

# Effect of spraying with a combination of nano-fertilizers on some chemical characteristics of two pomegranate cultivars under salt stress conditions

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## Abstract

The research was conducted in the plant canopy of the Department of Horticulture and Landscape Engineering / College of Agriculture / University of Karbala, from the beginning of March to October 2021, to find out the effect of spraying a combination of nano-fertilizers on vegetative and root growth and the chemical content of seedlings of two pomegranate cultivars under salt stress conditions. The first factor was spraying with several concentrations of the combination of nano-fertilizers (0 ml L<sup>-1</sup> Optimus plus 0 g L<sup>-1</sup> IQ combi and 1 ml L<sup>-1</sup> Optimus plus + 0.5 g L<sup>-1</sup> IQ combi and 1.5 ml L<sup>-1</sup> Optimus plus + 1 gm liter - 1 IQ combi). As for the second factor, the variety (Wonderful, Slimy), and the third factor, irrigation with three different salt concentrations (1.7, 5, and 10 dSm<sup>-1</sup>). The results were analyzed using the Genstat statistical analysis program, and the averages were compared using the least significant difference (L.S.D) under the probability level of 0.05.

## The results can be summarized as follows

1. The treatment with a combination of nano-fertilizer at a concentration of (1.5 ml L<sup>-1</sup> Optimus plus + 1 g L<sup>-1</sup> IQ combi) had the highest percentage in the leaves of (chlorophyll, carbohydrates, nitrogen, phosphorus, potassium, calcium, zinc and iron) as recorded While the treatment (0 ml liter - 1 Optimus plus + 0 g liter - 1 IQ combi) recorded the highest percentage of (proline, sodium and chloride) in the leaves.
2. The cultivar Wanderfel outperformed the cultivar Salimi and recorded the highest percentage in the leaves of (chlorophyll, carbohydrates, proline, phosphorous, potassium, calcium, zinc and iron), while the cultivar Salimi gave the highest percentage of (nitrogen, sodium and chloride) in the leaves.
3. Irrigation treatment with electrolyte water (1.7 dSm<sup>-1</sup>) showed the highest percentage of (chlorophyll, carbohydrates, nitrogen, phosphorus, potassium, calcium, zinc and iron) in the leaves, while irrigation with water (10 dSm<sup>-1</sup>) gave the highest percentage. In the leaves of (proline, sodium and chloride).
4. The double and triple interactions between the study factors led to a clear significant superiority in the studied traits compared to the comparison treatment, as the triple interaction treatment (1.5 ml liter - 1 Optimus plus + 1 gm liter - 1 IQ combi, the variety Wanderfel and the salinity of irrigation water with a concentration of 1.7 decimens M<sup>-1</sup>) was significant by giving the highest percentage of (chlorophyll, carbohydrates and iron) in the leaves. The treatment (1 ml liter-1 Optimus plus + 0.5 gm liter-1 IQ combi, the cultivar Wanderlust, and irrigation water salinity at a concentration of 10 dSm<sup>-1</sup>) recorded the highest content of (proline) in the leaves, while the treatment (0 ml liter-1 Optimus plus + 0 gm l-1 IQ combi and cultivar Salimi and the salinity of the irrigation water at a concentration of 10 dSm<sup>-1</sup>) gave the highest percentage of (sodium) in the leaves, and the treatment excelled (1.5 ml l-1 Optimus plus + 1 gm l-1 IQ combi and The cultivar, Salimi, and the salinity of the irrigation water at a concentration of 1.7 dSm<sup>-1</sup>) gave the highest percentage of (Zn) in the leaves.

**Keywords:** nano-fertilizers; pomegranate cultivars; chemical characteristics

## 1. Introduction

The pomegranate, *Punica granatum* L., is a deciduous fruit tree that belongs to the Punicaceae family. It is believed that the original home of the pomegranate tree is Iran and northern Iraq [1]. The number of pomegranate fruit trees in Iraq is about (6,495,705) trees, with a total production of (241,671) tons, and the rate of production per tree is (37.20) kg. Tree-1, and the production of the pomegranate crop constitutes (28.16%) of the total production of

summer fruit trees in Iraq. [2].

The importance of pomegranate comes from its fruits containing significant proportions of vitamins, mineral salts, dyes, fats, carbohydrates, sugars, protein, acids, fiber and nutrients, the quantities of which vary according to varieties [3].

Soil salinity is one of the most dangerous environmental factors that limit the growth and productivity of horticultural plants all over the world, as nearly 20% of the world's cultivated land and half of the world's irrigated land is considered affected by salinity, and one of the most important factors

contributing to soil salinity is the excessive use of fertilizers Chemical, the use of saline irrigation water and the rise in the water table [4].

