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# Effect of Adding Biofertilizer and Amino Acids on the Growth and Mineral Content of Santa Catrina Olive Seedlings

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**Abstract**: The study, which was conducted in the Plant Production Department of Agricultural Technical College Northern Technical University sought to demonstrate the effects of bio fertilizers and amino acids on enhancing the growth characteristics and mineral composition of one-year-old Santa Catrina seedlings. Two concentrations of the biofertilizer (Gorabac G) (0 and 10 g plants$^{-1}$) were applied once on March 15th, and three levels of amino acids (Tecamin Max commercial fertilizer) (0, 5 and 10 ml l$^{-1}$) were applied three times during the season (April 10th, April 30th, and May 20th). The experiment followed the design of an RCBD that had three repetitions of five different seedlings each, which resulted in a total of 90 seedlings. The results demonstrated that the utilization of the biofertilizer at a concentration of 10 g seedling and the amino acid fertilizer at a concentration of 10 ml liter had a significant effect on all vegetative growth indicators, including increased seedling height, diameter, and number. Its leaves and branches increased the efficiency of the mineral content of the leaves of nitrogen, phosphorus and potassium, thusplacing it in a position that surpassed the rest of the treatments and recorded the lowest values in all of the studied traits.

**Key words**: Fertilization: Biofertilizer: Amino acids: Seedlings: Olives: NPK.

## 1. Introduction

Olive seedlings of the variety *Olea europaea* L. are characterized by slow growth rates compared to other fruit seedlings, which prolongs their care in the nursery and increases their production costs. To overcome this obstacle and improve the quality of seedling growth before transferring them to permanent land, it is recommended to follow an integrated fertilization program that combines chemical, organic and bio-fertilizers, with the aim of stimulating vegetative and root growth and raising the efficiency of the seedling's mineral content (**Shayal Alalam and Alalaf, 2020).** Biofertilizers are environmentally friendly alternatives due to their effective role in promoting plant growth and increasing production efficiency either qualitatively or quantitatively. Their importance is manifested in protecting

water resources and the environment from pollution, besides producing healthy safe fruits for human consumption. Moreover, these fertilizers have an important role in reducing the costs of fertilization programs by minimizing the dependence on the traditional mineral fertilizers added to fruit crops. Biofertilizers have positive effects on plants and soil through three main axes; by providing macronutrients through fixing atmospheric nitrogen, dissolving phosphorus and potassium and converting them into a form readily available for absorption; by stimulating growth through secreting natural growth hormones and regulators such as indole-3-acetic acid, gibberellic acid among others; and affecting soil sustainability through improving its physical & chemical properties by increasing organic matter& supplying it with beneficial microbial communities that enhance its fertility **(Alalaf *et al*., 2023 and Hasan *et al*., 2025)**.Many researchers have pointed to the importance of adding biofertilizers in improving the growth of fruit seedlings and their mineral content, including olive seedlings, as in the results of **Muhammad and Fakhr Al-Din (2017), Alalaf and Nameer (2020), Salim and Shler (2022), and Al-Din and Alalaf (2025).** Amino acids are involved in the chelation process as a natural chelating agent that increases the permeability of cell membranes to accelerate and ease absorption and internal transport of mineral elements thus improving stomatal regulation through increased osmotic pressure in cytoplasm guard cells whereby energy is provided for protein, vitamin, enzyme synthesis. The foliar application with amino acids enhances the plant's resistance to environmental stresses such as high temperature and salinity by reducing osmotic pressure which improves seedling vegetative growth indicators evidenced by increased content of mineral elements in leaves that enhance efficient seedling growth ready for permanent planting **(Raidasari *et al*., 2025).** These results agree with previous works which recorded the effectiveness of foliar feeding with amino acids as an important tool in stimulating vegetative growth and enhancing the efficiency of fruit seedlings' development of different types **(Yousef *et al*., 2011; Al-Isaw and Atheer, 2021; Alalaf *et al*., 2022 and Abdulqader *et al*., 2024).** The present experiment was conducted to show the effect of biofertilization and foliar spraying with amino acids on promoting vegetative growth indicators besides improving the nutritional status of olive seedlings so as to ensure producing high-quality seedlings having a strong structure that qualifies them to succeed well when cultivated permanently at location.

