

Growth, Flowering, Yield and Oil Characteristics of Picual Olives as Affected by Foliar Application of Vitamins and Amino Acids

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Abstract: During 2014 and 2015 seasons, Picual olive trees subjected three times with vitamins B₆ and B₁₂ each at 100 ppm and/ or amino acids/ (glutamic and asparatic acids) each at 0.1%. The target was examining the effect of these vitamins and amino acids on growth, flowering, fruit setting, yield as well as fruit and oil characteristics. Single and combined applications of vitamins B₆ and B₁₂ each at 100 ppm and amino acids namely glutamic and asparatic acids each at 0.1% were superior than non- application in enhancing all growth, flowering, fruit setting, yield as well as fruit and oil characteristics. Using amino acids was superior than using vitamins. Combined applications were preferable than using each material alone. For promoting yield as well as fruit and oil characteristics of Picual olive trees, it is suggested to use a mixture of vitamins B₆ and B₁₂ each at 100 ppm plus two amino acids namely glutamic acid and asparatic acid each at 0.1% three times.

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1. Introduction

The olive tree is an evergreen tree that is native to the coastal areas of the eastern Mediterranean and adjoining coastal areas of southeastern Europe, western Asia, and northern Africa. It is an attractive ornamental, produces table fruit, and oil. Crop production is irregular under cool coastal conditions. Olives for canning and pickling are usually harvested in September and October. Commercially, heavy crops of small fruit unsuited for canning are left on the trees until January or February and harvested for their oil. It is generally seen as a symbol of peace but can also be a symbol of wisdom, glory, fertility, power, and pureness. It is also associated with the color green, which signifies life.

Olive is a rich source of valuable nutrients and bioactives of medicinal and therapeutic interest. Olive fruit contains appreciable concentration, 1–3% of fresh pulp weight, of hydrophilic (phenolic acids, phenolic alcohols, flavonoids and secoiridoids) and lipophilic (cresols) phenolic compounds that are known to possess multiple biological activities such as antioxidant, anticarcinogenic, antiinflammatory, antimicrobial, bantihypertensive, antidyslipidemic, cardiogenic, laxative, and antiplatelet. Other important compounds present in olive fruit are pectin, organic acids, and pigments. Virgin olive oil (VOO), extracted mechanically from the fruit, is also very popular for its nutritive and health-promoting potential, especially against cardiovascular disorders due to the presence of high levels of monounsaturates and other valuable minor

components such as phenolics, phytosterols, tocopherols, carotenoids, chlorophyll and squalene. (Rahele Ghanbari *et al.*, 2012).

Nowadays, many efforts were established for improving growth and fruiting of Picual olive trees by using safe stimulants especially vitamins and amino acids.

Recently, it was suggested that all vitamins participate a vital role in enhancing cell division, nutrient uptake, absorption of water, translocation of organic feeds building of natural hormones, photosynthesis protein synthesis and plant pigments their antioxidative properties plan defense against oxidative stress induced by unsuitable conditions (Samiullah *et al.*, 1988).

The stimulating effect of amino acids on growth and fruiting of fruit crops might be ascribed to the important of these amino acids on enhancing the biosynthesis of all types of proteins, DNA, RNA, different enzymes, antioxidants, vitamins, cell division, building and movement of sugars and their roles as important antioxidants responsible for inhibiting the formation of ROS (reactive oxygen species) that caused a great damage on the permeability of cell walls and the death of plants. Their important roles in the biosynthesis of natural hormone namely tryptophane and ethylene did not neglect in this respect (Taiz and Zeiger, 2002).

Previous studies showed that using vitamins (Gad El- Kareem, 2012; Ahmed, *et al.*, 2013; Rizk, 2013; A Wasfy, 2013; Osman- Samak, 2015 and Omar, 2015) and amino acids (Haggag- Laila

et al., 2013, Hassan- Huda, 2014; Hassan, 2014; Sayed- Ola, 2014 and Mohamed, 2016) were very effective in enhancing growth, pigments and nutrients in the leaves flowering, fruit setting, yield and fruit characteristics).

The merit of this study was examining the effect of single and combined applications of vitamins B and amino acids on growth and fruiting of Picual olive trees.

2. Material and methods

This study was carried out during 2014 and 2015 seasons on uniform in vigour 10- years old Picual olive trees the selected trees were grown in a private orchard located at West Samalout, Minia Governorate/. The trees are plants at 5x5 meters apart in sandy soil under drip irrigation system. The selected trees are subjected to the common and regular horticultural practices that already used in the orchard.

