EFFECT OF CONSUMED-TEA RESIDUE APLICATION LEVELS ON AVAILABILITY OF SOME NUTRIENTS IN A CALCAREOUS SOIL

Jabar Jalal FAQE

MASTER THESIS

Department of Soil Science and Plant Nutrition

Supervisor: Assoc. Prof. Dr. Ali Rıza DEMİRKIRAN

2017

REPUBLIC OF TURKEY
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This dissertation was accepted by the following committee on 23.05.2017 with the vote unity

Assoc. Prof. Dr.	Prof. Dr.	Assoc. Prof. Dr.
Ali Rıza DEMİRKIRAN	Alaaddin YUKSEL	Veli UYGUR
Supervisor	Member	Member

I confirm the result above

Prof. Dr. İbrahim Y. ERDOĞAN
Director of Institute of Science

بِسْمِ اَللهِ اَلرَحمنِ اَلرَحيمْ

الَّذِي جَعَلَ لَكُمُ الْأَرْضَ فِرَاشًا وَالسَّمَاءَ
بِنَاءً وَأَنْزَلَ مِنَ السَّمَاءِ مَاءً فَأَخْرَجَ بِه
مِنَ الثَّمَرَاتِ رِزْقًا لَكُمْ فَلَا تَجْعَلُوا لِلَّهِ
أَنْدَادًا وَأَنْتُمْ تَعْلَمُونَ (٢٢)

سورة البقرة الاية (٢٢)

DEDICATION

Many thanks in advance to My Lord of the Worlds “**Allah** ” who bestowed mercy over us with science and affection, and **He** give me health in order to complete my studies.

Thanks to my cherished wife who encouraged me, throughout the period of my research and stood beside me to supplement my study.

Jabar Jalal FAQE
Bingöl 2017

PREFACE

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LIST OF SYMBOLS AND ABBREVIATIONS

Chayhana	: Traditional public place for drinking tea in the middeleast countries
CTR	: Consumed tea residue
CRD	: Complete randomized design
SRS	: Simple randomize sampling
OM	: Organic matter
OF	: Organic fertilizer
%	: Percent
^oC	: Celsius (Temperature)
g	: Gram
kg	: Kilo gram
OZ	: Ounce = 28.3495231 grams
V	: Volume
L	: Liter
W	: Weight
Cm	: Centimeter
m	: Meter
Decar	: 1000 m^2
Hectar	: 10 000 m^2
EC	: Electrical conductance
CEC	: Cation Exchange Capacity
µS	: Microsimens
dS	: Desisemens
FC	: Field capacity
SP	: Saturation point

FAO	: Food and agriculture organization
EPA	: Environmental protection administration
MEA	: Ministry of economic affairs
pH	: -log of Hydrogen activity
OH-	: Hydroxyl ion
$CaCO_3$	: Calcium Carbonate
HCO_3	: Bicarbonate
Fe	: Iron
S	: Sulphur
Zn	: Zinc
Mn	: Manganese
Mg	: Magnesium
Cu	: Cupper
Al	: Aluminum
Cr	: Chromium
Ni	: Nickel
Pb	: Lead
B	: Boron
Ca	: Calcium
N	: Nitrogen
P	: Phosphorus
K	: Potassium
C	: Carbon

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KULLANILMIŞ ÇAY ATIĞININ KİREÇLİ TOPRAKTA BAZI BESİN ELEMENTLERİ ÜZERİNE ETKİSİNİN ARAŞTIRILMASI

ÖZET

Hasat atıkları ve bitkisel kökenli her türlü organik atıklar direk olarak ya da kompostlama sonrasında toprakların organik madde içeriğini arttırmak ve/veya bitki besin maddesi kaynağı olarak yaygın olarak kullanılmaktadır. Bu çalışmada işlem görmeden kireçli toprağa uygulanan kullanılmış çay kalıntısının (KÇK) mısır bitkisinin (*Zea mays* L.) büyüme performansına etkisi ve mikro besin elementi sağlama potansiyeli araştırılmıştır.

20 farklı noktadan alınan kompozit kireçli toprak örneği 4 mm den elenerek saksı denemesinde kullanılmıştır. Kurutulmuş KÇK, 18 kg'lık toprağa 0, 180, 360, 450 ve 540 g karıştırılarak uygulanmıştır. Saksı denemesi 3 tekerrürlü olarak tesadüf parselleri deneme deseninde kurulmuştur. 60 günlük yetişme periyodu sonunda bitkiler toprak yüzeyinden hasat edilerek farklı kısımlarda üretilen biyomas ve besin elementleri belirlenmiştir.

Varyans analizi uygulama dozunun incelenen parametreler üzerine önemli derecede etkili olduğu belirlenmiştir. Gerek bitki biyomas değerleri gerekse bitki besin elementleri açısından en iyi performansı 360 g saksı uygulaması göstermiştir. Bu uygulamayı 180 g saksı dozu takip etmiştir. Yüksek dozlarda ise KÇK'nin etkinliği azalmıştır. Bu da ayrışmanın sınırlandırılmasına bağlı olarak gerçekleştiği düşünülmektedir. Sonuçlar KÇK nın toprak organik maddesinin arttırılması ya da çevreye duyarlı ve ucuz organik bitki besin maddesi kaynağı olarak kullanılabileceğini göstermiştir.

Anahtar kelimeler: Kullanılmış çay kalıntıları **(**KÇK), kireçli toprak, besin elementi kullanılabilirliği, mısır.

EFFECT OF CONSUMED-TEA RESIDUE APPLICATION LEVELS ON AVAILABILITY OF SOME NUTRIENTS IN A CALCAREOUS SOIL

ABSRACT

Harvest and any plant originated organic residues are commonly used directly or after composting processes towards increasing soil organic matter content and/or plant nutrient sources. Non-composted consumed tea residue (CTR) was utilized in this study in a calcareous soil to investigate its effects on growth performance of corn plant (*Zea mays* L.) and micro nutrient supplying potential.

A composite surface (0-20 cm) soil sample was obtained by simple randomized sampling (SRS) then homogenized soil sample sieved through 2 mm was used in pot trial. 0, 180, 270, 360, 450 and 540 g of dried CTR were thoroughly mixed 18 kg of soil. The pot trial was set up in completely randomized design with three replications. The plants were harvested after 60 days of growth period and analyzed for biomasses partition between different organs and their plant nutrients (N, Fe, Cu, Mn and Zn).

ANOVA analysis indicated that the application doses of CTR influenced the investigated parameters. In terms of either biomass parameters or nutrient uptake best performance was obtained for 360 g CTR application and followed by 180 g treatment. The efficiency of CTR was to decrease at doses above 360 g CTR. This behavior may be related to decomposition limited conditions. Therefore it can be concluded that the CTR can be used to increase soil organic matter content or as an environmentally friendly and cheap organic nutrient source.

Key words: Consumed Tea Residue (CTR), calcareous soil, nutrients availability, corn.

1. INTRODUCTION

Tea is an important and popular drink in the world, especially in Middle East Countries because they have a strong social life and good hospitality traditions culture. That consumption of tea is increasing with increasing of the populations. The all idea is manage recycling this huge amount of consumed tea which throw away daily to the garbage from tea drinkers at house keeper or public Cafeteria and Chaykhana, then can be reused as organic fertilizer directly to plants.

Top 10 tea consuming countries in the world are:
Turkey 7.54 kg (266 oz) per capita, Morocco 4.34 kg (153 oz) per capita, Ireland 3.22 kg (114 oz) per capita, Mauritania 3.22 kg (114 oz) per capita, United Kingdom 2.74 kg (97 oz) per capita, Seychelles 2.08 kg (73 oz) per capita, United Arab Emirates 1.89 kg (67 oz) per capita, Kuwait 1.61 kg (57 oz) per capita, Qatar 1.60 kg (56 oz) per capita,10. Kazakhstan 1.54 kg (54 oz) per capita (FAO 2017).

There are limited number of studies dealing with the effects of locally producible organic materials' composts such as consumed-tea on the microelement availability in calcareous soils of Iraq (Havlin et al. 2007).

It is known that degradation of soil fertility is almost and always associated with loss of organic matter related features of soils such as soil structure, related features of soils such as lower water infiltration, soil compaction, increasing erodibility, and leaching. Such degradations of soils in fact lead to decrease in nutrient holding capacities and a poorer environment for biological activities (Joergensen and Potthoff 2005).

Dramatic increase of the world population requires mass amount of agricultural production, especially in poor or developing countries, hence enriching the organic matter content of the soils is of significant steps of maintaining soil fertility.

The other point is eliminating huge amounts partially consumed food residues by composting processes may be regarded as an environmentally friendly way of increasing soil organic matter content. hence there requirements for new technical information on waste materials as compost and have clearly increased over the last decade, this fact is important both developed and undeveloping countries as the practice and interest in commercial production of vegetables using soil-less media have increased amidst major long-term continually issues such as rising prices of imported peat based growth media (Jayasinghe et al. 2010).

Iraqi farmers have always concerned about the quality and fertility of their fields because of most of these soil has high contain of $CaCO_3$ and low availability of nutrients, therefore should consider to locally supplied a cheap and safe fertilizer such as composted material as organic fertilizer source because composts/organic fertilizers are not only makes available essential nutrients to plants, it can also increases soil quality (Arumugam 2012).

Nowadays is proven that bio composts became important since the chemical fertilizers and pesticides cause a lot of environmental complications health risks and soil degradation, in contrast organic matter contain very essential and safe sources of nutrients for accelerating crop production (Soomro et al. 2013).

In order to prevent our soil and cultivated products from disease, generally compost organic matter is a sustainable cost-effective and reasonable way to efficiently consume nutrients from pre and post-consumed food waste and vegetative wastes from modern agriculture because composed waste can be specifically prepared for use as a soil organic matter and nutrient sources, can also produce a disease suppressant for soil (Ingham 2005).

Compost maturity is another important characteristic contributing to compost tea quality. Mature composts generally release higher levels of soluble mineral nutrients and fewer phytol-toxic organic acids and heavy metals than immature materials. The water-soluble biochemical compounds contained in compost are assumed to be extracted into compost tea, so compost age may contribute to the quality of compost tea (Griffin and Hutchinson 2007).

The demand for technical information and predominantly approaches on compost and composed tea made from readily available local waste materials has significantly increased over the last decade (St. Martin and Brathwaite 2012).

