BIOACCUMULATION OF SOME HEAVY METALS BY TWO ORNAMENTAL SUNFLOWER CULTIVARS IRRIGATED WITH UNTREATED WASTEWATER AT TWO LEVELS

Arsalan Azeez MARIF

MASTER THESIS

Department of Soil Science and Plant Nutrition
Supervisor: Assoc. Prof. Dr. Abdulkadir SÜRÜCÜ

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This thesis was unanimously Approved by the following jury on 27.12.2016

Assoc. Prof. Dr. Abdulkadir SÜRÜCÜ Chairman of the Jury	Assoc. Prof. Dr. Veli UYGUR Member	Prof. Dr. Alaaddin YUkSEL Member

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Director of the Institute

PREFACE

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Arsalan Azeez MARIF
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LIST OF SYMBOLS

SYMBOL	: DESCRIPTION
°C	: Degrees Centigrade
MS	: Mean Square
$CaCO_3$	: calcium carbonate
EC	: Electrical Conductivity
G	: Gram
K	: Potassium
MSE	: Mean Square of Error
Meq	: Mille equivalent
Mg	: Magnesium
Na	: Sodium
OM	: Organic Matter
P	: Phosphorus
Ph	: Power of Hydrogen
PPM	: Part Per Million
BAF	: Bio accumulation factor
TF	: Translocation factor
Ni	: Nickel
Zn	: Zinc
Cr	: Chromium
Co	: Cobalt
Fe	: Iron
Mn	: Manganese
Ww	: Waste water
C	: Cultivar
L	: Level of Irrigation
DF	: Degree of Freedom
Aqua reggia	: HCl 37%Concentration +70-72 HNO3 (3:1V/V)
HCl	: Hydrochloride Acid
HNO_3	: Nitric Acid
%	: Percentage
NW	: Normal Water
ES	: Evening sun sunfloer
GS	: Giant sunflower
NS	: Not significant
*	: Significant($p<0.05$)
**	: significant($p<0.01$)
V/v	: Volume/Volume

FARKLI DÜZEYLERDE TEMIZ VE ATIK SU ILE SULANAN AYÇIÇEĞI BITKISINDE BAZI AĞIR METALLERIN BIRIKIMININ BELIRLENMESI

ÖZET

Sulama bitkisel üretimde yüksek verim ve kalite elde edilebilmesi için en önemli girdilerden bir tanesidir. Ancak sulamaya uygun suyun yeterli olmadığı durumlarda farklı derecelerde kirlenmiş atık sular da sulamada kullanılabilmektedir. Bu çalışmada Biyo birikim ve Translokasyon faktörü ile Zn, Mn, Fe, Co, Cr, ve Ni derecede kirletilmiş olan atık suyun ayçiçeği yetiştiriciliğinde kullanılması durumunda ortaya çıkan Zn, Mn, Fe, Co, Cr, ve Ni elementlerine ait biyo-akümülasyon ve translokasyon faktörleri kaliteli sulama suyu ile karşılaştırılmıştır. Araştırmada iki su kaynağı, iki sulama düzeyi (35%, 60%) ve iki farklı ayçiçeği çeşidi (*Helianthus annus.L* ve *Helianthus giganteus*) kullanılarak ayçiçekleri tam olum dönemine kadar saksılarda yetiştirilmiştir.

Anahtar Kelimele: Biyo birikim faktörü, Translokasyon faktörü, Ayçiçeği (giant sunflower, even sun sunflower), Ağır metal, Artılmamış atık Sulama.

BIOACCUMULATION OF SOME HEAVY METALS BY TWO ORNAMENTAL SUNFLOWER CULTIVARS IRRIGATED WİTH WASTE WATER AT TWO LEVELS

ABSTRACT

Irrigation is one of the most important inputs to achieve high yield and quality in vegetable production. However, contaminated wastewater of different grades can also be used for irrigation when water suitable for irrigation is not sufficient. In this study, bioaccumulation and translocation factors of Zn, Mn, Fe, Co, Cr, and Ni elements were compared with quality irrigation water when the waste water different degrees contaminated with Zn, Mn, Fe, Co, Cr and Ni elements was used in sunflower cultivation. İn this research, sunflowers were grown in pots until full maturity using two water sources, two irrigation levels (35%, 60%) and two different sunflower types (*Helianthus annus .L and Helianthus giganteus).*

Key words: Bioaccumulation factor, Translocation factor, Sunflower, Heavy metal, waste water.

1. INTRODUCTION

The factors of active economic growth, increasing population expansion and opened up civilization, overusing of water resource and increasing levels of chemical pollutants in the environmental matrices of water, air and soil were often accompanied by restricting the sustainable development of agriculture production.

Additionally, in many arid or semi-arid regions, there a serious fresh-water scarcity thus any kind of water source which can be used for irrigation, even though polluted by any means, is considered by planners and decision makers in order to ensure agricultural productivity and economical development (Pescod 1992). The use of residual and sewage water is a common practice in rural field of many parts of the world (Feigin et al. 1991) , the treatment of wastewater made from several activities has increased as a result of the rapid enhancement of living standards (UNEPA 1994). To blend for the deficit in the last decades of water, sewage watering has been extensively used world wide , For example in China wastewater has been used since 1972 as an imperative additive and substituted water resources (Yang and Abbaspour 2007). The advantage of sewage water for irrigation are not only shortened freshwater demand (USEPA 1992) but also supply some nutrients and organic matter into the soil (Horswell et al. 2003). However, waste water probably contain heavy metals such as Pb, Zn, Cd, Ni, Cu, Cr and Mn. As and effect of long-term untreated water irrigation generally cause soil fertility decline which in turn became a potential problem. , heavy metal accumulation in the agricultural environment is almost impending (Singh. 2004; Li. 2005; Sharma et al. 2007; Yang et al. 2008). This accumulation may accelerat to human health (Mapanda et al. 2005; Muchuweti et al. 2006; Al-Lahham et al. 2007; Singh et al. 2012). Long-term waste water irrigation soil affection decline have become a usage of problem. Some plants named as be hyper accumulators in the can uptake, accumulate and tolerate comparatively higher amounts of heavy metals which can be used reclamation of either soils and/or waters (Cunningham et al. 1995; Chaney et al. 1997; Kabata-Pendias and Pendias 1999; Khan et al. 2000).

There are some bio remediation technologies to clean polluted wastewater from heavy metals. Despite this practice is used it has disadvantages such as time consuming, possible ecosystem demages during the cleaning process, adaptation problem of seedling to highly polluted environment, lack of specific plant in the market for complex polution facts (Landberg and Greger 1996; Mertens et al. 2004). Some group of plants that labeled metallophytes that can grow in common mineral fields, either natural (e.g. serpentine (ultramafic) soils) or anthropogenic ones (e.g. tailing dumps metal and smelter wastes) have a kind of tolerance mechanisms excessive concentration of heavy metals where normal plants can not grow. (Reeves and Baker 2000).

Some of ornamental plants have ability to remediate ecosystem pollutions through accumulating contaminants in their tissues. Sunflower. It is one of the most promising terrestrial candidates for metal and radionuclide removal from soil (Prasad 2007).

An Bioaccumulation factor (BAF) is frequently used to evaluate environmental hazards or risks of pollutants (Badr et al. 2012) , BAF is used in measuring of the degree uptake and accumulation of toxic compounds in animals and plants (Connell 1997). The BAF refers to the amount of any plant metal concentration in roots tissues to the soil or polluted environment. The researchers have out that the capability of bioaccumulation has generally been characterized by a translocation factors (TF), which is represent as the amount of the metal concentration in the shoots tissues to that in the roots tissues (Baker 1981; Yoon et al. 2006; Usman et al. 2009). Plants with TF values greater than 1 are accepted as high-activity plants for metal translocation (Ma et al. 2001).On the other hand, soil moisture is one of the pre-eminent great factors of plant growth and it determines the status of plant growth and agriculture production from germination to yield, water availability determines the plant performance. Response of plants to soil-moisture are commonly well known to farmers.

The objective of the presented study was to determine bioremediation capacity of two type of ornamental sunflower cultivar (*Helianthus annus*.L, Evening sun sunflower, and *Helianthus giganteus* , giant sunflower) for a variety of heavy metalsthrough bioaccumulation factor (BAF) and translocation factors (TL) under two irrigation levels with waste water and normal water.

2. LITERATURE REVIEWS

Heavy metal contaminated soils has inverse effects on not only the yield and quality yield but also the health of humans through the food chain (Chen et al. 2000; Ownby et al. 2005; Makino et al. 2006). There are waste areas which are moderately polluted therefore producing sufficient and healthy food for rapidly increasing population has a priority. Immediate measures are to be taken in order to reduce potential risks of contaminated lands to human health (Yu et al. 2006).

Areas is being continuously contaminated due to human using such as industrial expansion, urbanization, mining and demanding agriculture (Marchiol et al. 2007). In non-ferrous metal especially smelter fields, agricultural area is usually polluted with heavy metal by sewage water, and is inadequate for agriculture using. Some heavy metal is a biologically non necessary element for plant (Satarug and Moore 2004). But some heavy metal is an important trace element of consumption to plant, but excessive of this heavy metal is harmful. Plants easily take up heavy metal from the soil. Studies objected that heavy metal compete for uptake and translocation in plants (Hart et al. 1998; Cakmak et al. 2000).

The accumulation of this toxic metalloid in plant parts needs urgent study. No comprehensive reports are available regarding heavy metal accumulation and its transport to photosynthetic and edible parts of two cultivar of ornamental sun flower.

Sunflower has been used as an phytoextracter of heavy metals to remediated polluted soils (Liphadzi et al. 2003; Tandy et al. 2006; Lin et al. 2009). Sunflower has the ability to produce very high amounts of vegetative biomass in short time and uptake and tolerate considerable amount of Pb thus it could be used for phytoremediation studies of heavy metals. Thus ornamental sunflower cultivars are appropriate plant to clean up the heavy metal polluted lands.

The polluted soils are usually characterized by a little concentration of organic matter, small levels of nutrients, pH inequality, and other physical abnormalities (Ye et al. 2002; Chiu et al. 2006).Addition of organic fertilizer can significantly reduce the mobility of trace metal in soil (Madejon et al. 2006; Pichtel and Bradway 2008), but increase their amounts in plant shoots overall because of increasing biomass.

Nowadays pollution has become an ecosystem issue in both developed and developing countries in the world (Sun et al. 2010). Hazardous elements are of great concern due to their wide sources, toxicity, non-biodegradable properties and accumulative behaviors (Islam et al. 2014). In new studies, there has been a concern regarding soil pollution by various toxic metals due to quick industrialization and civilization (Chen et al. 2010; Suns. et al 2010). Urban areas are mainly under continuous effect of toxic elements being and other pollutants. The into the urban soils may lead to the deterioration of soil biology and function, changes the soil physicochemical properties and causes other environmental problems (Papa et al. 2010). Therefore, the remediation of polluted soil has a priority in order to reduce acute risks for the soil environment (Yu et al. 2012; Yuan et al. 2014 Cui et al. 2004; Li et al. 2009).

More and more recognized as useful models to simplify management of chemicals that are liberated to the environment. During to methods are just an approximation of the factual and more compound fate of chemicals, it is great to connect clearly the hazards associated with model effect. Sensitivity and risk analysis can also be useful to the model developer and to users who are interested in applying existing models to new ecosystem affection. Using model inputs that can focus consideration on accurately quantifying the values.

Phytoremediation or bio-accumulation technology has been taking a great deal of interest in recent years as in situ due to cost effective and environmentally friendly nature for reclamation of polluted sites (Saltpeter 1995).

The common usage of this economically friendly technology (phytoremediation) depends on more factors including: identifying or creating an ideal phytoextraction plant, optimizing soil and crop management process, and promoting ways for biomass treating and metal collection (Blaylock et al. 1997). Trace element plants have been showed to be in soil clean-up, as they can absorb very high concentration of metals from the polluted soils but their small biomass production limit the phytoremediation potential. For example, Thlaspi caerulescens is commonly referred to as a well-known Cd/Zn hyper accumulator, which can accumulate and tolerate up to 10,000 mg kg^{-1} of Zn and 100 mg kg^{-1} of Cd in shoots (dry matter) without showing any sign of toxicity (Escarré et al.2000). Also there are over 400 types of hyper accumulator plants (Baker et al. 2000) and studies have objected the expediency of natural hyper accumulators or other possible plants for phyremediation performance in vivo. From a practical aspect, the Cd/Zn hyper accumulator (Zhao et al. 2003) and the Cd hyper accumulator (Zhuang et al. 2005) could be suitable for phytoextraction of metal from moderately polluted soil.

Bio-accumulation perhaps defined as the treatment of plants including grasses and trees to cleanup or insulate risk contaminants from environment such as water, soil and air (Prasad 2003;Chaney et al.1997; Salt et al.1998), is profiting an active factor in recent time since it is gifted an expensive powerful technology, as well as a notable green, sustainable process (Song 2004 ; Wei and Zhou, 2004). Plants with metal refusal mechanisms based on removal can be worked for phytostabilization process (Wei et al. 2005). Accumulating plants, in distinction, it could become profitable for draw out hazards elements from the soil and thus safe area and restore fertility in contaminated areas (Barcelo and Poschenrieder, 2003). Accumulators practice are plants that have an innate ability to absorb metal at levels 100 times bigger than average plants (Baker and Brooks 1989; Yang et al. 2004; Zhou and Song 2004). They are often found in more metal contain area where those habit probably give them a competitive benefited and adopt to their ecosystem (Ma etal. 2001; Sun et al. 2005; Gonzaga et al. 2006). Hyper accumulators are refers based on the following properties: (1) shoots metal concentrations are >10,000 mg/kg dry weight of shoots for Zn and Mn, 1000 mg/kg for Ni, Co, Cu, As and Se, and100 mg/kg for Cd (Baker and Brooks 1989; Zhou and Song 2004); (2) bio concentration factor (amount of metal concentration in plant to soil) is bigger than 1.0 some tested reaching 50–100 (Brooks 1998; Cluis2004); (3) translocation factor (ratio of metal concentration in shoots to roots) is greater than 1.0 (Zhou and Wei 2004).So far, more than 400 types of natural metal accumulators belonging to 45 families have been documented in the world, but hyper accumulation of Cd and As are a rare fact in the plant kingdom (Song and Zhou 2004).

The word bioaccumulation represent an active process in which uptake metal is metabolically controlled. In spite of, heavy metal bio accumulation and toxicity in aquatic area depend essentially on many environmental irregular (Pawlik2002). Uptake metals is basically considered as a two-step process (Goyal et al. 2003; Ferraz et al. 2004). Complexion ion exchange adsorption inorganic small matter precipitation oxidation and/or reduction have been planned to explain the uptake process Metal ions are adsorbed first to the surface of cells by the in tractions between the metal ions and metal-functional. Groups for example phosphate, carboxyl, hydroxyl, sulphur, amino, sulphide, thiol, etc. present in the cell wall and then they interred the cell membrane and enter the cells. At the out cellular concentration of metal ions is bigger than that of inner cellular, metal ions can penetrate into the cell across the cell wall, and in fact several possible mechanisms have been recommended to underline their transport (Van Ho et al. 2002; Zalups and Ahmad 2003).

In accumulator plants the range of the concentration of elements in the plant to that in the soil is In refuse plants, metal concentration in aerial parts are mange low and constant over a big amount of metal concentration in soil, up to a critical value above which the reject mechanism breaks down, resulting in unrestricted transport and hazards, plant/soil concentration factors is <1. Sign plants the transport and uptake of metals are regulated in such a method that the amount of the concentration of element in the plant to that in the soil is >1. Bio-concentration factor (BCF) and translocation factor (TF) are important indicator in heavy metal uptake research’s (Marchiol et al. 2004: Zayed et al. 1998).

Important components of ecosystems are plants as they absorption elements from abiotic into biotic area. The primary resource of elements from the soil and water to plants. Most important to consider in use of food chain pollution are Co, Cd, Hg and Pb. together, micro nutrient (e.g. Cu, Cr, Ni, Zn) may be unsafe to both animals and plants at high concentration (McLaughlin et al. 1999). The bio possibility of elements to plants is controlled by many factors associated with climatic and soil conditions.

The phytoremediation of metal unsafe areas often involves costly and environmentally invasive and more design based practices (Marques et al. 2008). A period of technologies such as leaching, fixation, soil excavation, and removing of the top polluted soil exist have been used for the purification of metals. More of these models have big maintenance costs and may effect secondary contamination or adverse effect on activity of organism, fertility of soil and structure, (Pulford and Watson 2003). Extraction or binding of metals from contaminated area by physicochemical process is often desirable for small area where quick or complete safe is required (Martin and Bardos 1995; BIO-WISE 2000). In spite of the high expensive of these approaches necessitated the need for a less costly cleanup method. A promising approach is the phytoremediation model where living plants are used to separate trace metals from impacted fields. The enhancement of phytoremediation is driven primarily by the big amount cost of many other techniques as well as the desire to use a green supportable process. Because the amount costs of growing a crop are lowest when compared to those of soil removal and restoration, the use of plants to remediate toxic soils is seen as having great powerful (Chaney et al. 1997; Marques et al. 2008). First of the subgroup phytoremediation is phytoextraction, a model by which plants remove pollutants from soil and concentrate them in the green part of the plant. The plants are used to purification the contaminants via accumulation of the metal of the soil with incorporation in the plant tissues (Berti and Cunningham 2000). Subsequently, the harvestable parts big amount in accumulated metal.

The plants worked in a phytoextraction scheme should ideally have big biomass yield and accumulate high concentration of metals in the above- ground parts (hyper accumulators).

Heavy metals are big hazards because of their non-bio reduce able nature long biological half-lives and their powerful to accumulate in various body parts. More of the heavy metals are extremely unsafe because of their dissolve in water. Even little concentrations of heavy metals have reduced effects to animals and man because there is no good process for their rejection from the body. Recent test heavy metals are omnipresent because of their extra use in industrial using. Sewage water contains substantial amounts of hazard heavy metals, which make problems (Chen et al. 2005). Extra accumulation of heavy metals in soil agricultural through sewage water irrigation, may not just result in soil contamination, but also effect food safety and quality (Muchuweti et al. 2006). Water and Food are the main sources of our necessity metals; these are also the media through which sometime exposed to various toxic metals. Heavy metals are simply accumulated in the usable parts of vegetables like leaf part, as compared to fruit and grain products (Nyamangara et al. 2005). Vegetables uptake heavy metals and accumulate them in their usable (Bahemuka and Mubofu 1991) and un useable parts in quantities big amount to cause clinical problems both to human and animals beings consuming most metal rich plants (Alam et al. 2003). A number of limit health problems can increase as a result of extra take up of dietary heavy metals.

Heavy metals are insisted in easily and nature accumulate to hazard levels in mammals. however some metals are essential for affection because they provide essential cofactors for enzymes and, metalloproteinase at high concentrations they may exert adverse activity by blocking necessary functional types, removing other metal ions, or modifying the active conformation of biological molecules (Stotzky and Collins 1989). From soils, metals exert a determined effect on the quality of food and, soils availability yield. Many studies have been conducted on the health and environment effects produced by pollution of terrestrial ecosystems with metals (Caussy et al. 2003 ; Li et al. 1995). Most resource of heavy metals in sewage water originate from industrial and urban effluents as well as the deterioration of waste water pipes fixtures and plumbing. The new urban lands have been increasing and have caused contamination by heavy metal in urban and suburban areas.

Urban areas were the recipients of large ratio of heavy metal from a different of sources (Tiller 1992). Other resource of heavy metal pollution associated with soil of agriculture are untreated water sludge, pesticides, and fertilizer (Ross 1997; Alloway and Ayres

1993). The pollution of soils directly affected public health, because soils exert a direct caused on human health due to the fact that individuals simply come into contact with them (Cui et al. 2004; De Mignel et al. 1998; Mielke et al. 1999; Madrid et al. 2002). Some of the most significant contaminants are heavy metals such as zinc (Zn) , copper (Cu), and lead (Pb) (Selim and Iskandar ; Farid et al . 1992) the soil releases heavy metals into environment where growing in soils, and metals through available element for plants. Edible plants are considered to be respective sources of natural activity and essential metals which play a very effective factor in the formation of bioactive constituents and role as co factors for many enzymes required for therapeutic action. In common, metal ions in plants are up take in both above-ground and roots plant tissues in the underneath soil effect to bioaccumulation.

The ratio of bio accumulated heavy metals in the plants found on the soil composition as heavy metals are non-thermo-degradable or non-biodegradable and are transported in one system to other e.g., environment to plants. In this significant, it may be evolved that edible plants cultivated in metal contaminated areas may be fated to be phytotoxic and perhaps role as a medium for movement bigger amount of the heavy metals from un safe soil to the food-chain and may pose a caused of metal threating and related human life harmful. This supposition was derived from the tested showing high level of heavy metals in vegetables and edible plants.

Plants are none specially while taking up heavy metals from field area for which non necessary heavy metals, like Cd, Ni, Co, and Pub, active in lands would also be accumulated in vegetables and plants.

Sun flower is a powerful type of ideal natural source for the phytoremediation of contaminated fields. And (giant sunflower ornamental sunflower and evening sun sunflower) very common cultivar in a field. It is resistant to adverse ecosystem, fast expanding and with big biomass, under feasible ecosystem phase, its biomass could large rapidly (Wei et al. 2005).

Sunflowers (Helianthus giganteus, Helianthus annuus L) after peanuts, rape and soy, belongs to the more commonly grown ornamental plants and oil in worldwide. Represented the lists of FAO for the time between1961-2004, the largest cropping area of this plant is found in Russia and Ukraine (for merly the USSR), where last year it reached 4 500 000 and 3 320 000 ha regardly. (Helianthus annus L. Helianthus giganteus), one of the most active crops worldwide is a plant not only with food and energy assess but also with phytoremediation process. Sunflower is a calculated metal accumulator (Rojas-T. et al. 2012; Cindy et al. 2006; Niu et al. 2007; Fassler et al. 2010).

Land areas may become unsafe by the accumulation of heavy metals and metalloids through emissions from the quickly expanding using areas, disposal of high metal wastes, mine tailings, animal manures, soil adding of fertilizers, untreated water sludge, herbicides, sewage irrigation, charcoal combustion disposal, spillage of petrochemicals, and atmospheric deposition. Heavy metals constitute an imprecise group of inorganic hazards chemical and those most commonly appears at contaminated station are zinc (Zn), cadmium (Cd), lead (Pb), chromium (Cr), arsenic (As), copper (Cu), mercury, and nickel (Ni).

Soils are the big place for heavy metals released into the ecosystem by aforementioned anthropogenic using and undesirable organic pollutants that are oxidized to carbon (4) oxide by microbial activity, more metals do not undergo chemical degradation or microbial, which build up their concentration in lands persists for a long time after they are imported into soil.

In spite of, changes in their material forms and bioavailability are capable. The increment of cost activity and ecosystematicaly friendly technics for the remediation of sewage contaminated with danger substances soil is a first of global affection. The value of metal-accumulating plants to wetland remediation has been comprehended (black 1995). This possibility is gained in reducing unsafe heavy metals and trace elements from contaminated waters and soils in a remediation technology.

Heavy metals have risks in light of the role that they have a tendency to accumulate. Bioaccumulation involve a development in the collecting of a substance in a natural organic entity after little time, contrasted with the compound's focus in the earth. Mixes amass in living things at whatever time they are taken up and put away rapider than they are removed excreted or (metabolized).

Heavy metals supply to environmental contamination because of their exclusive properties, basically that they are not biodegradable, not thermo degradable and commonly do not leach from the soil first layer. Dissimilar hydrocarbons of petroleum and smaller that clearly build- up in soils, heavy metals do bio accumulate unnoticed to risk concentrations (Bohn et al. 1985) that effect animal and plant life. The period of pollution by heavy metals perhaps for thousands or hundreds of years, even after their increasing to soils had been ended. The time taken for Cu, Cd with Pb to reach half their concentrations in soil were found to be 310–1500 , 15–1100, and 740–5900 years, regardly controlled by soil type with physiochemical indicators (allowed and ayers 1993).

Metals increased in low concentrations find specific absorption sites in soil where they are contained more actively, either on organic and inorganic colloids (sauve et al. 2000). Following increasment to soil, organic loading of sewage go through decomposition to CO2, little molecular weight organic soluble acids, organic residual matter and inorganic capacity (Boyd et al. 1980). Corruption can also liberation heavy metals into water or soil solution. But, because of their low solubility and limited taking up by plants, heavy metals due to accumulate in top soil and will be part of the environment of soil matrix. Repeated with sewage using, heavy metals may be accumulate in soil to risk concentrations for plant growth (Chang et al. 1992), some of heavy metals in soil are product of human activity. Heavy metals from soil originally arose in the net effects of soil-forming with geological processes of the elements (Kabata-p. and Adriano 2010) also the concentration in soil is directed by the climate, parent material, slope and human movement, effects which are responsible for soil formation. Sandy soils from granite stones generally contain littler concentrations of heavy metals than clay soils imitative from mafic rocks (Ross 1994). According to (Ayres and Alloway 1993) heavy metals may goes to soil from agricultural works sources for example fertilizers, pesticides, peat moss and manure, and untreated wastewater sludge.

