Response of *Melia dubia Cav*. trees to Humic acid and NPK fertilization and their effect on vegetative traits and mineral content

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Abstract:

This experiment was conducted on *Melia dubia Cav.* to know the response of some vegetative growth traits and chlorophyll and mineral content of leaves to levels of humic and NPK fertilizers. The experiment was designed according to a randomized complete block design (RCBD) under the split plot system with two factors and three replicates. The two factors are: organic fertilizer (humic) and chemical fertilizer (NPK) and were added at three levels for each (0, 50, 100) g.seedling^{-1}. The data were analyzed using the SAS program and the difference between the means of the different treatments was tested using Duncan's multiple range test at a probability level of 5%. The results showed a clear significant effect of NPK fertilizer on all studied traits (leaf chlorophyll content (SPAD), number of leaves, stem height, stem diameter, number of branches, percentage of each of nitrogen, phosphorus and potassium in leaves) for plants treated with a fertilizer level of 100 g.seedling^{-1} compared to control plants. The results also showed a significantly excelled of the effect of humic on the traits (leaf chlorophyll content (SPAD), stem diameter, number of branches, and percentage of both phosphorus and potassium in leaves) of plants treated with a fertilizer level of 100 gm.seedling^{-1} compared to the same traits of plants treated with concentrations of (0, 50) g.seedling^{-1}. The study concluded that *Melia dubia* Cav. significantly responded to humic and NPK fertilizers at a concentration of 100 g.seedling^{-1}, due to their effective role in improving most of the studied traits.

Keywords: *Melia dubia* Cav., humic acid, chlorophyll content (SPAD), nitrogen, phosphorus and potassium in leaves .

Introduction:

Melia dubia Cav. is a fast-growing deciduous tree belonging to the Meliaceae family. Its native habitat is India, and most plants in this family are perennial [25]. It is a non-toxic tree with no side effects and possesses medicinal properties that can be used to treat various diseases. Extracts of the entire plant are used as antioxidants against cancer, diabetes, and infections, as antibacterial and antiviral agents, and as insecticides and fungicides. [18]. It is an environmentally friendly tree if planted and managed sustainably, especially in plant diversity and reforestation programs. This tree offers key environmental and economic benefits as it absorbs CO_2 improves soil and prevents erosion its fast-growing wood is a renewable source for timber biofuel and bioenergy it supports clean energy by providing biomass for bioethanol biogas and power pellets and is also used in plywood and paper industries [18]. One of the requirements of the scientific narrative is to

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identify the nature of the organic and chemical fertilizers used in this experiment and the importance of using each of them. Organic humic acid is a substance derived from the leonardite rock. The humic acid molecule contains mainly about 60% organic carbon, which plays an important role in the growth of microorganisms in the soil, it also contains nitrogen, oxygen, hydrogen, and sulfur [33]. Its benefits are numerous, as it increases the plant's ability to absorb nutrients because it reduces its acidity and increases the effectiveness of beneficial bacteria in the soil, making it a good stimulant for roots. It also increases the soil's ability to retain water and nutrients, especially micronutrients, by chelating and transporting them jointly to the plant [37]. It also works to precipitate toxic heavy metals, thus reducing their absorption by the plant [36]. Humic acids also increase crop growth by increasing growth-promoting hormones such as auxin and cytokinin, which help in stress resistance, nutrient chelation and photosynthesis [13]. Humic acid was adopted as one of the study factors in this experiment because it contributes significantly to soil treatment and plant growth promotion [13]. The adoption of NPK as a second factor in fertilization processes is due to the fact that it provides important nutrients to the plant. Each of its three components has its own specific function: it increases photosynthetic activity, produces strong, dark green vegetative growth, and increases the percentage of carbohydrates [24]. NPK is considered one of the essential macronutrients, and its use improves plant production by approximately 50%. However, it must be added at absorption rates that are balanced with growth rates [9]. While organic fertilization contributes to improving soil fertility and sustainability, and chemical fertilization provides nutrients more quickly, thus improving plant growth and increasing production efficiency, there is a need to study the effect of different fertilization patterns (organic and chemical) on the vegetative characteristics and mineral content of the experimental plant. The aim of the study is to evaluate the response of *Melia dubia* (Cav.) trees to levels of humic acid and NPK fertilizers, and to study the effect of each type of fertilizer on some vegetative traits and leaf content of nitrogen, phosphorus, and potassium.

