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Effect of Foliar Application with Dry Yeast Extract and Benzyladenine on Growth and Yield of Manzanillo Olive Trees.

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ABSTRACT

Manzanillo olive trees (Olea euroea L.) were sprayed twice at full bloom stage and two weeks later with dry yeast extract (20 and 40 g/L) and benzyladenine (60, 80 ppm), each alone or in combination besides control (spraying with water only) during 2013 and 2014 growing seasons. Results cleared that, foliar applications of dry yeast extract at 40g / L + benzyladenine at 60 ppm or dry yeast extract at 40 g/ L are recommended for improving yield, fruit quality (fruit weight, length, diameter, seed weight, fruit flesh weight, pulp/seed percentage and fruit moisture percentage) and fruit oil content of Manzanillo olive trees. Improving productivity attributed to increase flowering density, perfect flowers percentage, and fruit set percentage as well as leaf area, specific leaf dry weight, total chlorophyll contents and leaf mineral content (N, P, K,Mg, Fe, Zn and Mn).

Keywords: Olive - Benzyladenine - Yeast - Synthetic growth regulators - Biostimulants - Yield - Fruit Quality.

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INTRODUCTION

Many trials have been carried out for increasing yield and fruit quality and reducing fruit drop by the use of different factors including plant growth regulators. Applying growth regulators especially cytokinin may modify morphological and physiological characteristics of plant and may also induce better adaptation of plant to environment through improve the growth and improve yield by increasing fruit set, fruit number and size. Improvement in vegetative growth and yield attributes may enhance crop productivity. Productivity in horticultural systems is often dependent on manipulation of physiological activities of the crop by chemicals means [1]. Benzyladenine (BA) is one of the most active cytokinins which regulates various growth processes in plant and improve yield and chemical constituents of many crops and recently, BA has been identified as a natural cytokinin in a number of plants. Nevertheless, physiological responses to BA application may be associated with increased endogenous cytokinin concentrations [2]. Yeast (natural stimulator) is characterized by its richness in proteins large amount of vitamin B (thiamin, riboflavin and pyridoxines), amino acid also yeast are prolific producers vitamins, hormones and natural plant growth regulating substances hormones namely cytokinins [3]. Also, application of active dry yeast was very effective in releasing CO_2 which reflected on improving net photosynthesis [4], besides its effectiveness in improving growth, nutritional status and productivity of fruit crops was mentioned by [5-11].

Hence, this study aimed to study the effect of dry yeast extract and benzyladenine on growth, total chlorophyll, leaf mineral content, flowering, yield/tree fruit physical properties (fruit weight, length, diameter, seed weight, fruit flesh weight, pulp/seed percentage and fruit moisture percentage) and fruit oil content of Manzanillo olive trees and possibility of using dry yeast extract as a replacement to synthetic growth regulator benzyladenine.

MATERIALS AND METHODS

This study was carried out during two successive seasons 2013 and 2014 on ten years old Manzanillo olive trees, planted at 5 X 5 m in sandy soil in a private orchard located at Cairo – Alexandria, desert road (about 50 Km from Cairo), Egypt. Trees were of normal growth, uniform in vigour and received normal fertilization and cultural practices as scheduled in the program of the orchard. The experiment followed complete randomized block design on 27 trees as 9 treatments were applied. Each tree was considered a replicate, three replicates trees per each treatment. Selected trees were sprayed twice at full bloom stage and after two weeks from the first one as follows: -

1. Dry yeast extract at 20g/ L.
2. Dry yeast extract at 40g/ L
3. Benzyl adenine at 60 ppm.
4. Benzyl adenine at 80 ppm.
5. Dry yeast extract at 20g/L + Benzyl adenine at 60 ppm.
6. Dry yeast extract at 20g/L + Benzyl adenine at 80 ppm.
7. Dry yeast extract at 40g/ L+ Benzyl adenine at 60 ppm
8. Dry yeast extract at 40g/ L+ Benzyl adenine at 80 ppm.
9. Control (sprayed with water only).

