Effect of adding palm frond waste and spraying with tryptophan on the vegetative growth traits of olive seedlings of Manzanillo and Bashiqi cultivars

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Abstract

The experiment was carried out in the plant canopy of the Department of Horticulture and Landscape Engineering/College of Agriculture, University of Kerbala, located in the Al-Husseiniyah area in Kerbala Governorate, on 11/10/2023. The experiment aimed to determine the best level of palm frond waste, along with determining the best concentration of tryptophan acid and the extent of their effect. On some characteristics of vegetative growth of olive seedlings, the experiment was carried out according to a randomized complete block design (RCBD) according to the order of the factorial experiment, with three replications. The first factor included two varieties of olive (Manzanillo and Bashiqi), while the second factor included three levels of palm frond waste (0, 3% and 6%) and the third factor included three concentrations of tryptophan acid (0, 75 and 150 ml L^{-1}). The results showed that the Manzanillo cultivar excelled in seedling height, stem diameter, number of leaves per seedling, leaf area, relative moisture content of leaves, and the percentage of dry matter of the shoot system, with averages of (25.385 cm, 2.083 mm, 537.60 leaf $seedling^{-1}$, 21.497 cm^2, 77.615% and 61.071% respectively). It was also noted that the addition of palm frond waste had a significant effect, as the third level (6%) excelled in all of the aforementioned traits with averages of (28.811 cm, 2.442 mm, 611.50 leaf $seedling^{-1}$, 24.648 cm^2, 79.977%, and 70.957%). As for spraying with tryptophan acid, it was observed that the concentration (150 ml L^{-1}) was superior to the same traits with averages of (24.689 cm, 2.124 mm, 529.50 leaf $seedling^{-1}$, 21.351cm^2, 76.760% and 61.894%). The results also showed that the interactions between the factors were significant in all the characteristics under study.

Keywords: Olive, Palm frond waste, Tryptophan acid, Vegetative growth indicators.

Introduction

Olive (*Olea europaea* L.) is an evergreen tropical fruit that lasts for hundreds of years and belongs to the Oleaceae family, which includes 30 genera, including the genus Olea sp. Which includes 35 species, including olives, which is the only species that is of economic importance and has fruits suitable for human consumption [1]. The slow growth of olive seedlings and the time period required to reach the stage suitable for sale are among the main problems in increased production costs by farmers, which necessitated the use of organic fertilizers, including palm frond waste and amino acids [2].

Studies have recently focused on the use of organic fertilizers, as organic materials are defined as natural materials consisting of the remains of plants, animals, and primitives[3]. Organic fertilizers contain important nutrients that improve the soil structure and increase its ability to retain water and nutrients, they also encourage the growth of beneficial microorganisms in the soil, which help decompose organic materials and release nutrients in a way that plants can benefit from, therefore, it is a balanced group. It contains essential nutrients such as nitrogen, phosphorus, and potassium, in addition to microelements. In addition, it helps in environmental sustainability, as the use of organic fertilizers reduces dependence on chemical fertilizers that can be harmful to the environment when used excessively [4]. In a study conducted by [5] when adding fertilizer prepared from palm frond waste to the soil at a level of 250 g of seedlings^{-1}, it led to an increase in the number of leaves, leaf area, and length of branches on olive seedlings.

Foliar feeding is a complementary method to ground fertilization and is not a substitute for it. It has become necessary to spray nutrients on the aggregate and vegetative growth of the plant to overcome these problems. Foliar feeding aims to develop flower buds in the vegetative growths of fruit seedlings to build bearing units in the future [6]. Spraying amino acids on plants has a major role in stimulating biochemical and physiological processes, as these acids participate in the manufacture of carbohydrates. By building chlorophyll and stimulating the process of photosynthesis [7]. A study he carried out [8] it was found that spraying Valencia orange trees with the amino acid tryptophan at a concentration of (0, 25, 50, and 100 mg L^{-1}) caused a significant increase in most of the vegetative growth characteristics (branch length, branch diameter, number of leaves, leaf area, Where the spray treatment at a concentration of 100 mg L^{-1} showed significant superiority over the rest of the concentrations and for all the mentioned traits. As found [9] when spraying the amino acid tryptophan at concentrations (0, 100, 200 and 500 mg L^{-1}) on palm trees, it led to an improvement in vegetative characteristics, leaf area, and number of leaves, as the spraying treatment with tryptophan at a concentration of 500 mg L^{-1} showed It was significantly superior to the rest of the concentrations. Therefore, the experiment aimed to determine the best level of palm frond waste and the best concentration of the amino acid tryptophan and their effect in improving the vegetative growth characteristics of olive seedlings of Manzanillo and Bashiqi varieties.