Materials and Methods:

The study was conducted at the Horticulture Department Research Station, College of Agriculture, Tikrit University, from March 21, 2022 to November 15, 2022, on Malabar neem *Melia dubia* (Cav.) trees. The study aimed to determine the extent to which these trees responded to levels of NPK and humic acid fertilizers and their effects on vegetative traits and leaf mineral content ; the following images describe the steps involved in carrying out the experiment, from the planting stage right through to the fruit-setting stage:





(1)





(2)

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(3) (4)





(5)





(6) (7)

(1) Planting seedlings and building irrigation channels .

(2) Completion of planting and construction of the plant bed .

(3) Plant Adaptation and Growth .

(4) Applying fertilizer .

(5) Increase in total vegetative mass .

(6) Plant flowering .

(7) Fruit development .

Study factors and studied traits:

The experiment was designed with two factors and three replicates:

1- Factor 1: Adding humic acid (A) at three levels:

A0: No addition (control)

A1: 50 g. seedling^{-1}

A2: 100 g. seedling^{-1}

2- Factor 2: Adding NPK fertilizer (B) at three levels:

B0: No adding (control)

B1: 50 g. seedling^{-1}

B2: 100 g. seedling^{-1}

Thus, we have [3*3 = 9 factor treatments * 3 replicates * 3 seedlings per experimental unit = 81 seedlings]. At the end of the experiment, the following parameter were measured:

A) Vegetative traits:

1. The relative chlorophyll content of mature and fully expanded leaves was estimated using a SPAD-502 chlorophyll meter supplied by Minolta Co., Ltd., Japan.

2. Main stem height: The stem height was measured using a measuring tape from soil level to the tip of the growing tip of the main branch. The data were then recorded and statistically analyzed.

3. Number of leaves: The number of leaves was calculated for each experimental unit, then the data were recorded and statistically analyzed.

4. Number of branches: The number of branches was calculated for each

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experimental unit, then the data were recorded and statistically analyzed.

5. Main stem diameter: The stem diameter was measured at a height of 5 cm above the soil surface for each experimental unit using a Vernier caliper. The data were then recorded and statistically analyzed.

b) Mineral content of leaves:

Mature young leaves were taken with their petioles [28] after the fruit ripened, while they were in the stage of relative stability and stabilization of the elements [21]. The taken leaves were then washed with water to remove dust and dried in an air oven at 70°C until the weight was constant. They were then ground and passed through a 0.2 mm sieve. They were then wet digested using sulfuric and perchloric acids, as mentioned in [10]. The elements were then estimated as follows:

1- Nitrogen (N%): Nitrogen was estimated using a Micro Kjeldahl device, as mentioned in [22]..

2- Phosphorus (P) (ppm): Phosphorus was determined using ammonium molybdate and ascorbic acid using a UV-VIS Spectrophotometer Model 80 D, at a wavelength of 662 nm [29].

3- Potassium (K%): Potassium was determined using a Flame photometer as mentioned [10].

Statistical Analysis:

This experiment was conducted using a randomized complete block design (RCBD) under a split-plot system and spraying within the main plots. Data were analyzed using SAS software, and the differences between the means of the different treatments were tested using Duncan's multiple range test at a 5% probability level [8].

Planting date, dimensions, planting method, and irrigation system:

The seedlings were planted on March 21, 2024, at the age of 6 months. Holes measuring 50x50x50 cm^3 were dug, and a quantity of composted soil was placed at the bottom of each hole. The planting dimensions were 2x2 m2. One seedling was placed in each hole and buried in composted soil. The soil was firmly pressed around each tree. The irrigation system used was a drip irrigation method with (3) drip lines, according to the experimental design.

Irrigation:

The seedlings were irrigated every three days for the months of March, April, May, and October. For the months of June, July, August, and September, the trees were irrigated every two days.

