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ASSESSMENT OF THE MACR-MICRONUTRIENTS AND TRACE METAL ELEMENTS IN PLANT LEAVES AROUND JEBEL MUN WESTERN SUDAN

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ABSTRACT

The plants need many different metal elements a classified macro, micronutrient, and trace elements for growth development, and reproduction, which have mobilized from the soil and absorbed by the roots as metal ions. The study focused on four plants including (Allium Cepavar, Cajanus Cajan, Cirullus Lanatus, and Tomato Leaves) from farms around jebel Mun areas. Using Inductively Coupled Plasma Emission spectroscopy. The concentrations of macronutrients were (0.02 - 1.60, 1.80- 11.0, 0.01 – 0.12, 0.05 -0.34, and 0.17 - 1.50 ppm) for Mg, P, S, K, and Ca respectively. Whereas micronutrient concentrations reveals (0.02- 0.12, 0.05- 4.60 0.00 - 0.02, 0.00 - 0.09, and 0.01- 0.017 ppm) for Mn, Fe, Ni, Cu, and Zn respectively. While beneficial elements of B and Si were recorded (0.01-0.14, 0.01 -0.05 ppm).

KEYWARDS: Macronutrient and micronutrients metals element in Plant Leave around Jebel Mun.

INTRODUCTION

macr-micronutrient and mojar metals elements a play a significant processes the chemical biological metabolism of plants such as protein, DNA, RNA, enzyme cofactors associated with metabolites transport reactions in the living cells moreover photosynthetic components (Olowoyo et al., 2012; Pogrzeba et al., 2018). Arnon and Stout in 1939 are identifie, three criteria to consider an element as essential: firsts a plant cannot complete its life cycle in the absence of the mineral element. Secondly, a task of the element is not replaceable by another mineral element. Thirdly the element is directly involved in plant metabolism (Kaur et al., 2015). Measurement of the metals elemental composition is necessary tool for the detection of nutritional disorders. Probability for imbalances arise, changes in the elemental composition may constitute a remarkable physiological indicator of plants response to environmental parameters however interpretation of results based on concentrations of essential elements. A number of researchers studying the relationship between maximum yield and concentrations of essential elements. whereas respect to human nutrition, the content of essential trace elements, such as Fe and Zn, in vegetable food products is indicated that large resources are devoted to the improvement of the content and bio-availability of significant micro-nutrients (Hansen et al., 2009; Baker et al., 2000). Overall plants usually need about fourteen essential mineral elements for growth and development to all plants. From these elements, eight such as boron magnesium, silicon phosphor, sulfide, potassium, calcium, manganese, iron nickel, copper, and zinc are required in relatively large amounts (≥1000 mg kg-1 dry weight) recognized as microelements. Thus elements like boron, chlorine, iron, nickel, copper, manganese, zinc, and molybdenum are needed in smaller amounts (≤100 mg kg-1 dry weight) and are thus called trace elements (Vatansever et al., 2016; Dalcorso et al., 2014) The accumulation of trace metals by plants is one of the major serious environmental recently. Due to come by effects of toxic metals on animals and human health. However heavy metal contamination in agricultural environments through atmospheric fallout, pesticides, contamination by chemical fertilizers, and irrigation with water of poor quality (Olowoyo et al., 2012).

2.1. Study area description

The Jebel Mun area located in Sudan at the northeast part of Elgeneina of western Darfur, Jebel Mun is 100 km from. It bounds by latitudes 12°–14°30′ N and longitude

30° E at the Sudan-Chad border. The geology of the area is characterized by the existence of granitic and syenitic intrusions as the most interesting feature and associated ring dykes and dyke swarms together with the Nubian Sandstone sediment (Sirelkhatim, 2003).

2.2. Sample collection

Plants of leaves samples were collected from four plants First, the green leaves were separated from the plants using a stainless steel knife, then the leaves washed three times with water, then with deionized water. They were spread on clean papers, covered with plastic sheets, the samples were dried air at room temperature. Based on the Kendal methods about 3g of each sample were weighed then added 20 ml of HNO_3 (65%) concentrated and wait until the reaction was completed, Then transfer to the autoclave for 90 min at 200 ◦C for digestion finally, a mixture of samples was moved to the volumetric flask and dilute with deionized water measured by ICP-AES.