Materials and Methods

The experiment was carried out in the plant canopy of the Department of Horticulture and Landscape Engineering/College of Agriculture, University of Kerbala, located in the Al-Husseiniyah area in Kerbala Governorate, for the period from 11/10/2023 until 1/7/2024. 270 one-year-old olive seedlings (Manzanillo and Bashiqi) were selected, influenced by the amount of potential in their size, vegetative growth, and collections of pathological and mechanical signs. The plants were attracted from the Department of Horticulture in Hindi/Tuwayrej/Kerbala.The experiment aimed to determine the best level of palm frond waste, along with determining the best concentration of tryptophan acid and the extent of their effect. On some characteristics of vegetative growth of olive seedlings, the experiment was carried out according to a randomized complete block design (RCBD) according to the order of the factorial experiment, with three replications. The first factor included two varieties of olive (Manzanillo and Bashiqi), while the second factor included three levels of palm frond waste (0, 3% and 6%) The components of the absence of palm fronds were analyzed in the laboratories of the Karbala Agriculture Directorate and were found to be as follows(2.66, EC) pH, 7.04) and (43.7 C%) and (C/N%, 19.0) and (2.93) Ca and (mg% 0.580) and (k%, 2.80) and (P%, (0.650)%N,2.30) and (cu%,50)and the third factor included three concentrations of tryptophan acid (0, 75 and 150 ml L^{-1}). Thus, the total number of experimental units is (54) experimental units, each replicate includes (18) treatments, with (5) seedlings per experimental unit. Tryptophan acid was sprayed an average of 4 times every month, starting from 15/10/2023 until 15/11/2023. Spraying was stopped in the months of December and January,Because it is directly linked to a slowdown in temperature and humidity, which slows down the movement of fertilizer in the leaves. The higher the temperature, the less fertilizer, which stops spraying in the monthly period .December and January and the spraying process was resumed for the spring season with three sprays starting from 15/2/ _ 15/4/2024. and spraying was done after watering the seedlings one day before the spraying date in order to increase the efficiency of the plant in absorbing the sprayed material, as moisture has an important role in the process of swelling of guard cells and opening of stomata, in addition to the fact that watering before spraying works to reduce the concentration of solutes in the leaf cells, thus increasing From the penetration of ions of the spray solution into the leaf cells [10].

Data recorded

Seedling height (cm): The increase was measured by finding the difference in stem height before and after the study treatments, using a measuring tape graduated from the surface of the soil to the top of the main stem, and extracting the average in each experimental unit for the treatments used in the study and for each replicate.

Seedling diameter (mm): The increase in stem diameter was measured before and after the study treatments at a distance of 5 cm from the soil surface, using a digital foot (Vernier), and the average was extracted in each experimental unit for the treatments used in the study and for each replicate.

Number leaves (leaf seedling^{-1}): The total number of leaves for each seedling was calculated at the end of the study, and then the average number of leaves in each experimental unit was extracted for the treatments used in the study and for each replicate.

Leaf area (cm^2): The leaf area was calculated by gravimetric method, based on dry weight, and based on [11], where five leaves were taken for each fully expanded seedling, and 5 pieces with an area of 0.5 cm^2 were taken using a cork drill (driller). The leaves and pieces were dried in an electric oven at a temperature of 70°C until the weight was stable. Then the dry weight of the leaves and the dry weight of the pieces was recorded and the average was calculated. Then the area of one leaf was calculated according to the following equation:

$$\text{Leaf area (cm2)} = \frac{\text{Mean leaf weight (g) x average area of the cut part of the leaf}}{\text{Mean weight of cut part (g)}}$$

Relative moisture content of leaves (%): The moisture content in the leaves of pomegranate seedlings was estimated according to the method of [12] by weighing 20 wet leaves for each seedling of the experimental units with a sensitive balance with a sensitivity of 0.0001, recording their wet weight, and then submerging them in water. Distilled for 16-18 hours at room temperature 23 - 25 ° C and under low light conditions, with the aim of saturating the leaves with distilled water and recording the weight of the swollen leaves in the state of saturation. Then, the leaves were dried in the electric oven at a temperature of 70 ° C ± 1, until the weight was stabilized and recorded. The dry weight of the leaves and then calculate the relative moisture content of the leaves for each treatment according to the following equation:

$$\text{Relative moisture content of leaves (\%)} = \frac{\text{Wet weight} - \text{dry weight of the leaf}}{\text{Swelling weight} - \text{the dry weight of the leaf}}$$