Therefore, it was necessary to use some methods to stop this deterioration and reduce the damage resulting from salt stress in lands that are irrigated with water with high salinity levels, including the use of some types of nutritious fertilizer treatments to encourage the absorption of water and nutrients by plants and reduce salt stress [5] such as Optimus nano fertilizer plus and IQ Combi. Many studies have shown that spraying nutrients on plants is an effective way to reduce the harmful effects of salt stress [6].

A lot of research and studies in recent years have dealt with the introduction of nanotechnology in the agricultural field, which is known as Agro-Nanotechnology, which has had a significant impact on the economy in the world, and agriculture occupies the second place in the use of nanotechnology after energy production, storage and conversion[7]. This technology provided exploration of nanomaterials or nanostructures as carriers for fertilizers or materials whose release is controlled towards smart fertilizers to enhance the efficiency of fertilizer use and reduce environmental pollution and agricultural inputs.[8].

Due to the lack of studies on the effect of nano-fertilizers in reducing salt stress on pomegranate seedlings, the study was conducted to find out the effect of spraying a combination of nano-fertilizer Optimus plus and IQ combi in improving the growth of two varieties of pomegranate seedlings, Enderfel and Salimi under salt stress conditions.

## 2. 2-Materials and Methods

The experiment was carried out in the plant canopy of the Department of Horticulture and Landscape Engineering / College of Agriculture / University of Karbala / Al-Hussainiya district for the period from March to October 2021 in order to know the effect of spraying a combination of nano-fertilizers on the growth of seedlings of two cultivars of pomegranate under salt stress conditions.

162 seedlings of two pomegranate cultivars were selected, with 81 seedlings for each variety, as homogeneous as possible with strong growth. They were obtained from the Horticultural and Forestry Station / Al-Hindiya District. They were planted in polyethylene bags with a capacity of (1.25 kg), then the seedlings were transferred on 3/1/2021 to pots with a capacity of 10 kg filled with sandy soil mix.

A factorial experiment ( $3 \times 3 \times 2$ ) was followed by a randomized complete block design (R.C.B.D) with three replications, as each repetition includes (18) treatments with 3 seedlings per experimental unit. The first factor was spraying a mixture of nano-fertilizers with three concentrations (0 ml L-1 Optimus plus + 0gl-1 IQ combi and 1ml-1 Optimus plus + 0.5gl-1 IQ combi and 1.5ml-1 Optimus plus + 1gl-1 IQ combi). The second factor was represented by two varieties of pomegranate (Wonderful and

Slimy), and the third factor was irrigation with three different salt concentrations (1.7, 5 and 10 dSm-1).

I sprayed the seedlings with a combination of nano-fertilizers in the early morning using a manual sprinkler with a capacity of (2 liters) starting from 3/15/2021 until 9/15/2021 after adding (1 cm<sup>3</sup>) of detergent (Al Zahi) with each concentration to break the surface tension of the water until wet. The seedlings were completely sprayed as the comparison treatment with distilled water only after the watering process was carried out for the seedlings one day before the spraying process to increase the efficiency of the plants in absorbing the sprayed material [9]. The seedlings were also watered with saline water twice a week.

### Studied traits

Samples were taken to the laboratory on 10/1/2021, as follows:

- The content of leaves of chlorophyll
- Percentage of carbohydrates
- The content of the leaves of proline
- Sodium concentration
- Zinc concentration
- Iron element concentration

## 3. Results

### 3-1- Leaves content of chlorophyll (mg. g<sup>-1</sup>)

The results in Table (1) indicate that there are significant differences between the two pomegranate cultivars, Wonderfull and Salimi, in the content of the leaves of chlorophyll, as the highest percentage of chlorophyll content was achieved with the variety and Wonderfull amounted to (47.943 mg. g<sup>-1</sup>) compared to the Salimi variety, which gave the lowest percentage of (45.371 mg. g<sup>-1</sup>). As for the fertilizer concentration, the treatment (1.5 ml liter<sup>-1</sup> Optimus plus + 1 gm liter-1 IQ combi) excelled as it gave the highest content of (49.040 mg. g<sup>-1</sup>) compared to the comparison treatment that gave the lowest content of (44.656 mg. g<sup>-1</sup>). The salinity concentration (1.7 dSm<sup>-1</sup>) recorded the highest content (50.389 mg. g<sup>-1</sup>) compared to the concentration (10 dSm<sup>-1</sup>), which gave the lowest content (41.279 mg. g<sup>-1</sup>).

