



Effect of Humic Acid and NPK Nanocomposite on the Chemical Content of Fronds of Three Cultivars of Young Palm Trees *Phoenix Dactylifera L.*

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Abstract

To investigate the impact of adding organic acid (humic acid) and spraying, the experiment was carried out in the palm grove at the Agricultural Research and Experiment Station at the Sayada site of the College of Agriculture/University of Kirkuk/Republic of Iraq from 6/15/2022 to 4/15/2023. Three different types of date palms received the NPK compound fertilizer treatment. Al-Khastawi, Al-Khaddrawy, and the yellow Shwathi. Three replications of the factorial experiment were conducted using the RCBD and split plot designs, respectively. Duncan's multiple limit test was used to assess the data at the probability level (0.05). The interaction treatment between the treatment and the treated variety T5V2 (NPK nanocomposite fertilizer and the Khestawi variety) was superior in the percentage of the wicker content of carbohydrates, nitrogen, and chlorophyll, reaching (8.19%), 2.02% 30.33 mg gm⁻¹ fresh weight) respectively. The concentration of (1.5 g liter⁻¹) of NPK nanocomposite fertilizer (T5) affected all the studied chemical properties. The yellow Shuwathi cultivar outperformed the Khastawi and Khadrawi cultivars in the treatment of T5V1 (nano compound fertilizer NPK). The percentage of phosphorus and potassium in the vine reached (0.97, 0.91%), respectively. Wicker's potassium content as a percentage reached 0.74%.

Keywords: humic acid, NPK nanoparticles, the yellow Shwathi cultivar, al-Khastawi, al-Khaddawi

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Introduction

The date palm, one of the most significant monocotyledonous trees, is the most significant member of the arecaceae family, which is part of the order Palme and which Phoenix dactylifera L. belongs to. The date palm is one of the oldest fruit plants known to man and is found in the Mesopotamian and Nile valleys. It is a blessed tree that is mentioned twenty times in all the heavenly books in the Holy Qur'an. [2] [1] Date palm agriculture is becoming increasingly significant in the Arab world as a source of export and food. Along with other natural resources like crude oil and other resources, the date palm is a significant natural resource in Iraq, alongside additional natural resources like crude oil and others. Due to wars and the high saline levels in some of the areas where palm trees were planted, date palms have returned to our country after more than ten years. [3] Because it includes high amounts of nutrients and enhances the physical and chemical characteristics of the soil, humic acid is an organic fertilizer that is essential to promoting plant growth. It is regarded as secure in terms of the environment, because it prevents pollution of the soil, water, or air [4] The activity of soil microorganisms is significantly increased by humic acid [5]. Because nanomaterials produce properties different from those of materials when they have traditional dimensions of more than 100 nanometers, nanotechnology or nanoscience is thought to be one of the contemporary sciences that deals with the study of material processing on the atomic scale 10^{-9} of a meter [6]. and nano fertilizers have unique characteristics that set them apart, due to their tiny size and large surface area, which together act to improve the absorption surface, they became increasingly desirable and widely employed. As a result, the plant produces more active molecules and the process of photosynthesis accelerates [7]. Chemical fertilizers, especially compound

fertilizers, are necessary for the palm tree because they contain the three major mineral elements that the plant needs in large amounts for healthy growth, increased yield, and higher-quality fruits: nitrogen, phosphorus, and potassium, to achieve healthy development, boost production, and enhance the quality of its fruits [8].

By adding humic acid and nanocomposite fertilizer NPK, it may be possible to improve the chemical composition of the young trees of three varieties of palm trees grown in Kirkuk Governorate. The research aims to identify the ideal concentration of each type of organic fertilizer and nanocomposite fertilizer as well as the interactions that result in improved chemical composition in the trees Boys for three varieties of palm.

