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EFFECT OF SOME NATURAL EXTRACTS, INDOLBUTIRIC ACID AND NAPHTHALENE ACETIC ACID ON ROOTING OF PICUAL OLIVE CUTTINGS

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ABSTRACT: This study was carried out during 2014 and 2015 seasons in a private plastic green house at Belbies District, Sharkia Governorate, Egypt in an attempt to replace the traditional olive cutting rooting synthetic growth regulators by some auxin releasing natural extracts. Cuttings of Picual olive cv. were prepared on November of each season (about 15 cm long and7-9 mm in diameter), cutting were dipped in concentrations of indole-3-Butyric acid (IBA) at 4000 ppm and naphthalene acetic acid (NAA) at 500 ppm solution for 5 seconds or soaked in the natural extracts for half hour. The results revealed that the maximum rooting percentage (81.44 and 85.60%), number of roots/cutting (14.84 and 14.90 root/cutting), shoot number/ transplant (2.74 and 2.17 shoot/plant), leaf number/plant (6.49 and 6.61 leaf/plant) and bud sprouting percentage (48.46 and 48.14 %) respectively were recorded for cuttings dipped in IBA at 4000 ppm in comparison with those dipped in moringa extracts, which gained the lowest values of the considered parameters during the two seasons. The highest cutting survival percentages were recorded for IBA and NAA treatments, garlic at 10 or 20%, liquorice at10 g and algae at 2.5 or 5 cm in both seasons without significant differences between them. Total carbohydrates percentages in the roots and shoots were gradually increased with the advance in planting months, and reached the highest values after seven months, but total soluble phenols in the roots were decreased after six months then increased in the seventh month in both seasons. The algae, garlic and liquorice treatments were considered the best natural extracts compared to yeast and in turn can be used as an alternative of growth regulators for rooting Picual olive cuttings.

Key words: Olive, picual, rooting (%), sprouting (%), growth regulators, natural extracts.

INTRODUCTION

Vegetative propagation through rooting leafy cuttings in a mist system is widely used for the propagation of olive (*Olea europaea* L.) trees. Olives are commonly propagated by leafy cuttings under mist irrigation **(Peixe *et al*., 2007).** Stem cuttings are the most important simple and economical means of vegetative propagation. This technique is considered to be easy, inexpensive and appropriate for mass plant production within a short time, but there are great differences in the rooting potential among olive cultivars. Thus, it has been categorized into three groups, easy, moderate and hard-to-root cultivars **(Fernandes *et al*., 2002; Pio *et al*., 2005).** Although self-rooted cultivars can be very interesting in establishing new olive orchard, the low rooting ability, the unsatisfactory viability and the low rooting quality of cuttings in some cultivars represent limiting factors **(Wiesman and Lavee, 1994).** Between several factors, internal concentrations of auxins and carbohydrates have been reported to play an important role in rooting process. The external application of auxins is one of the most important factors in increasing the rooting ability of many species **(Hartmann *et al*., 2002; Kelen and Ozkan, 2003; Negash, 2003).** It is well known that auxins stimulate rooting of cuttings, while cytokinins and gibberellins generally inhibit rooting **(Hartmann *et al*.,**

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2002). The external application of auxins, especially IBA usually increases the rooting ability of cuttings. However, IBA treatment has not always stimulate root initiation in olive **(Aslmoshtaghi and Shahsavar, 2010a).**

The use of auxin, mainly Indole butyric acid (IBA), has become a vital practice for induction of adventitious roots in nurseries. Various attempts have been made to enhance rooting ability of olive cultivars with wounding **(Ayoub, 1995).** Severance from the stock plant induces the biosynthesis of phenolic compounds, which is why many authors have detected an increased phenolic content level in the first days after the establishment of cuttings **(Quaddoury and Amssa, 2004; Osterc and Štampar, 2008).** After application of exogenous IBA on cuttings, the endogenous auxin concentration reaches a peak after wounding coinciding with the initation of the rooting process. Interaction between endogenous IAA and exogenous IBA during adventitious root formation has been suggested and the performance of IBA versus IAA explained by several possibilities: higher stability, differences in metabolism, differences in transport, and IBA as a slow release source of IAA. Furthermore, IBA is reported to increase the rate of ethylene biosynthesis, and the auxin-ethylene relationship during root development has been shown by a number of isolated mutants that have resistance to both hormones. In addition, jasmonates and cytokine are involved in the regulation of sink-source relationsships, leaf senescence, and control of meristematic activity during adventitious root formation **(Perilli *et al*., 2010; Pop *et al*., 2011).**

Algae extract as a new biofertilizer containing some macro (N, P, K, Ca, Mg and S) and micro nutrients (Zn, Fe, Mn, Cu, Mo and Co) as well as some growth regulators, polyamines and vitamins required to be applied for improve nutritional status, vegetative growth, yield and fruit quality in different fruit orchards **(Abd El-Migeed *et al.,* 2004; Abd El-Moniem and Abd-Allah, 2008; Spinelli *et al.*, 2009)**. Leaves of moringa are rich in zeatin, it can be used as natural source of cytokinin **(Fuglie, 2000).** In addition, moringa leaves also rich in ascorbates, carotenoids, phenols, potassium and calcium, which have plant growth promoting capabilities and often applied as exogenous plant growth enhancers **(Foidl *et al.,* 2001)**. It also contains indole acetic acid and plant growth regulators **(Sachan *et al.,* 2011).** Garlic also contains vitamins, minerals, flavonoids, ascorbic acid, sulphur and trace of iodine. Seventeen amino acids are found in garlic, including eight essential ones. Effect of garlic extract on plant characters has been interpreted by **El-Shayeb (2009).** The licorice extract contain more than 100 various compounds, some of which accumulated in large amounts, which most important of them are triterpene saponins (including glycyrrhizin) and phenolic compounds **(Shabani *et al*., 2009).** *Agrobacterium rhizogenes* induces formation of adventitious roots at sites of infection, resulting in a hairy-root phenotype. This extensive root formation is caused by expression of *A. rhizogenes* encoded by T-DNA, a fragment of DNA originating from a root-inducing plasmid **(Moore *et al.,* 1979).** In addition, yeast is a natural source of many growth substances as a protective agent, and most of nutritional elements (Na, Ca, Fe, K, P, S, Mg, Zn and Si) and contains cytokinin as well as some organic compounds **(Nagodawithana, 1991).**

The objective of this work is finding out auxin releasing natural extracts used as cuttings rooting enhancement instead of the conventional olive rooting hormones.

MATERIALS AND METHODS

This study was carried out during two seasons of 2014 and 2015 in a private plastic greenhouse at Belbies District, Sharkia Governorate, Egypt. One-year-old shoots of the current season were collected from Picual olive cv. (*Olea europea* L.). The semi-hardwood cuttings (middle part portion) were prepared on November of each season of about 15 cm in long and 7- 9 mm in diameter with five nodes and two pair of leaves.

