EFFECT OF NANO AND CHEMICAL FERTILIZATION WITH NPK AND CHELATED ZINC ON VEGETATIVE GROWTH OF TAIFI AND KAMALI GRAPE CULTIVARS

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ABSTRACT

This research was performed during the 2021 seasons in private orchard located in Bara-Bhar-Duhok governorate to study the effect of soil application of chemical and Nano-NPK, foliar spray with chelated Nano-Zinc and their interaction on vegetative growth of Taifi and Kamali grape cultivars (*Vitis vinifera* L.). NPK (20:20:20) was added to the soil at five levels (0, 216 g.vine^{-1}, 324 g.vine^{-1} chemical NPK, 3.24 and 6.48 g.vine^{-1} Nano-NP) , chelated Nano-Zinc was added at three concentration (0, 100 and 200 mg.l^{-1}). The results showed the superiority of the Taifi cultivar in traits of number of leaves per vine, Single leaf Area and leaves dry weight over the Kamali cultivar, while Kamali cultivar was superiority in traits of leaf area per cluster ratio and total chlorophyll over the Taifi cultivar. Soil application of chemical and Nano-NPK and foliar application of Nano-zinc fertilizer achieved significant increase in vegetative growth (number of leaves, Single leaf Area, and total leaves area per vine, total chlorophyll and leaves dry weight) compare to control. Furthermore, combination among high concentration of Nano-NPK, Nano-zinc for Taifi and Kamali cultivars improved all parameters in comparison with the control.

Keywords: chemical, Nano- NPK, chelated Nano –zinc, Grapevines, vegetative growth.
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تاثير التسميد بسماد NPK النانوي والكيميائي والزنك المخلبي النانوي في صفات النمو الخضري لصنفي العنب الطائفي والكمالي

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المستخلص

تم اجراء هذا البحث خلال موسم 2021 في أحد البساتين الخاصة في محافظة دهوك لدراسة تأثير اضافة السماد المركب NPKالكيمياوي و النانوي والرش الورقي بالزنك المخلبي النانوي وتداخلاتها في النمو الخضري لصنفي العنب طائفي وكمالي (*Vitis vinifera* L.) . تمت اضافة السماد المركب (20:20:20) NPK الى التربة بخمسة مستويات وهي (0، 216 ، 342 غم.كرمة$^{-1}$ NPKكيمياوي، 3.24 و 6.48 غم .كرمة$^{-1}$ NPK نانوي). وتم الرش الورقي بالزنك المخلبي النانوي بثلاث مستويات (0، 100 ،200 ملغم .لتر$^{-1}$). اظهرت النتائج تفوق الصنف الطائفي في صفة عدد الاوراق لكل كرمة ، المساحة الورقية للكرمة والوزن الجاف للأوراق على الصنف كمالي، بينما تفوق الصنف كمالي في صفة مساحة الورقة الواحدة ، المساحة الورقية للعنقود ونسبة الكلوروفيل الكلي على الصنف طائفي حققت الاضافة الارضية لسماد NPK الكيميائي والنانوي والتسميد الورقي بالزنك المخلبي النانوي زيادة معنوية في النمو الخضري (عدد الاوراق ، مساحة الورقة الواحدة ،المساحة الورقية الكلية للكرمة، الكلوروفيل الكلي والوزن الجاف للأوراق) مقارنة مع معاملة الكونترول (بدون اضافة). علاوة على ذلك، فان الجمع بين التركيز العالي من Nano– NPK و Nano–Zinc مع صنفي العنب طائفي وكمالي ادى الى تحسين جميع الصفات مقارنة مع الكونترول

الكلمات الافتتاحية: كيميائي، نانوي، NPK، زنك نانوي مخلبي، كرمة، نموخضري
البحث جزء من اطروحة دكتوراه للباحث الاول