Heavy metals in soils are identified with a large number of physicochemical shapes that in turn effects their availability. A big factor limiting heavy-metal bioavailability and taking up inter roots is slow transport in soil particles to root surfaces (Tinker and Nye 1977; Barber 1984). This is mainly specified by the heavy-metal sorption to the most active soil constituents such as humus clay, and organ mineral complex. Chemical conditions of heavy metals, particularly from rhizosphere area (a soil cylinder of a given horizon all over living roots of plant that is effected by the root working), can be very different from those of the nonrhizosphere (bulk) as a result of root exudation, water and nutrient uptake, and microbial activity.

Plant cultivar accumulate metals differently, which may affect the types of metal cultivar with in rhizosphere place and total soils. Thus, knowledge of rhizosphere chemistry and rhizosphere activity is respective for characterizing metal using in environment as well as taking up by plants. Plant absorption of heavy metals activity hyper accumulators provides a big cleaner of polluted soils. The hyper-accumulating plants can derived the possibility not just to survive in metal-rich soils but also to sequester and store high levels of metal and metalloids in their shoots.

Excessive metal uptake by hyper-accumulator plants has been found to be associated with partial reduction of ability, simply bioavailable metal basin in the rhizosphere (Whiting et al. 2001; Fitz et al. 2003; Hammer and Keller 2002; Puschenreiter et al. 2003; Whiting et al. 2001) and good working root propagation toward polluted zones (Schwartz et al. 1999). Hyper-accumulators are able to develop a mechanism by which metals are taken up from non-mobile fractions (McGrath et al. 1997), implying that the plant-available division of heavy metals are not controlled to the solution and exchangeable division.

Following chemical extraction process have been actively working to examine these physicochemical models and to good understand the technic that effects element availability from rhizosphere.

Despite the limitations of sequential chemical extraction as compared to single extraction, it appears to be a model with some potential to provide relatively more detailed information on the status of trace metals in rhizosphere area. Accordingly, the main aim of the more tested research were to determine the chemical speciation of background essential heavy metals [manganese Mn, iron Fe, zinc Zn] in the fractionated root-zone soils (rhizosphere and rhizoplane) and bulk components of sunflower grown in a humic and sol. We studied how plants change the chemical properties of heavy metals in the root zone soils and bulk components and demonstrate that changes are involved in plant uptake.

Water activity in more parts of the world are decreasing through multiple system of allocation to and meeting through civil cities, industrial, agricultural, and environment groups. In the same time, the kind of the water sources is deteriorating caused to the build-up of contaminants and salts other. To improve security of water, new models must be sought to make more judicious repeat of the degraded, often wastewaters, and saline for the improvement of selected horticultural and agronomic crops. Increased guidelines for selection and improvement of crops quality for water reuse model will conserve clean water activities and reduce the volume of drainage water requiring disposal, minimize discharge of salts to the environment and suitable field productivity. In order too many big value ornamental crops are accepted to be salt sensitive, farmers have been reluctant to chance floral quality and economic return by activity recycled waters, saline for watering. Presently, concerns about ecological, environmental, and regulatory problem limited with the discharge of waters from ornamental plant operations are growing. Reuse, retention, and capture of degraded waters offer an active solution inasmuch as more economically-regard cut flower crops are, in fact, moderately salt resistant. Advances in models of growing and using along with gained in selection and breeding techniques have enabled users to using recycled waters for production and watering of cut flower crops without loss of yield and quality. Dianthus, Limonium, Chrysanthemum, Celosia, Gypsophila, Matthiola, Antirrhinum have been identified as suitable for water reuse systems (Carter and Grieve 2008; Carter et al. 2005; Grieve et al. 2006; Friedman et al. 2007; Shillo et al. 2002). Sunflower Ornamental plants have been yield under irrigation with many sources of recycled waters. (Arnold et al. 2003) according to the response of sunflower towatering with direct growing place runoff, wetland treated municipal tap water, and recycled nursery runoff, with and without the addition of sodium chloride.

Horticultural propagation has supply to quickly economic growth, and demand for horticultural activity has continued to enlargement with moving of population (Jackson 1997). This has affected in more horticultural interested, one of which is green production at municipal fields and using waste- water for watering. Waste water use happened either indirectly, when untreated effluent is discharged and partially into stream or lakes that used water for cultivation watering, or at municipal farms directly, when partially treated waste water effluent is conveyed into some fields. Research tested had shown that these developmental activity, made with the objective of growing socio economic profit, have also worked adverse environmental effect (FAO 2000) such as soil degradation. The studies also showed land disposal of waste water as the main resource of Zn, Cd, Cu and Pb enrichment of range land.

Field Soil, as filters of risk chemicals, can adsorb and retain heavy metals from sewage. But when the ability of soils to retain risk metals is reduced due to continuous loading of changes or pollutants make different in pH, soils can release heavy metals into soils deep layer or soil solution available and using by plants.

The amount of heavy metals moved in a soil environment is work of clay concentration pH, organic matter concentration, soil properties, and CEC or cat ion exchange capacity making each soil unique in terms of pollution management (William and Kimberly 1999). With the exception of Se ,Mo and As, heavy metal mobility decreases with increasing soil pH due to precipitation of, carbonates or formation ,hydroxides insoluble organic complexes (simth1996). Heavy metals are able of making insoluble complex compounds with organic matter and soil according to (Sauve et al. 2000) solid-solution partitioning of Cu, Ni Cd, Pb and Zn is dependent on soil solution pH, soil organic matter and total metal concentration.

civil society in developing countries improve, and inhabitant investigate better living standards, bigger amounts of clean water are diverted to drink using, economic, and sectors of industrial, which active greater volumes of wastewater (Asano et al. 2007;Lazarova and Bahri 2005; Qadir et al. 2007). Generally swage water is discharged with lowing or no treatment in natural resource water bodies, which can become largely unsafe. Urban farmers and per field urban of nearly all progress countries who are in demand of water for watering have often no other alternative than applying sewage water. They even calculatingly use undiluted sewage water as it provides is more reliable nutrients or cheaper than other water sources (Scott et al. 2004; Keraita and Drechsel 2004). So that farmer’s good thought this model can many harm to the environment and human health (Qadir et al. 2007 mainly due to not just the associated pathogens, but also heavy metals and other undesirable constituents using onthe source. municipal wastewater or Industrial or is mostly used for the irrigation of crops, basically in per urban environment, due to its easy activity, disposal issues and risk of clear water. (Nalvd 2008).

3. MATERIALS AND METHODS

3.1. Materials

Irrigation Water

Waste water and normal water were used in 35% and 60% levels of both measuring some parameter of water sources, especially waste water.

Soil

Composite surface soil samples (0-20 cm) were collected and air-dried to gently crush and pass through 4 mm stainless-steel sieve. Some part of the soil was sieved through 2 mm to determine pysio-chemical properties of the soils.

Description of the Study Area

A greenhouse study was conducted in Forestry Nursery of Bingöl. The experimental set-up was completely randomized design in triplicates with factorial arrangement. The factors were two sunflower cultivars (*Helianthus annus, L and Helianthus giganteus*), two irrigation water sources (waste water and tap water) and two irrigation levels (60% and 35%of available water).

Figure 1. The Soil Sample

Figure 2. Sieving of Soil in Sieve 4 mm

3.2. Methods

Particle Size Distribution (Texture Class)

The amounts of sand, silt and clay sized soil fractions were determined by a hydrometer in dispersed soil suspensions ad described by Bouyoucos (1952) and texture class of soils were determined from the texture triangle (Gee and Bauder 1986). The fraction of sand, silt and clay and texture classes were given in Table 2.

3.3. Soil pH

The soil pH was determined in 1:1 soil: distilled water suspension after 24 h of equilibration. A pH meter (give trade and model of the instrument) equipped with a combined colomel electrode was used to measure -log (H^+) by means of Wheatstone approach. The results were tabulated in Table 1.

3.4. Soluble Salts (Conductivity Method (EC))

Total soluble salts were determined in 1:2.5 soil: waster suspension by means of conductance-Resistance meter (YSI 34). The result was given in Table 1 .

Table 1. Physiochemical Properties Of Soil

EC(μS/cm)	pH	Percentage moisture %	Sand%	Silt%	clay%	Soil Texture Type
153.5	6.2	4.1	41.95	20.46	37.59	Clay Loam

3.5. Calcium Carbonate Equivalent

The amounts of CO2 evolved from the carbonates reacting with 10% HCl was determined by means of a manometric method. Then the calcium carbonate equivalent was calculates by using Boyle-Mariotte equation given below (Gülçür 1974):

$V_O = V_t \times (b – e) \times 273/760 \times (273 + T)$

$V_O = V_t \times (b – e) \times 273/760(273+T)$

% $CaCO_3$ = 100* $V_O \times 0.4464/ A$

Where:

V_o = Gas volume converted at normal conditions (cm^3).

V_t = Gas volume on calcimeter (cm^3).

b = Recovered Barometer pressure (mmHg).

e = V a p o r pressure of water at‘t’ ºC (mmHg).

t = Temperature (ºC).

A = Soil sample weight (g).

3.6. Soil Organic Matter

Soil organic matter concentration was determined by a wet oxidation with $K_2Cr_2O_7$ in acid media as described by Walkley-Black (reference). The organic matter concentration was then calculated from the equation given below:

% Organic Matter = A-(B*Nk) * 0581/T

A: The volume (mL) of $K_2Cr_2O_7$.

B: The volume (mL) of consumed iron sulphate 0.5 N.

T: Weight of soil.

Result presented in Table.3.

3.7. Olsen Phosphorus (Plant Available Phosphorus)

A mass of 2 g soil and 40 ml of extracting solution (0.5 M $NaHCO_3$ at pH 8.5) were placed in 125 ml conical flask. The suspensions were shaken for 30 min and filtered through filter paper. An aliquot of sample containing 2–40 lg P was reacted with ascorbic acid color reagent After development of stable color the absorbance and P concentration was determined at 880 nm wavelengths by a UV/VIS spectrometer (Kuo 1996).

3.8. Soluble Ca, Mg, K and Na Cations

Ammonium acetate (1 N NH_4OAc at pH 7.0) method with 1/10 soil/solution ratio was used for extraction of plant available Ca, Mg, K, and Na (Helmke and Sparks, 1996). Soluble Ca and Mg measured by titration methods and K and Na in the filtrate were determined by AAS in emission mode (perkin elmer precious AAnalyst 800) and data were given in Table 2.

Table 2. Physiochemical Other Properties Of Soil

Soluble Na Meq/100 soil	**Soluble K Meq/100 soil**	**Soluble Ca Meq/100 soil**	**Soluble Mg Meq/100 soil**	**$CaCO_3$%**	**Available P Kg /da**	**Organic Matter%**
0.15	0.75	4.43	5.55	0.579	4.328	1.582

3.9. Analysis Soil Heavy Metals (Zn, Mn, Fe, Co, Cr, and Ni)

1 g of soil sample in triplicates was wet a shed with 10 mL of aqua-reggia (HCl:HNO3 mixture, 3:1 V/V) in microwave oven (CEM corporation, Marsexpres 6) and data were given in Table 3.

Table 3. Heavy Metal Concentrations Of The Experimental Soil

Sample	**Total Zn $\mu g\ g^{-1}$**	**Total Mn $\mu g\ g^{-1}$**	**Total Ni $\mu g\ g^{-1}$**	**Total Cr $\mu g\ g^{-1}$**	**Total Co $\mu g\ g^{-1}$**	**Total Fe $\mu g\ g^{-1}$**
Soil sample	76.9	315.7	38.58	160.3	3.63	43750

3.10. Analysis Wastewater Samples, And Normal Irrigation Water.

pH and electrical conductivity (EC) and total dissolved salts(TDS)

pH and EC and TDS of both waste water and fresh water were determined after filtration by means of pH meter and EC meter (Orion 3 Star).Result were showed in Table 4.

Total Suspended Solids (TSS)

Filtration procedure take 1 L sample and filtrate the water sample then weight the difference in the filter paper. Table 4.

Table 4. Physiochemical of Water Analysis

Sample	EC(µS/cm)	pH	TDS µg mL^{-1}	TSS µg mL^{-1}
Normal Irrigation water	107	7.4	37	0.01
Waste water	424	8.6	226	0.218

3.11. Concentration Of Water Samples Na, K, Ca and Mg

Analysis of action Na, K and an ion Na, K, Ca and Mg concentration of water were determined by AAS after filtration. The data were presented in Table .5accordind to (Sularin Analġz Parametrelerġ 850CK0011 2011) heavy metal range noraml for agricultural Irrigatio.

Table 5. Physiochemical Other Properties Of Water Analysis

Sample	Total Na µg L^{-1}	Total Ca µg L^{-1}	Total Mg µg L^{-1}	Total K µg L^{-1}
Normal water	6.3	34.4	32.5	2.7
Waste water	9.6	92.8	207.6	7.5

3.12. Heavy Metal Concentration Of Water Samples (Co, Mn,Cr,Zn,Fe , and Ni)

Heavy metal concentrations of water samples were determined by means of AAS and the data were given in Table 6, accordind to (Sularin Analġz Parametrelerġ 850CK0011 2011) heavy metal range noraml for agricultural Irrigation .

Table 6. Data Heavy Metal Water Analysis

Sample	Total Zn µg mL^{-1}	Total Mn µg mL^{-1}	Total Ni µg mL^{-1}	Total Cr µg mL^{-1}	Total Co µg mL^{-1}	Total Fe µg mL^{-1}
Normal water	0.01	0.1	0.005	0.003	0.12	0.36
Waste water	0.04	0.3	0.006	0.0042	0.14	0.54

3.13. Post Experiment Analysis Of Soil And Plant

At the end of the pot experiment roots, stems, and leaves of sunflower plants were separately sampled. After removal of possible contaminants by washing with tap water and distilled water, respectively, plant samples were oven-dried at 65 °C. The samples were homogenized by reducing the particle size below 0.5 mm with a grinder. Then the samples were ashed in microwave oven. The mineral composition of digest were then determined by AAS or spectrometer. Procedures

According to soil which taked in pots it’s used for research

Soil samples were passed through 2 mm seive then ashed with aqua reggia in microwave oven as described earlier on. Then the composition of digests was determined by AAS.

3.14. Pot Experiment

The experimental set-up was completely randomized design in three replication with factorial arrangement. The factor was irrigation water source and irrigation level and sunflower cultivar. The seeds were sowed on 10/04/2016 and the plants were harvested on 14/07/2016. The seeds were first sowed in a germination trace and three weeks after emergence the seedlings were transplanted in to 32 L pots filled with 23 kg soil. The the plants were grown with two different irrigation waters (normal water and waste water) at two different irrigation levels (35% and 60% of available water.

Figure 3. A Picture Of Pot Experiment At Very Early Stage Before Transplanting

Figure 4. Sunflower Ornamental Plant Cultivar Number One (Evening Sun Sunflower)

Figure 5. Sunflower Ornamental Plant Cultivar Number Two (Giant Sunflower)

Table 7. Experimental Design.

M1C	M1W	M2W	M2C	M2C	M1W	M2W	M2W
M2C	M1C1	M2W	M1W	M1W	M2C	M1C	M1C
M2C	M1W	M2W	M1C1	M1C	M2W	M1W	M2C
Sunflower ornamental specie1 no1 (Eveningsun sunflower)				Sunflower ornamental species no2 (Giant Sunflower)			
M1=35%moisture depletion , M2= 60% moisture depletion				W= waste water, C= Normal water,			

3.15. Palnt Analysis

At the end of the pot experiment roots, stems, leaves and seeds of sunflower plants were separately sampled. After removal of possible contaminants by washing with tap water and distilled water, respectively, plant samples were oven-dried at 65C. The samples were homogenised by reducing the particle size below 0.5 mm with a grinder. Then the samples were ashed in microwave oven. The mineral composition of digest were then determined by AAS or spectrometer.

3.16. Calculating Bio Accumulation Factor (BAF) and Translocation Factor

- Bio- accumulation factor (BAF) refers to the ratio of plant metal concentration in roots tissues to the soil or polluted environment [(Metal) root/ (Metal) polluted environment or substrate].

- Translocation factor which was determined from the ratio of the metal concentration in the shoots to that in the roots.

Table 8.Total Irrigation Water Used In The Experiment

Cultivar	Replication	Amount of water use 35 %Normal water. kg/pot	Amount of water use 60% Normal water. kg/pot	Amount of water use 35%waste water. kg/pot	Amount of water use 60% waste water. kg/pot
Evening sun sunflower	R1	50.7	40	54	36
	R2	49.9	39	48.7	39
	R3	48.9	41	51	40
Giant sunflower	R1	48.5	40	50.7	34
	R2	49.5	40	48.5	37
	R3	51	35	44.7	41

Statistical Analysis

The data were subjected to ANOVA by using JMP 5 statistical program. The separation between the treatments was made least significant difference test (LSD).

Green House Temperature

During growing season average temperature of experiment between (21-34°C).

4. RESULTS AND DISCUSSION

4.1. Explained Zn Bio Accumulation Factor Effects

BAF values for different heavy metals were given in Figure 6 and appendix anova Table1 shows BAF Zn treatment induced changes for Zn. Sunflower cultivars responded significantly different to water sources. The BAF value of Zn which it is significant in cultivar($P<0.05$), Maximum value BAF is (0.619) at 60% normal irrigation levels use of cultivar Evening sun sunflower and the minimum Value of BAF is (0.357) at Giant sunflower cultivar does not have any significant water type and levels use of irrigation and there inter actions and explain in the Figure 6 It is clear the different value between the maximum and minimum of the Zn value.

Table 9. The Main Effects of The Treatments On BAF of Zn

Cultivars	Evening Sun Sunflower	0.51
	Giant Sunflower	0.39
Water Source	Waste Water	0.41
	Normal Water	0.48
Irrigation Levels	35%	0.43
	60%	0.46
LSD	LSD=0.056 (Cultivar)	

And according to Table 9 no difference between irrigation levels and water source but happened difference between two cultivars (LSD=0.056), these results are in agreement with result and report (Salih et al. 2014) and (Jamal M. K. et al. 2009). Also according to appendix an ova Table 1 significant ($P<0.05$) only in significant

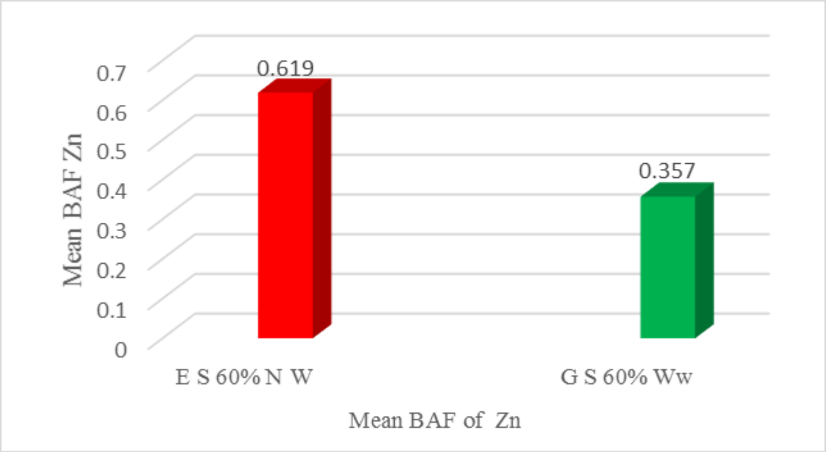

Figure 6. Relation Between Mean Zn Baf Value And Cultivar With Levels Of Irrigation Use

4.2. Explained Mn Bio Accumulation Factor Effects

According to Figure 7 showed second element Mn is respective cultivar, water type ($p<0.01$), levels of irrigation use ($P <0.05$) and inter actions between value is (1.052) of Giant sunflower cultivar of 60% normal irrigation water and the lowest level of BAF value is (0.112) of evening sun sunflower of 35% waste water. According to Table 10. Difference happened between cultivar (LSD=0.294) therefore respect for giant sunflower and no active for Evening sun sunflower. Also between water source according (LSD=0.099) normal water is high than waste water, according to levels or levels of irrigation difference between 35%and 60% happened (LSD=0.161) (Salih et al. 2014)Level 60% is higher than 35%.

According to appendix anova Table 3 significant ($P<0.01$) of cultivar, also interaction between cultivar and irrigation levels, but significant in ($P<0.05$) water source

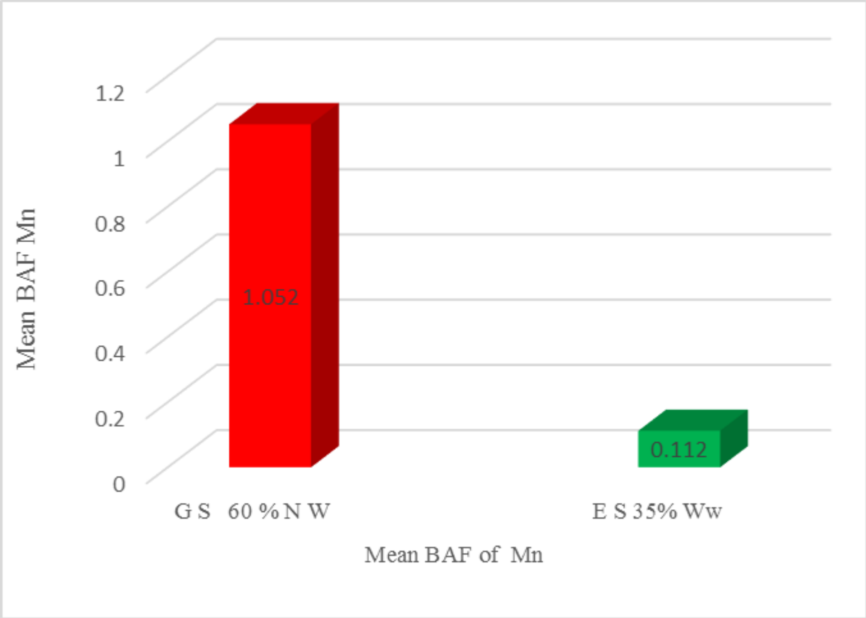

Figure 7. Relation Between Mn BAF And Cultivar With Levels Of Irrigation Use

A good answered for BAF of Mn effected and absorption of this heavy metal accumulation in the soil to the root moving extra Mn from soil and consumption to sunflower shoots acceptant, which it is Giant sunflower cultivar obtain a big role in soil purity of excess Mn nutrition which the remain excess element toxic and dis availability is happen ,powerful of water availability and ratio of moisture depletion in normal irrigation ,big levels of irrigation however Evening sun sunflower cultivar in cleaning of soil excess Mn effective and waste water depletion for low level respective , Accumulation Ability of giant sunflower greater than Evening sun sunflower. Mn BAF answer are online with (Salih et al. 2014) and (Muhammad et al. 2009).

Table 10. The Main Effects Of The Treatments on BAF of Mn

Cultivars	Evening Sun Sunflower	0.18
	Giant Sunflower	0.67
Water Source	Waste Water	0.34
	Normal Water	0.50
Irrigation Levels	35%	0.28
	60%	0.57
LSD	LSD=0.161(D) LSD=0.099(W), LSD=0.294(C)	

4.3. Explained Fe Bio Accumulation Factor

Main effect of the treatment on BAF of Fe difference in cultivar evening sun sunflower is active answer and high level (LSD=0.122) than giant sunflower. Water source and irrigation levels not have any difference also data significant appendix anova Table 5 and Figure 9 According to BAF Fe value is powerful in cultivar, and not have any significant in water type and levels of irrigation use and inter actions between all of it. The BAF significant value of cultivar type of ornamental sunflower is(0.390) of cultivar evening sun sunflower at both level 35%,60% normal levels of irrigation use of available moisture depletion because powerful in same value, and the lowest value of Fe BAF is (0.139) of 60% waste water levels of giant cultivar .