The Experimental Procedures

The prepared cuttings were subjected to the following 13 dipping and soaking treatments:

1. Control (dipping cuttings in IBA solution at 4000 ppm)
2. Dipping cuttings in NAA solution at 500 ppm
3. Dipping cuttings in IBA solution at 4000 ppm + NAA at 500 ppm

4. Soaking cuttings in moringa extract at 10%.
5. Soaking cuttings in moringa extract at 20%.
6. Soaking cuttings in garlic extract at10%.
7. Soaking cuttings in garlic extract at 20%.
8. Soaking cuttings in liquorice extract at10 g/l.
9. Soaking cuttings in liquorice extract at 20 g/l.
10. Soaking cuttings in yeast extract at 5%.
11. Soaking cuttings in yeast extract at 10%.
12. Soaking cuttings in algae extract at 2.5 cm/l.
13. Soaking cuttings in algae extract at 5 cm/l.

This experiment included 39 combinations which were between 13 dipping and soaking treatments and three sampling dates (5, 6, 7 months after cutting planting).

Picual cuttings of treatments from 1 to 3 were dipped in the growth regulators solution for 5 seconds, while the treatments from 4-13 were soaked in natural extracts for half hour then planted at a depth of five cm in plastic flats filled with a mixture of silt, peat moss and sand (1: 1: 1 by volume). The flats were kept under tunnel held at green house.

This experiment was used 702 cuttings (6 cuttings × 3 replicates × 3 dates after planting × 13 treatments) in each season.

The responses of the tested semi-hardwood cuttings Picual olive cv. to the applied dipping and soaking treatments were evaluated through the following parameters:

Rooting characteristics

Rooting percentage and number of roots/ cutting.

Growth measurements

Bud sprouting percentage, survival percentage, shoot number/transplant and leaf number/ shoot.

$$\text{Survival percentage} = \frac{\text{Number of survived cuttings}}{\text{Total number of cuttings}} \times 100$$

$$\text{Bud sprouting percentage} = \frac{\text{Number of sprouted buds on cuttings}}{\text{Total number of buds on cuttings}} \times 100$$

Chemical determinations

Shoot and root carbohydrates percentage

About 0.2 g of dry matter samples was added to 50 mM of sulfuric acid (1 p) in Pyrex test tubes +24 cm of concentrated sulfuric acid and complement with distilled water. The tubes are placed in a water bath for 3 to 4 hours at a temperature of 70°C offset losses with distilled water to maintain the size and focus Nominate standard samples in flasks of 50 cm and then complement to the mark with distilled water. Then 1 cm from the filtrate was taken + 1 cm phenol 5% (5 g phenol in 10 cm distilled water) + 5 cm sulfuric acid. Samples are read on the device Spectrophotometry on the wave length of 490 nm. Compare readings on the device and the corresponding readings were in hard-hit **(AOAC, 2012).**

Determination of total soluble phenols

Samples of about 5 g fresh weights were taken from the shoots and roots at the end of different periods, placed in a glass cup convenient with the addition of 30 cm alcohol ethyl 80% to cover the sample surface and heats in water bath at 70° for 15 minutes. The ethyl extract was transformed into aqueous phase by evaporation at 30 ± 2°C under vacuum for determining total phenols. Folin-Denis Spectrophotometry (750 mu) was used to estimate phenols concentrations as pyrogallol on dry weight basis of cutting tissue (g/100 g) **(Cheng and Hanning, 1955)**.

Statistical Analysis

The obtained data were statistically analyzed according to the complete randomized block design with 3 replicates each treatment. Data were subjected to analysis of variances (ANOVA) according to **Snedecor and Cochran (1990)** using the CO-STAT program. Differences between means were compared by using Duncan's multiple range test at 0.05 level **(Duncan, 1958).**

RESULTS AND DISCUSSION

Root Characteristics

Rooting percentage

Results in Table 1 show that treating with some natural extracts and synthetic growth

Table 1. Effect of some natural extracts and synthetic growth regulators on rooting percentage of Picual olive cuttings (2014 and 2015 seasons)

Treatment	Rooting percentage (%)							
	First season (2014)				Second season (2015)			
	Months after cutting planting				Months after cutting planting			
	5	6	7	Trea. av.	5	6	7	Trea. av.
IBA at 4000 ppm	88.87 a	77.73ab	77.73ab	81.44 A	77.73ab	77.73 ab	100.00 a	85.6A
NAA at 500 ppm	44.40cde	44.40cde	55.50bcd	48.10 DEF	55.50bcd	55.50 bcd	44.40 cd	51.800DEF
IBA at 4000+NAA at 500 ppm	66.60abc	55.50bcd	66.60abc	62.90 BCD	77.73ab	77.73ab	77.73 ab	77.73AB
Moringa extr. at 10%	11.10f	11.10 f	11.10 f	11.10G	11.10e	11.10e	11.10 e	11.10G
Moringa extr. at 20%	11.10f	22.20 ef	11.10 f	14.80G	11.10e	11.10e	11.10e	11.10G
Garlic extr.at 10%	55.50bcd	66.60 abc	55.50bcd	59.20CDE	55.50 bcd	55.50 bcd	55.50bcd	55.50CDE
Garlic extr.at 20 %	55.50 bcd	77.73 ab	55.50bcd	62.91BCD	66.60 bc	66.60 bc	77.73ab	70.31ABC
Liquorice extr.at 5 g	44.40cde	66.60 abc	44.40 cde	48.10DEF	44.40 cd	44.40 cd	44.40cd	44.40 EF
Liquorice extr.at 10 g	55.50bcd	77.73 ab	55.50 bcd	55.50C-F	55.50 bcd	66.60 bc	66.63bc	62.91 BCD
Yeast extr.at 5 %	33.30def	44.40cde	44.40 cde	40.70F	44.40 cd	33.30 de	33.30de	37.00 F
Yeast extr.at 10 %	44.40cde	55.50bcd	33.30def	44.40EF	44.40 cd	44.40 cd	44.40cd	44.40EF
Algae extr.at 2.5 cm/l	66.60abc	66.63 abc	77.73 ab	70.32ABC	55.50bcd	66.60 bc	77.73ab	66.61BCD
Algae at extr. 5 cm/l	77.73ab	77.73 ab	77.73 ab	77.73AB	77.73 ab	77.73 ab	77.73ab	77.73AB
Date av.	50.39 A	54.66 A	51.24 A		52.09A	52.95 A	55.52A	

Means in each column which have the same letter(s) are not significantly different.

regulators significantly affected rooting percentage of Picual olive cuttings in the two seasons. However, IBA at 4000 ppm (control treatment) recorded the highest rooting percentage (81.44 and 85.60%) without significant differences with those of algae at 2.5 and 5 cm treatments (70.32 and 77.73%) in the first season and IBA at 4000 ppm + NAA at 500 ppm and algae extract at 5 cm (77.73%) in the second one. The lowest rooting percentage was gained by both Moringa extract at 10 and 20% treatments (from 11.10 to 14.80 %) in the two seasons. The other soaking treatments (garlic, liquorice and yeast) resulted in between rooting percentages in descending order during the both seasons.

Number of months after planting insignificantly affected rooting percentage in both seasons.

The interaction between dipping treatments and number of months after planting were significant in the two seasons. Higher rooting percentages (88.87 and 100.00%) were recorded for cuttings dipped in IBA at 4000 ppm after five and seven months in the first and second seasons, respectively compared with those soaked in moringa extract at 10 and 20% throughout all months after planting in both seasons. The other combinations produced intermediate similar statistically percentages in most cases.