Percentage of dry matter of the shoot system (%): The percentage of dry matter of the shoot was measured by separating the shoot from the root system in the crown area and taking the wet weight of the leaves, stem and branches (shoot). The dry weight was then taken after placing them in perforated paper bags in an electric oven at a temperature of 70°C until Weight stability. It was weighed with a sensitive balance and the percentage of dry matter of the shoot was calculated. The average wet and dry weight of the shoot for each experimental unit was extracted from the experimental treatments and the percentage was calculated as follows[13]:

Statistical analysis

The results were statistically analyzed according to the analysis of variance (ANOVA) as per the randomized complete block design (R.C.B.D), the least significant difference ($L.S.D_{0.05}$) test was used to compare and separate the means [14], this is done using statistical analysis software GenStat12.

Results and Discussion

Seedling height (cm)

Table (1) indicates the significant effect of the variety, palm frond waste, and spraying with the amino acid tryptophan on the mean increase in seedling height. The Manzanillo variety outperformed the Bashiqi variety in giving the highest average increase for this trait, amounting to 25.385 cm, compared to the Bashiqi variety, which recorded the lowest average of 19.681 cm. An increase of 28.98%. The increase in the levels of palm frond waste led to an increase in this trait, as the 6% treatment of palm frond waste gave the highest mean of 28.811 cm, while the lowest average in the comparison treatment was 16.611 cm, and the percentage of increase was 73.44%. It was found that increasing the concentrations of amino acid tryptophan led to an increase in this trait, as the 150 mg L^{-1} amino acid tryptophan treatment gave the highest average of 24.689 cm, while the lowest average of 20.467 cm in the comparison treatment, and the increase rate reached 20.62%. The binary interactions between the study factors showed a significant effect on the average of this trait. The Manzanillo variety with a level of 6% palm frond waste gave the highest average of 32.289 cm, while the lowest average of the Bashiqi variety without adding palm frond waste amounted to 14.732 cm, an increase of 119.16%. When treated with 150 mg L^{-1} of the amino acid tryptophan, the Manzanillo variety gave the highest mean of 27.489 cm and the lowest average of the Bashiqi variety when treated as a comparison amounted to 17.844 cm, with an increase rate of 54.05%. The effect of the interaction between palm frond waste and the amino acid tryptophan on the average increase in this trait. The treatment with 150 mg L^{-1} amino acid tryptophan and the 6% palm frond waste treatment gave the highest average of 31.933 cm, while the lowest average was in the comparison treatment (0 palm frond waste +0 amino acid tryptophan) amounted to 14.833 cm, with an increase rate of 115.28%. The effect of the triple intervention was significant in increasing the average of this trait, as the Manzanillo variety gave a level of 6% palm frond waste and a concentration of 150 mg L^{-1} amino acid tryptophan and the highest average reached 34.800 cm, while the variety gave Bashiqi. Without adding palm leaf waste and the amino acid tryptophan, the lowest average was 13.333 cm, with an increase of 161.00%.

Table (1): Effect of cultivar, palm frond waste, tryptophan acid and their interaction on the average increase in seedling height.

Cultivars	**Frond waste Palm (%)**	**Tryptophan acid concentrations**			**Cultivars × Palm frond waste**
		0	75	150	
Manzanillo	0	16.333	18.867	20.267	18.489
	3	23.133	25.600	27.400	25.378
	6	29.800	32.267	34.800	32.289
Bashiqi	0	13.333	14.667	16.200	14.733
	3	17.667	18.867	20.400	18.978
	6	22.533	24.400	29.067	25.333
$L.S.D_{0.05}$		0.6947			0.4011
mean tryptophan acid		20.467	22.444	24.689	mean cultivars
$L.S.D_{0.05}$		0.2836			
Cultivars × Tryptophan					
Manzanillo		23.089	25.578	27.489	25.385
Bashiqi		17.844	19.311	21.889	19.681
$L.S.D_{0.05}$		0.4011			0.2316
Palm frond waste x Tryptophan					**mean palm frond waste**
0		14.833	16.767	18.233	16.611
3		20.400	22.233	23.900	22.178