Preparation of dry yeast extract

The dry pure yeast powder was activated by using sources of carbon and nitrogen with the ratio of 6:1 [12]. This ratio is suitable to get the highest vegetative production of yeast (each ml yeast contained about 12000 of yeast cells), and then the media was frozen and thawed directly before using. The yeast extract used in the present study was analyzed for phytohormones, mineral elements “macro and micro”, amino acid, total carbohydrates, reducing sugars as glucose, enzymes and Vitamins by [3] as shown in Table 1.

Benzyl adenine (BA) was dissolved in 25 ml of 95% ethanol, heated and mixed with distilled water. That cytokinin stock solution was diluted into 10 L aliquots of 60 and 80ppm BA, each containing 10 ml (0.1%). All mixtures were formulated 1 day before being applied [13].Tween- 20 was added as a spreading agent.

The response to investigated treatments was evaluated through determining the following parameters: -

Leaf area (cm2): Was measured by using portable leaf area meter,Li-Cor model Li-2000 Ano Pam167.

Leaf dry weight (LDW): Leaves were dried in the electric oven at 70ºc for 48 h until constant weight, measured and used to calculate LDW.

Specific leaf dry weight: Specific leaf dry weight (SLDW) mg/cm² from the following equation according to [14].

Specific leaf dry weight = Leaf dry weight (g) × 1000 / Leaf area (cm²).

Total chlorophyll contents: Was measured in the field by using Minolta chlorophyll meter SPAD- 502.

Leaf mineral content: Leaf mineral content at mid. July of each season, twenty leaves from the middle portion at one year old shoot each replicate tree were taken, washed with tap water then with distilled water, dried at 70°c until constant weight, for determination of the following nutrient elements (percentage as dry weight) N, P, K, Mg, Fe, Mn and Zn according to A.O.A.C. [15].

Flowering behavior

Before beginning the flowering at mid-March, twenty shoots per tree was labeled to record the following parameters at full bloom mid-April.

Flowering density (average number of inflorescences/m)

On each replicate tree twenty shoots distributed on different sides were chosen randomly and tagged at the beginning of the growing season. All inflorescences on each shoot were counted and recorded to estimate as average number of inflorescences per meter.

Percentage of perfect flowers

Percentage of perfect flowers (expressed as percentage of perfect flowers to total number of flowers) according to [16]. One hundred inflorescences were collected randomly from each replicate to estimate average number of perfect flowers/ inflorescences.

Fruit set percentage

After sixty days from flowering, fruit set percentage on replicate trees of the studied treatments was calculated from the following, equation [17]:

$$\text{Fruit set (\%)} = FR \times 100 / AVF \times ANF$$

FR = Number of fruit / m.
AVF= Average number of perfect flowers/ inflorescences.
ANF=Average number of inflorescences /m.

Yield and Fruit Quality

At maturity stage (early October), fruits of each replicate tree were separately harvested, then weighted and yield as Kg/tree was estimated, then 20 fruits from each replicate tree i.e. 60 fruits from each of the applied treatments were picked randomly at harvest to determine: fruit weight (g), fruit length (cm), fruit diameter (cm), fruit shape index (L/D ratio), seed weight (g), fruit flesh weight (g), percentage of pulp/seed, fruit moisture percentage according [18] and fruit oil content (%) according A.O.A.C.[15].

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Statistical analysis

All obtained data during both 2013 and 2014 experimental seasons were subjected to analysis of variances according to [19] using (SAS/STAT). Least significant difference (L.S.D) was used to compare between means of treatments according to [20] at probability of 5%.

Table 1: Chemical analysis of dry yeast extract.

