Effect of Copper Nanopartical and Magnetized Salty Water in Chlorophylls and Carotenoids content of Tomato (*Lycopersicon esculentum* L .)

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ABSTRACT

The results of study showed that Cu nanoparticale at concentration of 5 M caused decreasing in chl.a content of tomato leaves significantly and the treatment of river water with Cu nanopartical at 5 M caused the highest value of chl.a (0.494 mg/g) , Cu nanoparticles of all it concentration caused decreasing in chl.b content of tomato leaves significantly comparing with control also with treatment of magnetic distilled water at 2000 Gauss, the concentrations of almost treatments increased the content of chl.b significantly comparing with control ,the treatment of drainage water(7 mmohs/cm) with magnetic water of 2000 Gauss caused the highest value of chl.b (0.695 mg/g). Cu nanoparticale at concentration of 0.5 M with magnetized distilled water caused decreasing in carotenoids of tomato leaves significantly, drainage water (7 mmohs/cm) with Cu nanoparticle at (0.5 and 9 M) caused decreasing in carotenoid comparing with control. The highest value of Cu nanopartical (9M) with drainage water (7 mmohs/cm) caused enhancement in carotenoid content (0.157 mg/g) comparing with control and treatment of drainage water at 7 mmohs/cm alone. Cu nanoparticale at concentration of 5 M caused decreasing of total chlorophyll content of tomato leaves significantly .

***Key wards** : Salinity, Cu NPs, Magnetic water, Lycopersicon esculntum L.*

Introduction

A saline soil have a high concentration of soluble salts, high enough to affect plant growth .Salt stress is one of the major abiotic threats to plant life and significantly reduces crop yield in affected areas. Excessive salt above what plants need limits plant growth and productivity and can lead to plant death. About 20% of all irrigated land is affected by soil salinity, decreasing crop yields[1] . Salinity posses two major threats to plant growth: osmotic stress and ionic stress [2] . Several studies have been conducted to investigate the salinity effect in plant growth and productivity [3]. Exposed the castor (*Ricinus communis*) plant to salt stress caused a decrease in surface of leaf chlorophyll content, photosynthesis rate , and reduced plant productivity, noting that these effects increased with increasing salt concentration. It was also found that salt stress limits the growth of cucumber plant (*Cucumis sativus)* and causes dry of leaves [4] . [5] had resulted that salinity cause a decrease in dry weight and water content of the rest of the *Vicia faba* . The results of the study [6] showed that the amount of chlorophylls (Chl.a , Chl.b ,Chl.a/b) and carotenoid varied by increasing or decreasing the period of exposure to salt stress in Ricinus plant. Some researcher [7,8] emphasized the increase in chlorophyll plant content in low salinity and its degradation with high salinity.

Nanoparticles are minutes fintes with lengths ranging from 1-100 nanometers. They have unique physical and chemical properties. They have a large surface area to their size, making them highly motivating on influencing the growth and development of different types of plants , these effects may be either positive or negative [9].

Copper is one of the essential nutrients for plant growth in low concentrations because it needs very small quantities. Copper is involved in many vital processes to form protein and is the main component in the synthesis of many plant enzymes that activate oxygen reduction reactions such as cytochrome oxides, ascorbic acid oxides and lactase [10].\ Copper is widely distributed in plant tissues and is essential micronutrient for growth and involved in many physiological processes [11 , 12] .

It is widely used in agricultural industries, cosmetics, coatings, environmental remediation, fungicides, food industry, chemical industry, textile industries, medical industry, paints, plastics, wastewater treatment, and electronics [13]. Copper as an element converts toxic above a threshold level, which depends on the type of crop plants [14]. The plant content of copper ranges from 2 to 20 ppm in plant dry matter and has the highest concentration of copper in chloroplasts , also it plays an important role in the transmission chain of electrons and contributes to chlorophyll synthesis [15].

The magnetic field is defined as the magnetic force that arises in the area surrounding the magnetic body or in other words can be described as the area surrounded the magnet and shows the effect (in a given material) ,the magnetization of matter under the influence of an external magnetic field is due to the alignment of atoms or molecules of matter when the material exposed to the magnetic field becomes dipole of its atoms and its molecules are aligned towards the field used [16]. Water is the most important factor for plant growth, the attempts to increase food and energy production for satisfying growing needs led to intensive development of plant production through the use of chemical additives, which in its turn caused more pollution of soil, water and air [17] . Magnetic treatment of water has been reported to change some of the physical and chemical properties of water, mainly hydrogen bonding, polarity, surface tension, conductivity, pH and solubility of salts. These changes in water properties may be capable of affecting the growth of plants [18]. [19] reported an increase in water productivity in both crop and livestock production with magnetically treated water. The aim of this study is to treat the salinity by the use of magnetized water as well as the copper nanoparticale and the interaction between them , when apply in tomato by chlorophyll content.