As for the two-way interaction between the variety and the nano-fertilizer combination, there were significant differences between the treatments in this characteristic. The treatment (Wonderful and 1.5 ml liter<sup>-1</sup> Optimus plus + 1 gm liter<sup>-1</sup> IQ combi) excelled by giving the highest rate of (50.113 mg.g. <sup>-1</sup>) Compared to the treatment (Slimy and 0 Optimus plus + 0 IQ combi), which gave the lowest rate of (43.268 mg. g<sup>-1</sup>). While the results of the table indicate the bilateral interaction between the variety and the salinity of the irrigation water that there are significant differences, the treatment (Wonderful and 1.7 decimens M<sup>-1</sup>) excelled by giving it (50.863 mg.g<sup>-1</sup>) compared to the treatment (Slimy and 10 decimens M<sup>-1</sup>) that was given The lowest rate was (38.553 mg.g<sup>-1</sup>).

1). As for the binary interaction between the combination of nano-fertilizer and the salinity of the irrigation water, it was significant, as the treatment (1.51.5 ml L<sup>-1</sup> Optimus plus + 1 g L<sup>-1</sup> IQ combi and 1.7 dSEMs M<sup>-1</sup>) gave the highest values with an average of (52.740 mg .g<sup>-1</sup>) compared with the treatment (0 Optimus plus + 0 IQ combi and 10 decimens M<sup>-1</sup>), which gave the lowest rate of (39.540 mg.g<sup>-1</sup>).

As for the triple interaction between the factors, it was significant, as the treatment (Wonderful and 1.5 ml L<sup>-1</sup> Optimus plus + 1 gm L<sup>-1</sup> IQ combi and 1.7 decimens M-1) recorded the highest value of (53.227 mg.g<sup>-1</sup>) compared to the treatment (Slimy, 0 Optimus plus + 0 IQ combi, and 10 decimens M<sup>-1</sup>), which gave the lowest value of (36.173 mg.g<sup>-1</sup>).

### 3-2- Percentage of carbohydrates in leaves (%):-

In table (2), the cultivar Wanderfel outperformed the cultivar Salimi, as it gave the highest percentage of carbohydrates in the leaves, which was (8.849%), compared to the percentage of carbohydrates in the leaves of the other cultivar, Salimi, which was (8.118%). As for the fertilizer concentration, the treatment (1.5 ml. L-1 Optimus plus + 1 gm L-1 IQ combi) was superior as it gave the highest percentage of carbohydrates and it was (9.397%) compared to the comparison treatment that gave the lowest percentage (7.587%). As for salinity, the concentration (1.7 dSm-1) gave the highest percentage of carbohydrates in the leaves, amounting to (10.057%), compared to the concentration (10 dSm-1), which gave the lowest percentage of carbohydrates, which was (6.580%).

The results showed in the same table that the two interactions had a significant effect between the variety and the combination of nano-fertilizer, the treatment (Wonderful and 1.5 ml liter-1 Optimus plus + 1 gm liter-1 IQ combi) excelled by giving the highest percentage of carbohydrates in the leaves amounted to (9.697). %) compared to the treatment (Slimy and 0 Optimus plus + 0 IQ combi), which gave the lowest rate of (7.198%), As for the bilateral interaction between the variety and the salinity of the irrigation water, it also had a significant effect. The treatment (Wonderful and 1.7 decimens M-1) excelled as it gave the highest rate of (10.236%) compared to the treatment (Slimy and 10 decimens M-1) which gave the lowest percentage. of carbohydrates amounted to (5.986%).

As for the bilateral interaction between the salinity of the irrigation water and the combination of the nano-fertilizer, it was significant, as the treatment (1.5 ml liter-1 Optimus plus + 1 g liter<sup>-1</sup> IQ combi and 1.7 decimens M<sup>-1</sup>) gave the highest values with a percentage of (11.250%). ) compared with the treatment (0 Optimus plus + 0 IQ combi and 10 decimens M<sup>-1</sup>), which gave the lowest percentage of (5.793%).