Materials and methods

The experiment was carried out in the palm orchard at the Agricultural Research and Experiments Station at the Fishery Site of the Faculty of Agriculture/University of Kirkuk/Republic of Iraq, during the seasons 2022–2023 and from 15 June 2022 to 15 April 2023. The work experiment was carried out in accordance with the Split plan Reformulation the sentence in order to investigate the effects of organic acid addition (Hiomic acid) and nanostructured NPK fertilizer spraying on three variety Al-Khastawi, Al-Khaddrawy, and the yellow Shwathi. 45 young palms were found throughout the search. 15 palms were selected from each category. The number of transactions ($5 * 3 = 15$) was treated, 3 bis, and each experimental unit represented one tree. The number of trees was $3 * 3 * 5 = 45$ homogeneous trees in terms of growth and size as possible, the field was prepped and agricultural service activities were performed. To manage agricultural pests (insects and fungus diseases).

Factors considered in the experiment

1- The first factor: fertilized transactions (humic acid and nanoscale compound NPK), the concentrations of which were as follows:

Zero gm Tree⁻¹, comparison treatment, symbolized as T1, adding 20 gm Tree⁻¹ of humic acid, symbolizing T2, adding 40 gm Tree⁻¹ of humic acid, symbolizing T3, and spraying with NPK nanocomposite at a concentration of 1 g L⁻¹, symbolizing T4, and spraying with the NPK nanocomposite at a concentration of 1.5 gm L⁻¹ and symbolizes it as T5.

2- The second factor: three varieties of young palm trees as follows:

- Al Shuwathi yellow variety, symbolized by V1
- Al-Khastawi variety, denoted by V2
- Al-Khadrawi variety, denoted by V3.

Studied Traits

1- Estimate the percentage of carbohydrates in the wicker.

2- Percentage of nitrogen in palms.

3- Percentage of potassium in palms.

4- Percentage of phosphorus in palms.

5- Estimate the content of chlorophyll in laboratory wicker (leaves)

Determination of carbohydrates and macronutrients (NPK) in fronds:(%)

It was assessed in the Graduate Studies Laboratory at the University of Kirkuk's College of Agriculture. Samples were taken from the middle leaves (khus) from different locations of the fronds, and dried in a temperature of 65 °C + 5 °C for 72 hours until the weight stabilized. The dry samples were ground well and taken. (0.2 g) of each experimental unit of the plant sample, to which (4 ml) of sulfuric acid concentration (H₂SO₄) and (1 ml) of concentrated perchloric acid (HClO₄) were added to it and The samples were put in bottles with a capacity of (50 ml), and the volume was filled with distilled water to the mark drawn on the bottles in accordance with the method described in, and the samples were put in bottles with a capacity of (50 ml), and the volume was filled with distilled water to the mark

marked on the bottles in accordance with the procedure described in [9]. The following estimates were made:

1- Nitrogen (%): Determine the nitrogen utilizing a micro-kjeldant tool based on [10].

2- Phosphorus (%): Phosphorus was determined utilizing a Spectrophotometer (V-1EMCLab100) within an array of (490 nm) in accordance with [11] method.

3- Potassium (%): Using a flame Photometer of the type (V-1 EMC Lab100) at a wavelength of (490 nm), potassium was calculated using the technique described in [12].

4- Carbohydrates (%): He claimed measurements were taken with a Spectrophotometer (V-1 EMC Lab100) at a wavelength of 490 nm to quantify the total carbs in wicker. [13].

5- Total chlorophyll (mg gm⁻¹ fresh weight) was estimated according to the method [14].

Results and discussion

Percentage of carbohydrates in Khus %:

The results of Table (1) showed the superiority of T5 treatment (1.5% of NPK nanocomposite fertilizer) in the ratio of carbohydrates overall experimental treatments, with an increase of 64.5% versus the comparator therapy.

As for the effect of cultivars on the ratio of carbohydrates in vines, it was found from the same table that there were no significant differences between the three cultivars (The Yellow -Shwathi , Al-Khastawi and Al-Khadrawi).

As for the interaction coefficients between the experiment factors, the results of the same table showed a significant superiority of the interaction between the T5 treatment and the Khastawi variety T5V2 (1.5 of the NPK nanocomposite fertilizer and the Khastawi variety) over most of the binary interference treatments, amounting to 8.19%, while the T2V2 treatment gave the lowest readings and amounted to 4.39 %.