Fertilizer type, quantity, time, and method of application:

Two types of fertilizers were used: 95% humic acid (Diamond Grow), American-made, and a balanced NPK fertilizer (SMART FERT 20-20-20+TE), Jordanian-made. Humic acid, which represents the first factor, was added at three levels (0, 50, and 100) $g.seedling^{-1}$ to each replicate of the experiment. The same applies to NPK fertilizer, which also represents the second factor, at three levels (0, 50, and 100) $g.seedling^{-1}$. The fertilization process was applied as described in [27], with some modifications to the number of weekly applications, from twice a week to once every 7-14 days. The application time was after 5 p.m it is during the summer months that the highest temperatures are typically recorded. The application method was used with irrigation water at a rate of 10 g.seedling per week until the amount added to each application level for both fertilizers was completed.

Agricultural Service Operations:

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Tree maintenance operations, including irrigation, weeding, and pest control, continued throughout the study period, with frequent maintenance of drip irrigation pipes, particularly the maintenance of water flow points (nozzles) at each tree to prevent clogging.

Results and Discussion: -

Table (1) Effect of adding humic fertilizer and NPK fertilizer (g. seedling^{-1}) on the leaf chlorophyll content (SPAD unit).

Humic fertilizer (A) / NPK fertilizer(B)		NPK fertilizer 0g B0	NPK fertilizer 50g B1	NPKfertilizer 100g B2	Effect of humic fertilizer)A(
Humic (A0)	**0g**	41.990 h	46.487 g	49.100 f	**45.859 c**
Humic (A1)	**50g**	52.267 h	55.584 d	59.139 c	**55.663 b**
Humic (A2)	**100g**	56.500 d	61.700 b	65.967 a	**61.389 a**
Effect of NPK fertilizer(B)		**50.252 c**	**54.590 b**	**58.069 a**	

Different letters within column indicating of significant differences (p<0.05)

Table (1) indicates the significant effect of both humic and NPK fertilizers on the chlorophyll content of leaves, as the highest value of the effect of humic on the chlorophyll percentage in leaves was reached at a concentration of 100 g. seedling-1 (61.389 SPAD units), while the lowest chlorophyll percentage was recorded in the control treatment 0 g. seedling^{-1}, which amounted to (45.859) SPAD units. The highest value of the effect of NPK on the chlorophyll percentage in leaves was reached at a concentration of 100 g. seedling^{-1} (58.069 SPAD units), while the lowest value of chlorophyll was in the control treatment 0 g. seedling^{-1}, which amounted to (50.252) SPAD units. This may be due to the role of humic in facilitating the transfer of nutrients to the rest of the plant parts by chelating them, in addition to the role of NPK fertilizer in providing the plant with important nutrients to activate the photosynthesis process and increase chlorophyll in the leaves, thus giving strong vegetative growth. [24]. This is consistent with what [3] concluded in his thesis on the role of NPK fertilizer in increasing the chlorophyll content of leaves.

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As for the interaction between humic and NPK factors, Table (1) shows clear significant differences in the effect of each factor on the chlorophyll content in leaves, with the highest value at a concentration of 100 g. seedling-1 reaching (65.967) SPAD units, while the lowest chlorophyll content was recorded in the control treatment of 0 g. seedling-1, reaching (41.990) SPAD units. This is due to the role of NPK in making nutrients available to the plant and its participation in photosynthesis and chlorophyll formation [37].

Table (2) The effect of adding Humic fertilizer and NPK fertilizer (g .seedling^{-1}) on the number of leaves (leaf.seedling^{-1})

Humic fertilizer (A) / NPK fertilizer(B)		NPK fertilizer 0g	NPK fertilizer 50g	NPK fertilizer 100g	Effect of humic fertilizer)A(
		B0	B1	B2	
Humic (A0)	0g	75.11 d	156.89 a	130.00 ab	120.66 a
Humic (A)1	50g	95.66 cd	120.33 bc	118.00 bc	111.33 a
Humic (A2)	100g	138.33 ab	126.11 abc	147.22 ab	137.22 a
Effect of NPK fertilizer(B)		103.034 b	134.440 a	131.738 a	

Different letters within column indicating of significant differences (p<0.05)