This experiment included the following seven treatments:

- 1- Control.
- 2- Spraying vitamin B₆ (peroxine) at 100 ppm.
- 3- Spraying vitamin B₁₂ (cyanocobalamine) at 100 ppm.
- 4- Spraying geletamic acid and asparatic acid each at 0.1%.
- 5- Spraying vitamin B₆ + both amino acids each at 0.1%.
- 6- Spraying vitamin B₁₂ + both amino acids each at 0.1%.
- 7- Spraying vitamins B₆ + B₁₂+ each at 100 ppm glutamic acid + asparatic acid each at 0.1%.

Therefore, Each treatment was replicated three times, two trees per each. Vitamins and amino acids were sprayed three times at growth start (1st week of Mar), just after fruit setting (1st week of May) and at one month later (1st week of June). Spraying was done by using Triton B as a wetting agent at 0.05 and spraying was done till runoff. Randomized complete block design was followed.

During both seasons, the following measurements were recorded:

- 1- Vegetative growth characteristics namely number of shoots per branch/ shoot length (cm), number of leaves/ shoot and leaf area (cm²) (Ahmed and Morsy, 1999).
- 2- Total chlorophylls (chlorophyll a + b) and total carotenoids as mg/ 100 g F.W. (Von-Wettstein, 1957).
- 3- Percentages of N, P, K, Mg as well as Zn and Fe (as ppm) in the leaves on dry weight basis (Cottene et al., 1982).
- 4- Flowering and fruit setting aspects namely inflorescence (cm.), number of flowers/

inflorescence, perfect flowers %, flower density / m initial/ fruit setting and fruit retention %.

5- Yield / tree:

6- Percentage of soil in the fruit, oil yield per tree and per fed. (kg)

7- Fruit characteristics namely fruit weight (g.) and dimensions (diameter and height, cm), flesh %, acid value % (as oleic acid), peroxide value (mg O₂ / kg oil), total tocopheral (mg/ 1 kg oil) and total polyphenals (mg/ 1 kg oil) (A.O.A.C., 2000), unsaturated and saturated fatty acids %, oleic acid %, linolenic acid %, palmitic acid % and stearic acid%.

Statistical analysis was done (Gomez and Gomez, 1984) and the treatment means were compared using New L.S.D. at 5%.

3. Results

1- Growth characteristics and chemical constituents of the leaves:

Data in Tables (1 & 2) clearly show that single and combined applications of vitamins B₆ and B₁₂ each at 100 ppm and the two amino acids namely glutamic acid and asparatic acid each at 0.1 % significantly was accompanied with stimulating number of shoots per branch, shoot length, number of leaves / shoot, leaf area, total chlorophylls total carotenoides, N, P, K, Mg, Zn and Fe relative to the check treatment. Using the two amino acids namely glutamic and asparatic acid each at 0.1% was significantly favourable than using vitamins B₆ and B₁₂ each at 100 ppm. Combined applications significantly were preferable than using each material alone in improving growth and chemical constituents of the leaves. Using vitamins B₁₂ significantly was superior than using vitamin B₆ in this respect. The maximum values were recorded on the trees that received all vitamins and amino acids. The untreated plants gave the lowest values. These results were true during both seasons.

2- Flowering and fruit setting aspects:

Table (2) show that spraying vitamins B₆ or B₁₂ and/ or amino acids caused a significant promotion on inflorescence length, number of flowers/ inflorescence perfect flowers %,m flower density / on initial fruit setting and fruit retention over the control treatment. Using amino acids was significantly preferable than using vitamins in improving these parameters.

Combined application of vitamins and amino acids was significantly superior than using vitamins or amino acids alone in this respect. The best results were obtained when vitamins B₆ & B₁₂, glutamic and asparatic acids were applied together. The lowest values were recorded on untreated trees. Similar results were announced during both seasons.

3- Yield/ tree:

Yield/ tree was significantly improved in response to application of vitamins and/ or amino acids over the control treatment. Significant differences on the yield were observed among the seven treatments. Application of amino acids at 0.1% significantly improved the yield rather than using vitamins. Using vitamins plus amino acids significantly improved the yield than using each material alone. Using vitamin B12 significantly surpassed the application of vitamin B6 in this respect. The maximum yield (49.5 and 50.5 kg) were recorded on the three that treated with vitamins and amino acids. The untreated trees produced the lowest values (33.0 & 33.0 kg) during both seasons, respectively.

4- Percentage of fruit oil:

It is revealed from the data in Table (4) that single and combined applications of vitamins B₆ and B₁₂ and amino acids (glutamic and asparatic acids) significantly was very effective in increasing fruit oil % compared to the control treatment significant differences on such characters were observed among the seven treatment.

