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EFFECT OF SOIL NPK FERTILIZER AND AMINO ACIDS ON GROWTH, LEAVES MINERALS AND TOTAL PHENOLIC CONTENT OF APPLE TRANSPLANTS CV. IBRAHIMI

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ABSTRACT

The research was carried out on two years of "Ibrahimi" apple cultivar, in Al-Karma - Fallujah. The research aims to increase and improve vegetative growth of transplants through soil application of NPK fertilizer 20:20:20 with three levels of 0, 20g, and 50g, as N0 and N1, N2 respectively, and the second factor included two amino acids concentrations 5ml L^{-1} and 10ml L^{-1} As A1 and A2 respectively. There were 36 transplants total since the factorial experiment was conducted using a randomized complete block design (RCBD) with three replications and two transplants per experimental unit. results showed that NPK fertilizer had a significant effect on plant height (178.70 cm. seedling), number of branches (21.67 seedling branches), number of leaves (404 seedling leaves), and leaf content of N, K, P (0.190, 0.122, 0.393%) and chlorophyll (34.00 mg). 100 gm fresh weight. As for the amino acid treatment, the A2 treatment gave the highest rate of plant height (173.1 cm seedling), number of branches (20.33 seedling branches), number of leaves (341 seedling leaves), and leaf content of N, P, and K (0.168, 0.116, 0.378%, chlorophyll (30.00 mg. 100 g fresh weight), and total phenols (1.902 mg g dry weight). As for the A2N2 intervention treatment, it gave the highest rates for the measured traits.

Keywords: Apple, transplants, growth, soil fertilizer, phenols

INTRODUCTION

Apple *Malus domestica* L. it is one of the most important species of the Malus genus, belonging to the Rosaceae family. According to Bal [10] and Al-Araji [5], apples are thought to have originated in the temperate region of East Asia between Caspian and Black Sea, and from there they moved to Europe and other parts worldwide. According to Al Nuaimi [2], such apples were a part of Mesopotamia Valley culture from the end of the fifth millennium BC, when humans first settled there and throughout subsequent generations. An estimated 2,176,339 apple trees have been planted in Iraq; the Salah al-Din governorate

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holds the highest number of these plants, succeeded by the governorates of Anbar and Baghdad. A single tree produces roughly 30.2 kg on average [11]. Chemical fertilizers are classified as complex of simple depending on how many fertilizer elements they contain [4]. Simple fertilizers only contain one fertilizer element. One of the most significant components for the growth and development of plants is nitrogen. Generally speaking, dry leaves have a nitrogen content of 2–4%, according to the type of plant and how it grows [32].

One of able to move in plants as well, phosphorus is primarily used in the enzymes and the energy-rich substance adenosine triphosphate (ATP). It promotes the quick growth of plants and is crucial for the development of flowers and roots [30]. According to Gibson *et al.* [18], potassium is regarded as the third most significant macronutrient because of its critical involvement in life cycle completion and plant growth [37]. Potassium is essential for controlling plant water status, photosynthesis, stomata opening, and sugar transfer. It creates internal pressure on the cell walls, which facilitates stomata opening, increased transpiration, and the entry of atmospheric carbon dioxide into the leaf, all of which aid in photosynthesis process [11, 15, 38].

According to Majeed and Joody [28a] and Majeed and Joody [29b], applying nitrogen fertilizer to the soil increased the amount of nutrients in apple tree leaves, the amount of carbohydrates in branches, and vegetative growth. According to Dalal et al. [15], amino acids could be supplied to plants to promote biological processes as well as increase their tolerance to physiological and environmental influences. Furthermore, they are essential for the synthesis of hormones, enzymes, proteins, antioxidants, nucleic acids, and other critical elements [40, 41]. Those organic sources are employed in agricultural production and are considered environmentally beneficial as they leave no residue on the soil or plant. According to Taha and Abood [42], for optimal plant growth, the plant needs nitrogen, potassium, and phosphorus. Amino acids either indirectly or directly impact the yield and growth of plants.