6	26.167	28.333	31.933	28.811
L.S.D$_{0.05}$	0.4912			0.2836

Seedling diameter (mm)

The results of the statistical analysis in Table (2) show that there is a significant difference in the average increase in seedling diameter for the variety, palm frond waste, and amino acids. The Manzanillo variety outperformed the Bashiqi variety in giving the highest average increase in this trait, as it reached 2.083 mm compared to the Bashiqi variety, which recorded the lowest. The average reached 1,811 mm and the increase rate reached 15.01%. The increase in palm frond waste levels also affected the average diameter of the seedlings, as the 6% level of palm frond waste gave the highest average of 2.442 mm, while the lowest average amounted to 1.505 mm when treated as a comparison, and the increase rate reached 62.25%. Also, increasing the concentrations of amino acids led to an increase in this trait, as the treatment with 150 mg L^{-1} of the amino acid tryptophan gave the highest average. 2.124 mm, while the lowest average in the comparison treatment was 1.781 mm, and the percentage of increase was 19.25%. The binary interactions between the study factors showed a significant effect on the average increase for this trait, as the Manzanillo variety gave the highest average for this trait when treated with a level of 6% palm frond waste, which amounted to 2.669 mm, and the lowest average for the Bashiqi variety when treated as a comparison amounted to 1.454 mm, with an increase rate of 83.56%. Also, the Manzanillo variety, when treated with a concentration of 150 mg L^{-1} of amino acids, gave the highest average amounting to 2.290 mm, while the lowest average of the Bashiqi variety without adding amino acids amounted to 1.640 mm, with an increase rate of 39.63%. Effect The interaction between palm frond waste and the amino acid tryptophan in the average increase for this trait. The 6% palm frond waste treatment and the 150 mg L^{-1} amino acid treatment gave the highest average of 2.716 mm, while the lowest average was in the comparison treatment (0 palm frond waste + 0 amino acids). It reached 1.392 mm, with an increase rate of 95.11%. The triple intervention had a significant effect on the average increase in this trait, as the Manzanillo variety, when treated with a concentration of 6% palm leaf waste and 150 mg L^{-1} amino acids, gave the highest average amounting to 2.987 mm, while the Bashiqi variety without adding palm leaf waste and the amino acid tryptophan gave the lowest average amounting to 1.347 mm, an increase of 121.75%.

Table (2): Effect of cultivar, palm frond waste, tryptophan acid and their interaction on the average increase in seedling diameter.

Cultivars	Frond waste Palm (%)	Tryptophan acid concentrations			Cultivars × Palm frond waste
		0	75	150	
Manzanillo	0	1.437	1.583	1.647	1.555
	3	1.875	1.967	2.237	2.026
	6	2.457	2.563	2.987	2.669
Bashiqi	0	1.347	1.464	1.553	1.454
	3	1.641	1.774	1.878	1.764
	6	1.934	2.267	2.445	2.215
L.S.D0.05		0.6947			0.0010
mean tryptophan acid		1.781	1.936	2.124	mean cultivars
L.S.D0.05		0.0007			
Cultivars × Tryptophan					
Manzanillo		1.923	2.037	2.290	2.083
Bashiqi		1.640	1.835	1.958	1.811
L.S.D0.05		0.0010			0.0005
Palm frond waste x Tryptophan					mean palm frond waste
0		1.392	1.523	1.600	1.505
3		1.758	1.870	2.057	1.895
6		2.195	2.415	2.716	2.442
L.S.D 0.05		0.4912			0.0007

Leaves number (leaf seedling^{-1})

