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Response of Chrysanthemum Indicum Plant to Treatment with Nano-Seaweed Extract and its Imitation on Some Physiological Growth Characetristics of the Plant

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ABSTRACT

This research was conducted in the Department of Biology /College of Education for girl Mosul University, during the month of November 2020 until early February 2021 on the Dawoodi plant. The factorial experiment was carried out using a complete random design. As the study included two factors, the first three levels of marine nano-algae extract are: Zero (distilled water only), 1.5 and 3 mg/l (t1, t2, t3) respectively. The second factor treated with conventional organic fertilizer with three concentrations: zero, 1.5 and 3 mg/l (t1, t2, t3), respectively, with three Replicators for each factor treatment, and the most important results: Treatment with organic (seaweed extract) nano and conventional fertilizer had the clear effect in improving most of the studied traits. Fertilization with organic nano-fertilizer improved most of the studied vegetative growth characteristics.

1. Introduction

The Dawoodi plant, *Chrysanthemum indicum* L., belongs to the compound family Asteraceae. The genus *Chrysanthemum* contains more than 160 species. The number of Dawoodi cultivars is constantly increasing as a result of the breeding and improvement processes that take place on it, as China and some countries of East Asia consider as the origin to this plant (2016, Kemper). It is a herbaceous perennial plant that is planted in a short day and is renewed annually, and its height ranges between (40-90) cm (Nguyen *et al* ,2019). Dawoodi flowers are important and desirable because they remain for a long time and retain their beauty in the vase. Dawoodi plants reach their peak in autumn when most of the summer ornamental blooms are about to expire (Mark, 2005), So Dawoodi are known as the queen of autumn (Michael and Leener, 2003), as they are planted during the summer season. October, flowers and fruits during March until July (Van and Heuvelink , 2006; Nguyen *et al* ,2022). It does not give flower yield during the first year of its cultivation but in the second to the fourth year, and cut flowers live for 3-4 weeks in coordination pots. The photoperiod length can be controlled (Teixeira da Silva *et al*. 2013). Dawoodi produce about 30% of the world's commercial cut flowers (Budiarto et al., 2006), and they can also be used for commercial purposes because their flowers contain biologically active substances against

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pests and harmful substances. Insects that infect humans, animals, plants, domestic and stored insects and their various stages, and in the United States the United States has taken care of the production of daisy flowers throughout the year until it has become one of the most famous flowers and has surpassed roses and carnations in sales imports (Teixeira da Silva *et al*., 2013).

Organic fertilizers help to rationalize the use of chemical fertilizers, which reflects on public health and the environment. Among the materials used in this field are marine algae extracts, which have been shown to have an effect on different growth parameters of different plants (Rioux *et al*., 2007), and organic fertilizers improve physical and chemical properties and characteristics. Thus, the biological properties of the soil enhance soil quality and crop production when properly applied and thus create the right conditions for root development and strengthening, which leads to an increase in the yield and an improvement in its quality (Abou El-Majed *et al*. 2008). Marine algae extracts have been shown to affect various plant growth factors and are widely used. In agriculture, they are used as vectors for plant growth and have a role in enhancing root biomass in addition to their ability to relieve biotic and abiotic stresses for crop plants. They are plant extracts that carry half the natural properties of the substances in these plants and are extracted by special methods. Seaweed extracts mainly consist of sea algae and are now widely used due to their diverse content of micro-nutrients such as Co, Bo, Mo, Zn, Cu, Mg and N, which increases plants resistance to stress and drought, which increases photosynthesis efficiency Delaying aging, reducing disease, and increasing the ability of roots to grow and absorb nutrients. (Demir *et al*. 2006) indicated that seaweed extracts contain essential nutrients for the plant, as they contain major nutrients K, P, N and micronutrients Fe, B, Mg, Zn, Mo, Cu, as well as phytohormones. Such as auxins, gibberellins and cytokinins. These hormones when added to the soil or sprayed on plants stimulate root growth, increase stem thickness and increase vegetative growth by increasing the efficiency of photosynthesis, as well as protecting the plant from stress conditions such as drought, cold and aging by supporting the plant cell. Yidirim (2007) indicated that marine algae extracts lead to an increase in leaf area and an increase in the content of chlorophyll, thus increasing the carbohydrates formed by photosynthesis, as well as leading to the formation of a strong and branched root system, which gives the plant strength for growth and increases the absorption of nutrients from the soil in addition to increasing the plant's resistance to freezing, diseases and insects.