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INREODUCTION

The grape (*Vitis vinifera* L.) is an important and economic proposition for the farmers among the horticultural crops grown worldwide. It is one of the oldest plants known to man and grows in virtually every country in the world (9). Grapes were first cultivated in Caucasia about 6000 B.C. according to Avdiev (6). Grape is among the first fruit species to be domesticated and remain the world's most economically important fruit crop, mainly due to that is added during postharvest processing (15). There are more than 100 cultivars of grapes grown in Iraq including dessert grapes, varieties that are used as table grape or may be dried to give currants and raisin and varieties that can be used for the production of juice and wine. We have the land suitable for these grapes yet regrettably we are heavily dependent on neighboring countries for grapes and their products, as a result of the Insert of new varieties by the agricultural circles and by some growers, the number of cultivars has increased to more than 100 cultivars (9,6). A great number of different grape varieties are found in Iraq among them are Taifi and Kamali, Taifi variety is planted in nearly all Iraqi governorates, especially in the irrigated areas. It is also planted in rain-fed areas with deep and wet soils. Its origin is Saudi Arabia, and it is an old variety known in several areas of the world. It is considered to be a good table grape. The pruning practice is to leave a number of fruiting canes with 6-8 buds (eyes) with 2-3 renewal spurs, and will respond to T-shaped training. The inflorescence of this variety is hermaphroditic and it is a good pollinator for the pistillate varieties (6). Kamali is one of the local Iraqi grape varieties, a result of natural mutation from the Taifi–red variety. It is widely planted in central Iraq and in irrigated vineyards in nearly all Iraqi governorates. This variety is considered to be the best table grape, with excellent commercial properties. The variety needs pollinators because of its inflorescence, which is pistillate type. When pruning it is recommended to leave 12 buds per cane (eyes) with a renewal spur (9). Fertilization is one of the most promising tools to increase production. Mineral nutrition is one of the main tools to optimize fruit yield and quality (22). Nanotechnology has become a new method for the development and application of new types of fertilizers. The Nano term is from the Greek word meaning many small Particles which have at least one dimension less than hundred (nm) are known as Nano-particles (24). Most of the researchers are giving their priority to make enhanced fertilizers using nanotechnology in different ways. The urgency of such research is now increasing due to the need for sustainable agriculture around the globe (21). Nowadays, the use of fertilizers containing NPK is crucial for the improvement of harvest yield and fruit quality supplying vital nutrients for plant development (20). The supplies of the mineral nutrients affect various aspects of vine growth and development and also enhance better quality production of the fruit. Besides grapes is also considered as a heavy feeder of mineral nutrients, particularly that of macronutrients (Nitrogen, Phosphorus and Potassium). Nutrient deficiency in grapes leads to reduced growth, yield as well as quality of the produce (15, 16). (2) Found that Superior grapevines grown under Minia region conditions were fertilized with NPK via Nano technology versus normal NPK during 2016 and 2017 seasons. The vines received Nano NPK at 10, 14 and 40 g / vine and normal NPK at 60, 84 and 240 g/ vine, respectively. Yield and berries characteristics were improved by using all NPK fertilizers either alone or in combinations via Nano or normal methods. Using these fertilizers via Nano was materially preferable than using them via normal method. For promoting yield and berries quality of Superior, grapevines grown under Minia region conditions, it is suggested to use NPK via Nano system at 10, 14 and 40 g / vine, respectively. Zinc (Zn) is the only metal found in all six enzyme classes, viz. oxidoreductases, lyases, isomerases, transferases, hydrolases and ligases (11). Zinc being essential micronutrient plays an important role in many integral metabolic processes (17). Zn can also help increase the biosynthesis of chlorophylls and carotenoids and enhance the photosynthetic apparatus of the plant (10), many crops reveals positive effects by using zinc directly or natural extracts have naturally occurring zinc (5, 8, 19) Spraying grapevines