Table (3) shows a significant effect of the variety, palm leaf waste, and the amino acid tryptophan on the average increase in the number of leaves per seedling, as the Manzanillo variety outperformed the Bashiqi variety in giving the highest average for this trait, amounting to 537.60 leaf seedling^{-1}, compared to the Bashiqi variety, which recorded the lowest. An average of 454.93 leaf seedling^{-1}, the increase rate was 18.17%. It was also found that increasing the levels of palm frond waste led to an increase in this characteristic, as a 6% treatment of palm frond waste gave the highest average of 611.50 leaf seedling^{-1}, while the lowest average amounted to 381.33 leaf seedling^{-1}at in the comparison treatment, the increase rate was 60.35%. Also an increase The concentrations of amino acids led to an increase in this trait, as the 150 mg L^{-1} amino acid treatment gave the highest average of 529.50 leaf seedling^{-1}, while the lowest average in the comparison treatment amounted to 459.27 leaf seedling^{-1}, the percentage of increase was 15.29%. The results showed that the binary interaction between The study factors had a significant effect on the average of this trait. The Manzanillo variety, when treated with 6% palm frond waste, gave the highest average for this trait, which amounted to 627.53 leaf seedling^{-1}, the lowest average for the Bashiqi variety when treated with the comparison treatment amounted to 312.47 leaf seedling^{-1}, an increase of 100.82%. The Manzanillo variety, when treated with a concentration of 150 mg L-1 of amino acids, gave the highest average of 572.93 leaf seedling^{-1}, while the lowest average was lost to the Bashiqi variety without the addition of amino acids. It reached 432.13 leaf seedling^{-1}, an increase of 32.58%. The effect of the interaction between palm leaf waste and the amino acid tryptophan on the average of this trait. The treatment of 6% palm leaf waste and the treatment of 150 mg L^{-1} of amino acids gave the highest average of 655.20 leaf seedling^{-1}, while the lowest. The average for the comparison treatment (0 palm frond residue + 0 amino acids) reached 340.50 leaf seedling^{-1}, with the increase rate reaching 92.42%. The triple intervention had a significant effect in increasing the average of this trait, as the Manzanillo variety gave the result when treated with a concentration of 6% palm frond residue and 150 mg L^{-1} amino acids had the highest average of 665.80 leaf seedling^{-1}, while the Bashiqi variety without adding palm leaf waste and the amino acid tryptophan gave the lowest average of 293.00 leaf seedling^{-1}, with an increase rate of 127.23%.

Table (3): Effect of cultivar, palm frond waste, tryptophan acid and their interaction on the average increase in leaves number.

Cultivars	Frond waste Palm (%)	Tryptophan acid concentrations			Cultivars × Palm frond waste
		0	75	150	
Manzanillo	0	388.00	477.20	485.40	450.20
	3	493.00	544.60	567.60	535.07
	6	578.20	638.60	665.80	627.53
Bashiqi	0	293.00	318.20	326.20	312.47
	3	437.00	446.20	487.40	456.87
	6	566.40	575.40	644.60	595.47
L.S.D$_{0.05}$		6.150			3.551
mean tryptophan acid		459.27	500.03	529.50	mean cultivars
L.S.D$_{0.05}$		2.511			
Cultivars × Tryptophan					
Manzanillo		486.40	553.47	572.93	537.60
Bashiqi		432.13	446.60	486.07	454.93
L.S.D$_{0.05}$		0.0010			2.050
Palm frond waste x Tryptophan					mean palm frond waste
0		340.50	397.70	405.80	381.33
3		465.00	495.40	527.50	495.97
6		572.30	607.00	655.20	611.50
L.S.D$_{0.05}$		0.4912			2.511

Leaf area (cm^2)

Table (4) shows a significant effect of the variety and the concentrations of palm frond waste and the amino acid tryptophan on the average area per leaf of seedlings. The

Manzanillo variety outperformed the Bashiqi variety in giving the highest average for this trait, reaching 21.497 cm^2, compared to the Bashiqi variety, which recorded the lowest average, amounting to 17.588 cm^2. The percentage of increase was 22.28%, and the increase in the levels of palm frond waste led to an increase in this characteristic, as the treatment of 6% palm frond waste gave the highest average amounting to 24.648 cm^2, while the lowest average amounted to 14.731 cm^2in the comparison treatment, and the increase percentage was 67.32%. It was also found that an increase in concentration Amino acids lead to This trait increased, as the treatment with 150 mg L^{-1} of the amino acid tryptophan gave the highest average amounting to 21.351 cm^2, while the lowest average in the comparison treatment amounted to 17.759 cm^2, with an increase rate of 20.22%. The bilateral interactions between the study factors showed a significant effect on the average of this trait, so the variety gave Manzanillo, when treated with 6% palm frond waste, had the highest average for this trait, amounting to 26.950 cm^2, the lowest average for the Bashiqi variety, when treated in comparison, amounted to 13.397 cm^2, with an increase rate of 101.16%. The Manzanillo variety, with a concentration of 150 mg L^{-1} of the amino acid tryptophan, gave the highest average, amounting to 23.294, while it was the lowest. mean for the class Bashiqi, at a concentration of 0, it reached 15.981, with an increase rate of 45.76%. The effect of the interaction between palm frond waste and the amino acid tryptophan on the average of this characteristic. The treatment with 150 mg L^{-1} of the amino acid tryptophan and the treatment with 6% palm frond waste gave the highest average of 26.931 cm^2, while the lowest average. When compared with the comparison treatment (0 palm frond waste + 0 the amino acid tryptophan), it reached 13.020 cm^2, with the increase rate reaching 106.84%. The effect of the triple intervention was significant in increasing the average of this trait, as the Manzanillo variety gave a level of 6% palm frond residue and a concentration of 150 mg L^{-1} of the amino acid tryptophan. The highest average amounted to 28.663 cm^2, while the Bashiqi variety without adding palm leaf waste and the amino acid tryptophan gave the lowest average, amounting to 11.803 cm^2, with an increase rate of 142.84%.