Table (2) indicates that there are no significant differences in the effect of adding humic acid on the number of leaves, as the highest and lowest number of leaves reached (137.22 and 111.33) leaves . seedling^{-1} at the addition level of 0 g and 100 g, respectively. The reason for the lack of significance may be due to the plant resorting, at the age of approximately one year, to reducing the number of its leaves as one of the plant's adaptations to the surrounding sandy soil conditions, which are characterized by their low ability to retain water to reduce transpiration and maintain moisture inside the plant, as well as to maintain the amount of water in the soil around the plant's roots to increase its chances of survival, or due to the unsuitability of the nature of the medium in which the seedlings grow with the amount of added humic acid. This is consistent with what [32] reached in his study when comparing the effect of adding humic acid and NPK fertilizer to different media on *Melia azedarach* L growth. This result differs from what was reached by [6, 7, and 16] in their studies on strawberry, olive, and apricot trees, respectively. It is also noted from Table (2) that the two treatments for the effect of NPK on the number of leaves (50 g and 100 g) significantly excelled on the 0 g treatment, reaching (134,440 and 131,738) leaves. Seedling^{-1} These results are consistent with what was reached by [20] in his study on the response of local orange seedlings to

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compound fertilizer, and with what was reached by [25] in their experiment on the effect of NPK fertilizer on growth and nutrient accumulation in juniper trees (*Juniperus procera*). They also differ from what was reached by [15] in his study on Ashoka trees (*Saraca acacia*) to demonstrate the effect of NPK fertilizer on the vegetative growth of these trees. As for the interaction between humic and NPK, it is noted from Table (2) that the highest value reached 156.89 leaves . seedling at a fertilizer level of (0 humic, 50 NPK) g. seedling^{-1}, while the lowest value was 75.11 leaves . seedling^{-1} in the control treatment (0 humic, 0 NPK) g. seedling^{-1}. These results are somewhat consistent with [23] in his study evaluating the growth and productivity of neem seedlings using different doses of organic fertilizers and NPK fertilizers. They differed from the findings of [7] in his study on the effect of humic acid fertilization on some growth traits of olive seedlings (*Olea europaea* L.) of the Baashiqi variety.

Table (3) Effect of adding humic and NPK fertilizers (g. seedling^{-1}) on the height of the main stem (cm. plant^{-1})

Humic fertilizer (A) / NPK fertilizer(B)		NPK fertilizer 0g	NPK fertilizer 50g	NPK fertilizer 100g	Effect of humic fertilizer
		B0	B1	B2	)A(
Humic (A0)	**0g**	158.33 c	183.33 abc	189.33 ab	177.00 b
Humic (A1)	**50g**	180.22 abc	184.11 ab	181.11 abc	181.81 a
Humic (A2)	**100g**	164.48 bc	196.89 a	182.44 abc	181.27 b
Effect of NPK fertilizer(B)		167.677 b	188.108 a	184.294 a	

Different letters within column indicating of significant differences (p<0.05)

Table (3) shows the effect of humic acid addition on stem height for individual treatment, with the highest value reaching 181.81 cm plant-1 at the fertilization level of (50 g humic), which was significantly higher than the treatments of 100 g and 0 g, which reached (181.27, 177.00) cm. plant-1, respectively. These results are consistent with [11] in their experiment on the effect of humic acid on the vegetative and floral growth of (*Pelargonium graveolens* L.), and differ from what [7] reached in his study on the effect of fertilization with humic acid on some growth characteristics of olive seedlings (*Olea europaea* L.) Baashiqi variety. The effect of NPK fertilizer on stem height was significantly superior to the control treatment (0 g) and reached (188.108 and 184.294) cm.plant^{-1} and the control treatment 167.677 cm.plant^{-1}. These results agreed with [30] in

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his research to estimate the growth of bay seedlings (*Laurus nobilis* L) . And their interaction with different amounts of NPK. They also agreed with what was stated by [31] in his study on the effect of fertilization with NPK compound fertilizer on the growth and development of myrtle plant (*Myrtus communis*), and differed from what was reached by [3] in his thesis on the role of NPK fertilizer in increasing the height of pear seedlings. The positive effect of NPK on plant height can be explained by the added nutrients stimulating auxin production, thereby promoting plant cell elongation and increasing plant height [35]. As for the effect of the interaction between humic and NPK on plant height, it is noted from Table (3) that the interaction treatment (100 g humic, 50 g NPK) significantly excelled the control treatment, reaching 196.89 cm plant-1, while it reached 158.33 cm. plant-1 in the control treatment. This result is consistent with what [16] found in his experiment on the effect of humic acid on stem height in Canino apricot trees.