with zinc Nano-particles (NPs) help to release the required nutrients gradually in small amounts and improve the spraying efficiency of zinc than the sulphate or chelated forms, also using Nano form reduces the problems of soil pollution caused by the excess use of chemical fertilizers (18).(18) showed that spraying flame seedless grape vines with 565 ppm zinc sulfate, chelated zinc 140 ppm and Nano zinc in three concentrations: 0.4, 0.8, and 1.2 ppm, spraying at a concentration of 0.4 ppm of Nano fertilizer led to a significant increase in leaf area, leaves fresh and dry weight, leaf content of mineral elements iron, zinc, total carbohydrates, compared with other fertilizers used in this research. This study aims to determine the role of Nano-fertilization with NPK and foliar fertilization with chelated Nano-zinc, individually or in combination, in vegetative growth of the two cultivars of grapes, Taifi and Kamal. Given the lack of studies in the use of Nano fertilization techniques, especially on the Taifi and Kamali cultivars, in vineyards, especially in Iraq, we had this research plan to do this study.

MATERIALS AND METHODS

This study was carried out in a private vineyard situated at Bara-Buhar village, Duhok governorate, Kurdistan region, Iraq, during 2021 growing season to investigate the effect of soil application of chemical and Nano-NPK, foliar sprays with chelated Nano-Zinc and their interaction on vegetative growth of Taifi and Kamali grape cultivars, 15 years old. NPK fertilizer (20:20:20) was added to the soil at five levels (0, 216 g.vine-1, 324 g.vine^{-1} chemical NPK, 3.24 and 6.48 g.vine^{-1}, Nano-NPK) and Chelated Nano-Zinc as foliar application at three concentrations (0, 100 and 200 mg.l^{-1}). Mineral fertilizer NPK was added to the soil once during the season, while the Nano NPK fertilizer was added twice per season. The first addition was in 13/4/2021, when the vines began to grow. The second addition was on 24/5/2021. Whereas chelated Nano-Zinc was sprayed three times per season, the first was when the shoot length reaches 10-15 cm in 15/4/2021; the second was in 27/4/2021 before flowering for the vines, the third and final spraying took place in 31/5/ 2021. Tween 20 (as wetting agent) was applied at 0.1% to all spray solutions and the vines were sprayed till runoff. The vines with T-trained of Taifi and Kamali grapevines were taken in this study were chosen to be uniform as possible in vigour, and were planted at 1.8 × 3m apart. Pruning was done in second week of March by leaving 48 buds per vine (6 canes per vines each with 8 eyes plus 4 renewals spur each with 2 eyes for both cultivars. The vines were irrigated with drip irrigated system. All grapevines under taken in this study were receiving the regular agricultural and horticultural practices that usually carried out in the fruit orchards.

Statistical analysis

the experiment is consist of thirty treatments (five levels of NPK, three conc. of chelated Nano-Zinc × 2 cultivars), with three replication, with one individual grapevine for each experiment unit and applied as sub-sub plot design in factorial experiment by using (RCBD) design, observation on different growth parameters were recorded at the end of experiment. Duncan Multiple Range Test was used for the comparison of treatment means at 5% level (7)**.** All the data were tabulated and statistically analyzed with computer using SAS system 2000.

RESULTS AND DISCUSSION

1- Number of leaves. Vine^{-1}

Data in table (1) clearly show the maximum number of leaves.vine^{-1} (2580.6) was corded for Taifi cv. compare with the minimum number of leaves.vine^{-1} (2346.77) were recorded for Kamali cv. It's evident from the data in same table that numbers of leaves.vine^{-1} were affected by adding (6.48 g.vine^{-1}) of Nano-NPK which provided the maximum number of leaves.vine^{-1} (2962. 3) compare with the lowest number of leaves.vine^{-1} (1776.49) in control treatment. Spraying with Nano-chelated zinc was significantly improved the number of leaves.vine^{-1} (Table 1). The maximum numbers of leaves.vine-1 (2640.20) were obtained by spraying 200 mg.l^{-1} zinc compared with the lowest number of leaves.vine^{-1} (2290.8) in control treatment. The application of Nano-NPK+ Zinc concentrations on the two cultivars combination were significantly increased the number of leaves.vine^{-1}, table (1) refer that highest number of leaves (3115.6 leaves.vine^{-1}) was obtained with combination among the

Taifi cv., soil application of 6.48 g.vine^{-1} Nano-NPK and 200 mg.l^{-1} of Nano-chelated zinc compared with the lowest No. of leaves.vine^{-1} (1600) obtained with the interaction of Taifi cv. + Zero NPK+ Zero mg.l^{-1} Zinc.