Table (4): Effect of cultivar, palm frond waste, tryptophan acid and their interaction on the average increase in leaf area.

Cultivars	Frond waste Palm (%)	Tryptophan acid concentrations			Cultivars × Palm frond waste
		0	75	150	
Manzanillo	0	14.238	15.955	17.999	16.064
	3	19.398	21.816	23.219	21.478
	6	24.976	27.210	28.663	26.950
Bashiqi	0	11.803	13.445	14.944	13.397
	3	15.953	17.020	18.084	17.097
	6	20.188	21.653	25.198	22.346
L.S.D0.05		0.5472			0.3159
mean tryptophan acid		17.759	19.517	21.351	mean cultivars
L.S.D0.05		0.2234			
Cultivars × Tryptophan					
Manzanillo		19.537	21.660	23.294	21.497
Bashiqi		15.981	17.373	19.409	17.588
L.S.D0.05		0.3159			0.1824
Palm frond waste x tryptophan					mean palm frond waste
0		16.472	14.700	13.020	14.731
3		20.651	19.418	17.675	19.248
6		26.931	24.432	22.582	24.648
L.S.D0.05		0.3869			0.2234

Relative moisture content of leaves (%)

From Table (5), which shows the significant effect of the variety and the concentrations of palm leaf waste and the amino acid tryptophan on the relative moisture content of the leaves, the Manzanillo variety outperformed the Bashiqi variety in giving the highest average for this trait, reaching 77.615% , compared to the Bashiqi variety, which recorded the lowest average, amounting to 72.416%, The percentage of increase reached 7.17%. The table also showed that increasing levels of palm frond waste led to an increase in this characteristic. The 6% treatment gave the highest average of 79.977%, while the lowest average in the comparison treatment amounted to 70.512% in the comparison treatment, and the percentage increase reached 13.42%. It was also found that increasing the concentrations of amino acids led to an increase in this trait, as the treatment with 150 mg L^{-1} gave the amino acid tryptophan higher. The average was 76.760%, while the lowest average was 73.303% and the percentage increase was 4.71%. The binary interactions significantly affected the average of this trait, as the Manzanillo variety with a level of 6% palm frond residue gave the highest average amounting to 82.313%, while the lowest average loss of the Bashiqi variety without adding palm frond residue amounted to 67.780%, with an increase rate of 21.44%. The Manzanillo variety, at a concentration of 150 mg L^{-1} tryptophan, gave the highest average, amounting to 79.112%. While the

Bashiqi variety, at a concentration of 0 tryptophan, gave the lowest average, amounting to 70.607%. With an increase rate of 12.04%. The effect of the interaction between palm leaf waste and the amino acid tryptophan on this average. Characteristic, it was treated with 6% palm frond waste and 150 mg L^{-1} The amino acid tryptophan had the highest average, reaching 82.228%, while the lowest average in the comparison treatment (0 palm leaf waste + 0 amino acid tryptophan) reached 69.011%, with the increase rate reaching 19.15%. The effect of the triple intervention was significant in increasing the average of this trait, as the Manzanillo variety, with a level of 6% palm frond waste and a concentration of 150 mg L^{-1}, gave the amino acid tryptophan the highest average, amounting to 82.228%, while the Bashiqi variety without adding palm frond waste and the amino acid tryptophan gave the lowest average, amounting to 66.501%. An increase of 26.20%.

Table (5): Effect of cultivar, palm frond waste, tryptophan acid and their interaction on the average increase in relative moisture content of leaves.

