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Effect of Some Natural Products As an Alternative Chemical Growth Regulators on Rooting Response, Growth and Chemical Composition of Rosemary Cutting

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ABSTRACT

This study was conducted at the Experimental Station and Laboratory of Vegetable and Floriculture Department, Fac. of Agric., Mansoura Univ., Egypt, during 2015/2016 and 2016/2017 seasons to investigate the effect of some natural products and some alternative chemical growth regulators on rooting response, growth and chemical composition of cuttings of rosemary (*Rosmarinus officinalis* L.) plants. The layout of the experiment was completely randomized block design (CRBD) with three replications. The obtained results could be summarized as the following: It is worthy to mention that the highest values of all studied vegetative growth characters and chemical constituents of rosemary were resulted from treating terminal cuttings with coconut milk at the highest rate (75%) in both seasons. With exception, fresh weight of shoots, which, obtained when treating terminal cuttings with seaweed extract at the rate of 50 % and total phenols percentage, which obtained from control treatment (treating cuttings with water only) in both seasons. Using natural products such as coconut milk, seaweed extraction, yeast extract and honey bee were better than using chemical growth regulators like Indole butyric acid (IBA) in both seasons. It can be concluded that treating terminal cuttings of rosemary (*Rosmarinus officinalis* L.) with coconut milk at the rate of 75 % as natural growth regulator in order to enhance rooting, vegetative growth and chemical constituents.

Keywords: Rosemary, natural growth regulators, yeast extract, honey bee, coconut milk, seaweed extraction, IBA, rooting response.

INTRODUCTION

Rosemary (*Rosmarinus officinalis* L.) is a member of the mint family, *Lamiaceae*. It is an evergreen, perennial shrub that is endemic to The Mediterranean region and has been cultivated since ancient times. It has opposite, simple, entire, evergreen leaves that are a shiny green on top and whitish below. The plant begins to bloom in the late spring and continues through the summer. Flowers are usually blue although there are cultivars with pink or white blooms (Simon *et al*., 1984).

Medicinal and aromatic herbs are characterized by low seed viability and low germination capacity as a result of the lack of seed selection and processing programs (Nicola *et al*., 2005). Therefore, the vegetative propagation is widely preferred rather than propagation by seeds. Cutting is one of the most important means of vegetative plant propagation. Cutting propagation is fast, simple and does not require special techniques and methods use such are used in grafting, budding or micro-propagation. Cutting is a well-known common and relatively cheap method used in the propagation of many ornamental plant species. It overcomes the difficulties of propagation by plant seeds. Also, one parent plant can provide great number of quality cuttings. Furthermore, each cutting can become a plant with desirable genetic properties same as a parent plant (Hartmann *et al.,* 1997). For the successful rooting of cuttings, the quality substrates must be used with good water-air relations as well as good water retaining capacity to minimize the risk of the root zone becoming dry. It was previously recorded that different types of substrates have influence on morphological and physiological properties of flowering plants (Parađiković *et al*., 2013). Induction of adventitious roots on cuttings is governed by the complex interaction of several factors that could be classified under two major sections. The first would involve the stock mother plants' physiological status and their environmental conditions in addition to treatments applied to the mother plants' themselves (e.g. etiolation, girdling and spraying with chemicals) The second includes factors concerned with the post harvested cuttings which basically include both chemical and mechanical treatments imposed on cuttings [e.g. wounding, centrifugation and growth regulator application (Hartmann, 1990). Hormones are produced by plants that regulate the growth processes and the same are applied by horticulturist to promote growth and development of crops. They can be used to stimulate root development, control plant height in greenhouse investigation. They are usually applied in small quantities which are measured in parts per million (ppm) and horticulturists use them to understand and manipulate plants for specific purposes (Whiting *et al.,* 2014).

Honey is a natural source of many vitamins like vitamin B1 and vitamin C, which found in many plants root initiation of cuttings (Turetskaya and Polikarpova, 1968). Vitamins have long been found to promote root formation in numerous plant species (Chee, 1995). Yeast as a natural stimulator characterized by its richness in protein (47%), carbohydrates (33%), nucleic acid (8%), lipids (4%) and different minerals (8%) such as Na, Fe, Mg, K, P,S, Zn, Mn, Cu, Si, Cr, Ni, Va and Li, in addition to thiamin, riboflavin, pyridoxine, hormones and other growth regulating substances, such as biotin, B12 and folic acid (Nagodawithana, 1991). Coconut milk contains a content of cytokinins (especially zeatin) and auxin which helps to stimulate the growth of roots and shoots (Dunsin *et al*., 2016 and Yong *et al*., 2013). Seaweed extract contains three groups of plant hormones: gibberellins, cytokinins and auxins. It is supplemented by potassium salts of amino acids at 10%. The preparation enhances uptake of macro- and microelements and their translocation within plants, increases the respiration rate and root growth, participates in photosynthesis and other metabolic processes. It positively affects plant resistance to stresses, accelerates flowering set. (Bai *et al*., 2007).

The aim of this study is to assess the effect of some natural products like honey bee, yeast extract, coconut milk and seaweed extraction as natural alternative chemical growth regulators like Indole butyric acid (IBA) on rooting response, growth and chemical composition of cutting of rosemary (*Rosmarinus officinalis* L.).