Minerals				Amino acids (mg/100g fresh weight)		Total carbohydrates (mg/100g dry weight)		Enzymes (mg/100g fresh weight)		Vitamins (mg/100g fresh weight)	
Macro (g/100g dry weight)		Micro (mg/100g dry weight)									
Total N	6.23	Al	200.2	Arginine	1.99	Carbohydrates	13.2	Cytochrome oxidase	0.35	Vitamin B1	3.94
P_2O_4	45.68	Ba	105.6	Histidine	1.63	Glucose	11.3	Cytochrome peroxidase	0.29	Vitamin B2	4.27
K_2O	34.39	Co	47.8	Isoleiucine	1.31			Catalase	0.063	Nicotinic acid	25.89
NaO	0.35	Pb	238.6	Leucine	2.09					Biotin	0.09
MgO	3.76	Mn	61.3	Lysine	1.95					Panthothenic acid	13.56
CaO	2.05	Sn	123.9	Methionine	0.72					Folic acid	2.36
SiO_2	1.55	Zn	235.6	Pheylalanine	1.01					P-amino benzoic acid	6.23
SO_2	0.49			Threonine	1.09					Vitamin B6	4.15
Cl	0.06			Tryptophan	0.45					Vitamin B12	1.53 (µg/100g)
FeO	0.92			Valine	1.19					Inositol	202.1 (µg/100g)
NaCl	0.30			Glutamic acid	1.00						
				Serine	1.59						
				Aspartic acid	1.33						
				Cystine	0.23						
				Proline	1.53						
				Tyrosine	1.49						

RESULTS

It is obvious from Table 2 that different applied treatments i.e., dry yeast extract and benzyladenine as well as combinations significantly increased vegetative growth characteristics of Manzanillo olive cv. in both seasons of this study. The highest increase of leaf area (4.17and 4.25 cm) was existed with 40 g/ L dry yeast extract + 60 ppm benzyladenine/tree treatment followed by dry yeast extract at 40g/ L/tree (3.86 and 3.77 cm)in both seasons respectively. Meanwhile, the lowest leaf area was existed by control (3.28 and 3.33 cm) in both seasons respectively. Also, it is obvious from the results that dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree exhibited the highest leaf dry weight (2.68 and 2.99g) in comparison with the other treatments. In this respect, specific leaf weight of the treatment dry yeast extract at 40 g/ L+ benzyladenine 60 ppm/tree gave the highest significant values (642.67 and 703.53 mg/cm²)in the first and second seasons respectively, while control treatment gave the lowest value (402.44 and 513.51 mg/cm²) in the first and second seasons respectively. Total chlorophyll results took the same trend of vegetative growth. Dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree gave the highest significant total chlorophyll (75.62 and 79.17) in seasons 2013 and 2014 respectively. While, the lowest total chlorophyll recorded by the control trees (50.04 and 52.15) in seasons 2013 and 2014 respectively.

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Table 2: Effect of spray with dry yeast extract and benzyladenine on leaf area, leaf dry weight, specific leaf weight and total chlorophyll of Manzanillo olive trees during 2013 and 2014 seasons.

Treatments	Leaf area (cm^2)		Leaf dry weight (g)		Specific leaf weight(mg/cm^2)		Total chlorophyll	
	2013	2014	2013	2014	2013	2014	2013	2014
1. Dry yeast extract at 20g/ L	3.34c	3.35c	1.44fe	1.79de	431.14d	534.33d	52.13fe	55.04fe
2. Dry yeast extract at 40g/ L	3.86ba	3.77ba	2.47b	2.56b	639.90ab	679.05b	70.56ba	74.28ba
3. Benzyl adenine at 60 ppm	3.83ba	3.71ba	1.99c	2.49bc	519.58c	671.16bc	69.51ba	72.83ba
4. Benzyl adenine at 80 ppm	3.47c	3.58c	1.57e	1.86d	452.45dc	519.55307	55.23e	69.19e
5. Dry yeast extract at 20g/L + Benzyl adenine at 60 ppm	3.60bc	3.65bc	1.88d	1.95cd	522.22c	534.25d	66.46bc	68.43bc
6. Dry yeast extract at 20g/L + Benzyl adenine at 80 ppm	3.55bc	3.26bc	1.84de	1.9cd	518.31c	582.82cd	58.34d	61.26d
7. Dry yeast extract at 40g/ L+ Benzyl adenine at 60 ppm	4.17a	4.25a	2.68a	2.99a	642.67a	703.53a	75.62a	79.17a
8. Dry yeast extract at 40g/ L+ Benzyl adenine at 80 ppm	3.59bc	3.61bc	1.86de	1.91cd	518.11c	529.09ef	60.37dc	65.42dc
9. Control	3.28c	3.33c	1.32f	1.71e	402.44e	513.51f	50.04f	52.15f