These findings are in agreement with those reported by **Aslmoshtaghi and Shahsavar (2010a), Aslmoshtaghi *et al.* (2014), Khajehpour *et al.* (2014), Porghorban *et al.* (2014), Hamooh (2014), Lazaj *et al.* (2015)** and **Mohamed (2015).** They all reported that IBA increased rooting percentage. Similar trends were confirmed when seaweed extracts was used **(Thorsen *et al.*, 2010**; **Krajnc *et al.*, 2012; Urbanek *et al.*, 2012**; **Vinoth *et al.*, 2012;**

Lazaj *et al*., 2015). Németh (2011) stated that, cuttings of clonal mahaleb cultivar 'Egervár' were rooted the best by direct Kelpak treatment.

Number of roots per cutting

The obtained results in Table 2 reveal that number of roots/cutting was significantly affected by dipping in the natural extracts and synthetic growth regulators in the two seasons. However, IBA at 4000 ppm (14.84 and 14.90 root/cutting) induced the highest number of roots/ cutting, followed by those dipped in IBA 4000 ppm + NAA 500 ppm (11.27 and 11.24 root/ cutting) with significant differences between them in the first and second seasons, respectively. The least number of roots/cutting was recorded for cuttings treated with moringa extract at 10 and 20% (2.00 and 2.32 and 2.02 and 2.34 root/cutting) in the two seasons, respectively. The other treatments tended to a significant decrease in the number of roots/ cutting in both seasons. The number of roots/ cutting generally, ranged from 2.00 to 14.84 root/ cutting in the first season and 2.02 to 14.90 root/ cutting in the second one.

The number of months after cutting planting significantly affected the number of roots/ cutting in both seasons. The highest numbers were recorded for cuttings left until the seventh month after planting (8.04 and 8.35 root/cutting) compared with those which were remained for 5 months (5.71 and 5.82 root/cutting) as those gained the lowest numbers in the first and second seasons, respectively.

The interaction between dipping or soaking treatments and number of months after planting was significant throughout the studied seasons, and support the above mentioned trends with regard to the effect of each individual factor on number of roots/cutting. So, the highest number of roots/cutting was recorded with cuttings treated with IBA at 4000 ppm and left until the 7^{th}, 6^{th} and 5^{th} months from planting (15.80, 15.47 and 13.24 roots in the first season and 16.20, 15.19 and 13.30 roots in the second one), respectively. The lowest root number was resulted from the combinations between moringa extract at 10 and 20% throughout all months after planting without significant differences between them in both seasons. The other combinations were in-between.

The obtained results are in harmony with those reported by **Negash (2003), Sebastiani and Tognetti (2004), El-Ghayaty *et al.* (2010), Ismaili and Fiku (2010), Aslmoshtaghi and Shahsavar (2010a), Khajehpour *et al.* (2014), Porghorban *et al.* (2014), Hamooh (2014), Jan *et al.* (2014), Lazaj *et al.* (2015), Mohamed (2015)** who reported that using IBA increased number of roots on olive cuttings. **Jones and van Staden (1997)** cleared that using Kelpak (commercial seaweed) increased rooting percentage and improved rooting quality above that of the control, also, resulting in the development of a vigorous root system consisting of numerous lateral roots. **Németh (2011)** stated thst, cuttings of clonal mahaleb cultivar 'Egervár' was rooted the best by direct Kelpak (seaweed) treatment.

Vegetative Growth Parameters

Bud sprouting percentage

It is clear from results presented in Table 3 that, bud sprouting percentage of Picual olive cuttings was significantly affected by the different investigated treatments in both seasons. The uppermost percentages of bud sprouting were recorded for treatments of IBA at 4000 ppm (48.46 and 48.14%), of IBA at 4000 + NAA at 500 ppm (31.48 and 44.44%), garlic extract at 20% (28.72 and 44.42%) and liquorice extract at 10 g (31.48 and 43.04%) without significant differences between them in both seasons. The differences between treatments of algae extract at 5cm, garlic extract at 20% and liquorice extract at 10 g were insignificant in both seasons. Moringa extract and yeast treatments recorded the lowest percentages.

The results cleared also that bud sprouting percentage in Picual olive cuttings were significantly differed by the various dates after cutting planting in both seasons. The highest values of bud sprouting percentage (33.40 and 33.55%) were detected after seven month from planting in both seasons. The least sprouting percentage was recorded after the fifth month from planting (23.08 and 22.12%) in the two seasons.

The interaction between treatments and number of months after planting on bud sprouting percentage was significant in both

Table 2. Effect of some natural extracts and synthetic growth regulators on root number / cutting of Picual olive variety (2014 and 2015 seasons)

Treatment	Number of roots/ cutting							
	First season (2014)				Second season (2015)			
	Months after cutting planting				Months after cutting planting			
	5	6	7	Trea. av.	5	6	7	Trea. av.
IBA at 4000 ppm	13.24abc	15.47 ab	15.80 a	14.84 A	13.30 bc	15.19 ab	16.20 a	14.90 A
NAA at 500 ppm	7.80 f-j	8.81e-h	9.74def	8.78 CD	7.13 h-n	9.10 d-h	10.03 d-g	8.76 CD
IBA at 4000 + NAA at 500 ppm	9.34 d-g	11.70 cd	12.78 bc	11.27B	9.33 d-h	11.10 cde	13.278 bc	11.24 B
Moringa extr. at 10%	1.47 s	2.07rs	2.47 qrs	2.00H	1.53s	1.90rs	2.63 qrs	2.02 G
Moringa extr. at 20%	1.77 s	2.30rs	2.90 p-s	2.32GH	2.10 rs	2.23rs	2.70 qrs	2.34G
Garlic extr.at 10%	4.70 m-r	7.10f-m	7.51 f-l	6.44E	4.33 n-s	7.23g-m	7.90 f-j	6.49E
Garlic extr.at 20 %	5.18 j-q	7.21f-m	7.97 f-j	6.79E	5.20 j-q	7.40 f-l	8.47 e-i	7.02 E
Liquorice extr.at 5 g	4.81 k-r	6.50h-o	7.57 f-k	6.29E	5.07 k-q	6.83 h-o	7.90 f-j	6.60 E
Liquorice extr.at10 g	5.65 i-p	7.45 f-m	8.45 e-i	7.18DE	5.73 i-p	7.63 f-k	8.50 e-i	7.29 DE
Yeast extr.at 5 %	2.78qrs	3.83 o-s	4.72 l-r	3.78FG	3.23 p-s	4.03 o-s	4.70 l-r	3.99 F
Yeast extr.at 10 %	3.23 p-s	4.13 n-s	4.64 m-r	4.00F	3.43p-s	4.53m-r	5.10 j-q	4.36 F
Algae extr.at 2.5 cm/l	6.78 g-n	7.18 f-m	9.17 d-h	7.71CDE	6.70 h-o	7.40 f-l	9.40 d-h	7.83 DE
Algae at extr. 5 cm/l	7.51f-l	9.53 d-g	10.81 cde	9.28C	8.53 e-i	10.17 def	11.80cd	10.17 BC
Date av.	5.71C	7.18 B	8.04 A		5.82C	7.29 B	8.35 A	

Means in each column which have the same letter(s) are not significantly different.