MATERIALS AND METHODS

This study was conducted at the Experimental Station and Laboratory of Veget. and Flori. Depart., Fac. of Agric., Mansoura Univ., during 2015/2016 and 2016/2017 seasons to investigate the effect of chemical growth regulators like Indole butyric acid (IBA) and some natural products like yeast extract honey bee, coconut milk and seaweed extraction on rooting response, growth and chemical composition of cuttings of rosemary (*Rosmarinus officinalis* L.) plant.

Plants which are chosen as a mother stock for collecting cuttings were obtained from a commercial orchard at El-kanater El-khyrea and planting in ground of the nursery. Terminal cuttings of 12 cm length were planted in plastic pots, 5 cm in diameter at a depth of 3 - 5 cm approximately each contained peat moss: washed sand (1:1 V/V) were placed on the soil surface in greenhouse with mist irrigation unit. The cuttings were immersed for 15 minutes in a fungicide (rizolix) before immersed it in growth regulator at rate 3 g/L of tap water to control possible fungal infections. The cuttings were prepared and planted on 24th and 20th February in 2015/2016 and 2016/2017 seasons, respectively. The layout of the experiment was completely randomized block design (CRBD) with three replications. Each experiment included sixteen treatments comprising, one types of growth regulator Indole butyric acid (IBA) and four type of natural product like honey bee, yeast extract, coconut milk and seaweed extraction and three concentrations besides control treatment. In both years, the base of terminal cuttings was immersed in IBA, which were mixed with talc powder at rates of 75, 100 and 125 mg/L. In the yeast extract treatment the cuttings were soaked at the rates of 2, 4, and 6 g/L for one hour. While, in honeybee treatment which were mixed with boil water, the coconut milk treatment and the seaweed extraction treatment cuttings were soaked at the rates of 25, 50 and 75 % for one hour. The control cuttings were treated with water only. Chemical analyses of honey bee, yeast extract, coconut milk and seaweed extraction were shown in Tables (1, 2, 3 and 4) respectively.

Table 1. Chemical analysis of honeybee (according to Ball, 2007).

Components %				
Butyric acid	Ca	0.004	Water	18
Valeric acid	Fe	0.0007	Fructose	30
Caproic acid	Mg	0.18	Glucose	40
Lactic acid	P	0.11	Protein	1.2
Acetic acid	Na	0.007	Vitamin C	0.20 - 0.54
Succinic acid	Cl	0.001	Vitamin B_1	0.1
Oxalic acid	S	0.001	Vitamin B_2	0.12
Tartaric acid	Diastase		Vitamin B_3	0.2
Malic acid	Oxdidase		Vitamin B_4	0.1
flavonoids	Amylase		Vitamin B_6	0.5

Table 2. Chemical analysis of yeast extract (according to Khedr and Farid, 2000).

Minerals				Amino acids		Carbohydrates		Enzymes		Vitamins	
Macro	(g/100g DW)	Micro	(mg/100gDW)	(mg/100 g DW)		(mg/100 g DW)		(mg/100 g DW)		(mg/100 g DW)	
		Al	650.2	Arginine	1.99						
		B	175.6	Histidine	2.63						
		Co	67.8	Isoleucine	2.31					Vitamin B_1	2.23
		Pb	438.6	Leucine	3.09					Vitamin B_2	1.31
		Mn	81.3	Lysine	2.95					Riboflavin	4.96
		Sn	223.9	Methionine	0.72					Nicotinic acid	39.88
		Zn	335.6	Phenylalanine	2.01					Panthothenic acid	19.56
P_2O_5	7.23	NaO	0.35	Thereonine	2.09	Carbohydrate	23.2	Cytochrome	0.35	Biotin	0.09
K_2O	51.68	MgO	5.76	Tryptophan	0.45	Glucose	13.33	Oxidase	0.29	P-amino benzoic acid	9.23
N	34.39	Cao	3.05	Valine	2.19					Vitamin B6	1.25
		SiO_2	1.55	Glutamic acid	2.00					Folic acid	4.36
		SO_2	0.49	Serine	1.59					Thiamine	2.71
		Cl	0.06	Aspartic acid	1.33					Pyridoxine	2.90
		FeO	0.92	Cystine	0.23					Vitamin B12	153
		NaCl	0.30	Proline	1.53					Inositol	203
				Tyrosine	1.49						

DW: dry weight

Table 3. Chemical analysis of coconut milk (according to Yong *et al.*, 2009).

Proximates	g/100g	Proximates	g/100g
Water	94.45	Vitamin C	2.4
Dry	5.01	Thiamin (B_1)	0.03
Energy value	19kcal	Riboflavin (B_2)	0.057
Protein	0.72	Niacin (B_3)	0.08
Total lipid (fat)	0.2	Pantothenic acid (B_5)	0.043
Carbohydrate	3.71	Pyridoxine (B_6)	0.032
Total Sucrose	2.61	Folate	0.03
Calcium, Ca	24	Glutamic acid	0.165
Iron, Fe	0.29	Glycine	0.034
Magnesium, Mg	25	Histidine	0.017
Phosphorus, P	20	Lysine	0.032
Potassium, K	250	Methionine	0.013
Sodium, Na	105	Phenylalanine	0.037
Zinc, Zn	0.1	Tryptophan	0.008
Copper, Cu	0.04	Auxin	0.07
Manganese, Mn	0.142	Scyllo-inositol	0.05

Table 4. Chemical analysis of seaweed extract (according to Abou El-Yazied *et al.*, 2012).