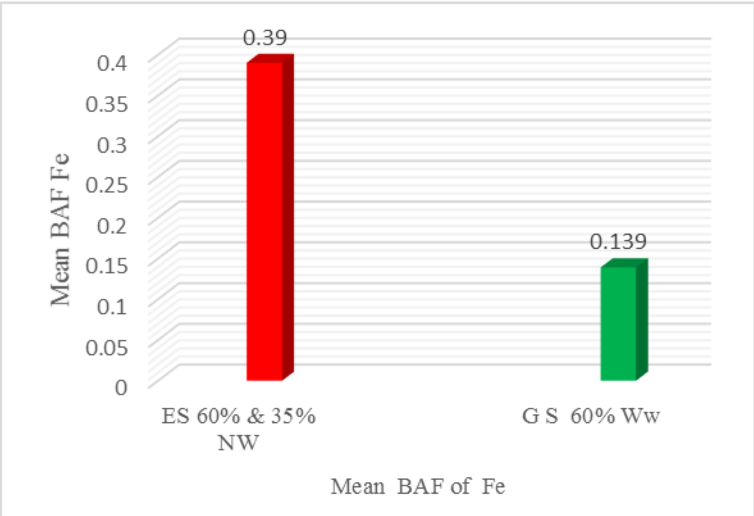

Figure. 8 . Relation between Fe BAF Value And Cultivar And Levels Of Irrigation Use

Table 11. The Main Effects Of The Treatments on BAF of Fe

Cultivars	Evening Sun Sunflower	0.32
	Giant Sunflower	0.19
Water Source	Waste Water	0.20
	Normal Water	0.30
Irrigation Levels	35%	0.27
	60%	0.23
LSD	LSD=0.122 (C)	

Absorption of Fe plant nutrition answer active evening sun sunflower cultivar, soil accumulation of Fe heavy metal corresponding in normal water availability phase with various level (35.60 %) high with low acceptant value important point both moisture kind similar effect with one cultivar plant next small accumulation Fe respect happened for giant sunflower cultivar, sewage water active for irrigation and nutrition sunflower type with large answer of moisture depletion level. Current accumulation Of Fe suggested that various cultivar with assorted water irrigation caused cleaning and purification of soil contaminated of heavy metal excess. Fe accumulation results are in approving with ((Salih et al. 2014) , 2014) result. And (Muhammad,etal,2009) reports. In the appendix anova Table.5 Iron significant($P<0.05$)in Cultivar only. (Salih et al. 2014) .

4.4. Explained Co Bio Accumulation Factor Effects

Appendix anova Table 7 and Figure 10 Concern Co passed ($p<0.01$) in cultivar and in interactions between cultivar and water type respective level value ($P<0.05$) is (0.650) of ornamental sun flower cultivar evening sun sunflower cultivar at 35% of available moisture depletion (Tarek et al. 2014) the lowest value and the minimum level of Co BAF value is the (0.331) of ornamental sunflower cultivar Giant sunflower cultivar at 60% of available moisture depletion.

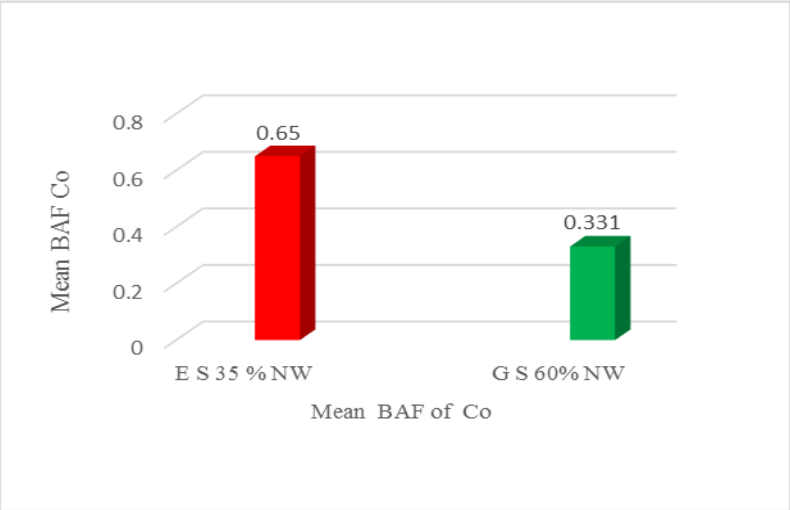

Figure 9. Relation Between Co BAF Value with Cultivar And Levels of Irrigation Use

Table 12. The Main Effects Of The Treatments on BAF of Co

Cultivars	Evening Sun Sunflower	0.58
	Giant Sunflower	0.37
Water Source	Waste Water	0.47
	Normal Water	0.48
Irrigation Levels	35%	0.48
	60%	0.47
LSD	LSD=0.122 (C)	

Data result Table 12 displayed that main effects of the treatments on BAF of Co only cultivar regards LSD=0.122 for evening sun sunflower but giant sunflower lower than it, also according to water source and irrigation level not difference between each other's.

4.5. Explained Cr Bio Accumulation Factor Effects

According to appendix anova Table 9 displayed high significant (P<0.01) in inter action between cultivar and irrigation levels with water type, irrigation level and cultivar but significant (P<0.05) in cultivar, water type and irrigation levels, Figure.11 displayed highest powerful of Cr BAF is (3.05) of ornamental sunflower cultivar giant at 35% of available moisture depletion unactive result level is (0.194) of giant ornamental sunflower cultivar at 60% waste water depletion.

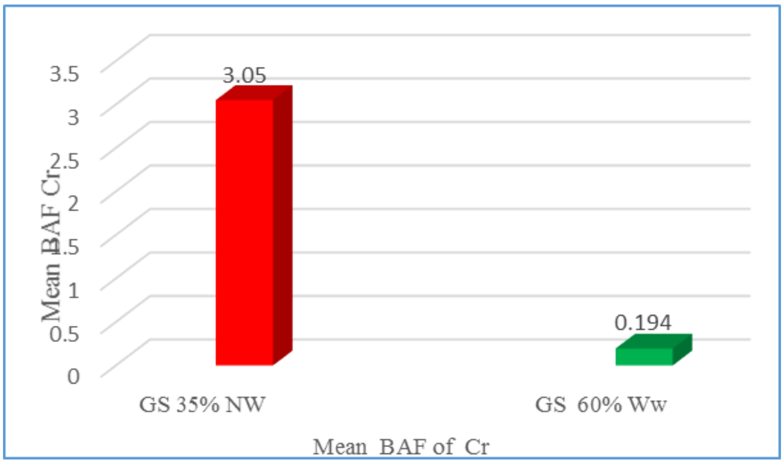

Figure 10. Relation Between Cr BAF Value With Cultivar And Levels Of Irrigation Use

Data result for Cr main effect of the treatment showed difference in cultivar for respect of evening sun sunflower cultivar(LSD=0.485),difference between water source (LSD=0.871) and between two levels of irrigation(LSD=0.463).These results are in agreement with Result, (Muhammad et al. 2009) and (Tarek et al. 2014).

Table 13 the Main Effects Of The Treatments on BAF of Cr

Cultivars	Evening Sun Sunflower	0.53
	Giant Sunflower	1.10
Water Source	Waste Water	0.36
	Normal Water	1.27
Irrigation Levels	35%	1.08
	60%	0.55
LSD	LSD=0.463 (D) , LSD=0.871 (W), LSD=0.485 (C)	

4.6. Explained Ni Bio Accumulation Factor Effects

Observed in appendix nova Table 11 of Ni BAF significant ($p<0.05$) on the levels of water use and inter actions between cultivar and water source Also Figure 12 showed maximum levels of Ni BAF value is (0.455) of giant sunflower cultivar at 60% normal irrigation water or moisture depletion and the minimum levels of Ni BAf Value is (0.064) of evening sun sunflower cultivar at the 35% normal irrigation water use or 35% of moisture depletion.

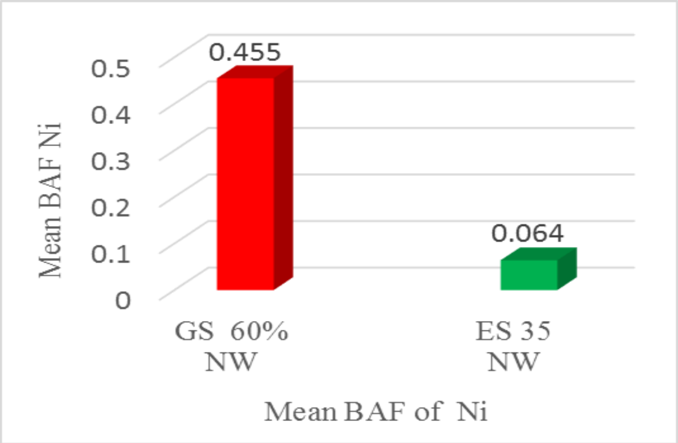

Figure 11. Relation Between Ni BAF Value with Cultivar And Levels of Irrigation Us

Table 14. The Main Effects Of The Treatments on BAF of Ni

Cultivars	Evening Sun Sunflower	0.14
	Giant Sunflower	0.25
Water Source	Waste Water	0.17
	Normal Water	0.21
Irrigation Levels	35%	0.12
	60%	0.27
LSD	LSD=0.106 (levels)	

cultivar and ability answer for good accumulation of Ni greater despite of activity of normal depletion with high level levels range and the cleaning and purification soil heavy metal un respective product for Ni with the other cultivar parallel low level water depletion with cultivar for accumulation in small answer ability indicate for that cultivar giant sunflower is greater power than evening sun sunflower. Results are in similarity with ((Salih et al. 2014) and (Tarek et al. 2014). Also observed in data result Table. 14 of main effect of the treatments just in Irrigation levels LSD=0.106, according to other effect not respect answer.

4.7. Explained Different BAF In Maximum Levels

Current research displayed results of BAF various value between (Zn, Mn, Fe, Co, Cr, and Ni). Maximum powerful answer heavy metal Cr highest respect (3.05) ,important accumulation happened of 35% normal irrigation water , Giant ornamental sunflower it is mean forceful cultivar with activity working of normal depletion with high level levels, Next heavy metal (Mn) (1.052) is smaller than Cr (Cr>Mn) same cultivar of sunflower and same available moisture depletion wit same water type ,waste water un active answer for Mn high level accumulation also next heavy metal (Co) (0.650) active answer cleaning soil excess metal with Evening sun sunflower cultivar parallel with low levels of normal water use and levels display (Mn>Co), also (Zn) (0.619) is powerful moving happened for obtain bio accumulation with good ability answer of evening sun sunflower cultivar its respective normal water with high level levels depletion sewage water un active for high answer of Zn accumulation therefore Co activity is greater than Zn(Co > Zn) , next metal (Ni) (0.455) good remark accumulation of cleaning and purification activity of giant sunflower cultivar same depletion and type water of Zn metal worked active but waste water not respective work according to water type and levels of irrigation use therefore Zn accumulation more than Ni(Zn > Ni), last heavy metal (Fe) (0.390) online and power full for collecting high level with various level irrigation use and moisture depletion type of Evening sun sunflower cultivar it’s mean Ni collecting ability is greater than Fe . These results more answer according to ability of accumulation and cleaning soil case, a ranking order (Cr > Mn > Co > Zn > Ni > Fe) shows maximum bio accumulation answer according to their heavy metal from greatest to smallest accumulation explained in Figure 12.

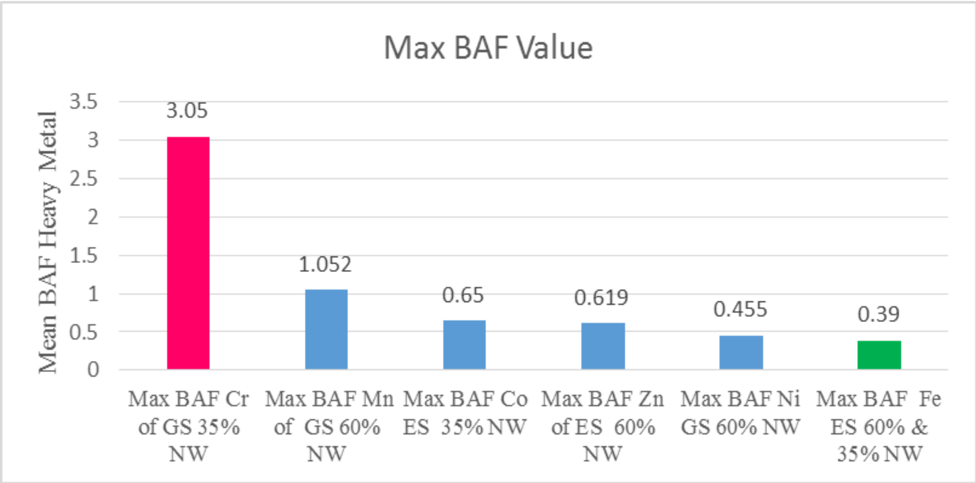

Figure 12. Relation Between Heavy Metal Element Baf Value with Cultivar And Levels of Irrigation use In Maximum Levels

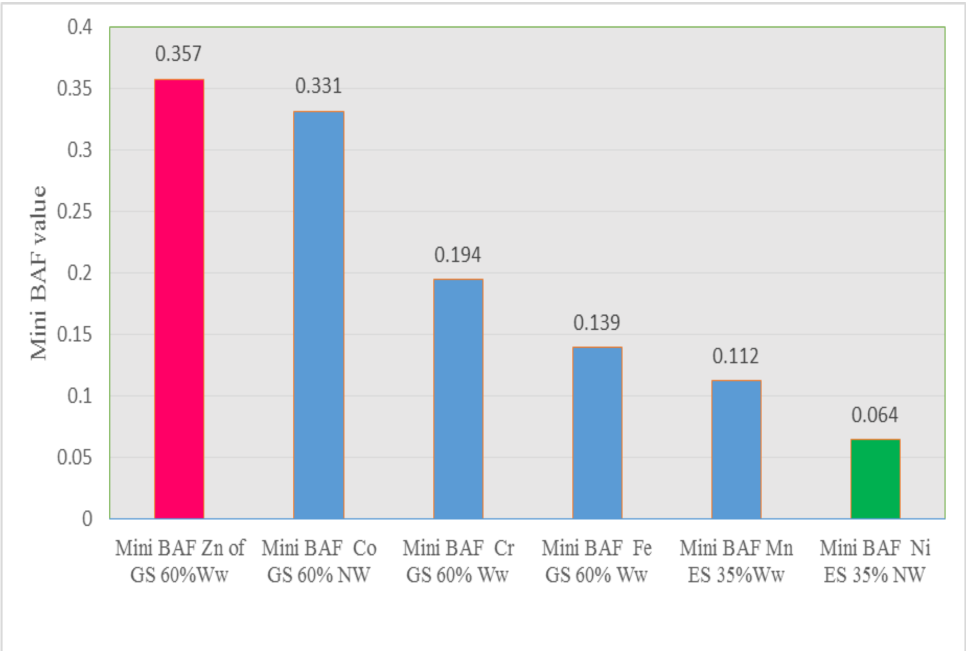

Figure 13. Relation between heavy metal element baf value with cultivar and levels of irrigation use in minimum levels

4.8. Explained different BAF in minimum levels

Figure.13 Waste water effect active in explained minimum level of heavy metal BAF value shows that big effect happened on low level of metal activity but normal irrigation working in high concentration metal also high respect BAF concentration, on the other side waste water worked low accumulation of soil cleaning and consumption of nutrient element important cultivar that big effect in accumulation is giant sunflower it is mean ability of accumulation of giant sunflower is greater than evening sun sunflower, current research more minimum respect happened started Zn next Co to Cr after Fe than Mn last level of minimum is Ni it is mean respect activity in minimum level showed in ranking order(Zn> Co> Cr> Fe> Mn> Ni) . Smallest answer is Ni accumulation answer effect, show this result more activity obtained for soil purification and removing large amount of heavy metal. These results are in agreement with (Salih et al. 2014) result and online with (Muhammad etal.2009) paper.

4.9. Explained Zn Translocation Factor Effects

According to appendix anova Table 2 Translocation factor TF displayed Zn significant ($p<0.01$) in cultivar, Figure 15 displayed highest level of TF value of Zn is (0.912) of giant sunflower cultivar at 60% waste water or available moisture depletion and the minimum level of TF of Zn value (0.478) of evening sun sunflower cultivar at 60% normal irrigation water.

Table 15. The Main Effects Of The Treatments on TF of Zn

Cultivars	Evening Sun Sunflower	0.61
	Giant Sunflower	0.69
Water Source	Waste Water	0.77
	Normal Water	0.65
Irrigation Levels	35%	0.59
	60%	0.46
LSD	LSD=0.122 (Water type)	

Data result Table 15 displayed respect difference between water source LSD=0.122 and according to others not any difference between cultivar and irrigation level.

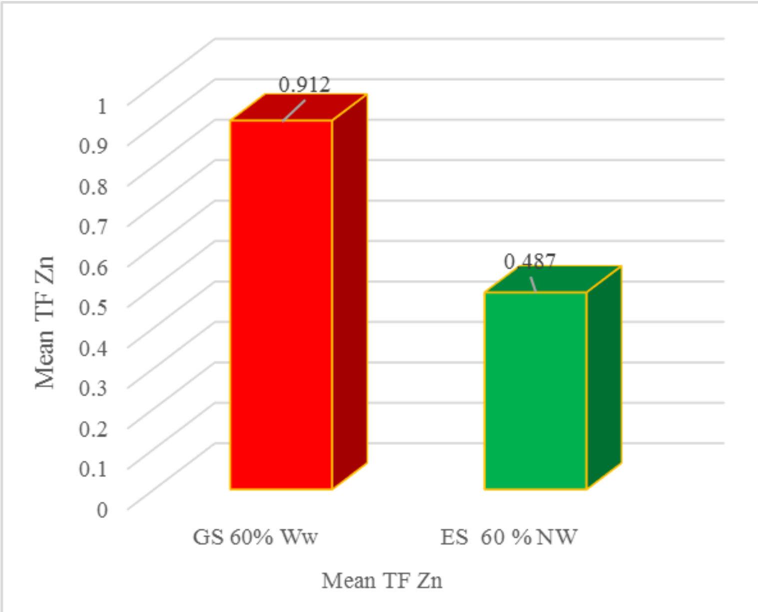

Figure 14. Relation Between Zn TF Value with Cultivar And Levels of Irrigation Use

Figure 15 explained respect metal Zn active answer by giant sunflower cultivar also moving excess ion metal through root to shoots increased it is mean plant tissue powerful for carrying ion and translocation to green shoots of plant, waste water good answer with high level water does this mean translocation happened for Zn with active sewage use but in minimum answer of translocation Evening sun sunflower respect with normal moisture depletion it is present Giant sunflower translocation is greater than evening sun sunflower with different in water type good result for answering to different water type and levels . These results are in acceptant with (Salih et al. 2014) result, (Zhuang et al. 2007) works, (Muhammad etal. 2009) research's.

4.10. Explained Mn Translocation Factor Effects

Showed appendix anova Table 4 Mn is significant ($p<0.01$) in interaction between cultivar and irrigation level also significant in interaction between water type and irrigation levels. Figure 16 The biggest number value of TF value of Mn trace element is (1.422) of giant sunflower cultivar at 35%waste water but the smallest value of Mn TF is (0.109) of giant sunflower cultivar at 60%waste water.Respect of Mn translocation good result for absorption and pleasurable action through plant tissue of giant sunflower cultivar ability of excess Mn in soil and Root tissue positive effect in accumulation and decrease the harmful of Mn element ,also waste water active answer in high level of accumulation and low level of moisture depletion ,but for accumulation Mn sewage irrigation positive effect and good answer in both stage of sunflower it is important thing same cultivar giant sunflower powerful for accumulation and translocation of metal ion . But Evening sun sunflower un active answer for translocation of metal ion compared to giant sunflower, also normal moisture depletion un powerful compared to waste water, positive Mn trans location factor are similar with research paper (Salih et al. 2014), (Zhuang et al. 2007), (Riffat et al. 2010), (Muhammad etal. 2009) and (Tarek et al. 2014).

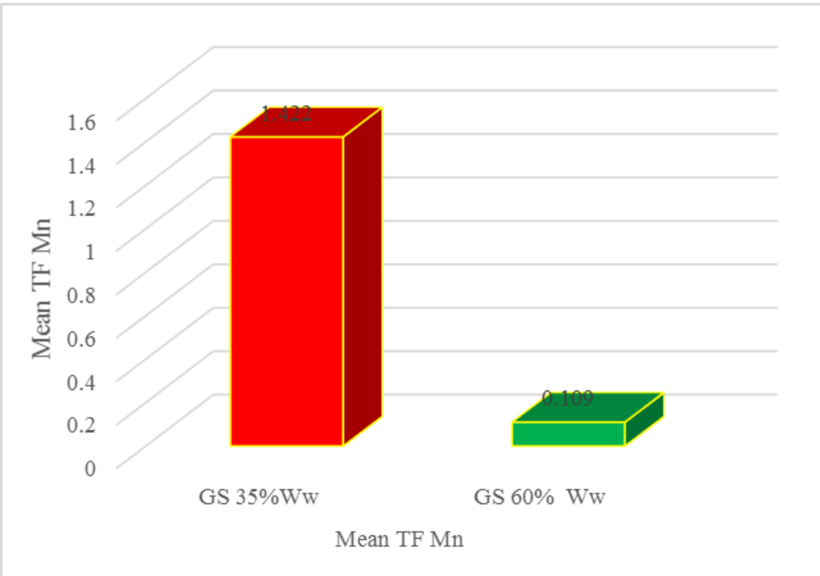

Figure 15. Relation Between Mn TF Value with Cultivar And Levels of Irrigation Use

Table 16. The Main Effects Of The Treatments on TF of Mn

Cultivars	Evening Sun Sunflower	0.55
	Giant Sunflower	0.56
Water Source	Waste Water	0.58
	Normal Water	0.37
Irrigation Levels	35%	0.67
	60%	0.57
LSD	NS	

According to data result Table 16 No significant and not difference between each other's.

4.11. Explained Fe Translocation Factor Effects

According to appendix anova Table.6 and data result Table 17 main effect of Fe not-significant ($P<0.05$).

Table 17. The Main Effects of The Treatments on TF of Fe

Cultivars	Evening Sun Sunflower	0.34
	Giant Sunflower	0.53
Water Source	Waste Water	0.48
	Normal Water	0.49
Irrigation Levels	35%	0.43
	60%	0.23
LSD	NS	

4.12. Explained Co Translocation Factor Effects

Figure 16 displayed effect Co respect high level translocation obtain with giant sunflower cultivar and good answer of normal moisture depletion, also significant($p<0.01$) in cultivar and interactions cultivar with water type and inter actions between water type and cultivar according to appendix anova Table.8 , big effect Co TF value (4.967) happened sewage not affected in both respective levels , it is mean waste water not have any important to Co translocation happened actively point and the lowest value of translocation factor of Co is (0.751) of evening sun sunflower cultivar at 35% normal irrigation levels, clear various translocation respect in sunflower cultivar from biggest level to smallest collecting of Co metal concentration in shoots sign to activity both cultivar however amount of metal accumulation happened mean decrease metallic harmful. Results are in activity with (Salih et al. 2014), (Zhuang et al. 2007), (Muhammad etal. 2009) and (Tarek et al. 2014) .

Table 18. The Main Effects Of The Treatments on TF of Co

Cultivars	Evening Sun Sunflower	0.34
	Giant Sunflower	0.53
Water Source	Waste Water	0.48
	Normal Water	0.49
Irrigation Levels	35%	0.43
	60%	0.23
LSD	LSD=1.065 (C)	

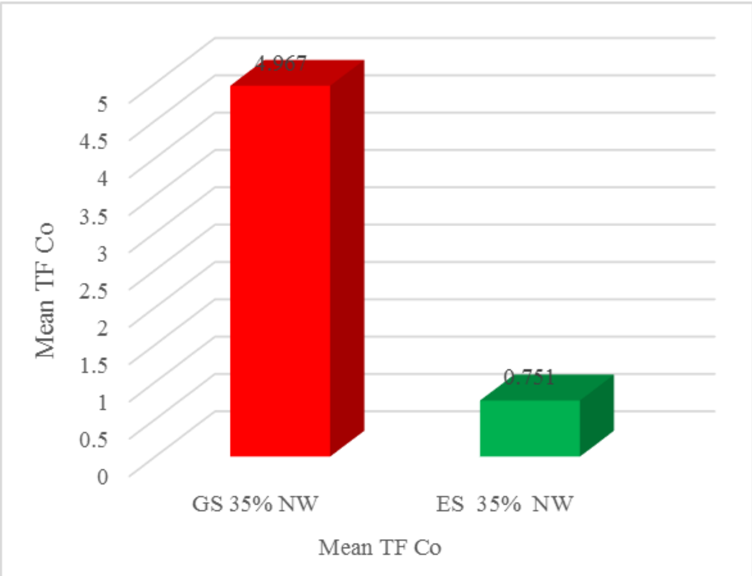

Figure 16. Relation Between Co TF Value With Cultivar And Levels Of Irrigation Use

Also difference of main effect of the treatment Co in cultivar giant sunflower LSD=1.065 no have any difference others, according to data result Table 18.