Means in each column with similar letters are not significantly different**.**

The influence of foliar dry yeast extract, benzyladenine and their combination on some leaf macro and micro elements content of Manzanillo olive trees (2013 and 2014 seasons) are presented in Tables 3, 4.

Nitrogen %: Foliar application of Manzanillo olive trees with dry yeast extract, benzyladenine and their combination led to obvious significant increase in the leaf nitrogen content. The highest significant values were obtained from dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree (1.15 and 1.17 %) in both two seasons respectively. Meanwhile the lowest values were obtained from the control trees (1.00 and 1.02 %) in the first and second seasons, respectively (Table3).

Phosphorus %: The combination between the two studied substances, proved that treatment of 40 g/L dry yeast extract plus 60 ppm benzyladenine / tree gave the highest significant phosphorus content in the leaves (0.19 and 0.17%) during seasons 2013 and 2014, whereas the lowest phosphorus content was obtained in the control trees (0.13 and 0.14%) during seasons 2013 and 2014 respectively (Table 3).

Potassium %: Dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree treatment gave the highest significant potassium values (1.11 and 1.08%) in the first and second seasons respectively. Meanwhile the lowest potassium values were obtained from the control trees (0.75 and 0.79 %) in both two seasons respectively (Table 3).

Magnesium %: Table (3) clearly show that foliar application with dry yeast extract and benzyladenine as well as combinations caused significant increases in magnesium content in the leaves compared with control treatments. The combination between the two studied substances, proved that treatment of 40 g/L dry yeast extract plus 60 ppm benzyladenine / tree gave the highest significant values (19.39 and 18.23 ppm) during seasons 2013 and 2014, whereas the lowest magnesium content was obtained in the control trees (11.82 and 11.73 ppm) during seasons 2013 and 2014 respectively.

Iron content: It is obvious from Table 4 that iron content in the leaves was influenced by foliar application with dry yeast extract, benzyladenine and their combination treatments during both seasons of the study. The highest significant iron content in the leaves was obtained from dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree (226.6 and 225.9 ppm), whereas the lowest iron content in the leaves resulted from the control trees (188.9 and 194.5 ppm) in seasons 2013 and 2014 respectively.

Zinc content: Foliar dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree gave the highest significant zinc content in leaves (70.5 and 69.7 ppm) in the first and second seasons respectively. Meanwhile the lowest zinc content in the leaves was obtained from the control trees (58.4 and 60 ppm) in both seasons respectively (Table 4).

Manganese content: Table 4 clearly show that the combination between the two studied substances, proved that treatment of 40 g/L dry yeast extract plus 60 ppm benzyladenine / tree gave the highest significant manganese content in the leaves (42.5 and 44.3 ppm) during seasons 2013 and 2014, whereas the lowest magnesium content was obtained in the control trees (39.1 and 37 ppm) during seasons 2013 and 2014 respectively.

Table 3: Effect of spray with dry yeast extract and benzyladenine on some leaf macro elements content of Manzanillo olive trees during 2013 and 2014 seasons.

