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THE EFFECT OF ADDING ZINC OXIDE SOL-GEL NANO ON THE CHEMICAL CHARACTERISTICS OF GROWING *CAPSICUM FRUTESCENS* PLANT IN HYDROPONIC SYSTEM

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ABSTRACT : The study included two experiments, the first laboratory and the second field experiment, for the period from 1/2/2018 to 1/11/2018. The laboratory experiment was performed in the laboratories of the College of Education for the Pure Sciences, University of Diyala, where ZnO have been prepared by using sol-gel method. the field experiment was conducted in the Agricultural Department of Diyala, inside the plastic house covered with polyethylene. The *Capsicum frutescens* plant was rotated into the pot Hydroponic system containing the medium of the perlite and the concentrations of 0, 25 and 75 mg/l were added of Nano zinc oxide to the nutrient solution of *Capsicum frutescens* plant. the experiment was designed in a completely randomized design (CRD) with three replication for each treatment and three samples for each treatment, this experiment included four different treatment, control treatment (without zinc), Cooper solution (with zinc) 25 and 75 mg/l ZnO. The comparison between the mean of the treatment was done using Duncan at 0.05 level of significance. The results showed that zinc oxide granular size of 2872. nm, as it was diagnosed using the technique of diffraction X-Ray and the use of the Debye – Scherrer equation. as well as that the prepared material of ZnO is pure material has been diagnosed using the Energy Dispersive X-ray Spectroscopy (EDX). Use of ZnO at 25 mg/l concentration caused significantly influenced in the leaves content of chlorophyll and at a rate of 112.7 SPAD unit compared with the control treatment, which gave a rate of 92.0 SPAD unit and the same treatment caused an increase in the percentage of nutrient concentrations in leaves at a rate of 3.19% for nitrogen, 0.41% for phosphorus, 1.21% for zinc and 19.9% for protein, while the control treatment gave a percentage of 2.0% for nitrogen, 0.38% for phosphorus, 0.88% for zinc and 12.7%, for protein, the same treatment showed an increased in the fruits content of vitamin C and increased the leaves content of Auxin at a rate of 36.0 mg/ml and 14.5 mg/kg, respectively, compared with the control treatment, which gave rate of 23.0 mg/ml and 9.4 mg/kg , respectively.

Key words : Nano ZnO, hydroponic system, *Capsicum frutescens*, sol-gel, X-ray, EDX.

INTRODUCTION

Capsicum frutescens is one of the groups of the Solanaceae is an enormous shifted group of herbs, trees, and bushes including 90 genera and in excess of 2000 species (Shah, 2013). *Capsicum frutescens* is one of the most prominent vegetable yields and its known for high dietary esteemed, developed in tropical and subtropical pieces of the world. It is a decent wellspring of nutrients A, B, C, E and minerals, furthermore, contain flavonoid and phenolic that are enemies of oxidants, has anticancer and antimicrobial attributes, and has prophylactic and healing qualities for some ailments, for example, cerebral pain, stiffness joint inflammation, colds, and bronchitis and numerous different sicknesses (Saleh *et al*, 2018). Hydroponic framework is the developing of plants in a supplement arrangement with or without the utilization of fake media commonly utilized mediums incorporate perlite, wood fiber, coir and vermiculite, Hydroponics framework has been perceived as a suitable strategy for creating vegetables (peppers, tomatoes, cucumbers, and lettuce) (Shrestha and Dunn, 2013). Nanotechnology opens a major scope of novel applications in the territory of plant nourishment expected to satisfy the future needs of the developing populace in light of the fact that nanoparticles have interesting physicochemical qualities, for example molecule morphology, high reactivity, high surface territory, and tunable pore size (Ditta and Arshad, 2016). Zinc oxide is an inorganic white powder and is generally utilized as an added substance in various items and materials including pottery, salves, glass, concrete, plastics and rubber (Sabir, 2014), it is utilized in organic and pharmaceutical applications and it advances development and adjusts the insusceptibility and can go about as an antibacterial agent (Swain, 2016) zinc oxide nanoparticles have been appeared to positively affect plants and could be utilized to build crop (Chanu and Upadhyaya, 2019). Zinc is planted micronutrient, which is engaged with numerous physiological procedures its deficient supply will lessen harvest yields, it likewise has a functioning job in the creation of a basic development hormone (Hafeez *et al*, 2013). Zn has significant capacity in sugar digestion, photosynthesis, phytohormone movement, protein combination and quality articulation and guideline (Sadeghzadeh, 2013). Because of food and medical importance to plant chili and to improve plant growth and increase production using the latest methods and techniques, as well as the lack of research carried out on the use of fertilizer nanoparticles in the production of hot pepper plant using aquaculture system in Iraq, carried out this experiment.

