# Effect of four Nano fertilizers in vegetative growth and mineral content of four potato (Solanum tuberosum L.) varieties.

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### Abstract

To investigate the response of four potato varieties (Arizona, Florice, Laperla, Montreal) to four Nano fertilizers Kind (K, B. Zn, Fe 2 gm. L.<sup>-1</sup>) with recommend dosage of NPK as well as the recommend dosage of NPK 20:20:20 at 600 Kg.ha<sup>-1</sup> as control a field experiment was conducted during spring season of 2020. Nano fertilizers were spraying at 2 gm. L.<sup>-1</sup> constriction three times in the season. The treatments were arranged in factorial experiment in split plot with in randomized complete block design with three replicates . The results showed that Florice variety gave the highest value of plant height (45.26 cm.), nitrogen percentage in leaves (3.816%) and phosphorus percentage in leaves (0.351%) and Montreal variety gave the highest value of leaf area (4347.7 cm<sup>2</sup>.) and dry matter% in vegetative growth (14.392%) while the highest value of chlorophyll content in the leaves (44.956 SPAD) and potassium percentage in leaves (2.624%) was from Laperla variety. The four types of Nano fertilizers showed a significant effect on plant height, number of stems per plant , leaf area, chlorophyll content, and dry matter% in vegetative growth compared to control treatment. Also the interaction treatments between varieties and Nano fertilizers types showed a significant effect on all studied parameters.

Key word : Potato, Nano fertilizers, leaf area, variety, Spraying.

### 1- Introduction:

Potato varieties is very important factor many researchers to increased the yield, study the effect of different cultivars on potato growth and yield. [1] studied three cultivars of potato Arizona, Agria and Riviera, Arizona achieved the highest values vegetative growth with significant in differences compared to the Rivier and Agria cultivars. [2] found that the variety Qamarin achieved the least days for field emergence of tubers and was significantly superior in the number of aerial stems and the percentage of dry matter in the shoots, while the variety Barcelona achieved the highest value of leaf area.

Other experiment study five cultivars of potatoes (Arnova - Arizona - Riviera-Burren -Sifra) confirmed that the Arizona variety achieved the best results in (number of aerial stems, leaf area of plant), while the Burren variety exceeded in plant height, chlorophyll

content of, and the percentage of dry matter in leaves [3].

Apart from macronutrient requirement, micronutrients play important role for growth development of potato crop. and As micronutrients, mainly zinc (Zn), boron(B), iron(Fe), manganese (Mn), are concerned with nutrient management of potato. Each of these micronutrients have specific role for the development of quality tuber[4].Although micronutrients are needed in trace amount, but many soils are incapable to supply them in adequate quantity for optimum yield. The use of high analysis NPK fertilizer, improved potato varieties, unavailability of organic manure and its application to potato field in low dose have altogether augmented the need to supply micronutrients in potato cultivation. Foliar spray of nutrients is considered as the most important agricultural practices that affects the growing period of plant foliage and tuber formation as well as quality of produced

yield[5,6]. Foliar application of micronutrient and macronutrient to plants is considered the most effective methods in correcting nutrient deficiency in plant as compare to soil application [7] .Nano fertilizers are important in increasing the efficiency of nutrients, having a higher yield, better quality, and safer environment. It reduces soil contamination as

**2-** . Materials and Methods :

To investigate the response of four potato cultivars (Arizona, Florice ,Laperla, Montreal ) to four Nano fertilizers kind at 2 gm. L. $^{-1}$  ( K 27%, B. Zn 12%, Fe 9%) with recommend dosage of NPK, as well as the recommend dosage of NPK 20:20:20 at 600 Kg.ha<sup>-1</sup> as control a field experiment was conducted during spring season of 2020. The four potato cultivars were sown on 26 February , sprouted seed tubers were planted at 25 cm apart within the row at drip irrigation system T- tap [9]. The Nano fertilizers were spraying at 2 gm. L.<sup>-1</sup> constriction three times, first one after 15 days of sprouting, the second after 20 days from the first, and the third after 20 days from the second. The treatments were arranged in factorial experiment in split plot with in randomized complete block design with three replicates . Iraq. The data were recorded on the following parameters: plant height (cm.), number of stems per plant., leaf area of plant (cm<sup>2</sup>), chlorophyll content (SPAD )in leaves,. dry matter in vegetative growth., N P K percentage in plant laves .The results were statistically analysis according to the statistical analysis system (SAS) and compared with the means by Duncan multiple rang test at 0.05 level [10].

**3-** Results :

Data in table (1) indicated a significant superiority of Florice variety in plant height than the other varieties ,as well as a significant superiority of spraying the four nano fertilizers over the comparison treatment and that the highest plant height (39.663 cm.) was from spraying K nano . The interaction well as potential adverse effects when conventional mineral fertilizers are applied [8].