Table (1) the impact of humic acid and NPK nanocomposite, as well as their interaction, on the proportion of carbohydrates in the fronds of young trees of three different cultivars of palm plants. %

Treatment	Varieties			The Average
	V1	V2	V3	
T1	4.82 e	4.45 e	5.10 de	4.79 cd
T2	5.14 de	4.39 e	4.40 e	4.65 d
T3	6.17 cd	6.04 cd	7.03 bc	6.41 b
T4	5.24 de	5.47 de	5.27 de	5.33 c
T5	7.65 ab	8.19 a	7.80 ab	7.88 a
The Average	5.80 a	5.71 a	5.92 a	

** According to Duncan's multiple range test, the same-letter values for each factor or its interactions separately are not substantially different at the probability level of 0.05.

Percentage of nitrogen in wicker %:

The results of table (2) showed that all the experimental treatments were superior to the comparison treatments, as the T5 treatment ratio the best outcomes in terms of nitrogen percentage, increasing by 85.96% vs the comparative treatment.

The yellow Shwathi, Al-Khastawi, and Al-Khadrawi are the three cultivars, and there aren't any notable differences between them.

As for the interaction between the factors of the study in the same table, it

was found that the interaction of (NPK nano-compound fertilizer with the Khastawi variety) T5V2 had achieved a significant superiority over all the two-interference treatments in the wicker content of the percentage of nitrogen by 2.20% and did not differ significantly with the two treatments T5V1 and T5V3 and T3V1 as They reached (2.11, 2.07, 2.01) % sequentially, while it was the lowest percentage of nitrogen in the wicker when T1V1 treatment was 1.06%.

Table (2) the impact of humic acid and NPK nanocomposite as well as their combination on the amount of nitrogen in the shoots of three different cultivars of palm trees %

Treatment	Varieties			The Average
	V1	V2	V3	
T1	1.06 e	1.21 de	1.13 e	1.14 e
T2	1.25 de	1.34 cd	1.13 e	1.24 d
T3	2.01 ab	1.93 b	1.93 b	1.96 b
T4	1.49 c	1.37 cd	1.37 cd	1.41 c
T5	2.07 ab	2.20 a	2.11 ab	2.12 a
The Average	1.58 a	1.16 a	1.54 a	

** According to Duncan's multiple range test, the same-letter values for each factor or its interactions separately are not substantially different at the probability level of 0.05.

The percentage of phosphorous in the wicker %:

In Table (3) the result showed that the concentration of 1.5 g L⁻¹ of the nanocomposite fertilizer (NPK T5) had a positive effect as it exceeded all the experimental treatments with an increase rate of 80.95%, compared to the control treatment

According to the information in the aforementioned table, there were no appreciable variations in the proportion of phosphorus in the vine among the three kinds utilized in the experiment. The proportion of phosphorus in the wicker was significantly impacted by the

binary interaction between the treatments and cultivar in the same table., as the treatment T5V1 outperformed all the binary overlap treatments by 0.97, which did not differ significantly with the two

overlap treatments (T5V3 and T5V2), while the percentage of phosphorus in the wicker was lowest at T2V2 transaction, reaching 0.35%.

Table (3) Effect of humic acid and NPK nanocomposite and their interaction on the level of phosphorus in the young trees' vines of three different cultivars of palm %

Treatment	Varieties			The Average
	V1	V2	V3	
T1	0.45 ef	0.38 ef	0.41 ef	0.42 d
T2	0.42 ef	0.35 f	0.39 ef	0.38 d
T3	0.65 bc	0.59 c	0.58 cd	0.61 b
T4	0.48 de	0.56 cd	0.58 cd	0.54 c
T5	0.97 a	0.75 a	0.74 ab	0.76 a
The Average	0.56 a	0.53 a	0.54 a	

** According to Duncan's multiple range test, the same-letter values for each factor or its interactions separately are not substantially different at the probability level of 0.05.