Table (4) Effect of adding humic and NPK fertilizers (g. seedling^{-1}) on stem diameter (cm. plant$^{-1)}$

Humic fertilizer (A) / NPK fertilizer(B)		NPK fertilizer 0g	NPK fertilizer 50g	NPK fertilizer 100g	Effect of humic fertilizer)A(
		B0	B1	B2	
Humic (A0)	0g	19.3510 f	22.1100 E	24.3633 d	21.9414 c
Humic (A1)	50g	25.0133 cd	25.5400 c	27.8297 b	26.1277 b
Humic (A2)	100g	25.2033 cd	28.3510 b	29.8567 a	27.8037 a
Effect of NPK fertilizer(B)		23.1892 c	25.3337 b	27.3499 a	

Different letters within column indicating of significant differences (p<0.05)

Table (4) indicates the significant effect of both humic and NPK fertilizers on the main stem diameter of the study plants, as the highest value of the effect of humic on the stem diameter was reached at a concentration of 100 g. seedling^{-1} (27.8037 cm. plant-1), while the lowest stem diameter was recorded in the control treatment 0 g. seedling-1, which amounted to (21.9414) cm. plant-1. The highest value of the effect of NPK on the stem diameter was reached at a concentration of 100 g. seedling-1 (27.3499) cm. plant-1, while the lowest stem diameter was in the control treatment 0 g. seedling-1, which amounted to (23.1892) cm. plant-1. These results largely agreed with what was reached by [17] in their research to improve the growth of *Khaya senegalensis* and *Swietenia mahagoni* trees using NPK fertilizer with biological fertilizers. It also agreed with what

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was reached by [14] in his study on the effect of adding urea fertilizer and humic acid on the growth of almond seedlings *Prunus amygdalus* (Batsch). The increase in stem diameter may be due to humic acid enhancing nutrient availability and absorption, especially NPK, and promoting efficient root development [7]. As for the interaction between the humic and NPK factors, it is noted from Table (4) that there are clear significant differences in the effect of each of the two factors on the diameter of the main stem, as the highest diameter at a concentration of 100 g. seedling-1 reached (29.8567) cm. plant-1, while the lowest diameter was recorded in the control treatment of 0 g. seedling-1, reaching (19.3510) cm. plant-1. This result is consistent with what was found in [1] in his study on the effect of adding urea and humic acid on the growth of seedlings of the *Yankee dnia*. The reason for the significant superiority may be due to the role of nitrogen in the formation of cytokinins, which work to increase the activity of lateral meristematic cell division, thus increasing plant growth and, consequently, stem diameter [34].

Table (5) Effect of adding humic and NPK fertilizers (g.seedling^{-1}) on the number of branches (branch.plant^{-1})

Humic fertilizer (A) / **NPK fertilizer(B)**	**NPK fertilizer 0g**	**NPK fertilizer 50g**	**NPK fertilizer 100g**	**Effect of humic fertilizer)A(**
	B0	**B1**	**B2**	
Humic (A0)	**0 g**	5.9967 f	10.4400 e	12.1100 cd	9.5156 b
Humic (A1)	**50g**	11.5533 d	12.4400 cd	13.6633 b	12.5522 a
Humic (A2)	**100g**	12.2200 cd	12.7767 bc	14.6633 a	13.2200 a
Effect of NPK fertilizer(B)	9.9233 c	11.8856 b	13.4789 a		

Different letters within column indicating of significant differences (p<0.05)

Table (5) on the effect of humic fertilizer on the number of branches indicates a significant superiority of the two batches (100 g, 50 g) over the control treatment, as they reached (13.2200, 12.5522) branches. plant-1, respectively, compared to 9.5156 branches. plant-1 in the control treatment. Humic acids are characterized by increasing crop growth by increasing plant growth-promoting hormones, such as auxin and cytokinin, which lead to stimulating growth and encouraging and increasing the number of branches on the plant. This is consistent with what was stated by [2] in his study on the response of olive seedlings to foliar spraying with Green Plant organic fertilizer and mineral NPK. As for the

