2.5)	(>2.5)
Iron (mg Kg^{-1})	25-50	50-100	>100

Iron= -0.3525 log Zinc +0.7689 (r=-0.75) ----- eq. (1)

The regression equation of Zn and Iron shows that there is significant negative relationship between them in the analysed soil sample.



Graph 1: Show relationship between Zinc (y axis) and Iron (x axis)

Discussion

The Zinc value of a particular sample ranges from log 0.7708 to 0.8524. The Iron value in log between 0.4698 to 0.4983. Antagonism between two nutrients occurs when the response to one nutrient declines as the level of the other nutrient increases. This type of interaction is known as negative interaction. (V.D Fageria 2006) [14] (Rene P. J. *et al*. 2017) [12] The high iron solubility in rice paddy soils, which is maintained by the synthesis of $Fe_3(OH)_8$, decreased the zinc solubility through the creation of $ZnFe_2O_4$. (K.S Sajwan *et al*. 1986) [16] (R Prasad *et al*. 2016) (P Bridgemohoan *et al*. 2020) [4], Zinc reacts adversely with phosphorus, calcium, iron, and copper, reducing the amount of zinc that the root can absorb.

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