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EFFECT OF ZINC OXIDE MOLECULES AND ZINC SULFATE ON SOME VEGETATIVE GROWTH AND FLOWERING IN CARNATION (*DIANTHUS CARYOPHYLLUS* L.)

Jihan Yahya Al-Hatem*, Amina Ahmad yahya, Azhar Abd-Al jabar Hamed and Baan Kallel

College of Education for Girls, Mosul University, Iraq.

Abstract

This study was conducted in the Department of Biology/College of education for girls at the Mosul University during the period from October 6th 2017 until July 28th 2018 on the Carnation (*Dianthus caryophyllus* L.). The purpose of research is to note response of the plant to fertilization with the Zinc Oxide Nanoparticles (ZnO NPs) fertilizer with three concentrations: zero, 40 and 80 mg.L^{-1} and the fertilization with the Zinc sulphate ($ZnSO_4$) in three concentrations: zero, 40 and 80 mg.L^{-1}. The experiment was performed By designing partisan experience conducted in the design of complete randomized sectors. The outcomes showed that Oxide zinc (ZnO NPs) fertilization in its two concentrations 40, 80 mg.L^{-1} has an important impact recording highest values for characteristics of the total number of leaves, diameter of flower and diameter of anthophors. The outcomes as well showed the fertilization with concentrations ZnO NPs 40 mg.L^{-1} with concentration (ZnSO4) 40 mg.L^{-1} recorded best values and gave significant rise in height of plant, leaves number, fresh and dry weight, flower number and diameter of flower.

Key words: Carnation, Zinc Nano Fertilizer, Zinc sulphate, Number of flower

Introduction

Carnation (*Dianthus caryophyllus* L.) belongs to family of caryophyllaceae, native to Europe and Asia with some species widening south to North Africa (Hughes, 1993). It has been cultivated by man for over 2000 years. Carnation is one of the most important commercial cut flowers in world commercially. It holds second position after Rose. Actually, it is one of the most popular annual grown in garden, excellent for bedding, herbaceous borders, edgings, pots and as cut flower (Galbally and Galbally, 1997 and Raabe *et al.,* 2002 and Al-Snafi, 2017).

Fertilizers has a significant part where the old chemical fertilizers are exchanged with Nano and bio fertilizers with their qualifications and environment-friendly nature (Lav *et al.,* 2007). Fertilization is a significant tool for potential and fruitful administration of crops. Capability of plant leaves to suck water and foods known almost three centuries ago (Fernández and Eichert, 2009). A supply of inorganic substances from outside known as mineral nutrition. Besides the major elements, the micronutrients like zinc as well have a major effect on increase and efflorescence of carnation (Mir *et al.,* 2007). Zinc adjusts different metabolic responses and effects figuration on increasing hormones in the plant and helps in reproduction of certain plants (Shankar and Prasad, 1998).

In the past few years, many researchers have aimed to discuss the possibility of nano technology to ameliorate fertilizer use ability . These potentials lead to nanofertilizer development (Kundu *et al.,* 2013). Nano technology-based fertilizers maybe more dissolvable or more interactive their bulk counterparts (Naderi and Danesh-Shahraki, 2013). Nano subedit fertilizers maybe facilely sucked through plants and show long periods of efficacious of nutritious equipping in soil or plant (Rameshaiah and J. pallavi, 2015). For same reason, nano grains maybe utilized to wrap zinc to obtain diffused and soluble zinc (Naderi and Abedi, 2012). Prasad *et al*., (2012) show that in an experiment, peanut seeds were independently curing at various concentricity of nanoscale zinc Oxide (ZnO NPs) and chelated bulk zinc sulfate (ZnSO4) commentary (a common zinc supplement) essentially. Influence of treatment on plant efflorescence, growth of

***Author for correspondence:** E-mail : jahanyalhatem@yahoo.com

seedlings, chlorophyll content, seeding increase, efflorescence, pod yield and root growth were examined. Indeed, the treatment of nanoscale (ZnO NPs) (25nm means molecules size) at 1000ppm concentricity enhancement together plant efflorescence plant growth and conversely appeared quickly establishing in soil through efflorescence and higher leaf chlorophyll content. Grains showed efficient in rising trunk and root growth. Pod yield for plant was 34% higher comparison with chelated bulk (ZnSO4) (Lawe and Rashar, 2014).