MATERIALS AND METHODS

Preparation of zinc oxide

Preparation of 0.1 M of Zn $(CH_3COO)_2{\bullet}2H_2O$ and preparation of 0.1 M of citric acid. Zinc acetate solution was placed on the hot plate magnetic rotor and slowly added the citric acid solution. This mixture was left on the machine for 40 minutes at room temperature with 450 cycles The ammonia was added to the solution in droplets until it became pH 7, after which the temperature of the solution was raised to 90 m to completely evaporate the water and form a gelatinous substance, dried the material at 80°C for two hours and then burned in the oven at 450°C for three hours (Mubarak, 2013).

Characterization techniquesnanoparticles

The metal oxides nanoparticles were depicted by a couple of systems including X-pillar diffraction (XRD), Energy Dispersive X-beam Spectroscopy (EDX) and Scanning electron amplifying instrument (SEM). Crystallinity, structure and crystallite size of nanoparticles were constrained by XRD using a Shimadzu (Kyoto, Japan) Miniflex X-pillar diffractometer with Cu-Ká radiations (ë = 0.15406 nm) in the 2è region from 20° to 80°.(EDX) Energy Dispersive X-beam Spectroscopy at the University of Kashan/Iran. SEM evaluation was finished using a 200 kV Zeiss (Germany) checking electron amplifying the focal point.

Field experiment

The experiment was conducted in the Agricultural Department of Diyala, inside the plastic house covered with polyethylene. The *Capsicum frutescens* plant was rotated into the pot Hydroponic system containing the medium of the perlite and the concentrations of 0, 25 and 75 mg/l were added of nano zinc oxide to the nutrient solution of *Capsicum frutescens* plant. The nutrient solution (Cooper solution) was prepared as mentioned (Cooper, 1979).

Chemical characteristics studied of *Capsicum frutescen*s plant

The measurement Chemical characteristics of *Capsicum frutescens* plant were as shown in Table 1.

RESULTS AND DISCUSSION

Characteristics of (ZnO) nanoparticles

Fig. 1 shows the XRD pattern of ZnO nanoparticles. It can be noticedshowed that the highest peaks obtained for diffraction angles were (31.7, 34.3, 36.12) 2è and these peaks indicate the nature of the crystalline structure of ZnO. These peaks were compared with the standard database of ZnO (JCDPS) and were found to be identical (Jurablu *et al*, 2015).

Energy Dispersive X- ray Spectroscopy analysis (EDX)

Fig. 2 shows the EDX investigation of ZnO nanoparticles. EDX range shows tow peaks which are recognized as zinc and oxygen, it very well may be seen that unadulterated ZnO nanoparticles (Brintha and Ajitha, 2015).

Scanning electron microscopy analysis (SEM)

Fig. 3 shows the scanning electron microscopy images of the ZnO nanoparticles sample.

Table 1 : Methods of measured chemical characteristics of *Capsicum frutescen*s plant.

No	Chemical characteristics	Method of measurement
1	Chlorophyll (SPAD Unit)	measured by method (Loh *et al*, 2000)
2	Nitrogen %	measured by method (Gresser and Parson, 1979)
3	Phosphorus %	measured by method (Chapman and Pratt, 1961)
4	Potassium %	measured by method (Gresser and Parson, 1979)
5	Zinc %	measured by method (Gresser and Parson, 1979)
6	Protein %	measured by method (Thachuk *et al*, 1977)
7	Auxin Mg/ kg	measured by method (Nuray *et al*, 2002)
8	Vitamin C Mg/ ml	measured by method (Ranganna, 1977)

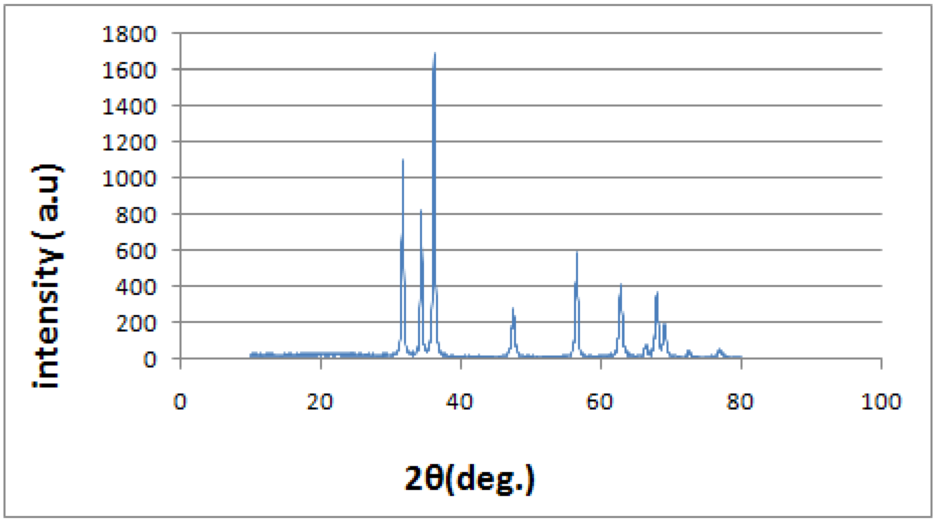

Fig. 1 : XRD pattern of ZnO nanoparticles.