Truly CTR and composting tea is a “green” method of disposal and fantastic for the health of all plants, providing organic matter to increase total soil quality and determining indicator parameters of soils (Lee et al. 2004).

Compost application to agricultural land can result in changes in soil physical properties such as structure, water retention and infiltration rates, biological properties and crop yields. Moreover, organic materials such as compost can act as a valuable source of plant available nutrients (e.g. nitrogen (N), phosphorus (P), potassium (K), Sulphur (S) and magnesium (Mg) and thereby reduce the need for manufactured fertilizer inputs (Rollett et al. 2010).

According to laboratory analysis, study of CTR and many more studies showed that the effect of plant harvest residue shows that has a good role to supply soil with N, P and C Many studies showed plant residue has a positive role among accelerating the mineralization of Nitrogen and microbial biomass activity because the residue contains enough amount of necessary nutrients and energy that plant needs for growth (Kumaraswamy 2014).

Generally it is well known that using different kind of plant residue with good tillage may improve the physio-chemical properties of soil and rather than there is a few or no more studies about using consumed-tea residue as a direct organic fertilizer source soil without decomposition process, especially to calcareous soil. Therefore this study were to investigate, the aim of this study is to know the effect of 6 different levels of air dried consumed-tea residue on availability of some nutrients such as (N, Fe, Zn and Mn) in calcareous soil and amount of availability of those nutrients uptake by plant.

2. LITERATURE REVIEW

2.1. Consumed Tea Residues

Numerous studies have demonstrated the potential of composted organic wastes not only as substitutes for peat as a growth substrate but also to stimulate plant growth and suppress soil-borne diseases. The major impediment to the use of compost as substrates or biocontrol agents has been variation in physical and chemical characteristics and disease suppression levels across and within compost types, sources, and batches.

Composting has been defined as a biological process through which microorganisms convert organic materials into useful end products, which may be used as soil conditioners and organic fertilizer. Consumed Tea Residue that is any how wasted, especially in urban areas which is not utilized for any purpose and discarded as wet garbage. Consumed-Tea Residue can be a great source of biodegradable garbage and it can make a good source of compost and reduces nutrients loss (Stoffella and Kahn 2001).

Compost teas may supply microbial biomass, fine particulate organic matter, organic acids, plant growth regulator like substances and soluble mineral nutrients to plant surfaces and soils and an assessment of relationships between biochemical properties of composts and their teas would improve current understanding of the mechanisms for compost tea's effects on crop yield and nutritive quality (Edwards et al. 2006).

The net effect of compose tea is to improve the health of the soil at a low cost and is disease suppression induced by compost and provide "free" nutrients to the crop as the considerable evidence shows that compost and liquid preparations such as compost tea made from compost can suppress many disadvantage microorganisms in the soil, some research showed that Compost tea as soil drench is an alternative approach to control bacterial wilt in brinjal (Santos et al. 2010).

Tea residue waste was also used as low cost adsorbent for removal of heavy metals and turbidity from synthetic wastewater, because tea waste has a strong capacity of binding of Pb and Cu from aqueous solutions, therefor many experiments showed that 96.4% of ions of Pb removed by tea waste, the adsorption capacity is highest at solution of pH between 5 and 6 (Sabrina and Hasmah 2008).

The addition of tea waste by industry product and hazelnut husk mixture to a soil at 5% rate on weight basis increased the urease activity in soil well above the control treatment (Kızılkaya and Ekberli 2008).

Most of developing countries to address food and nutrition security through resource maximization and the development of rural communities through agriculture, appropriate technology, and entrepreneurship recycling biodegradable waste into compost and compost teas is being promoted as a viable option for treating waste material. As well as the use of compost as a bulk fertilizer and soil ameliorant, there is considerable evidence that shows that compost and liquid preparations such as compost tea made from compost can suppress soil-borne diseases (Bonanomi et al. 2010)

Soil fertility management and balanced is the most important practice issue in cultivation process, for preserve and restore soil fertility should add organic matter and preferentially should be sufficiently stabilized to produce beneficial effects (Pasquini and Harris 2005).

The study about determination of nutrition status of tea plant in the East Black Sea Region of Turkey, shows the amount of Fe, Zn, Mn and Cu content of both soil and plant samples was sufficient and high because Black Sea Region have low soil pH level between 3.22 to 5.37, therefore must apply lime to this soil in order to invoked the toxicity of high levels of those nutrients above (Adiloglu et al. 2006).

Decomposing and mineralizing of organic matter through the activity of soil microorganisms, can led to increasing the solubility of phosphate, due to the organic anion compute with the phosphate ions for making layers by binding on the soil colloids, and because tea residue itself contains Fe, Mn and Zn hence after decomposing these nutrients can easily release to soil solution (Dilshad and Kocher 2010).

2.2. Calcareous Soils

The most important problem in calcareous soils is low availability of most nutrients, because $CaCO_3$ in soil directly or indirectly may affects plant availability of N,P, K, Calcium (Ca), Mg, Mn, Zn, Fe and phosphate fixation and unavailability is a major soil fertility problem due to high pH concentration and high contains of $CaCO_3$ the chemical (Amundson et al. 2003).

The alkalinity of soil and alkali ions play an important role in many biological phenomena, availability of nutrients and especially the maximum availability of Fe, Mn, Zn, Cu and Ni nutrients are between 6.8 and 7.2 pH levels, except Mo and due to the study soil has a high carbonate minerals and slightly alkaline pH 8.6, therefore cations being more strongly bound to the soil and not as readily exchangeable making more precipitation them in form of hydroxyl or carbonate components and became non-available to plant as shown in equation 2.1 (Havlin et al. 2007)

$$CaCO_3 + H_2O \longrightarrow Ca^{2+} + HCO_3^- + OH^- \qquad (2.1)$$

High concentration of HCO_3^- became toxic to plants.
Micronutrients (Fe, Zn, Mn, Mg, etc.) + (in calcareous soil) $\longrightarrow$ Unavailable forms of micronutrients for plants as shown in equation 2.2 and 2.3:

$$Fe^{3+} + 3\,OH^- \longrightarrow Fe(OH)_3 \qquad (2.2)$$

$$Fe^{2+} + HCO_3^- + OH^{-1} \longrightarrow FeCO_3 + H_2O \qquad (2.3)$$

High carbonate and high pH also increase the rate of volatilization and losing of nitrogen as well (Havlin et al. 2005).

The most of Iraq soils parent material are also calcareous and contain from 15 to 35% limestone, in the plain of mountain some soils have only 2-7% in the surface but more than 50% in the sub soil (Buringh 1960). But in southern of Iraq and epically the low hills the soils have more than 25% lime content and throughout the profile of the Al-Jazeera soils generally contain more than 60% $CaCO_3$ while those of the desert lands have more than 25% in the surface and up to 50% in the subsurface layers (Buday and Hak 1980).

The other study was conducted to determine the major and trace elemental composition in soils of the Kurdistan region of Iraq, and their geochemical features. Soil samples were taken from five of them from forest soils and two others from non-cultivated soils (Rate and Sheikh- Abdullah 2017).

The calcareous soil of the Mesopotamian plain contain from 15 to 35% lime mainly as $CaCO_3$ and $MgCO_3$ (10%), these kinds of soils also have high deficient of available nutrients (Plaziat and Younis 2005).

Most of the calcareous soil contain carbonate induced high soil pH influence chemical solubility and plant availability of nutrient elements, pesticides' performace and organic matter decomposition (Habby 1993).

It is known that pH value of soil plays a main role of soil fertility and availability of nutrients, because of this reason good pH value may increase the mobility and availability of most of elements and cation exchange capacity (CEC) rate may increase at the same time, the adsorption and absorption rate between the roots and the surrounding medium increase also, the optimum condition for CEC took place when pH value ranged between 6 and 7 (Al-Mossawi 2005).

The objectives of this research were to investigate consumed-tea residue as organic matter which is an agent for promoting the soil fertility and decreasing alkalinity to some extent by the effect of decomposing products such as low molecular weight organic acids and complexation products such as humin compounds (Staunton and Leprince 1996).
To describe the effect of CTR on the *Zea mays* L. growth, fixation and unavailability of some nutrients is major soil fertility.

3. MATERIAL AND METHOD

3.1. Material

3.1.1. Consumed tea residue (CTR)

Consumed Tea-Residue (CTR), as "Organic Fertilizer": Wet consumed tea-residue was collected from local Café and house keeper in Kurdistan Region of Iraq . The collected wet CTR about 15 kg and placed under shadow at open area for few days with room temperature until became air dried (Figure 3.1).

Figure 3.1. Wet consumed tea residue

3.1.2. Soil

In this study, surface soil samples (20 cm) were collected from the Agricultural Research Center of Sulaymani–Bakrajo and air-dried then passed through a 4 mm screen. (Figure 3.2 and Figure 3.3).

3.1.3. *Zea mays* L.

Zea mays L. Dkc 6724 Monsanto (American), F1 variant seeds were taken from Department of Field Crops, Faculty of Agriculture (Figure 3.4), Bingöl University, Turkey.

Figure 3.2. Consumed-Tea Residue

Figure 3.3. Air-dried calcareous soil passed through a 4 mm screen

Figure 3.4. *Zea mays* L. Dkc.F1.Monsanto, USA

Figure 3.5. Experimental materials for pot trial

3.2. Methods

The pot experiment were arranged with totally 20 pots used and was set up in completely randomized design with three replicates. The doses of CTR were 0., 1, 1.5, 2, 2.5, and 3% on weight basis. To maintain these conditions 0, 180, 270, 360, 450, and 540 g of CTR were thoroughly mixed with 18 kg of air-dry calcareous 20 L plastic pots. These application and 6840 kg da-1 in the field by considering the bulk density of rates were equivalent to 0, 2280, 3420, 4560, 5700, soils. Then the mixture filled in experimental soil. Then 3 seeds of *Zea mays* L. Dkc 6724 Monsanto (American) was sowed in each pot on 17/6/2016.