Components	Value
Total amino acid	6 %
Carbohydrates	35 %
Alginic acid	10 %
Manitol	4 %
Betaines	0.04 %
IAA	0.03 %
Cytokinins(Adenine)	0.02 %
Organic (N)	3.12 %
P2O5	2.61 %
K2O	4.71 %
Ca	0.25 %
S	3.56 %
Mg	0.58 %
Micronutrients	1 – 6 %
Cu	12 ppm
Fe	150 ppm
Zn	70 ppm
Mn	13 ppm
B	60 pm
I	30 pm

Data recorded:

The cuttings were left to grow for 45 days, and then the following data were recorded:

A. Vegetative growth characters:

1. Plant height (cm).
2. Number of leaves/plant.
3. Fresh weight of shoots (g).
4. Dry weight of shoots (g).
5. Root length (cm).
6. Number of roots/cutting.
7. Fresh weight of roots (g).
8. Dry weight of roots (g).
9. Average number of roots per cutting = $\frac{\text{Total number of roots in successful cuttings}}{\text{Number of cuttings}}$
10. Average length of roots in cutting = $\frac{\text{Total length of roots in successful cuttings}}{\text{Number of cuttings}}$
11. Increase in cuttings length (cm).
12. Rooting percentage (%) = $\frac{\text{Number of rooted cuttings}}{\text{Total number of cuttings in the treatment}} \times 100$

B- Chemical constituents:

1- Total chlorophylls and carotenoids: were determined (mg/ g FW) according to Wettestein, (1957)

2- Nitrogen (%): was determined by modified Micro Kjeldahl method as described by Pregl (1945).

3- Phosphorus (%): was determined according to Jackson (1967).

4- Potassium (%): was determined according to Black (1965).

5- Total carbohydrates in leaves (%): was determined by using colorimetric method according to Dubois *et al.,* (1956).

6-Total soluble phenols (%): were determined using folin reagent and colorimetric method by using spectrophotometer at wave length of 730 nm described by A.O.A.C (1970) and modified by Daniel and George (1972) and a standard curve of pyrogallol.

7- Total soluble indoles (%): were colormetrically estimated at the wave length of 530 nm using p-dimethyl amino benzaldhyde test as adopted by Selim *et al.,* (1978) using a standard curve of IAA.

A randomized complete blocks design with three replicate was used according to Steel and Torrie (1980). Data were subjected to the statistical analysis according to SAS Institute (1994). The treatments mean were compared using the least significant difference (LSD) at 0.05 levels, as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

It could be stated that types and concentrations of some growth regulators *i.e.* indole butyric acid (IBA), honey bee, yeast extract, coconut milk and seaweed extraction at three different rates significantly affected vegetative growth characters (plant height, number of leaves/plant, fresh and dry weights of shoots, root length, number of roots/cutting, fresh and dry weights of roots, average number of roots per cutting, average length of roots in cutting, increase in cuttings length and rooting percentage) and chemical constituents (total chlorophylls and carotenoids, total nitrogen, phosphorus, potassium, carbohydrates, soluble phenols and soluble indoles percentages) of rosemary in the two growing seasons as shown in Tables (5, 6, 7 and 8), Fig. (1) and Photo (1).

Table 5. Plant height, number of leaves/ plant, fresh and dry weights of shoots and number of roots/ cutting of rosemary (*Rosmarinus officinalis* L.) as affected by types and concentrations of growth regulators during 2015/2016 and 2016/2017 seasons.