Table 1. effect of Fertilization with NPK and chelated Zinc on number of leaves per vine of Taifi nd Kamali Grape cultivars (*Vitis vinifera* L).

cultivars	NPK (mg.L^{-1})	Zinc (mg.l^{-1}) 0	100	200	CV. × NPK	Mean Effect of cultivar
Taifi	0	1600 h	1803 gh	2103 e-h	1835.3 de	2580.6 a
	NPK20	2108 e-h	2446 b-f	2782.6 ab	2445.5 bc	
	NPK30	2743 abc	2828.3 ab	2995 a	2855.4 a	
	NPK Nano6	2390 b-f	3017.3 a	3050.6 a	2819.3 ab	
	NPK Nano12	2810.6 ab	2915.6 ab	3115.6 a	2947.3 a	
Kamali	0	1662.3 h	1716 gh	1774.6 gh	1717.6 e	2364.8 b
	NPK20	1999.0 fgh	2134.8 e-h	2222.8 c-g	2118.9 cd	
	NPK30	2202.3 d-g	2247.5 c-g	2423.5 b-f	2291.1 c	
	NPK Nano 6	2596 a-e	2706.8 a-d	2853.5 ab	2718.80 ab	
	NPK Nano12	2796.6 ab	3054.4 a	3080.8 a	2977.3 a	
cv. x Zink	Taifi	2330.3 c	2602.0 b	2809.4 a	Main	
	kamali	2251.2 c	2371.9 c	2471.0 bc	effect of NPK	
NPK × Zinc	0	1631.1 h	1759.5 gh	1938.8 gh	1776.4 d	
	NPK20	2053.5 fg	2290.4 ef	2502.7 cde	2282.2 c	
	NPK30	2472.6 de	2537.9 cde	2709.2 bcd	2573.2 b	
	NPK Nano6	2493 de	2862.1 abc	2952.1 ab	2769.07 ab	
	PK Nano12	2803.6 a-d	2985.0 ab	3098.2 a	2962.3 a	
Mean effect of Zinc		2290.8 c	2487.0 b	2640.2 a		

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level

2- Single leaf area (cm^2)

Data in table (2) indicated that leaf area was noticeably increased due to cultivars, the high leaf area obtained in Kamali cultivar (147.7cm^2.leaf^{-1}) which significant surpass on Taifi cultivar (125.1cm^2.leaf^{-1}) The result in the same table indicated adding 6.48 g.vine^{-1} of Nano-NPK fertilizer resulted in maximum significant leaf area (141.51cm^2.leaf^{-1}) compared with control treatment which recorded the lowest values of leaf area (131.61cm2.leaf^{-1}). For the Foliar application of Nano-Zinc fertilizer, the results showed the treatment of 200 mg.l^{-1} was exceeded and reached (140.9 cm^2.leaf^{-1}) over the control treatment that reached (127.42 cm^2.leaf^{-1}). The results in table (2) also showed that there were significant differences between all interactions of factors especially in the triple interference on the treatment of adding, the maximum leaf area was resulted from the interaction among soil application of 3.24 g.vine^{-1} Nano NPK and foliar application of 200mg.L^{-1} Nano zinc on Kamali cultivar.