Table 3.1. Experimental set up in the completely randomized design

Consumed-Tea Residue, gram			
Level	Replicate 1	Replicate 2	Replicate 3
L-1 (0%)	R-1(0)	R-2(450)	R-3(270)
L-2 (1%)	R-1(180)	R-2(360)	R-3(450)
L-3 (1.5%)	R-1(270)	R-2(540)	R-3(360)
L-4 (2%)	R-1(360)	R-2(180)	R-3(0)
L-5 (2.5%)	R-1(450)	R-2(270)	R-3(540)
L-6 (3%)	R-1(540)	R-2(0)	R-3(180)

The irrigation requirement or field capacity was determined by (Saxton and Willey 2006) equations (3.1, 3.2, 3.3) as below:

$$F.C=(\%\ clay\ x\ 0.39)+13 \quad (3.1)$$

$$F.C=(49\ x\ 0.39)+13=32.11 \quad (3.2)$$

$$32.11\ x\ 18180/100=5837\ g. \quad (3.3)$$

The irrigation practice was repeated 7 times in a week. Each irrigation time the evapotransporated water was determined by weighing and the loss was replenished.

3.2.1. Soil Sampling

Soil samples were taken in field research area shown in (Figure 3.8) in Sulaymaniya – Bakrajo research area N 350 32- 30, E 450 21- 00, with 760 m maximum point on Sea and 715 m minimum point on sea, Simple Randomize Sampling method were used and (20 undisturbed sample) in different places were taken from (20 cm) depth, showed in (Figure 3.8) then all samples were mixed together and passed through a 2 mm sieve for physico-chemical analysis at Bingöl University-Department of Soil Science and Plant Nutrition Laboratory, Turkey.

20 pots were used including water indicators, each pot (Figure 3.5) contain 18000+ 0, 90, 180, 270 and 360 g air dry soil mixed with 0, 180, 270, 360, 450 and 540 g air dried consumed tea residue and 3 seeds of *Zea mays* L. Dkc 6724 Monsanto (American) was planted in each pot on 17/6/2016, and the soil in each pots was estimated as a field capacity which the amount of water requirement were determined by (Saxton and Willey, 2006) equations (3.4, 5) as below:

$$FC\ (\%)=(clay\ \%\ x\ 0.39) + 13 \quad (3.4)$$

$$FC\ (\%)=(49\ x\ 0.39) +13=32.11 \quad (3.5)$$

32.11 x 18180/100 =5837 g water require for each pots in order to reach the moisture of input soil of the pots to field capacity range.

3.2.2. Water Source

During the cultivation period all plants were irrigated with tap water to maintain soil moisture near field capacity.

3.2.3. Calculation of water requirement for irrigation by indicators

Calculation of water requirement for irrigation by using two indicators contained 0 and 360 g air dried CTR mixed with air dried soil were used to know how amount water require for each pot per irrigation. In the each pot small rocks were used under the soil to make easier drainage after irrigation.

1-Indicator L-0: Weight of the Indicator including soil, draining rocks, pot without water and CTR=21000 g

Weight of water requiring for each pot to reach FC=5837 g

Total weight of indicator L-0 with water=21000+5837=26837 g

2-Indicator L-360 with: Weight of the indicator including soil, draining rocks, pot, and CTR without water=19448 g

Total weight of indicator L-360 with water=19448 + 5837=25285 g

100 g air dried soils were put in oven 105^{o}C, after 24 h became 98 g, so the moisture of air dried soil was 2%. And it is not very high therefore was neglect it.

Before each irrigation, the weights of indicator pots were weighted by electronical balance, then the amount of loosed water were applied in order to the moisture of the soil were return to the FC level and as beginning again, and so on Figure 3.6.

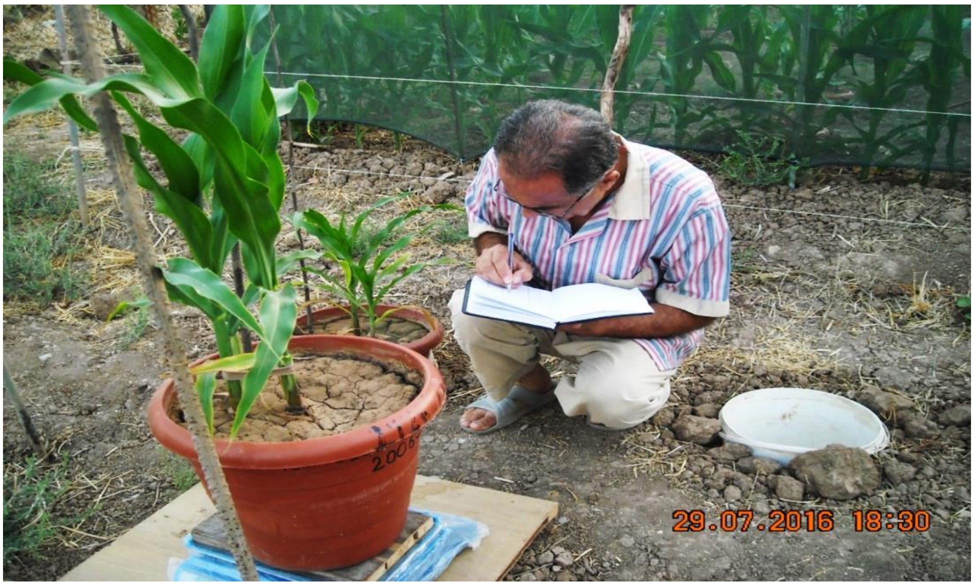

Figure 3.6. Water requirements measuring

3.2.4. Calculation of CTR using with different doses for each pot

Soil bulk density of experiment were determined as 1.14 g/cm3 (ISO 11272 1993). The weight of soil in a decare field for 20 cm depth =1000*0.20*1.14 = 228000 kg and weight of required soil for 20 L volume pot is: W = 1.14 x 20= 22.8 kg pot^{-1}

This means the full capacity of each pot to fill with oven-dried soil is 22.8 kg, but 18 kg air-dry soil was used for each pot^{-1}. So the required CTR weight for 1% doses = 18/100 x 1000 = 180 g CTR. The required CTR for 1.5, 2, 2.5, and 3% treatments are therefore 270, 360, 450, and 540 g respectively and they are equivalent to 0, 2280, 3420, 4560, 5700, and 6840 kg consumed tea residue per decare area. Total air dried CTR used in the experiment was 5.4 kg whereas total air dried soil was 364 kg.

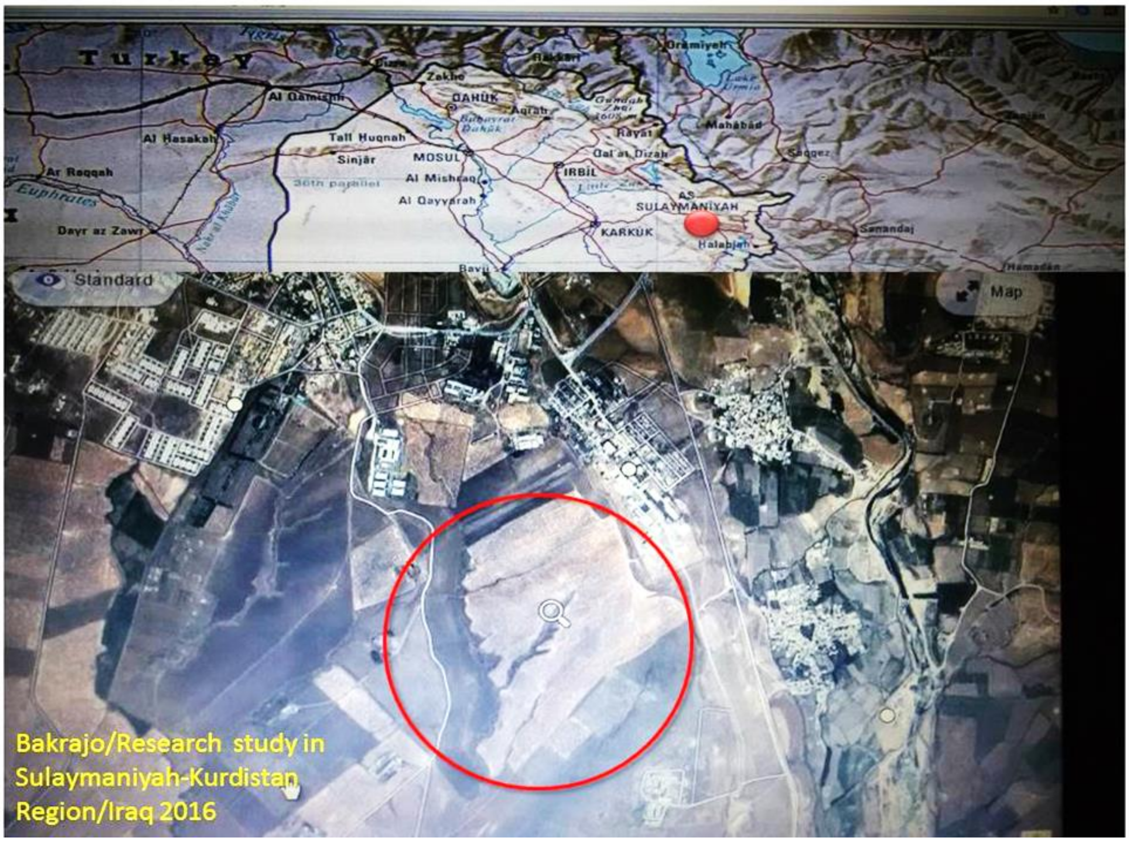

Figure 3.7. Satalite image of research area in Bakrajo

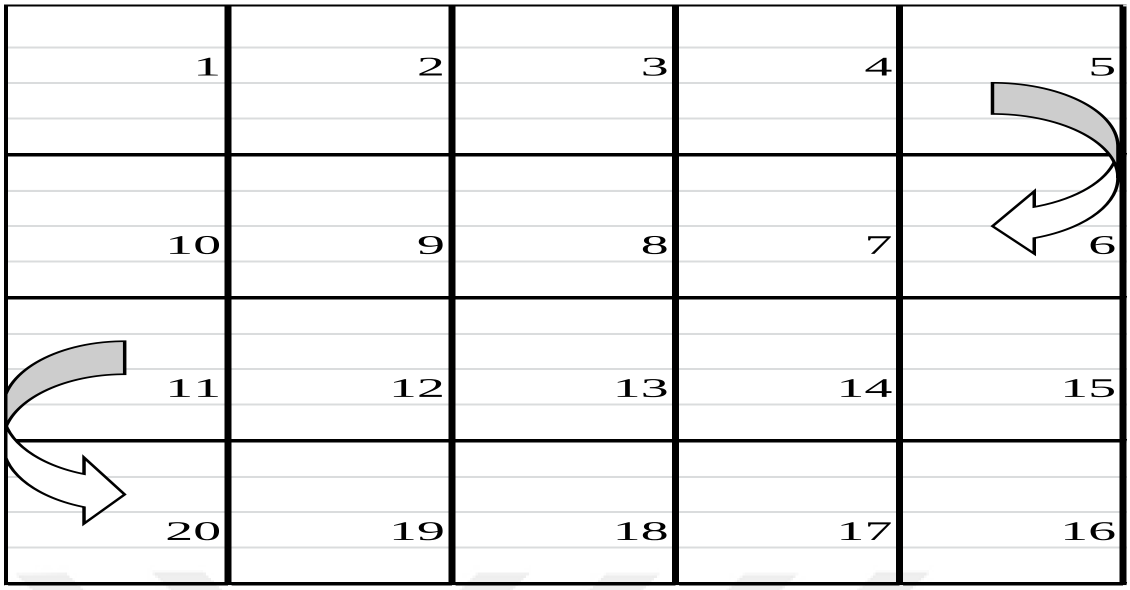

Figure 3.8. Soil sampling method

3.3. Analysis method

The methods of descriptive soil analyses were given below:

3.3.1. Physical analysis

Texture of soil determined by Bouyoucos (1962), Bulk density determined by Blake et al (1986), Saturation % by Richards (1954),

3.3.2. Chemical properties analysis

The pH determined in with ratio 1:2.5 by Grewling and Peech (1960) and EC determined in saturated paste with EC meter by Richards (1954), total salt determined by Jackson (1962), CEC was determined using the fixed-pH ammonium acetate method of by Dawson et al (1974), organic matter determined by wet oxidation method (Walkley and Black 1934), $CaCO_3$ was determined in with ratio 1:3 HCl 37% by Balázs et al. (2005),

3.3.3. Concentration of some soil nutrients

Total-N determined by Bremner (1968), available-P determined by Olsen et al. (1954), extractable-K determined by Kalra and Maynard (1991), extractable-K, Ca, Mg determined by Kalra and Maynard (1991), available-Fe, Mn, Cu, Zn and Cr determined by using DTPA extract with AAS (Lindsay and Norvell 1978).

Corn plant, *Zea mays* L. were harvested after two months of planting (from 17 June 2016 until 17 August 2016) and cut it on the soil surface and separated into leaf, stem and root, and wet weighted as fresh, then were oven dried at 70 ^{o}C for 48 hours and weighted again, after that all parts of plant grinded separately and ground in a micro mill to pass a 40-mesh sieve and analyzed at the Labs of Soil department and Plant Nutrition at Bingöl University in Turkey.

3.3.4. Plant analysis

Corn plant, *Zea mays L.* were harvested just above the soil surface after two months of growth period (from 17 June 2016 until 17 August 2016) and partitioned into leaf, stem and root. Fresh and oven dry (dried in an oven at 70^{o}C for 48 hours) weights of the plant parts were weighted. The plant samples were homogenized by reducing the particle size below 40 meshes. The samples were then wet-ashed and analyzed for nutrient content in the Soil Department and Plant Nutrition Laboratories of Bingol University, Turkey.

One gram of plant samples were digested in a mixture of 4:1 nitric acid 65% and perchloric acids HClO4 72% (Isaac and Kerber 1971) then total Fe, Mn, Cu and Zn concentrations of the digests were determined by a Carl Zeiss Atomic Absorption spectrophotometer.

3.3.5. Consumed Tea-Residue analysis

2 g of CTR was grinded and boiled with 150 ml distillated water on 80 ^{0}C temperature, coldly determined pH by Grewling and Peech (1960), EC determined by Richards (1954), Total-N determined by Chapman and Pratt (1961), Total-Fe, Mn, and Zn determined by DTPA method and Carl Zeiss Atomic Absorption spectrophotometer.

3.3.6. Statistically analysis

The data were subjected to ANOVA by using JAMP 5.01 statistical package. The effect of CTR treatments on the measured nutrient and plant parameters were separated by Tukey-Kramer multiple comparison test. The optimum doses of CTR for different traits were determined by regression analysis.

4. RESULT AND DISCUSSİON

4.1. Soil physico-chemical parameters

The soil which used for experimental pots was silty clay texture with a clay type and according to my primary study determinations shown on (Table 4.2), the soil contains low nitrogen (0.05 %), organic matter (1.34 %) and alkaline in reaction with a pH value as 8.163. The salinity soil of research area was determined as 0.125% its means is not salinity problem. The calcium carbonate content of this soil was determined very high level is classified as a calcareous soil. The CEC was determined 29.48 mg/100 g soil was low level. The potassium, calcium and magnesium contents of the used soil were obtained high level. The data of the soil analyses were given the result as shown in (Table 4.2).

4.1.2. Consumed tea-residue CTR

Consumed tea-residue were also determined pH and EC and some nutrients were determined also such as total N% , total (Fe, Mn and Zn), the result showed (Table 4.1)

Table 4.1. CTR measurements of pH and EC

pH	EC	Temperature	mg kg $^{-1}$			
	µmhos/cm	^{0}C	Fe	Zn	Mn	Total N
5.56	526	21	0.65	0.323	2.512	2.789

Table 4.2. Descriptive physico-chemical properties of the experimental soil

Soil properties	Unit	Results		
Particle Size Distributions	g/kg	Sand	106.0	Texture class
		Silt	403.7	Silty-clay
		Clay	490.3	
Bulk Density	g/cm^3	1.14		
Saturation	mL/kg	642		
Field Capacity (W/W)	g/kg	327		
Name	Unit	Results		
pH (in soil suspension, 1:2.5)	-	8.16		
EC	µS/m	537		
Salinity (saturation paste)	g/kg	1.25		
$CaCO_3$	g/kg	254		
Organic matter	g/kg	13.4		
Total N	mg/kg	0.63		
CEC	cmol/kg	29.5		
Available P	mg/kg	6.00		
Extractable K	mg/kg	670.8		
Extractable Ca	mg/kg	12155		
Extractable Mg	mg/kg	1190.5		
DTPA extractable-Fe	mg/kg	10.04		
DTPA extractable-Zn	mg/kg	0.794		
DTPA extractable Mn	mg/kg	18.9		
DTPA extractable Cu	mg/kg	2.01		
DTPA extractable Cr	mg/kg	5.15		

4.2. Plant and some soil nutrients analysis

Micronutrients are required for plant in small amounts and they affect directly or indirectly photosynthesis, vital processes in plant such as respiration, protein synthesis, and reproduction phase (Hythum and Nasser, 2012).

Figure 4.1. Preparatory grinded of (soil, leaf, stem, and root from down to upper) for analysis

Physiologically, it is known that the most important role of micronutrients in plant such as Fe, Zn and Mn that correlated with metabolites for plant growth are abbreviated:

Iron (Fe)

Iron is an important and essential micronutrient which promotes formation of chlorophyll, acts as an oxygen carrier and reactions involving cell division and growth**.**

Manganese (Mn)

It is a micro nutrient, manganese functions is as a part of certain enzyme systems, key element of chlorophyll production aids in chlorophyll synthesis, increases the availability of P and C, influences earliness and uniformity of maturity and increases iron utilization in plants.

Zinc (Zn)

It is a micronutrient, zinc function is aids plant growth hormones and enzyme system, necessary for chlorophyll production, necessary for carbohydrate formation, necessary for starch formation and aids in seed formation.

Nitrogen (N)

Nitrogen is an important macro nutrient and key nutrient element for plants Nitrogen is the nutrient in most demand imbalance of nitrogen compared with other nutrients can make plants more prone to pest and disease attack a very large, and potentially the most environmentally damaging loss of nitrogen can happen via the leaching of nitrate. The majority of soil nitrogen is relatively immobile and when nitrogen is converted to nitrate it becomes very mobile.

The role of nitrogen are necessary for formation of amino acids, the building blocks of protein, essential for plant cell division vital for plant growth, directly involved in photosynthesis. Nitrate, (NO_3^-) is a negatively charged ion (anion). Very little nitrate can be stored in the soil and negatively charged soil colloids (such as clay and humus) largely repel it. Therefore when water drains through the soil nitrate leaches out.

4.2.1. Some nutrients taken up by different parts of corn

Zea mays L. had grown in pots under field conditions of Bakrajo, Sulaymaniyah-Iraq at Field Crop Research Center for lifespan of two months (17/June until 17 August 2016) at temperature between 35-48^{o}C. ANOVA analysis revealed that there were significant differences between the CTR application rates at either $p \leq 0.01$ or $P \leq 0.05$ probability levels. In general the minimum values were obtained for the control treatment with no CTR addition whereas the maximum values were recorded for either 180 or 360 g CTR pot^{-1} treatments. In case of micronutrients, availability of Fe, Zn and Mn (Table 4.4.) were significantly treatment-induced (Salem and El-Gizawy 2012; Rathod et al. 2012).

The highest availability values or the maximum nutrients uptakes were recorded for 360 g CTR application dose as observed for N% (0.395 g pot^{-1}) by leaf, Fe (2.346 mg pot^{-1}) by root, Mn (2.465 mg pot^{-1}) by root and Zn (0.739 mg pot^{-1}) by stem respectively. While the lowest nutrient uptake from soil by corn were recorded for control treatment (L-1 no CTR) as determined for N% (0.106 g pot^{-1}) by root, Fe (0.519 mg pot^{-1}) by leaf, Mn (0.579 mg pot^{-1}) by leaf and Zn (0.250 mg pot^{-1}) by root of corn, respectively. This means the CTR were positively affected on the availability of total N, Fe, Zn and Mn to be uptake from soil by plant and in variant parameters.

The statically analysis of Variance in (Table 4.3.) indicated also the second good affected level is (L-180 g CTR 18 kg^{-1} Soil), after the first one (L-360 g CTR 18 kg^{-1} Soil). In another hand high addition of CTR as indicated in L-360, L-450 and L-540 because of using high doses of CTR may even refer to releasing much more nutrients to the soil solution in a high concentration and this may cause to toxicity either for plant or to those beneficial microorganisms that related with mineralization process, this can clearly be seen with treatments in (Table 4.4) and (Table 4.5) as well.