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effect of NPK on the number of branches, it is noted from Table (5) that there are highly significant differences between the addition treatments, as the (100 g) treatment significantly excelled the (50 g) and (0 g) treatments, reaching, according to the sequence, 13.4789, 11.8856, and 9.9233) branches.plant-1, respectively. This may be due to the role of the added fertilizer elements, especially phosphorus and potassium, as phosphorus contributes primarily to energy production and gives the plant strength to grow, increase the number of branches, and strengthen the root system [10]. Potassium plays a pivotal role in facilitating the transportation of carbohydrates and nutrients to the growth zones of the plant, thereby stimulating the development of new branches [5]. As for the interaction effect between humic and NPK, Table (5) shows clear significant differences in the effect of each factor on the number of branches.

The number of branches at a concentration of 100 g.seedling^{-1} reached (14.6633) branches.plant^{-1}.While the lowest number of branches was recorded in the control treatment of 0 g/seedling, reaching (5.9967) branches.plant-1. These results are consistent with what [19] concluded in their experiment on the effect of adding NPK fertilizer and humic substances on the vegetative growth of one olive variety.

Table (6) Effect of adding humic fertilizer and NPK fertilizer (g.seedling-1) on the percentage of nitrogen (N%) in leaves.

Humic fertilizer (A) / **NPK fertilizer(B)**		**NPK fertilizer 0g**	**NPK fertilizer 50g**	**NPK fertilizer 100 g**	**Effect of humic fertilizer)A(**
		B0	**B1**	**B2**	
Humic (A0)	**0g**	1.5557 bc	1.5433 bc	1.5033 c	1.5341 a
Humic (A1)	**50g**	1.4100 c	1.6793 abc	1.9800 a	1.6898 a
Humic (A2)	**100g**	1.5360 bc	1.5200 bc	1.8833 ab	1.6464 a
Effect of NPK fertilizer(B)		1.50056 **b**	1.58089 **b**	1.78889 **a**	

Different letters within column indicating of significant differences (p<0.05)

Table (6) indicates that there are no significant differences in the effect of adding humic acid on the percentage of nitrogen concentration in plant leaves, as the highest and lowest percentages reached (1.6464 and 1.5341)% at the addition level of 0 g and 100 g, respectively. This is consistent with what [32] reached in his study when comparing the effect of adding humic acid and NPK fertilizer to different media on the growth of neem plant. It also agrees to some extent with what [26] reached in their experiment to compare the effect of adding humic acid and NPK fertilizer to different media on the

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growth of neem plant. It differed from what [1] reached in his research on the effect of adding urea and humic acid on the growth of seedlings of Eriobotrya. As for the effect of NPK fertilizer on the percentage of nitrogen (N%) in the leaves, the (100 g) treatment significantly excelled the two control treatments (0 g) and (50 g) and reached 1.7888% compared to (1.5808 and 1.5005)%, respectively. These results are consistent with what was reached by [38] in their research to study the effect of NPK fertilizer on vegetative growth and nutrient content of *Swietenia mahagoni* L. (Jacq.) seedlings in different growing environments, and differ from what was reached by [24] in their study of adding levels of NPK fertilizer and its effect on the growth of *Tecoma stans* plants and the nitrogen content of leaves. As for the effect of the interaction between humic and NPK on the percentage of nitrogen in the leaves, it is noted from Table (6) that the interaction treatment (50 g humic, 100 g NPK) significantly excelled the control treatment, reaching 1.9800%, while it reached 1.5033% in the treatment (0 g humic, 100 g NPK). This result is consistent with what [3] concluded in his thesis on the role of NPK fertilizer in increasing the nitrogen content of leaves.

Table (7) Effect of adding humic fertilizer and NPK fertilizer (g.seedling^{-1}) on the percentage of phosphorus (P%) in the leaves.