The aim of this study was to investigate the response of vegetative growth and mineral content of four potato varieties to four types of Nano fertilizers

treatment between varieties and fertilization, showed that the highest plant height (48.667 cm.) was from the interaction between the Florice variety and spraying with B nano fertilize, and the lowest value (25.733 cm.) was from the interaction between Laperla and control.

From table (2) the data showed no significant differences between the four varieties in number of stems per plant . While a significant superiority of spraying the four nano fertilizers was found over the control treatment. . The interaction treatment

between varieties and fertilization, showed that the highest number of stems per plant (5.800) was from the interaction between the Arizona variety and spraying with F nano fertilizer. While the lowest number of stems per plant (2.933) was from the interaction treatment between Montreal variety and control.

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Varieties	Fertilizer T	Varieties Mean				
	Recomn. NPK (Control)	Recomn. NPK +NanoZn	Recomn. NPK +Nano Fe2g.	Recomn NPK +Nano B	Recomn. NPK +Nano K	
		2g. L <sup>-1</sup>	L-1	2g. L <sup>-1</sup>	2g. L <sup>-1</sup>	
Arizona	30.133	35.933	36.733	38.600	38.333	35.947
	d – f	c – e	b – e	b – d	b – e	B
Florice	38.533	46.933	45.067	48.667	47.133	45.267
	b – d	A	Ab	a	A	A
Laperla	25.733	31.800	30.467	31.333	32.533	30.373
	F	d – f	d – f	d – f	c – f	C
Montreal	29.800	38.133	40.400	37.667	40.533	37.307
	Ef	b – e	a – c	b – е	a – c	B
Fertilizer Treatments Mean	31.050 B	38.200 A	38.167 A	39.067 a	39.633 A	37.223

Table (1) effect of varieties and Nano- fertilizer treatments in plant height (cm.)

Table (2) effect of varieties and Nano- fertilizer treatments in number of stems per plant.

Varieties	Fertilizer T	Varieties Mean				
	Recomn. NPK	Recomn. NPK	Recomn. NPK	Recomn NPK	Recomn. NPK	
	(Control)	+NanoZn 2g. L <sup>-1</sup>	+Nano Fe2g. L <sup>-1</sup>	+Nano B 2g. L <sup>-1</sup>	+Nano K 2g. L <sup>-1</sup>	
Arizona	3.666	5.266	5.800	5.666	5.533	5.186
	b – e	A	A	a	A	A
Florice	3.600	5.266	5.400	4.800	5.400	4.893
	c – e	A	A	a – c	A	A
Laperla	3.466	5.000	5.400	4.933	4.600	4.680
	De	A	A	ab	a – d	A
Montreal	2.933	4.800	5.666	5.733	4.833	4.793
	E	a – c	A	a	a – c	A
Fertilizer Treatments Mean	3.416 B	5.083 A	5.566 A	5.283 a	5.091 A	4.888

Table (3) revealed that Montreal variety gave the highest leaf area ( $4347.7 \text{ cm}^2$ ) than the other varieties. Also a significant superiority of spraying the four nano fertilizers over the control treatment and the highest leaf area  $(4710.9 \text{ cm}^2)$  was from K nano fertilizer. The interaction treatments between varieties and fertilization, showed that the highest leaf area

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 $(5655.0 \text{ cm}^2)$  was from the interaction between the Montreal variety and spraying with K nano fertilizer. While the lowest leaf area (2921.0 cm<sup>2</sup>) was from the interaction treatment between Arizona variety and control.

Varieties	Fertilizer Treatments						
	Recomn. NPK	Recomn. NPK	Recomn. NPK	Recomn NPK	Recomn. NPK		
	(Control)	+NanoZn	+Nano Fe2g.	+Nano B	+Nano K		
		2g. L <sup>-1</sup>	L-1	2g. L <sup>-1</sup>	2g. L <sup>-1</sup>		
Arizona	2921.0	4866.3	4133.0	4168.3	4599.0	4137.5	
	J	Bc	c – g	b – g	b – e	ab	
Florice	3129.3	4995.0	4651.7	3747.7	4599.0	4224.5	
	Ij	Ab	b - d	f – i	b – e	ab	
Laperla	2993.0	4432.3	4555.3	3597.7	3990.7	3913.8	
	Ij	$\mathbf{b} - \mathbf{f}$	b - f	g — j	d - h	b	
Montreal	3240.0	4540.0	4509.7	3794.0	5655.0	4347.7	
	h - j	$\mathbf{b} - \mathbf{f}$	b - f	e – i	a	А	
Fertilizer Treatments Mean	3070.8 C	4708.4 A	4462.4 A	3826.9 B	4710.9 a	4155.8	

Table (3	) effect (	of varietie	s and Nano-	fertilizer	treatments	in leaf	area of	plant (c	$cm^2$ )
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Table (4) effect of varieties and Nano- fertilizer treatments in chlorophyll content (SPAD )in leaves.