Using amino acids significantly was superior than using vitamins in this respect. Combined applications were significantly superior than using each material alone in this respect. The maximum values (34.6 & 35.0 %) were recorded on the trees that received vitamins and amino acid together during 2014 and 2015 seasons, respectively. The untreated trees produced the lowest values (29.9 & 31.1 %) during both seasons, respectively. These results were true during both seasons.

5- Oil yield/ tree and per fed.

Data in Table (4) clearly show that simple and combined applications of vitamins B₆ and B₁₂ and amino acids significantly enhanced oil yield per tree and per fed. over the control treatment. Using amino acids significantly was superior than using vitamins B₆ and B₁₂. Combined applications was significantly favourable than using each material alone in improving oil yield per tree and per fed. Treating the trees with all materials together gave the maximum oil yield per tree (17.1 & 17.7 kg) and per fed. (2872.8 & 2973.0 kg) during both seasons, respectively. Similar trend was observed during both seasons.

6- Fruit and oil characteristics:

It is clear from the data in Tables (4 & 5 & 6) that single and combined applications of vitamins and amino acids significantly was accompanied with increasing weight, height and diameter of fruit, flesh % peroxide value, total tocopherol, total polyphenols, unsaturated fatty acids %, oleic acid %, and linoleic acid and decreasing saturated fatty acids%, palmitic acid and stearic acid over the control treatment. The effect either increase or decrease was significantly associated with using amino acids compared for using vitamins. Combined application was significantly superior than using each material alone. The best results with regard to fruit and oil characteristics were obtained due to using all materials together. These results were true during both seasons.

Table (1): Effect of some vitamin and amino acid treatment on some growth aspects and total chlorophylls and carotenoids of Picual olive trees during 2014 and 2015 seasons.

Vitamin and amino acids treatment	Number of shoots branch		Shoot length (cm.)		Number of laves / shoot		Leaf area (cm) ²		Total chlorophylls (mg/ 100 g F.W.)		Total carotenoids (mg/ 100 g F.W.)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	20.1	19.0	15.0	14.8	16.0	15.0	3.1	2.9	7.1	6.8	3.1	3.0
Vitamin B ₆ at 100 ppm	22.3	21.3	16.7	16.8	18.1	17.0	3.4	3.2	7.6	7.4	3.4	3.2
Vitamin B ₁₂ at 100 ppm	25.0	23.9	18.7	19.0	20.2	18.9	3.7	3.6	8.1	8.0	3.7	3.6
Glutamic + Asparatic each at 0.1%	27.6	26.0	20.0	20.7	22.5	21.0	4.0	4.0	8.6	8.4	4.0	4.0
Vitamin B ₆ + Amino acids	30.0	28.3	21.6	23.0	25.0	22.6	4.3	4.3	9.1	8.8	4.3	4.3
Vitamin B ₁₂ + Amino acids	32.0	30.7	23.3	25.0	26.9	24.3	4.6	4.6	9.6	9.2	4.6	4.6
All vitamins and amino acids	34.0	33.0	25.6	27.1	29.0	26.9	4.9	4.8	10.0	9.7	5.0	5.0
New L.S.D. at 5%	2.0	1.9	1.4	1.5	1.4	1.5	0.2	0.2	0.3	0.3	0.2	0.2

Table (2): Effect of some vitamin and amino acid treatment on the percentages of N, P, K, Mg and Zn and Fe, (as ppm) in the leaves of Picual olive trees during 2014 and 2015 seasons.

Vitamin and amino acids treatment	Leaf N %		Leaf P %		Leaf K %		Leaf Mg %		Leaf Zn (ppm)		Leaf Fe (ppm)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	1.61	1.69	0.18	0.17	1.11	1.20	0.55	0.56	50.1	50.9	41.0	39.3
Vitamin B ₆ at 100 ppm	1.68	1.75	0.20	0.19	1.16	1.25	0.59	0.60	53.1	55.0	44.0	41.9
Vitamin B ₁₂ at 100 ppm	1.75	1.81	0.23	0.21	1.22	1.30	0.64	0.66	57.0	58.1	47.3	44.3
Glutamic + Asparatic each at 0.1%	1.83	1.87	0.25	0.23	1.27	1.34	0.8	0.71	60.0	61.2	50.0	47.0
Vitamin B ₆ + Amino acids	1.90	1.93	0.28	0.25	1.31	1.38	0.72	0.76	63.1	64.0	53.0	48.5
Vitamin B ₁₂ + Amino acids	1.96	2.00	0.30	0.27	1.36	1.42	0.76	0.81	66.0	67.0	55.0	50.0
All vitamins and amino acids	2.02	2.05	0.32	0.30	1.40	1.46	0.80	0.86	69.3	73.0	58.3	52.5
New L.S.D. at 5%	0.06	0.05	0.02	0.02	0.04	0.04	0.03	0.03	2.1	2.2	2.0	1.9

Table (3): Effect of some vitamin and amino acid treatment on flowering and fruit setting aspects of Picual olive trees during 2014 and 2015 seasons.