Humic fertilizer (A) / NPK fertilizer(B)		NPK fertilizer 0g B0	NPK fertilizer 50g B1	NPK fertilizer 100g B2	Effect of humic fertilizer)A(
Humic (A0)	**0g**	0.0866 ab	0.0563 a	0.0876 ab	0.0768 b
Humic (A1)	**50g**	0.0630 b	0.0666 ab	0.0810 ab	0.0702 b
Humic (A2)	**100g**	0.0860 ab	0.1010 a	0.0916 ab	0.0928 a
Effect of NPK fertilizer(B)		0.0785 b	0.0746 b	0.0867 a	

Different letters within column indicating of significant differences (p<0.05)

Table (7) indicates the effect of humic fertilizer on the percentage of phosphorus (P%) in leaves, indicating that the treatment (100 g humic) was superior to the treatments (0 g , 50 g) of humic, reaching 0.0928% compared to (0.0768, 0.0702)%. This result is consistent with what was reached by [11] in their experiment on the effect of humic acid on the vegetative and floral growth of *Pelargonium graveolens* L. and its role in increasing the plant's phosphorus content. As for the effect of NPK fertilizer on the percentage of phosphorus (P%) in leaves, the treatment (100 gm) was significantly superior

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to the control treatments (0 gm) and (50 gm), reaching 0.0867% compared to (0.0746 and 0.0785)%, respectively. These results are consistent with the findings of [24] in their study of adding levels of NPK fertilizer and its effect on the growth of *Tecoma stans* plants and leaf phosphorus content. They are also consistent with the findings of [4] in their study on the effect of NPK and Brassinolide fertilizers on some vegetative growth traits and leaf phosphorus content of Khastawi date palm trees. As for the interaction between humic and NPK, it is noted from Table (7) that the highest value reached 0.1010% at the fertilizer level (100 humic, 50 NPK), while the lowest value was 0.0563% in the control treatment (0 humic, 50 NPK). These results are consistent with the findings of [12] in their study investigating the effect of spraying humic and NPK on some chemical traits, including leaf phosphorus content, of Maktoum date palms.

Table (8) The effect of adding humic fertilizer and NPK fertilizer (g.seedling^{-1}) on the percentage of potassium (K%) in the leaves.

Humic fertilizer (A) / NPK fertilizer(B)		NPK fertilizer 0g B0	NPK fertilizer 50g B1	NPK fertilizer 100g B2	Effect of humic fertilizer)A(
Humic (A0)	**0g**	0.3250 bcd	0.2840 cd	0.3000 bcd	0.3030 b
Humic (A1)	**50g**	0.2266 d	0.4073 abc	0.4883 a	0.3741 ab
Humic (A2)	**100g**	0.3333 bcd	0.4366 ab	0.5233 a	0.4311 a
Effect of NPK fertilizer(B)		0.2950 b	0.3760 b	0.4372 a	

Different letters within column indicating of significant differences (p<0.05)

Finally, Table (8) shows the effect of humic on the percentage of potassium (K%) in the leaves. The treatment (100 g humic) (0.4311%) was superior to the control treatment (0.3030%), which did not differ significantly from the treatment (50 g humic) (0.3741%). This result is consistent with [12] in their research to study the effect of spraying humic and NPK on some chemical characteristics, including the leaf content of potassium for date palms of the Maktoum variety. As for the effect of NPK fertilizer on the percentage of potassium (K%) in the leaves, the table above indicates that the treatment (100 g NPK) (0.4372%) is superior to the treatments (50 g NPK and control 0 g) (0.3760, 0.2950)%, respectively. This result is consistent with what was reached by [4] in his study on the effect of NPK and Brassinolide fertilizers on some vegetative growth traits

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and the potassium content of leaves for Khastawi date palm trees. Regarding the effect of the interaction between humic and NPK on the percentage of potassium in leaves, Table (8) shows that the treatments (100 humic, 100 NPK) and (50 humic, 100 NPK) significantly excelled all control treatments for this trait. This result is consistent with [12] in their study of the effect of spraying humic and NPK on some chemical traits, including leaf potassium content of the Maktoum date palm. It is also consistent with the findings of [24] in their study of adding levels of NPK fertilizer and its effect on the growth of *Tecoma stans* plants and leaf potassium content.

Conclusions:

We conclude from the study that the vegetative growth and mineral content of Cav. *Melia dubia* can be improved by adding humic and NPK fertilizers at a concentration of 100 g/seedling-1, based on the results showing a significant increase in most of the studied traits.

Conflict of Interest :

The authors declare no conflicts of interest associated with this manuscript.

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