## 2. Materials and methods

The experiment was conducted in the Plant Production Department (Northern Agricultural Technical College) from March 1st up to October 1st ,2025. The response of Santa Catrina olive seedlings to biofertilization and spraying with amino acids besides their growth and mineral content is studied. One-year-old olive seedlings of uniform growth 40-50 cm plant height, main stem diameter3-4 mm were selected. They are planted in plastic bags(5kg) filled with river soil growing medium. All seedlings were subjected to standardized horticultural practices throughout the study period which includes irrigation, weeding, and pest control for continuous growth and uniform growing conditions. Gorabac G biofertilizer (produced by a Hungarian company) was added as a powder once on March 15, 2025, at two concentrations: 0 and 10 g1. The fertilizer contains a mixture of three bacterial genera: *Azotobacter chroococcum* (nitrogen-fixing), *Bacillus megaterium* (potassium-fixing), and *Pseudomonas putida* (phosphorus-enhancing). Inoculation was carried out by directly adding the fertilizer to the soil at a bacterial concentration of 2 x $10^6$/g. The second component was represented by the utilization of the commercial amino acid fertilizer (Tecamin Max); a product from Spain that is characterized by its high concentration of total amino acids at a rate of (14.40%) as well as free amino acids at a rate of (13.0%), in addition to organic nitrogen (8.0%) and organic matter (50.0%), with a pH of 6.6. It was employed as a spray on the foliage of the seedlings at three different concentrations (0, 5, and 10 ml $L^{-1}$) and the seedlings were sprayed three times during their growing season (10/4, 30/4, and 20/5). The experiment was conducted as a 2 × 3 experimental design with a random complete block design (RCBD). It had two components: biofertilization at two different levels and amino acid fertilizer at three different levels. The treatments were assigned with three replicates, using five seedlings per experimental unit, for a total of 90 seedlings participated in the study. At the conclusion of the

experiment, the following properties were assessed: (% of nitrogen in the leaves, % of phosphorus in the leaves, % of potassium in the leaves, the increase in height of the seedling, the increase in diameter of the seedling, the increase in number of leaves, the increase in number of branches).

## 3. Results and Discussion

The results in Table (1) indicate that the addition of bio-fertilizer or amino acids to the soil, each separately, had a significant effect on the content of mineral elements in the leaves (nitrogen, phosphorus, and potassium). The treatment of bio-fertilizer at a concentration of 10 g seedling$^{-1}$ and amino acids at a concentration of 10 ml L$^{-1}$ had the greatest significant difference compared to the control treatment. When communicating, it appears that the treatment of 10 g of seedling$^{-1}$ of bio-fertilizer plus 10 ml of amino acids had the greatest significant increase in the content of leaves of elements in comparison to the other interactions.

The outcomes in Table (2) demonstrate that the addition of bio-fertilizer had a significant impact on all of the studied vegetative growth properties. The addition of bio-fertilizer to the soil at a concentration of 10 g seedling$^{-1}$ increased the greatest significant value of (the increase in height, diameter, and number of leaves and branches), this value was significantly greater than the control. For the spraying of foliage with amino acids, it was observed that the concentration of 10 ml L$^{-1}$ was significantly more effective than the control in the studied traits. The treatment with spraying at a concentration of 5 ml L$^{-1}$ was also more effective than the control. When the two factors were combined, it became apparent that the greatest significance of the traits was achieved by the treatment that combined a concentration of 10 g seedling$^{-1}$ of bio-fertilizer with a concentration of 10 ml L$^{-1}$ of amino acids, in comparison to the other treatments.