Materials and Method

Tomato (*Lycopersicon esculentum* L.) seedlings class california with two month-old were planted at 2 December , 2018. These seedlings were transferred to plastic pots containing a mixed soil: batmos with a ratio of 1: 1, capacity of 1.5 kg and 144 pots (48 treatments and 3 replicates per treatment). The physical and chemical properties of soil were analyzed (table 1) in the laboratories of the Soil Department / College of Agriculture / Al-Qasim Green University.

Table 1 : Physical and chemical propreties of soil

Sand	720	gm /kgm
Silt	179	gm kgm^{-1}
Clay	101	gm kgm^{-1}
Ph	7.45	
Ec	1.32	dSm^{-1}
Ca	4.60	$mlmolkgm^{-1}$
Mg	2.81	$mlmolkgm^{-1}$
Na	3.39	$mlmolkgm^{-1}$
K	0.60	$mlmolkgm^{-1}$
Cl	6.92	$mlmolkgm^{-1}$
SO_4	3.21	$mlmolkgm^{-1}$
CO_3	Nill	$mlmolkgm^{-1}$
HCO_3	2.13	$mlmolkgm^{-1}$

The seedlings in the greenhouse were grown at a temperature (25±), the seedlings were treated with salt water (0, 2.83, 4, 7 mmohs /cm) , magnetized water (0, 2000, 3000 Gauss) and Cu nanoparticles in concentrations (0, 0.5, 5, 9 M) and interaction experiments between the three factors were treated with salt water and magnetized water by watering, while the nanomaterial was sprayed.

The experiment was completed in February 1, 2019, and the leaves were taken at the age of four months of plant , the leaves between the third and fifth of the top of plant taken to determine of chlorophylls a, b, total chlorophyll and carotenoids from fresh samples , the chlorophyll content was determined by dipping a specific weight of(0.25) g in 15 ml of acetone (85%), and the samples were kept in the dark at room temperature 25± 2 ºC for a week. Chlorophyll was then estimated by method [24] , and the carotenoids content was estimated by method [25].

Completely Randomized Design (CRD) was used with a three-factor and three-replication , including salinity, magnetic water and Cu nanoparticles concentrations. The values were statistically analyzed by the statistical system Gen Stat Release 12.1 . Least significant difference (L.S.D.) was used. On the level of probability of 0.05 to compare the differences between the averages [26].

Results :

Table 2 refers that Cu nanoparticles at concentration of 5 M caused decreasing in chl. a content of tomato leaves significantly. All concentrations of all treatments increased the content of chl.a significantly comparing with control . The treatment of river water (2.83 mmohs/cm) with Cu nanoparticales of 5 M caused the highest value of chl.a (0.494 mg/g).

Table 2 : Effect of copper nanoparticle and magnetized salty water in chlorophyll a mg/g f.w. of tomato (*Lycopersicon esculentum* L .)

Salt concentration mmohs/cm	**Cu nanoparticle M Magnetic water Gauss**	**0**	**0.5**	**5**	**9**
d. W 0	0	0.049	0.135	0.037	0.114
	2000	0.148	0.142	0.186	0.289
	3000	0.249	0.333	0.453	0.395
River water 2.83	0	0.346	0.090	0.494	0.387
	2000	0.126	0.270	0.252	0.086
	3000	0.366	0.168	0.353	0.362
Drainage water 4	0	0.119	0.119	0.241	0.326
	2000	0.260	0.190	0.345	0.326
	3000	0.225	0.180	0.134	0.301
Drainage water 7	0	0.320	0.139	0.383	0.249
	2000	0.279	0.153	0.153	0.390
	2000	0.362	0.176	0.176	0.410
L.S.D. 0.05 = 0.006					

Table 3 refers that Cu nanoparticles of all it concentration caused decreasing in chl.b content of tomato leaves significantly comparing with control also with treatment of magnetic distilled water at 2000 Gauss. The concentrations of almost treatments increased the content of chl.b significantly comparing with control . The treatment of drainage water(7 mmohs/cm) with magnetic water of 2000 Gauss caused the highest value of chl.b (0.695 mg/g).

Table 3:Effect of copper nanoparticle and magnetized salty water in chlorophyll b mg/g f.w. of tomato (*Lycopersicon esculentum* L .)