Table 2. effect of Fertilization with NPK and chelated zinc single leaf area (cm^2) of Taifi and Kamali Grape cultivars (*Vitis vinifera* L.)

cultivars	NPK ($mg.L^{-1}$)	Zinc ($mg.l^{-1}$) 0	100	200	cv. × NPK	Mean Effect of cultivar
Taifi	0	104.6 n	121.7 jkl	129.1 i	118.5 g	125.1 b
	NPK20	121.1 kl	129.2 i	138.0 efg	129.5 e	
	NPK30	125.0 j	135.3 gh	121.5 kl	127.2 f	
	NPK Nano6	116.3 m	118.4 lm	120.0 kl	118.2 g	
	NPK Nano12	122.9 jk	132.3 hi	140.3 ef	131.8 d	
Kamali	0	131.9 hi	157.3 b	144.7 d	144.6 b	147.7 a
	NPK20	137.2 efg	151.7 c	136.9 fg	141.9 c	
	NPK30	138.2 efg	157.5 b	152.6 c	149.4 a	
	NPK Nano 6	135.9 g	153.8 c	163.7 a	151.2 a	
	NPK ano12	140.5 e	150.8 c	162.0 a	151.1 a	
cv x Zink	Taifi	118.0 f	127.4 e	129.8 d	Main effect of NPK	
	Kamali	136.8 c	154.2 a	152.0 b		
NPK × Zinc	0	118.3 i	139.5 cd	136.9 e	131.6 d	
	NPK20	129.2 g	140.4 c	137.5 de	135.7 c	
	NPK30	131.6 f	146.4 b	137.0 e	138.3 b	
	NPK Nano6	126.1 h	136.1 e	141.8 c	134.7 c	
	NPK Nano12	131.7 f	141.6 c	151.2 a	141.5 a	
Mean effect of Zinc		127.4 b	140.8 a	140.9 a		

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level

3-Total leaves area per vine (m^2)

In Table (3) the results indicate that there are no significant differences between the varieties in the characteristic of the total leaves area of the vine. As for the effect of the fertilization treatment with NPK fertilizer data in same table shows that the maximum total leaves area was recorded by adding ($6.48g.vine^{-1}$) of Nano-NPK gave 39.99 $m^2.vine^{-1}$ a leaves area. Spraying with chelated zinc 200 $mg.l^{-1}$ gave the highest values for the leaves area of the vine, which amounted to 35.49 $m^2.vine^{-1}$. As for the triple interaction between the cultivars, the fertilization with NPK and foliar spraying with chelated zinc, the results showed that the fertilization with Nano- NPK fertilizer $6.48g/vine^{-1}$ + spraying with 200 mg/l^{-1} with chelated zinc for the Kamali cv. was superior to the most treatments 45.39 $m^2.vine^{-1}$, while the control treatment recorded the lowest value of this character 16.73 $m^2.vine^{-1}$.

Table 3. effect of Fertilization with NPK and chelated zinc total leaf area (m^2) of Taifi and Kamali Grape cultivars (*Vitis vinifera* L.)

cultivars	NPK ($mg.L^{-1}$)	Zinc ($mg.l^{-1}$) 0	100	200	CV. × NPK	Mean Effect of cultivar
Taifi	0	16.73 m	21.92 klm	27.16 g-k	21.94 f	32.50 a
	NPK20	25.54 h-l	31.61 d-i	38.51 a-d	31.89 cd	
	NPK30	34.30 d-g	38.27 bcd	36.38 cde	36.32 abc	
	NPK Nano6	27.82 f-k	35.75 cde	36.62 cde	33.40 bc	
	NPK Nano12	34.55 def	38.54 a-d	43.73 ab	38.94 a	
Kamali	0	19.94 lm	24.54 i-l	23.35 j-m	22.61 ef	31.93 a
	NPK20	24.89 i-l	29.44 e-j	27.71 f-k	27.35 de	
	NPK30	27.68 f-k	32.23 d-h	33.61 d-g	31.17 cd	
	NPK Nano 6	32.08 d-h	37.85 bcd	42.42 abc	37.45 ab	
	NPK Nano12	35.80 cde	41.91 abc	45.39 a	41.03 a	
cv. x Zink	Taifi	27.79 c	33.22 b	36.48 a	Main effect of NPK	
	Kamali	28.08 c	33.19 b	34.49 ab		
NPK × Zinc	0	18.33 h	23.23 g	25.25 g	22.27 d	
	NPK20	25.22 g	30.53 ef	33.11 def	29.62 c	
	NPK30	30.99 ef	35.25 cde	35.00 cde	33.75 b	
	NPK Nano6	29.95 f	36.80 bcd	39.52 bc	35.42 b	
	NPK Nano12	35.17 cde	40.22 b	44.56 a	39.99 a	
Mean effect of Zinc		27.93 c	33.21 b	35.49 a		