**Table (1). Effect of adding bio-fertilizer and amino acids on the vegetative growth characteristics of olive seedlings**

| Levels of Amino Fast (ml.L$^{-1}$) | Biofertilier | | |
|---|---|---|---|
| | **Control** | **10 g seedlings$^{-1}$** | **Means** |
| | **Nitrogen (%)** | | |
| **0** | 1.837 d | 2.050 cd | **1.943 c** |
| **5** | 2.190 c | 2.680 b | **2.435 b** |
| **10** | 2.573 b | 2.993 a | **2.783 a** |
| **Means** | **2.200 b** | **2. 574 a** | |
| **Phosphorus (%)** | | | |
| **0** | 0.151 f | 0.324 e | **0.237 c** |
| **5** | 0.237 d | 0.507 c | **0.372 b** |
| **10** | 0.581 b | 0.707 a | **0.644 a** |
| **Means** | **0.323 b** | **0.512 a** | |
| **Potassium (%)** | | | |
| **0** | 0.430 e | 0.577 d | **0.503 c** |
| **5** | 0.740 c | 0.710 c | **0.725 b** |
| **10** | 0.933 b | 1.103 a | **1.018 a** |
| **Means** | **0.701 b** | **0.797 a** | |

**Table (2). Effect of adding bio-fertilizer and amino acids on the mineral content of olive seedlings**

| Levels of Amino Fast ($ml.L^{-1}$) | Biofertilier | | |
|---|---|---|---|
| | Control | 10 g seedlings$^{-1}$ | Means |
| | Length transplants (cm) | | |
| **0** | 61.41 d | 72.84 c | **67.13 c** |
| **5** | 72.55 c | 70.80 c | **71.68 b** |
| **10** | 78.56 b | 83.25 a | **80.90 a** |
| **Means** | **70.84 b** | **75.63 a** | |
| **Number of leaves (leaf. transplant$^{-1}$)** | | | |
| **0** | 104.7 c | 129.3 b | **117.0 c** |
| **5** | 132.3 b | 135.7 b | **134.0 b** |
| **10** | 139.7 b | 159.0 a | **149.3 a** |
| **Means** | **125.6 b** | **141.3 a** | |
| **Number of branches (Branch. transplant$^{-1}$)** | | | |
| **0** | 2.33 c | 3.67 c | **3.00 c** |
| **5** | 3.33 c | 5.67 b | **4.50 b** |
| **10** | 6.33 b | 8.33 a | **7.33 a** |
| **Means** | **4.00 b** | **5.89 a** | |
| **Diameter transplants (mm)** | | | |
| **0** | 3.893 c | 5.347 b | **4.620 b** |
| **5** | 4.513 c | 5.453 b | **4.983 b** |
| **10** | 6.033 b | 7.477 a | **6.755 a** |
| **Means** | **4.813 b** | **6.092 a** | |

The significant improvement in vegetative growth characteristics and leaf mineral content of the 10 g seedling biofertilizer treatment is attributed to the crucial role of the *Azotobacter chroococcum* bacteria present in the fertilizer. Their importance lies in increasing nutrient availability in the seedling rhizosphere, particularly nitrogen. They are chief participants in the process of biological nitrogen fixation, hence a leading role among all free-living and associative diazotrophs for transformation from its primary gaseous state into a fixed form taken up as ammonium ions available for absorption specifically by these organisms possessing an enzyme system capable to break triple bonds between atoms within molecules forming atmospheric N2 thus ensuring continuous flow towards roots with positive impact on development structural components enhancing growth efficiency **(Nongthombam *et al*., 2021 and Al-Baldawy *et al*., 2023).** Increased availability has stimulated uptake through root system then translocation, this was clearly reflected in the increased nitrogen content of leaves, a cornerstone of plant life, as nitrogen is directly involved in the formation of amino acids and structural and functional proteins. Furthermore, absorbed nitrogen plays a pivotal role in the synthesis of nucleic acids (DNA and RNA), enzymes, and plant hormones that support growth, making it the primary driver of the formation of vital parts and the increase in vegetative mass of seedlings **(Havlin *et al*., 2005).** As a result, all of this had a positive impact on the growth properties of the seedlings' olives. The fertilizer also contains *Bacillus subtilus* bacteria in addition to *chroococcum Azotopacter* bacteria, the two types have multiple functions, including producing some vitamins, such as riboflavin, thiamine, amino acids, and growth regulators, such as gibberellins and auxins, which have a positive effect on the enhancement of

vegetative growth characteristics. Additionally, they attempt to enhance the chemical and biological properties of the soil, which would release the greatest possible amount of mineral elements that could be absorbed by the roots. This increases the capacity of the roots to absorb water and other mineral components, this is reflected positively in the ability of the plants to increase the efficiency of their photosynthesis process, which leads to an increase in the vegetative growth characteristics of the seedlings **(Abioye and David, 2024).**