Characters / Treatments	Plant height (cm)		Number of leaves / plant		Fresh weight of shoots (g)		Dry weight of shoots (g)		Number of roots / cutting	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	14.83 g	15.58 g	45.00 h	49.00 g	0.69 d	0.71 e	0.11 d	0.08 h	10.50 g	12.33 g
IBA (75 mg/ L)	18.50 bcde	19.33 abc	58.00 defg	61.33 cdefg	0.82 cd	1.14 abcd	0.41 bcde	0.54 bc	14.33 fg	20.33 bcde
IBA (100 mg/ L)	18.66 bcde	18.58 abcd	70.33 abcd	67.00abcde	0.96 bcd	0.90 cde	0.29 defgh	0.14 gh	19.66 ef	17.16cdefg
IBA (125 mg/ L)	17.13 efg	19.41 abc	74.66 ab	69.66 abc	0.98 bcd	0.79 de	0.16 fgh	0.33 def	20.83 cdef	16.83 defg
Honey (25 %)	16.11 fg	15.25 g	48.50 gh	50.83 fg	0.99 bcd	0.91 cde	0.13 gh	0.25 efgh	15.33 fg	13.50 fg
Honey (50 %)	18.20 bcdef	16.48 de	55.83 fgh	56.33 defg	0.88 cd	1.11 abcd	0.59 ab	0.15 fgh	17.16 fg	15.00 efg
Honey (75 %)	17.50 def	17.26 cde	53.16 fgh	54.16 efg	0.92 cd	0.96 bcde	0.26 defgh	0.27 defg	19.83 def	19.83 bcde
Yeast extract (2 g/ L)	18.91 bcde	17.91 bcd	61.33 cdef	53.50 fg	0.72 d	1.12 abcd	0.34 cdefg	0.37 cde	15.66 fg	19.33bcdef
Yeast extract (4 g/ L)	18.91 bcde	18.43 abcd	70.50 abc	58.16 cdefg	1.15 bcd	1.34 ab	0.61 ab	0.56 b	28.16 bc	23.50 ab
Yeast extract (6 g/ L)	17.60 cdef	16.73 de	60.50 cdefg	57.83 cdefg	0.98 bcd	1.07 abcde	0.48 abcd	0.55 b	27.66 bcd	23.00 abc
Coconut Milk (25 %)	19.98 ab	20.16 ab	75.50 ab	70.50 abc	1.14 bcd	1.29 ab	0.41 bcde	0.45 bcd	30.16 ab	24.50 ab
Coconut Milk (50 %)	19.50 abcd	18.33 abcd	76.33 ab	75.66 ab	1.29 abc	1.07 abcde	0.53 abc	0.81 a	33.83 ab	27.83 a
Coconut Milk (75 %)	21.68 a	20.25 a	81.33 a	78.50 a	1.44 ab	1.00 abcde	0.65 a	0.84 a	37.83 a	28.33 a
Seaweed extracts (25 %)	18.33 bcdef	18.18 abcd	56.83 efgh	63.00 bcdef	0.89 cd	1.20 abc	0.35 cdef	0.36 cde	26.33 bcde	24.16 ab
Seaweed extracts (50 %)	19.81 abc	19.48 abc	64.33 bcdef	69.50 abc	1.73 a	1.35 a	0.31 cdefgh	0.15 gh	20.16 def	21.66 bcd
Seaweed extracts (75 %)	19.08 bcde	18.66 abcd	68.83 bcde	67.33 abcd	1.67 a	1.04 abcde	0.23 efgh	0.15 fgh	20.33 cdef	19.16bcdef
LSD at 5 %	2.30	2.28	12.34	13.15	0.49	0.38	0.22	0.18	2.97	2.12

Means with the same letter are not significantly different at P < 0.05.

Table 6. Root fresh and dry weights (g), averages number and length/ cutting, increase in cuttings length and rooting (%) of rosemary (*Rosmarinus officinalis* L.) as affected by types and concentrations of growth regulators during 2015/2016 and 2016/2017 seasons.

Characters	Fresh weight of roots (g)		Dry weight of roots (g)		Average number of roots / cutting		Average length of roots in cutting (cm)		Increase in cuttings length (cm)		Rooting (%)	
Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	0.03 f	0.03 g	0.01 f	0.01 d	1.75 g	2.05 g	0.60 c	0.51 e	2.83 g	3.25 e	2.77 e	2.08 e
IBA (75 mg/L)	0.08 ef	0.05 g	0.03 efd	0.04 bcd	2.39 fg	3.91 ab	0.71 abc	0.63 dec	6.50bcde	7.33 abc	5.55 abc	5.21 abc
IBA (100 mg/L)	0.06 f	0.05 g	0.02 ef	0.02 cd	3.27 fe	2.86cdefg	0.81 abc	0.61 de	6.66bcde	6.58abcd	5.90 ab	4.86abcd
IBA (125 mg/L)	0.07 ef	0.23bcde	0.03 def	0.03 cd	3.47 cdef	2.80 defg	0.78 abc	0.85 abc	7.50abcd	7.41 abc	4.86 bcd	4.16 cd
Honey (25 %)	0.04 f	0.06 g	0.01 ef	0.05 bcd	2.55 fg	2.25 fg	0.69 abc	0.60 de	5.13 efg	3.58 e	4.86 bcd	3.82 d
Honey (50 %)	0.07 ef	0.05 g	0.04cdef	0.04 bcd	2.86 fg	2.50 efg	0.88 ab	0.76abcd	4.11 fg	4.48 de	5.21abcd	5.55 ab
Honey (75 %)	0.17 cde	0.11 efg	0.03 def	0.04 cd	3.30 def	3.30 bcde	0.64 bc	0.62 de	5.50 def	5.26 cde	5.90 ab	5.21 abc
Yeast extract (2 g/ L)	0.08 ef	0.09 fg	0.03 def	0.05 bcd	2.61 fg	3.22bcdef	0.72 abc	0.76abcd	6.91bcde	5.91 bcd	4.16 d	4.51 bcd
Yeast extract (4 g / L)	0.13cdef	0.13defg	0.04 cdef	0.03 cd	4.69 bc	3.38 bcde	0.67 bc	0.87 ab	6.91bcde	6.43abcd	5.21abcd	4.86abcd
Yeast extract (6 g / L)	0.30 ab	0.29 abc	0.09 ab	0.08 ab	4.61 bcd	3.83 abc	0.81 abc	0.69bcde	7.81 abc	7.48 abc	5.90 ab	5.90 a
Coconut Milk (25 %)	0.24 bc	0.19 cdef	0.04cdef	0.04 cd	5.03 ab	4.03 ab	0.83 abc	0.79abcd	5.60 cdef	4.73 de	4.51 cd	5.90 a
Coconut Milk (50 %)	0.22 bcd	0.25 bcd	0.05cdef	0.06 bc	5.63 ab	4.64 a	0.79 abc	0.77abcd	7.98 ab	8.16 ab	5.90 ab	5.21 abc
Coconut Milk (75 %)	0.35 a	0.40 a	0.10 a	0.11 a	6.30 a	4.72 a	0.93 a	0.97 a	9.68 a	8.25 a	6.25 a	5.91 a
Seaweed extracts (25 %)	0.32 ab	0.35 ab	0.08 abc	0.06 bc	4.39bcde	4.08 ab	0.88 ab	0.79abcd	6.20bcdef	6.18abcd	5.90 ab	4.86abcd
Seaweed extracts (50 %)	0.12 def	0.14 defg	0.06 bcd	0.04 cd	3.36 def	3.61 bcd	0.76 abc	0.86 ab	6.33bcdef	6.33abcd	5.55 abc	5.90 a
Seaweed extracts (75 %)	0.11 def	0.08 fg	0.05 cde	0.03 cd	3.39 cdef	3.19bcdef	0.74 abc	0.74bcde	7.08bcde	6.67abcd	4.16 d	4.16 cd
LSD at 5 %	0.11	0.12	0.04	0.05	1.32	1.02	0.24	0.22	2.30	2.28	1.11	1.35