Salt concentration mmohs/cm	**Cu nanoparticle M Magnetic Water Gauss**	**0**	**0.5**	**5**	**9**
d. W 0	0	0.072	0.036	0.060	0.041
	2000	0.020	0.027	0.063	0.078
	3000	0.148	0.086	0.191	0.147
River water 2.83	0	0.027	0.246	0.068	0.265
	2000	0.386	0.126	0.245	0.308
	3000	0.097	0.126	0.096	0.402
Drainage water 4	0	0.083	0.211	0.202	0.102
	2000	0.262	0.592	0.075	0.051
	3000	0.069	0.114	0.157	0.156
Drainage water 7	0	0.089	0.070	0.451	0.153
	2000	0.695	0.212	0.176	0.247
	3000	0.285	0.202	0.342	0.284
L.S.D0.05 =0.006					

Table 4 indicate that Cu nanoparticle at concentration of 0.5 M with magnetized distilled water caused decreasing in carotinoids of tomato leaves significantly. Drainage water (7 mmohs/cm) with Cu nanopartiecl at (0.5 and 9 M) caused decreasing in carotenoid comparing with control. The highest value of Cu nanoparticle (9M) with drainage water (7 mmohs/cm) caused enhancement in carotenoid content (0.157 mg/g) comparing with control and treatment of drainage water at 7 mmohs/cm alone.

Table 4 : Effect of copper nanoparticle and magnetized salty water in carotinoids of tomato (*Lycopersicon esculentum* L .)

Salt concentration mmohs/cm	**Cu nanoparticle M Magnetic water Gauss**	**0**	**0.5**	**5**	**9**
d.W 0	0	0.080	0.099	0.083	0.087
	2000	0.075	0.072	0.077	0.092
	3000	0.134	0.155	0.107	0.100
River water 2.83	0	0.150	0.110	0.119	0.094
	2000	0.134	0.080	0.084	0.128
	3000	0.105	0.177	0.118	0.108
Drainage water 4	0	0.200	0.179	0.161	0.165
	2000	0.194	0.120	0.121	0.153
	3000	0.083	0.089	0.101	0.168
Drainage water 7	0	0.129	0.013	0.183	0.072
	2000	0.105	0.126	0.202	0.193
	3000	0.197	0.120	0.110	0.157
L.S.D0.05 = 0.002					

Table 5 refers that Cu nanoparticle at concentration of 5 M caused decreasing of total chlorophyll content of tomato leaves significantly . All concentrations of all treatments increased the content of total chlorophyll significantly comparing with control . The treatment of drainage water(7mmohs/cm) with magnetic water of 2000 Gauss caused the highest value of total chlorophyll (0.978 mg/g).

Table 5 : Effect of copper nanoparticle and magnetized salty water in total chlorophyll (mg/g f.w.)of tomato (*Lycopersicon esculentum* L .)

Salt concentration mmohs/cm	Cu nanoparticle M Magnetic water Gauss	0	0.5	5	9
d.W 0	0	0.123	0.176	0.099	0.158
	2000	0.173	0.174	0.256	0.377
	3000	0.403	0.424	0.649	0.547
River water 2.83	0	0.334	0.339	0.551	0.654
	2000	0.518	0.591	0.512	0.399
	3000	0.330	0.293	0.449	0.786

***Cont...* Table 5 : Effect of copper nanoparticle and magnetized salty water in total chlorophyll (mg/g f.w.) of tomato (*Lycopersicon esculentum* L .)**

Drainage water 4	0	0.427	0.653	0.447	0.476
	2000	0.527	0.794	0.457	0.384
	3000	0.297	0.335	0.295	0.441
Drainage water 7	0	0.412	0.212	0.842	0.422
	2000	0.978	0.282	0.571	0.577
	3000	0.765	0.457	0.728	0.710
L.S.D0.05 = 0.008					

Discussion

The plant growth subjected to high levels of Cu nanoparticle leads to reduce in biomass, chlorotic in leaves as well as decreasing in chlorophyll content , which is resulted from the change in the chloroplast structure lead to increase oxidation fat and then reduces the content of fatty acids. The Cu nanopartical appears like the normal copper effect , nanoparticales cause many changes morphological and physiological to plants depending on the characteristics of these nanoparticales , may vary the efficiency of nanoparticales by the chemical composition , size and space surface and reactivity [28] as well as the dependent on the type of plant and concentration as it is different from plant to time [9]

Conclusion

1- The river water (2.83 mmohs/cm) and drainage water (4 and 7 mmohs/cm) enhanced the chlorophyll content.

2- The copper nanoparticles at different concentrations vary in effects on chlorophylls but these were no change in carotenoids significantly.

3- All the type water in current study which magnetized of 2000 Gauss enhanced the chlorophylls and carotenoid.

4- The interaction between types of water, Cu nanoparticles and magnetized water , all of increased the chlorophyll content comparing with control.

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Conflict of Interest: None to declare.

Ethical Clearance: All experimental protocols were approved under the Ministry of Education, Iraq and all experiments were carried out in accordance with approved guidelines.

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