Materials and methods

The study was conducted in greenhouses of the department of biology, College of Education for Girls, University of Mosul, Iraq during the period from October 6th 2017 until July 28th 2018 on the Carnation (*Dianthus caryophyllus* L.). Soil structure of empirical place is sandy site, included 52% and 33% silt and 15% mud and includes 0.17% organic materials (OM) with a pH of 7.27, with electric accessibility (EC) = 1.64 ds m^{-1}. The plants were planted in $30cm^2$ diameter pottery. The experiment includes the following:

Zinc Nano Fertilizer: (ZnO NPs) zinc Oxide nanoparticles of 5µm Reagent plas[R] powder size procured from Oma International Trading Authorized Partner of Sigma Aidrich/Germany, was used in this study in comparison with $ZnSO_4$, have been utilized in this research as foliar application with three concentrations control, 40 and 80 $mg.L^{-1}$ treatment adding to levels twice; the first when the length of plan amount to 10-15cm, the second, one month next first drizzle, then major element is calculated and put in major plot.

Zinc sulphate ($ZnSO_4$): In this study, it has been used as foliar application with three concentrations: control, 40, 80 $mg.L^{-1}$. Treatment was made by using zinc sulphate twice, one week after fertilization using Zinc Nano fertilizer, the second :one month after first drizzle. Concerning control plants, they were sprinkled with filtered water (Ewaid *et al.,* 2019a, b; Ewaid and Abe, 2017). It was considered as a secondary plot, early morning sprinkle until moisture is done. Expanding material is gathered for all condensation in order to reduce tightening surface of the solution, get rid of, fling and follow up insects and diseases processes when it is requisite. Experiment actually includes 9 factorial treatments: 3 levels of zinc Oxide nanoparticles (ZnO NPs), 3 concentrations of Zinc sulphate ($ZnSO_4$). All treatment were duplicated three times (3 × 3 × 3), Factorial Experience was done in Randomized Complete Block Design.

Study Features of Green Growth: Measurement of information when efflorescence was 60% just as follows:

Plant height (cm): was gauged by utilizing Tape measure beginning from plant trunk until upper edge of plant.

Number of total leaves (leaf.plant^{-1}): choosing three plants in all empirical unit.

Fresh & dry weight of vegetative group (g): by recording fresh weight of plant (g), drying on 70°c until stable weight, dried weight is counted (g).

Number of flowers (flower. plant^{-1}): selecting five plants in each experimental unit.

Diameter of flowers (flower. plant^{-1}): selecting five plants in each experimental unit.

Diameter of anthophores (mm): selecting five plants in each experimental unit.

Statistical analysis: information was analyzed through utilizing SAS (2001), Duncan multiple range test was applied with accessibility level 5%.

Results

Plant height (cm):

The data in table 1 it shows that zinc NPs did not differ significantly, but the highest value was recorded when zinc sulphate was used at concentration of 40 $mg.L^{-1}$ as it reached 37.22, anther other hand, the height number of plant height 41.97cm record when zinc NPs fertilization at 40mg/L combined with 40$mg.L^{-1}$ zinc sulphate combined with control 25.1cm. All superior results may be refer to high significant effect for fresh & dry weight of vegetative group and number of flowers on this character as shown in correlation coefficient (r = 0.35, 0.43, 0, 42 respectively) table 9.

Number of leaves (leaf. Plant^{-1})

Table 2 shows that the zinc NPs 40 $mg.L^{-1}$ gave a higher value of leaves number 48.08 leaf. plant^{-1}

Table 1: Effect Oxide zinc NPfertilizer and Zinc sulphate height plant (cm) of (*Dianthus caryophyllus* L.).