Means with the same letter are not significantly different at P < 0.05.

Table 7. Total chlorophylls, carotenoids (mg/ g FW) total nitrogen and phosphorous (%) in rosemary (*Rosmarinus officinalis* L.) as affected by types and concentrations of growth regulators during 2015/2016 and 2016/2017 seasons.

Characters	Total chlorophylls (mg/ g FW)		Total carotenoids (mg/ g FW)		Nitrogen (%)		Phosphorous (%)	
Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	28.84 d	30.46 d	2.04 d	1.39 d	1.30 l	1.17 p	0.20 m	0.21 k
IBA (75 mg/ L)	38.41 abc	41.50 ab	3.12 cd	3.64 abc	1.73 h	1.61 k	0.24 hi	0.26 ghi
IBA (100 mg/ L)	38.13 abc	39.44 ab	3.24 cd	2.65 bcd	2.17 e	2.07 f	0.28 ef	0.29 cdef
IBA (120 mg/ L)	35.98 abcd	36.49 bcd	3.49 bcd	3.47 abc	2.36 c	2.24 d	0.29 cd	0.31 abcd
Honey (25 %)	32.82 bcd	32.27 cd	4.15 abcd	3.77 abc	1.56 i	1.51 l	0.23 ij	0.25 hij
Honey (50 %)	30.25 cd	31.69 cd	4.76 abc	4.03 ab	2.11 e	2.00 g	0.27 fg	0.29 def
Honey (75 %)	37.22 abcd	37.92 abc	3.71 abcd	2.79 bcd	1.92 f	1.81 i	0.27 g	0.27 fgh
Yeast extract (2 g/ L)	37.25 abcd	37.18 abcd	3.17 cd	3.18 abcd	1.56 i	1.43 m	0.23 jk	0.24 ijk
Yeast extract (4 g/ L)	32.19 bcd	36.01 bcd	4.23 abcd	3.59 abc	1.99 f	1.90 h	0.26 kl	0.28 efg
Yeast extract (6 g/ L)	38.54 abc	34.80 bcd	3.37 cd	2.48 bcd	2.42 c	2.32 c	0.30 ab	0.32 abc
Coconut Milk (25 %)	39.06 abc	39.57 ab	3.04 cd	3.07 abcd	1.47 j	1.33 n	0.22 kl	0.23 ijk
Coconut Milk (50 %)	39.25 ab	39.64 ab	5.67 ab	4.26 ab	2.50 b	2.42 b	0.31 ab	0.33 ab
Coconut Milk (75 %)	44.40 a	44.13 a	5.82 a	5.03 a	2.62 a	2.52 a	0.32 a	0.34 a
Seaweed extracts (25 %)	35.75 abcd	39.33 ab	4.84 abc	4.22 ab	1.39 k	1.27 o	0.21 lm	0.22 jk
Seaweed extracts (50 %)	37.63 abcd	39.38 ab	3.19 cd	2.94 bcd	1.82 g	1.72 j	0.25 h	0.29 cdef
Seaweed extracts (75 %)	31.90 bcd	36.74 bcd	3.47 bcd	2.03 cb	2.27 d	2.14 e	0.29 de	0.30 bcde
LSD at 5 %	8.90	7.02	2.23	1.97	0.07	0.05	0.03	0.03

Means with the same letter are not significantly different at P < 0.05.

Table 8. Total potassium, carbohydrates, phenols and indoles (%) in rosemary (*Rosmarinus officinalis* L.) as affected by types and concentrations of growth regulators during 2015/2016 and 2016/2017 seasons.