2. 3 MATERIALS AND METHODS

A total of 12 elements from each sample were analyzed by ICP-AES model Shimadzu PQ 9000. Each leaves plant sample was digested with 20 ml HNO_3 65% conc deionized water was added to the sample and homogenized. The residue was filtered through Whatman filter paper then transferred to a 100 ml volumetric flask. leave of plants sample solutions was nebulized and the aerosol was transported by argon carrier-gas to the plasma torch. The spectra are dispersed by a grating spectrometer, and the intensities of the line spectra are monitored at specific wavelengths between 167 to 850 nm paths. Finally, photocurrents from the photosensitive device are processed and controlled by a computer. The twelve elements chosen for investigation were boron magnesium, silicon, phosphorus, sulfide, potassium calcium, manganese, iron, nickel, copper, and zinc. The following introduces samples setup and Instrument operating conditions.

2.4 Instrument operating conditions

Radio Frequency Power: 1.2 (kW)
Plasma Gas: 10 (L/min)
Auxiliary Gas: 0.6 (L/min)
Carrier Gas: 0.7 (L/min)
Misting Chamber: Cyclone Chamber
Plasma torch: Mini Torch View method: Axial/Radial

2.5 Project method

This study assessed the plant leaves at farms, in eight rural areas close to and surrounding Jebel Mun mountain during the period 2018. The study highlight identifying macro, micronutrient, and trace elements such as boron magnesium, silicon, phosphorus, sulfide, potassium, calcium, manganese, iron, nickel, copper, and zinc. Assess plants' leaves for micronutrients and major metals elements, which are necessary to guide the plant tissue or leaves analysis is a complementary diagnostic tool that can help farmers with fertilizer and provide develop crops with additional nutrient.

3. RESULTS AND DISSECTION

Macronutrients Elements (Mg, P, S, K, and Ca)

Crops require both macro and micronutrients for good growth including Potassium, nitrogen, and phosphorus are suggested that important the macronutrients that can need in large quantities. Essential micronutrients are boron, copper, iron, manganese, molybdenum, nickel and zinc witch need in smaller quantities (Andersson, 2016).

The results was determine that concentrations for Mg, P, S, K and Ca of plant leaves were (0.02 - 1.60, 1.80-11.0, 0.01 – 0.12, 0.05 -0.34, and 0.17 - 1.50 ppm) respectively. Shows Table 2 macronutrients, micronutrient elements, trace element. Figure 1 shows a maximum concentration of micronutrients in plant leaves in the study area.

Micronutrients Elements (Mn, Fe, Ni, Cu, and Zn)

Micronutrients that related to their availability to the plants. The data can be used in two pathways. Identify soil response to an application of the element in results obtained might be expected or to identify or confirm a micronutrient deficiency following an observation that lack of element might be the cause of poor growth. Identify soils, especially contaminated soils, where crops uptake of an element could lead to problems of food feed quality(Hotel Loftleidir, Reykjavík, 2005). The concentrations of metals at plants leaves were reveals (0.02- 0.12, 0.05- 4.60 0.00 - 0.02, 0.00 - 0.09, and 0.01-0.017 ppm) for Mn, Fe, Ni, Cu, and Zn respectively.

Non-Essential Several Circumstances Beneficial Elements

Others essential element involving in healthy plant growth and development is boron. It includes wide physiological processes, such as ammonium and nitrogen digested, cytoskeleton polymerization, and permeability and changes of the phenolic compounds(Vatansever, R., Ozyigit, 2017). found or absence of non-essential elements have a positive and negative impact on plant tissue The non-essential elements can be effective at their low concentrations and function as co-factors for some specific enzymes (Kaur, S., Kaur, N., Siddique, K.H.M. and Nayyar, H et al., 2016). The concentrations of B and Si were in the range (0.01-0.14, 0.01 -0.05 ppm) respectively.

Tables 1: Plant leaves sampling location and with coordinates and Radex meter reading.

Sample ID	Site location and plant leaves type		Geographic Data	
	Location	**Plants type**	**Latitude N**	**Longitude**
PL1	Malm	*Allium Cepavar* Leaves	22.41.763	13.50.932
PL2	Aborumayl	*Cajanus Cajan* Leaves	22.48.58	13.47.051
PL3	Aborumayl	*Cajanus Cajan* Leaves	22.48547	13.49096
PL 4	Algorf	*Cirullus Lanatus* Leaves	22.49.004	13.46.498
PL5	Kaga	*Cajanus Cajan* Leaves	22.49.221	13.46.691
PL 6	Mostareiha	Cajanus Cajan Leaves	22.50863	13.45.957
PL 7	Kroluko	*Tomato Leaves*	22.42.201	14.06.157
PL 8	Kerkro	*Tomato Leaves*	22.44.380	14.05.119

Table 2: Macronutrient, Micronutrient and heavy metals in leaves plant by ICP.