Nanofertilizers are carriers of nutrients with sizes of 1-100 nanometers, and nano-fertilizers are (one billionth of a meter or one of a color of a millimeter). In total size, it is the most innovative and has undergone significant improvement in recent years, and the effectiveness of nano fertilizers exceeds conventional fertilizers. Nano fertilizers gradually feed crop plants in a controlled manner in contrast to the rapid and spontaneous release of nutrients from chemical fertilizers. Increased ability to control directing process and increase plant response to easy entry into cells Nano-fertilizers are more effective in terms of nutrient uptake and utilization due to significantly lower losses in the form of leaching and volatilization. Nanoparticles register much higher absorption due to the free passage of nano-sized pores and through molecular carriers as well as radical exudates Kumar (2013) reported that NPS nanoparticles at scale less than 100 nm exhibit material properties different from materials when they are in real dimensions greater than 100. Nair *et al*. (2010) explained that nanomaterials possess many properties for their use in the agricultural field as fertilizers, such as the use of nano-fertilizers, which are characterized by high solubility, stability and good efficacy, as well as control over their release time and are less toxic than traditional chemical fertilizers. It can be used in small quantities and with high efficiency (**Prasad** *et al*., 2014). Nanotechnology has provided the advantage of loading microorganisms on nanoparticles that have a large surface area, and this greatly contributes to the availability of nutrients, improving soil fertility and crop growth and productivity (Nicole *et al*. 2008). Also, the use of nanomaterials as a carrier of fertilizers or vectors that control the release of nutrients, which is called (smart fertilizers), which has a significant role in improving the efficiency of nutrient use and reducing environmental pollution (Meetoo, 2011).

In recent years, the demand for the use of agricultural crops produced from organic farming, which is considered a safe food from a health point of view, has increased, and thus increased interest in the use of organic fertilizers, as well as the use of organic nano-fertilizers in order to increase the growth of various plants, increase their agricultural yield and increase the economic return of these agricultural products. The research aims to evaluate the effectiveness of using organic fertilizers in its traditional and nano forms, and to study their effect on the vegetative growth index of the Dawoodi plant used in the research.

2. Materials and Research Methods

The experiment was designed according to a completely randomized design (CRD) with two factors and three replicates (3×3×3), which means (27) experimental units. A factorial experiment was conducted according to a completely randomized design (CRD) and with three replications, in order to know the effect of using traditional and nano seaweed extracts on some vegetative growth characteristics of the Dawoodi plant. Use nano seaweed extract fertilizer (Super Fifty) as an agricultural fertilizer - seaweed, it is a compound manufactured according to nanotechnology consisting of seaweed (Ascophyllum Nodosum Seaweed Extract), the manufacturer (Agressess Company) and the producer in Izmir - Turkey. This fertilizer was used in three levels It is: (a treatment of zero (distilled water only) and an addition treatment of 1.5 mg. L and an addition treatment of 3 mg. L) (and it was considered the first factor).

The (conventional) seaweed extract (Fitoalg) was used at three levels: (treatment of zero (distilled water only), treatment addition of 1.5 mg. L and treatment of adding 3 mg. L) (the second factor was considered) and the data were measured using Duncan's multiple range test at the probability level 5% and using the SAS program to analyze the data. The process of adding the extracts was done after the appearance of the true leaves of the plant and continued until maturity, at an average of ten days between one spray and another. The service operations of irrigation, hoeing and weeding were conducted whenever needed.

3. Results

It is noticed from the results of Table (1) that the best significant value of the binary interaction was when the interaction between the nano-organic fertilizer with a concentration of 3 mg/L and the fertilization with the traditional organic fertilizer was 1.5 mg/L, which amounted to 10,833 cm compared to the lowest significant values of the comparison treatment.