Characters	Potassium (%)		Total carbohydrates (%)		Total phenols (%)		Total indoles (%)	
Treatments	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	1.52 l	1.41 l	21.68 p	25.33 k	3.50 a	3.46 a	0.68 p	0.71 p
IBA (75 mg/L)	2.08 ij	1.97 i	22.89 k	26.57 hi	3.38 b	3.35 b	0.83 cdefg	0.96 cd
IBA (100 mg/L)	2.61 de	2.49 e	24.04 f	27.85 cdef	3.16 d	3.16 d	0.92 bc	0.99 bc
IBA (120 mg/L)	2.86 c	2.72 cd	24.61 d	28.34 abcd	2.87 g	2.76 h	0.84 cdefg	0.87 efg
Honey (25 %)	1.96 j	1.68 j	22.65 l	26.31 ij	3.05 e	3.06 e	0.74 hijk	0.77 jkl
Honey (50 %)	2.52 ef	2.38 ef	23.81 g	27.60 defg	2.64 i	2.57 j	0.80 efghi	0.83 ghi
Honey (75 %)	2.28 gh	2.18 gh	23.36 i	27.07 fghi	2.96 f	2.87 g	0.86 cdef	0.90 ef
Yeast extract (2 g/ L)	1.69 k	1.71 j	22.42 m	25.36 k	3.27 c	3.26 c	0.88 cde	0.91 de
Yeast extract (4g/ L)	2.38 fg	2.26 fg	23.58 h	27.33 efgh	2.37 d	2.29 m	0.90 cd	0.87 efg
Yeast extract (6g/ L)	2.95 bc	2.80 bc	24.85 c	28.61 abc	2.55 j	2.47 k	0.78 fghij	0.82 hij
Coconut Milk (25 %)	1.73 k	1.60 jk	22.20 n	26.78 ghi	2.26 n	2.96 f	0.72 ijk	0.75 klm
Coconut Milk (50 %)	3.05 ab	2.92 ab	25.05 b	28.92 ab	2.31 m	2.19 n	1.01 ab	1.03 ab
Coconut Milk (75 %)	3.16 a	3.02 a	25.26 a	29.17 a	2.07 p	1.99 p	1.05 a	1.08 a
Seaweed extracts (25 %)	1.64 kl	1.52 kl	21.96 o	25.54 jk	2.17 o	2.09 o	0.70 jk	0.73 lm
Seaweed extracts (50 %)	2.15 hi	2.06 hi	23.13 j	26.82 ghi	2.46 k	2.38 l	0.76 ghijk	0.79 kij
Seaweed extracts (75 %)	2.72 d	2.63 d	24.37 e	28.12 bcde	2.75 h	2.65 i	0.82 defgh	0.85 fgh
LSD at 5 %	0.13	0.13	0.19	0.92	0.02	0.02	0.09	0.05

Means with the same letter are not significantly different at P < 0.05.

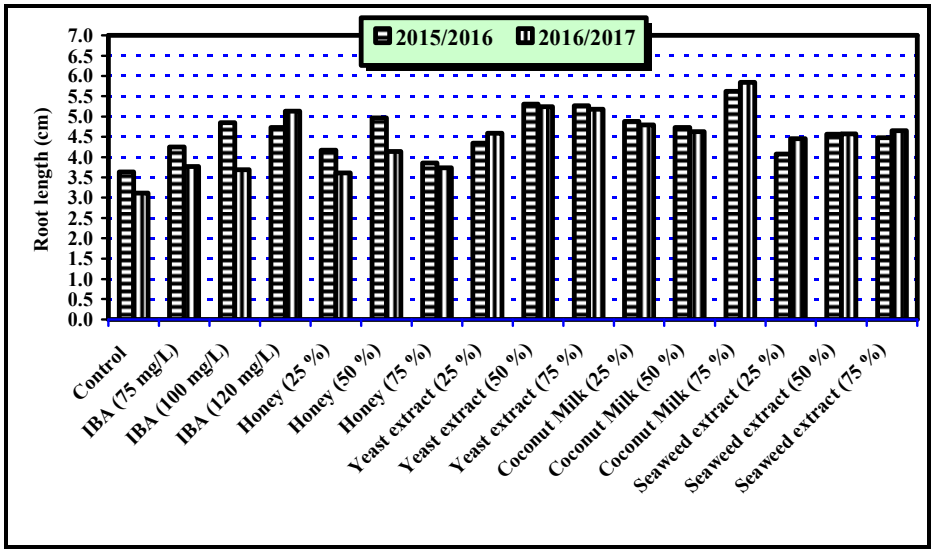

Fig. 1. Root length of rosemary (*Rosmarinus officinalis* L.) as affected by types and concentrations of growth regulators during 2015/2016 and 2016/2017 seasons.

It is worthy to mention that the highest values of all studied vegetative growth characters and chemical constituents of rosemary were resulted from treating terminal cuttings with coconut milk at the highest rate (75%) in both seasons. With exception, fresh weight of shoots, when treating terminal cuttings with seaweed extract at the rate of 50 % and total phenols percentage, which obtained from control treatment (treating cuttings with water only) in both seasons.

These results may be ascribed to coconut milk appears to have growth regulatory properties, e.g., cytokinins, which are a class of phytohormones, which enhancing growth characters and chemical constituents of rosemary. These results came in the similar point of view with those reported by Krajnc *et al*., (2013), Shidiki *et al*., (2013), Dunsin *et al.,* (2016), Ibironke (2016 a and b).

control **IBA (125 mg/L)** **Coconut Milk (75 %)**

Photo 1. Root length of rosemary (*Rosmarinus officinalis* L.) as affected by types and concentrations of control, IBA (125 mg/L) and Coconut Milk (75 %).

This desirable effect of treating terminal cuttings of rosemary with seaweed extract on fresh weight of rosemary shoots may be ascribed to very high content of organic carbon in seaweed extract (particularly carbohydrates such as alginic acid, laminaren and mannitol) and polysaccharides, but yet very low of N. P and K. Seaweed is well known for its trace mineral content (Fe, Cu, Zn, Co, Mo, Mn, and Ni), the presence of a range of biologically active growth promoting hormones (IAA and IBA, Cytokinins), vitamins and amino acids. These results are in good accordance with those of Sathees Kannan *et al.,* (2014), Dunsin *et al.,* (2016), Ibironke (2016 a) and Ibironke (2016 b).