Vitamin and amino acids treatment	Inflorescence length (cm)		No. of flowers per inflorescence		Perfect flowers %		Flower density / meter		Initial fruit setting		Fruit retention %	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	1.8	1.7	8.0	9.0	69.0	67.0	54.0	54.0	15.0	16.0	0.6	0.9
Vitamin B ₆ at 100 ppm	2.0	2.0	8.6	10.0	71.0	69.0	55.1	55.5	16.2	17.2	1.1	1.2
Vitamin B ₁₂ at 100 ppm	2.2	2.2	9.6	11.0	73.3	71.5	56.4	57.0	18.0	18.5	1.6	1.6
Glutamic + Asparatic each at 0.1%	2.5	2.5	10.7	12.0	76.0	73.0	58.0	58.3	19.5	19.0	2.0	2.0
Vitamin B ₆ + Amino acids	2.08	2.8	12.7	12.9	78.0	75.0	59.1	60.0	21.0	20.3	2.4	2.3
Vitamin B ₁₂ + Amino acids	3.0	3.0	15.9	14.0	79.5	77.0	60.9	61.3	22.3	21.0	2.7	2.6
All vitamins and amino acids	3.3	3.3	19.0	16.9	81.7	78.6	63.9	62.7	24.0	22.3	3.0	3.0
New L.S.D. at 5%	0.2	0.2	0.5	0.5	1.5	1.4	1.0	1.0	1.1	1.2	0.4	0.3

Table (4): Effect of some vitamin and amino acid treatment on yield, fruit oil, oil yield/ tree and fed as well as fruit weight and height of Picual olive trees during 2014 and 2015 seasons.

Vitamin and amino acids treatment	Yield/ tree (kg.)		Fruit oil m%		Oil yield/ tree (kg.)		Oil yield/ fed. (kg.)		Fruit weight (g.)		Fruit height (cm.)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	33.0	33.0	29.9	31.1	9.9	10.2	1663.2	1713.6	5.1	4.9	2.71	2.69
Vitamin B ₆ at 100 ppm	35.0	35.5	30.5	30.8	10.7	10.9	1797.6	1831.2	5.3	5.1	0.81	2.79
Vitamin B ₁₂ at 100 ppm	37.3	38.0	31.2	31.5	11.6	12.0	1948.8	2016.0	5.5	5.3	2.90	2.88
Glutamic + Asparatic each at 0.1%	40.0	40.0	32.0	32.3	12.8	13.1	2150.4	2200.8	5.8	5.5	2.97	2.97
Vitamin B ₆ + Amino acids	43.0	43.0	32.8	33.0	14.1	14.1	2368.8	2368.8	6.0	5.9	3.04	..05
Vitamin B ₁₂ + Amino acids	46.0	46.5	34.0	34.3	15.6	15.9	2620.8	2671.2	6.2	6.1	3.10	3.11
All vitamins and amino acids	49.0	50.5	34.6	35.0	17.1	17.7	2872.8	2973.6	6.4	6.4	3.25	3.26
New L.S.D. at 5%	2.0	0.2	0.5	0.5	0.8	0.7	90.0	88.1	0.2	0.2	0.04	0.05

Table (5): Effect of some vitamin and amino acid treatment on the percentages of fruit diameter (cm), flesh %, acid value %, peroxide value (meq/ O₂/ kg oil), total tocopheral (mg/ kg oil) and total polyphenals (mg/ kg oil) of Picual olive trees during 2014 and 2015 seasons.

Vitamin and amino acids treatment	Fruit diameter (cm)		Flesh %		Acid value %		Peroxide value (meq/ O ₂ / kg oil)		Total tocopheral (mg/ kg oil)		Total polyphenals (mg/ 1 kg oil)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	2.11	2.14	69.0	69.1	0.99	1.00	8.0	9.0	241	241	141	142
Vitamin B ₆ at 100 ppm	2.20	2.23	71.0	70.2	0.98	1.00	8.6	9.7	244	244	145	146
Vitamin B ₁₂ at 100 ppm	2.27	2.30	71.0	70.9	0.97	0.99	9.3	10.5	247	247	148	150
Glutamic + Asparatic each at 0.1%	2.34	2.37	71.9	72.0	0.97	0.98	10.0	11.0	249	250	152	153
Vitamin B ₆ + Amino acids	2.39	2.42	72.7	72.8	0.96	0.98	11.0	11.6	252	253	157	156
Vitamin B ₁₂ + Amino acids	2.44	2.47	73.2	73.6	0.96	0.97	12.0	12.2	255	255	160	162
All vitamins and amino acids	2.49	2.52	73.9	74.3	0.96	0.97	12.5	13.0	258	256	164	166
New L.S.D. at 5%	0.04	0.04	0.4	0.5	NS	NS	0.5	0.5	1.5	2.0	2.9	3.0