They lower production costs by enhancing and increasing the efficiency of the fertilizer [25, 33, 34, 46]. It was noted that amino acids have beneficial effects on reducing plant damage from abiotic stresses [26, 39]. Along with ascorbic acid content, such substances positively impact photosynthesis, respiration, and water cycle [31, 34]. Plant productivity, height, and leaf area might all be increased by such procedures [24]. Additionally, [6] discovered that applying amino acids to bitter gourd hybrids significantly increased the yield of both vegetative and fruiting growth. Transplants and fruit trees could benefit from using amino acids and chemical fertilizers, according to numerous studies conducted over the last 20 years. According to Majeed and Joody [28 a], applying amino acids at a 6g.L^{-1} concentration to date palm transplants increased the amount of phosphorus, nitrogen, and iron in the leaves Abdulraheem and Hadi [1] also reported that Royal Summer grape transplants treated with NPK fertilizer at a dose of 3gL^{-1} showed increases in leaf area and chlorophyll, phosphorus, nitrogen, and potassium content. According to Hasan and Kader [22], applying NPK fertilizer to pomegranate trees at a 3g.L^{-1} concentration resulted in a notable rise in amounts of nitrogen, potassium, and phosphorous in leaves. The study aimed to enhance and optimize the vegetative growth regarding transplants by adding soil NPK and amino acids, To "Ibrahimi" apple cultivar.

MATERIALS AND METHODS

The research was carried out on 2 years old of "Ibrahimi" apple cultivar, at Karma-Fallujah region season 2022. Three replicates and 2 factors made up factorial experiment within RCBD; the first factor has been neutral NPK fertilizer 20:20:20 with 3 soil application levels of 0, 20g, and 50g, As N0, N1, and N2, respectively; the second factor was 2 amino acids with 2 concentrations of 5ml L and 10ml L^{-1} soil application, represented as A1 and A2, respectively; the experimental unit included two transplants. Therefore, there were a total of 36 transplants. Also, transplants were placed in plastic pots holding 20 kg of soil, and t table 1 summarized the soil's physical and chemical properties.

1st April, all treatments have been administered and have been repeated every 15 days for a two-month period. The ready-made program Genstat was used to analyze the results, and the differences between the means were compared according to the least significant difference (LSD) test under the probability level of 0.05.

Table 1: Some chemical and physical characteristics of pots soil

measured characteristic	values	units
pH 1:1	7.25	
EC 1:1	1.4	$Ds.m^{-1}$
K	211.03	$ml.kg^{-1}$
P	5.25	
N	24.00	
CaCO3	251.3	$g.kg^{-1}$
O M	7.4	
Mg+2	5.35	meq .L^{-1}
Ca+2	9.13	
Cl	12.37	Meq. L^{-1}
HCO3	1.0	
Na+	1.25	
K	0.45	
Soil texture	Loamy Sand	
Loam	90	$g.kg^{-1}$
Clay	38	
Sand	872	

Studied characteristics

1-Stem height (cm): The main stem of all seedlings was standardized by marking it in the beginning of the experiment (1^{st} March) and at the end of the growing season (1^{st} January). The increase in stem length was measured from the marked area that represents the increase in stem length.

2- Shoots number (Shoot.$transplant^{-1}$): The number of Shoots in the experimental unit was calculated at the end of the experiment on (15^{th} October) and divided by a number of plants in it to extract the average.

3- Leaves number (Leaves.$transplant^{-1}$): In the end of the experiment (1^{st} January), the number of leaves in the experimental unit has been estimated as well as divided by the total number of the plants in the unit to determine the average.

4-Leaves nitrogen content (%): Nitrogen content has been calculated using procedure outlined in [12] On (15th October).

5-Leaves phosphor content (%): Phosphorus was calculated using procedure outlined by Page [36] on 15th October.

6-Leaves Potassium content (%): Potassium is estimated using approach recommended by Haynes [23] on 15th October.

7-Leaves chlorophyll content (mg. $100g^{-1}$ fresh weight): The approach Goodwin [20] has been used for estimating the leaves' chlorophyll concentration on 15th October).

8-Leaves total phenolic compounds (mg/g dry weight): The approach that has been provided by Mahadevan and Sridhar [27] has been used for estimating the total phenolic content in the leaves. On 15th October).