Generally, using natural growth regulators such as coconut milk, seaweed extraction, yeast extract and honey bee were better than using chemical growth regulators like Indole butyric acid (IBA) in both seasons. Conversely, the lowest values of all studied

vegetative growth characters and chemical constituents were obtained from control treatment (treating cuttings with water only), excluding total phenols percentage, which obtained from treating terminal cuttings with coconut milk at the rate of 75 % in rosemary during the two growing seasons.

It can be concluded that treating terminal cuttings of rosemary (*Rosmarinus officinalis* L.) with coconut milk at the rate of 75 % as natural growth regulator in order to enhance rooting, growth and chemical constituents.

REFERENCES

A.O.A.C. (1970). Official Methods of Analysis. 13th Ed. Association of Official Analytical Chemists, Washington, pp: 376-384.

Abou El-Yazied, A. and M.A. Mady (2012). Effect of boron and yeast extract foliar application on growth, pod setting and both green and seed yield of broad bean (*Vicia faba* L.). J. American Sci., 8(4): 517-534.

Bai, N.R.; N.R.L. Banu; J.W. Prakash and S.J. Goldi (2007). Effects of *Asparagopsis taxiformis* extract on the growth and yield of *Phaseolus aureus*. J. Basic Appl. Biol., 1(1): 6-11.

Ball, D.W. (2007). The chemical composition of honey. J. Chem. Educ., 84 (10): 1643-1644.

Black, C.A. (1965). "Methods of soil analysis". Part 1. Physical and mineralogical. ASA Madison, Wise., USA (C.F. computer Search).

Chee, P.P. (1995). Stimulation of adventitious rooting of Taxus species by thiamine. Plant Cell Reports, 14: 753-757.

Daniel, H.D. and C.M. George (1972). Peach seed dormancy in relation to endogenous inhibitors and applied growth substances. J. Am. Soc. Hortic. Sci., 97: 651-654.

Dubois, M. ; K.A. Gilles; J. K. Hamilton; P.T. Rebers and F. Smith (1956). Colorimetric method for determination of sugars and related substances. Analytical chem.., 28(3): 350-356.

Dunsin, O.; G. Ajiboye and T. Adeyemo (2016). Effect of alternative hormones on the rootability of *Parkia biglobosa*. Sci. Agri., 13(2): 113-118.

Gomez, K.N. and A.A. Gomez (1984). Statistical procedures for agricultural research. John Wiley and Sons, NY, 2nd ed., 68 p (C.F. computer Search).

Hartmann, H.; D. Kester and F. Davies (1990). Plant Propagation: Principles and Practices. 5th Ed., p. 1-100. Prentice Hall International Editions, Englewood Cliffs, New Jersey, USA.

Hartmann, H.T.; D.E. Kester; F.T. Davies and R.L. Geneve (1997). Plant Propagation: Principles and Practices. Prentice Hall, Inc., New Jerse, USA.

Ibironke, O.A. (2016 a). Effects of rooting hormones on the propagation of bougainvillea from cuttings. Intern. J. Res. in Agric. and For., 3(1): 57-62.

Ibironke, O.A. (2016 b). Effect of growth promoting substances on selected three ornamental plants. Adv. in Crop Sci. and Tech., 4(3): 1-4.

Jackson, M. L. (1967). "Soil Chemical Analysis" Prentica Hall Inc, Engleweed Cliffs, N. J (C.F. computer Search).

Khedr, Z. and S. Farid (2000). Response of naturally virus infected tomato plants to yeast extract and phosphoric acid application. Annals Agric. Sci. Moshtohor, 38(2): 927-939.

Krajnc, A.U.; M. Turinek and A. Ivancic (2013). Morphological and physiological changes during adventitious root formation as affected by auxin metabolism: Stimulatory effect of auxin containing seaweed extract treatment. Agricultura, 10(1-2): 17-27.

Nagodawithana, W.T. (1991). Yeast technology. Universal Foods Cooperation Milwauke, Wisconsin. Published by Van Nostrand, New York.

Nicola, S.; E. Fontana; J. Hoeberechts and D. Saglietti (2005). Rooting products and cutting timing on sage (Salvia officinalis L.) propagation. Acta Hort., 676: 135-141.

Parađiković, N.; S. Zeljković; M. Tkalec; T. Vinković; I. Dervić and M. Marić (2013). Influence of rooting powder on propagation of sage (Salvia officinalis L.) and rosemary (Rosmarinus officinalis L.) with green cuttings. Poljoprivreda, 19(2): 10-15.

Pregl, F. (1945). "Quantitative Organic Microanalysis 4th." Ed. I. Chudrial, London.

SAS, Institute (1994). Statistics user's Guide: 4th Ed., SAS Institute Inc., Cary, N.C., USA.

Sathees Kannan, T.; S. Sownthariya and S. Anbazhakan (2014). In vitro mass propagation of Withania somnifera Dunal using seaweed extracts. Intern. Letters Natural Sci., 24: 8-14.

Selim, H.M. (1978). Transport of reactive solutes during transient, unsaturated water flow in multilayered soils. Soil Sci., 126(3): 127-135.