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level

4- Leaf area per cluster (cm^2):

The results in Table (4) indicated that Kamali var. was significantly superior to the Taifi var. in the leaf area per cluster, which reached 11213.0 cm^2. The addition of NPK fertilizers showed that control treatment gave the significantly superior of leaf area per cluster, while addition of 20 kg of NPK gave the lowest value of this parameter. While the foliar spray with 200 $mg.l^{-1}$ of Nano-chelated zinc gave the highest values 11267.0 cm^2 .$cluster^{-1}$ of leaf area per cluster compared with 0 and 100 $mg.l^{-1}$ of Nano-chelated zinc . Addition of 30 kg NPK + spraying with zero $mg.l^{-1}$ of zinc for Taifi cv. caused a significant increase of leaf area per cluster compared with most treatments , while addition of 20 kg of NPK + spraying with 200 $mg.l^{-1}$ of zinc for Taifi cv. caused the lowest value of leaf area per cluster.

Table 4. effect of Fertilization with NPK and chelated zinc on leaf area per cluster of Taifi and Kamali Grape cultivars (*Vitis vinifera* L.)

cultivars	NPK ($mg.L^{-1}$)	Zinc ($mg.L^{-1}$) 0	100	200	CV. × NPK	Mean Effect of cultivar
Taifi	0	9391.6 hij	8001.6 kl	12452.4 cd	9948.5 e	10379.6 b
	NPK20	7689.8 kl	10324.5 fgh	6988.4 l	8334.2 f	
	NPK30	16054.5 a	10264.4 fgh	8122.6 kl	11480.5 bcd	
	NPK Nano6	11295.4 ef	10278.5 fgh	8148.0 k	9907.3 e	
	NPK Nano12	15738.4 a	9798.4 gh	11144.8 ef	12227.2 ab	
Kamali	0	12481.1 cd	13541.3 bc	11772.6 de	12598.3 a	11213.0 a
	NPK20	10123.4 fgh	10949.6 efg	13766.4 b	11613.1 bc	
	NPK30	7523.6 kl	11531.4 de	13387.8 bc	10814.3 d	
	NPK Nano 6	9701.4 hi	9365.2 hij	15057.3 a	11374.7 cd	
	NPK Nano12	8602.6 ijk	8560.4 jk	11829.3 de	9664.1 e	
cv. x Zink	Taifi	12033.9 b	9733.5 d	9371.2 d	Main effect of NPK	
	Kamali	9686.4 d	10789.6 c	13162.7 a		
NPK × Zinc	0	10936.3 bcd	10771.4 cd	12112.5 a	11273.4 a	
	NPK20	8906.6 g	10637.0 d	10377.4 de	9973.7 c	
	NPK30	11789.0 a	10897.9 bcd	10755.2 cd	11147.4 ab	
	NPK Nano6	10498.4 de	9821.9 ef	11602.7 ab	10641.0 b	
	NPK Nano12	12170.5 a	9179.4 fg	11487.1 abc	10945.7 ab	
Mean effect of Zinc		10860.2 b	10261.5 c	11267.0 a		

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level

5- Total chlorophyll (mg. g F.W)