Fertilizer Treatments						Varieties
Varieties						Mean
	Recomn.	Recomn.	Recomn.	Recomn	Recomn.	
	NPK	NPK	NPK	NPK	NPK	
	(Control)	+NanoZn	+Nano Fe2g.	+Nano B	+Nano K	
		2g. L <sup>-1</sup>	L-1	2g. L <sup>-1</sup>	2g. L <sup>-1</sup>	
Arizona	35.690	40.737	43.563	41.027	42.740	40.751
	Fg	c - f	a – d	b - f	a – e	В
Florice	33.957	43.920	46.320	45.673	44.950	42.964
	G	a – d	a – c	a – c	a – d	Ab
Laperla	38.743	43.283	48.890	47.850	46.013	44.956
	d – g	a – e	а	ab	a - c	А
Montreal	36.777	42.563	47.797	43.457	45.250	43.169
	e – g	a – e	ab	a – d	a – d	Ab
Fertilizer Treatments Mean	36.292 C	42.626 B	46.643 a	44.502 ab	44.738 ab	42.960

Table (4) revealed that Laperla variety gave the highest chlorophyll content (44.956). Also a significant superiority of spraying the four nano fertilizers was found over the control treatment and the highest chlorophyll content (46.643) was from Fe nano fertilizer. The interaction treatments between varieties and fertilization, showed that the highest value of chlorophyll content (48.890) was from the interaction between the Laperla variety and spraying with Fe nano fertilizer. While the lowest value of chlorophyll content (33.957) was from the interaction treatment between Florice variety and control.

Table (5) showed that Montreal variety gave the highest dry matter percentage (14.392%) with significantly superior than others varieties A significant superiority of spraying the four nano fertilizers was found over the control treatment and the highest dry matter value Table (5) effect of varieties and Nano- fertilizer (14.418%) was from Fe nano fertilizer. The interaction treatments between varieties and fertilization, showed that the highest dry matter value (15.816%) ) was from the interaction between the Montreal variety and spraying with Zn nano fertilizer.

Table (6) indicate, it was found that the highest percentage of nitrogen in laves 3.816%) was from Florice variety with significant superior than Montreal and Laperla varieties. On the other hand no differences between the spraying of the four nano fertilizers and control was found. The interaction treatment between varieties and fertilization, showed that the highest value of percentage (4.026) was from the nitrogen interaction between the Florice variety and control. While the lowest value (2.790) was the interaction treatment between from Montreal variety and control.

Table (5) effect of varieties and Nano- fertilizer treatments in percentage of dry matter in vegetative growth.

Varieties	Fertilizer Tı	Varieties Mean				
	Recomn. NPK	Recomn. NPK	Recomn. NPK	Recomn NPK	Recomn. NPK	
	(Control)	+NanoZn	+Nano Fe2g.	+Nano B	+Nano K	
		2g. L 1	$\Gamma_{-1}$	2g. L <sup>-1</sup>	2g. L <sup>-1</sup>	
Arizona	12.003	13.980	14.250	13.833	13.733	13.560
	Ef	a – e	a – d	a – e	b – e	В
Florice	12.243	13.676	13.870	13.056	14.343	13.438
	d - f	b – e	a – e	c – e	a – c	В
Laperla	10.963	13.723	14.243	14.350	14.413	13.238
	F	b – e	a – d	a – c	a – c	В
Montreal	10.866	15.816	15.310	15.093	14.873	14.392
	F	А	ab	a – c	a - c	А
Fertilizer Treatments Mean	11.519 B	14.299 A	14.418 a	14.083 A	14.340 A	13.732

Varieties	Fertilizer T	Varieties Mean				
	Recomn. NPK	Recomn. NPK	Recomn. NPK	Recomn NPK	Recomn. NPK	
	(Control)	+NanoZn 2g. L <sup>-1</sup>	+Nano Fe2g. L <sup>-1</sup>	+Nano B $2\alpha I^{-1}$	+Nano K 29 L <sup>-1</sup>	
Arizona	3.603	3.403	3.976	4.010	3.313	3.661
	a – c	a - c	a	a	a - c	Ab
Florice	4.140	3.893	3.603	4.026	3.420	3.816
	A	Ab	a – c	a	a - c	A
Laperla	3.336	3.860	3.213	3.590	2.946	3.389
	a – c	Bc	a – c	a – c	Bc	B
Montreal	2.790	2.833	2.830	2.883	3.283	2.924
	C	C	c	bc	a – c	C
Fertilizer Treatments Mean	3.467 A	3.497 A	3.405 a	3.627 a	3.240 A	3.447

Table (6) effect of varieties and Nano- fertilizer treatments in nitrogen percentage in plant laves .