4.13. Explained Cr Translocation Factor Effects

In appendix anova Table 10 observed heavy metal Cr non-significant ($p<0.05$).

Table 19. The Main Effects Of The Treatments on TF of Cr

Cultivars	Evening Sun Sunflower	0.92
	Giant Sunflower	1.76
Water Source	Waste Water	1.91
	Normal Water	1.02
Irrigation Levels	35%	1.65
	60%	0.55
LSD	NS	

Data in appendix anova Table 12 presented heavy metal Ni is active ($p<0.05$) in Irrigation levels of water and inter actions between cultivar and water type, Figure 18.displayed highest value of Ni TF value is (9.696) of evening sun sunflower cultivar at 35% of normal irrigation water active answer of translocation grateful for soil purification through root absorption to shoots , positive answer of normal moisture depletion grate role for accumulation , also waste water respect value on low level Ni is (2.518) of giant sunflower , clearly different answer of both type of ornamental sun flower to both type of water with different levels indicate the ability of translocation obtain with activity of accumulation process for moving and pumping metal ion which It makes problem in soil media . These results are in agreement with research paper (Zhuang et al 2007), (Riffat et al. 2010).

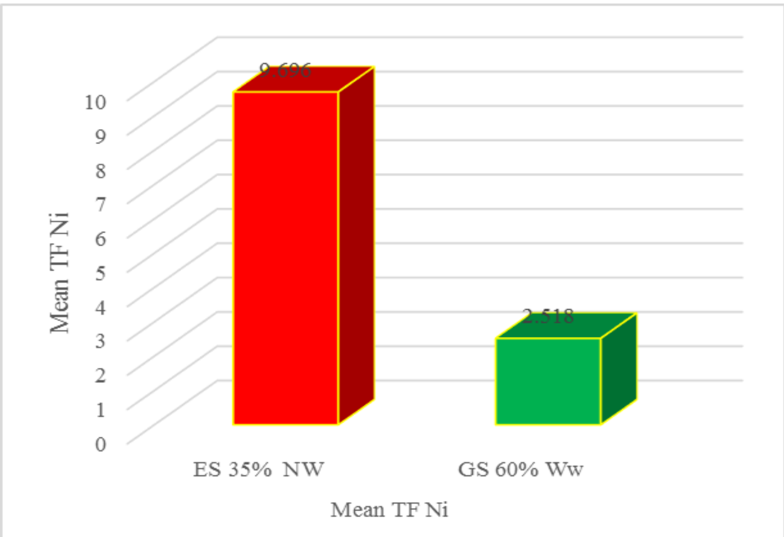

Figure 17. Relation Between Ni TF Value with Cultivar And Levels of Irrigation Use

Table 20. The Main Effects Of The Treatments on TF of Ni

Cultivars	Evening Sun Sunflower	5.25
	Giant Sunflower	5.24
Water Source	Waste Water	4.25
	Normal Water	4.81
Irrigation Levels	35%	7.34
	60%	0.27
LSD	LSD=3.358 (Levels)	

Data Table 20 main effect of the treatment on TF of Ni displayed irrigation levels difference happened for 35% of moisture depletion not have any difference between each of others.

4.14. Explained Different Translocation Factor In Maximum Levels.

Result and Figure.18 displayed maximum level of translocation ,Ni respect high level of active regards of Evening sun sunflower cultivar (9.696) and regards of normal moisture depletion next Co (4.967) regard value after Ni accumulation good pass due to giant sunflower cultivar at 35%normal irrigation water ,cultivar powerful and good activity for pumping trace metal to green plant parts it is mean Ni accumulation ability is grater then Co(Ni>Co) also Cr heavy metal element (3.812) of giant sunflower cultivar at 35% waste water respect level of moving metal ion to shoots, sewage active role for obtain translocation activity and regarding, therefore Cr is smaller than Co (Cr<Co) next element is Mn (1.422) regard cultivar is giant sunflower active answer of moisture depletion is 35% waste water, in this case sewage active answer for moving and obtain significant metal translocation also cultivar is same active answer for more trace metal translocation and purification process obtain .React Cr is more active than Mn(Cr>Mn) .next heavy metal Zn (0.912)respect with giant sunflower regard answer of 60% waste water this indicated sewage positive role to translocation happened also Mn is greater than Zn (Mn>Zn) last metal explain next ranking order ability of elements translocation (Ni>Co>Cr>Mn>Zn) .These results regarding with researches of (Salih et al. 2014), (Zhuang et al. 2007).

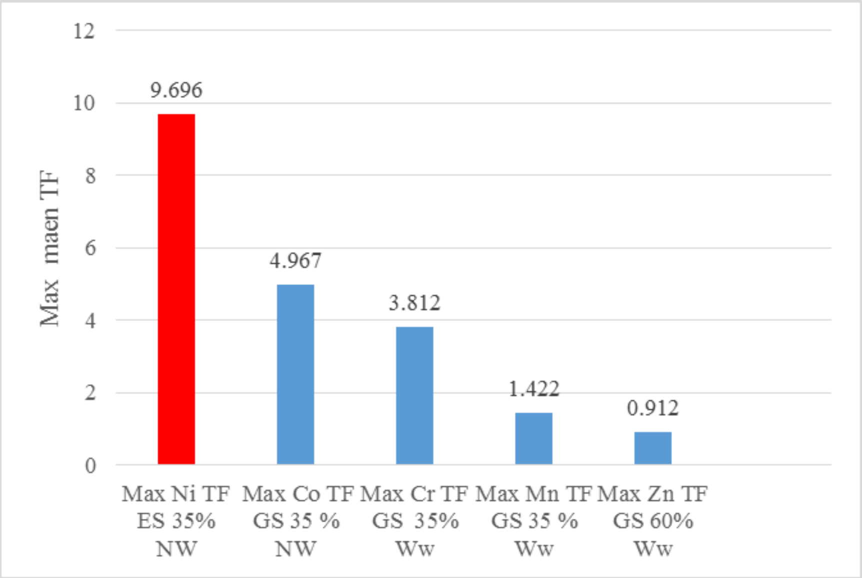

Figure 18. Relation Between Maximum Heavy Metal Element TF Value with Cultivar And Levels of Irrigation Use

4.15. Explained Different Translocation Factors In Minimum Levels

Between the minimum level of translocation factor of (6) heavy metal in current research explained in Figure 19 in the first maximum level of the minimum regarding Ni respect of giant sunflower and active answer of 60% waste water next metal ion Powerful with regarding of evening sun sunflower cultivar also respect moisture water type is 35% normal irrigation next heavy metal in minimum answer Zn TF value of evening sunflower cultivar regarding with 60% normal irrigation water depletion then heavy metal Cr powerful and activity high with Evening sun sunflower and respect with 60%normal irrigation water next metal activity smallest of minimum level regarding of translocation happened is Mn giant sun flower at 60% waste water, waste water effect at lowest level of regarding . This ranking order showed minimum level of translocation happened (Ni>Co>Zn> Cr>Mn).

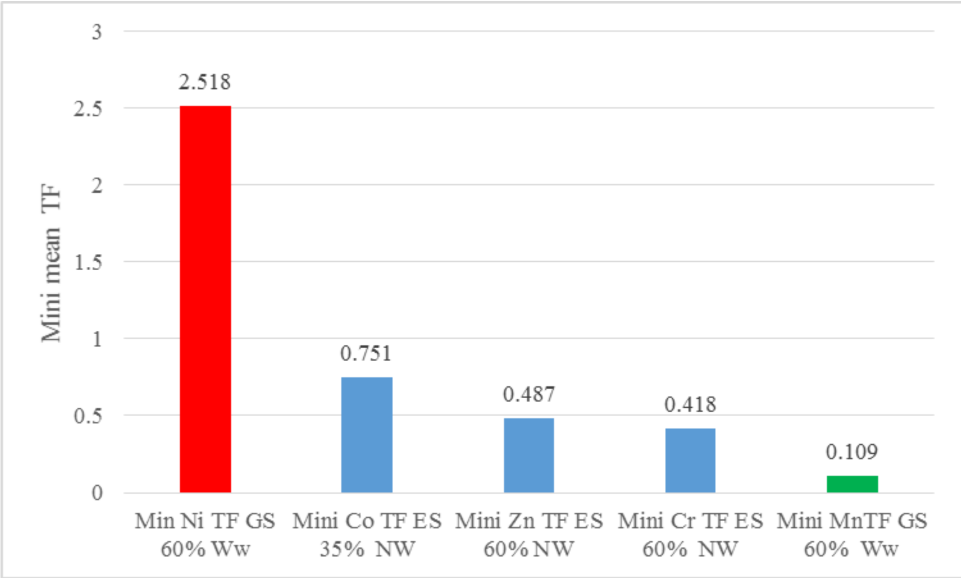

Figure 19. Relation Between Heavy Metal Elements TF Value with Cultivar and Levels of Irrigation Use In The Minimum Levels

4.16. Explained Zn Shoots Uptake Concentration

Observed in Figure 20 and appendix anova Table.13 shoots concentration of Zn (µg g $^{-1}$) result regards Zn significant ($p<0.05$) irrigation levels and the highest level of mean shoots concentration of metal Zn is (20.867 µg g $^{-1}$) of evening sun sunflower cultivar and 60% normal irrigation water , respect high level Zn shoots dry matter concentration active answer of moving and shifting ion metal (Salih et al. 2014),(Riffat et al. 2010) , also activity of sunflower cultivar of Evening sun sunflower good answer of changing ion quantity levels role of normal moisture depletion important but sewage un active answer for cultivar active (Chojnacka et al. 2005) ,lowest answer of mean shoots concentration of Zn concentrations (14.75 µg g -1) regard cultivar Evening sun sunflower cultivar and 35% normal irrigation water use levels, positive indicator however in the small level but effect of changing and pumping through root system to shoots power answer(Raymond et al. 2011) ,also regarding of normal water positive with evening sun sunflower cultivar(Muhammad etal. 2009) but sewage no respective with cultivar activity but normal moisture regards with cultivar and moving meal ion activity ,and cleaning soil of excess heavy metal .

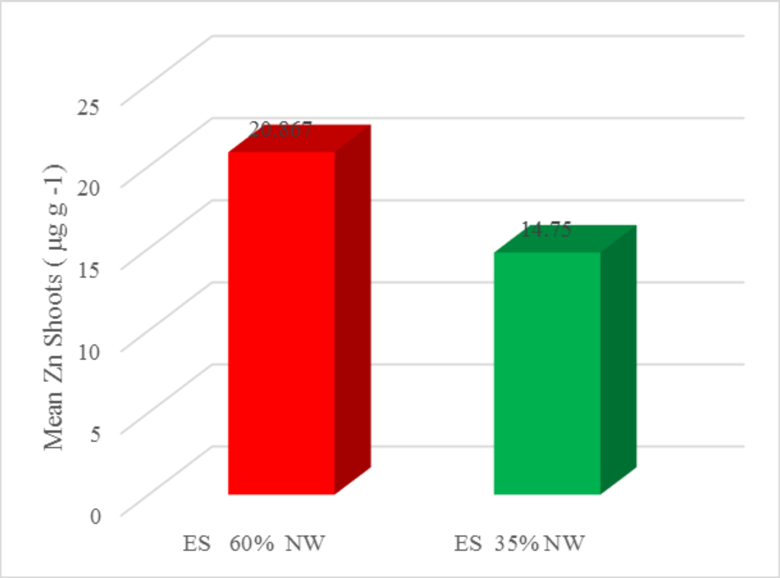

Figure 20. Relation Between Zn Shoot Concentration (µg g $^{-1}$) Value Cultivar with Levels of Irrigation Use

Table 21. The Main Effects of The Treatments on Shoots Concentration of Zn

Cultivars	Evening Sun Sunflower	17.0
	Giant Sunflower	17.0
Water Source	Waste Water	15.7
	Normal Water	18.2
Irrigation Levels	35%	15.7
	60%	18.3
LSD	LSD=4.827 (levels)	

Data result in Table 21 displayed the main effects of the treatments on shoots concentration of Zn Irrigation levels (LSD=4.827) for 60 % no other difference between cultivar and water source.

4.17. Explained Mn Shoot Uptake Concentration

Trace metal mean Mn concentration of shoots (µg g $^{-1}$) according to and Figure 21 and appendix anova Table 17 shoots concentration is significant ($p<0.05$) and water type ($p<0.05$)and very important in interaction between water source and Irrigation levels, maximum level of Mn shoots concentration is (14.35 µg g $^{-1}$) of giant sunflower cultivar at 35% normal irrigation use (Salih et al. 2014), (Zhuang et al.2007) regarding high level of collecting metal concentration satisfied result for good answer of giant sunflower cultivar(Muhammad et al. 2009) waste water un active regarding to accumulation and changing metal ion through root to green part of plants (Raymond et al. 2011) but normal moisture depletion respect with cultivar and accumulation to shoots and increased activity of moving plant nutrition Mn to green part of sunflower plant, also minimum level of Mn shoots concentration is (3.03 µg g $^{-1}$) of evening sun sunflower at 35% waste water, (Chojnacka et al. 2005) small regarding of cultivar with sewage water (Muhammad. et al. 2009) but normal water no good answer for minimum activity (Tarek et al. 2014) ,clear various regarding between maximum and minimum of accumulation to shoots parts and different happened with water types good answer for remediation of Mn by sunflower cultivar and using waste water for irrigation .

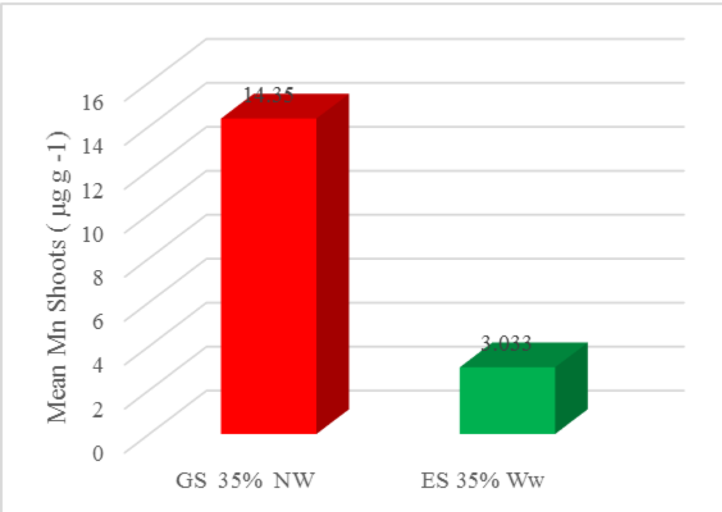

Figure 21. Relation between Mn mean shoot (µg g $^{-1}$) Value Cultivar with Levels of Irrigation Use

Table 22. The Main Effects of The Treatments on Shoots Concentration of Mn

Cultivars	Evening Sun Sunflower	4.68
	Giant Sunflower	8.52
Water Source	Waste Water	5.04
	Normal Water	8.17
Irrigation Levels	35%	7.19
	60%	6.01
LSD	LSD=3 (C)	

Displayed data Table 22 important of Cultivars evening sun sunflower cultivar LSD=3 and no any difference between water source and Irrigation levels.

Table 23. The Main Effects of The Treatments on Shoots Concentration of Fe

Cultivars	Evening Sun Sunflower	3678.9
	Giant Sunflower	4213.8
Water Source	Waste Water	4090.3
	Normal Water	3802.4
Irrigation Levels	35%	3775.7
	60%	4117.0
LSD	NS	

According to data Table .23 and appendix anova Table 21 Fe is not significant.

4.18. Explained Co Shoot Uptake Concentration

Data of appendix anova Table 25 and Figure 22 In current research shoots heavy metal concentration Co regard significant ($p<0.01$) of cultivar and inter actions between cultivar and water type significant ($p<0.01$) and interactions between cultivar water type with levels of irrigation($p<0.05$) actions between cultivar and Irrigation levels($p<0.05$) , highest concentration Co of shoots (20.958 µg g^{-1}) of giant sunflower cultivar at 60% normal irrigation water levels (Salih et al. 2014). Respect answer of high regard of giant sunflower big effect of shoots accumulation and heavy metal absorption in root system active point with normal moisture depletion, waste water unacceptable with cultivar this negative point for sewage depletion availability, (Riffat et al. 2010), (Muhammad.et al.2009) also regarding on lowest levels of concentration of Co shoots concentration is (7.7 µg g $^{-1}$) of evening sun sunflower at 35% normal irrigation water use powerful activity on low level answer of Evening sun sunflower cultivar same high regard significant normal moisture depletion important role for absorption and moving ion translocation to green part of plant (Zhuang et al. 2007), same respect significant cultivar sewage negative answer for accumulation and soil cleaning(Tarek et al. 2014),big different happened between maximum and minimum shoots accumulation concentration it's indicator for plant use for phytoremediation process .

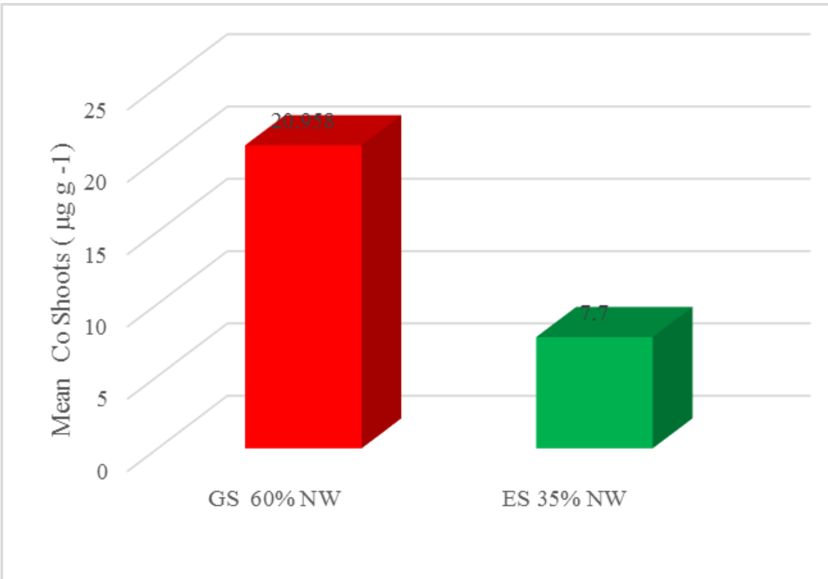

Figure 22. Relation Between Co Mean Shoot (µg g $^{-1}$) Value Cultivar with Levels of Irrigation Use

Table 24. The Main Effects of The Treatments on Shoots Concentration of Co

Cultivars	Evening Sun Sunflower	10.7
	Giant Sunflower	18.3
Water Source	Waste Water	15.0
	Normal Water	14.1
Irrigation Levels	35%	13.8
	60%	15.3
LSD	LSD=1.229 (levels), 3.247 (SxW), 2.012 (C), LSD=2.458 (SxWxD)	

Data result Table 24. showed difference between cultivars LSD=2.012 for giant sunflower and water source for waste water type also between water levels for 60% and inter action between water source , level of waters.

4.19. Explained Cr Shoots Uptake Concentration

Shoots concentration Cr according to appendix anova Table 29 regard significant ($p < 0.05$) in cultivar, water type ($p<0.01$) , interactions between cultivar with water type($p<0.05$), interactions between cultivar with levels of irrigation($p<0.01$), inter actions between water type with levels of irrigation use ($p<0.01$), and interactions between cultivar with levels of irrigation and water source ($p < 0.01$).

Figure 23 shows respect answer shoots concentration Cr (20.567 $\mu g\ g^{-1}$) powerful with giant sunflower cultivar high activity with 60% normal irrigation water (Salih et al. 2014), (Zhuang et al. 2007), agreeable level of cultivar for accumulation of shoots and purification of root and soil together because shoots accumulation work on ion activity after root absorption working obtain, smallest mean shoots concentration concentration Cr (10.558 $\mu g\ g^{-1}$) acceptant with Evening sun sunflower cultivar at 60% normal irrigation water, moisture depletion normal type active with both regard cultivar also sewage negative answer with Cr shoots accumulation (Chojnacka et al. 2005), (Raymond et al. 2011) explained clearly big different in high level to low level and answer of both cultivar for Cr concentration in shoots good indicator for heavy metal accumulation by sunflower plants.

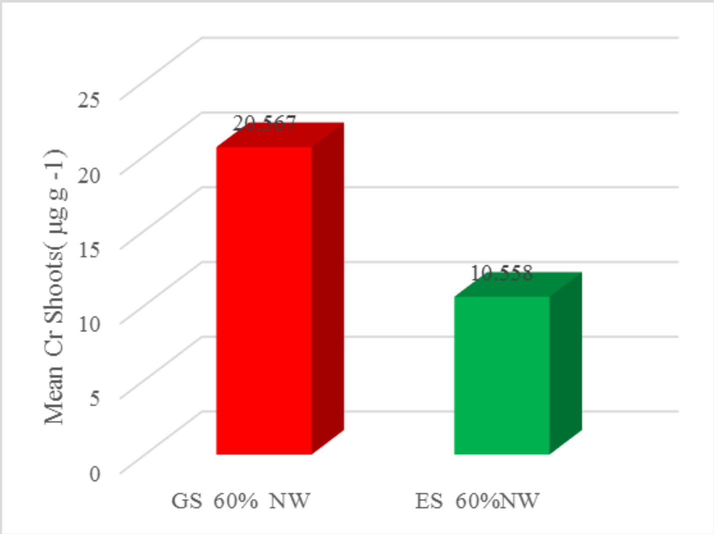

Figure 23. Relation Between Cr Mean Shoots (µg g $^{-1}$) Value Cultivar with Levels of Irrigation Use

Table 25. The Main Effects of The Treatments on Shoots Concentration of Cr

Cultivars	Evening Sun Sunflower	17.09
	Giant Sunflower	19.86
Water Source	Waste Water	19.54
	Normal Water	17.42
Irrigation Levels	35%	19.11
	60%	17.85
LSD	LSD=2.619 (CxDxW), LSD=1.851 (WxD), LSD=1.851 (CxD), LSD=1.385 (CxW), LSD=0.978 (W), LSD=1.76 (C)	

Result Table 25 shows different between cultivars, water source and irrigation levels, and inter action between all together good role for accumulation and purity of soils.

4.20. Explained Ni Shoot Uptake Concentration

Ni concentration in shoots significant ($p<0.01$) in cultivar, inter actions between cultivar with levels of irrigation and water type ($p<0.01$) , interactions between cultivar and water type($p<0.01$) showed in appendix anova Table 33, also Figure 24 showed biggest regarding Ni concentration shoots (33.133 µg g $^{-1}$) satisfied with giant sunflower cultivar powerful with 60% normal irrigation water (Salih et al. 2014), (Zhuang et al. 2007) high active answer of shoots accumulation positive activity of sunflower cultivar with pleasurable of normal moisture concentration (Tarek et al. 2014) waste water unsatisfied with high level concentration of shoots concentration also the smallest Ni concentration shoots concentration (15.783 µg g $^{-1}$) respect valuable answer with Evening sun sunflower cultivar at 60% normal irrigation water, (Muhammad et al. 2009) waste water absence activity for both cultivar for shoots accumulation concentration opposite normal irrigation water active for both cultivar , also various answer happened of shoots concentration concentration explained in Figure 24 according to cultivar and moisture depletion.

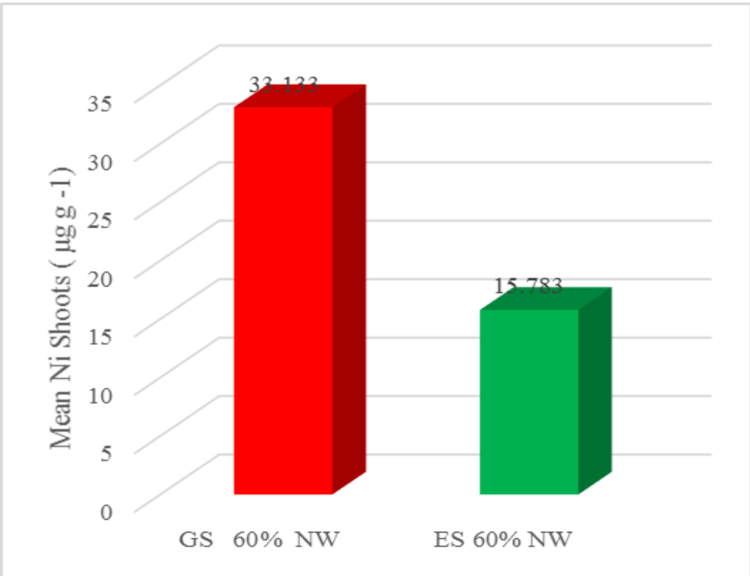

Figure 24. Relation between Ni Mean Shoots (µg g $^{-1}$) value Cultivar with Levels of Irrigation Use

Table 26. The Main Effects of the treatments on Shoots Concentration of Ni

Cultivars	Evening Sun Sunflower	18.2
	Giant Sunflower	27.4
Water Source	Waste Water	21.5
	Normal Water	24.0
Irrigation Levels	35%	22.8
	60%	22.7
LSD	LSD=1.8 C	

Table 26 showed difference of cultivars evening sunflower LSD=1.8 only but no difference in water source and irrigation levels.

