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Magnesium Nanoparticles, Zinc Nanoparticles, and Seaweed Extract Solutions Effects on Rosemary [*Salvia Rosmarinus L.*] Plant Chemical Compositions

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Abstract

The reaction of rosemary (*Salvia Rosmarinus L.*) plants on the influence of nanoparticles (zinc and magnesium) and seaweed extract carried out in 2024 on fields in Wasit University. Three replications of a perfectly randomized factorial experiment (5 × 5 × 3) were used to produce the treatment. The rosemary plants treated with nanoparticles (zinc oxide) with concentrations (0, 0.03, 0.05) mg/mL and (magnesium oxide) with concentrations (0, 0.02, 0.04) mg/Ml. Moreover, rosemary treated with seaweed extract with concentrations (0, 50, 100, 150, 200) gm/L. Studying the plant fresh weight, number of branches, protein percentage, carbohydrates content, phenols content and oils content. The findings showed that the development and production characteristics of rosemary were significantly impacted by a single application of the previously mentioned variables, especially when present in high amounts, two-way communication produced different results. The production of oils was the most significant impact seen based on results. The Addition of nano zinc and nano magnesium and seaweed extract to the rosemary. Regardless of vegetable qualities or chemical content, the plant considerably raised all traits utilizing the greatest doses whether used alone or in combination with two interactions.

Keywords: Mg and Zn Nanoparticles, *Salvia Rosmarinus L.,* Plant Chemical Compositions.

1. Introduction

Plants were first cultivated in the Mediterranean basin, which includes Algeria, France, Spain, and Portugal [1]. Plants also cultivated in many nations across the world, including India, Central Asia, America, South Africa, Southeast Africa, the United States, and Brazil [1-2].

Plants grown in fields, farms, and home gardens several active compounds, including caffeine, diterpenes, flavonoids, triterpenes, and volatile oil, are found in rosemary plants [2].

The rosemary plant has many benefits as it is used as an antispasmodic in renal colic and dysmenorrhea and in relieving respiratory disorders and stimulation of hair growth [3]. The mountain has the therapeutic potential, for the treatment or prevention of bronchial asthma, diabetes and peptic ulcer, rosemary contains antioxidants and used as against meat rotting [3-5].

The rosemary plant is a perennial shrub with woody, aromatic leaves that resemble needles and are always fragrant. In the *Lamiaceae* family of mints, plant growing upward (erect), it can reach a height of two meters, with evergreen leaves from two to four cm in length, and two to five mm in diameter. Leaves are dense, short, woolly hairs on the underside and green on the underside. Rosemary comes in a variety of colours, including white, pink, purple, and blue flowers. Also, in varying leaf sizes and branch development habits [6, 7].

Varieties of rosemary plants that are botanical led to variations in the chemical components, oil output, and herbal properties of rosemary [8, 7]. Nanotechnology means nanomaterials technology, microscopic technology, or the ability to measurement, processing and manufacture of nanotechnology. The term nanotechnology was first used in 1999 by Norio Taniguchi, a professor at the University of Tokyo, to describe tools that use nanomaterials, and nanoscience is concerned with the study of materials on the nanoscale 9-10 of a meter [9-10].

Nanomaterials have special optical, electrical or mechanical properties that differ from what they are in normal dimensions of more than 100 nm. As there is a change in the ratio of surface area to volume, and the increase in surface area to size increases as the particle size decreases. There is also a change in the melting point, freezing and characteristic properties at the nanoscale [10].

Zinc is an essential micronutrient for plant growth and development. Foliar plants showed that foliar application of zinc nano fertilizers resulted in significant improvements in plant height, plant biomass, and nutrient uptake. Nano fertilizers enhanced the uptake and utilization of these essential micronutrients, which improved plant growth application of nano fertilizers can deliver these nutrients directly to the leaves, enhancing their better uptake. This can help alleviate nutrient deficiencies and enhance plant vitality [11].

Additionally, magnesium oxide nanoparticles show several benefits, including low phytotoxicity, thermal stability, non-genotoxicity, and non-biotoxicity to people. These benefits allow for excellent plant protection application opportunities [12]. Nanoparticles have several other traits that make them excellent candidates for use in a variety of other agricultural applications [13].

Furthermore, by improving seedling development and plant growth, these nanoparticles aid in the expansion of peanut agricultural production. They are also utilized as accepted food additives, supplements, and colorants [12, 14]. Some research suggested that because SWE may contain both major and minor elements, it could partially replace fertilizers [15-17]. SWE's saccharides may trigger defence systems in plants [18-20]. Extracts from the brown algae (*Ascophyllum nodosum L.*). *Le Jolis (Fucaceae*) are among the most significant and well-known SWE found worldwide.