Table 3. Effect of some natural extracts and synthetic growth regulators on sprouting percentage of Picual olive cuttings (2014 and 2015 seasons)

Treatment	Percentage of sprouting (%)							
	First season (2014)				Second season (2015)			
	Months after cutting planting				Months after cutting planting			
	5	6	7	Trea. av.	5	6	7	Trea. av.
IBA at 4000 ppm	38.90a-f	52.80ab	53.67 a	48.46 A	41.67 b-f	44.43 a-e	58.33ab	48.14 A
NAA at 500 ppm	13.89g-k	33.33b-g	30.57 c-h	25.93CD	27.77 e-j	37.50 c-g	19.47g-l	28.24CD
IBA at 4000 + NAA at 500 ppm	33.30b-g	19.45f-k	41.70a-e	31.48BCD	33.33 d-h	44.43 a-e	55.57abc	44.44AB
Moringa extr. at 10%	5.57 jk	5.57jk	8.33ijk	6.49 E	16.68 h-l	8.33kl	8.33kl	11.11F
Moringa extr. at 20%	2.78 k	5.57jk	11.10h-k	6.48 E	12.51i-l	5.53l	8.33kl	8.79 F
Garlic extr. at 10%	8.33 ijk	27.77c-i	45.83abc	27.31BCD	25.00 f-k	41.67 b-f	41.64 b-f	36.10BC
Garlic extr. at 20 %	25.00d-j	16.70g-k	44.47a-d	28.72BCD	30.53 e-i	58.30 ab	44.43 a-e	44.42AB
Liquorice extr. at 5g/l	22.24e-k	16.65g-k	20.83f-k	19.91 D	25.00 f-k	19.44 g-l	25.00 f-k	23.15DE
Liquorice extr.at10 g/l	25.00d-j	30.57c-h	38.87a-f	31.48BCD	29.17 e-j	38.87 c-f	61.10 a	43.04AB
Yeast extr.at 5 %	30.57c-h	33.30b-g	45.83 abc	36.57 BC	12.51i-l	11.12jkl	14.07i-l	12.57EF
Yeast extr.at 10 %	25.01d-j	16.65 g-k	33.30 b-g	24.99CD	8.33kl	11.12jkl	19.44 g-l	12.96EF
Algae extr.at 2.5 cm/l	25.00d-j	37.57a-f	20.83 f-k	27.80BCD	11.12 jkl	41.67 b-f	30.57 e-i	27.78CD
Algae at extr. 5 cm/l	44.47a-d	33.33b-g	38.88 a-f	38.89AB	13.89 i-l	44.47 a-e	49.87 a-d	36.07BC
Date av.	23.08 B	25.33B	33.40 A		22.12 B	31.30 A	33.55 A	

Means in each column which have the same letter(s) are not significantly different.

seasons. The highest percentage of bud sprouting was detected from each of the following combinations IBA at 4000 ppm, IBA at 4000 ppm + NAA at 500 ppm and liquorice extract at 10 g after 7 month from planting. In addition, the combination of garlic extract at 20% after 6 month from planting and algae extract at 5 cm after 7 months from planting gained the percentages of bud sprouting (58.30 and 49.87%) in the second season.

The obtained results are in line with those reported by **Patil *et al.* (2001) Mayer *et al*. (2013) and Gill *et al.* (2014)** who reported that used IBA improved sprouting percentage.

Number of shoots / transplant

Results presented in Table 4 reveal significant differences among the different treatments in both seasons. The highest shoot number/ transplant was obtained from each of the following treatments, IBA at 4000 ppm (2.74 and 2.17 shoot/transplant), IBA at 4000 ppm + NAA at 500 ppm (2.01 ; 2.39 shoot/ transplant), garlic extract at 10 and 20% (2.10 ; 2.20 and 2.33 ; 2.73 shoot/transplant), liquorice extract at 10 g (2.09 and 2.11 shoot/transplant) and algae extract at 5cm (2.38 and 2.29 shoot/transplant) in the 1st and 2nd season, respectively. The lowest numbers of shoot / transplant were recorded for the two concentrations of moringa extract (10 and 20%) and yeast extract (5 and 10%) in both seasons without significant differences between the two concentrations.

Results clarified significant differences between the dates after planting on number of the shoots per transplant in the two seasons. The optimum number of shoots / transplant (2.16 and 2.16 shoot/transplant) was traced seven months after planting in both seasons. The lowest number of shoots/ transplant (1.73 and 1.45 shoot/transplant) was found fifth month after planting in both seasons. Insignificant differences between 5 and 6 months in the first season and likewise, between 6 and 7 months in the second season were traced.

The interaction between treatments and number of months after planting on number of shoots per cutting was significant in both seasons. The highest number of shoots/cutting were recorded for IBA at 4000 ppm + NAA at 500 ppm treatment after 7 months, garlic at 20 after 6 and 7 months and algae at 5 cm after 7 months from planting in the two seasons .

Similar trends were reported by **Martins *et al.* (2001), Patil *et al.*(2001), Da Silva *et al.* (2013)**, **Khajehpour *et al.* (2014), Sharma *et al.* (2014), Jan *et al*. (2014) and Jana *et al*. (2015). T**hey all cleared that IBA increased shoot number / cutting of fruit species.

The increase in shoot characteristics might also be due to the auxins content in the seaweed extracts which have an effective role in cell division and enlargement; this leads to increase the shoot growth, leaf area and plant dry weight **(Gollan and Wright, 2006)**. **Arthur *et al*. (2003)** showed that seaweed improves root-growth, vegetative and reproductive growth of many plants**. Mansour *et al*. (2006)** and **Abd El-Moniem and Abd-Allah** (**2008)** showed that the applied of algae extract was very effective in stimulating the growth characters.

At contrast, **Sadak (2016)** reported that yeast extract caused significant decreases in number of shoot of *Pisum sativum* L. plant.

Leaf number/shoot

As shown in Table 5 the effect of the tested treatments on number of leaves/ cutting was significant in the two seasons. The highest leaf number per cutting was recorded for each of the following treatment, IBA at 4000 ppm (6. 49 and 6.61), IBA at 4000 ppm + NAA at 500 ppm (5.85 and 5.80), liquorice 10 g (6.01 and 5.48) and algae 5 cm (6.29 and 6.16) in the two seasons, respectively without differences between most of them. The differences between the two concentrations of moringa, yeast and algae on number of leaves per cutting were insignificant in the two seasons. The lowest numbers of shoots/plant were gained the two concentrations of moringa (1.08, 0.98 and 1.21, 1.17) in both seasons, respectively without significan differences between them.

Also, the effect of months after planting on number of leaves/ cutting was significant in the two seasons. The highest number of leaves/ cutting (5.97 and 6.02 leaves/ cutting) was found seven months after planting in both seasons. The lowest number of leaves/ cutting (4.21 and 3.36 leaves/ cutting) was traced 5 months after planting in both seasons.