Regarding the significant advantage of foliar spraying with amino acids, particularly at a concentration of 10 ml $L^{-1}$, in increasing leaf mineral content, this can be explained by the direct role of these compounds in plant nutrition. Nitrogen is the primary component in the structure of amino acids. Foliar application enters quickly through both stomata and the waxy cuticle, thus providing organic nitrogen- a source that does not need to undergo any complex metabolic pathway for mineral nitrogen assimilation. This resulted in an increase of total nitrogen content within leaf tissues **(Sotiropoulos *et al*., 2023).** They enhance directly or indirectly different physiological activities because they form metabolic enzymes, vitamins, endogenous growth regulators synthesized within plants; protoplasm formation where cell division and elongation efficiency is increased by them. Increased biological activity supports structural development at cellular level together with activation of biochemical reactions manifested finally as vegetative growth and development. It also increases enzyme activity, which breaks down organic compounds, releasing certain elements and increasing their availability and translocation to the leaves, where they accumulate and increase their concentration, leading to higher plant growth rates. That is exactly how inorganic elements are mobilized from dead organic matter in the soil through mineralization by microbes which mostly belong to bacteria in soils with high aeration or fungi dominate poorly aerated soils. **(Al-Janabi, 2020 and Mohamed, 2020).**

## 4. Conclusions and Recommendations

The results confirm the effective and positive role of combining biofertilization and amino acid foliar application on growth efficiency and mineral content of Santa Catrina olive seedlings. A treatment combination containing 10 g per seedling of biofertilizer with 10 ml $L^{-1}$ amino acids recorded significant improvement in all studied indicators. Therefore, the study recommends adopting these fertilization treatments to produce strong, fast-growing seedlings that will be used for earlier transplanting to their permanent location, hence reducing the nursery development period.

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# تأثير اضافة السماد الحيوي والاحماض الامينية في النمو والمحتوى المعدني لشتلات الزيتون صنف Santa catrina

**فارس فيصل عبدالغني الزهيري**

**قسم تقنيات مكافحة التصحر ، الكلية التقنية الزراعية ، الجامعة التقنية الشمالية ، العراق**

**الخلاصة**

استهدفت هذه الدراسة المنفذة في قسم الإنتاج النباتي بالكلية التقنية الزراعية الجامعة التقنية الشمالية بيان تأثير السماد الحيوي والأحماض الأمينية في تحسين مؤشرات النمو والمحتوى المعدني لشتلات الزيتون صنف (Santa Catrina) بعمر سنة واحدة من خلال اضافة تركيزين من السماد الحيوي (Gorabac G) وهما (٠ و١٠ غم شتلة−١) واضيف مرة واحدة بتاريخ ٣/١٥ ، وثلاث مستويات من الاحماض الاميني بشكل سماد تجاري Tecamin Max وهي (٠، ٥ و١٠ مل لتر−١) واضيف ثلاث مرات خلال موسم النمو (٤/١٠ و ٤/٣٠ و٥/٢٠)، صممت التجربة وفق تصميم RCBD بثلاث مكررات وبخمسة شتلات لكل مكرر وبذلك بلغ عدد الشتلات المستخدمة في التجربة ٩٠ شتلة، من خلال النتائج تبين ان اضافة السماد الحيوي بتركيز ١٠ غم شتلة−١ والسماد الاميني بتركيز ١٠ مل لتر−١ سجلا تفوقاً معنوياً ملحوظاً لكافة مؤشرات النمو الخضري، بما في ذلك الزيادة في ارتفاع الشتلات وقطرها وعدد أوراقها وأفرعها، بالإضافة إلى رفع كفاءة المحتوى المعدني للأوراق من عناصر النتروجين والفسفور والبوتاسيوم، متجاوزةً بذلك بقية المعاملات وبفارق إحصائي كبير عن معاملة المقارنة التي سجلت أدنى القيم في الصفات المدروسة كافة.

**الكلمات الدالة :** تسميد ، حيوي: احماض امينية ، شتلات ، الزيتون ، NPK