Oxide zinc NPs($mg.L^{-1}$)	Zinc sulphate ($mg.L^{-1}$) Zero	40	80	mean Oxide zinc NPs ($mg.L^{-1}$)
Zero	25.1 e	39.17 ab	32.6 c-d	33.24a
40	38.3 a-c	41.97 a	33.6 b-d	34.88 a
80	31.67 d	30.53 de	32.93b-d	33.83 a
mean Zinc sulphate ($mg.L^{-1}$)	33.04 b	37.22 a	31.69 b	

Each means in row for one or interactions factors with various letters are clearly diverse at P = 0.05 utilizing Duncan multiple range test.

compared with 39.73 leaf. plant^{-1} for control. the interaction between zinc NPs at 80mg.L^{-1} combined with zinc sulphate at zero and 40mg.L^{-1} gave the significantly height value 52.63 and 50.83 leaf. Plant respectively . All superior results may be refer to significant and high significant effect for fresh weight of vegetative group, number of flowers and diameter of anthophors on this character as shown in correlation coefficient (r = 0.42, 0.36, 0.39 respectively table 9.

Fresh weight of plant (g):

In table 3, the interaction treatment between zinc NPs at 40gm.L^{-1} and zinc sulphate at 40 and 80mg.L^{-1} was distinct by increasing fresh weight significantly gave 14.36 and 13.97gm respectively combined with control 8.39gm. All superior results may be refer to high significant effect for fresh weight of vegetative group, number of flowers and total leaves on this character as shown in correlation coefficient (r = 0.73, 0.63, 0, 39 respectively) table 9.

Table 2: Effect Oxide zinc NP fertilizer and Zinc sulphate total number of leaves (leaf.plant^{-1}) (*Dianthus caryophyllus* L.).

Oxide zinc NPs(mg.L^{-1})	Zinc sulphate (mg.L^{-1})			mean Oxide zinc NPs (mg.L^{-1})
	Zero	40	80	
Zero	31.1 c	41.5 a-c	42.73 a-c	39.73 b
40	42.67 a-c	46.0 b	50.83 a	48.08 a
80	52.63 a	46.83 b	39.33 bc	42.93 ab
mean Zinc sulphate (mg.L^{-1})	41.67 b	44.78 ab	44.67 a	

Each means in row for one or interactions factors with various letters are clearly diverse at P = 0.05 using Duncan multiple range test.

Table 3: Effect Oxide zinc NP fertilizer and Zinc sulphate Fresh weight of the plant (g) of (*Dianthus caryophyllus* L.).

Oxide zinc NPs(mg.L^{-1})	Zinc sulphate (mg.L^{-1})			mean Oxide zinc NPs (mg.L^{-1})
	Zero	40	80	
Zero	8.39 c	11.30 a-c	12.37 a-c	11.11 a
40	9.00 c	14.36 a	13.97 a	11.44 a
80	9.79 a-c	13.35 ab	11.07a-c	11.98 a
mean Zinc sulphate (mg.L^{-1})	9.06 b	13.00 a	12.47 a	

Each means in row for one or interactions factors with different letters are clearly diverse at P = 0.05 utilizing Duncan multiple range test.

Table 4: Effect Oxide zinc NP fertilizer and Zinc sulphate Dry weight of the plant (g)) of (*Dianthus caryophyllus* L.).

Oxide zinc NPs(mg.L^{-1})	Zinc sulphate (mg.L^{-1})			mean Oxide zinc NPs (mg.L^{-1})
	Zero	40	80	
Zero	2.67 b	3.38 ab	3.801 ab	3.769 a
40	3.17 ab	4.607 a	4.588 a	3.483 a
80	3.25 ab	4.224 a	3.126 ab	3.743 a
mean Zinc sulphate (mg.L^{-1})	3.03 b	4.07 a	3.84 ab	

Each means in row for one or interactions factors with different letters are clearly diverse at P = 0.05 utilizing Duncan multiple range test

Dry weight of plant (g):

Table 4 shows that there was no significance when zinc NPs being added, whereas more important value of dry weight treatment when sprinkling with zinc sulphate at 40 mg.L^{-1} recorded 4.07g opposite to lowest value of control treatment plant 3.03g.

Furthermore, height dry weight of plant recorded 4,067 and 4,588g respectively when plant fertilized with zinc NPs at 40mg.L^{-1} with zinc sulphate at 40 and 80 mg.L^{-1}, so fertilized with zinc NPs at 80mg.L^{-1} with zinc sulphate at 40mg.L^{-1} recorded 4.224g compared with control 2.67g.