Table 4. Effect of some natural extracts and synthetic growth regulators on shoot number/ cutting of Picual olive variety (2014 and 2015 seasons)

Treatment	Shoot number/ transplant							
	First season (2014)				Second season (2015)			
	Months after cutting planting				Months after cutting planting			
	5	6	7	Trea. av.	5	6	7	Trea. av.
IBA at 4000 ppm	2.20 a-g	3.12 a	2.91 ab	2.74 A	1.87 c-i	2.43a-g	2.20b-h	2.17B-E
NAA at 500 ppm	1.58 e-j	2.24 a-g	2.24 a-g	2.02 BC	1.33 h-m	2.15b-h	1.80c-i	1.76DE
IBA at 4000 + NAA at 500 ppm	1.79 d-i	1.66 d-i	2.58 a-e	2.01 BC	1.63e-k	2.43a-g	3.10ab	2.39AB
Moringa extr. at 10%	0.44k	0.57 jk	0.90h-k	0.64 D	0.43 m	0.57 lm	0.67klm	0.56F
Moringa extr. at 20%	0.57 jk	0.77 ijk	0.90h-k	0.74 D	0.43 m	0.57 lm	0.77j-m	0.59 F
Garlic extr. at 10%	1.33 g-k	2.12a-g	2.85abc	2.10 BC	1.80 c-i	2.43a-g	2.77abc	2.33ABC
Garlic extr. at 20 %	1.80 c-i	2.23a-g	2.58 a-e	2.20 ABC	2.20 b-h	2.73abc	3.27 a	2.73 A
Liquorice extr. at 5g/l	1.91 b-h	2.16a-g	2.10 a-g	2.06 BC	2.00 c-i	1.43h-l	2.00c-i	1.81CDE
Liquorice extr.at10 g/l	2.34 a-g	1.68 d-i	2.24a-g	2.09 BC	1.57 f-k	2.20b-h	2.57a-e	2.11B-E
Yeast extr.at 5 %	2.16 a-g	2.10 a-g	2.66a-d	2.31 ABC	1.35 h-m	1.50g-l	2.00c-i	1.62E
Yeast extr.at 10 %	1.90 b-h	1.51 f-j	1.85c-h	1.75 C	1.15 i-m	1.70d-j	2.00c-i	1.62E
Algae extr.at 2.5 cm/l	1.91 b-h	1.90 b-h	1.85b-h	1.89 BC	1.43 h-l	2.20b-h	2.23b-h	1.96B-E
Algae at extr. 5 cm/l	2.57 a-f	2.13a-g	2.45a-f	2.38 AB	1.67 e-j	2.53a-f	2.67a-d	2.29A-D
Date av.	1.73 B	1.86 B	2.16A		1.45 B	1.91 A	2.16A	

Means in each column which have the same letter(s) are not significantly different.

Table 5. Effect of some natural extracts and synthetic growth regulators on leaf number/ shoot of Picual olive variety (2014 and 2015 seasons)

Treatment	Leaf number/ shoot							
	First season (2014)				Second season (2015)			
	Months after cutting planting				Months after cutting planting			
	5	6	7	Trea. av.	5	6	7	Trea. av.
IBA at 4000 ppm	5.49 b-i	5.67 b-i	8.32a	6.49 A	5.13 g-n	6.82 b-f	7.89 ab	6.61AB
NAA at 500 ppm	4.13hij	3.03jk	5.80b-h	4.32 D	3.53n-q	5.12 g-n	5.62 d-k	4.76 DE
IBA at 4000 + NAA at 500 ppm	4.45hij	6.53 a-g	6.55a-g	5.85AB	3.75m-q	6.75 b-g	6.91 b-e	5.80 BC
Moringa extr. at 10%	0.89 l	1.07 l	1.30kl	1.08 E	0.75r	1.07r	1.13r	0.98G
Moringa extr. at 20%	0.87l	1.27 kl	1.50kl	1.21E	0.89r	1.22r	1.40r	1.17G
Garlic extr. at 10%	3.80ij	4.1000 hij	6.74 a-f	4.88 BCD	3.28pq	5.53 e-l	7.61ab	5.48 CD
Garlic extr. at 20 %	5.14d-i	4.89f-j	6.93 a-e	5.65 AB	3.37 opq	5.00h-o	7.42abc	5.26 CD
Liquorice extr. at 5g/l	4.53hij	4.83f-j	7.16 abc	5.51 ABC	3.93l-p	4.63j-p	6.45 b-i	5.01 CDE
Liquorice extr.at10 g/l	5.25c-i	5.55 b-i	7.23 ab	6.01 A	3.94k-p	5.92 c-j	6.58 b-h	5.48CD
Yeast extr.at 5 %	4.64 g-j	3.83ij	5.08 e-i	4.52 CD	2.20qr	3.97 k-p	5.18 f-n	3.78 F
Yeast extr.at 10 %	5.03 e-i	5.57 b-i	5.80 b-h	5.47 ABC	3.38 opq	3.77m-q	5.24e-m	4.13 EF
Algae extr.at 2.5 cm/l	5.12d-i	5.66b-i	7.00 a-d	5.93AB	4.60j-p	7.25a-d	8.03 ab	6.63 AB
Algae at extr. 5 cm/l	5.44 b-i	5.31 c-i	8.13 a	6.29 A	4.87i-p	7.78 ab	8.82 a	7.16 A
Date av.	4.21 B	4.41 B	5.97 A		3.36 C	4.99 B	6.02A	

Means in each column which have the same letter(s) are not significantly different.

The interaction between treatments and number of months after planting on leaf number per cutting was significant in both seasons. The highest number of leaves/cutting was recorded for each of the combinations IBA at 4000 ppm, IBA at 4000 ppm + NAA at 500 ppm, garlic, liquorice and algae 7 months after planting without significant differences between them in the two seasons. All combinations of moringa levels at different dates gave the lowest number of leaves /cutting in both seasons.

These findings are entirely in agreement with those reported by **Patil *et al.* (2001), Sharma *et al.* (2014) and Jan *et al.* (2014)** reported that IBA increased leaf number/cutting of fruit species (olive, pear, apple and grapvine). On the other hand, IBA did not significantly affect on leaf number/cutting **(Dolor *et al.*, 2010).**

Mansour *et al.* (2006), Abd El-Moniem and Abd-Allah (**2008), Vinoth *et al.* (2012), Abdulrahman (2013)** and **Ibrahim (2013)** reported that the applied of algae extract was very effective in stimulating the growth characters (*i.e.,* leaf number/cutting) of olive cv. Hojblanca. **Babilie *et al.* (2015)** mentioned that licorice roots and seaweed extracts significantly increased plant height, length of the tallest leaf and number.

Zaki and Rady (2015) showed that the *Moringa oleifera* leaf extract (MLE) significantly increased growth characteristics (*i.e.,* shoot length, number and area of leaves per plant, and plant dry weight) when compared with the controls.

Taha *et al.* (2016) cleared that yeast extract had no significant effect on stem diameter, number of leaves/plant and root length of *Azadirachta indica* plants. On the other hand, **Sadak (2016)** mentioned that yeast extract caused significant decreases in number of leaves of *Pisum sativum* L. plants.

Survival percentage of cuttings

Results in Table 6 indicate that, the effect of the studied treatments on survival percentage of cuttings was significant in the two seasons. The highest survival percentage was recorded for each of the following treatments IBA at 4000 ppm and NAA at 500 ppm, garlic at 10 and 20, liquorice extract at 10 g and algae at 2.5 and 5 cm in both seasons without significant differences between them. The least survival percentage was gained by the two concentrations of moringa extract at 10% (11.10 and 22.20%) and 20% (11.10 and 29.60%) in both seasons without significant differences between the two concentrations in both seasons.

The effect of different months after planting on the survival percentage of cuttings was significantly differed in both seasons. The maximum survival percentages were traced fife and six months after planting (69.30 , 57.22% and 75.18, 57.65%) in the first and second season, respectively. The differences between survival percentage of cuttings after 6 and 7 months were insignificant in the two seasons.