Potassium content in wicker %:

The final results shown in Table (4) indicated that the percentage of potassium in vines increased significantly when spraying with the NPK nanocomposite fertilizer, as the T5 the treatment gave the highest values, with an expansion of 57.14% in contrast to the comparison remedy. Concerning how cultivars affect the wicker's potassium content, outperformed the V1 variety (The yellow Shwathi) as it reached 0.74% over the other two

varieties, Al-Khastawi and Al-Khadrawi, as it recorded (0.67, 0.66) %, respectively.

The study overlaps coefficients showed the presence of substantial variations amongst them, since the treatment produced the wicker with the highest potassium content. T5V1, reaching 0.91%, while the lowest results were in the two overlap treatments for the percentage of potassium in the wicker in T2V2 (T2V3) with a rate of 0.51%.

Table 4: Effect of humic acid and NPK nanocomposite and the interaction between they on the potassium content of tender leaf tissue trees of three palm cultivars.

Transactions	Varieties			The Average
	V1	V2	V3	
T1	0.57 fg	0.54 g	0.58 fg	0.56 d
T2	0.66 def	0.51 g	0.51 g	0.56 d
T3	0.84 ab	0.81 abc	0.74 bcd	0.80 b
T4	0.70 cde	0.59 efg	0.61 efg	0.64 c
T5	0.91 a	0.89 a	0.85 ab	0.88 a
The Average	0.74 a	0.67 b	0.66 b	

** According to Duncan's multiple range test, the same-letter values for each factor or its interactions separately are not substantially different at the probability level of 0.05.

Wicker's overall chlorophyll content: (mg 100 g⁻¹ fresh weight).

The results of Table (5) indicate that all the experimental treatments are superior to the comparison treatment, where

when spraying at a concentration of 1.5 g L⁻¹ of the nanocomposite fertilizer NPK gave the highest values with an expansion of 43.84% compared to the comparison treatment.

The same table demonstrates that there are no appreciable variations between the three kinds in terms of the influence of variety. (Yellow Shwethi, Al-Khastawi and Al-Khadrawy), and We observe that there are large discrepancies between them based on the overlap coefficients..the Fresh weight did not

differ significantly with the three treatments (T5V1 and T5V3and T5V2), as they recorded (30.00 and 29.33 and 30.33 mg 100 g⁻¹ fresh weight) respectively, while the lowest values were in the treatment T1V1 and T1V3, as they amounted to 20.33 (mg 100 g⁻¹ fresh weight).

Table (5): The total chlorophyll concentration in young plants of three palm cultivars was affected by humic acid, NPK nanocomposite, and their interactions (mg-1 fresh weight).

Transactions	Varieties			The Average
	V1	V2	V3	
T1	20.33 c	21.67 bc	20.33 c	20.78 c
T2	24.33 b	24.67 b	23.33 bc	23.56 b
T3	24.67 b	22.33 bc	23.67 bc	23.67 b
T4	25.00 b	22.67 bc	23.33 bc	24.11 b
T5	29.33 a	30.33 a	30.00 a	29.89 a
The Average	24.73 a	24.33 a	24.13 a	

** According to Duncan's multiple range test, the same-letter values for each factor or its interactions separately are not substantially different at the probability level of 0.05

Discussion

Compared to the comparison treatment, the results in tables (1, 2, 3, 4, 5) show that humic acid fertilization of the soil significantly improved the chemical characteristics of the fronds (carbohydrates, nitrogen, phosphorus, potassium, and chlorophyll). Humic acid also increases the nutrient content of the leaves. By enhancing the soil's physical, chemical, and biological properties, such as enhancing the function and activity of microorganisms, which increases the rate at which nutrients are absorbed by the roots and transferred to other areas of the plant [15]. This maybe as a result of the numerous organic acids, organic nitrogen, and organic materials that humic acid contains, and a lot of macro and micronutrients, as well as amino acids in various ratios, as they play a part in making many nutrients in the soil more plant-ready by lowering the pH of the soil. [16], this increases the amount of the macronutrients potassium, phosphorus, and nitrogen in the leaves, which is consistent with [17] on apple trees and the findings shown in Tables (1, 3, 2, 4),

the superior results of applying NPK nanocomposite fertilizer over a control treatment. The categories of properties that are involved in the synthesis and building of chlorophyll include the amino acids RNA and DNA. [18], this causes it to grow in the plant. Enhancing the plant's ability to endure diverse pressures by raising the chlorophyll content of the leaves [19], this outcome is consistent with that of palm trees [20].