Cultivars	Frond waste Palm (%)	Tryptophan acid concentrations			Cultivars × Palm frond waste
		0	75	150	
Manzanillo	0	71.520	73.585	74.627	73.244
	3	76.022	77.063	78.780	77.288
	6	80.459	82.554	83.927	82.313
Bashiqi	0	66.501	67.900	68.941	67.780
	3	70.005	71.716	73.758	71.826
	6	75.315	77.081	80.529	77.642
L.S.D0.05		0.5823			0.3362
mean tryptophan acid		73.303	74.983	76.760	mean cultivars
L.S.D0.05		0.2377			
Cultivars × Tryptophan					
Manzanillo		76.000	77.734	79.112	77.615
Bashiqi		70.607	72.232	74.409	72.416
L.S.D0.05		0.3159			0.1941
Palm frond waste x Tryptophan					mean palm frond waste
0		69.011	70.742	71.784	70.512
3		73.013	74.389	76.269	74.557
6		77.887	79.817	82.228	79.977
L.S.D0.05		0.4117			0.2377

Percentage of dry matter of the shoot system (%)

Table (6) indicates that the effect of the variety and the concentrations of palm frond waste and the amino acid tryptophan was significant on the percentage of dry matter of the shoot, as the Manzanillo variety outperformed the Bashiqi variety in giving the highest average for this trait, amounting to 61.071%, compared to the Bashiqi variety, which recorded the lowest. The average was 55.985% and the increase rate was 9.08%. It was also found that increasing the concentrations of palm frond waste led to an increase in this characteristic, as the 6% treatment gave palm frond waste the highest average of 70.957%, while the lowest average in the comparison treatment was 47.027% and the increase rate was 50.88%, Increasing the concentrations of amino acids led to an increase in this trait, as the treatment with 150 mg L^{-1} of the amino acid tryptophan gave the highest average. It reached 61.894%, while the lowest average was 54.761% when compared to the comparison treatment, and the increase rate was 13.02%. The table showed that there was a significant effect between the study factors on the average of this trait, as the Manzanillo variety, when treated with a level of 6% palm frond residue, gave the highest average, amounting to 72.723%, while the Bashiqi variety, without adding palm frond residue, gave the lowest average, amounting to 43.205%, with an increase rate of 68.32%. The binary interaction between palm frond waste and the amino acid tryptophan had a significant effect on the average of this trait, as the treatment with 6% palm frond waste and the treatment with 150 ml L^{-1} of the amino acid tryptophan gave the highest average 75.451%, while the lowest average at the maximum limits (0 palm frond waste + 0 amino acids) reached 44.441%, with the total percentage of excellence being 69.77%. The effect of the triple intervention was significant in increasing the average of this trait, as the Manzanillo variety gave 6% free when complete. Palm frond and 150 ml L^{-1} of the amino acid tryptophan had the highest average amounting to 76.205%, while the Bashiqi variety without the addition of palm frond and the amino acid tryptophan had the lowest average amounting to 40.854%, an increase in quantity of 86.53%.

Table (6): Effect of cultivar, palm frond waste, tryptophan acid and their interaction on the average increase in percentage of dry matter of the shoot system.

Cultivars	Frond waste Palm (%)	Tryptophan acid concentrations			Cultivars × Palm frond waste
		0	75	150	
Manzanillo	0	48.029	50.927	53.592	50.849
	3	57.793	59.650	61.474	59.639
	6	68.113	73.853	76.205	72.723
Bashiqi	0	40.854	43.509	45.251	43.205
	3	50.314	56.216	60.143	55.558
	6	63.463	69.414	74.697	69.191
L.S.D$_{0.05}$		0.8007			0.4623
Mean tryptophan acid		54.761	58.928	61.894	Mean cultivars
L.S.D$_{0.05}$		0.3267			
Cultivars × Tryptophan					
Manzanillo		57.978	61.477	63.757	61.071
Bashiqi		51.544	56.380	60.030	55.985
L.S.D$_{0.05}$		0.4623			0.2669
Palm frond waste x Tryptophan					Mean palm frond waste
0		44.441	47.218	49.422	47.027

3	54.053	57.933	60.808	57.598
6	65.788	71.633	75.451	70.957
L.S.D$_{0.05}$	0.5662			0.3269

The difference between olive varieties in vegetative growth characteristics is due to several factors, including: genetic differences, as each variety has a unique set of genes that control vegetative growth characteristics such as seedling height, stem diameter, number and size of leaves, and other traits, these genetic differences determine how plants respond to the environment and external factors [15]. Some olive varieties are more tolerant to certain conditions, such as drought, salty soil, or cold. These differences in tolerance affect the plant's growth and development in different environments. In addition, some varieties may require greater or lesser amounts of nutrients to achieve optimal growth. This variation in nutritional requirements affects the extent and speed of growth of the vegetative parts [16]. Some studies have also indicated that some varieties begin vegetative growth early while others lag behind. This variation in the nature of growth can affect the growth rate and development of the vegetative parts at different times of the year [17,18].

