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Effect of zinc on growth and yield of wheat: A review

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Abstract
Zinc is plant micronutrient which is involved in many physiological functions its inadequate supply will reduce crop yields. Zinc deficiency is the most wide spread micronutrient deficiency problem, almost all crops and calcareous, sandy soils, peat soils and soils with high phosphorus and silicon are expected to be deficient. Zinc deficiencies can affect plant by stunting its growth, decreasing number of tillers, chlorosis and smaller leaves, increasing crop maturity period, spikelet sterility and inferior quality of harvested products. Beside its role in crop production Zinc plays a part in the basic roles of cellular functions in all living organisms. Wheat is the main source of food materials for human. The soil and wheat analysed by atomic absorption spectroscopy (AAS) technique.

Keywords: zinc, Hoshangabad, yield, wheat, growth, deficiency

1. Introduction
India is second largest population of developing country so raising more increasing problem for food scarcity. Continually crop land decreased by house holds infrastructures. Zinc is essential for the growth in animals, human beings and plants it is vital to the crop nutrition as required in various enzymatic reactions, metabolic processes and oxidation reduction reactions. In addition, Zinc is also essential for many enzymes which are needed for nitrogen metabolism, energy transfer and protein synthesis. Zinc deficiency not only retards growth and yield of plants, but it also has effects on human beings.

Material and Methods
The sample was collected according to standard method of collective sample at international level. Prior to this a through Survey has conducted to know about probable nutrient source and other relevant features. The sampling preservation of samples, pre-treatment of sample and all the methods to be undertaken for analysis shall be as recommended by APHA, BIS, AWA and environmental protection agency. The experimental site is located at Government Narmada Maha vidhyalaya, Hoshangabad district of Madhya Pradesh. This district bounded by Satpura ranges in south and Narmada River in the north. The area slopes North West toward. The land surface attain a maximum altitude of 1352 meter above mean sea level at Dhupgarh 77°22’30”:22° 27’ 00” altitude near Pachmarhi and minimum altitude of 270 meter mean sea level at confluence of Ganjal river with the Narmada 77°12’30”:22°33’30”. The soil and wheat sample collected by different area of district and analyzed by atomic absorption spectroscopy (AAS) technique.

Observation

Table 1

Protocol			
Element:	Zn	EHT:	540 V
Wavelength:	213.5 nm	Int. Time:	01.00 Sec
Slit:	1.1 nm	BGC:	OFF
Current:	04.4 mA	Burner:	Air-Acetylene
Flame:	Stoichiometric	Date:	9/April, 2019

Concentration Standard Calibration

Table 2: Number of Standard-4

Standard Number	Concentration (ppm)	Absorbance (Abs)
1	0.2	0.0941
2	0.4	0.1707
3	0.6	0.2426
4	0.8	0.3155

Samples

Table 3: Number of samples: 15

Sample	Absorbance (Abs)	Concentration (ppm)	Dilution factor	Con'percent (%)
Sample 1	0.1064	0.25	1	0.0000
Sample 2	0.0962	0.22	1	0.0000
Sample 3	0.1007	0.24	1	0.0000
Sample 4	0.1064	0.25	1	0.0000
Sample 5	0.0995	0.23	1	0.0000
Sample 6	0.0840	0.19	1	0.0000
Sample 7	0.1463	0.35	1	0.0000
Sample 8	0.1223	0.29	1	0.0000
Sample 9	0.0908	0.21	1	0.0000
Sample 10	0.1239	0.30	1	0.0000
Sample 11	0.0548	0.12	1	0.0000
Sample 12	0.1524	0.37	1	0.0000
Sample 13	0.1099	0.26	1	0.0000
Sample 14	0.1400	0.34	1	0.0000
Sample 15	0.1296	0.31	1	0.0000
Average value	0.11088	0.262	1	0.0000

The present study of Effect of Zinc on Growth and yield of Wheat of Hoshangabad district of Madhya Pradesh was found average Zinc absorbance 0.11088, concentration 0.262 ppm and dilution factor one

Role of Zinc in Plants

The Zinc plays very important role in plant metabolism by influencing the activities of hydrogenase and carbonic anhydrase, stabilization of ribosomal fractions and synthesis of cytochrome (Tisdale, Nelson and Beaten, 1984). Areas between nervure in plants are yellow by zinc deficient (Vitosh *et al.*, 1994). Plant enzymes activated by Zinc are involved in carbohydrate metabolism, maintenance of the integrity of cellular membranes, protein synthesis regulation of auxin synthesis and pollen formation (Marschner, 1995) [39]. The regulation and maintenance of the gene expression required for the tolerance of environmental stresses in plants are Zinc dependent (Cakmak, 2000) [70].