The data showed that the second best application dose was 180 g CTR pot^{-1} treatment. On the other hand high addition of CTR above 360 g pot^{-1} was supposed to release higher amounts of nutrients. In fact during decomposition of CTR a considerable amount of N mineralized at 180 and 360 g CTR treatments. However, the cease of increase in N uptake by plant upon increasing CTR application indicate that the mineralization of CTR is likely to be limited due to lack of nitrogen in the soil. Since the soil is poor in nitrogen and organic matter contents and no N fertilization was practiced in this study the N limited decomposition of CTR resulted in lesser amounts of N uptake by plant. On the other hand non synchronized release of nutrient elements from the CTR may result in smaller uptake of N.

Table 4.3. The effects of applications of CTR on some Nutrients concentration (N, Fe, Mn and Zn) in different parts of corn

Doses	N (g/ pot)			Fe (mg/pot)			Mn (mg/pot)			Zn (mg/pot)		
	leaf	stem	root	leaf	stem	root	leaf	stem	root	leaf	stem	root
L1	0.313	0.162	0.106 d	0.519b	0.456	1.25b	0.579bc	1.218	1.18b	0.243bc	0.239 c	0.250c
L2	0.395	0.226	0.144cd	0.859a	0.718	1.508 a	0.867 b	2.090	1.25 b	0.329a	0.367bc	0.372bc
L3	0.317	0.205	0.184bc	0.927a	0.618	1.637ab	0.540 c	1.854	1.78ab	0.230bc	0.431b	0.419abc
L4	0.358	0.237	0.270a	1.069a	0.729	2.346 a	0.749abc	2.132	2.47a	0.266abc	0.739a	0.590a
L5	0.377	0.229	0.229ab	0.930a	0.652	1.850ab	0.693abc	1.826	1.76ab	0.220c	0.718a	0.436ab
L6	0.348	0.162	0.130cd	0.994a	0.785	1.773a	0.813ab	1.912	1.865ab	0.284ab	0.394bc	0.444 ab
Tukey $P \le 0.01$	NS	NS			NS			NS				
$P \le 0.05$			**	**		*	**		*	**	**	**

NS: Means values in columns followed by the same alphabets indicate not significantly different between themselves according to Tukey test at $P \le 0.01$ and $P \le 0.05$. Means with different alphabets in the same column indicate significant difference between treatments by Tukey at $P \le 0.01$**, $p \le 0.05$*, respectively.

The amounts of nutrients may take up from leaf early in the growing season are small, but the nutrient concentrations in the soil surrounding the roots of the small plant at that stage often must be high, the seasonal pattern of nutrient accumulation in the plant is similar to that of dry matter accumulation and nutrient uptake begins even before the plant emerges from the soil (Karlen et al. 1988).

The discovery of nutrient movement and confirmation of remobilization by Hanway (1962) proposed that nutrients vary in degrees of plant mobility, some nutrients including N, P, and Zn are highly mobile and begin translocation to corn grain at the various growth stage, while micronutrients B, Mn, Cu, and Fe possess limited or non-existent remobilization characteristics, may for this reason the amount of nutrients are more concentrated in root of corn (*Zea mays* L.) than the other parts of plant (Hanway 1962; Hanway 1963; Karlen et al. 1988).

An essential nutrient is any element required for the completion of a plant's life cycle, nutrients involved in plant life cycle processes are often categorized according to nutrient concentration within a plant (Havlin 2005).

It is known that corn requiring for nutrient is depend on the age and stage of plant growth and adequate supply of each nutrient at each stage is essential for optimum growth at all stage , example uptake of potassium is completed soon after sinking, but uptake of the other essential nutrients such as nitrogen and phosphorus continues until near maturity.

In high pH soils, the phosphate availability and phosphate adsorption are also dependent on pH value, availability and adsorption are increases as pH decreases, and organic acids greatly increase the availability of phosphorous, Fe, Zn and Mn (Grossl and Inskeep 1991).

Much nitrogen and phosphorus and some other nutrients like Fe uptake occurred before flowering compared to only one-half of P, S, are translocated from vegetative plant parts to the developing grain later in the season. Nutrient uptake with an estimated 55% and 80% of P and K that uptake occurring before flowering (Hanway 1963).

More doses and good environment of CTR as shown in treatments may increase the availability or amount of some nutrients in stem and root for a unknown and optimum time, means it is clearly seen in some replicate with Level-540 in Table 4.5 and Table 4.8.but in some others is not positive significant, for example bioavailability of Mn in soil which is strongly influenced by the amount and the quality of organic matter that can react with it, OM forming complexes and chelates of varying stability (Leita et al. 1999).

CTR as an organic fertilizer and natural organic materials as well, such as peat moss, compost, and wheat and clover straw and plant residue have increased the solution and exchangeable Mn (Tisdale et al. 1993).

Incorporation of large amounts of CTR with low pH and considerable amounts of N, Fe, Mn and Zn can have contribution to available pool of the mentioned elements. The hot water during the brewing processes may release some of these elements in to soluble forms. Additional decomposition of the organic compounds after the incorporation into soil at comparatively high temperature during growth period may also increase the decomposition induced contribution of the nutrient elements (Tisdale et al. 1993).

The addition of CTR as an or similar to OM or OF for soil might thus have increased the uptake of Zn either by increasing the potential mobility of the investigated Zn by formation of soluble organic - metallic complexes or improving the growth conditions of microorganisms through the additional nutrients provided, my result may agree with those reported by Almas and Singh (2001).

These results are in agreement also with who reported that materials such as sewage sludge, animal manure, hamates and compost may be rich in iron Fe^{+2}, Fe^{+3} and in metal binding biochemical that help keep Fe and other metals in solution through chelation and also stimulate chemical and biological reactions which make Fe more available (Hallorans et al. 2004).

It is a well-known fact that all kind of OM can improve physical, chemical and biological properties of soil like pH, structure, drainage, infiltration, aeration, capacity of microorganism’s biochemical activity and CEC.

OM may increases the solubility of those nutrients and may be CTR as an organic fertilizer released some complex organic anion chelate or may organic compounds protect some nutrients from fixation specific in calcareous soil by making a binding around the soil clay particles, then may led to decreasing the rate of precipitation or may be decreasing leaching of some nutrients such as Fe^{+3},Mn^{+2}, Zn^{+2}, Ca^{+2} and Al^{+3} in calcareous soil and due to this action and gradually decomposing of CTR may increase also the concentration of those nutrients a rounding the root area and then by physiological mechanisms absorbed through the external membrane of the roots or may moves towards the roots by diffusion phenomenon ,high accumulation and concentration of Fe^{+3}, Mn^{+2} , Zn^{+2} round the root of corn as shown on Tables 4.3, 4.4 and 4.5 are agree with the similar result that reported by Karlen et al. (1988).

In addition the OM can improve soil aggregation formation and structure stability this resulting cause decreasing of soil bulk density and gradually increase porosity. The enhancements of the soil structure could be supply better environment for plant roots elongation and respiration by proper aeration in soil and drainage of water, these results and explanation agree with those reported by Somani and Kanthaliya (2004).

Because tea plant can uptake very high amounts of Mn during its growth under severe acid condition and low redox potential of soil. The application of higher levels of consumed tea residue to soil, and these higher levels may be decomposed or mineralized by microbial activities, this mineralization led to release of some micronutrients such as Fe, Mn, and Cu with present originally in CTR of soil solution by Dilshad and Kocher (2010). A similar result was also reported by Somani and Kanthaliya (2004), Adiloglu and Adiloglu (2006).

4.2.2. Some nutrients taken up by calcareous soil

The comparisons between primary study of the soil of research areas shown in(Table 4.2) with experimental analysis of the same soil after experiment as showed in (Table 4.4.) and according to Tukey test analysis of variances ($P \leq 0.01$ and $P \leq 0.05$) the CTR were significantly affected amount of nutrients positively by increasing the rate of CTR for all additional levels L-2, L-3, L-4, L-5 and specifically L-6 (2.583) is register the highest record, while L^{-1} (1.350) is the lowest). The highs amount of total N% at L-2 (12.7 g kg^{-1}), Fe L-6 (11.983 mg kg^{-1}), Mn L-6 (31.933 mg kg^{-1}) and Zn L-6 (1.86 mg kg^{-1}) was increased and the lowest affected were recorded by levels N% L-1(0.046 g kg^{-1}) , Fe L-5 (10.277 mg kg^{-1}) , Mn L^{-1} (17.303 mg kg^{-1}) and Zn L-1 (1.113 mg kg^{-1}).

Table 4.4. The effect of CTR on some Soil properties and amount of some nutrients (N, Fe, Mn and Zn) in calcareous soil which taken by doses

Doses	pH	EC	OM	N	Fe	Mn	Zn
L1	8.15	0.570	13.5b	0.046c	10.3abc	17.3c	1.11b
L2	8.00	0.523	21.5a	0.094abc	10.9ab	23.1bc	1.57ab
L3	8.02	0.530	22.1a	0.074bc	10.3abc	21.8bc	1.61ab
L4	8.03	0.523	22.7a	0.095abc	9.17bc	25.0b	1.65a
L5	7.98	0.520	24.2a	0.129 a	8.73c	28.3ab	1.75a
L6	8.00	0.533	25.8a	0.116ab	12.0a	31.9a	1.86 a
Tukey $P \leq 0.01$ or $P \leq 0.05$	NS	NS					
			**	**	**	**	**

NS: Means values in columns followed by the same alphabets indicate not significantly different between themselves according to Tukey test at $P \leq 0.01$ and $P \leq 0.05$. Means with different alphabets in the same column indicate significant difference between treatments by Tukey at $P \leq 0.01$**, $p \leq 0.05$*, respectively.