One of the essential nutrients for boosting photosynthesis is nitrogen, which is also a crucial component of the enzymes and amino acids that make up the protein system. The effectiveness of the photosynthetic process is increased by the foliar application of nitrogen-containing fertilizer, which also enhances the accumulation of carbohydrates in the branches. Additionally, phosphorus is crucial for the synthesis of acids. chloroplast proteins and amino acids. This could also be a result of potassium's participation in the activation of several enzymes necessary for the production of chlorophyll, which aids in the

development of chloroplasts, and its function in promoting the enzymes needed to synthesize energy and carbohydrates, which improves the plant's nutritional state [21] [22] [23] This is in line with the conclusions that were made [24] on Khastawi date palm trees.

The differences in genotypes among cultivars, the degree of their adaptation to the surrounding environmental conditions, and the degree to which they benefit from the absorption of nutrients [24] from the soil may all be responsible for the effect of cultivars on the chemical characteristics as shown in Tables (4). These outcomes concur with the findings of [25]. And the conclusions we came to in our study concur with those obtained in [26] for seed orange plants and [27] for grape trees.

Conclusions

Through our results, it was found that the best superior concentration is (1.5 gm L⁻¹ of NPK nanocomposite fertilizer) in most chemical properties, and we conclude that the best interaction between the cultivar and treatment is T5V2 (1.5 gm L⁻¹ of NPK nanocomplex fertilizer and class Al-Khastawi) and that the best cultivar responding to the treatments was the yellow Shuwathi cultivar V1.

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تأثير حامض الهيوميك و المركب النانوي NPK في المحتوى الكيميائي لسعفات ثلاثة أصناف من أشجار النخيل الفتية *Phoenix dactylifera.L*

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- تاريخ استلام البحث 2023/04/13 وتاريخ قبوله 2023/06/04
- البحث مستل من رسالة ماجستير للباحث الأول .

المستخلص

أجريت التجربة في بستان النخيل في محطة البحوث والتجارب الزراعية في موقع الصيادة التابعة لكلية الزراعة / جامعة كركوك / جمهورية العراق خلال الموسمي 2022 - 2023 ولفترة من 2022/6/15 الى 2023 /4/15 لدراسة تأثير إضافة الحامض العضوي (حامض الهيوميك) والرش السماد المركب NPK النانوي على ثلاثة اصناف من النخيل الشويثي الاصفر والخستاي والخضراوي ، نفذ تجربة العملية وفق نظام الواح المنشقة Split plot design ووفق تصميم قطاعات العشوائية الكاملة RCBD وبثلاثة مكررات وتم تحليل البيانات حسب اختبار دنكن متعدد الحدود عند مستوى احتمالية (0.05) بينت النتائج تفوق تركيز (1.5 غم لتر⁻¹ من السماد المركب النانوي NPK النانوي T5) على جميع الصفات الكيميائية المدروسة وبينما تفوقت معاملة التداخل بين المعاملة والصنف المعاملة T5V2 (السماد المركب النانوي NPK والصنف الخستاي) في النسبة المئوية لمحتوى الخوص من الكربوهيدرات والنتروجين والكلوروفيل اذ بلغ (8.19% ، 2.02 % 30.33 ملغم غم⁻¹ وزن طري) على التوالي . وتفوق معاملة T5V1 (السماد المركب النانوي NPK والصنف الشويثي الأصفر) في النسبة المئوية للفسفور والبوتاسيوم في الخوص اذ بلغ (0.97،0.91%) بالتتابع، وتفوق صنف الشويثي الأصفر على الصنف الخستاي والخضراوي في النسبة المئوية لمحتوى الخوص من البوتاسيوم اذ بلغ 0.74%

الكلمات المفتاحية: حامض الهيوميك، NPK النانوي، صنف الشويثي الأصفر، الخستاي، الخضراوي.