Treatments	Nitrogen (%)		Phosphorus (%)		Potassium (%)		Mg(ppm)	
	2013	2014	2013	2014	2013	2014	2013	2014
1. Dry yeast extract at 20g/ L	1.02c	1.03c	0.14cd	0.15cd	0.80cd	0.86cd	12.46bc	14.35bc
2. Dry yeast extract at 40g/ L	1.13ab	1.15ab	0.17b	0.16 b	0.98a	1.05ab	18.77a	17.25a
3. Benzyl adenine at 60 ppm	1.12ab	1.14ab	0.16bc	0.16bc	0.96ab	1.04ab	17.79a	17.29a
4. Benzyl adenine at 80 ppm	1.02c	1.03c	0.14cd	0.15cd	0.75e	0.80d	14.36abc	15.27abc
5. Dry yeast extract at 20g/L + Benzyl adenine at 60 ppm	1.12ab	1.14ab	0.16bc	0.16bc	0.89b	0.97bc	17.26ab	16.34ab
6. Dry yeast extract at 20g/L + Benzyl adenine at 80 ppm	1.03c	1.04c	0.16bc	0.16bc	0.81cd	0.85cd	15.77abc	15.49abc
7. Dry yeast extract at 40g/ L+ Benzyl adenine at 60 ppm	1.15a	1.17a	0.19a	0.17a	1.11a	1.08a	19.39a	18.23a
8. Dry yeast extract at 40g/ L+ Benzyl adenine at 80 ppm	1.09b	1.10b	0.16bc	0.16bc	0.85bc	0.96bc	16.53abc	15.44abc
9. Control	1.00c	1.02c	0.13d	0.14d	0.75e	0.79d	11.82c	11.73c

Means in each column with similar letters are not significantly different**.**

The results in Table 5 presented the effect of spray with dry yeast extract and benzyladenine on flowering behavior of ''Manzanillo'' olive trees during the two studied seasons. Results revealed that all treatments increased flowering density (number of inflorescences/m) than the control in both seasons of this study. In this respect, dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree gave the highest significant flowering density (19.42 and 20.59 /m) during seasons 2013 and 2014 respectively followed by dry yeast extract at 40g/ L/tree (17.67 and 19.58/ m) in both seasons respectively, whereas the lowest number of inflorescences/m in both seasons were obtained in the control (6.00 and 8.99/m) during seasons 2013 and 2014 respectively. The highest significant perfect flowers percentage (84.67 and 85.94 %) was obtained from application with dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree followed by dry yeast extract at 40g/ L/tree in both seasons respectively, whereas the lowest percentage of perfect flowers was obtained in the control (51.16 and 55.27%) in the first and second season, respectively. As for fruit set, all treatments significantly increased the percentage than the control during the two seasons. Application with dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree recorded the highest significant values of percentage of fruit set (11.49 and 14.25%) during both seasons followed by dry yeast extract at 40g/ L/tree (9.14 and 11.37%) in both seasons respectively. Whereas control treatments recorded the lowest percentage of fruit set in this respect; since it gave (4.75 and 5.06%) in the first and second seasons, respectively.

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Table 4: Effect of spray with dry yeast extract and benzyladenine on some leaf micro elements content of Manzanillo olive trees during 2013 and 2014 seasons.

Treatments	Iron (ppm)		Zinc (ppm)		Manganese (ppm)	
	2013	2014	2013	2014	2013	2014
1. Dry yeast extract at 20g/ L	190.9d	195.2d	66.2de	60.5e	39.4cd	38.5d
2. Dry yeast extract at 40g/ L	225.7a	224.5a	69.8a	69.5a	40.8b	41.5ab
3. Benzyl adenine at 60 ppm	223.4ab	223.8ab	67.3ab	67.1b	40.9b	40.5bc
4. Benzyl adenine at 80 ppm	190.1d	194.6d	65.7d	62.2d	39.4d	37.9d
5. Dry yeast extract at 20g/L + Benzyl adenine at 60 ppm	199.9c	200.1b	66.1bc	65.6bc	40.7b	40.9bc
6. Dry yeast extract at 20g/L + Benzyl adenine at 80 ppm	194.1cd	197.3c	67.9c	64.3c	39.8c	40.6bc
7. Dry yeast extract at 40g/ L+ Benzyl adenine at 60 ppm	226.6a	225.9a	70.5a	69.7a	42.5a	44.3a
8. Dry yeast extract at 40g/ L+ Benzyl adenine at 80 ppm	193.0cd	199.5bc	65.5bc	65.9bc	39.9c	40.5bc
9. Control	188.9e	194.5d	58.4e	60.0e	39.1d	37.0e

Means in each column with similar letters are not significantly different.