Table (1) Effect of fertilizing with organic nano-fertilizer and conventional organic fertilizer on the plant height characteristic of *Chrysanthemum indicum*

nanofertilizer NPs (mg/L)	organic fertilizer (mg/L)			mean NPs (mg/L)
	Zero	1,5	3	
Zero	7.167 c	7.933 bc	9.000 a-c	8.033b
1,5	8.500 bc	9.433 ab	10.833 a	9.589 a
3	9.667 ab	9.000 a-c	8.000 bc	8.889 ab
mean organic fertilizer (mg/L)	8.444 b	8.789ab	9.277a	

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

It is clear from the results of the binary interaction between the studied treatments in Table (2) that the best significant value was when using nano-organic fertilizer with a concentration of 1.5 mg/L. This is overlapping with the use of traditional organic fertilizer with a concentration of 1.5 mg/L, which amounted to 7.567 branches, compared to the least significant value of the comparison treatment.

Table (2) Effect of fertilizing with nano-organic fertilizer and conventional organic fertilizer on the characteristics of the number of branches

nanofertilizer NPs (mg/L)	organic fertilizer (mg/L)			mean NPs (mg/L)
	Zero	1,5	3	
Zero	4.000 c	6.333 ab	6.000 ab	5.444 a
1,5	5.667 a-c	7.567 a	6.677 ab	6.637 a
3	6.333 ab	5.333 a-c	5.667a-c	5.777 a
mean organic fertilizer (mg/L)	5.333a	6.411 a	6.115 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.

It is clearly evident from **Table (3**) that the largest number of leaves was obtained when treated with nano-organic fertilizer at a concentration of 1.5 mg / liter, as it reached 30.00 leaves / plant compared to the least significant value of the comparison treatment. From the follow-up to the results of the binary interaction, the use of nano-organic fertilizer with a concentration of 1.5 mg / liter overlapping with the use of traditional organic fertilizer with concentrations of 1.5 and 3 mg / liter recorded the best significant values for this trait. It reached 30.00 and 34.00 leaves / plant as well when the non-use of organic fertilizer overlapped. Nano with the use of traditional organic fertilizer with a concentration of 1.5 mg / liter compared to the lowest significant value for the control treatment, which amounted to 16.00 leaves / plant for the control treatment.

Table (3): Effect of fertilizing with nano-organic fertilizer and organic fertilizer on the number of leaves

nanofertilizer NPs (mg/L)	organic fertilizer (mg/L)			mean NPs (mg/L)
	Zero	1,5	3	
Zero	16.00 c	30.67 a	26.67 ab	24.44 a
1,5	26.00 ab	30.00 a	34.00 a	30.00 a
3	22.67 ab	19.33 bc	16.00 c	19.33 a
Mean organic fertilizer (mg/L)	21.56 b	26.67 a	25.56 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 (4) shows that the use of nano-organic fertilizer at a concentration of 1.5 and 3 mg / liter improved the characteristic of the basal interphalangeal diameter, as it reached 2.70 and 2.78 mm compared to the lowest significant value of the comparison treatment, while no significant differences were observed in this characteristic when using organic fertilizer traditional.

Among the results of the binary interaction, it is noted that the best significant value was when the non-treatment of nano-organic fertilizer overlapped with the use of traditional organic fertilizer with a concentration of 3 mg/L. Also, when using nano-organic fertilizer at a concentration of 3 mg/L with no treatment with conventional organic fertilizer, which amounted to 3.20 and 3.10 mm, respectively, compared to the lowest significant values of the comparison treatment, which amounted to 1.73 mm.

Table (4): Effect of fertilization with organic nano-fertilizer and conventional organic fertilizer on the basal interphalangeal diameter

nanofertilizer NPs (mg/L)	organic fertilizer (mg/L)			mean NPs (mg/L)
	Zero	1,5	3	
Zero	1.73 c	2.80 ab	3.20 a	2.57 b
1,5	2.43 ab	2.83 ab	2.83 ab	2.70 a
3	3.10 a	2.63 ab	2.60 ab	2.78 a
mean organic fertilizer (mg/L)	2.42 a	2.76 a	2.88 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 (5) shows that the best significant value for root diameter characteristic, as it was noted that the best significant value was obtained when using organic fertilizer with a concentration of 1.5 and mg / l, as it was 3.12 and 3.07 mm. There are significant differences were observed between the rest of the studied treatments, which differed significantly. compared to the comparison treatment, as this treatment gave the lowest significant value of 1.73 mm.