S.NO	Type leaves	*Macronutrient, Micronutrient and Non-Essential elements in leaves plant*											
		B	**Mg**	**Si**	**P**	**S**	**K**	**Ca**	**Mn**	**Fe**	**Ni**	**Cu**	**Zn**
PL1	Allium	0.04	0.02	0.31	10.0	0.31	0.49	0.02	0.02	0.02	0.08	0.05	0.12
PL2	Cajanus	0.05	0.01	0.29	2.00	0.29	0.43	0.01	0.01	0.01	0.03	0.03	0.09
PL3	Cajanus	0.03	0.01	0.31	3.70	0.31	0.48	0.01	0.01	0.01	0.05	0.04	0.10
PL4	Watermelon	0.03	0.01	0.23	3.00	0.23	0.38	0.01	0.01	0.01	0.03	0.02	0.02
PL5	Cajanus	0.14	0.03	0.33	8.00	0.33	1.50	0.02	0.02	0.02	0.09	0.17	0.11
PL6	Cajanus	0.05	0.01	0.26	11.0	0.26	0.47	0.02	0.02	0.02	0.08	0.05	0.08
PL7	Tomato	0.04	0.04	0.34	5.20	0.34	0.49	0.01	0.01	0.01	0.03	0.02	0.03
PL8	Tomato	0.05	0.01	0.25	2.00	0.25	0.48	0.01	0.01	0.01	0.00	0.03	0.10
PL9	Cajanus	0.01	0.05	0.05	1.80	0.05	0.17	ND	ND	ND	0.02	0.01	0.01

Note: ND* Not Detected

Table 3: Summary statistics of macronutrient, micronutrient and non-essential several circumstance beneficial elements.

Summary statistics	Macronutrient elements				
	Mg	**P**	**S**	**K**	**Ca**
Average	0.82	5.19	0.07	0.26	0.54
S.D	0.41	3.60	0.04	0.09	0.37
Median	0.83	3.70	0.09	0.29	0.48
Minimum	0.02	1.80	0.01	0.05	0.17
Maximum	1.60	11.0	0.12	0.34	1.50
Micronutrient element					
	Mn	Fe	Ni	Cu	Zn
Average	0.07	1.18	0.01	0.05	0.05
S.D	0.04	1.56	0.01	0.03	0.05
Median	0.09	0.49	0.01	0.03	0.03
Minimum	0.01	0.05	0.01	0.00	0.01
Maximum	0.12	4.60	0.02	0.09	0.17
Non-essential several circumstance beneficial elements					
	B	**Si**			
Average	0.05	0.26			
S.D	0.04	0.09			
Median	0.04	0.29			
Minimum	0.01	0.05			
Maximum	0.14	0.34			

Table 4: Correlation coefficient between macro-micro nutrient and trace metals elements at leaves plants.

	B	*Mg*	*Si*	*P*	*S*	*K*	*Ca*	*Mn*	*Fe*	*Ni*	*Cu*	*Zn*
B	*1.00*											
Mg	*-0.02*	*1.00*										
Si	*0.51*	*-0.41*	*1.00*									
P	*0.39*	*-0.07*	*0.42*	*1.00*								

S	*0.51*	*-0.41*	*1.00*	*0.42*	*1.00*							
K	*0.98*	*0.05*	*0.52*	*0.40*	*0.52*	*1.00*						
Ca	*0.63*	*-0.39*	*0.69*	*0.88*	*0.69*	*0.60*	*1.00*					
Mn	*0.63*	*-0.39*	*0.69*	*0.88*	*0.69*	*0.60*	*1.00*	*1.00*				
Fe	*0.63*	*-0.39*	*0.69*	*0.88*	*0.69*	*0.60*	*1.00*	*1.00*	*1.00*			
Ni	*0.55*	*-0.07*	*0.44*	*0.89*	*0.44*	*0.59*	*0.83*	*0.83*	*0.83*	*1.00*		
Cu	*0.96*	*0.04*	*0.43*	*0.49*	*0.43*	*0.98*	*0.65*	*0.65*	*0.65*	*0.70*	*1.00*	
Zn	*0.52*	*-0.51*	*0.61*	*0.43*	*0.61*	*0.49*	*0.69*	*0.69*	*0.69*	*0.50*	*0.54*	*1.00*

The correlation coefficient a significant of the assessed macro –micronutrient and trace elements in leaves of plants, the correlation revealed that potassium show strong positive correlation with boron and copper with potassium r = 0.98. Showing excellent correlation between nickel with phosphor r = 0.89. Followed a significant correlation were found calcium, manganese and iron with phosphor correlation coefficient recorded r = 0.88. whereas was found a good correlation linearly was found between Ni-Ca-Mn-Fe respectively, r = 0.83. while high correlation linearly was show Zn-Ca- Mn-Fe, r = 0.69. However important correlation liner were show Cu- Ca- Mn-Fe, r = 0.65. Moderately correlation coefficient linearly was recorded K-Si-S, r= 0.52.