Shidiki, A.; M. Akalusi and D. Jatau (2013). The effects of coconut milk on the rooting of two types of cutting of *Terminalia catappa*. Intern. J. for Sci. Res. & Dev., 1(5): 1176-1178.

Simon, J.E. ; A. Chadwick and L. Craker (1984). Herbs: an indexed bibliography, 1971-1980. The scientific literature on selected herbs and aromatic and medicinal plants of the temperate zone. Archon, Hamden, Corm.

Steel, R. G. D. and G. H. Torrie (1980). Principles and Procedures of Statistics, 2nd Ed. Mc Graw-Hill, book Co. Inc. New York, U.S.A. pp.633.

Turetskaya, R. and F. Polikarpova (1968). Plant propagation using plant growth regulators. Publ. Science, Moscow (In Russian).

Wettstein, V.D. (1957). Chlorophyll-letale und der submikroskopische Formwechsel der Plastiden. Exp. Cell Res., 12(3): 427-506.

Whiting, D.; M. Roll and L. Vickerman (2014). Colorado master gardener garden notes: plant growth factors-plant hormones. Retrieved from http: //www. ext. colostate. Edu /mg / gardennotes /145.html.

Yong, J.W.H.; L. Ge ; Y.F. Ng and S.N. Tan (2009). The chemical composition and biological properties of coconut (*Cocos nucifera* L.) water. Molecules, 14: 5144-5164.

Yong, W.H.; G. Jean N.D. Yan-Fei and N.T. Swee (2013). The composition of plant growth regulators in coconut water. MIT, Cambridge, MA 02139, USA 3Natural Sciences & Science Education, Nanyang Technological University, Nanyang Walk, Singapore 637616.

تـأثير بعض المـواد المنتجـات الطبيعيـة كبـديل لمنظمـات النمـو علـي صفات التجذير والنمـو الخـضري والتركيـب الكيميائي لعقل نبات الروزماري

حكمت يحيي مسعود ، مهند محمد عبد الباسط وأحمد عبد الله محمد بدران غزي
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أجريت هذه التجربة في مشتل ومعمل قسم الخضر والزينة بكلية الزراعة - جامعة المنصورة خلال موسمي ٢٠١٥/٢٠١٦ و٢٠١٦/٢٠١٧ لدراسة تأثير منظمات النمو مثل اندول حمض البيوتريك بثلاث تركيزات (٧٥، ١٠٠ ، ١٢٥ ملليجرام/ لتر) وبعض المنتجات الطبيعية مثل مستخلص الخميرة بثلاث تركيزات (٢ ، ٤ ، ٦ جرام/ لتر) وعسل النحل ولبن جوز الهند ومستخلص الطحالب بثلاث تركيزات مختلفة لكل منها وهي (٢٥% ، ٥٠% ، ٧٥%) علي صفات التجذير والنموالخضري والتركيب الكيميائي لعقل نبات الروزماري. وكان التصميم التجريبي المستخدم هو قطاعات كاملة العشوائية. وكانت أهم النتائج كما يلى: أظهرت النتائج وجود فروق معنوية نتيجة تأثير أنواع وتركيزات منظمات النمو مثل اندول حمض البيوتريك وبعض المنتجات الطبيعية مثل عسل النحل ومستخلص الخميرة ولبن جوز الهند ومستخلص الطحالب بثلاث معدلات مختلفة علي صفات النمو الخضري (ارتفاع النبات / عدد الأوراق علي النبات / الوزن الطازج والجاف للمجموع الخضري / طول الجذور / عدد الجذورعلي العقلة / الوزن الطازج والجاف للجذور / متوسط عدد الجذور في العقل الناجحة / متوسط طول الجذور في العقل الناجحة /معدل الاستطالة في العقل / نسبة التجذير) والتركيب الكيميائي (الكلوروفيل الكلي والكاروتين ، النسبة المئوية للنيتروجين ، الفوسفور، البوتاسيوم، الكربوهيدرات، الفينولات، الاندولات) لنبات الروزماري في كل من موسمي الزراعة . من الجدير بالذكر أن أعلي قيم تم الحصول عليها لجميع صفات النمو الخضري والمكونات الكيميائية لنباتات الروزماري تحت الدراسة نتجت من معاملة العقل الطرفية بلبن جوز الهند بتركيز ٧٥% في كلا الموسميين، باستثناء صفة الوزن الطازج للمجموع الخضري والتي تم الحصول علي أعلي قيمة لها عند معاملة العقل الطرفية بمستخلص الطحالب بتركيز ٥٠% والنسبة المئوية للفينولات والتي تم الحصول علي اعلي قيمة لها عند معاملة العقل الطرفية بدون أي اضافات (معاملة الكنترول) في كلا الموسمين. عموماً توضح النتائج المتحصل عليها أن المعاملة بمنظمات النمو الطبيعية مثل لبن جوز الهند ، مستخلص الخميرة ، مستخلص الطحالب وعسل النحل أعطت أفضل النتائج مقارنة بالمعاملة بمنظم النمو الصناعى (اندول حمض البيوتريك) في كلا الموسمين. من نتائج هذه الدراسة يمكن التوصية بمعاملة العقل الطرفية لنبات الروزماري بلبن جوز الهند بتركيز ٧٥% كمنظم نمو طبيعي لتحسين وتشجيع تكوين الجذور علي العقل.