According to several studies, SWE increased the growth of vegetable [21-22], fruit [23-26]. Research indicated improved fruit yield, sugar content, chlorophyll content, vegetative development, and resistance to soil-borne and leaf-borne diseases [27-28].

2. Materials and methods

Experimentation commenced in November 2023 at the private Archard field in Waist university, College of Science. Soil mixture was placed in anvils, with capacity of 10 kg. Then, watered, and on foliar spraying operations were applied. Soil spraying to the recommended concentrations, as well as spraying plant leaves until the entire leaf is covered with concentrations of nanocomposites and seaweed extract.

Spraying was repeated and addition after a month of the first treatment agricultural service operations of plant watering and soil fertilization were carried out throughout the duration of the experiment. Nanocomposites were prepared at certain concentrations depending on the manufacturer concentrations (0, 0.02, 0.04, 0.03, 0.05) mg/mL, by dissolving the required concentrations with 5 mL of ethanol.

The volume is supplemented to 500 mL of deionized water to obtain the above-required concentrations, as well as the usage of seaweed extract in concentrations of (0, 50, 100, 150, and 200) gm/L. Attended concentrates were dissolved with distilled water and complete the volume to 1 litre.

There were 75 panels the foliar spraying of nanoparticles at concentrations (0.02, 0.03, 0.04, 0.05) and seaweed extract at concentrations (50, 100, 150, 200). Foliar spraying at one time ensures for treatment in the vegetative stage of the plant. After two weeks, Foliar spraying was completed for the second time. Then, after two weeks estimation of plant fresh weight, number of branches and protein percentage, and the statistical analysis examining the differences between statistically significant treatments was made easier. Using Randomized Complete Block Design (RCBD) analysis of variance test. The mean comparison was evaluated using the least significant differences (LSD) at 0.05 percent levels [29].

3. Results

3.1 Average Protein in Plant

Nano compound significantly affects average protein are shown in (table 3). When the concentration of nano zinc 0.05 mg/mL, the mean protein (6.36 %). Plants treated with control grew the fastest (7.03 %). Nano magnesium also significantly affected average of protein. Similarly, when the concentration of nano magnesium is 0.02, it increased the average protein.

The greatest average of protein was created by seaweed extract at 150 gm/L (7.75 %). In comparison with 50 (6.87 %) and the control (6.65 %). Nano compound and seaweed extract had a significant interaction effect. Plants treated with 0.03 mg/mL of Nano zinc and 50 of Seaweed extract average of protein.

3.2 Average Estimating of Oils Percentage in The Plant

The result shows that nano compound significantly affects average The percentage of oils in the plant. When the concentration of nano zinc 0.05 mg/ml the mean the percentage of oils in the plant (0.863%). Plants treated with control grew the fastest (0.868%).

Nano magnesium also significantly affected average the percentage of oils in the plant. Similarly, when the concentration of nano magnesium 0.02 mg/ml, it increased the average The percentage of oils in the plant. The greatest average of the percentage of oils in the plant was created by Seaweed extract at 150 gm /L (0.814) compared to 50 gm/L (0.787%) and the control (0.814%). Nano compound and Seaweed extract had a significant interaction effect. Plants treated with 0.03 mg/ml of Nano zinc and 50 gm/Lof Seaweed extract average of the percentage of oils in the plant.

3.3 Average Estimating of Oil Production in One Plant

Nano compounds significantly affect average production of oil in one plant. Concentration of nano zinc (0.05) mg/mL the mean production of one plant of oil in grams (0.0342) mg. Plants treated with control grew the fastest (0.0345) mg/L. Nano magnesium also significantly affected average production of one plant in grams. Similarly, when the concentration of nano magnesium (0.02) mg/mL, it increased the average of production. The greatest average of production was created by seaweed extract at 150 gm/L (0.0628) mg/L. Compared to 50 gm/L (0.0429) mg/L and the control (0.0617) mg/L. Nano compound and seaweed extract had a significant interaction effect. Plants treated with 0.03 mg/mL of Nano zinc and 50 gm/L of seaweed extract average production of oil in one plant.

Table 1: The effect of nano magnesium, nano zinc, and seaweed extract on average protein percentage.

Seaweed Extract (E)	Nano compounds					Average of Seaweed Extract (E)
	0	0.02 (MgO) mg/mL	0.04 (MgO) mg/mL	0.03(Z) mg/mL	0.05 (ZnO) mg/mL	
0	6.85	8.17	6.56	5.98	5.68	6.65
50 gm/L	4.38	6.71	6.33	7.00	9.92	6.87
100 gm/L	7.00	5.69	5.25	5.69	5.40	5.80
150 gm/L	5.53	11.21	10.21	6.71	5.11	7.75
200 gm/L	7.51	5.69	4.38	6.33	5.69	5.92
Average of Nano compounds	7.03	6.72	6.55	6.34	6.36	Nano compounds
LSD (P = 0.05)	1.616					LSD (P = 0.05) 1.616
Two-way Interaction LSD (P = 0.05)	3.613					

Table 2: The effect of Nano magnesium, Nano zinc, and seaweed extract, on the average percentage of oils in the plant.