4.21. Explained Different Mean Shoots Concentration in Maximum Levels

Various result shoots concentration therefore compared between (5) element of heavy metal in maximum levels (µg g^{-1}) but Fe shoots concentration is not significant and Figure 25 displayed Ni shoots concentration is largest value (33.13 µg g^{-1}) of giant sunflower cultivar at 60% normal irrigation water acceptable of Ni shoots for soil and root cleaning of excess metal ion after Co shoots concentration (20.96 µg g^{-1}) of giant sunflower cultivar at 60% normal irrigation water. respect of Co in shoots concentration active answer and grateful role for translocation of heavy metal, it is mean regard answer of Ni is grater then Co (Ni>Co) next Zn shoots concentration (20.867 µg g^{-1}) of Evening sun sunflower cultivar at 60% normal irrigation water, active ability of Zn is smaller of Co (Zn < Co) Next powerful answer Cr shoots concentration (20.57 µg g^{-1}) of giant sunflower of 60% normal irrigation water therefore Cr is low level then Zn (Cr < Zn) also last metal Mn shoots concentration (14.35 µg g^{-1}) of giant sunflower at 35% of normal irrigation water. Last value answer of Mn,regard Cr is grater then Mn (Cr > Mn) ,Explain ranking order from the largest to smallest of maximum value of shoots concentration concentration in(µg g^{-1}) ,(Ni >Co> Zn>Cr>Mn) , normal moisture depletion regard answer to current research mean shoots concentration concentration in maximum level Figure 25 waste water type negative answer to heavy metal shoots accumulation and cleaning soil and root part of sunflower .

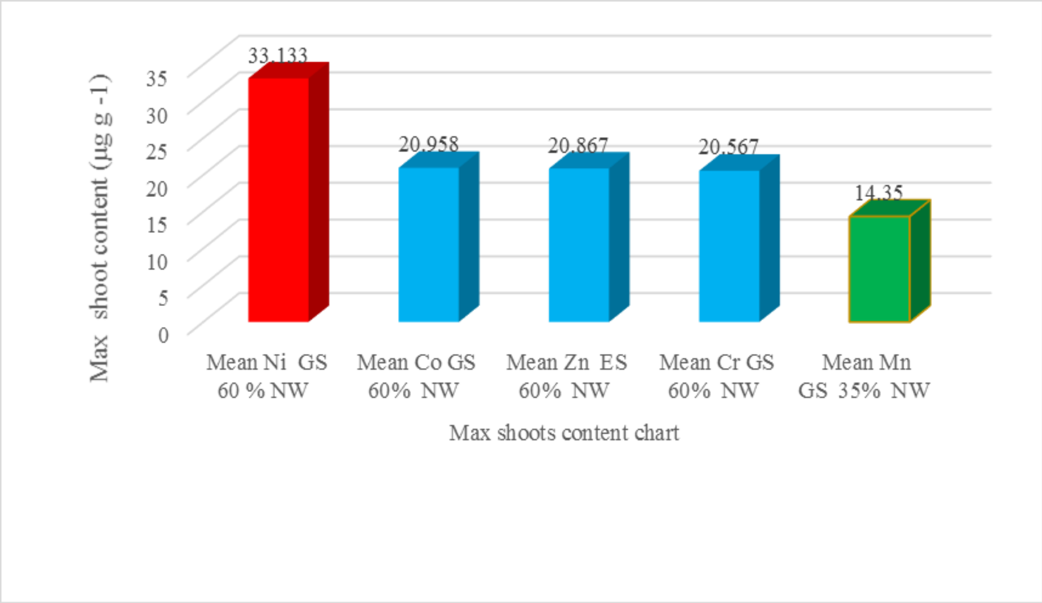

Figure 25. Relation Between Maximum Heavy Metal Element Mean Shoots Concentration, Cultivar and Levels of Irrigation Use

4.22. Explained Different Mean Shoots Concentration in Minimum Levels

For determination of minimum shoots concentration between (5) element of heavy metal amount in minimum shoots in (µg g $^{-1}$) Fe shoots is not significant. Figure.26 displayed all minimum level answer of shoots concentration first regard Ni shoots concentration (15.78 µg g $^{-1}$) of Evening sun sunflower cultivar at 60% normal irrigation water Next minimum level Zn shoots concentration (14.75 µg g $^{-1}$) of evening sun sunflower cultivar at35% normal irrigation water it is mean Zn is smaller than Ni shoots concentration(Zn < Ni), next metal shoots concentration in minimum level Cr shoots concentration (10.558µg g $^{-1}$) of Evening sun sunflower of 60% normal irrigation water(Cris smaller than Zn), also Co shoots concentration (7.7µg g $^{-1}$) of evening sun sunflower of 35% normal irrigation water it is mean Cr is grater then Co (Cr > Co) , the lowest level of the minimum shoots concentration is Mn (3.033µg g $^{-1}$) of 35% waste water, explained ranking order from the largest to smallest of minimum value of shoots concentration in(µg g $^{-1}$) , (Ni> Zn> Cr> Co> Mn), Lowest regard of mean shoots concentration concentration displayed effect of cultivar of shoots accumulation of heavy metal with Evening sun sunflower cultivar opposite of giant sunflower in the maximum level. And activity of normal water working with sewage but ability of waste water in lowest level and normal water in high level.

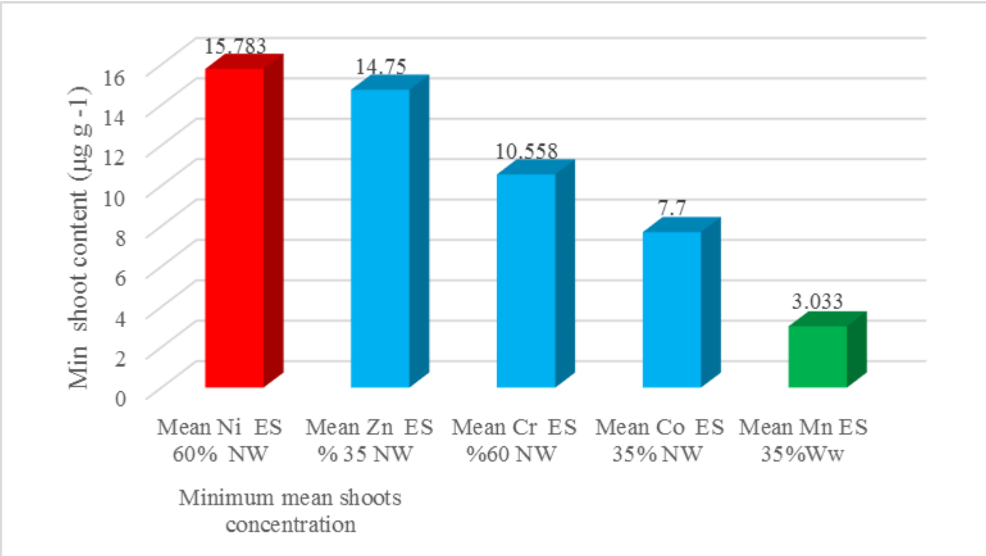

Figure 26. Relation Between Minimum Heavy Metal Element Mean Shoots Concentration and Cultivar with Levels of Irrigation Use

4.23. Explained Mean Zn Root Up Take Concentration

Heavy metal Mean root concentration Zn regard significant ($p<0.05$) cultivar respect according to appendix anova Table 14 ,also Figure.27 displayed high level mean root Zn concentration (35.94 µg g $^{-1}$) active answer cultivar Evening sun sunflower with powerful moisture depletion 60% normal irrigation water(Salih et al. 2014), (Zhuang et al. 2007) high level root concentration indicate of cultivar important role of absorption and collecting of Zn metal and decrease side effect of excess metal in soil ,waste water negative answer with high level also normal moisture depletion regarding with high concentration significant(Chojnacka et al. 2005), (Raymond et al. 2011) low level of Zn mean concentration is (21.38 µg g $^{-1}$) respect active result with giant sunflower cultivar powerful available depletion 60% waste water(Muhammad et al 2009) activity of cultivar in low answer regard result of root accumulation and purification of plant grow media and sewage respect answer positive point with available moisture depletion. Different respect between high levels of Evening sun sunflower cultivar, normal available depletion happened with low level of giant sunflower cultivar, sewage moisture depletion which explained in Figure 27

Table 27. The Main Effects of The Treatments on Root Concentration of Zn

Cultivars	Evening Sun Sunflower	29.2
	Giant Sunflower	23.5
Water Source	Waste Water	24.0
	Normal Water	24.6
Irrigation Levels	35%	25.7
	60%	18.3
LSD	LSD=4.827 (C)	

Also result Table 27 showed that difference happened in cultivar for evening sun sunflower (LSD=4.827).But no any effect of the treatment of root concentration of Zn.

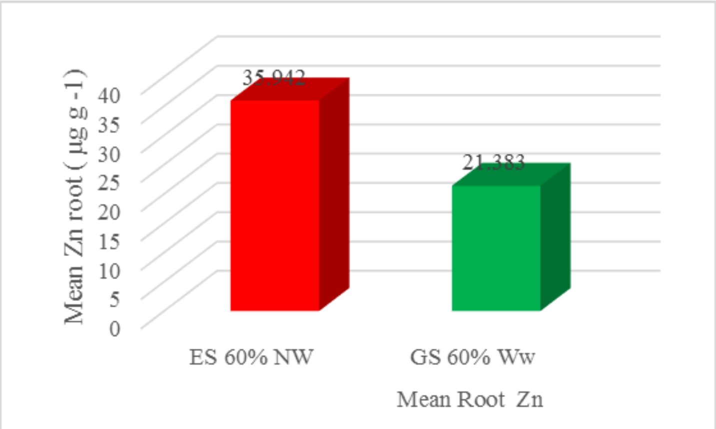

Figure**27** . Relation Between Root Zn Mean Concentration (µg g^{-1}) Value Cultivar with Levels of Irrigation Use

4.24. Explained Mean Mn Root Up Take Concentration

Data analysis result in appendix anova Table 18 displayed Mn respect significant ($p<0.01$) in cultivars, irrigation levels ($p<0.01$), interactions between cultivar with levels of irrigation use significant ($p<0.01$), interactions between levels of irrigations with water source significant ($p<0.05$). Figure 28 displayed big satisfied of mean Mn root concentration (47.567 µg g $^{-1}$) regard answer with giant sunflower cultivar respect powerful with 60% normal irrigation water(Muhammad et al 2009) and (M.Galal, Tarek et al, 2014), waste water un active answer with high level of root accumulation , smallest level of mean Mnroot concentration (6.925 µg g $^{-1}$) agreeable cultivar Evening sun sunflower cultivar with respect availability of 35% waste water (Salih et al. 2014), (Zhuang et al. 2007), (Chojnacka et al 2005), clear different happened between maximum and minimum level of mean root concentration , also both cultivar with both water type and level levels of irrigation active answer with accumulation.

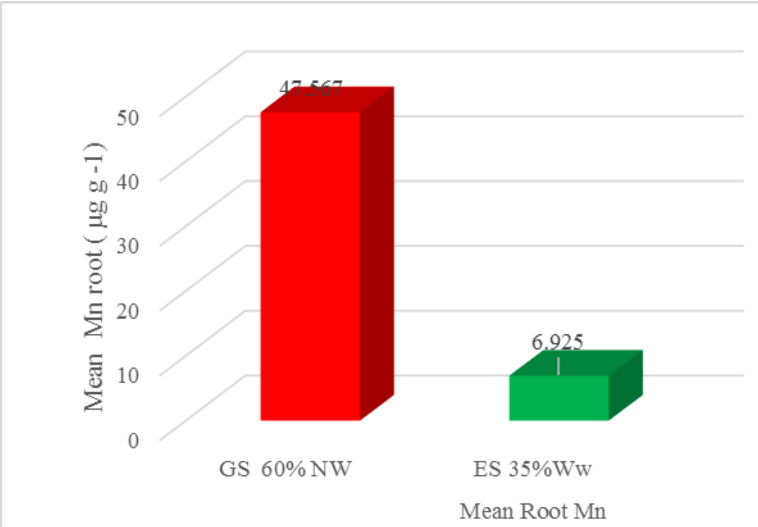

Figure28 . Relation Between Root Mn Mean Concentration (µg g $^{-1}$) Value Cultivar with Levels of Irrigation Use

Table 28. The Main Effects of The Treatments on Roots Concentration of Mn

Cultivars	Evening Sun Sunflower	9.9
	Giant Sunflower	32.3
Water Source	Waste Water	18.9
	Normal Water	23.8
Irrigation Levels	35%	13.8
	60%	6
LSD	LSD=10.4 (SxDxW), LSD=7.36 (DxW), LSD=7.36 (SxD), LSD=5.204 (D	

Data result Table 28 Displayed that more difference happened between cultivars, water source and Irrigation levels .therefor Mn main effect is very important for according to other elements also for for accumulation by two cultivar.

4.25. Explained Mean Fe Root Up Take Concentration

According to appendix anova Table 22 and data Table 29 main effect of the treatment on root concentration of Fe is Significant.

Table 29.The Main Effects of The Treatments on Root Concentration of Fe

Cultivars	Evening Sun Sunflower	11401
	Giant Sunflower	8339
Water Source	Waste Water	8168
	Normal Water	9547
Irrigation Levels	35%	10284
	60%	4117
LSD	NS	

4.26. Explained Mean Co Root Up Take Concentration

Result appendix Table 26 displayed that mean root Co concentration regard significant($p<0.01$) water type , interactions between cultivar and water type($p<0.05$), interactions between cultivar with levels ($p<0.01$), and interactions between cultivar water type with levels of irrigation($p<0.01$), Figure 29 showed highest respect mean root concentration Co (81.917 µg g^{-1}) of evening sun sunflower acceptant with moisture depletion of 60% normal irrigation water (Salih et al. 2014), (Zhuang et al. 2007), (Chojnacka et al. 2005), lowest level of Root Co concentration is(5.308 µg g^{-1}) regard answer with giant sunflower powerful activity of moisture depletion of 60% normal irrigation water, waste water absence activity with both level and both cultivar of sunflower but normal water active answer with both level high and low and both cultivar , various different happened in accumulation of root concentration .

Table 30. The Main Effects of The Treatments on Root Concentration of Co

Cultivars	Evening Sun Sunflower	27.5
	Giant Sunflower	9.2
Water Source	Waste Water	7.4
	Normal Water	10.5
Irrigation Levels	35%	11.2
	60%	15.3
LSD	LSD=2.566 (SxDxW), LSD=1.814 (SxD), LSD=2.787 (SxW), LSD=1.97 (W)	

Data result Table 30 showed that more difference happened between cultivar and water source and Irrigation levels therefore main effect of the treatment very important of the Co.

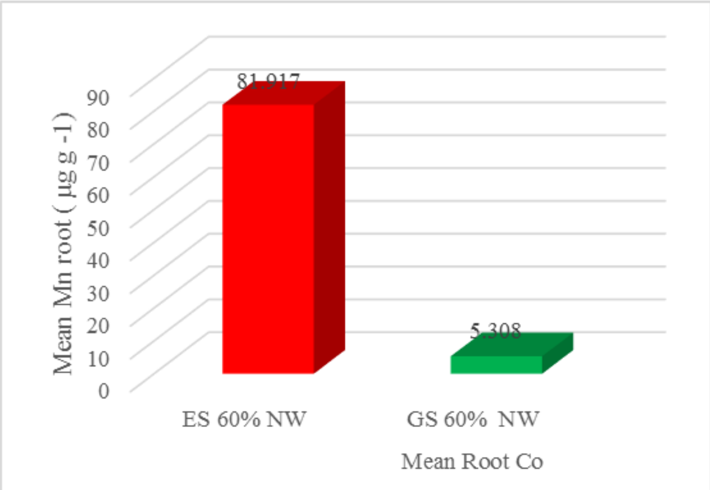

Figure 29. Relation Between Roots Co Mean Concentration Dry Matter (µg g^{-1}) Value Cultivar With Levels Of Irrigation Use

4.27. Explained Mean Cr Root Up Take Concentration

Data result appendix anova Table 30 displayed mean root Cr concentration regard significant ($p<0.05$) in water type, Figure 30 Biggest value of Cr root concentration is (25.533 µg g^{-1}) interest with Evening sun sunflower cultivar respect answer of 60% normal irrigation water ,(Naseem et al. 2010), (Muhammad et al.2009),waste water absence activity with high level of significant cultivar , smallest value of root Cr concentration (12.225 μg g $^{-1}$) active answer with giant sunflower cultivar moisture availability respect with 35% waste water , respect sewage answer with minimum level indicate factor for effecting waste water of accumulation and plant grow media cleaning, clearly different obtained between maximum and minimum root concentration and positive answer of both cultivar with both water type in maximum and minimum answer showed ability of both cultivar of adaptation with type of water and amount of absorption metal ion concentration in grow media and moving to green part of plant explained the different between cultivar and type of water .

Table 31. The Main Effects of The Treatments on Roots Concentration of Cr

Cultivars	Evening Sun Sunflower	20.3
	Giant Sunflower	18.5
Water Source	Waste Water	14.8
	Normal Water	20.3
Irrigation Levels	35%	19.3
	60%	17.8
LSD	LSD=6.395 (W)	

Data result Table 31 Showed that difference between water source for normal water (LSD=6.395) according to others not any difference happened.

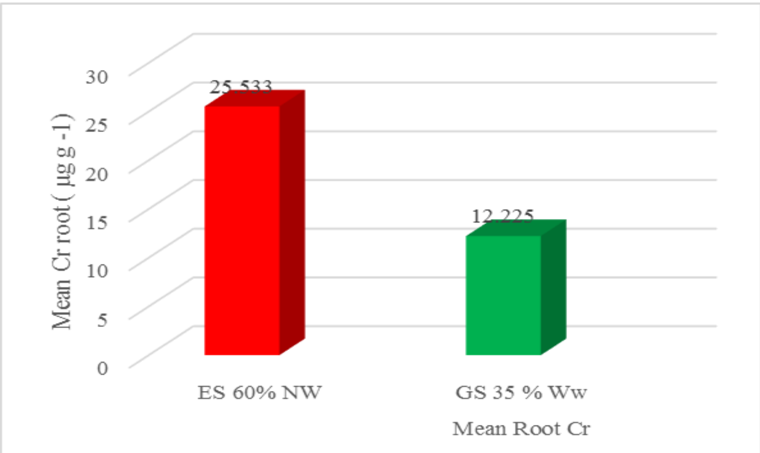

Figure 30. Relation Between Root Cr Mean Concentration (μg g $^{-1}$) Value Cultivar with Levels of Irrigation Use

4.28. Explained Mean Ni Root Up Take Concentration

According to appendix anova Table 34 showed that root concentration Ni presented regard significant ($p<0.05$) in cultivar, levels of irrigation water ($p<0.05$) and interactions between cultivar with water type ($p<0.05$). Figure 31. Displayed that big satisfied effect root Ni concentration is (13.742 µg g^{-1}) respect answer with giant sunflower agreeable moisture depletion of 60% normal irrigation water(Salih et al 2014), (Muhammad et al. 2009),waste water absence availability of moisture depletion on high level of significant cultivar for root accumulation . Lowest level of root Ni concentration (2.217 µg g^{-1}) regarding with Evening sun sunflower cultivar active answer of availability moisture depletion with 35% normal irrigation water, (Zhuang et al. 2007), sewage un active answer with both cultivar of sunflower and both levels of root concentration.

Table 32. The Main Effects of The Treatments on Root Concentration of Ni

Cultivars	Evening Sun Sunflower	4.6
	Giant Sunflower	7.7
Water Source	Waste Water	5.7
	Normal Water	7.4
Irrigation Levels	35%	4.0
	60%	22.7
LSD	LSD=3.078 (levels), LSD=2.287 (CxW), LSD=3.087 (C)	

Data result Table 32 showed to main effect of the treatment mean root Ni concentration more difference is happened between cultivar, water source and Irrigation levels significant for giant sunflower cultivar, also interaction between water source and cultivar.

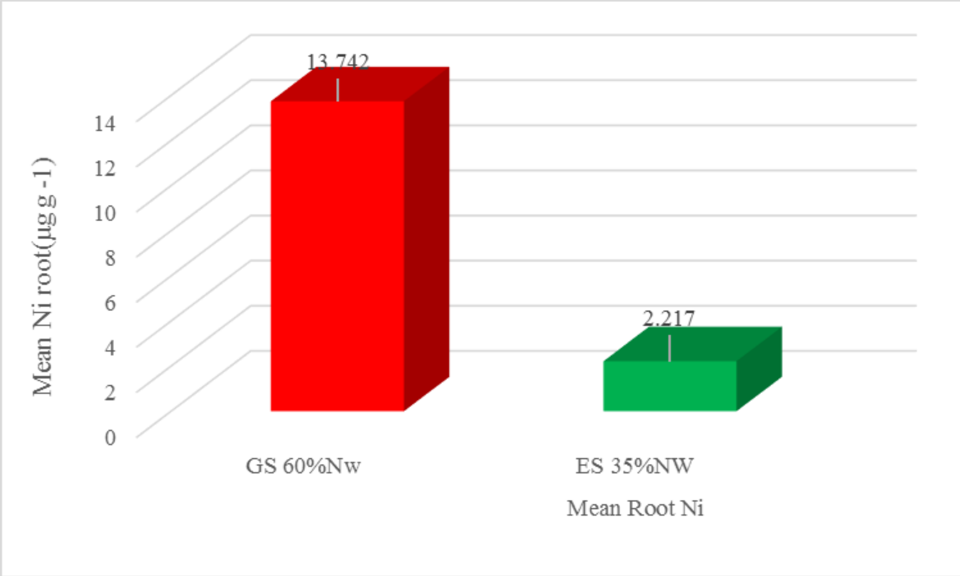

Figure 31. Relation Between Roots Ni Mean Concentration (µg g $^{-1}$) Value Cultivar with Levels of Irrigation Use

4.29. Explained Different Mean Root Uptake Concentration in Maximum Levels

Result analysis of root concentration showed big different between (5) element (Zn, Mn, Co, Cr and Ni) in the maximum quantity root concentration happened interest result to determination which that big effect of absorption and purification respect mean root Co concentration (81.917 µg g $^{-1}$) of evening sun sunflower regarding with moisture depletion 60% of normal irrigation water next agreeable result mean root Mn concentration concentration (47.567 µg g $^{-1}$) of giant sunflower cultivar 60% normal irrigation water clear ability of root concentration to Co is grater then Mn (Co> Mn) after regarding mean root Zn concentration (35.942 µg g $^{-1}$)of evening sun sunflower 60% normal irrigation water displayed Mn respect for root concentration is grater then Zn(Mn> Zn) lower level respect is mean root Cr concentration concentration (25.533 µg g $^{-1}$) of evening sun sunflower 60% normal irrigation next present that Zn respect level is grater then Cr(Zn> Cr)last mean root Ni concentration (13.742 µg g $^{-1}$) of giant sunflower 60% normal irrigation, and display that Cr regard answer is grater then Ni(Cr > Ni)which explained in Figure.32 it is clear the different value of maximum mean heavy metal concentration in root tissue of plant. This ranking order is present

(Co>Mn>Zn>Cr>Ni) from maximum to minimum level of significant answer of cultivar with availability of moisture depletion, waste water negative answer with maximum level of root concentration concentration but normal water powerful with root concentration, both cultivar is active with high and low respect value, this indicator to using both cultivar for phytoremediation and cleaning growing media of heavy metal effect explained in Figure 32.