Table 4.5. The effect of CTR on availability of some nutrients, taken up from soil by different parts of plant and totaldry matter

Doses	N (g/ kg)			Fe (mg/kg)			Mn (mg/kg)			Zn (mg/kg)			Total Dry Matter (g)
	leaf	stem	root	leaf	stem	root	leaf	stem	root	leaf	stem	root	
L1	10.6	0.596	0.588c	21.7c	16.7	68.0	24.2ab	44.7	65.2ab	10.2a	8.77b	14.0b	69.0b
L2	12.7	0.537	0.672bc	27.5be	17.4	69.7	27.8a	50.9	58.4b	10.5a	9.03b	17.3ab	93.8a
L3	11.0	0.536	0.858ab	32.2ab	16.1	76.5	18.9b	48.3	83.1ab	8.04be	11.3b	19.5ab	88.7a
L4	1.22	0.563	1.051a	36.3a	17.3	90.9	25.4ab	49.8	95.2a	9.05ab	17.5a	23.1a	97.6a
L5	1.14	0.567	0.970a	28.1b	16.1	77.9	21.0ab	45.2	73.3ab	6.67c	17.7a	18.4ab	97.0a
L6	1.113	0.385	0.596c	31.8ab	17.9	80.0	26.0ab	43.6	84.0ab	9.09ab	9.10b	20.2a	97.1a
Tukey	NS	NS			NS	NS		NS					
P≤0.01, P≤0.05			**	**			*		*	**	**	**	**

NS: Means values in columns followed by the same alphabets indicate not significantly different between themselves according to Tukey at P≤0.01 and P≤0.05. Means with different alphabets in the same column indicate significant difference between treatments by Tukey at P≤0.01**, p≤0.05* respectively.

4.2.3. Concentration of some nutrients in different parts of corn

This comparison is also clearly referee that CTR as an organic fertilizer has significant affected of some soil properties and amount of some soil nutrients as well in calcareous soil. In (Table 4.6) and according to Tukey test analysis of Variance ($P \leq 0.01$ or $P \leq 0.05$) there are a significant differences among different levels.

The highest value of nutrients concentration were recorded first by dose (L-360 g CTR 18 kg^{-1} Soil) as following N% (1.216 g/100 g)in leaf, Fe (90.887 mg kg^{-1}) in root, Mn (95.203 mg kg^{-1})in root, Zn (23.067 mg kg^{-1})in root and total dry matter (97.583 g) respectively and the second significant doses is (L-180 g CTR 18 kg^{-1} soil) as following N% (1.268 g/100 g) in leaf, Fe (69.710 mg kg^{-1}) in root, Mn (50.933 mg kg^{-1}) in stem, Zn (10.530 mg kg^{-1}) in leaf and total dry matter (93.83 g) respectively in corn, while the lowest value of nutrient concentration were recorded by dose (L^{-1} g CTR 18 kg^{-1} Soil) N% L^{-1} (0.588 g/100g) in root, Fe L-1(21.690 mg kg^{-1}) in leaf, Mn L-1 both (leaf and root 24.700, 44.700 mg kg^{-1}), Zn L-1 both(stem and root 8.767, 13.967 mg kg^{-1}) and total dry matter is(69.00 mg kg^{-1}) respectively in corn. This means the CTR were positively affected on the concentration of nutrients N, Fe, Zn , Mn and total dry matter in (L4-360 g CTR 18 kg^{-1} soil) firstly and (L-180 g CTR 18 kg^{-1} soil) secondly. For more understanding these relationships and concentration of nutrients are exposes on Figure 4.2, 4.3, 4.4, and 4.5 in page 28, 29 and 30 as.

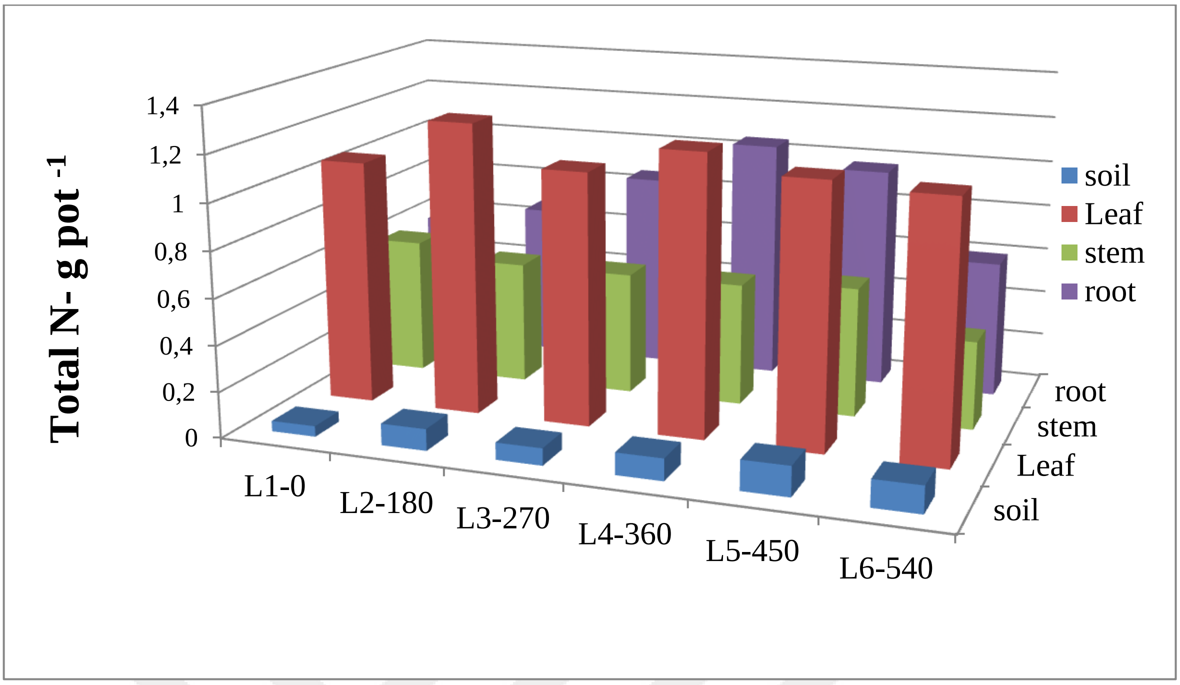

Figure 4.2. Effect of CTR on the concentration of average total N% g pot^{-1}in (soil, leaf, stem and root) at calcareous soil

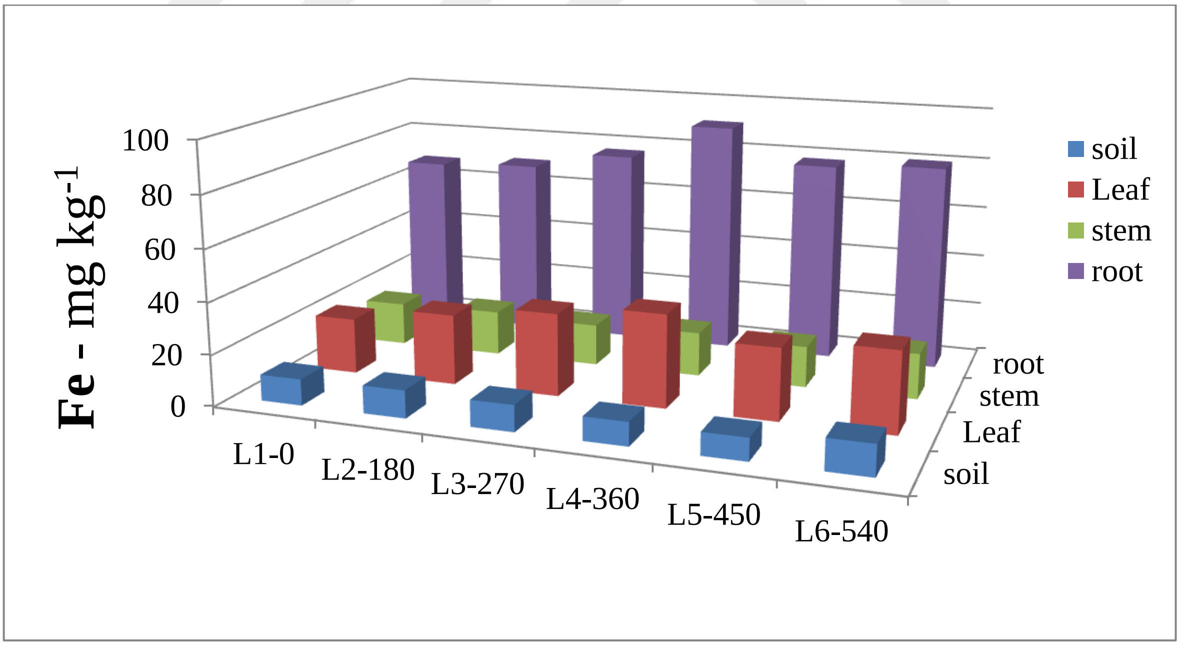

Figure 4.3. Effect of CTR on the concentration of average available Fe mg kg-1 in (soil, leaf, stem and root) at calcareous soil

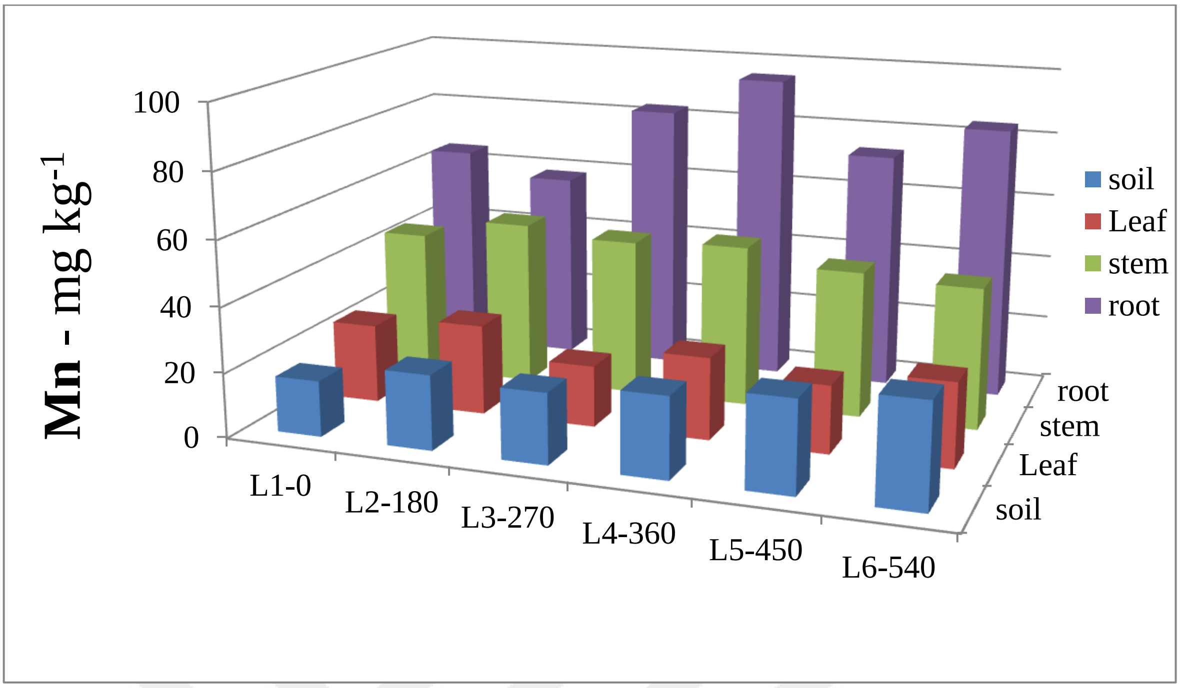

Figure 4.4. Effect of CTR on the concentration of average available Mn mg kg-1 in (soil, leaf, stem and root) at calcareous soil