While the triple interactions between the variety, the combination of nanofertilizer and the salinity of the

irrigation water showed significant differences, as the treatment (Wonderful and 1.5 ml liter<sup>-1</sup> Optimus plus + 1 gm liter<sup>-1</sup> IQ combi and 1.7 decimens M-1) gave the highest percentage and was (11.473%) ) compared to the treatment (Slimy, 0 Optimus plus + 0 IQ combi, and 10 decimens M<sup>-1</sup>), which gave the lowest percentage of carbohydrates (5.247%)

### 3-3- Proline content of leaves (mg. g<sup>-1</sup>):-

It is noted from table (3) that the cultivar Salimi outperformed the cultivar Wanderville in the leaf content of proline, as it amounted to (6.479 mg. g-1), compared to the cultivar Wanderville, which reached (7.972 mg. g-1). As for the concentration of the nano-fertilizer combination, the treatment (1.5 ml liter-1 Optimus plus + 1 gm liter-1 IQ combi) excelled by giving the lowest rate of (6.099 mg. g-1) compared to the comparison treatment that gave the highest rate of (8.269 mg. g-1). As for salinity, the concentration (1.7 dSm-1) gave the lowest rate of proline content, amounting to (5. mg. g-1), compared to the concentration (10 dSm-1), which gave the highest content of proline, amounting to (10.823 mg. g-1).

The same table shows that there is a significant effect of the binary interactions between the variety and the combination of nanofertilizer. The treatment (Wonderful and 1.5 ml liter-1 Optimus plus + 1 gm liter-1 IQ combi) excelled by giving the lowest rate of (5.559 mg. g<sup>-1</sup>) compared to the treatment. (Wonderful and 0 Optimus plus + 0 IQ combi), which gave the highest value of (8.952 mg. g<sup>-1</sup>). As for the bilateral interaction between the cultivar and the salinity of the irrigation water, it also had a significant effect. slimy and 1.7 decimens M-1), which gave the lowest rate (4.834 mg. g<sup>-1</sup>) compared to the treatment (Wonderful and 10 decimens M-1), which gave the highest value and was (12.207 mg. g<sup>-1</sup>).

The binary interaction between the combination of nanofertilizer and the quality of irrigation water showed a significant effect on this characteristic, and this indicates that the combination of nanofertilizer reduced the salt stress to which the plant is exposed, and thus reduced the proline values of the treatments in which the nanofertilizer was used, as the treatment was (1.5 ml L-1 Optimus plus + 1 gm L-1 IQ combi and 1.7 decimens M-1) excelled significantly as it gave the lowest rate of (4.107 mg.g-1) compared to the treatment (0 Optimus plus + 0 IQ combi and 10 decimens M-1), which It gave the highest rate of proline (11.830 mg.g-1).

In the same table, the triple interactions between the cultivar, irrigation water salinity, and nano-fertilizer combination showed that there were significant differences, as the treatment recorded (slimy and 1.5 ml liter-1 Optimus plus + 1 g liter-1 IQ combi and 1.7 dSEM-1) was the lowest content and was ( 3.870 mg.g<sup>-1</sup>) compared to the treatment (Wonderful and 1 ml L-1 Optimus plus + 0.5 gm L-1 IQ combi and 10 decimens M-1) which recorded the highest content was (13.657 mg.g<sup>-1</sup>).

### 3-4- Percentage of Sodium in Leaves (%): -

It is noted from Table (4) that the variety Wanderfel

surpassed the cultivar Wanderfel in the percentage of sodium element in the leaves, which amounted to (0.765%) compared to the cultivar Salimi, which reached (0.801%). As for the concentration of the nano-fertilizer combination, the treatment (1.5 ml liter-1 Optimus plus + 1 g liter-1 IQ combi) excelled by giving the lowest percentage of (0.622%) compared to the comparison treatment that gave the highest percentage of (1.077%). As for salinity, the concentration (1.7 dSm-1) gave the lowest rate of sodium (0.510%), compared to the concentration (10 dSm-1), which gave the highest percentage of sodium (1.200%).

The same table shows that there is a significant effect of the binary interactions between the variety and the combination of nanofertilizer. The treatment (Wonderful and 1.5 ml liter -1 Optimus plus + 1 gm liter -1 IQ combi) excelled by giving the lowest percentage of (0.610%) compared to the treatment (Slimy and 0 Optimus plus + 0 IQ combi), which gave the highest value and was (1.110%). As for the bilateral interaction between the cultivar and the salinity of the irrigation water, it also had a significant effect. ) as it gave the lowest percentage of (0.494%) compared to the treatment (Slimy and 10 decimens M-1), which gave the highest value and was (1.234%). The binary interaction between the combination of nanofertilizer and the quality of irrigation water showed a significant effect on this characteristic, and this indicates that the combination of nanofertilizer reduced the salt stress to which the plant is exposed, and thus reduced the sodium values of the treatments in which the nanofertilizer was used, as the treatment was (1.5 ml L-1 Optimus plus + 1 gmL-1 IQ combi and 1.7 decimens M-1) were significantly superior as it gave the lowest percentage of (0.440%) compared to the treatment (0 Optimus plus + 0 IQ combi and 10 decimens M-1) which gave the highest percentage of sodium In papers, it amounted to (1.751%).