RESULTS

1- Stem length (cm)

Table 2 showed that chemical fertilizer has a significant effect in increasing the average length of the main stem, as the (N1) treatment was significantly different from the treatment without the addition of (N0) at a rate of 178.7 cm. It is also noted from the same table amino acids have a significant effect in increasing main stem. Treatment A2 gave the highest rate of 173.1 cm, which was significantly different from treatment A1. As for interaction, treatment between the chemical fertilizer and the amino acids (N1A2) gave the highest rate of 186.0 cm compared to the treatment (N0A1) for the stem height trait.

Table 2: Effects of NPK fertilizer and amino acids and their interaction on stem length (cm)

NPK Fertilizer (g/L)	Amino acid (ml/L)		Average
	A1	A2	
N0	150.0	179.3	164.7
N1	171.3	186.0	178.7
N2	163.3	154.0	158.7
LSD	13.74		9.72
Average	161.6	173.1	
LSD	7.93		

2- Shoot number (Shoot.transplant $^{-1}$)

Table 3 showed that chemical fertilizer NPK had a significant effect in increasing number of Shoot of the main stem, as NPK treatment (N1) was significantly distinguished by a rate of 21.67 (Shoot. transplant^{-1}) over treatment without addition of (N0), and the amino acid treatment (A2) also gave the highest rate of. 20.33 (Shoot.transplant^{-1}), which did not differ significantly from treatment (A1). As for the binary interaction, the chemical fertilizer treatment with amino acids (N1A2) gave the highest average number of Shoots, reaching 23.00 (Shoot.transplant^{-1}), which did not differ significantly from rest of treatments compared to (N0A1) treatment.

Table 3: Effects of NPK fertilizer and amino acids and their interaction on shoot number (shoot.transplant^{-1})

NPK Fertilizer (g/L)	Amino acid (ml/L)		Average
	A1	A2	
N0	7.33	21.67	14.50
N1	20.33	23.00	21.67
N2	21.33	16.33	18.83
LSD	7.06		4.99
Average	16.33	20.33	
LSD	N.S		

3- Leaves number (Leaf. Transplant^{-1})

It can be seen from Table 4 that applying chemical fertilizer has a considerable impact on leaf count. Specifically, N1 treatment resulted in a considerably higher number of leaves when put to rate of 404 (Leaf. Transplant^{-1}) comparison with N0 treatment. The highest rate was also obtained by amino acid treatment A2 rate of 341 (Leaf. transplant^{-1}), which did not differ considerably from treatment A1. The most leaves were produced by the interaction treatment between amino acids N1A2 rate of 425 (Leaf. transplant^{-1}) and NPK fertilizer, which did not differ substantially from the other treatments in comparison to N0A1 treatment.

Table4: Effects of NPK fertilizer and amino acids and their interaction on shoot number (leaf.transplant^{-1})

NPK Fertilizer (g/L)	Amino acid (ml/L)		Average
	A1	A2	
N0	230	380	305
N1	383	425	404
N2	305	219	273
LSD	101.8		72..0
Average	306	341.38	
LSD	N.S		

4- Leaves nitrogen content (%)

Leaves' nitrogen content is significantly increased by the chemical fertilizer, as shown in Table 5 giving the greatest rate of 0.190 (%) in comparison to treatment N0, which did not differ considerably from N1 treatment, allowing the N1 treatment to stand out. Nitrogen levels in the leaves were significantly increased by amino acids as well; treatment A2 produced the highest rate of 0.168(%) when put to comparison with treatment A1. Concerning the NPK-amino acid interaction, N1A2 rate of 0.203 (%) treatment produced the maximum nitrogen rate in the leaves whereas N0A1 treatment produced the lowest rate.