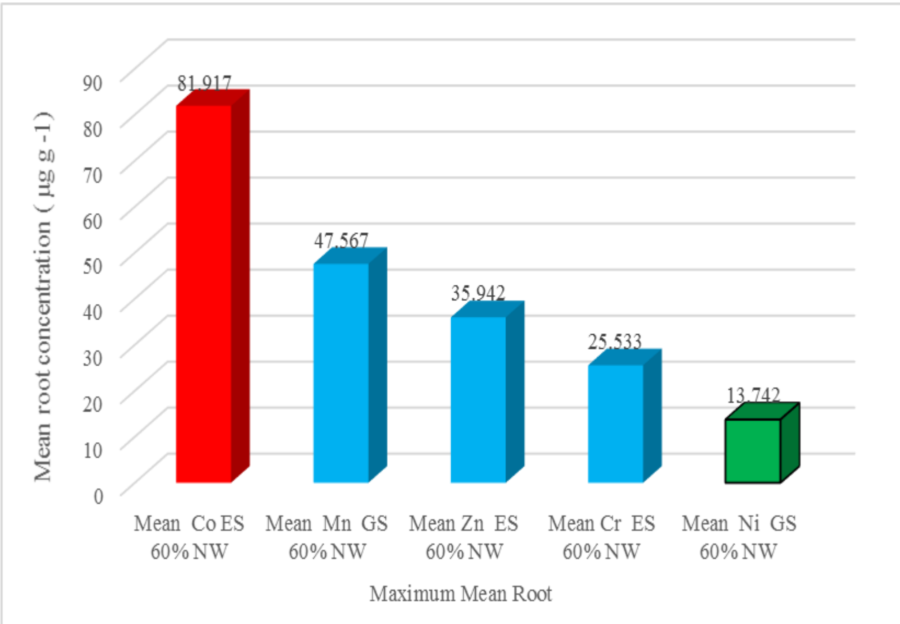

Figure 32. Relation Between Maximum Heavy Metal Element Mean Root Concentration Value and Cultivar and Levels of Irrigation Use

4.30. Explained Different Mean Root Uptake Concentration in Minimum Levels

Display Figure 33 result analysis of root concentration minimum between (5) minimum regard answer (Zn, Mn, Co, Cr and Ni) of root mean root Zn (21.383 µg g $^{-1}$) of giant sunflower cultivar at 60% waste water high level in minimum regarding answer next mean root Cr concentration (12.225µg g $^{-1}$) of giant sun flower 35% waste water mean root , it is mean Cr is smaller than Zn(Cr < Zn)next minimum metal Mn concentration (6.925 µg g $^{-1}$) of evening sun sunflower cultivar of 35% waste water result displayed Mn is smaller mean root concentration in minimum level than Cr(Mn < Cr) next mean root

Co concentration (5.308 µg g $^{-1}$) of giant sunflower cultivar at 60% normal irrigation water showed result Co is smaller than Mn(Co< Mn) last element is mean root Ni concentration (2.217 µg g $^{-1}$) of evening sun sunflower cultivar 35% normal irrigation water is the smallest mean root concentration respect answer with cultivar and available moisture depletion , ability of Ni is smaller than Co (Ni < Co) . Clear the different value of minimum from largest mean to smallest mean value. Showed in this ranking order (Zn>Cr>Mn>Co>Ni) smallest value concentration of root concentration, interest result is showed that big different happened of both cultivar and both water type, big point is waste water is significant in more minimum level this positive answer for remediation of heavy metal accumulation and using sewage water for irrigation, according to cultivar both cultivar in minimum levels active answer to regarding for phytoremediation of using both cultivar .

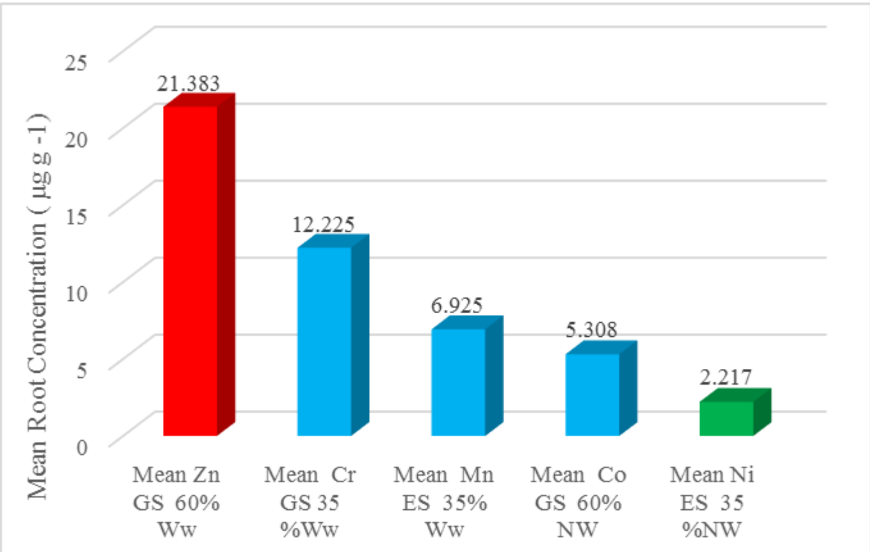

Figure 33. Relation Between Minimum Heavy Metal Element Mean Root Concentration value ,Cultivar and Levels of Irrigation Use

4.31. Briefly Explained Mean Seed Uptake Concentration

Data which result table of seed concentration metal concentration in (µg g^{-1}) it is measured after digesting seed matter in CEM machine and preparing seed extraction solution then measuring by atomic absorption spectrophotometer PerkinElmer precious AAnalyst800. Three element heavy metal is not significant ($p<0.05$) (Zn, Mn,and Co).

4.32. Explained Mean Zn Seed Uptake Concentration

According to appendix anova Table 15 and data Table 33 main effect of the treatment of Zn seed uptake is not significant($p<0.05$).

Table 33.The Main Effects of The Treatments on Seed Concentration of Zn

Cultivars	Evening Sun Sunflower	32.0
	Giant Sunflower	28.2
Water Source	Waste Water	30.8
	Normal Water	29.3
Irrigation Levels	35%	30.0
	60%	30.1
LSD	NS	

4.33. Explained Mean Mn Seed Uptake Concentration

According to appendix anova Table 19 and data Table 34 main effect of the treatment of Mn seed uptake is not significan

Table 34.The main effects of the treatments on seed concentration of Mn

Cultivars	Evening Sun Sunflower	4.7
	Giant Sunflower	8.5
Water Source	Waste Water	5.0
	Normal Water	8.2
Irrigation Levels	35%	7.2
	60%	6.0
LSD	NS	

4.34. Explained Mean Fe Seed Uptake Concentration

Appendix data Table 23 displayed Mean Fe seed concentration is significant ($p<0.05$) in interactions between levels of irrigation and water type, also Figure 34 showed highest level value Fe seed concentrations (3403.125 µg g^{-1}) of Evening sun sunflower cultivar at 60% normal irrigation water respect answer of cultivar positive point for seed accumulation, mean moving metal ion through soil to root than shoots to seed part of green part of plants (Zhuang et al. 2007), (Chojnackaet al. 2005).Waste water un active point of high level of cultivar but normal moisture depletion active with high level of seed accumulation. lowest respect Fe (932.708 µg g^{-1}) of giant sunflower at 35% normal irrigation water which explained in Figure.34, powerful cultivar with low level of seed concentration and normal moisture depletion also sewage negative answer with low level of seed concentration and cultivar with water levels and type (Muhammad et al. 2009) , Various different happened between high level and low level also significant between both cultivar and water levels of irrigation with absence of waste water source Current research explained to using both cultivar for phytoremediation and plant grow media cleaning of excess heavy metal effect .

Table 35.The Main Effects of the Treatments on Seed Concentration of Fe

Cultivars	Evening Sun Sunflower	2274
	Giant Sunflower	2093
Water Source	Waste Water	2626
	Normal Water	1740
Irrigation Levels	35%	2025
	60%	2341
LSD	LSD=1469.899 (Levels xW)	

Data result Table 35 showed that difference between level of Irrigation and water source LSD=1469.899, but for the other not more difference happened.

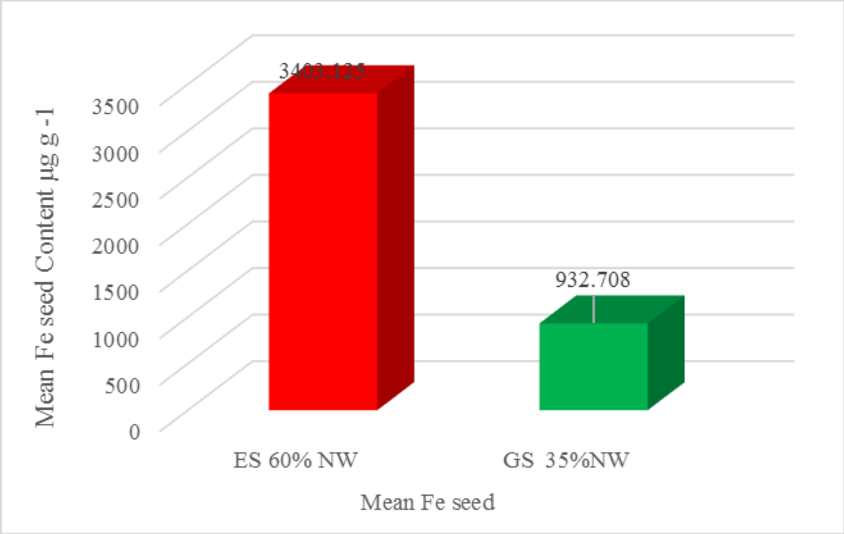

Figure 34. Relation Between Fe Mean Seed Concentration (µg g $^{-1}$) Value Cultivar with Levels Irrigation Use

4.35. Explained Mean Co Seed Uptake Concentration

According to appendix anova Table 27 and data Table 36 main effect of the treatment of Mn seed uptake is not significant.

Table 36.The Main Effects of the Treatments on Seed Concentration of Co

Cultivars	Evening Sun Sunflower	2.2
	Giant Sunflower	3.3
Water Source	Waste Water	2.8
	Normal Water	2.8
Irrigation Levels	35%	2.6
	60%	2.9
LSD	NS	

4.36. Explained Mean Cr Seed Uptake Concentration

Displayed appendix anova Table .31 that trace metal Cr (µg g $^{-1}$) active answer with level of Irrigation ($p<0.05$) and inter action between water type Irrigation levels with cultivar ($p<0.05$) , Figure. 35 in the current research showed seed concentration (Cr) (19.233 µg g^{-1}) regarding with giant sunflower cultivar important with 60% waste water (Salih, N., M., et al, 2014), (Zhuang et al, 2007), sewage active answer with high level seed concentration respect with giant cultivar in high level interest result with working positive between cultivar and sewage water respect with low level(5.525 µg g^{-1}) of giant sunflower cultivar important moisture depletion with 35% normal irrigation water (Raymond, A. W., et al 2011), ,(Riffat, N.M., et al 2010), which explained in Figure.35 also clearly different respect obtained between high and low levels and between both respective cultivar with both water type and various levels, regard result of Cr seed concentration because both cultivar, both water type and both levels of irrigation, interest product for phytoremediation by using sunflower plants.

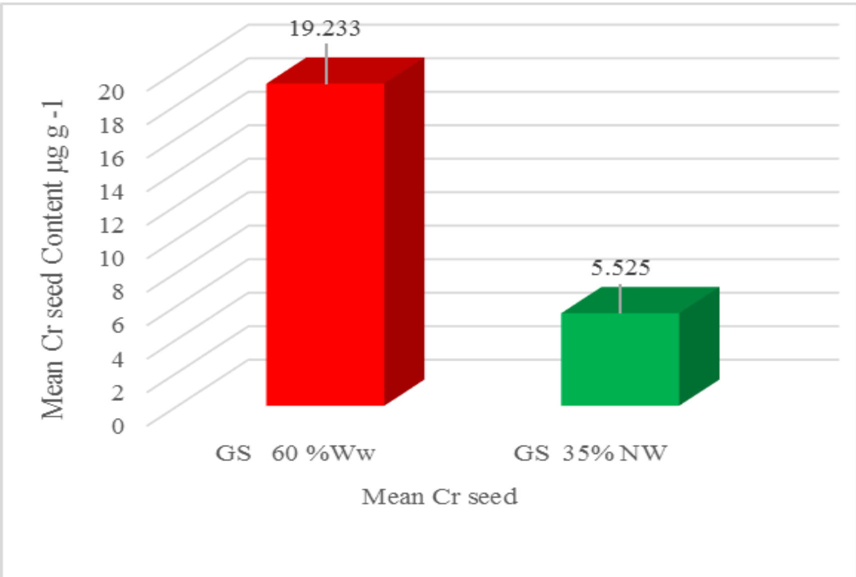

Figure 35. Relation Between Cr Mean Seed Concentration (µg g^{-1}) value Cultivar with Levels of Irrigation Use

Table 37.The Main Effects of The Treatments on Seed Concentration of Cr

Cultivars	Evening Sun Sunflower	9.3
	Giant Sunflower	14.4
Water Source	Waste Water	13.1
	Normal Water	10.6
Irrigation Levels	35%	10.4
	60%	13.3
LSD	LSD=3.913 (CxLevels), LSd=1.934 (levels)	

Data result Table 37 showed more difference between levels of irrigation LSD=1.934, for 60% also inter actions between cultivar with level of irrigation LSD=3.913.

4.37. Explained mean Ni seed uptake concentration

data result appendix anova Table 35 showed seed concentration Ni significant ($p<0.05$) in cultivar , also significant ($p<0.05$) in Irrigation levels and interactions between water source with levels of irrigation ($p<0.05$), Figure 36. satisfied highest level seed Ni concentration (16.142 µg g^{-1}) respect with giant sunflower cultivar positive answer with 60% waste water (Muhammad etal. 2009) and (Tarek et al. 2014), sewage active answer with high level, and respect with giant sunflower. Lowest regard of seed concentration (5.325 µg g^{-1}), active answer with Evening sun sunflower cultivar active answer with35% waste water (Salih et al. 2014), (Zhuang et al. 2007), explained in Figure 36 regard result of Ni seed concentration concentration effect of both cultivar in high and low level of seed accumulation and absorption of ion metal through soil, root, shoots and seed activity, also waste water activity in both level high and low level significant of both cultivar also in high and low level, according to result pleasurable and certain to using both cultivar for bio accumulation of heavy metal and growing media cleaning.

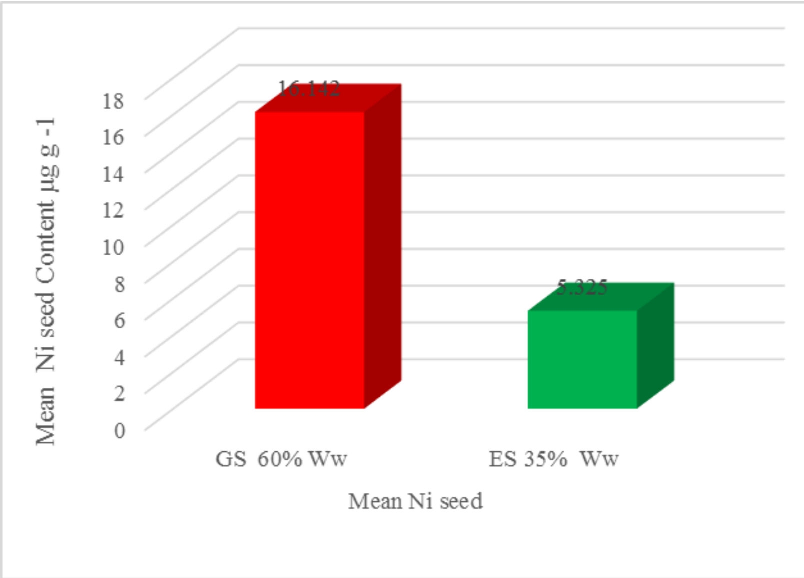

Figure 36. Relation Between Ni Mean Seed Concentration (µg g $^{-1}$) Value Cultivar with Levels of Irrigation Use

Table 38.The Main Effects of The Treatments on Seed Concentration of Ni

Cultvars	Evening Sun Sunflower	9.3
	Giant Sunflower	11.8
Water Source	Waste Water	11.1
	Normal Water	10.0
Irrigation Levels	35%	8.9
	60%	12.2
LSD	LSD=3.459 (Wxlevels), LSD=2.458 (levels), LSD=2.478 (C)	

Data result in Table.38 showed difference cultivar LSD=2.478 for giant sunflower also difference between levels of irrigation LSD=2.458,also difference happened between water source and level of irrigation LSD=2.478..

4.38. Explained Different Between Mean Seed Uptake Concentration In Maximum & Minimum Levels

Seed result explained between (3) significant trace element in extraction of seed, but big regard Fe seed concentration .Mean Fe seed concentration is bigger than Cr and Ni value in high and low in (µg g^{-1}).Seed Cr concentration is (19.233µg g^{-1}) highest value of giant sunflower 60% waste water than minimum level high respect of Cr seed concentration powerful of Ni seed concentration (16.142 µg g^{-1}) of giant sunflower cultivar at 60% waste water. ranking order displayed maximum different seed concentration (Fe>Cr>Ni)which Fe is greater than Cr also Cr is greater than Ni .and the different between minimum level we can observed amount of Cr seed concentration(5.525 µg g^{-1}) of evening sun sunflower at 35%waste water then Ni seed concentration (5.325 µg g^{-1}) of evening sun sunflower cultivar at 35% waste water, and observed in this ranking order (Fe>Cr>Ni).respect high level of Fe seed concentration (3403.125 µg g^{-1}) of Evening sun sunflower cultivar at 60% normal irrigation water with lowest respect Fe (932.708 µg g^{-1}) of giant sunflower at 35% normal irrigation water positive result with waste water also Cr and Ni in high and low level same in regarding with active answer of both cultivar giant sunflower and Evening sun sunflower in interactions between water type sewage irrigation water and various level dosage .indicator to activity of both cultivar and water types to use for phytoremediation and removing increase heavy metal amount in soil and moving to green part of plant explained in Figure 37 according to Fe seed uptake not used for in the Figure 37 because Fe it's a big value only compared between Ni andCr.

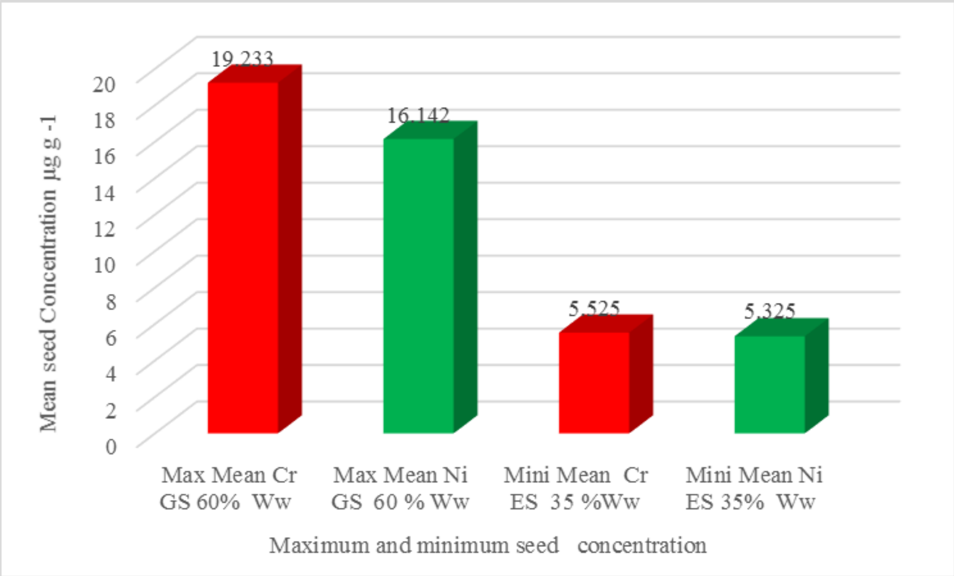

Figure 37. Relation Between Maximum And Minimum Heavy Metal Element Mean Seed Concentration Value and Cultivar with Levels of Irrigation Use

4.39. Briefly Mean Weight Dry Matter (gm) on Root, Shoots, Seeds, And Total Mass Weight

Displayed result of weight dry matter (gm.) in shoots, root, seed and total mass of it after grinding of dry matter on grinder machine Zm200 and weight all dry matter according cultivar and water type with levels of water irrigation use.

4.40. Explained shoots weight (gm) Effect

Appendix anova Table 37 displayed active significant ($p<0.05$) cultivar, interactions between cultivar with water source ($p<0.05$), interactions between cultivar with levels of irrigation ($p<0.05$) and interactions between cultivar, watersource of Irrigations with levels of irrigation($p<0.05$). Showed Figure.38 Regard answer mean weight of shoots weight (86.106 gm.) respect result with Evening sun sunflower cultivar acceptable with moisture depletion of 35% waste water (Salih et al. 2014) , low level mean weight shoots concentration (41.668gm)powerful with giant sunflower pleasurable with 35% waste water(Raymond et al. 2011). Waste water active answer with mean shoots weight this indicator to collecting of more quantity of heavy metal in shoots green parts regarding of both cultivar on both high and low level, But normal water un active answer with cultivar and mean shoots quantity (gm) .current research displayed interest result according to mass weight shoots dry matter with both cultivar and high with low level and activity with available waste water it is showed accumulation happened in shoots.

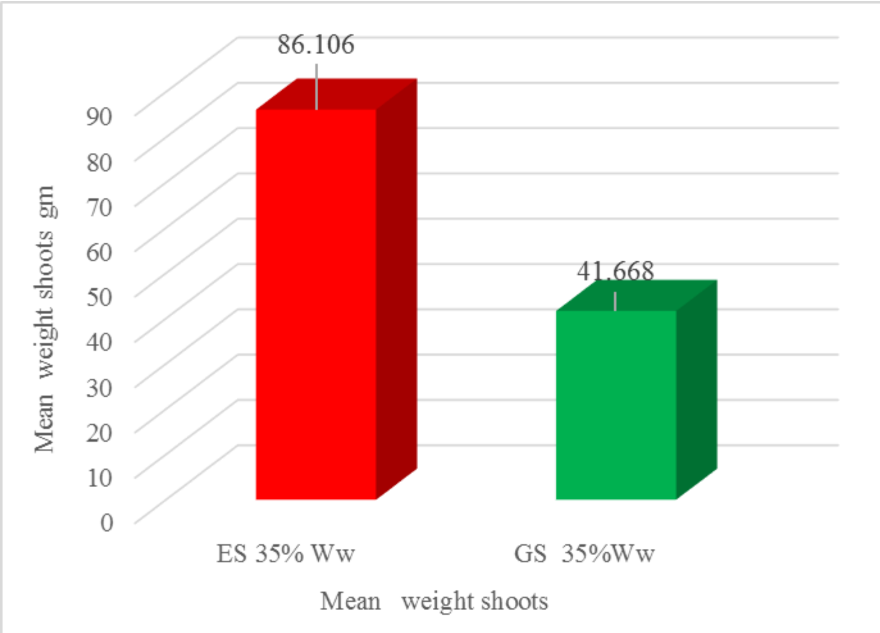

Figure 38. Relation Between Mean Shoots Weight with Cultivar and Levels of Irrigation Use

Table 39. The Main Effects of the Treatments on Mean Weight of Shoots Weight

Cultivars	Evening Sun Sunflower	78.7
	Giant Sunflower	54.7
Water Source	Waste Water	64.1
	Normal Water	69.3
Irrigation Levels	35%	67.8
	60%	65.6
LSD	LSD=12.016 (CxWxD), LSD=8.497 (CxD), LSD=8.241 (CxW), LSD=18.532©	

Data result Table 39 displayed that more difference happened between cultivars ,water source and Irrigation levels.there fore big affect of shoot weight of accumulation in shoots .

4.41. Explained Root Weight (gm) Effect

Appendix anova Table.38 also data result Table 40 shpoweed that root weight is not significant.

Table 40.The Main Effects Of The Treatments on Mean Weight of Root Weight

Cultvars	Evening Sun Sunflower	17.1
	Giant Sunflower	14.9
Water Source	Waste Water	15.7
	Normal Water	16.0
Irrigation Levels	35%	16.0
	60%	65.6
LSD	NS	

4.42. Explained Seeds Weight (gm) Effect

Data appendix anova Table 39 displayed mean seed weight dry matter (gm) regard significant ($p<0.01$) in cultivar, Figure 39 Displayed biggest mean weight seed (19.43 gm) of giant sunflower cultivar powerful with 60% waste water (Salih et al. 2014), (Zhuang et al. 2007) presented smallest mean seed weight (13.759gm) respect with Evening sun sunflower cultivar active answer 35% normal irrigation water (Muhammad et al. 2009)) and (Tarek et al. 2014). Respect answer with cultivar effect of both cultivar is clear happened explained in Figure 39 also both type moisture depletion and levels of water irrigation use.Sewage active answer with mean weight seed indicator to interest product with availability of sewage moisture depletion and adaptation of sunflower with sewage irrigation.Current research data result Tabe 41 main effect of the treatment seed weight is happened of cultivar LSD=2.023.