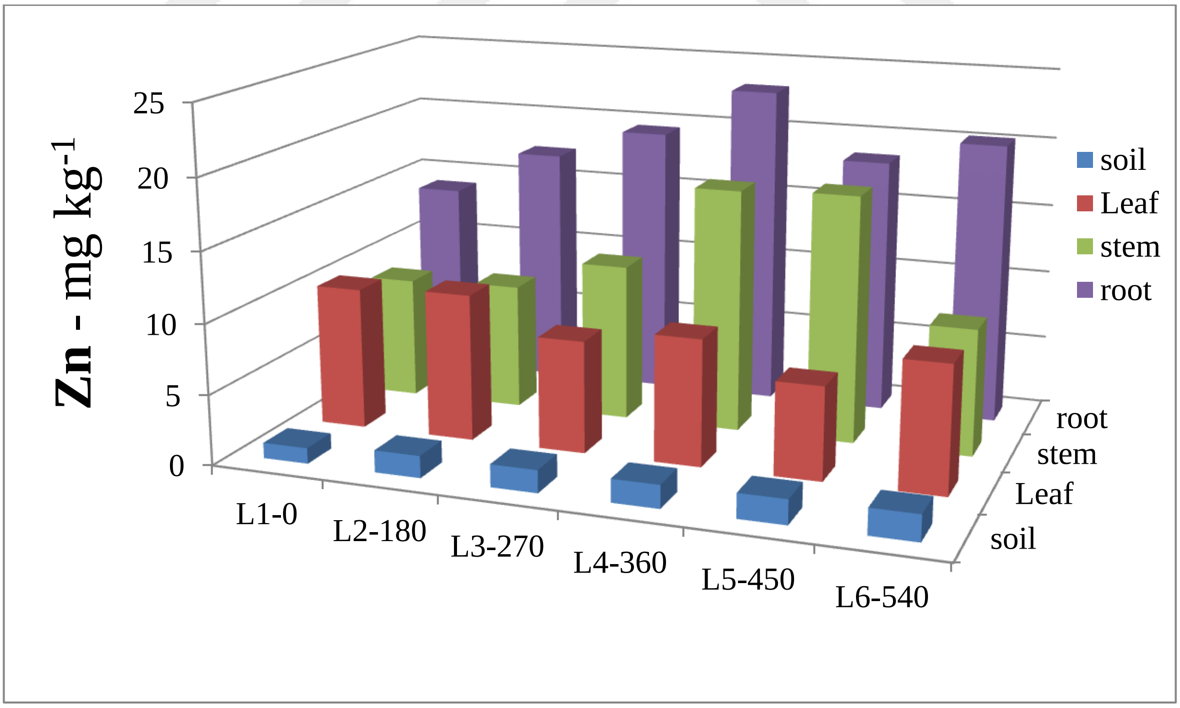

Figure 4.5. Effect of CTR on the concentration of average available Zn mg kg-1 in (soil, leaf, stem and root) at calcareous soil

4.2.4. Chlorophyll concentration in leaf of corn

Multiple comparison test of Tukey ($p<0.05$) showed that L-540 CTR treatment had only significant effect on chlorophyll content of fully expanded young leaves on 30/4/2016 date. However no significant differences were recorded subsequent measurement times. The overall averages of chlorophyll somehow were different for different CTR doses. There were increasing trend depending on the increasing amounts of CTR addition to soil. Thus the minimum chlorophyll content was obtained for the control and the maximum for the highest CTR application.

Figure 4.6. Measurements of chlorophyll

4.2.5. Nutrients uptake by biomass

CTR application had significant influence on N, Fe, Mn and Zn concentration of shoots. L4-360 treatment was performed better than the others to supply N, Fe, Mn, and Zn to corn plant. The highest value of nutrients up taken by biomass of corn were recorded by dose (L-360 g CTR 18 kg^{-1} Soil) as following N% (0.864 g/100 g), Fe (4.143 mg kg^{-1}), Mn (5.346 mg kg^{-1}) and Zn (1.595 mg kg^{-1}), while the lowest value of nutrient up taken by biomass of corn were recorded by dose (L-1 g CTR 18 kg^{-1} Soil) and (L-540 g CTR 18 kg^{-1} soil) respectively.

Table 4.6. Effect of CTR on average mean of chlorophyll in corn by (µmol/m2)

Doses	Date (23/7/2016)	Date 31/07/201646	Date 07/08/201642	Date 14/08/201644	Mean Average
L1-0	36.2	46.6	42.5	44.0	42.3b
L2-180	45.5	52.5	46.2	46.1	47.6 ab
L3-270	41.4	49.0	46.7	46.6	45.9ab
L4-360	43.9	51.5	46.9	47.4	47.4ab
L5-450	49.0	52.0	47.7	46.4	48.8ab
L6-540	45.40a	55.0	48.8	49.8	49.8a
Tukey P≤0.01 & P≤0.05	NS	NS	NS	NS	
					*

NS:Means values in columns followed by the same alphabets indicate not significantly different between themselves according to Tukey test at P≤0.01 and P≤0.05. Means with different alphabets in the same column indicate significant difference between treatments by Tukey at P≤0.01**, p≤0.05* respectively.

Table 4.7. The effect of CTR on N, Fe, Mn and Zn taken up by biomass from soil

Doses	N (%)	Fe (mg kg^{-1})	Mn (mg kg^{-1})	Zn (mg kg^{-1})
L1-0	0.581 c	2.226 b	2.973 b	0.732 d
L2-180	0.765 ab	3.085 ab	4.209 ab	1.068 c
L3-270	0.706 abc	3.183 ab	4.173 ab	1.080 bc
L4-360	0.864 a	4.143 a	5.346 a	1.595 a
L5-450	0.835 a	3.432 ab	4.276 a	1.374 ab
L6-540	0.641 c	3.552 ab	4.590 a	1.121 bc
F test Prob. P>F	**	*	**	**

Means with different alphabets in the same column indicate significant difference between treatments by Tukey at P≤0.01**, p≤0.05*, respectively.

4.2.6. Biomass production

Multiple comparisons of biomass in different part of the plant were given in Table 4.8. In general the control groups and CTR treated groups were significantly different at p<0.01 confidence level. Maximum total biomass was recorded for 360 g pot-1 CTR treatment but the other CTR treatments was in the same group with this treatment. The performance of 360 g CTR treatment for other biomasses traits was also higher than the other treatments but 450 g CTR treatment produced higher leaf biomass than the rest of the treatments. These results suggest that CTR are able to supply a significant amount of plant nutrition that distinctly changed the biomass production of corn plant but the limitation of biomass production above 360 g application doses indicated an adverse effect probably related to lack of decomposition synchronisation with plant nutrient requirements.

Table 4.8. Effect of CTR on mean dry matter production parts of corn

Doses	leaf (g)	stem (g)	root (g)	total (g)
L1-0	23.917 b	27.250 b	17.833 b	69.000 b
L2-180	31.250 a	41.083 a	21.500 ab	93.833 a
L3-270	28.833 a	38.333 ab	21.500 ab	88.667 a
L4-360	29.417 a	42.417 a	25.750 a	97.583 a
L5-450	33.083 a	40.417 a	23.500 ab	97.000 a
L6-540	31.250 a	43.750 a	22.083 ab	97.083 a
Tukey P≤0.01	F test Prob. P>F			
	**	**	*	**

Means with different alphabets in the same column indicate significant difference between Treatments by Tukey at P≤0.01**, p≤0.05*, respectively.

5. CONCLUSIONS AND RECOMMENDATIONS

Daily waste of CTR as a wet garbage, rich contain of benefit nutrients and concerning about negative environmental consequences, soil degradation and yield intensification which leads to high inputs of nutrients in the form of chemical fertilizers and in another hand low productivity of calcareous soil because of leaching some elements, fixation and unavailability of nutrients especially micro nutrients such as Fe, Mn and Zn.

High contain of calcium carbonate in Iraqi-Kurdistan Region soil and Since there are little or no studies about the role of organic fertilizers especially local organic fertilizer source such as CTR and using it direct to soil may increasing micro nutrient availability in such soil, for those reasons may leading me to think and finding way for recycling and using CTR as alternative of organic fertilizer and can be used to improve physiochemical soil properties of calcareous soil. On the results obtained, it might be concluded that CTR application of micronutrients could be useful for improving the nutrient status in soil, physiological performance and may to decrease the pH value in cancerous soil which contain a high amount of carbonate and calcium carbonate ions.

The Fe and Zn contents of both shoot and root were inversely proportional to rhizosphere pH. The Mn contents also increased with decreasing pH but a sharp increase was apparent below pH 5.5. The shoot Fe, Zn and Mn content were significantly correlated with the extractable levels determined in the rhizosphere and non-rhizosphere soil (Lutz et al. 1972).

The result of study showed that CTR with good management significantly affected of the availability of some nutrients in calcareous soil that up taken by Maize (*Zea mays* L.) and total dry matter of crop. The best CTR dose is L-360 which superior over all doses and after that is L-180.

The study has also helped to lay bare a number of important knowledge and this has resulted in the following recommendations for future studies:

1-The concentration on the interactions between the amount of CTR as organic fertilizer and plant sorts in calcareous soil is important.

2-CTR Should be applied to agricultural soils which contain high amount of clay additionally with moist, hence in winter because a microorganism activity may dominating in moist environment and may accelerates the decomposing of CTR then releasing more available nutrients to soil.

3-Should non exaggerating and using high doses of CTR because the study result showed using high doses of it may lead to release more nutrient as a result of microbial activities and more mineralization thus may cause high concentrated of nutrients in soil solution then lead to toxicity to the root of plant.