Table (5): Effect of fertilizing with nano-organic fertilizer and conventional organic fertilizer on the root diameter

nanofertilizer NPs (mg/L)	organic fertilizer (mg/L)			mean NPs (mg/L)
	Zero	1.5	3	
Zero	1.37ab	3.75 a	3.07 a	2.85 a
1.5	2.36 b	2.70 ab	2.50 ab	2.52 a
3	2.95 ab	2.90 ab	2.80 ab	2.883 a
Mean organic fertilizer (mg/L)	2.34 b	3.12 a	2.79 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

The result of the two interactions between the studied treatments in Table (6) showed that the use of nano-organic fertilizer with both concentrations 1.5 and 3 mg/L overlapping with concentrations 0 and 1.5 mg/L of the traditional organic fertilizer recorded the best significant values, which amounted to 3.964 and 4.189 gm on the respectively. While the comparison treatment recorded the lowest significant values, which amounted to 1.971 g.

Table (6): Effect of fertilizing with nano-organic fertilizer and conventional organic fertilizer on the moisture weight of the rootstock

nanofertilizer NPs (mg/L)	organic fertilizer (mg/L)			mean NPs (mg/L)
	Zero	1,5	3	
Zero	1.971	3.279 a-c	2.545 cd	2.598 b
1,5	3.964 a	4.189 a	2.755 b-d	3.636 a
3	3.834 a	3.624 ab	2.190 d	3.216 a
mean organic fertilizer (mg/L)	3.26 a	3.69 a	2.49 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.

While Table (7) shows that the best significant value of the wet weight characteristic of the vegetative group was 3.187 gm when treating the Daudi plant with nano organic fertilizer compared to 2.37 g when using the concentration 3 mg / liter of nano organic fertilizer. It is also noted that the use of traditional organic fertilizer with a concentration of 1.5 mg /L recorded the best moral value for this trait

Table (7): Effect of fertilizing with nano-organic fertilizer and organic fertilizer on wet character of the group

nanofertilizer NPs (mg/L)	organic fertilizer (mg/L)			mean NPs (mg/L)
	Zero	1,5	3	
Zero	2.008 cd	3.501 ab	2.731 a-d	2.746 ab
1,5	3.630 a	2.868 a-d	3.063 a-c	3.187 a
3	2.857 a-d	2.500 b-d	1.781 d	2.37 b9
mean organic fertilizer (mg/L)	2.831 b	2.956 a	2.535 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.

Table (8) shows that the best significant value of the dry weight of the rootstock was 1.307 gm when treated with nano-organic fertilizer compared to 0.84 gm for the comparison treatment. Fertilizer has a significant lower value than the comparison treatment.

Table (8): Effect of fertilizing with nano-organic fertilizer and organic fertilizer on the dry weight characteristic of the root system

nanofertilizer NPs (mg/L)	organic fertilizer (mg/L)			mean NPs (mg/L)
	Zero	1,5	3	
Zero	0.727 ab	1.021 ab	0.798 ab	0.84b
1,5	0.743 ab	1.216 ab	1.307 a	1.089 a
3	0.943 ab	1.125 ab	0.662 b	0.909 ab
mean organic fertilizer (mg/L)	0.804 ab	1.120 a	0.922 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.

The results of the binary interaction in Table (9) are clearly evident that the best significant value was obtained when treated with nano-organic fertilizer at a concentration of 1.5 and 3 mg/L, overlapping with treatment with conventional organic fertilizer at a concentration of 1.5 mg/L, which amounted to 1.939 and 2.073 g, respectively. As well as when The use of nano-organic fertilizer at a concentration of 3 mg / liter overlapping with the non-use of traditional organic fertilizer, which amounted to 2.226 g compared to 0.613 g for the comparison treatment.