Table (7) illustrated the effect of varieties and fertilizer treatments in phosphorus percentage in leaves, it was found that the highest percentage(0.351%) was from Florice variety with significant superior than Montreal variety only. On the other hand no differences between the spraying of the four nano fertilizers and control was found. The interaction treatment between varieties and fertilization, showed that the highest value of phosphorus percentage (0.396) was from the interaction between the Florice variety and control. While the lowest value (0.263) was from the interaction treatment between Arizona variety and control.

Table (8) illustrated the effect of varieties and fertilizer treatments in potassium percentage in , it was found that the highest leaves percentage(2.624%) was from Laperla variety with significant superior than Florice variety other hand only. On the the highest percentage of potassium (2.650%) Was from spraying K- nano fertilizer with significant superior than Fe an Zn-nano fertilizers . The interaction treatment between varieties and fertilization, showed that the highest value of potassium percentage (2.753) was from the interaction between the Arizona variety and control. While the lowest value (1.890) was from the interaction treatment between Arizona variety and Zn-nano fertilizer.

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Varieties	Fertilizer T	Varieties Mean				
	Recomn. NPK (Control)	Recomn. NPK +NanoZn	Recomn. NPK +Nano Fe2g.	Recomn NPK +Nano B	Recomn. NPK +Nano K	
		2g. L <sup>-1</sup>	L-1	2g. L <sup>-1</sup>	2g. L <sup>-1</sup>	
Arizona	0.263	0.363	0.340	0.363	0.320	0.330
	с	a – c	a – c	a – c	a – c	Ab
Florice	0.336	0.336	0.350	0.396	0.336	0.351
	a – c	a – c	a – c	а	a – c	А
Laperla	0.326	0.383	0.313	0.363	0.310	0.339
	a – c	Ab	a – c	a – c	a – c	Ab
Montreal	0.316	0.326	0.306	0.283	0.266	0.300
	a – c	a – c	a – c	bc	С	В
Fertilizer Treatments Mean	0.310 A	0.352 A	0.327 a	0.351 a	0.308 A	0.330

Table (7) effect of varieties and Nano- fertilizer treatments in phosphorus percentage in plant laves .

Table (8) effect of varieties and Nano- fertilizer treatments in potassium percentage in plant laves .

Varieties	Fertilizer T	Varieties Mean				
	Recomn. NPK	Recomn. NPK	Recomn. NPK	Recomn NPK	Recomn. NPK	ivican
	(Control)	+Nano Zn 2g. L <sup>-1</sup>	+Nano Fe2g. L <sup>-1</sup>	+Nano B 2g. L <sup>-1</sup>	+Nano K 2g. L <sup>-1</sup>	
Arizona	2.753	1.890	2.626	2.530	2.710	2.502
	a	C	a	a	a	Ab
Florice	2.366	2.640	2.103	2.490	2.623	2.444
	Ab	A	bc	a	a	B
Laperla	2.686	2.616	2.613	2.573	2.633	2.624
	a	A	a	a	a	A
Montreal	2.626	2.546	2.470	2.606	2.636	2.577
	a	a	a	a	A	Ab
Fertilizer Treatments Mean	2.608 Ab	2.243 B	2.453 b	2.550 ab	2.650 A	2.537

## . 4- Discussion

It was noted that there were significant differences between the varieties in vegetative growth and mineral content traits of potato . This may be due to genetic differences between the varieties caused by the variation in genetic factors responsible for vegetative growth traits . This results are in alignment with [4,5,6].

Also spraying of nano fertilizers on potato increasing significantly vegetative plants growth parameters, and this may be attributed to the roles of chelated nano-fertilizer applied by spray solutions in many physiological processes such as increasing the chlorophyll content in the leaves, which is necessary to increase the efficiency of photosynthesis and the formation of the amino acid (Tryptophan) that is necessary for cell elongation. These interpretations are consistent with the study of [11].

The effect of boron foliar application plays a role in increasing the biological processes and the synthesis of sugars in the plant. Boron plays active role in protein synthesis during seed and cell wall formation. Boron also helps in water and nutrient transportation from root to shoot [12] .The superiority of nano-fertilizers than the conventional fertilizers is attributed to their high surface area and slow-release that helps in the speed of absorption of nutrients and speed of penetration, synthesis, and movement [13] . This leads to an increase in growth rate and an increase in yield and its quality (protein and starch) by activating the photosynthesis process [14]

Zinc is involved in hormone biosynthesis, cytoplasm synthesis, activation and function of different enzymes, protein synthesis etc. [15]

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