The main functions of this enzyme are: dehydration of carbon dioxide, increasing absorption of carbon dioxide per leaf area unit, increasing in photosynthesis and biomass production. In the plants that are confronted with zinc deficiency activity of this enzyme is stopped (Ohki, 1976 [47]; Dell and Wilson, 1985 [18]; Marschner, 1995) [39]. Superoxide dismutase zinc copper: In this enzymes zinc is connected to copper, it seems that zinc has catalytic and copper has building role. Superoxide dismutase activity decreased in zinc deficiency conditions and is associated with increased free radicals oxygen (super oxide), that it's a toxic substance and have a harmful affect on plants tissues due to lipids peroxidation of membrane and increasing its permeability (Marschner, 1995) [39]. According to the plant professional's research, zinc exerts a great influence on basic plant life processes, such as: nitrogen metabolism and uptake of nitrogen and protein quality; photosynthesis and chlorophyll synthesis, carbon anhydrase activity; resistance to abiotic and biotic stresses and protection against oxidative damage (Potarzycki and Grzebisz, 2009 [54]; Cakmak, 2008 [15]; Alloway, 2008 [6]; Mousavi, 2011) [25]. The effect of zinc fertilization were conducted on growth and yield of many plants such as alfalfa, wheat, maize, barley, cotton and potato were investigated in numerous researches and observed increasing in yield with zinc application (Bukvić1 *et al*., 2003; Kinaci and Kinaci, 2005 [36]; Shaheen *et al*., 2007 [61]; Mousavi *et al*., 2007 [43]; Galavi *et al*., 2011 [25]; Xi-Wen *et al.*, 2011 [75]; Efe and Yarpuz, 2011) [20]. Hexaploid or bread wheat (*Triticum aestivum* L.) and tetraploid or durum wheat (*Triticum durum* L.) are the wheat genotypes that are currently grown on large scale to feed millions of people around the world (FAO Database, 2005; Seleiman *et al.*, 2010) [60].

Many zinc deficiency problems around the world are associated with sandy soils and calcium carbonate-rich soils. Deficiencies of zinc occur in many parts of the world on a wide range of soil types but semi-arid areas with calcareous soils, tropical regions with highly weathered soils and sandy-textured soils in several different climatic zones tend to be the most seriously affected (Alloway, 2008 [6]; Akay, 2011) [2]. Zinc deficiency can be seen in eroded, calcareous and weathering acidic soils. Zinc deficiency is often accompanied with iron deficiency in calcareous soils. Zinc deficiency in these soils is related to adsorption of solution zinc in the soil by clay and limestone particles. In eroded soils, zinc deficiency is caused by organic matter deficiency. Also zinc deficiency may be related to weather conditions, zinc deficiency increases in cold and wet weather conditions. It may be due to the limited root growth in cool soils, or reduction activity of microorganisms and reduction the release of zinc from organic materials (Alam *et al*., 2010 [3]; Abdou *et al*., 2011 [1], Mousavi, 2011) [25]. High concentrations of bicarbonate (HCO_3) prevent of zinc uptake by plants shoot (Gokhan, 2002) [26]. In dicot plants internode distance and leaf size will be short and in monocot plants, corn especially, bands comes into the main nervure on both sides of leaves in zinc deficient condition Overall, shoot is more affected than the root growing by zinc deficiency (Boardman and McGuire, 1990 [11]; Gokhan, 2002 [26], Mousavi, 2011) [25]. Prevention of deficiencies is the best way to deal with micronutrients deficiencies, choose of resistant plant varieties and cultivars and appropriate management practices can be used to prevent of manganese deficiency occurrence. Soil analysis can be used to diagnose problems in existing crops but is more valuable for enabling deficiencies to be predicted and remedial action taken to avoid reduced yields in subsequent crops (Alloway, 2002 [5]; Mousavi *et al*., 2011) [25]. Zinc deficiency related to

soils pH and its value is very low in calcareous soils with high pH (Alloway, 2008 [6]; Alam *et al.*, 2010) [3].