Table (9) Effect of fertilizing with organic nano-fertilizer and organic fertilizer on the dry weight of the vegetative mass.

nanofertilizer NPs (mg/L)	organic fertilizer (mg/L)			mean NPs (mg/L)
	Zero	1,5	3	
Zero	0.613 d	1.807 ab	0.752 cd	1.057 b
1,5	1.668 ab	1.939 a	1.305 bc	1.637 a
3	2.226 a	2.073 a	0.959 cd	1.752 a
mean organic fertilizer (mg/L)	1.502 b	1.939 a	1.006	

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

It is noted from Table (10) that the use of nano and conventional organic fertilizer at a concentration of 1.5 mg/L improved the leaf area. As the best significant value was obtained 76.296 and 75.617 cm2 respectively, while the high concentration of nano and conventional organic fertilizer recorded the lowest significant value of 67.174 and 60.316 cm^2, respectively. The values of the two interactions between the studied traits showed that the best significant value of the leaf area was obtained when adding nano organic fertilizer at a concentration of 1.5 g/L and adding traditional organic fertilizer at a concentration of 1.5 g/L which amounted to 86.09 cm2 compared to the lowest significant value When using high concentration 3g/l for both fertilizers.

Table(10): Effect of fertilization with nano-organic fertilizer and organic fertilizer on the characteristic of leaf area

nanofertilizer NPs (mg/L)	organic fertilizer (mg/L)			mean NPs (mg/L)
	Zero	1,5	3	
Zero	5**1**.82 cd	83.71 ab	65.99 a-b	67.174ab
1,5	69.78 a-c	86.09 a	73.02 a-c	76.296 a
3	68.42 a-b	57.04b-d	41.94 d	55.800 b
mean organic fertilizer (mg/L)	63.34ab	75.617 a	60.316 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.

4. Discussion

It is clear from the values of the tables that the addition of nano and conventional organic fertilizers led to a significant increase in most of the studied traits. Perhaps the reason for the increase in this trait is due to the organic materials and nutrients that increase growth, such as nitrogen, which is one of the major nutrients that are contained in the organic fertilizer, whether nano or conventional (Davis,2013). The plant needs it in large quantities, as it enters the composition of a large number of organic compounds. For example, it enters the composition of nucleic acids, DNA and RNA, as well as its entry into the synthesis of proteins, chlorophyll and carotene, the formation of energy compounds, the formation of cell membranes, mitochondria and chloroplasts. And as a result, an increase in the size of leaves and stems occurs over By increasing vegetative growth in general, as well as increasing the growth of lateral buds(Ayad,1998).

The organic fertilizer also contains the dissolved potassium K element, which has an important role in activating the representation of proteins and enzymes that accompany the representation of carbohydrates, because it is an osmotic regulator that participates in the processes of opening and closing stomata and the consequent effect on increasing the absorption of water and nutrients (Al-Nuaimi, 2011).

Numerous researches have shown that fertilization is necessary for plant growth and development, including organic nutrition, especially nutrition with seaweed and algae extracts, which have a major role as primary products of organic materials, and synthetic materials such as marine algae cells, which consist of many important compounds such as sugars, amino acids, DNA, RNA, enzymes and proteins. It was noted from the chemical analysis of marine algae that most of them consist of important compounds such as vitamins, minerals and free amino acids (Demir, 2006). Also, seaweeds and algae contain vitamins E, B, and C, all of which have an important role in increasing the ability of plants to manufacture and accumulate dissolved substances. in the plant(Sheekh and Saieed ,2000) .

It was found that the seaweed extract activates the process of photosynthesis and increases its products from the sugars produced, which works to build other secondary products such as building glycosides .... etc., as these marine extracts improve the vegetative growth characteristics of the plant due to its content of organic compounds, amino acids and mineral elements. It has effectively contributed to the improvement of many physiological processes (Nicole *et al*. 2008), and substances similar to cytokinins increase in plants treated with seaweed extracts (Abou El-maged *et al*. 2008). These extracts act as an antioxidant and have an important role in increasing the concentration of chlorophyll.

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