Table (6): Effect of some vitamin and amino acid treatment on the percentages of unsaturated, saturated, fatty acids on oleic, linolenic, palmitic and stearic acids of Picual olive trees during 2014 and 2015 seasons.

Vitamin and amino acids treatment	Unsaturated fatty acids %		Saturated fatty acids %		Oleic acid %		Linoleic acid %		Palmitic acid %		Stearic acid %	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Control	84.0	85.0	16.0	15.0	73.0	73.3	0.71	0.69	13.0	12.9	5.0	4.9
Vitamin B ₆ at 100 ppm	84.5	86.0	15.5	14.0	73.7	74.0	0.74	0.71	12.5	12.4	4.7	4.4
Vitamin B ₁₂ at 100 ppm	85.0	86.5	15.0	13.5	75.0	75.0	0.77	0.74	12.0	12.0	4.3	4.0
Glutamic + Asparatic each at 0.1%	86.0	87.0	14.0	13.0	76.0	75.5	0.80	0.77	11.0	11.0	4.0	3.7
Vitamin B ₆ + Amino acids	86.5	87.5	13.5	12.5	77.0	76.3	0.82	0.80	10.5	10.0	3.7	3.4
Vitamin B ₁₂ + Amino acids	57.0	88.0	13.0	12.0	77.5	77.0	0.85	0.82	10.0	9.5	3.0	3.1
All vitamins and amino acids	88.0	89.0	12.0	11.0	78.0	78.0	0.87	0.86	9.5	9.0	2.7	2.9
New L.S.D. at 5%	0.3	0.3	0.3	0.3	0.5	0.5	0.2	0.2	0.3	0.3	0.2	0.2

4. Discussion

These results might be attributed to the effect of vitamins in enhancing cell division, nutrient uptake, absorption of water, translocation of organic feeds building of natural hormones, photosynthesis protein synthesis and plant pigments their antioxidative properties plan defense against oxidative stress induced by unsuitable conditions. The positive action of vitamins on fruiting of Picual olive cvs. might be attributed to their essential roles on protecting the plant cells from senescence and disorders as well as enhancing cell division, the biosynthesis of natural hormones such IAA and ethylene, nutrient and water uptake, photosynthesis, building of plant pigments and proteins, amino acids and plant metabolism. These important functions of vitamins were surely reflected on enhancing growth and vine nutritional status in favour of enhancing yield and fruit quality. (Robinson, 1973; Oretili, 1987; Samiullah *et al.*, 1988; Foyer and Lelandias, 1993 and Singh *et al.*, 2001).

The stimulating effect of amino acids on growth and fruiting of the Picual olive cvs might be ascribed to the important of these amino acids on enhancing the biosynthesis of all types of proteins, DNA, RNA, different enzymes, antioxidants, vitamins, cell division, building and movement of sugars and their roles as an important antioxidants prevented the formation of ROS (reactive oxygen species) that caused a great damage on the permeability of cell walls and the death of plants. Their important roles in the biosynthesis of natural hormone namely tryptophane and methionene did not neglect in this respect (Mengel and Kirkby, 1987; Chandler, 1987 and Mengel *et al.*, 2001).

The enhancing effect of amino acids (Haggag-Laila *et al.*, 2013, Hassan- Huda, 2014; Hassan, 2014; Sayed- Ola, 2014 and Mohamed, 2016).

These results are in harmony with those obtained by Gad El- Kareem, (2012); Ahmed, *et al.*, (2013); Rizk, (2013); Al- Wasfy, (2013); Osman- Samak, (2015) and Omar, (2015) who worked on vitamins and Haggag- Laila *et al.*, (2013), Sayerd- Ola (2014), Hassan (2014), Hassan- Huda (2014) and Mohamed (2016) who worked on amino acids.

Conclusion

The best results with regard to yield as well as fruit and oil characteristics were obtained due to treating Picual olive trees three times with vitamins B₆ and B₁₂ each at 100 ppm and glutamic and asparatic acids each at 0.1%.

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