Zinc is one of the most important elements in the carbohydrates metabolism; most enzymes that play a role in carbohydrates metabolism are activated by zinc (Mousavi, Galavi and Rezaei, 2013). In addition Carbonic anhydrase, Fructose-1, 6 bisphosphate and Aldolase enzymes are activated by zinc. These enzymes are active in the chloroplasts and cytoplasm, six-carbon sugar molecule are separated between chloroplasts and cytoplasm by Fructose 1, 6-bisphosphate and three-carbon sugars molecule in photosynthesis are transported from cytoplasm to chloroplasts by Aldolase. The activity of these enzymes decreased in zinc deficiency condition, in resulting carbohydrate accumulated in plants leaves (Marschner and Cakmak, 1989 [38], Mousavi, 2011 [25]; Taheri *et al*., 2011) [67]. Zinc is essential micronutrients for proteins production in plants; also zinc is main composition of ribosome and is essential for their development. Amino acids accumulated in plant tissues and protein synthesis decline by zinc deficit. One of the sites of protein synthesis is pollen tube that amount of zinc in there tip is 150 micrograms per gram of dry matter. In addition zinc will contribute on the pollination by impact on pollen tube formation (Marschner, 1995 [39]; Outten and O'Halloran, 2001 [48]; Pandey *et al*., 2006) [50]. Metabolism of plant hormones such as auxin (IAA) and tryptophan decreases in zinc deficiency condition, as a result leaf growth stops. In fact, zinc is essential for tryptophan synthesis, which is a prerequisite for auxin formation, therefore amount of auxin decreases by zinc deficiency (Marschner, 1995 [39]; Pedler *et al.*, 2000) [51]. In some conditions that plant are in zinc deficient, tryptophan may increased in the leaves as a result in impaired of protein synthesis. Zinc is necessary element for maintain living membranes. Zinc may be connected to membrane phospholipids or constituent groups of sulfhydryl or make up tetragonal compounds with residues of Cysteine polypeptide chains and thus, proteins and lipids were protect against oxidation damage (Salami and Kene, 1970 [59]; Domingo *et al*., 1992 [19]; Marschner, 1995) [39]. Zinc is main building part of some enzymes and is needed for the plant enzymes formation; in addition, many enzymatic reactions active by zinc (Vitosh *et al*., 1994; Pedler *et al.*, 2000 [51]; Akay, 2011) [2]. Zinc plays an important role in most of the enzymes that they can point to the following: Alcohol dehydrogenase: this enzyme molecule has two atoms of zinc. One of the atoms has a catalytic and other has a building role. Alcohol dehydrogenase enzyme has a catalytic role in regeneration of acetaldehyde to ethanol. In higher plants, ethanol is making in the root tip meristematic tissue under aerobic conditions, alcohol dehydrogenase enzyme declined by zinc deficiency in plants, as a result root development reduced (Marschner, 1995 [39]; Gokhan *et al*., 2003) [27].

Conclusion

Zinc is one of the eight trace elements which are essential for the normal healthy growth and reproduction of crop plants. When the supply of plant available zinc is inadequate, crop yields are reduced and the quality of crop products is frequently impaired. Zinc deficiency is the most wide spread micronutrient deficiency problem, almost all crops and calcareous, sandy soils, peat soils and soils with high phosphorus and silicon are expected to be deficient. Zinc deficiencies can affect plant by stunting its growth, decreasing number of tillers, chlorosis and smaller leaves, increasing crop maturity period, spikelet sterility and inferior quality of harvested products. Beside its role in crop production Zinc plays a part in the basic roles of cellular functions in all living organisms.

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