Table 41.The Main Effects of The Treatments on Mean Weight of Seed Weight

Cultivars	Evening Sun Sunflower	14.2
	Giant Sunflower	18.3
Water Source	Waste Water	16.3
	Normal Water	16.2
Irrigation Levels	35%	15.8
	60%	16.7
LSD	LSD=2.023(C)	

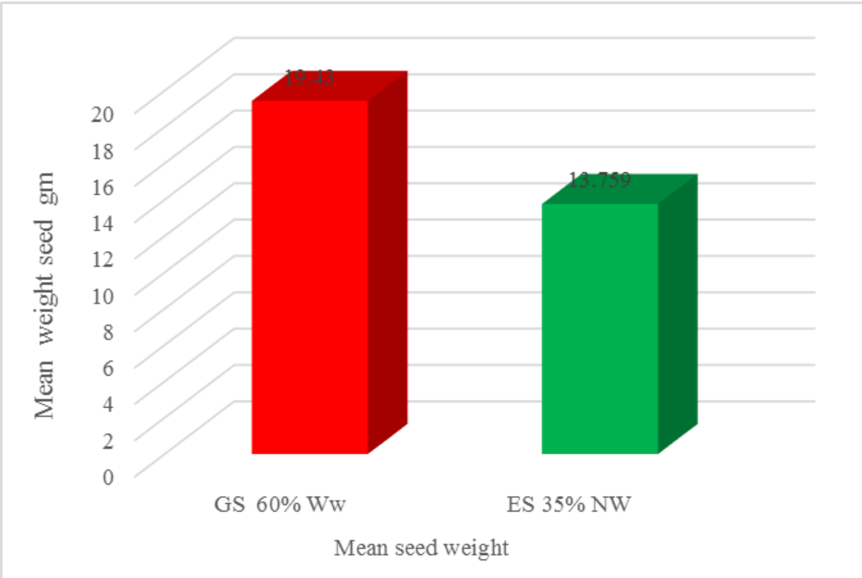

Figure 39. Relation Between Mean Seed Weight With Cultivar And Levels of Irrigation Use

4.43. Explained Total Mass weight (gm) Effect

Data appendix anova Table 40 displayed total mass weight significant in cultivar ($p<0.05$) and interactions between cultivar and water type ($p<0.05$), also on Figure 40. observed maximum answer total mean mass (116.344gm) Evening sun sunflower cultivar regard with moisture depletion 35% Waste water(Salihet al. 2014), (Zhuang et al. 2007) also minimum weight of mean total mass weight (73.522gm) respect answer cultivar with giant sunflower cultivar powerful moisture depletion with 35% waste water.

Table 42.The Main Effects of The Treatments on Mean Weight of Total Mean Weight

Cultivars	Evening Sun Sunflower	110.0
	Giant Sunflower	87.9
Water Source	Waste Water	96.1
	Normal Water	102.7
Irrigation Levels	35%	99.7
	60%	16.7
LSD	LSD=8.397 (CxW), LSD=18.632 (C)	

Data Table 42 main effect of the treatment on mean weight of total mass is happened of cultivars for evening sun sunflower LSD=18.632 and inter action between cultivar with water source LSD=8.397.

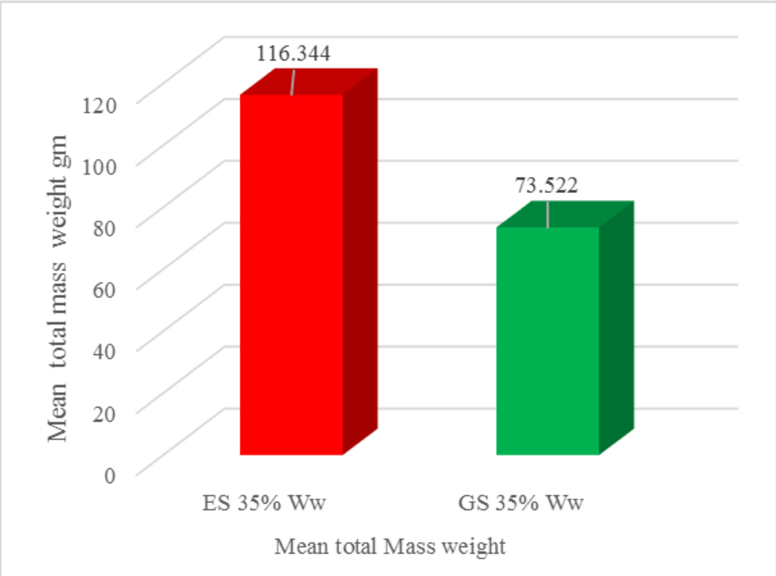

Figure 40. Relation Between Mean Total Mass Weight with Cultivar and Levels of Irrigation Use

4.44. Explained Different Mean Weight Dry Matter (gm) Effect In Maximum and Minimum Levels

Figure 41 displayed maximum level is (116.344gm) Is maximum mean Total mass of evening sun sunflower at35% waste water (Salih et al. 2014), (Zhuang et al. 2007), next respect answer (86.106 gm.) maximum mean weight of shoots of evening sun sunflower at35% waste water and also acceptable result maximum mean weight of seeds of giant sunflower at60% waste water is (19.43gm) (Chojnacka et al. 2005).It's mean (max mean total mass weight > max mean weight of shoots > max mean weight of seeds),and the minimum of the minimum level is mean of seed weight at 35% normal irrigation water of evening sun sunflower. Respect significant cultivar answer interest result to activity of both cultivar powerful of water type agreeable answer to sewage and normal water effect of activity of product and accumulation happened of heavy metal especially in dry matter.

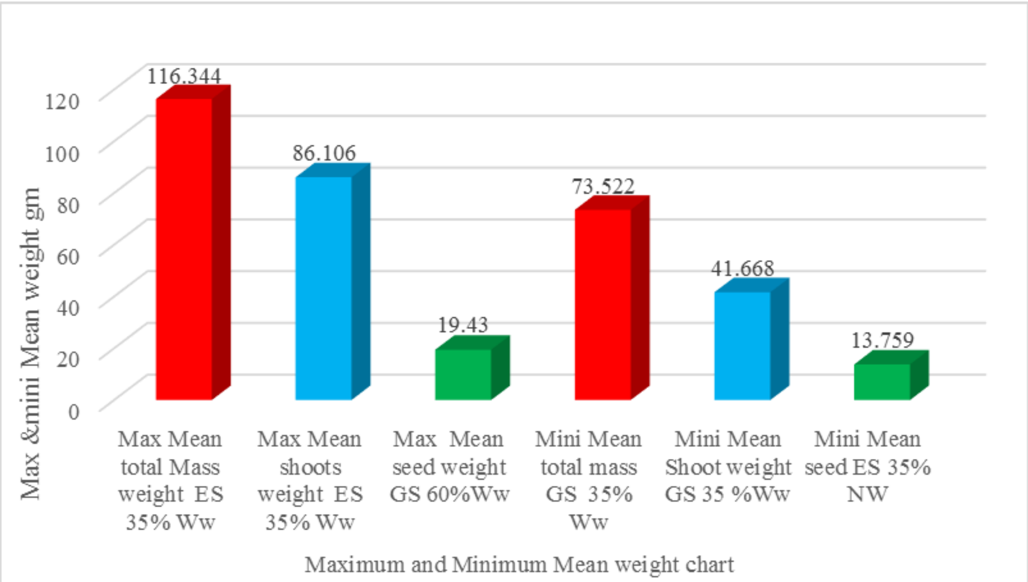

Figure 41. Relation Between Max&Mini Mean Weight (gm) With Cultivar And Levels Of Irrigation Use

4.45. Explained Soil Fe Heavy Metal Concentration

According to appendix anova Table 24 Fe significant in cultivar($P<0.05$) displayed Figure 42 regard answer Fe soil (46443.833 µg g^{-1}) respect cultivar giant sunflower powerful available moisture depletion with 35% normal irrigation water(Salih et al. 2014), low level regarding Fe (32644.792 µg g $^{-1}$) active answer cultivar with Evening sun sunflower pleasurable with moisture depletion 35% normal irrigation water,(Riffat et al. 2010). Interaction of sewage negative point with soil quantity of Fe concentration also normal water positive answer with both level high and low level both cultivar satisfied with soil quantity .

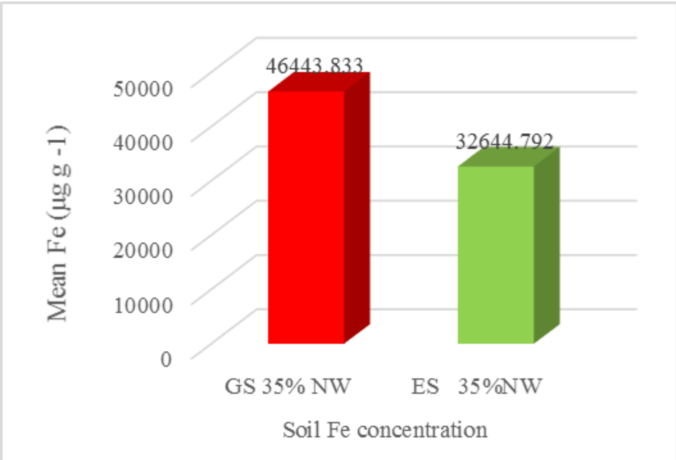

Figure 42. Relation Between Soil Fe Concentration Cultivar with Levels of Irrigation Use

Table 43.The Main Effects Of The Treatments On Soil Concentration of F

Cultivars	Evening Sun Sunflower	38383
	Giant Sunflower	44740
Water Source	Waste Water	42952
	Normal Water	43708
Irrigation Levels	35%	41267
	60%	2341
LSD	LSD=5797.176 (C)	

Data Table 43 displayed main effect of the treatment on soil concentration Fe difference happened in cultivar LSD= 5797.176, for giant sunflower cultivars.no difference happened in the other factors .

4.46. Explained Soil Co Heavy Metal Concentration

Soil ppendix anova Table 28 showed that Co significant ($p<0.05$) in levels of irrigation, and significant ($p<0.01$) interactions between cultivar , levels of irrigation and water type . Figure.43 explain highest level Co is (16.383 µg g $^{-1}$) of giant sunflower 35% waste water (Salih et al. 2014), also lowest level (14.175 µg g $^{-1}$) regard cultivar with Evening sun sunflower active moisture depletion 60% normal irrigation water (Tarek et al. 2014) ,also waste water respective with high level of soil quantity of heavy metal , and regarding both cultivar with both level of active answer , normal moisture depletion active answer with low level of soil heavy metal Co quantity.

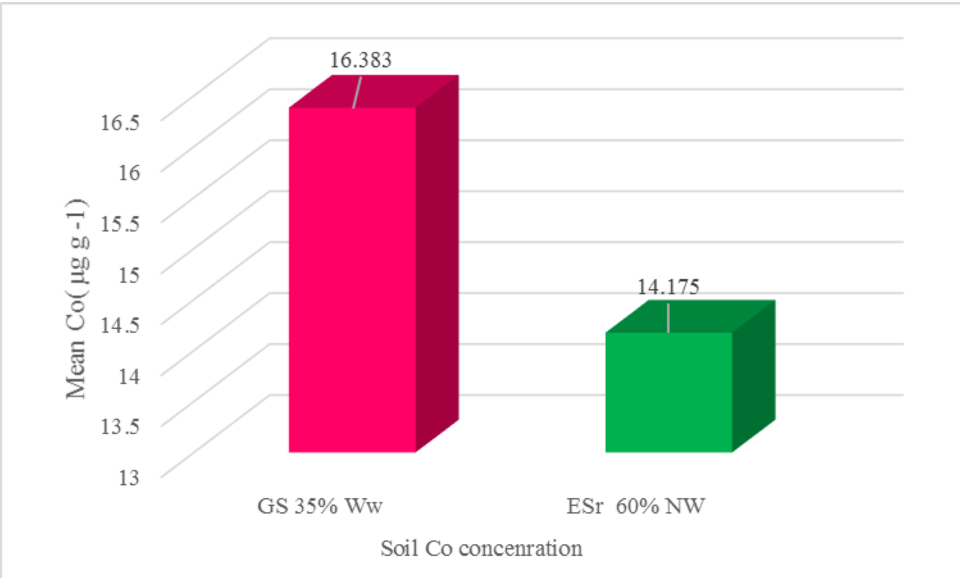

Figure 43. Relation Between Soil Co And Cultivar with Levels of Irrigation

Table 44.The Main Effects of The Treatments on Soil Concentration of Co

Cultvars	Evening Sun Sunflower	15.6
	Giant Sunflower	15.5
Water Source	Waste Water	15.7
	Normal Water	15.8
Irrigation Levels	35%	16.0
	60%	2.9
LSD	LSD=1.54 (CxlevelsxW), LSD=0.77 (levels)	

Data Table 44 explain main effect of the treatments on the soilconcentrationof co difference happened in levels of irrigation for 35% level (LSD=0.77) and difference happened in interaction between cultivar ,watersource and level of Irrigation(LSD=1.54).

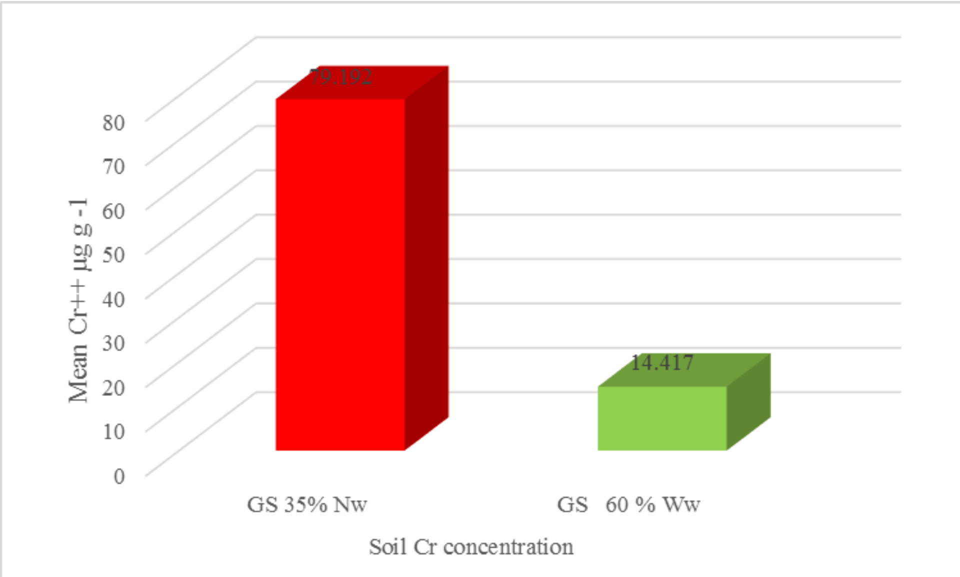

Figure 44. Relation Between Soil Cr and Cultivar with Levels of Irrigation Use

4.47. Explained Soil Zn ,Mn and Ni Heavy Metal Concentration

Accordind to appendix anova Table 16 and data Table 43 for Zn is not significant ,also appendix anova Table 20 with data Table 44 Mn is not significant.and appendix anova Table 35 with data result Table 45 Ni is not significant.

Table 45.The Main Effects of The Treatments on Soil Concentration of Zn

Cultivars	Evening Sun Sunflower	58.0
	Giant Sunflower	60.6
Water Source	Waste Water	58.9
	Normal Water	60.2
Irrigation Levels	35%	59.6
	60%	30.1
LSD	NS	

Table 46.The Main Effects of The Treatments on Soil Concentraion of Mn

Cultivars	Evening Sun Sunflower	58,6
	Giant Sunflower	53,7
Water Source	Waste Water	57,1
	Normal Water	54,6
Irrigation Levels	35%	60,4
	60%	7,9
LSD	NS	

Table 47.The Main Effects of The Treatments on Soil Concentraion of Ni

Cultvars	Evening Sun Sunflower	34.3
	Giant Sunflower	31.9
Water Source	Waste Water	34.1
	Normal Water	33.4
Irrigation Levels	35%	34.0
	60%	12.2
LSD	NS	

4.48. Explained Soil Cr Heavy Metal Concentration

Appendix anova Table 32 of soil Cr showed that Cr soil significant ($p<0.01$) in interactions between cultivar and levels of irrigationand significant ($p<0.05$) interactions between cultivar levels of irrigations and water type.Figure 45 displayed respect answer (79.192 µg g^{-1}) acceptable with giant sunflowerat35% normal irrigation water (Salihet al. 2014), (Zhuang et al, 2007), also lowest level (14.417 µg g^{-1}) powerful with giant sunflower, moisture depletion of 60% waste water(Muhammad et al 2009), Explained in Figure.44 according to significant cultivar, giant sunflower cultivar active point with both level high and low, also with both water type sewage and normal moisture depletion but Evening sun sunflower negative answer with high and low level of Cr concentration, and both water levels and type.

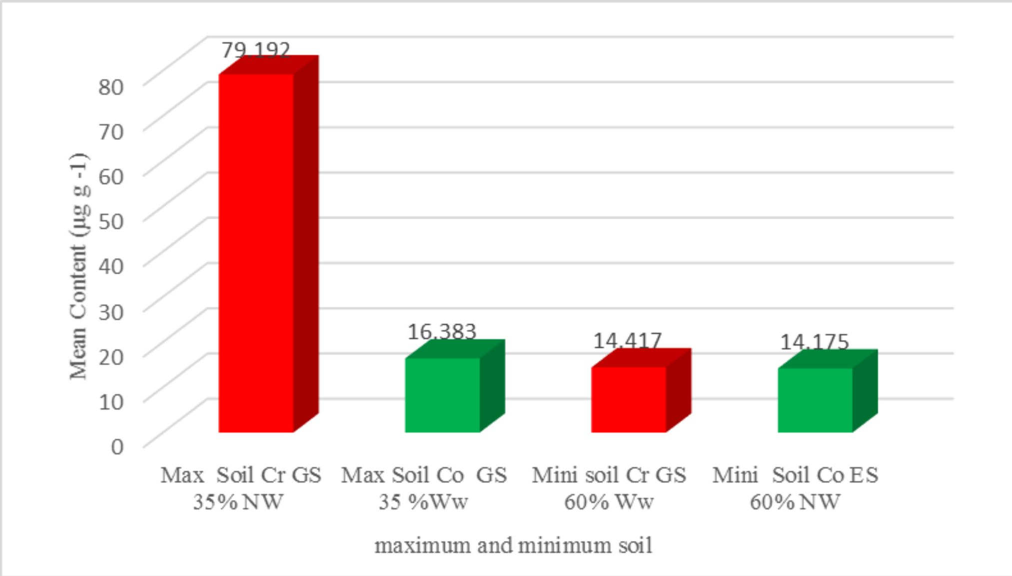

Figure 45. Relation Between Max And Minimum Soil Metal and Cultivar with Levels of Irrigation Us

Table 48.The Main Effects of The Treatments on Soil Concentration of Cr

Cultivars	Evening Sun Sunflower	50.8
	Giant Sunflower	45.8
Water Source	Waste Water	35.6
	Normal Water	66.0
Irrigation Levels	35%	56.6
	60%	13.3
LSD	LSD=34.294(CxLxW), 24.249 (CXL)	

Result Table 48 explained that difference happened in inter action between cultivars and level of irrigation LSD=24.249,also difference happened in interaction between cultivar ,watersource and level of irrigation LSD=34.294.

4.49. Explained Different Soil Heavy Metal Concentration

Regarding result (3) metal different concentration in soils but according to Fe metal big value just compared between Co and Cr in the Figure.45 displayed maximum level (79.192 µg g $^{-1}$) giant sunflower cultivar of moisture depletion 35% normal irrigation water of Cr concentration (Salih et al. 2014), and lowest regard of maximum level is Co (16.383 µg g^{-1}) respect with giant sunflower at35% waste water. It's mean (Fe>Cr>Co). And the minimum of the minimum level is (14.175 µg g^{-1}) of Co at60% normal irrigation water of Evening sun sunflower cultivar. According to regard cultivar interest result both cultivar significant in both levels high and low levels and water type both water type active answer normal moisture depletion in highest and waste water in low level, sewage water type pleasurable however in minimum level but good result for irrigation productivity and saving normal water and solving water problem quantity.

4.50. Explained Summary Result And Discussion

Summary result according to both cultivar activity divide to powerful ranking one for giant sunflower cultivar activity answer and the other Evening sun sunflower cultivar for determination different between two cultivar, Bio accumulation factor result determined in level in maximum level and minimum level, answer both cultivar in high and low level for heavy metal accumulation, in maximum level activity of giant sunflower Cr on moisture depletion 35% normal irrigation water is greater than Mn on moisture depletion 60%normal irrigation water and Mn is greater than Ni on 60% normal irrigation water. BAF ranking order of giant sunflower cultivar (Cr>Mn>Ni), three heavy metal significant in maximum level for giant sunflower cultivar.

For Evening sun sunflower cultivar Bioaccumulation answer activity ranking Co on 35% normal irrigation water is greater than Zn on 60% normal irrigation water and Zn is greater than Fe , BAF ranking order of Evening sun sunflower cultivar(Co>Zn>Fe) three heavy metal regarded result with Evening sun sunflower cultivar in maximum level.

Also BAF answer activity for Giant sunflower cultivar in minimum level change different value ranking order Zn of 60% waste water is greater than Co of 60% normal irrigation water, and Co is greater than Cr of 60% waste water, also Cr is greater than Fe of 60% waste water .BAF ranking order for Giant sunflower in minimum level (Zn>Co>Cr>Fe), four heavy metal active answer in minimum level with different moisture depletion.

Evening sun sunflower answer in minimum BAF ranking order to Mn of 35% waste water is greater than Ni of 35%normal irrigation water. BAF ranking order of Evening sun sunflower (Mn>Ni) two heavy metal active answer for Evening sun sunflower in minimum level.

Translocation factor for giant sunflower cultivar regard answer on maximum level of Co of 35% normal irrigation water is greater than Cr of 35% waste water, also Cr is greater than Mn of 35% waste water, and Mn is greater than Zn of 60% waste water, and Zn is greater, ranking order of Translocation factor maximum level of giant sunflower is (Co > Cr > Mn > Zn).

According to Translocation factor of maximum level of Evening sun sunflower just Ni of 35%normal irrigation water.

For Translocation factor of giant sunflower cultivar in minimum level Ni of 60% waste water is greater than Mn of 60% untreated waste eater, ranking order giant sunflower minimum level (Ni>Mn).

Also translocation factor of Evening sun sunflower cultivar of minimum level displayed Co of 35% normal irrigation water is greater than Zn of 60% normal irrigation water and Zn is greater than Cr of 60% normal irrigation water, and Cr is greater than Fe of 60% normal irrigation water, ranking order of Evening sun sunflower cultivar of minimum level (Co> Zn > Cr).

Shoots uptake of heavy metal of giant sunflower of maximum level regarding with Ni of 60% normal irrigation water is greater than Coof 60% normal irrigation water, also Co is greater than Cr of 60% normal irrigation water and Cr is greater than Mn of 35% normal irrigation water, ranking order of giant sun flower of maximum level (Ni > Co> Cr > Mn).

According to maximum level of Evening sun sunflower just Zn of 60% normal irrigation water regarding with it.

Shoots uptake of Evening sun sunflower of minimum level respect with Ni of 60% normal irrigation water is greater than Zn of 35% normal irrigation water , also Zn is greater than Cr of 60% normal irrigation water ,Cr is greater than Co of 35% normal irrigation water ‘also Co is greater than Mn of 35% waste water. Ranking order of Evening sun sunflower of minimum level showed (Ni > Zn> Cr > Co > Mn).

Root uptake of heavy metal of giant sunflower at maximum level regard with Mn of 60% normal irrigation water is greater than Ni of 60% normal irrigation water ,ranking order of giant sunflower root uptake of maximum level showed(Mn > Ni).

According to root uptake evening sun sunflower cultivar of maximum level respect Co of 60% normal irrigation water is greater than Zn of 60% normal irrigation water ,also Zn is greater than Cr of 60% normal irrigation water. Ranking order of maximum level of root uptake of Evening sun sunflower showed (Co > Zn > Cr).

According to minimum level Root uptake of giant sunflower respect activity with Zn of 60% waste water is greater than Cr of 35% waste water , and Cr is greater than Co of %65 normal irrigation water ,ranking order of root uptake of minimum level of giant sunflower showed(Zn > Cr> Co) .

For Root uptake of minimum level of Evening sun sunflower cultivar display Mn of 35% waste water is greater than Ni of 35% normal irrigation water. Ranking order of minimum level root uptake of evening sun sunflower cultivar showed (Mn > Ni).

Seed uptake of maximum level of giant sunflower regard answer with Cr of 60% waste water is greater than Ni of 60% waste water, ranking order of giant sunflower seed uptake at maximum level showed(Cr >Ni).

According to maximum level seed up take of Evening sun sunflower only regard with Fe of 60% normal irrigation water.

Seed up take of giant sunflower at minimum level only Fe of 35% normal irrigation water.

Seed uptake of minimum level of Evening sun sunflower respect with Cr of 35% waste water is greater than Ni of 35% waste water. Ranking order of seed up take at minimum level of evening sun sunflower cultivar showed (Cr > Ni).