Flower Number (flower. plant^{-1})

Concerning table 5, it shows that zinc NPs did not differ significantly, but when treatment with zinc sulphate at 80 mg.L^{-1}, it recorded height value 4.73 flower. plant^{-1} combined with control 3.204 flower. plant^{-1}.

The interaction between zinc NPs at 40 and 80mg.L^{-1} and zinc sulphate in any user concentration gave the significantly higher value combined with control 2.090 flower. plant^{-1}. All superior results may be refer to significant and high significant effect for diameter of flowers dry weight of vegetative group and total leaves, on this character as shown in correlation coefficient (r = 0.29, 0.06, 0.36 respectively) table 9.

The diameter of flower (mm):

Table 6 shows that the fertilizing zinc NPs at 80mg.L^{-1} gave higher number of diameter of the flower 42.65mm combined with control 38.94mm. So the highest value was 45.93mm registered when fertilizer with zinc sulphate at 80mg.L^{-1} gave height number 45.93mm.

The interaction between zinc NPs at 80mg.L^{-1} and zinc sulphate in any user concentration gave the significantly higher value combined, so when used with any user concentration zinc NPs with zinc sulphate at 80mg.L^{-1} gave height number combined with control 29.467mm.

Table 7 shows that zinc NPs at 40 and 80mg.L^{-1} caused significantly an increase in diameter of anthophors 3.975 and 4.153mm respectively compared with 3.59 for control. Zinc sulphate at 40 and 80mg.L^{-1} gave significantly best results; 3.97 and 4.15mm respectively compared with 3.37mm for control.

The highest dimeter record 4.306 and 4.163mm respectively when fertilized zinc NPs at 40 and 80mg.L^{-1} with 80mg.L^{-1} zinc sulphate and 4,336mm when plant fertilized with zinc NPs at 80mg.L^{-1} with zinc sulphate Zero compared with the lowest value of diameter of anthophors 2.70mm for control.

Table 5: Effect Oxide zinc NP fertilizer and Zinc sulphate Number of flowers (flower. plant^{-1}) of (*Dianthus caryophyllus* L.).

Oxide zinc NPs(mg.L^{-1})	Zinc sulphate (mg.L^{-1}) Zero	40	80	mean Oxide zinc NPs (mg.L^{-1})
Zero	2.090 b	4.423 a	5.553 a	4.252 a
40	4.136 ab	4.426 a	4.236 ab	4.191 a
80	3.386 ab	4.78 a	4.416 a	4.037 a
mean Zinc sulphate (mg.L^{-1})	3.204 b	4.543 ab	4.73 a	

Each means in row for one or interactions factors with various letters are clearly diverse at P = 0.05 utilizing Duncan multiple range test.

Table 6: Effect Oxide zinc NP fertilizer and Zinc sulphate Diameter of flowers (mm) of (*Dianthus caryophyllus* L.).

Oxide zinc NPs(mg.L^{-1})	Zinc sulphate (mg.L^{-1}) Zero	40	80	mean Oxide zinc NPs (mg.L^{-1})
Zero	29.467 c	34.39 b	46.51 a	38.94 b
40	34.817 b	33.66 b	43.35 a	40.01 ab
80	46.313 a	48.443 a	47.913 a	42.65 a
mean Zinc sulphate (mg.L^{-1})	36.87 b	38.83 ab	45.93 a	

Each means in row for one or interactions factors with various letters are clearly diverse at P = 0.05 utilizing Duncan multiple range test.

Table 7: Effect Oxide zinc NP fertilizer and Zinc sulphate Diameter of anthophors (mm) of (*Dianthus caryophyllus* L.).

Oxide zinc NPs(mg.L^{-1})	Zinc sulphate (mg.L^{-1}) Zero	40	80	mean Oxide zinc NPs (mg.L^{-1})
Zero	2.703 c	3.433 b	3.986 b	3.37 b
40	3.756 ab	3.87 ab	4.306 a	3.975 a
80	4.336 a	3.96 ab	4.163 a	4.153 a
mean Zinc sulphate (mg.L^{-1})	3.59 b	3.75 ab	4.152 a	

Each means in row for one or interactions factors with various letters are clearly diverse at P = 0.05 utilizing Duncan multiple range test.