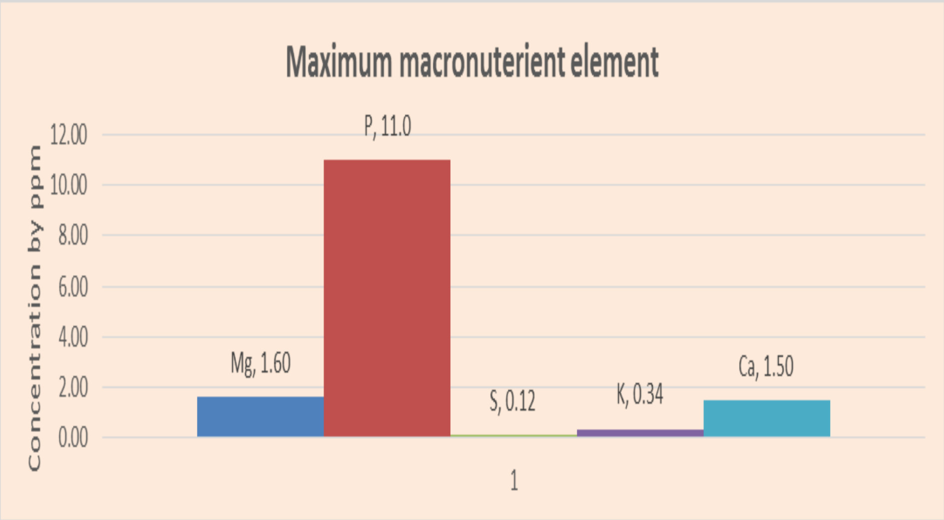

Fig 1 Maximum concentration macronutrient elements in plant leaves.

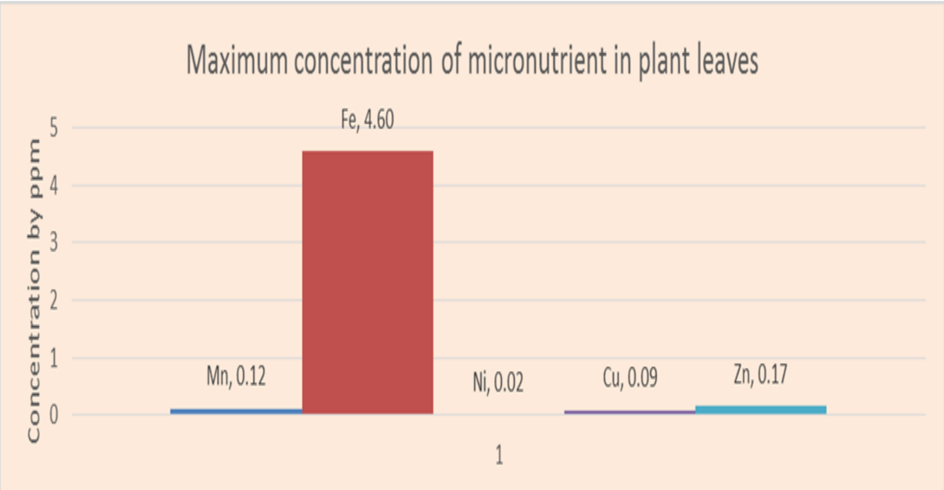

Fig 2 Maximum concentration micronutrient elements in plant leaves.

4. CONCLUSIONS

The samples have been collected from farms around Jebel Mun locality western Darfur -Sudan. The study highlight identifying macro, micronutrient, and trace elements such as boron, magnesium, silicon, phosphorus sulfide, potassium, calcium, manganese, iron, nickel, copper, and zinc. The study involved on four plants including (Allium Cepavar, Cajanus Cajan, Cirullus Lanatus, and Tomato Leaves). The average concentrations at leaves of plant samples of macronutrient, are ranged from (0.82,5.19,0.07, 0.26, 0.54 ppm) for magnesium, phosphor, sulphide potassium, calcium respectively. Whereas an average concentrations of micronutrients were (0.07,1.18, 0.01,0.05, 0.05 ppm) for manganese, iron, nickel, copper, and zinc respectively while non-essential metals element concentrations are boron and silicon was (0.05 and 0.026 ppm). The assess of the soil, and plant at farms, consider important preventing heavy metals from entering the vegetables are prerequisites for the prevention of potential health hazards to human beings.

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