Table 5: Effects of NPK fertilizer and amino acids and their interaction in leaves nitrogen content (%)

NPK Fertilizer (g/L)	Amino acid (ml/L)		Average
	A1	A2	
N0	0.126	0.163	0.145
N1	0.176	0.203	0.190
N2	0.146	0.140	0.143
LSD	0.023		0.016
Average	0.150	0.168	
LSD	0.013		

5- Leaves phosphor (%)

The results in Table 6 revealed that the chemical fertilizer significantly increased the content of phosphorus leaves. When comparing treatment N1 rate of t 0.122 (%) to treatment N0, there is a substantial difference in the assessed characteristic. Additionally, amino acids significantly increase the amount of phosphorus in leaves; treatment A2 produced the highest increase rate of 0.116

(%). In terms of interaction, N1A2 rate of 0.124 (%) treatment had a much higher effect rate than the N0A1 treatment.

Table 6: Effects of NPK fertilizer and amino acids and their interaction in leaves phosphor content (%)

NPK Fertilizer (g/L)	Amino acid (ml/L)		Average
	A1	A2	
N0	0.103	0.112	0.108
N1	0.119	0.124	0.122
N2	0.112	0.113	0.113
LSD	0.004		0.003
Average	0.112	0.116	
LSD	0.002		

6- Leaves Potassium (%)

The results in Table 7 show that chemical fertilizer has a major impact on raising the potassium content of leaves; treatment N1 greatly outperformed treatment N0 in terms of rate 0.393 (%) . The same data also shows that amino acids significantly increased the amount of potassium in leaves; treatment A2 showed the highest rate of 0.378 (%) when put to comparison with treatment A1. In terms of interaction between amino acids and NPK, potassium levels in the leaves were highest under the N1A2 rate of 0.490 (%) treatment and lowest under N0A1 treatment.

Table 7: Effects of NPK fertilizer and amino acids and their interaction in leaves potassium content (%)

NPK Fertilizer (g/L)	Amino acid (ml/L)		Average
	A1	A2	
N0	0.230	0.263	0.247
N1	0.297	0.490	0.393
N2	0.343	0.380	0.362
LSD	0.079		0.056
Average	0.290	0.378	
LSD	0.045		

7- Leaves chlorophyll content (mg. 100 g^{-1} fresh weight)

Table 8 demonstrates that NPK fertilizer application significantly increased the leaves' chlorophyll content. When put to comparison with N0 treatment, N1 treatment yielded the greatest rate of 34.00 (mg. 100 g^{-1} fresh weight), which did not differ substantially from the N2 treatment. Additionally, the amino acid treatment A2 produced the highest rate, which has not been appreciably different from treatment A1. Regarding the binary interactions, the highest chlorophyll content rate of 30.0 (mg. 100 g^{-1} fresh weight) in the leaves was obtained from the chemical fertilizer treatment including amino acids N1A2 rate of 39.0 (mg. 100 g^{-1} fresh weight), which did not differ considerably from N2A1 treatment when put to comparison with N0A1 treatment.

able 8: Effects of NPK fertilizer and amino acids and their interaction in leaves chlorophyll content (mg. 100 g^{-1} fresh weight)

NPK Fertilizer (g/L)	Amino acid (ml/L)		Average
	A1	A2	
N0	28.0	23.0	25.00
N1	29.0	39.0	34.00
N2	32.0	28.0	30.00
LSD	8.9		6.6
Average	29.6	30.0	
LSD	N.S		

8- leaves total phenolic compounds (mg/g dry weight)

Table 9 results demonstrated that the chemical fertilizer had a considerable impact on the characteristics that were evaluated. Treatment N1 stood out from treatment N0 through providing the highest rate of 1.975 (mg/g dry weight), and treatment A2 provided the highest rate of 1.902 (mg/g dry weight) relative to treatment A1. Amino acids considerably affected the amount of nitrogen in the leaves. In terms of how amino acids and NPK interacted, the N1A2 treatment produced the highest nitrogen rate of 1.986 (mg/g dry weight) in leaves whereas N0A1 treatment produced the lowest rate.