Seaweed Extract (E)	Nano compounds					Average of Seaweed Extract (E)
	0	0.02 (Mg) mg/mL	0.04 (Mg) mg/mL	0.03 (ZnO) mg/mL	0.05 (ZnO) mg/mL	
0	0.683	1.016	1.030	0.393	0.965	0.818
50 gm/L	0.709	0.634	0.859	0.659	1.075	0.787
100 gm/L	0.937	0.659	1.057	0.988	0.910	0.910
150 gm/L	0.953	0.705	0.991	0.717	0.705	0.814
200 gm/L	1.057	0.679	0.974	0.934	0.659	0.860
Average of Nano Compounds	0.868	0.739	0.982	0.738	0.863	Nano compounds (N)
LSD (P=0.05)	0.2653					LSD (P = 0.05) 0.2653
Two-way Interaction LSD (P = 0.05)	0.5932					

Table 3: The effect of nano compounds on average oil production of one plant in grams.

Seaweed Extract (E)	Nano compounds					Average of Seaweed Extract (E)
	0	0.02 (MgO) mg/mL	0.04 (MgO) mg/mL	0.03 (ZnO) mg/mL	0.05 (ZnO) mg/mL	
0	0.0328	0.0508	0.1757	0.0161	0.0333	0.0617
50 gm/L	0.0496	0..0486	0.0458	0.0315	0.0387	0.0429
100 gm/L	0.0169	0.0165	0.0378	0.0344	0.0455	0.0302
15 gm/L	0.0355	0.0188	0.0346	0.1892	0.0357	0.0628
200 gm/L	0.0378	0.0481	0.0526	0.0346	0.0179	0.0382
Average of Nano compounds	0.0345	0.0366	0.0693	0.0612	0.0342	Nano compounds (N)
LSD (P = 0.05)	0.06236					LSD (P = 0.05) 0.06236
Two-way Interaction LSD (P = 0.05)	0.1394					

4. Discussion

Robert George Douglas Steel shows that the use of nano zinc fertilizers increased the essential oil yield and improved the formation of volatile compounds in chrysanthemum plants [30]. That was obtained from results under study, as zinc in particular plays an important role in plant growth through its participation in the synthesis of auxins (plant hormones that regulate cell division and elongation) [30]. Zinc also activates enzymes that participate in the metabolism of carbohydrates, proteins and fats necessary for plant growth and development [31].

Ascophyllum nodosum seaweed extract showed to lessen the degree of disease in carrot and cucumber plants due to foliar pathogens *Alternaria cucumerinum*, *Alternaria radicina*, *Didymella applanata*, and *Botrytis cinerea* [32, 21]. Concentrations of proteins, enzymes, and other substances involved in defence responses increased as a result. According to several studies, kelp extracts can boost plants' uptake of nutrients [33-35]. This was linked to increased root growth, the capacity of certain kelp extract constituents, such as organic acids, to chelate nutrients [33]. Besides, increased expression of genes encoding proteins involved in nitrogen uptake and assimilation [35]. SWE was applied at (7 mL L−1), which may be consistent with earlier studies that used extracts from *Ascopyllum nodosum* on a variety of crops and suggested that drench administrations might have a greater effect on plants [25, 36].

Betaines, vitamins, cytokinin's, auxins, abscisic acid (ABA-Like), and macro- and microelements may all be present in commercial SWE [37-39]. Early research revealed that receptor proteins on plant cell membranes are bound by metabolic elicitors, making secondary metabolites like essential oils more abundant [40-42], as well in basil plants [43-44]. Nodosum SWE joint application with nitrogen and boron increased oil yield and enhanced the quality of the oil of olive trees by means of increasing the linoleic.

Also, oleic acid concentrations, the increase in essential oil content and the modified chemical composition might be attributed to several factors such as the presence of major and trace elements, and secondary metabolite elicitors in *Ascopyllum nodosum* extracts.

5. Conclusion

The impact of varying amounts of certain magnesium nanoparticles, zinc nanoparticles, and seaweed extract on the vegetative growth of rosemary (*Salvia Rosmarinus L.*). The application of the plant markedly enhanced all attributes, irrespective of whether the features of vegetables or chemical activity attained the maximum concentrations, yielding the most significant benefits.

6. References

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