According to total mean weight of giant sunflower in maximum level regard mean seed weight of 60% waste water.

But Evening sun sunflower in maximum level of mean weight displayed Total mass weigh of 35% waste water is greater than shoots weight of 35%waste water, ranking order of maximum level of weight of Evening sun sunflower showed(Total mass weigh > shoots weight).

Also in minimum level of mean weigh of giant sunflower displayed total mass weight of 35% waste water is greater than mean shoots weight of 35% waste water ,ranking order of minimum level of mean weight of giant sunflower showed(total mass weight > mean shoots weight).

But Evening sun sunflower at minimum level only regard with mean seed weight of 35% normal irrigation water.

Soil concentration of heavy metal of maximum level of giant sunflower cultivar respect value with Fe of 35% normal irrigation water is greater than Cr of 35% normal irrigation water and Cr is greater than Co of 35% waste water, ranking order of giant sunflower at maximum level (Fe > Cr > Co).

Soil concentration of heavy metal in minimum level of giant sunflower only regard with Cr60% waste water.

But Evening sun sunflower regard in minimum level that Fe of 35% normal irrigation water is greater than Co of 60%normal irrigation water ,ranking order of soil concentration of heavy metal showed (Fe> Co).

CONCLUSIONS

Findings from current research indicated that due to the purification effect by the macrophytes, through of bioaccumulation and Translocation factors (phytoremediation) are frequently listed among the best available technologies for cleaning up heavy metal contaminated soils. The present study showed that plants grown in contaminated areas have a high risk of having heavy metal concentrations beyond the permissible limit for each of them as compared to the less contaminated areas. Also indicated that both of the investigated macrophytes of ornamental sunflower cultivar (*Helianthus annus*.L, (Evening sunny cultivar), and *Helianthus giganteus* (giant cultivar) tend to absorb, translocate and accumulate needed and no needed heavy metals in their shoots and root tissues. Use of waste water for watering has profited interest throughout the countries due to activity water resources and expensive sewage water improvement for discharge, waste water effect can be put to good work as a resource of both plant nutrients and irrigation water. Different studies tested that the closing of waste water approved to be the best for physical using to remove heavy metals.

bioaccumulation and translocation factors regard result also both cultivar of sunflower acceptable using for phytoremediation and accumulation technology's under using of sewage or waste water use for irrigation. Uptake of heavy metal by both sunflower cultivar important result according to analysis of green macrophytes parts like shoots, root, and seed. Also

Both water levels active more powerful happened, Water source or waste water using suitable for irrigation of sunflower cultivar due to result analysis and accumulation active answer.

RECOMMENDATIONS

- Both cultivar of ornamental sunflower (Helianthus annus.L, (Evening sunny cultivar), and Helianthus giganteus (giant cultivar)) pleasurable for Bio accumulation and translocation process.
- Using of untreated wastewater important result and good answer with giant sunflower cultivar especially in 60% of available moisture depletion.
- Future implementing same research project in same place and green house directly after harvesting and collecting data, fall season growing planting. Two time planting in one year.
- Repeating research project in outdoor or open field to comparing between indoor and outdoor result.
- Using research project indoor but change soil type due to current research soil type clay loam texture heavy fine texture and cracking happened during growing seasons.
- Using same design research project indoor and changing sunflower cultivar to another cultivar.
- Research project using recycle sewage water or treated waste water with normal water to comparing result.
- Research project using implementing more than two water type for irrigation process in a gaining research.
- Future research project changing physiochemical parameter and heavy metal types.
- Renew research project comparing between waste water and treated waste water (recycle water) insists of comparing with normal water.
- Repeating research project but decreasing number plant per pots.
- Using Research project changing soil amount and pot size in future.

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APPENDIXES

Appendix .1 Anova Table BAF Zn

Source	Df	MS	MSE
Cultivar	1	0.08256	0.00253*
water type	1	0.03205	0.00674
Cultivar * water type	1	0.03227	0.00674
Irrigation Levelss	1	0.00404	0.004564
Cultivar *Irrigation Levelss	1	0.0146	0.00456
water type*Irrigation Levelss	1	0.00298	0.00456
water type*Irrigation Levelss*Cultivar	1	0.00176	0.00456

Appendix 2. Anova Table TL Zn

Source	Df	MS	MSE
Cultivar	1	0.04261	0.03351
water type	1	0.33154	0.01204**
Cultivar * water type	1	0.00015	0.01204
Irrigation Levelss	1	0.08352	0.01899
Cultivar *Irrigation Levelss	1	0.00287	0.01899
water type*Irrigation Levelss	1	0.04245	0.01899
water type*Irrigation Levelss*Cultivar	1	0.00369	0.01899

Appendix 3. Anova Table BAF Mn

Source	df	MS	MSE
Cultivar	**1**	**1.46733**	**0.06806****
water type	**1**	**0.16015**	**0.01158***
Cultivar * water type	**1**	**0.20515**	**0.01158***
Irrigation Levelss	**1**	**0.52071**	**0.03004***
Cultivar *Irrigation Levelss	**1**	**0.36969**	**0.03004****
water type*Irrigation Levelss	**1**	**0.0781**	**0.03004**
water type*Irrigation Levelss*Cultivar	**1**	**0.00097**	**0.03004**

Appendix 4. Anova Table TF Mn

Source	df	MS	MSE
Cultivar	1	0.00069	0.4041
water type	1	0.01177	0.1242
Cultivar * water type	1	0.80645	0.1242
Irrigation Levelss	1	0.32938	0.25675
Cultivar *Irrigation Levelss	1	2.3973	0.25675**
water type*Irrigation Levelss	1	1.34644	0.25675*
water type*Irrigation Levelss*Cultivar	1	0.00423	0.25675

Appendix 5.Anova Table BAF Fe

Source	df	MS	MSE
Cultivar	1	0.10113	0.01179*
water type	1	0.06128	0.02047
Cultivar * water type	1	0.01134	0.02047
Irrigation Levelss	1	0.0084	0.00711
Cultivar *Irrigation Levelss	1	0.00144	0.00711
water type*Irrigation Levelss	1	0.00012	0.00711
water type*Irrigation Levelss*Cultivar	1	0.0019	0.00711

Appendix 6. Anova Table TL Fe

Source	df	MS	MSE
Cultivar	1	0.22034	0.0546
water type	1	0.0558	0.02595
Cultivar * water type	1	0.07988	0.02595
Irrigation Levelss	1	0.00121	0.00958
Cultivar *Irrigation Levelss	1	0.00614	0.00958
water type*Irrigation Levelss	1	0.00019	0.00958
water type*Irrigation Levelss*Cultivar	1	0.00987	0.00958

Appendix 7. Anova Table BAF Co

Source	df	MS	MSE
Cultivar	1	0.25923	0.01182**
water type	1	0.00021	0.00159*
Cultivar * water type	1	0.02406	0.00159
Irrigation Levelss	1	0.00062	0.02182
Cultivar *Irrigation Levelss	1	0.00041	0.02182
water type*Irrigation Levelss	1	0.00837	0.02182
water type*Irrigation Levelss*Cultivar	1	0.0015	0.02182

Appendix 8. Anova Table TL Co

Source	df	MS	MSE
Cultivar	1	34.817	0.8875**
water type	1	1.95539	0.36417
Cultivar * water type	1	9.65037	0.36417**
Irrigation Levelss	1	0.0071	2.3025
Cultivar *Irrigation Levelss	1	0.80055	2.3025
water type*Irrigation Levelss	1	0.336	2.3025
water type*Irrigation Levelss*Cultivar	1	34.817	2.3025

Appendix 9.Anova Table BAF Cr

Source	df	MS	MSE
Cultivar	1	1.99682	0.18434*
water type	1	5.01667	0.59531*
Cultivar * water type	1	1.2536	0.59531
Irrigation Levelss	1	1.7016	0.24445*
Cultivar *Irrigation Levelss	1	5.44097	0.24445**
water type*Irrigation Levelss	1	0.60309	0.24445*
water type*Irrigation Levelss*Cultivar	1	3.11508	0.24445**

Appendix 10 .Anova Table TL Cr(NS)

Source	df	MS	MSE
Cultivar	1	4.18201	2.77657
water type	1	7.84738	2.49958
Cultivar * water type	1	2.41541	2.49958
Irrigation Levelss	1	2.31161	2.58095
Cultivar *Irrigation Levelss	1	1.87634	2.58095
water type*Irrigation Levelss	1	0.78229	2.58095
water type*Irrigation Levelss*Cultivar	1	3.7912	2.58095

Appendix 11. Anova Table BAF Ni

Source	df	MS	MSE
Cultivar	1	0.07695	0.0118
water type	1	0.01049	0.00282
Cultivar * water type	1	0.0332	0.00282*
Irrigation Levelss	1	0.13214	0.01295*
Cultivar *Irrigation Levelss	1	0.04167	0.01295
water type*Irrigation Levelss	1	0.01789	0.01295
water type*Irrigation Levelss*Cultivar	1	0.00052	0.01295

Appendix 12.Anova Table TL Ni

Source	df	MS	MSE
Cultivar	1	0.00023	10.2758
water type	1	23.7131	7.81716
Cultivar * water type	1	4.57583	7.81716*
Irrigation Levelss	1	105.708	12.7321*
Cultivar *Irrigation Levelss	1	7.47285	12.7321
water type*Irrigation Levelss	1	23.1613	12.7321

Appendix 13.Anova Table Shoots uptake Zn

Source	df	MS	MSE
Cultivar	1	0.0001	37.3575
water type	1	36.6301	6.22549
Cultivar * water type	1	3.8001	6.22549
Irrigation Levelss	1	40.9509	5.38685*
Cultivar *Irrigation Levelss	1	17.7676	5.38685
water type*Irrigation Levelss	1	10.7334	5.38685
water type*Irrigation Levelss*Cultivar	1	1.1926	37.3575

Appendix 14.Anova Table Root Uptake Zn

Source	df	MS	MSE
Cultivar	1	198.231	18.1554*
water type	1	127.075	18.7277
Cultivar * water type	1	73.2377	18.7277
Irrigation Levelss	1	11.1044	12.7609
Cultivar *Irrigation Levelss	1	26.7232	12.7609
water type*Irrigation Levelss	1	26.4075	12.7609
water type*Irrigation Levelss*Cultivar	1	0.28711	12.7609

Appendix 15.Anova Table Seed Uptake Zn

Source	df	MS	MSE
Cultivar	1	87.7838	31.2225
water type	1	12.8334	21.3197
Cultivar * water type	1	31.5104	21.3197
Irrigation Levelss	1	0.00844	17.9827
Cultivar *Irrigation Levelss	1	3.84	17.9827
water type*Irrigation Levelss	1	0.90094	17.9827
water type*Irrigation Levelss*Cultivar	1	31.5104	17.9827

Appendix 16.Anova Table Soil Zn concentration

Source	df	MS	MSE
Cultivar	1	40.4301	14.9316
water type	1	3.52667	21.4334
Cultivar * water type	1	17.9401	21.4334
Irrigation Levelss	1	2.5026	35.882
Cultivar *Irrigation Levelss	1	20.9067	35.882
water type*Irrigation Levelss	1	21.5651	35.882
water type*Irrigation Levelss*Cultivar	1	14.5704	35.882

Appendix 17.Anova Table Shoot Uptake Mn

Source	df	MS	MSE
Cultivar	1	88.5504	7.0237*
water type	1	58.9067	7.8063*
Cultivar * water type	1	3.26344	7.8063
Irrigation Levelss	1	8.3426	6.24719
Cultivar *Irrigation Levelss	1	117.927	6.24719
water type*Irrigation Levelss	1	0.05042	6.24719**
water type*Irrigation Levelss*Cultivar	1	30.7134	6.24719

Appendix 18.Anova Table Root Uptake Mn

Source	df	MS	MSE
Cultivar	1	3007.76	84.256**
water type	1	120.266	17.3146
Cultivar * water type	1	176.991	17.3146
Irrigation Levelss	1	1259.69	30.5717**
Cultivar *Irrigation Levelss	1	1077.7	30.5717**
water type*Irrigation Levelss	1	255.617	30.5717**
water type*Irrigation Levelss*Cultivar	1	3.06378	30.5717

Appendix19. Anova Table Seed Uptake Mn

Source	df	MS	MSE
Cultivar	1	0.00003	2.50042
water type	1	4.83753	1.05458
Cultivar * water type	1	2.20523	1.05458
Irrigation Levelss	1	1.29503	2.06339
Cultivar *Irrigation Levelss	1	0.48878	2.06339
water type*Irrigation Levelss	1	0.3094	2.06339
water type*Irrigation Levelss*Cultivar	1	8.43128	2.06339

Appendix 20.Anova Table Soil Mn Concentration(NS)

Source	df	MS	MSE
Cultivar	1	141.135	45.7493
water type	1	22.3301	52.0737
Cultivar * water type	1	56.1204	52.0737
Irrigation Levelss	1	422.101	139.816
Cultivar *Irrigation Levelss	1	19.44	139.816
water type*Irrigation Levelss	1	73.6751	139.816
watertype*Irrigation Levelss*Cultivar	1	2.22042	139.816

Appendix 21. Anova Table Shoot Uptake Fe(NS)

Source	df	MS	MSE
Cultivar	1	1716842	862759
water type	1	497246	1381314
Cultivar * water type	1	6579191	1381314
Irrigation Levelss	1	698999	707809
Cultivar *Irrigation Levelss	1	550869	707809
water type*Irrigation Levelss	1	307463	707809
watertype*Irrigation Levelss*Cultivar	1	1992471	707809

Appendix 22.Anova Table Root Uptake Fe(NS)

Source	df	MS	MSE
Cultivar	1	5.626e7	1.171
water type	1	6.948e7	1.176
Cultivar * water type	1	2500683	1.176
Irrigation Levelss	1	4119447	8673286
Cultivar *Irrigation Levelss	1	1.853e7	8673286
water type*Irrigation Levelss	1	124312	8673286
watertype*Irrigation Levelss*Cultivar	1	2595301	8673286

Appendix 23.Anova Table Seed Uptake Fe

Source	df	MS	MSE
Cultivar	1	196010	1674172
water type	1	4705392	2739777
Cultivar * water type	1	3776009	2739777
Irrigation Levelss	1	596697	1218928
Cultivar *Irrigation Levelss	1	1095416	1218928
water type*Irrigation Levelss	1	8368714	1218928*
watertype*Irrigation Levelss*Cultivar	1	1098002	1218928

Appendix 24. Anova Table Soil Fe concentration

Source	df	MS	MSE
Cultivar	1	2.424e8	2.617*
water type	1	4.642e7	7.081
Cultivar * water type	1	1.106e8	7.081
Irrigation Levelss	1	2080584	2.013
Cultivar *Irrigation Levelss	1	4.297e7	2.013
water type*Irrigation Levelss	1	2645276	2.013
watertype*Irrigation Levelss*Cultivar	1	1338994	2.013

Appendix 25.Anova Table Shoot Uptake Co

Source	df	MS	MSE
Cultivar	1	352.283	3.15594**
water type	1	4.95042	4.1101
Cultivar * water type	1	116.38	4.1101**
Irrigation Levelss	1	13.2017	1.70734*
Cultivar *Irrigation Levelss	1	8.10844	1.70734
water type*Irrigation Levelss	1	0.51042	1.70734
watertype*Irrigation Levelss*Cultivar	1	17.4251	1.70734*

Appendix 26.Anova Table Root Uptake Co

Source	df	MS	MSE
Cultivar	1	0.20628	1.39526
water type	1	69.275	3.02635**
Cultivar * water type	1	44.4857	3.02635*
Irrigation Levelss	1	101.579	1.86003
Cultivar *Irrigation Levelss	1	56.35	1.86003**
water type*Irrigation Levelss	1	96.5007	1.86003
water type*Irrigation Levelss*Cultivar	1	44.6219	1.86003**

Appendix 27.Anova Table Seed Uptake Co(NS)

Source	df	MS	MSE
Cultivar	1	7.01461	2.09008
water type	1	0.00128	0.1544
Cultivar * water type	1	0.50315	0.1544
Irrigation Levelss	1	0.62565	0.42464
Cultivar *Irrigation Levelss	1	1.72003	0.42464
water type*Irrigation Levelss	1	1.36565	0.42464
watertype*Irrigation Levelss*Cultivar	1	0.00315	0.42464

Appendix 28.Anova Table Soil Co concentration

Source	df	MS	MSE
Cultivar	1	0.05273	0.36966
water type	1	0.48878	0.32284
Cultivar * water type	1	1.36565	0.32284
Irrigation Levelss	1	4.79273	0.66984*
Cultivar *Irrigation Levelss	1	0.89128	0.66984
water type*Irrigation Levelss	1	0.67503	0.66984
watertype*Irrigation Levelss*Cultivar	1	7.56565	0.66984**

Appendix 29.Anova Table Shoot Uptake Cr

Source	**df**	**MS**	**MSE**
Cultivar	1	46.1344	2.41255*
water type	1	26.8288	0.7488**
Cultivar * water type	1	15.7221	0.7488*
Irrigation Levelss	1	9.5319	1.93818
Cultivar *Irrigation Levelss	1	36.6919	1.93818**
water type*Irrigation Levelss	1	36.199	1.93818**
watertype*Irrigation Levelss*Cultivar	1	59.299	1.93818**

Appendix 30.Anova Table Root Uptake Cr

Source	**df**	**MS**	**MSE**
Cultivar	1	19.6657	36.9367
water type	1	523.834	31.8764*
Cultivar * water type	1	16.7084	31.8764
Irrigation Levelss	1	0.35648	29.769
Cultivar *Irrigation Levelss	1	3.39378	29.769
water type*Irrigation Levelss	1	10.6334	29.769
watertype*Irrigation Levelss*Cultivar	1	21.8982	29.769

Appendix 31.Anova Table Seed Uptake Cr

Source	**df**	**MS**	**MSE**
Cultivar	1	158.492	40.0415
water type	1	38.6969	6.58487
Cultivar * water type	1	15.32	6.58487
Irrigation Levelss	1	51.8469	4.23242*
Cultivar *Irrigation Levelss	1	263.841	4.23242
water type*Irrigation Levelss	1	17.8969	4.23242
watertype*Irrigation Levelss*Cultivar	1	34.8607	4.23242*

Appendix 32. Anova Table Soil Cr concentration

Source	**df**	**MS**	**MSE**
Cultivar	1	18.6825	639.54
water type	1	4877.06	980.028
Cultivar * water type	1	2069.72	980.028
Irrigation Levelss	1	217.653	331.773
Cultivar *Irrigation Levelss	1	3166.53	331.773**
water type*Irrigation Levelss	1	121.388	331.773
watertype*Irrigation Levelss*Cultivar	1	2065.08	331.773*

Appendix 33.Anova Table Shoot Uptake Ni

Source	**df**	**MS**	**MSE**
Cultivar	1	507.84	2.55695**
water type	1	36.8776	0.52846
Cultivar * water type	1	301.042	0.52846**
Irrigation Levelss	1	0.09375	1.43854
Cultivar *Irrigation Levelss	1	3.26344	1.43854
water type*Irrigation Levelss	1	6	1.43854
watertype*Irrigation Levelss*Cultivar	1	19.5301	1.43854**

Appendix 34. Anova Table Root Uptake Ni

Source	**df**	**MS**	**MSE**
Cultivar	1	60.2459	7.42818*
water type	1	3.86003	2.03943
Cultivar * water type	1	37.6877	2.03943*
Irrigation Levelss	1	109.761	10.703*
Cultivar *Irrigation Levelss	1	37.9388	10.703
water type*Irrigation Levelss	1	14.8444	10.703
water type*Irrigation Levelss*Cultivar	1	0.81586	10.703

Appendix 35.Anova Table Seed Uptake Ni

Source	df	MS	MSE
Cultivar	1	39.5909	4.79242*
water type	1	7.6219	6.1919
Cultivar * water type	1	47.11	6.1919
Irrigation Levelss	1	66.75	6.82633*
Cultivar *Irrigation Levelss	1	36.9396	6.82633
water type*Irrigation Levelss	1	26.7232	6.82633*
water type*Irrigation Levelss*Cultivar	1	18.4188	6.82633

Appendix 36. Anova Table Soil Ni concentration(NS)

Source	df	MS	MSE
Cultivar	1	33.4884	7.09062
water type	1	25.7301	5.85458
Cultivar * water type	1	1.89844	5.85458
Irrigation Levelss	1	18.7267	11.6849
Cultivar *Irrigation Levelss	1	0.03375	11.6849
water type*Irrigation Levelss	1	0.03375	11.6849
water type*Irrigation Levelss*Cultivar	1	5.13375	11.6849

Appendix 37. Anova Table Shoot Weight

Source	df	MS	MSE
Cultivar	1	3434.97	267.476*
water type	1	158.063	26.4567
Cultivar * water type	1	296.185	26.4567*
Irrigation Levelss	1	31.3628	40.7383
Cultivar *Irrigation Levelss	1	263.559	40.7383*
water type*Irrigation Levelss	1	46.6642	40.7383
water type*Irrigation Levelss*Cultivar	1	282.148	40.7383*

Appendix 38. Anova Table Root weight(NS)

Source	df	MS	MSE
Cultivar	1	27.9774	4.97133
water type	1	2.43506	1.08463
Cultivar * water type	1	0.02802	1.08463
Irrigation Levelss	1	0.00943	3.16477
Cultivar *Irrigation Levelss	1	9.96333	3.16477
water type*Irrigation Levelss	1	0.62349	3.16477
watertype*Irrigation Levelss*Cultivar	1	0.0291	3.16477

Appendix 39.Anova Table Seed weight

Source	df	MS	MSE
Cultivar	1	97.1112	3.19119**
water type	1	0.00633	0.28556
Cultivar * water type	1	0.69694	0.28556
Irrigation Levelss	1	4.87297	1.36808
Cultivar *Irrigation Levelss	1	0.7107	1.36808
water type*Irrigation Levelss	1	2.6467	1.36808
water type*Irrigation Levelss*Cultivar	1	3.05392	1.36808

Appendix 40. Anova Table Total Mass

Source	df	MS	MSE
Cultivar	1	2920.7	270.362*
water type	1	197.493	27.4676
Cultivar * water type	1	331.686	27.4676*
Irrigation Levelss	1	12.1792	45.4589
Cultivar *Irrigation Levelss	1	193.796	45.4589
water type*Irrigation Levelss	1	85.5181	45.4589
water type*Irrigation Levelss*Cultivar	1	350.266	45.4589*

CURRICULUM VITAE

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Department of Soil science and plant Nutrition

Occupation: lecturer in technical Institute of Bakrajo. sulaimanyah polytechnic university

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University	College	Department	Type of Certificate	Year
Sulaimanyah	Agriculture	Soil And water Science	BSc	1993-1997

Language:-

Language	**Status**	**Note**
Kurdish	Excellent	Mother tongue
Arabic	Medium	Second language
English	Good	-
Turkish	Fair	-

Work background:

Work place	**Job Title**	**Year**
Food and Agriculture organization	Monitor +Super visor	1997-1998
Ministry of Higher Education University of sulaimany College of Agriculture	Responsible of Agro -Meteorological station in Bakrajo	1999-2000
Shamal Nursery for planting and Propagation of ornamental and Forestry.	Agricultural Engineer	2000-2002

Food and Agriculture organization	Local Agronomist	2002-2003
Ministry Of Agriculture General directorate of agriculture in sulaimanyah Khwrmal Agricultural branch(sub office)	Agricultural Engineer	2004-2005
Ministry Of Agriculture General directorate of agriculture in sulaimanyah Agricultural research Center	Assistant of Head Soil Science Department	2005-2010
Ministry Of Communication Sulaimanyah International Airport	Officer in Safety and Control Department	2010-2010
Ministry of Higher Education Sulaimany Polytechnic University Agricultural technical Institute of Bakrajo	Assistant of practical lecture	2010-2015
Present In Bingol University Faculty of Agriculture Department Of soil science and Plant nutrition	Master student	2015- now

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Program Name	**State Using**
Information Technology	Fair
Microsoft word	Good
Microsoft Excel	Good
Microsoft presentation	Good
Microsoft data processing	Good
Internet and Email	Good

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Awards:-

Awards place	**Description**	**types**	**Year**
Republic of south Korea	Water and Irrigational farming Method Process	Training Course Certificate	2008
Kingdom of Netherland	General Agricultural process and ornamental and Tissue culture processing	Training Course Certificate	2013
Iraq -Sulaimanyha	Participant in agricultural data analysis and planning and Administration	Training Course Certificate	2009
Turkey Bingol University	Participant in International Conference	Conference Certificate	2015

Good Lucks

Arsalan Azeez Marif

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