Table 9: Effects of NPK fertilizer and amino acids and their interaction in leaves total phenolic compounds (mg/g dry weight)

NPK Fertilizer (g/L)	Amino acid (ml/L)		Average
	A1	A2	
N0	1.803	1.763	1.783
N1	1.926	1.956	1.941
N2	1.963	1.986	1.975
LSD	0.045		0.032
Average	1.897	1.902	
LSD	0.026		

DISCUSSION

Through providing plants with the main important nutrients as well as the direct impact of such elements on plant growth, mineral fertilizer has a positive impact on vegetative as well as chemical growth characteristics (number of branches, plant height, number of leaves, leaf content of P, N, K, chlorophyll, and phenols). A number of proteins, amino acids, and nucleic acids, including tryptophan, which enters the auxin biosynthesis pathway and is a component of chlorophyll, are synthesized with the help of nitrogen. Furthermore, this aids in promoting cell division, photosynthesis, and elongation, all of which contribute to increased vegetative growth. One of the key components in the creation of sugars, phosphorylated lipids, energy compounds, and nucleic acids is phosphorus.

As a result, when it is present in enough and ready amounts, photosynthesis is facilitated more effectively, leading to ideal plant growth. Additionally, potassium has a function in activating the enzymatic system regarding photosynthesis, which increases the rate of photosynthesis when it is available to the plant at the right levels [9, 17, 43, 45]. The outcomes of [3, 16, 44, 47] are in agreement with these results.

Due to the fact that the amino acids play a role in biological activities, particularly the processes regarding plant cell expansion and division, they might improve the vegetative as well as chemical growth characteristics, including number of branches, plant height, and number of leaves, in addition to P, N, and K content of the leaves, chlorophyll, and phenolic compounds in leaves. Additionally, they contribute to the activation of enzymes which break down organic compounds and release elements from them, boosting their readiness and therefore accelerating plant development rates [13, 35]. According to Shafeek [40], amino acid materials support the synthesis of numerous essential compounds, including carbohydrates, proteins, alkaloids, purines, enzymes, vitamins, and chlorophyll. They promote the processes regarding carbon assimilation, which produces a variety of materials for plants during growth. These findings have been consistent with those by Al-Maamory et al. [8].

CONCLUSION

Using organic acids as an alternative to chemical fertilizers because they give higher results in most of the measured characteristics of apple seedlings and are less harmful to the environment.

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تأثير السماد الأرضي لل NPK والأحماض الأمينية في النمو ومحتوى الأوراق من العناصر والفينولات الكلية لشتلات التفاح صنف الابراهيمي

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الملخص

نفذ البحث على سنتين لصنف التفاح "الابراهيمي" في منطقة الكرمة – الفلوجة. يهدف البحث إلى زيادة وتحسين النمو الخضري للشتلات من خلال إضافة التربة لسماد NPK 20:20:20 بثلاثة مستويات هي 0، 20 غم و 50 غم N0 و N1 و N2 على التوالي، والعامل الثاني شمل مستويين من الأحماض الأمينية بتركيز 5 مل لتر $^{-1}$ و10 مل لتر $^{-1}$ A1 وA2 على التوالي. وبذلك يكون هناك 36 شتلة لكل التجربة، نفذت تجربة عاملية باستخدام تصميم القطاعات الكاملة العشوائية (RCBD) بثلاث مكررات وشتلتين لكل وحدة تجريبية. أظهرت النتائج أن للسماد NPK تأثير معنوي في ارتفاع النبات (178.70 سم شتلة)، عدد الأفرع (21.67 فرع شتلة)، عدد الأوراق (404 ورقة شتلة)، ومحتوى الورقة من N,P,K (0.190، 0.122، 0.393%) على التوالي والكلوروفيل (34.00 ملغم. 100 غم وزن رطب). أما بالنسبة للمعاملة بالأحماض الأمينية فقد أعطت معاملة A2 أعلى معدل لارتفاع النبات (173.1 سم شتلة $^{-1}$)، وعدد الأفرع (20.33 فرع شتلة $^{-1}$)، وعدد الأوراق (341 ورقة شتلة $^{-1}$)، ومحتوى الورقة من N,P,K (0.168، 0.116، 0.378%)، الكلوروفيل (30.00 ملغم. 100 غم وزن رطب)، والفينولات الكلية (1.902 ملغم وزن جاف)، أما معاملة التدخل A2N2 فقد أعطت أعلى المعدلات للصفات المقاسة.

كلمات مفتاحية: تفاح، شتلات، نمو، تسميد ارضي، فينولات

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