The results presented in table 5 showed that Kamali cultivar was superiors significantly on Taifi var. in the total chlorophyll content of leaves, which reached 1.69 mg. g F.W. However, fertilization with nano –NPK 6.48 and 3.24 $g.vine^{-1}$ gave the highest value of chlorophyll content 1.65 and1.64 mg. g F.W respectively, which surpassed significantly compared with addition of 0 NPK . The lowest value of chlorophyll content was 1.43 mg. g. F.W obtained from control treatment .Foliar application of 200 $mg.l^{-1}$ Nano-chelated zinc was a significant increase in leaf chlorophyll content gave the highest significant value 1.64 mg. g F.W compared to the lowest value of chlorophyll content in showed in control treatment 1.49 mg. g F.W. Regarding the interactions between all factors, the results showed that combination between fertilization with nano-NPK 6.48 $g.vine^{-1}$ + spraying with 200 $mg.l^{-1}$ Nano- chelated Zinc with Kamali cv. reached 1.90 mg. g F.W and gave the highest content of chlorophyll compared with control treatment ,which gave the lowest value 1.23 mg. g F.W.

Table 5. effect of Fertilization with NPK and chelated zinc on total chlorophyll of Taifi and Kamali Grape cultivars (*Vitis vinifera* L.)

cultivars	NPK (mg.L^{-1})	Zinc (mg.L^{-1}) 0	100	200	CV. × NPK	Mean Effect of cultivar
Taifi	0	1.23 m	1.37 l	1.39 l	1.33 e	1.47 b
	NPK20	1.42 kl	1.51 h-k	1.51 h-k	1.48 d	
	NPK30	1.45 i-l	1.49 ijk	1.53 g-j	1.49 d	
	NPK Nano6	1.51 h-k	1.54 ghi	1.6 fgh	1.55 cd	
	NPK Nano12	1.44 jkl	1.51 h-k	1.53 g-j	1.49 d	
Kamali	0	1.43 kl	1.6 fgh	1.6 fgh	1.54 cd	1.69 a
	NPK20	1.51 h-k	1.64 def	1.71 cde	1.62 c	
	NPK30	1.61 fg	1.7 cde	1.84 ab	1.71 b	
	NPK Nano 6	1.63 ef	1.76 bc	1.83 ab	1.74 ab	
	NPK Nano12	1.72 cd	1.81 b	1.90 a	1.81 a	
cv. x Zink	Taifi	1.41 e	1.48 d	1.51 d	Main effect of NPK	
	Kamali	1.58 c	1.70 b	1.77 a		
NPK × Zinc	0	1.33 i	1.48 gh	1.49 gh	1.43 c	
	NPK20	1.46 h	1.57 ef	1.61 cde	1.55 b	
	NPK30	1.53 fg	1.59 de	1.68 ab	1.60 ab	
	NPK Nano6	1.57 ef	1.65 bcd	1.71 a	1.64 a	
	NPK Nano12	1.58 ef	1.66 abc	1.71 a	1.65 a	
Mean effect of Zinc		1.49 c	1.59 b	1.64 a		

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level

6- Leaf dry weight (g.leaf $^{-1}$)

The data presented in Table 6 showed that Taifi cv. was superior in the leaf dry weight compared of Kamali cv. . Data in the same Table shows that leaf dry weight of addition (6.48g.vine^{-1}) of Nano-NPK was significantly superior to other treatments. Spraying with 100 mg.l^{-1} of zinc caused a significant increase in leaf dry weight Compared with other treatments.The analysis of variance of leaf dry weight (Table 6) showed the effect interaction of all factors. It was shown that the highest value of leaf dry weight at the vines fertilization with 30 kg NPK + spraying 100 mg.l^{-1} zinc of Kamili cv. 3353g. were significantly superior to the most treatments .While the vines fertilization with 30 kg NPK + spraying 0 mg.l^{-1} zinc of Kamali cv. gave the lowest value in leaf dry weight 1578.1g.