4-Irrigation management and water requirement should be arranged with the amount of CTR and in order to get a maximum decomposition during the stage of plant.

5-CTR may use as alternatives of the chemical fertilizers or mixed together because it is extremely cheap and non-harmful for the environment.

6-The extract of CTR, may be benefit, if it use as a foliate application to plant.

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Varians analysis test of (Table 4.3)

Analysis Variance of **N**, taken up by **leaf** from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.01591867	0.003184	2.2744	0.1131
Error	12	0.01679749	0.001400		
C. Total	17	0.03271616			

Analysis Variance of **Fe**, taken up by **leaf** from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.55163188	0.110326	18.8096	<.0001
Error	12	0.07038509	0.005865		
C. Total	17	0.62201697			

Analysis Variance of **Mn**, taken up by **leaf** from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.24880228	0.049760	6.3976	0.0041
Error	12	0.09333533	0.007778		
C. Total	17	0.34213761			

Analysis Variance of **Zn**, taken up by **leaf** from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.02427827	0.004856	9.2017	0.0009
Error	12	0.00633229	0.000528		
C. Total	17	0.03061056			

Analysis Variance of **N**, taken up by **stem** from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.01683378	0.003367	1.4884	0.2645
Error	12	0.02714467	0.002262		
C. Total	17	0.04397844			

Analysis Variance of **Fe**, taken up by **stem** from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.20161751	0.040324	5.5625	0.0070
Error	12	0.08699029	0.007249		
C. Total	17	0.28860780			

Analysis Variance of **Mn**, taken up by **stem** from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	1.6220829	0.324417	2.1571	0.1278
Error	12	1.8047513	0.150396		
C. Total	17	3.4268343			

Analysis Variance of **Zn**, taken up by **stem** from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.61239917	0.122480	31.6981	<.0001
Error	12	0.04636733	0.003864		
C. Total	17	0.65876650			

Analysis Variance of **N**, taken up by **root** from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.05941039	0.011882	16.4783	<.0001
Error	12	0.00865290	0.000721		
C. Total	17	0.06806329			

Analysis Variance of **Fe**, taken up by **root** from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	2.0481998	0.409640	1.9382	0.1613
Error	12	2.5362257	0.211352		
C. Total	17	4.5844255			

Analysis Variance of **Mn**, taken up by **root** from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	3.2848635	0.656973	3.7491	0.0282
Error	12	2.1028309	0.175236		
C. Total	17	5.3876945			

Analysis Variance of **Zn**, taken up by **root** from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.18260200	0.036520	8.2947	0.0014
Error	12	0.05283433	0.004403		
C. Total	17	0.23543633			

Varians analysis test of (Table 4.4.)

Analysis Variance of **N**, taken up from CTR by doses (soil)					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.01316111	0.002632	7.0748	0.0027
Error	12	0.00446467	0.000372		
C. Total	17	0.01762578			

Analysis Variance of **Fe**, taken up from CTR by doses (soil)					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	20.559244	4.11185	7.0734	0.0027
Error	12	6.975733	0.58131		
C. Total	17	27.534978			

Analysis Variance of **Mn**, taken up from CTR by doses (soil)					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	392.64280	78.5286	12.6672	0.0002
Error	12	74.39260	6.1994		
C. Total	17	467.03540			

Analysis Variance of **Zn**, taken up from CTR by doses (soil)					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.9927833	0.198557	5.3850	0.0080
Error	12	0.4424667	0.036872		
C. Total	17	1.4352500			

Analysis Variance of soil **pH**, by doses					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.05933333	0.011867	2.4866	0.0910
Error	12	0.05726667	0.004772		
C. Total	17	0.11660000			

Analysis Variance of **E.C**, by doses					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.00520000	0.001040	0.4426	0.8107
Error	12	0.02820000	0.002350		
C. Total	17	0.03340000			

Analysis Variance of **OM**, by doses					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	2.7495611	0.549912	8.5016	0.0012
Error	12	0.7762000	0.064683		
C. Total	17	3.5257611			

Varians analysis test of (Table 4.5.)

Analysis Variance of **N** concentration, taken up from soil by **leaf**					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.11384667	0.022769	1.7632	0.1950
Error	12	0.15495933	0.012913		
C. Total	17	0.26880600			

Analysis Variance of **Fe** concentration , taken up from soil by **leaf**					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	377.64593	75.5292	16.2658	<.0001
Error	12	55.72107	4.6434		
C. Total	17	433.36700			

Analysis Variance of **Mn** concentration , taken up from soil by **leaf**					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	164.15158	32.8303	3.5221	0.0343
Error	12	111.85527	9.3213		
C. Total	17	276.00685			

Analysis Variance of **Zn** concentration, taken up from soil by **leaf**					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	30.128400	6.02568	10.3677	0.0005
Error	12	6.974400	0.58120		
C. Total	17	37.102800			

Analysis Variance of **N** concentration, taken up from soil by **stem**					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.08393094	0.016786	1.4091	0.2891
Error	12	0.14294933	0.011912		
C. Total	17	0.22688028			

Analysis Variance of **Fe** concentration, taken up from soil by **stem**					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	7.885133	1.57703	2.4590	0.0936
Error	12	7.695867	0.64132		
C. Total	17	15.581000			

Analysis Variance of **Mn** concentration, taken up from soil by **stem**					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	134.52444	26.9049	0.5603	0.7287
Error	12	576.19333	48.0161		
C. Total	17	710.71778			

Analysis Variance of **Zn** concentration, taken up from soil by **stem**					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	271.94278	54.3886	27.2245	<.0001
Error	12	23.97333	1.9978		
C. Total	17	295.91611			

Analysis Variance of **N** concentration, taken up from soil by **root**					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.59241800	0.118484	17.6302	<.0001
Error	12	0.08064600	0.006721		
C. Total	17	0.67306400			

Analysis Variance ken of **Fe** concentration, taken up from soil by **root**					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	1008.6460	201.729	0.7604	0.5951
Error	12	3183.4270	265.286		
C. Total	17	4192.0731			

Analysis Variance of **Mn** concentration, taken up from soil by **root**					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	2746.2514	549.250	4.4586	0.0158
Error	12	1478.2738	123.189		
C. Total	17	4224.5252			

Analysis Variance of **Zn** concentration, taken up from soil by **root**					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	139.58278	27.9166	5.9630	0.0054
Error	12	56.18000	4.6817		
C. Total	17	195.76278			

Varians analysis test of (Table 4.6.) Chlorphyll

Analysis Variance of chlorophyll (23/7/2016)					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	285.99778	57.1996	2.2952	0.1107
Error	12	299.05333	24.9211		
C. Total	17	585.05111			

Analysis Variance of **chlorophyll** (31/7/2016)					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	129.10278	25.8206	2.4751	0.0921
Error	12	125.18667	10.4322		
C. Total	17	254.28944			

Analysis Variance of **chlorophyll** (7/8/2016)					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	69.98278	13.9966	1.9346	0.1619
Error	12	86.82000	7.2350		
C. Total	17	156.80278			

Analysis Variance of **chlorophyll** (14/8/2016)					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	52.97111	10.5942	0.6769	0.6492
Error	12	187.80000	15.6500		
C. Total	17	240.77111			

Analysis Variance of avarage **chlorophyll**					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	102.72208	20.5444	3.1681	0.0472
Error	12	77.81792	6.4848		
C. Total	17	180.54000			

Varians analysis test of (Table 4.8.) nutrients taken by Biomass

Analysis Variance of **N**, taken up by biomass from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	0.18310219	0.036620	10.0605	0.0006
Error	12	0.04368027	0.003640		
C. Total	17	0.22678245			

Analysis Variance of **Fe**, taken up by biomass from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	6.0005314	1.20011	4.9028	0.0113
Error	12	2.9373754	0.24478		
C. Total	17	8.9379068			

Analysis Variance of **Mn**, taken up by biomass from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	8.865327	1.77307	8.4067	0.0013
Error	12	2.530946	0.21091		
C. Total	17	11.396272			

Analysis Variance of Zn, taken up by biomass from soil					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	1.3047427	0.260949	20.9919	<.0001
Error	12	0.1491708	0.012431		
C. Total	17	1.4539136			

Varians analysis test of (Table 4.9)

Analysis Variance of avarage mean of **total dry matter of corn**					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	1837.4444	367.489	14.1607	0.0001
Error	12	311.4167	25.951		
C. Total	17	2148.8611			

Analysis Variance of avarage mean of dry matter of **leaf** of corn					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	151.48958	30.2979	12.5732	0.0002
Error	12	28.91667	2.4097		
C. Total	17	180.40625			

Analysis Variance of avarage mean of dry matter of **stem** of corn					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	536.98958	107.398	6.2022	0.0046
Error	12	207.79167	17.316		
C. Total	17	744.78125			

Analysis Variance of avarage mean of dry matter of **root** of corn					
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Doses	5	102.52778	20.5056	2.4679	0.0928
Error	12	99.70833	8.3090		
C. Total	17	202.23611			

BACKGROUND

My name is Jabar Jalal FAQE, I was living and working in Sweden more than 22 years in Stockholm city as well as I am a Swedish citizen. Originally I am Kurd from Iraq and I was born in 1957 in a nice Kurdish City in northern of Iraq knows as Sulaymaniyah with more than one and half millions of population. I am married and have six children, right now half of them are living in Sweden.

My Skills:
I finished both ground school and university in Sulaymaniyah City so I graduated BC.S since 1979 in agriculture college department of Soil Science at University of Sulaymaniyah. I was studied and educated IT-Networking system between 2002 until 2004 at King's Technical High School at Stockholm University in Sweden.

Now I am working as a lecturer at the Polytechnic University of Sulaymaniyah in a field of protected cultivation sections institute, since 2005. I started master program in Turkey in two years and between 2015 and 2017 at Bingöl University at Institute of Science, Faculty of Agriculture Department of Soil Science and Plant Nutrition.

I was participating many Vocational Educations Training both in Sweden and in Iraq and have good experience especially in vocational educations training as a trainer and leaderships focal point managing. I was held many different states and civilian Positions during my life.

I was traveling around many different countries and I know many languages like Kurdish, Arabic, English and Swedish. My interesting is Learning, Teaching, Reading, Traveling and voluntary working with civic organizations.


BİNGÖL
ÜNİVERSİTESİ
04.04.2016 10:55