In the same table, the triple interactions between the cultivar, the combination of nanofertilizer and the salinity of the irrigation water showed significant differences, as the treatment (Wonderful and 1.5 ml liter -1 Optimus plus + 1 gm liter -1 IQ combi and 1.7 dSEMs M -1) gave the lowest rate of (0.433%) compared to With the treatment (Slimy, 0 Optimus plus + 0 IQ combi, and 10 Decimens M-1), which gave the highest percentage of (1.823%).

### 3-5- The percentage of zinc in the leaves (mg kg-1):-

Table (5) shows the superiority of the cultivar Wanderfel over the cultivar Salimi in the concentration of zinc in the leaves, reaching (37.726 mg kg-1) compared to the zinc concentration of the other cultivar Salimi, which was (36.490 mg kg-1). As for the concentration of the mixture of fertilizers, the treatment (1.5 ml liter-1 Optimus plus + 1 gm liter-1 IQ combi) excelled by giving the highest concentration and it was (39.815 mg kg-1) compared to the comparison treatment, which recorded the

lowest concentration of (34.477 mg kg-1). As for salinity, the concentration (1.7 dSm-1) recorded the highest mean of zinc concentration and was (44.774 mg kg-1) compared to the concentration (10 dSm-1), which gave the lowest concentration of zinc, reaching (28.468 mg kg-1).

The results showed in the same table that there was a significant effect of the bilateral interaction between the variety and the combination of nano-fertilizer, where the treatment excelled (Wonderful and 1.5 ml liter-1 Optimus plus + 1 g liter-1 IQ combi) by giving the highest concentration of zinc amounted to (39.964 mg kg<sup>-1</sup>) compared to The treatment (Slimy and 0 Optimus plus + 0 IQ combi) which recorded the lowest concentration was (33.619 mg kg<sup>-1</sup>), while the bilateral interaction between the cultivar and the salinity of the irrigation water also had a significant effect, the treatment (Slimy and 1.7 dsimens M<sup>-1</sup>) was superior ) which gave the highest concentration of zinc in the leaves amounted to (45.193 mg kg<sup>-1</sup>) compared with the treatment (slimy and 10 decimens m<sup>-1</sup>), which recorded the lowest concentration of (27.147 mg kg<sup>-1</sup>).

As for the bilateral interaction between the salinity of the irrigation water and the combination of nano-fertilizers, it also had a significant effect, as the treatment (1.5 ml liter-1 Optimus plus + 1 gm liter-1 IQ combi and 1.7 decimens M-1) recorded the highest values with a concentration of (47.952 mg kg-1). 1) Compared with the treatment (0 Optimus plus + 0 IQ combi and 10 decimens M-1), which gave the lowest concentration of zinc (26.235 mg kg-1).

### 3-6- The percentage of iron in the leaves (mg-1):

The results shown in Table (6) indicate that there are significant differences between the two cultivars of Wonderville and Salimi in the concentration of iron in the leaves, as the highest concentration of iron was achieved with the cultivar Wonderville (112.900 mg kg 1) compared to the cultivar Salimi, which recorded the lowest concentration of (108.560 mg kg -1). As for the fertilizer concentration, the treatment (1.5 ml liter-1 Optimus plus + 1 gm liter-1 IQ combi) excelled by giving the highest concentration and it was (115.250 mg kg-1) compared to the comparison treatment, which recorded the lowest concentration of (105.640 mg kg-1). The salinity concentration (1.7 dSm-1) recorded the highest concentration of iron (124.440 mg kg-1) compared to the concentration (10 dSm-1), which gave the lowest concentration (94.520 mg kg-1).

As for the two-way interaction between the variety and the nano-fertilizer combination, there were significant differences between the treatments in this characteristic. The treatment (Wonderful and 1.5 ml liter-1 Optimus plus + 1 gm liter-1 IQ combi) excelled by giving the highest concentration of iron (117.090 mg kg-1). ) compared to the treatment (Slimy and 0 Optimus plus + 0 IQ combi), which recorded the lowest concentration of (103.640 mg kg-1), while the

results of the table in the bilateral interaction between the variety and the salinity of irrigation water indicate that there are significant differences, where the treatment excelled (Wonderful and 1.7 decimens M-1) by giving it (126.320 mg kg<sup>-1</sup>) compared to the treatment (slimy and 10 decimens M-1), which recorded the lowest concentration of (92.840 mg kg<sup>-1</sup>).