Table 6. effect of Fertilization with NPK and chelated zinc on Leaf dry weight of Taifi and Kamali Grape cultivars (*Vitis vinifera* L.)

cultivars	NPK (mg.L^{-1})	Zinc (mg.L^{-1}) 0	100	200	CV. × NPK	Mean Effect of cultivar
Taifi	0	2477.8 d-g	2568.3 c-f	2326.7 fg	2457.6 bc	2712.4 a
	NPK20	2454.1 d-g	2874.8 a-e	2298.6 fg	2542.5 bc	
	NPK30	3229.3 ab	2940.7 a-d	2301.2 fg	2823.8 a	
	NPK Nano6	2845.9 b-e	3251.9 ab	2552.3 c-f	2883.3 a	
	NPK Nano12	3124.6 ab	2880.0 a-e	2559.7 c-f	2854.8 a	
Kamali	0	2027.4 g	2372.5 efg	2573.1 c-f	2324.3 c	2550.2 b
	NPK20	2114.1 fg	2585.1 c-f	2851.8 a-e	2517.0 bc	
	NPK30	1578.1 h	3353 a	3032.4 abc	2654.5 ab	
	NPK Nano 6	2092.8 fg	2479.8 d-g	3040.3 abc	2537.6 bc	
	NPK Nano12	2413.1 efg	2512.0 d-g	3227.1 ab	2717.4 ab	
cv. x Zink	Taifi	2826.4 ab	2903.1 a	2407.7 c	Main effect of NPK	
	Kamali	2045.1 d	2660.5 b	2944.9 a		
NPK × Zinc	0	2252.6 e	2470.4 cde	2449.9 cde	2391.0 b	
	NPK20	2284.1 e	2730.0 bcd	2575.2 b-e	2529.8 b	
	NPK30	2403.7 de	3146.8 a	2666.8 bcd	2739.1 a	
	NPK Nano6	2469.4 cde	2865.8 ab	2796.3 bc	2710.5 a	
	NPK Nano12	2768.9 bc	2696.0 bcd	2893.4 ab	2786.1 a	
Mean effect of Zinc		2435.7 b	2781.8 a	2676.3 a		

Means with the same letter are not significantly different according to Duncan multiple ranges test at 5% level

It's clear from the tables 1-6 that soil application of NPK fertilizer in both forms chemical or Nano especially the Nano form of NPK had significant effect on improving vegetative growth traits of grapevine compare to untreated, this effect may be due to role of N, P and K in increasing spread and dissolution of nutrients and thus their availability to the plant which causes an increase in photosynthesis (23). Likewise, the role of the nitrogen component is to increase the efficiency of the plant to carry out the process of photosynthesis in conjunction with the element phosphorus. The nitrogen component also stimulates the production of Auxin, which encourages cell division and elongation of cells, as well as the role of potassium that controls the process of opening and closing the stomata through the osmotic regulation of plant cells (13). The superiority of Nano NPK over the chemical NPK may be attributed to the Nanotechnology has provided the feasibility of exploiting Nano-scale or nanostructured materials as fertilizers carry or controlled–release vectors for the building of so-called smart fertilizer as new facilities to enhance nutrient use efficiency (1,3). Nano chelated Zinc also caused significant improving in vegetative growth traits of grapevine compare to untreated, theses may be due to that zinc is essential for both enzymes and chlorophyll synthesis, accordingly, since it increase net photosynthetic rate which lead to increase vegetative growth traits (4), also Nano Zn particles could be beneficial for spraying grapevines, reduced the amounts of zinc needed for grape fertilizer and mitigated the problems of soil pollution caused by the excess use of chemical fertilizers (18). The previous tables also shows that the Taifi cultivar was superior to the cultivar Kamali in some traits of vegetative growth, while the cultivar Kamali was superior in other characteristics, and this difference in the characteristics of vegetative growth between the two cultivars is due to the difference in the genetic characteristics of them. The previous tables show that the cultivar was superior to the cultivar Kamali in some traits of vegetative growth, while the cultivar Kamali was superior in other traits

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