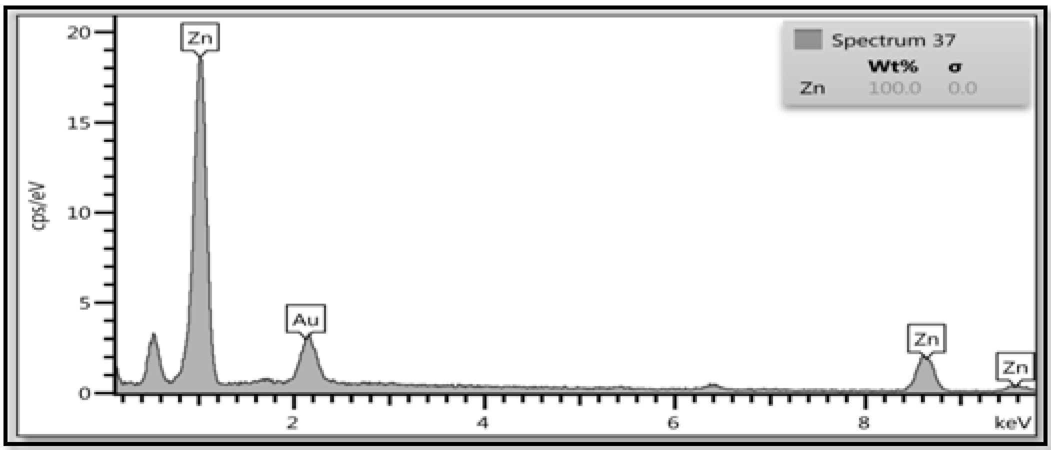

Fig. 2 : EDX pattern of ZnO nanoparticles.

Table 2 : Strongest three peaks in XRD of Zno nanoparticles.

No	Peak position 2è (°)	FWHM B size (°)	Dp (nm)	Dp average (nm)
1	36.174	0.3243	26.94	28.72
2	31.7044	0.2974	29.02	
3	34.341	0.2877	30.21	

Table 2 : Effect addition of nano zinc concentrations to nutrient solution of hydroponics in chemical characteristics of *Capsicum frutescens* plant.

Treatments \ Characteristics	Auxin (Mg/kg)	Vitamin C (mg/ml)	Protein %	Zn %	K %	P %	N %	Chlorophyll (SPAD Unit)
ZnO 25mg.l^{-1}	14.5a	36.0a	19.9a	1.21a	0.60a	0.41a	3.19a	112.7a
ZnO 75mg.l^{-1}	10.5b	26.0b	19.6a	1.14a	0.56a	0.39b	3.14a	111.4a
Cooper Solution	9.9b	25.0b	13.2b	0.89b	0.54a	0.39b	2.1b	92.6b
Cooper Solution without zinc	9.4b	23.0b	12.7c	0.88b	0.53a	0.38b	2.0c	92.0c

*Values with similar characters do not different significantly from each other.
*The concentration of vitamin C in 100 ml juice was calculated.

Chemical characteristics of *Capsicum frutescens* plant

The results shows in Table 3 that the leaves content of chlorophyll wasat a rate of 112.7 SPAD unit compared with the control treatment which gave a rate of 92.0 SPAD unit and the same treatment caused increased in percentage of nutrient concentrations in leaves at a rate of 3.19% for nitrogen, 0.41% for phosphorus, 1.21% for zinc and 19.9% for protein, while the control treatment gave a percentage of 2.0% for nitrogen, 0.38% for phosphorus, 0.88% for zinc and 12.7%, for protein, the same treatment showed increased in the fruits content