As for the bilateral interaction between the salinity of the irrigation water and the combination of nano-fertilizer, it was significant, as the treatment recorded (1.5 ml liter<sup>-1</sup> Optimus plus + 1 gm liter<sup>-1</sup> IQ combi and 1.7 decimens M-1) the highest concentrations, which was (130.630 mg kg<sup>-1</sup> ) compared with the treatment (0 Optimus plus + 0 IQ combi and 10 decimens M-1), which gave the lowest concentration (91.250 mg kg).

#### 4. Discussion

It is noted from Table (1) that there is an increase in the chlorophyll content of the leaves when using nano-fertilizers. Perhaps the reason is due to the role of the microelements in reducing salt stress through their entry into the composition of the chlorophyll molecule, in addition to their role in protecting the chlorophyll molecule from demolition [10] through Production of antioxidants peroxidase and catalase, which was reflected positively in increasing the content of leaves of chlorophyll and thus increasing the efficiency of the photosynthesis process and the accumulation of carbohydrates [11] Table (2). Where it was concluded [12] that spraying pear trees (*Pyrus communis* L.) cultivar Le-Conte with iron nano-

fertilizer led to a significant increase in the leaves content of chlorophyll and carbohydrates.

The decrease in proline content in the leaves (Table 3) when treated with a combination of nano-fertilizers may be attributed to the role of the microelements involved in the composition of the fertilizer in increasing the process of photosynthesis and the formation of carbohydrates and proteins, which are a source for building the necessary enzymes to reduce salt stress and thus reduce the accumulation of proline [13].

The high concentration of Zn and Fe elements, tables (5 and 6) sequentially, and the low concentration of Na, table (4) in pomegranate leaves of two cultivars, Enderfel and Salimi, under conditions of salt stress may be due to the role of the combination of nanofertilizers and the amino and organic acids it contains and microelements or Perhaps the reason is due to the high ability of the nanoparticles that make up the fertilizer mixture to penetrate and enter the various plant tissues as a result of their small size and speed of spread, especially the additive sprayed on the vegetative system and its access to the plasma membrane and then the cytosol [14].

Thus, increasing the concentration of Zn and Fe, in addition to the role of microelements, especially zinc, manganese and copper, in maintaining the integrity of cellular membranes and thus reducing sodium absorption [15] and stimulating the process of photosynthesis, respiration, and building nucleic acids, which may have been positively reflected in improving chemical properties and plant tolerance to salt stress [16]

**Table (1) Effect of cultivar, irrigation water quality and nano-fertilizer combination on chlorophyll content of leaves on pomegranate seedlings (mg.gm<sup>-1</sup>)**

Variety	Nano fertilizer combination			Salinity of irrigation water ds.m <sup>-1</sup>			
Wonderful	47.943	0	44.656	1.7		50.389	
		1 ml + 0.5 gm	46.274	5		48.279	
Slimy	45.371	1.5 ml + 1 gm	49.040	10		41.279	
L.S.D	0.2004	0.2454		0.2454			
Variety	Nano fertilizer combination			Variety	Salinity of irrigation water ds.m <sup>-1</sup>		
	0	1 ml + 0.5 gm	1.5 ml + 1 gm		1.7	5	10
Wonderful	46.044	47.671	50.113	Wonderful	50.862	48.917	44.050
Slimy	43.268	44.878	47.967	slimy	49.917	47.642	38.553
L.S.D	0.3470			L.S.D	0.3470		
Nano fertilizer combination	Salinity of irrigation water ds.m <sup>-1</sup>						
	1.7		5		10		
0	48.485		45.943		39.540		
1 ml + 0.5 gm	49.943		47.930		40.950		
1.5 ml + 1 gm	52.740		50.965		43.415		
L.S.D	0.4250						
Variety	Nano fertilizer combination		Salinity of irrigation water ds.m <sup>-1</sup>				
Wonderful	0		1.7		5		
			48.923		46.303		
	1 ml + 0.5 gm		50.473		48.340		
Slimy	1.5 ml + 1 gm		53.227		52.107		
	0		48.047		45.583		
	1 ml + 0.5 gm		49.450		47.520		
L.S.D	1.5 ml + 1 gm		52.253		49.823		
	0.6011						

**Table (2) Effect of cultivar, nanofertilizer combination and irrigation water quality on the percentage of carbohydrates in the leaves on pomegranate seedlings (%)**