The interaction between treatments and number of months after planting on survival percentage was significant in the two seasons. All combinations of synthetic growth regulators, garlic levels, liquorice extract at 10 g and algae extract after the different dates gave the highest survival percentage of cuttings without significant differences between them in both seasons.

Similar trends were reported by **Martins *et al.* (2001), Patil *et al.* (2001), Andrade and Martins (2003), Jiang *et al.* (2004), Samaan *et al.* (2010), Agele *et al.* (2013)**, **Mayer *et al.* (2014), Jan *et al.* (2014)** and **Soni *et al.* (2016)**. They all reported that IBA increased survival percentage of cuttings in different fruit species (olive, pear, apple, peach, plum, citrus and grapevine).

Vinoth *et al.* (2012) mentioned that the application of algae extract was very effective in stimulating growth characters *i.e.,* survival percentage of cuttings. **Arthur *et al.* (2003)** showed that seaweed increases seedling quality and survival, improves root-growth, vegetative and reproductive growth of many plants.

Chemical Constituents in Shoots and Roots of Survived Cutting

Total carbohydrates percentage

The results presented in Table 7 show that the highest content of total carbohydrates in roots of cuttings treated with IBA at 4000 ppm + NAA at 500 ppm (13.20 and 13.34%) in both seasons,

Table 6. Effect of some natural extracts and synthetic growth regulators on survival percentage of Picual olive cuttings (2014 and 2015 seasons)

Treatment	Survival percentage (%)							
	First season (2014)				Second season (2015)			
	Months after cutting planting				Months after cutting planting			
	5	6	7	Trea. av.	5	6	7	Trea. av.
IBA at 4000 ppm	88.87ab	77.73abcd	77.73abcd	81.44 A	88.87ab	77.73 abc	100.00a	88.87 A
NAA at 500 ppm	77.73abcd	66.63bcde	55.50cdef	66.62ABC	88.87ab	66.60 bcd	44.40def	66.62BCD
IBA at 4000 + NAA at 500 ppm	77.73abcd	55.50cdef	66.63bcde	66.61 ABC	77.73abc	77.73 abc	100.00a	85.16 A
Moringa extr. at 10%	11.10 g	11.10 g	11.10 g	11.10 D	44.40def	11.10 g	11.10g	22.20 E
Moringa extr. at 20%	11.10 g	11.10 g	11.10 g	11.10 D	44.40def	22.20 fg	22.20fg	29.60 E
Garlic extr. at 10%	100.00a	66.63bcde	66.63bcde	77.73 AB	100.00a	55.50cde	66.60bcd	74.03ABC
Garlic extr. at 20 %	88.87ab	66.63bcde	66.63bcde	74.03 AB	88.87ab	66.60bcd	77.73abc	77.73 AB
Liquorice extr. at 5g/l	88.87ab	55.50cdef	44.40 ef	62.92 BC	77.73abc	44.40def	55.50cde	59.21 CD
Liquorice extr.at10 g/l	88.87ab	55.50cdef	77.73abcd	74.03 AB	77.73abc	77.73abc	77.73abc	77.73 AB
Yeast extr.at 5 %	44.40ef	55.50cdef	49.93def	49.94 C	77.73abc	44.40def	33.30efg	51.81 D
Yeast extr.at 10 %	66.63bcde	49.93def	33.30 fg	49.944 C	55.50cde	49.93cdef	44.40def	49.94D
Algae extr.at 2.5 cm/l	77.73abcd	83.30abc	77.73abcd	79.59 AB	77.73abc	77.73abc	77.73abc	77.73 AB
Algae at extr. 5 cm/l	83.30abc	88.87ab	77.73abcd	83.30 A	77.73abc	77.73abc	77.73abc	77.73 AB
Date av.	69.63 A	57.22 B	55.08 B		75.18 A	57.65B	60.65B	

Means in each column which have the same letter(s) are not significantly different.

Table 7. Effect of some natural extracts and synthetic growth regulators on total carbohydrates percentage in roots of Picual olive variety (2014 and 2015 seasons)

Treatment	Total carbohydrates percentage of roots (%)							
	First season (2014)				Second season (2015)			
	Months after cutting planting				Months after cutting planting			
	5	6	7	Trea. av.	5	6	7	Av. trea.
IBA at 4000 ppm	12.08de	12.54 c	12.97 b	12.53 B	12.11hi	12.53 f	13.09c	12.57 B
NAA at 500 ppm	11.55ij	11.70hi	11.97 ef	11.74 D	11.59m	11.90j	12.30g	11.93 D
IBA at 4000 + NAA at 500 ppm	12.84 b	12.86 b	13.89 a	13.20 A	12.91 d	13.26 b	13.87 a	13.34 A
Moringa extr. at 10%	9.65w	9.85 uv	10.27st	9.92L	10.17z	10.27y	10.44w	10.29M
Moringa extr. at 20%	9.73vw	9.93u	10.45qr	10.04K	10.45w	10.51uv	10.63t	10.53K
Garlic extr. at 10%	10.17t	10.55pq	10.86o	10.53H	10.65t	11.19p	10.98r	10.94I
Garlic extr. at 20 %	10.92no	11.06mn	11.33kl	11.11 G	11.00r	11.08q	11.40 o	11.16H
Liquorice extr. at 5g/l	10.96no	11.21lm	11.65hi	11.27 F	11.03qr	11.23p	11.59lm	11.28 G
Liquorice extr.at10 g/l	11.16 m	11.33 kl	11.89fg	11.46E	11.20p	11.53n	11.85jk	11.53F
Yeast extr.at 5 %	9.86uv	10.24st	10.56pq	10.22J	10.34x	10.48vw	10.64t	10.49L
Yeast extr.at 10 %	9.94u	10.35rs	10.67p	10.32I	10.56u	10.63 t	10.81s	10.67J
Algae extr.at 2.5 cm/l	11.43jk	11.55ij	12.18 d	11.72 D	11.50n	11.65l	12.16h	11.77E
Algae at extr. 5 cm/l	11.77gh	11.95ef	12.68 c	12.13 C	11.79k	12.06i	12.65 e	12.17C
Date av.	10.93C	11.16 B	11.64 A		11.18 C	11.41 B	11.72 A	

Means in each column which have the same letter(s) are not significantly different.

respectively, with significant differences with the other treatments. The higher levels of all natural extracts significantly exhibited higher carbohydrates content than the lower levels. Moringa extract at 10% treated cuttings contains significantly the lowest carbohydrates percentage (9.92 and 10.29%) in both seasons, respectively, compared with the other treatments.

The total carbohydrates content in the root was gradually increased with advancing in planting months and reached the highest content seven months after planting (11.64 and 11.72%) in the two seasons, respectively.

The all combinations of IBA at 4000 ppm + NAA at 500 ppm x different dates gave the highest total carbohydrates content in roots with significant differences between them in both seasons.

The same trend in carbohydrates content in the shoots was observed in Table 8 in both seasons with the advance in planting months, and between treatments.