Adding organic materials, such as palm frond waste, can play an important role in improving the vegetative growth characteristics of the olive plant, by improving the soil structure. It works to improve the soil structure and increase its ability to retain water. It also works to improve soil aeration, as the fronds help chopped improves soil aeration, which promotes root growth and increases nutrient absorption [19]. When palm frond waste decomposes, it provides a group of nutrients in the soil, in addition to its role in providing other nutrients that were not ready for absorption by the plant, providing a sustainable source of nutrients necessary for plant growth [20,21]. Organic materials can contribute to increasing microbial activity, as they stimulate the activity of microorganisms in the soil, which helps improve the conversion of organic materials into materials that plants can easily absorb. Organic materials can also contribute to enhancing the ability of plants to resist environmental stress such as drought and salinity [22,23]. found that when spraying tryptophan acid at concentrations (0, 100, 200, and 500 ml L^{-1}) on palm trees, it led to an improvement in vegetative traits, leaf area, and number of leaves, as the spraying treatment with tryptophan at a concentration of 500 ml L^{-1} showed a significant superiority over the rest of the concentrations [24].

Spraying with tryptophan acid can contribute to increasing the vegetative growth characteristics of olive plants by stimulating the production of auxins, which are plant hormones that play an important role in regulating vegetative growth. Some studies also indicate that treatment with tryptophan has improved most of the vegetative growth characteristics, which may be due to the role of the acid. The amino tryptophan is important because it is the initiator of the biosynthesis of IAA, and there are four biological pathways for its manufacture, three of which depend on the amino acid tryptophan, and this multiplicity of pathways leads to the biosynthesis of IAA, especially from the amino acid tryptophan, as it shows the important role of this hormone in plant growth and development and being responsible for its elongation. Cells expand, as well as stimulate the production of amino and nuclear acids. It also works to elasticize the cell walls to help them increase in size and then fill them with water and food, which contributes to stimulating vegetative growth [25,26]. It has also been noted that tryptophan can improve the efficiency of photosynthesis by increasing the activity of the chlorophyll pigment and thus increasing the efficiency of the photosynthesis process, which works to increase the accumulation of dry matter [27]. Spraying with tryptophan acid can improve enzymatic activity by increasing the concentration of proteins and enzymes in plant cells, and this in turn helps improve metabolic processes such as photosynthesis and cellular respiration. It can also enhance the plant's ability to resist environmental stresses such as drought or salinity, and this is done by improving enzymatic activity that helps protect plant cells from the negative effects of stress [28]. Tryptophan acid can affect the synthesis of some vital enzymes, such as oxidation and reduction enzymes, which play an important role in defending against oxidation and improving the efficiency of growth and development processes, thus reflecting positively on the characteristics of vegetative growth, These results are consistent with [29,30]. Showed [31] that spraying tryptophan acid at a concentration of 0.05% on Mandarin (Balady) trees caused a significant increase in branch length as well as leaf area. That spraying with tryptophan acid on olive seedlings (Manzanillo variety) at three concentrations (0, 100, and 200 ml L^{-1}) led to improving the root and vegetative characteristics of the seedlings (increasing the number of roots as well as the diameter of the roots and the percentage of dry matter in the shoot). As well as the percentage of dry matter in the root system and also led to an increase in the diameter of the stem (as it was observed that the spraying treatment with tryptophan at a concentration of 200 ml L^{-1} was significantly superior to the rest of the concentrations [31].

It has been concluded based on these results that the selection of the variety played an important role in increasing some vegetative traits, through its suitability to environmental conditions in addition to its efficiency in exploiting the available nutrient resources. We can also conclude that adding palm frond waste has an important role in improving vegetative growth indicators, especially the third level (6%). This may be due to the sufficient amounts contained in this level for optimal plant growth. It was also noted from the results of the study that spraying with tryptophan acid, especially the concentration (150 ml L^{-1}) had a clear effect on some growth characteristics, and this could be due to its role in regulating some of the plant's biological and physiological processes.

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