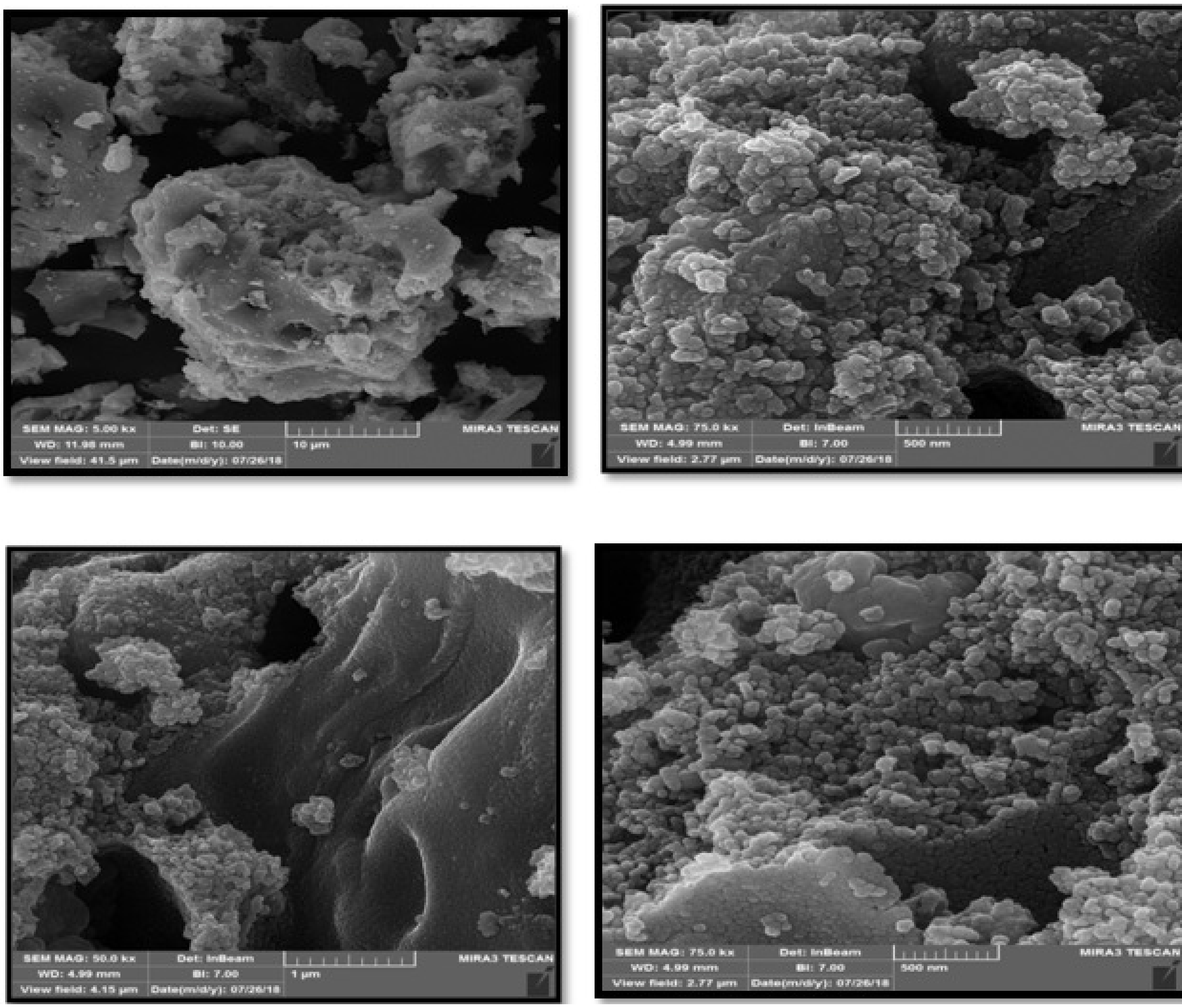

Fig. 3: SEM image of ZnO nanoparticles.

of vitamin C and increased the leaf content of Auxin at a rate of 36.0 mg/ml and14.5 mg/kg respectively, compared with the control treatment which gave rate of 23.0 mg/ ml and 9.4 mg/kg, respectively. Nanomaterials provide more surface area biochemical reactions in the plant which increases the rate of photosynthesis and produces more dry matter (Qureshi *et al*, 2018; Singh *et al*, 2017). In addition, nanomaterials play roles in improving the efficiency of nutrient uptake (Tripathi *et al*, 2018). Zn is an important component of many enzymes, which linked with the protein synthesis, regulation and safety of ribosomes and gene expression (Gowayed and Kadasa, 2016). Zn, it controls the chemicals needed in metabolic responses prompting the union of starches and chlorophyll, zinc increment the cation-trade limit of the roots, which thusly expands the retention of supplements, especially nitrogen which is responsible for higher protein content (Kisan *et al*, 2015). In expansion, the most significant elements of Zn in the plant interest in the combination of tryptophan in charge of amalgamation auxins (Bar³óg *et al*, 2016). Auxins assume jobs in the generation of longer roots with an expanded number of root hairs which are an expansion in supplement take-up (Kumar *et al*, 2014).

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