These results are in agreement with those reported by **Ling and Zhong (2012)** who elucidated that the highest total carbohydrates concentration and carbohydrate/nitrogen (C/N) ratio were recorded in the basal parts of the stem cuttings planted on 15 May, either before planting or 35 days after. A positive relationship of rooting percentage was found between total carbohydrates concentration and C/N ratio. No consistent relationship was established between total nitrogen and rooting percentage. Results showed also high and low negative relationship of the rooting percentage of the cuttings between indole-3-acetic acid (IAA) concentration and gibberellins (GAs) concentration, respectively. In addition, 35 days after planting, a positive relationship was detected between abscisic acid (ABA) concentration and the rooting percentage. From these results, 15 May be recommended as the ideal planting date for improving the rooting and the vegetative growth of Tetraploid Locust stem cuttings compared to the other investigated planting dates. New shoot growth of Tetraploid Locust stopped in July, followed by the accumulation of carbohydrates because photosynthetic products were not exhausted by new shoot growth, and then the carbohydrates were converted into fructose and glucose from July to March of the next year.

Several studies indicated that auxins have the greatest effect on the initiation of adventitious roots and the division of root initials. Carbohydrates are particularly important as an energy source in the rooting process of cuttings **(Fabbri *et al.*, 2004)**. The reduction in the rooting percentage observed in the July cuttings may be attributed to that mother plants tended to flower at this time, causing the utilization of auxin for floral bud development and the depletion of the carbohydrates reserves (**Hussein, 2003 and 2008).**

Total carbohydrates and total nitrogen levels and C/N ratio **(Druege *et al.*, 2004 ; Rapaka *et al.*, 2005)** have been reported to influence the adventitious rooting of plant species. Generally, nitrogen has been negatively correlated to rooting. Such effects have been suggusted to decreased carbohydrates levels and C/N ratio, as important for root formation **(Druege *et al.*, 2000).** In addition, **Kasim *et al.* (2009)** working on bitter almond found that high rooting ability was accompanied by their high C/N ratio during the growth season.

Hanafy *et al.* (2012) cleared that the highest values of total carbohydrates were obtained with garlic extract followed by yeast extract, thus application of garlic extract resulted in the highest values of all recorded root characters, whereas the lowest values of all recorded characters were resulted by control treatment in both seasons.

Total Soluble Phenols

Table 9 declare that IBA at 4000 ppm + NAA at 500 ppm treatment achieved the highest total soluble phenols in the roots in both seasons compared with the other treatments. The higher concentrations of all natural extracts significantly gained the highest total soluble phenols than the lower concentrations for each natural extract.

The total soluble phenols in roots were decreased after six months then increased in the seventh month in both seasons.

The differences between combinations of algae at 2.5 × 7 months after planting and IBA at 4000 ppm after 5 and 6 months were insignificant in the two seasons. The combinations of IBA at 4000 ppm + NAA at 500 ppm after 7 months gave the highest significant total soluble phenols concentration in the roots compared with the other combinations in the two seasons.

Table 8. Effect of some natural extracts and synthetic growth regulators on total carbohydrates percentage in shoots of Picual olive variety (2014 and 2015 seasons)

Treatment	Total carbohydrates percentage of shoots (%)							
	First season (2014)				Second season (2015)			
	Months after cutting planting				Months after cutting planting			
	5	6	7	Trea. av.	5	6	7	Trea. av.
IBA at 4000 ppm	16.44 d	16.75 cd	17.15 c	16.78 B	16.49f	16.78 e	17.133 d	16.80 B
NAA at 500 ppm	14.49 fgh	15.82 e	16.40 d	15.57 C	14.59k	14.90i	15.24h	14.91 C
IBA at 4000 + NAA at 500 ppm	18.41b	18.63 b	19.19a	18.74 A	18.49 c	18.74 b	19.16 a	18.80 A
Moringa extr. at 10%	11.26u	11.83 rst	12.34pq	11.81I	11.54e	12.27 a	12.37z	12.06M
Moringa extr. at 20%	11.44tu	11.95qrs	12.55op	11.98HI	11.63d	12.45y	12.54x	12.21 L
Garlic extr. at 10%	13.45n	15.66 e	14.09h-k	14.40E	13.49u	13.74s	14.09q	13.77I
Garlic extr. at 20 %	13.63lmn	13.93j-m	14.40ghi	13.99F	13.71s	13.95r	14.39o	14.02 G
Liquorice extr. at 5g/l	13.53mn	13.83k-n	14.14h-k	13.83F	13.56t	13.96r	14.13p	13.89 H
Liquorice extr.at10 g/l	13.81k-n	14.93 f	14.59fg	14.45E	13.94r	14.08q	14.49m	14.17 F
Yeast extr.at 5 %	11.54stu	12.23pqr	12.64op	12.14H	11.78c	12.44y	12.65w	12.29K
Yeast extr.at 10 %	12.34pq	12.47 op	12.84o	12.55G	11.98b	12.54x	12.83v	12.45J
Algae extr.at 2.5 cm/l	14.03i-l	13.99i-l	14.93 f	14.32E	14.55l	14.46 mn	14.91i	14.64E
Algae at extr. 5 cm/l	14.34g-j	14.63 fg	15.39 e	14.79 D	14.45n	14.86j	15.35g	14.89 D
Date av.	13.75 C	14.36 B	14.67 A		13.86C	14.24 B	14.56 A	

Means in each column which have the same letter(s) are not significantly different.

Table 9. Effect of some natural extracts and synthetic growth regulators on total soluble phenols in roots of Picual olive variety (2014 and 2015 seasons)

Treatment	Total soluble phenols of roots (mg/g. DW)							
	First season (2014)				Second season (2015)			
	months after cutting planting				Months after cutting planting			
	5	6	7	Trea. av.	5	6	7	Trea. av.
IBA at 4000 ppm	317.50 ef	320.37e	373.07 c	336.98 C	332.73 g	335.40 f	370.70 d	346.28 B
NAA at 500 ppm	390.63 b	305.27 fg	342.13 d	346.01 B	272.00 p	277.27 m	311.20j	286.82 E
IBA at 4000 + NAA at 500 ppm	374.73 c	383.63 bc	431.07 a	396.48 A	391.53 c	402.00 b	430.83 a	408.12 A
Moringa extr. at 10%	195.33 o-r	186.33 r	217.47 mn	199.71J	214.93 z	213.70 A	232.93 t	220.52K
Moringa extr. at 20%	204.80 n-q	191.53 qr	231.77 kl	209.37GHI	237.43 r	219.07 x	237.90 r	231.47 G
Garlic extr. at 10%	197.60 o-r	189.90 r	228.43 lm	205.31 HIJ	210.93 C	201.63 D	228.07 v	213.54 M
Garlic extr. at 20 %	206.40 no	191.90 qr	234.50 kl	210.93 GH	232.20 u	216.43 y	234.50 s	227.71 I
Liquorice extr. at 5g/l	203.60 opq	162.80 s	242.83 jk	203.08 IJ	226.00 w	213.33 A	242.13 q	227.16 J
Liquorice extr.at10 g/l	221.90 lm	244.90 jk	295.73 gh	254.18 F	233.83 s	276.07 n	294.13 k	268.01 F
Yeast extr.at 5 %	191.43 qr	194.00 o-r	226.47 lm	203.97HIJ	211.10 C	212.60 B	225.60 w	216.43 L
Yeast extr.at 10 %	205.70 nop	192.53 pqr	249.50 j	215.91 G	231.53 u	215.37 z	237.90 r	228.27 H
Algae extr.at 2.5 cm/l	265.63 i	256.13 ij	311.93 ef	277.90 E	283.43 l	273.00 o	312.20 i	289.54 D
Algae at extr. 5 cm/l	290.50 h	297.00gh	343.60 d	310.37 D	312.90 i	318.00h	342.00 e	324.30 C
Date av.	251.21B	239.72C	286.81 A		260.81 B	259.53 C	284.62 A	

Means in each column which have the same letter(s) are not significantly different.