Variety		Nano fertilizer combination			Salinity of irrigation water ds.m <sup>-1</sup>			
Wonderful	8.849	0	7.587	1.7		10.057		
		1 ml + 0.5 gm	8.467	5		8.814		
Slimy	8.118	1.5 ml + 1 gm	9.397	10		6.580		
L.S.D								
Variety		Nano fertilizer combination			Salinity of irrigation water ds.m <sup>-1</sup>			
		0	1 ml + 0.5 gm	1.5 ml + 1 gm	Variety	1.7	5	10
Wonderful	7.976	8.874	9.697		Wonderful	10.236	9.137	7.174
Slimy	7.198	8.060	9.097		Slimy	9.878	8.491	5.986
L.S.D					L.S. D			
Nano fertilizer combination		Salinity of irrigation water ds.m <sup>-1</sup>						
		1.7		5	10			
0		8.920		8.047	5.793			
1 ml + 0.5 gm		10.000		8.898	6.503			
1.5 ml + 1 gm		11.250		9.497	7.443			
L.S.D								
Variety		Nano fertilizer combination		Salinity of irrigation water ds.m <sup>-1</sup>				
Wonderful	0			1.7	5		10	
				9.143	8.443		6.340	
		1 ml + 0.5 gm		10.090	9.357		7.177	
		1.5 ml + 1 gm		11.473	9.610		8.007	
Slimy	0			8.697	7.650		5.247	
		1 ml + 0.5 gm		9.910	8.440		5.830	
		1.5 ml + 1 gm		11.027	9.383		6.880	
L.S.D								

**Table (3) Effect of cultivar, nano-fertilizer combination and irrigation water quality on leaf proline content on pomegranate seedlings (mg GM-1)**

Variety		Nano fertilizer combination			Salinity of irrigation water ds.m <sup>-1</sup>			
Wonderful	7.972	0	8.269		1.7	5.021		
		1 ml + 0.5 gm	7.309		5	5.833		
Slimy	6.479	1.5 ml + 1 gm	6.099		10	10.823		
L.S.D		0.1832	0.2244			0.2244		
Variety		Nano fertilizer combination			Salinity of irrigation water ds.m <sup>-1</sup>			
		0	1 ml + 0.5 gm	1.5 ml + 1 gm	Variety	1.7	5	10
Wonderful	8.952	8.324	6.639		Wonderful	5.207	6.502	12.207
Slimy	7.586	6.293	5.559		Slimy	4.834	5.163	9.440
L.S.D		0.3173			L.S.D	0.3173		
Nano fertilizer combination		Salinity of irrigation water ds.m <sup>-1</sup>						
		1.7		5	10			
0		5.945		7.032	11.830			
1 ml + 0.5 gm		5.010		5.477	11.440			
1.5 ml + 1 gm		4.107		4.990	9.200			
L.S.D		0.3887						
Variety		Nano fertilizer combination		Salinity of irrigation water ds.m <sup>-1</sup>				
Wonderful	0			1.7	5		10	
				6.117	7.627		13.113	
		1 ml + 0.5 gm		5.160	6.157		13.657	
		1.5 ml + 1 gm		4.343	5.723		9.850	
Slimy	0			5.773	6.437		10.547	
		1 ml + 0.5 gm		4.860	4.797		9.223	
		1.5 ml + 1 gm		3.870	4.257		8.550	
L.S.D		0.5497						

**Table (4) Effect of cultivar, nano-fertilizer combination and irrigation water quality on the percentage of sodium in leaves on pomegranate seedlings (%)**

Variety		Nano fertilizer combination		Salinity of irrigation water ds.m <sup>-1</sup>			
Wonderful	0.765	0	1.077		1.7	0.510	
		1 ml + 0.5 gm	0.650		5	0.640	
Slimy	0.801	1.5 ml + 1 gm	0.622		10	1.200	
L.S.D	0.0080	0.0098		0.0098			
Variety	Nano fertilizer combination			Variety	Salinity of irrigation water ds.m <sup>-1</sup>		
	0	1 ml + 0.5 gm	1.5 ml + 1 gm		1.7	5	10
Wonderful	1.044	0.642	0.610	Wonderful	0.494	0.635	1.166
Slimy	1.110	0.658	0.635	Slimy	0.525	0.644	1.234
L.S.D	0.0139			L.S.D	0.0139		
Nano fertilizer combination	Salinity of irrigation water ds.m <sup>-1</sup>						
	1.7		5		10		
0	0.631		0.848		1.751		
1 ml + 0.5 gm	0.458		0.551		0.941		
1.5 ml + 1 gm	0.440		0.520		0.908		
L.S.D	0.0170						
Variety	Nano fertilizer combination	Salinity of irrigation water ds.m <sup>-1</sup>					
		1.7	5	10			
Wonderful	0	1.7	5	10			
		0.596	0.856	1.680			
		1 ml + 0.5 gm	0.453	0.540	0.933		
Slimy	0	1.7	5	10			
		0.666	0.840	1.823			
		1 ml + 0.5 gm	0.463	0.563	0.950		
L.S.D	0.0241	1.5 ml + 1 gm	0.446	0.530	0.930		