Table 5: Effect of spray with dry yeast extract and benzyladenine on flowering behavior of Manzanillo olive trees during 2013 and 2014 seasons.

Treatments	Flowering density (number of inflorescences/m)		Perfect flower (%)		Fruit set (%)	
	2013	2014	2013	2014	2013	2014
1. Dry yeast extract at 20g/ L	7.33d	10.01d	52.77d	59.17de	5.51de	6.78de
2. Dry yeast extract at 40g/ L	17.67ba	19.58ba	84.39a	84.99a	9.14b	11.37b
3. Benzyl adenine at 60 ppm	16.67bac	17.90bac	81.57ba	83.73ba	8.38bc	11.15b
4. Benzyl adenine at 80 ppm	7.67d	10.12d	52.87d	60.13de	6.75cde	7.76cde
5. Dry yeast extract at 20g/L + Benzyl adenine at 60 ppm	14.67bc	15.19bc	74.43bc	77.23bc	8.15bc	10.56bc
6. Dry yeast extract at 20g/L + Benzyl adenine at 80 ppm	8.00d	11.00c	53.14d	69.11d	7.03bcd	8.51cd
7. Dry yeast extract at 40g/ L+ Benzyl adenine at 60 ppm	19.42a	20.59a	84.67a	85.94a	11.94a	14.25a
8. Dry yeast extract at 40g/ L+ Benzyl adenine at 80 ppm	13.33c	15.11bc	70.99c	73.22c	7.34bcd	9.55cd
9. Control	6.00d	8.99e	51.16d	55.27e	4.75e	5.06e

Means in each column with similar letters are not significantly different.

Table 6 cleared the effect of foliar application of dry yeast extract, benzyladenine and their combination on yield and fruit physical properties (fruit weight, length, diameter and shape) of ''Manzanillo'' olive trees during the two studied seasons. Results cleared that, all treatments increased yield compared with the control treatment in the 1st and 2nd seasons. Moreover, dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree achieved the highest significant yield (15 and 17.5 kg/tree) in the first and second season, respectively followed by dry yeast extract at 40g/ L/tree (13.33 and 14.76 kg/tree) in both seasons respectively. Meanwhile, the control gave the lowest yield (10.99 and 11 kg/tree) in both seasons. Regarding fruit physical properties (fruit weight, length, diameter and shape), the results revealed that these fruit quality parameters were significantly affected by all applications. Foliar application of dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree gave highest fruit weight (6 and 6.50 g) in the first season and second season respectively, fruit length (2.7 and 2.88 cm) during seasons 2013 and 2014 respectively and fruit diameter (1.97 and 1.99 cm) in the first and second season, respectively. Meanwhile, the lowest value of fruit quality

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parameters was recorded by the control; fruit weight was (4.97 and 4.90 g) in the 1st and 2nd seasons, fruit length was (1.27 and 1.35 cm) in both seasons and fruit diameter was (1.47 and 1.69 cm) during seasons 2013 and 2014 respectively. As for fruit shape index (fruit length/diameter), there were no significant differences between treatments and control in the two seasons.

Table 6: Effect of spray with dry yeast extract and benzyladenine on yield and fruit physical properties of Manzanillo olive trees during 2013 and 2014 seasons.