Discussion

Zn has a certain physiological tasks in all living systems, such as, (1) protection of structural and functional impartiality of biological membranes, (2) detoxification of highly toxic oxygen free radicals, (3) as a cofactor for more than 300 enzymes, (4) contribution to protein installation and gene terms beneath ordinary and exertion cases et. Among all minerals , Zn is needed by the greatest number of proteins. At least 2800 proteins are Zn rely and formed almost 10% proteins in eukaryotes, Zn has an important role in several body tasks such as vision, taste comprehension, awareness, cell proliferation, growth and impregnability, fight to some infectious diseases such as diarrhoea and immunity (Shankar and Prasad., 1998 & Reynold, 2002).

Nano particles (NPs) with small size and great surface area are expectant to be the perfect material for utilize as a Zn fertilizer in plants. actually, use of nanomaterials has been widened in all field of science, including agriculture. It has been said that, the use of micronutrient fertilizers in the shape of NPs is a significant way to leave the necessary foods progressively, and in a planned way, which is important to lessen issues of fertilizer pollutions (Naderi and Abedi, 2012). because of that, when materials are converted to Nano, they alteration their physical, chemical and biological features. The micronutrients in the shape of NPs maybe utilized in crop production to increase yield (Khanm *et al.,* 2017).

Nanotechnology-based fertilizers maybe more dissolvable or more interactive than their bulk counterparts Application of nanofertilizers may improve solubility and dispersion of insoluble nutrients in soil, decrease nutrient immobilization (soil stabilization) and increase the bio-availability (DeRosa *et al.,* 2010 and Naderi & Danesh-Shahraki, 2013). Nano-formulated fertilizers maybe facilely sucked by plants and they may show prolonged efficient duration of nutrient supply in soil or on plant (Rameshaiah and Jpallavi, 2015; Salim and Abed, 2017).

Also, several studies have shown that exogenous application of several nanoparticle maybe clearly improve plant growth (Zhang *et al.,* 2006 & Kata, 2011). Moreover, zinc is an important item of different enzyme systems for energy production, protein synthesis, energy production, preserves the structural solidity of biomembranes and growth regulation (Lin & Zing, 2008). Like iron, lack of zinc are basically found on sandy soils low in organic materials and on alkaline soils. Absorption of zinc as well is negatively

Table 8: Correlation coefficients between characters

Diameter of flowers (mm)	Number of flowers (flower plant^{-1})	Dry weight(g)	Fresh weight (g)	total leaves (leaf plant^{-1})	height plant (cm)	Characters
					0,28	total leaves (leaf.plant^{-1})
				0,42*	0,35*	Fresh weight (g)
			0,73**	0,25	0,43*	Dry weight (g)
		0,59**	0, 63**	0,36*	0,42*	number (flower.plant^{-1}) Flowers
	0,29*	0,13	0,23	0,27	-0,19	Diameter of flowers (mm)
0, 64**	0,31	0,06*	0,10	0,39**	0, 21	Diameter of anthophors (mm)

< 0.01 , respectively) * * < 0.05 and * r=) Critical values of correlation

influenced by high pH, high levels of available phosphorus and iron in soils (Wang & Wang, 2008; Abed, 2017).

Zinc is a necessary ingredient for the formation of Tryptophan, an amino acid that is composed of Indolacetic acid IAA. Zinc enters the synthesis of both the glycol dehydrogenases essential to represent the proteins and the glycine dipeptidases necessary for glycolysis in final stages of breathing in the plant. Zinc is also essential for the formation of chlorophyll and has an important role in pollinating the pollen on the on the flower misaim (Taiz and Zeiger, 2002; Ibraheen and Abed, 2017; Abed and Salim, 2019).

Conclusions

In this research, various treatment with Nano Zn oxide molecules and $ZnSO_4$ on Carnation such as, foliar enforcement were used to check the treatment influence. Outcomes indicate that Nano ZnO is sucked by plants to a greater extent reverse bulk $ZnSO_4$. Nano ZnO has showed great efficient in reinforcing productivity and capacity of Zn, Due to the high surface area to volume rate. (Laware & Raskar, 2014).

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