**Table (5) Effect of cultivar, nanofertilizer combination and irrigation water quality on the percentage of zinc in leaves on pomegranate seedlings (mg kg<sup>-1</sup>)**

Variety		Nano fertilizer combination		Salinity of irrigation water ds.m <sup>-1</sup>			
Wonderful	37.726	0	34.477		1.7	44.774	
		1 ml + 0.5 gm	37.032		5	38.082	
Slimy	490.36	1.5 ml + 1 gm	39.815		10	28.468	
L.S.D	0.3102	0.3799		0.3799			
Variety	Nano fertilizer combination			Variety	Salinity of irrigation water ds.m <sup>-1</sup>		
	0	1 ml + 0.5 gm	1.5 ml + 1 gm		1.7	5	10
Wonderful	35.334	37.880	39.964	Wonderful	44.354	39.036	29.789
Slimy	33.619	36.184	39.666	Slimy	45.193	37.129	27.147
L.S.D	0.5373			L.S.D	0.5373		
Nano fertilizer combination	Salinity of irrigation water ds.m <sup>-1</sup>						
	1.7		5		10		
0	41.717		35.478		26.235		
1 ml + 0.5 gm	44.653		37.773		28.670		
1.5 ml + 1 gm	47.952		40.995		30.499		
L.S.D	0.6580						
Variety	Nano fertilizer combination	Salinity of irrigation water ds.m <sup>-1</sup>					
		1.7	5	10			
Wonderful	0	1.7	5	10			
		41.427	36.897	27.680			
		1 ml + 0.5 gm	44.513	39.013	30.113		
Slimy	0	1.7	5	10			
		42.007	34.060	24.790			
		1 ml + 0.5 gm	44.793	36.533	27.227		
L.S.D	0.9306	1.5 ml + 1 gm	48.780	40.793	29.423		

**Table (6) Effect of cultivar, nanofertilizer combination and irrigation water quality on the percentage of iron in the leaves on pomegranate seedlings (mg kg<sup>-1</sup>)**

Variety		Nano fertilizer combination			Salinity of irrigation water ds.m <sup>-1</sup>			
Wonderful	112.900	0	105.640		1.7	124.440		
		1 ml + 0.5 gm	111.300		5	113.230		
Slimy	108.560	1.5 ml + 1 gm	115.250		10	94.520		
L.S.D	0.800	0.980			0.980			
Variety	Nano fertilizer combination			Variety	Salinity of irrigation water ds.m <sup>-1</sup>			
	0	1 ml + 0.5 gm	1.5 ml + 1 gm		1.7	5	10	
Wonderful	107.640	113.980	117.090		Wonderful	126.320	116.200	96.190
Slimy	103.640	108.620	113.410		slimy	122.570	110.270	92.840
L.S.D	1.386			L.S.D	1.386			
Nano fertilizer combination	Salinity of irrigation water ds.m <sup>-1</sup>							
	1.7		5		10			
0	118.570		107.120		91.250			
1 ml + 0.5 gm	124.130		114.320		95.450			
1.5 ml + 1 gm	130.630		118.270		96.850			
L.S.D	1.697							
Variety	Nano fertilizer combination		Salinity of irrigation water ds.m <sup>-1</sup>					
Wonderful	0		1.7	5		10		
			120.600	110.300		92.030		
			126.830	117.500		97.600		
			131.530	120.800		98.930		
Slimy	0		1.7	5		10		
			116.530	103.930		90.470		
			121.430	111.130		93.300		
			129.730	115.730		94.770		
L.S.D	2.400							

## 5. Conclusions

The cultivar Wonderful outperformed the cultivar Salimi in all chemical traits. Irrigation with a salinity level of (1.7 decimens M-1) led to superiority in all studied traits, while the concentration (1.5 ml L-Optimus plus + 1 g L-1IQ combi) achieved the highest results. For the combination of nano-fertilizers

## 6. Recommendations

The possibility of cultivating the pomegranate variety Wonderful in highly saline soils (10 ds.m<sup>-1</sup>) with the use of a combination of nano-fertilizer (1.5 ml. L-1 Optimus plus + 1 gm-1 IQ combi).

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