Total soluble phenols in shoots were gradually increased as presented in Table 10. The IBA at 4000 ppm + NAA at 500 ppm treatment achieved the highest values (532.31 and 520.19 mg/g DW) in the first and second seasons, respectively, while moringa extract at 10% was the lowest value in the first season (329.43 mg/g. DW) and yeast at 10% in the second season (346.97 mg/g DW). The other treatments were inbetween.

Aslmoshtaghi and Shahsavar (2010b) reported that there were significant differences between the tested cultivars in the total phenolic content and the highest phenolic compounds were found in "Konsrvalia" after 120 days and the lowest phenolic compounds were found in "Roghani" cultivar. In addition, **Denaxa *et al.* (2012)** showed that the pattern of changes in sugar concentrations at 3 and 7 days after planting was different for each cultivar. Initial internal sugar concentrations and their metabolism might be important during the early period of the rooting process.

Krajnc *et al.* (2012) cleared that, the twenty three days after severance a transient decline in total protein contents was accompanied by an increased accumulation of total phenolics in all Kelpak (brown algae) applications. Thirty six days after severance, a more than 220 % increase in total protein contents and a 50% decline in total phenolics were recorded in untreated cuttings when compared to the previous sampling date.

Abdalla (2013) showed that *Moringa oleifera* extracts increased the amounts of each of total sugars and phenols in rocket plants.

Taha *et al.* (2016) showed that application of yeast extract at 10, 15 and 20% resulted in the highest contents of total soluble phenols and total soluble sugars.

Table 10. Effect of some natural extracts and synthetic growth regulators on total soluble phenols in shoots of Picual olive variety (2014 and 2015 seasons)

Treatment	Total soluble phenols of shoots (mg/g. DW)							
	First season (2014)				Second season (2015)			
	months after cutting planting				months after cutting planting			
	5	6	7	Trea. av.	5	6	7	Trea. av.
IBA at 4000 ppm	425.73 e	419.87f	470.93 d	438.84 B	451.53d	446.93e	472.00 c	456.82 B
NAA at 500 ppm	414.63 g	406.33h	420.23 f	413.73 C	391.80l	387.43n	411.97g	397.07 D
IBA at 4000 + NAA at 500 ppm	481.70 c	580.30 a	534.93 b	532.31 A	513.40 b	512.60 b	534.57 a	520.19 A
Moringa extr. at 10%	314.60B	306.77E	366.93q	329.43L	341.13 v	342.03 v	362.53 t	348.57J
Moringa extr. at 20%	342.33u	332.67x	373.30mn	349.43I	376.33 q	379.03 p	397.93 j	384.43 G
Garlic extr. at 10%	315.63A	307.70D	373.07n	332.13K	342.70 v	333.10 w	372.10 r	349.30 J
Garlic extr. at 20 %	341.50 v	334.27 w	405.00 i	360.26 G	379.80 p	372.83 r	405.43 h	386.02 F
Liquorice extr. at 5g/l	331.40 y	319.87 z	385.43 k	345.57J	367.50 s	354.07 u	387.40 n	369.66 H
Liquorice extr.at10 g/l	365.63r	373.77m	370.73 p	370.04F	390.10 m	394.63 k	390.80 lm	391.84 E
Yeast extr.at 5 %	315.33A	308.77C	371.20 p	331.77 K	353.43 u	341.50 v	366.57 s	353.83I
Yeast extr.at 10 %	342.93u	334.43w	372.30 o	349.89 H	276.07 x	372.70 r	392.13 l	346.97K
Algae extr.at 2.5 cm/l	359.83s	349.90t	403.07j	370.93 E	382.23 o	371.83 r	403.60 i	385.89F
Algae at extr. 5 cm/l	385.33k	377.27l	426.00e	396.20 D	403.00i	395.00 k	425.40 f	407.80 C
Date av.	364.35C	365.53 B	405.63 A		382.23C	384.90 B	409.42 A	

Means in each column which have the same letter(s) are not significantly different.

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تأثير بعض المستخلصات الطبيعية وإندول حمض البيوتريك ونفتالين حمض الخليك على تجذير عقل الزيتون صنف بيكوال

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أجريت هذه الدراسة خلال موسمي ٢٠١٤ و٢٠١٥ في صوبة بلاستيكية خاصة في مركز بلبيس بمحافظة الشرقية لمحاولة استبدال منظمات النمو الصناعية التي تستخدم في تجذير عقل الزيتون بالمستخلصات الطبيعية الأخرى التي تحتوي على أوكسينات، جهزت عقل الزيتون صنف بيكوال في نوفمبر من كل موسم (بطول حوالي ١٥ سم وقطر ٧-٩ ملم)، وغمست العقل في تركيزات من محلول إندول حمض البيوتريك (IBA) بتركيز ٤٠٠٠ جزء فى المليون ونفتالين حمض الخليك (NAA) بتركيز ٥٠٠ جزء فى المليون لمدة ٥ ثواني أو نقعت في المستخلصات الطبيعية لمدة نصف ساعة، أشارت النتائج إلى الحصول علي أكبر نسبة تجذير (٨١,٤٤ و٨٥,٦٠%)، عدد الجذور/عقلة (١٤,٨٤ و١٤,٩٠ جذر/عقلة)، عدد الأفرخ/نبات (٢,٧٤ و٢,١٧ فرخ/نبات)، عدد الأوراق/ نبات (٦,٤٩ و٦,٦١ ورقة/نبات) ونسبة تفتح البراعم (٤٨,٤٦ و٤٨,١٤%) على التوالي في العقل التي غمست في محلول الـ IBA بتركيز ٤٠٠٠ جزء في المليون مقارنة مع تلك التي نقعت في مستخلص المورينجا الذي أعطى أدنى القيم في الصفات المدروسة خلال الموسمين.وسجلت أعلى القيم لنسبة البقاء في العقل التي عوملت بكل من IBA و NAA ومستخلصات الثوم (١٠ و ٢٠%) والعرقسوس بمعدل١٠ جم والطحالب بمعدل ٢,٥ و ٥ سم في كلا الموسمين دون وجود اختلافات معنوية بينهما، زادت نسبة الكربوهيدرات الكلية في الجذور والأفرخ تدريجيا مع التقدم في شهور الزراعة ووصل إلى أعلى القيم بعد سبعة أشهر، فى حين انخفضت كمية الفينولات الكلية في الجذور بعد ستة أشهر ثم زادت في الشهر السابع في كلا الموسمين، هذا وتعتبر معاملات النقع في مستخلصات الطحالب والثوم والعرقسوس أفضل المستخلصات الطبيعية مقارنة بغيرها ولا يوجد فرق معنوى بينها ومنظمات النمو المستخدمة ولذلك يمكن استخدامها اقتصادياً كبديل لمنظمات النمو لتجذير عقل الزيتون صنف بيكوال.

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