Treatments	Yield (Kg/tree)		Fruit weight (g)		Fruit length (cm)		Fruit diameter (cm)		Fruit shape L/D	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1. Dry yeast extract at 20g/ L	11.00c	11.92c	4.99d	5.10d	1.70de	1.47ef	1.54d	1.70bc	1.11a	1.00a
2. Dry yeast extract at 40g/ L	13.33ab	14.76ab	5.83a	5.90ab	2.63ab	2.63b	1.87ab	1.89ab	1.41a	1.40a
3. Benzyl adenine at 60 ppm	13.17b	14.29b	5.82ab	5.60bc	2.47b	2.51bc	1.87ab	1.85ab	1.32a	1.40a
4. Benzyl adenine at 80 ppm	11.00c	12.50c	5.06cd	5.20d	1.57c	1.85e	1.53d	1.53d	1.03a	1.21a
5. Dry yeast extract at 20g/L+ Benzyladenine at 60 ppm	12.33b	13.28b	5.70b	5.40bc	2.20bc	2.25dc	1.83b	1.84ab	1.20a	1.22a
6. Dry yeast extract at 20g/L+ Benzyladenine at 80ppm	12.44c	13.21c	5.32c	5.02d	1.80d	2.21dc	1.67c	1.77bc	1.10a	1.30a
7.Dry yeast extract at 40g/L+ Benzyladenine at 60ppm	15.00a	17.50a	6.00a	6.50a	2.70a	2.88a	1.97a	1.99a	1.40a	1.50a
8.Dry yeast extract at 40g/L+ Benzyladenine at 80ppm	12.40c	13.17c	5.69b	5.98ab	2.17bc	2.27dc	1.77bc	1.77bc	1.23a	1.30a
9. Control	10.99c	11.00c	4.97d	4.90e	1.27e	1.35f	1.47d	1.69bc	1.00a	1.00a

Means in each column with similar letters are not significantly different.

Results in Table 7 presented the effect of spray with dry yeast extract and benzyladenine and their combination on fruit flesh weight, seed weight, pulp/seed ratio, fruit moisture content and chemical properties (fruit oil content) of Manzanillo olive trees during the two seasons of this study.

Table7: Effect of spray with dry yeast extract and benzyladenine on physical and chemical properties of Manzanillo olive trees during 2013 and 2014 seasons.

Treatments	Fruit flesh weight (g)		Seed weight (g)		Pulp/seed ratio (%)		Fruit moisture content		Oil percentage	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
1.Dry yeast extract at 20g/ L	3.39ef	3.40de	1.60ab	1.70a	67.94ef	66.67de	68.07bc	68.34bc	18.13d	17.11d
2.Dry yeast extract at 40g/ L	4.81ab	4.78ab	1.02e	1.12ef	82.50ab	81.02ab	72.33ab	73.51ab	19.72ab	18.42ab
3.Benzyl adenine at 60 ppm	4.68bc	4.49b	1.14dc	1.11ef	80.41bc	80.18ab	71.43ab	73.19ab	19.14ab	18.44ab
4.Benzyl adenine at 80 ppm	3.59e	3.81cd	1.50b	1.39b	70.95de	73.27cd	64.20cd	66.15cd	14.47cd	16.13cd
5.Dry yeast extract at 20g/L +Benzyladenine at 60 ppm	4.39c	4.18c	1.31bc	1.22c	77.02bc	77.41c	68.67bc	69.17bc	19.87ab	17.99bc
6. Dry yeast extract at 20g/L +Benzyladenine at 80ppm	3.82de	3.88cd	1.50ab	1.14de	71.80de	77.29c	69.13b	70.11b	18.67bcd	17.18bcd
7.Dry yeast extract at 40g/L +Benzyladenine at 60ppm	4.99a	5.40a	1.01e	1.10e	83.17a	83.08a	74.33a	75.24a	20.52a	19.67a
8.Dry yeast extract at 40g/L +Benzyladenine at 80ppm	4.28d	4.82ab	1.41bc	1.16cd	75.22cd	80.60ab	68.33bc	68.75bc	17.67bc	18.12ab
9. Control	3.07f	3.20f	1.70a	1.70a	63.36f	65.31e	60.30d	64.05d	17.67d	17.00d

Means in each column with similar letters are not significantly different.

The highest significant fruit flesh weight (4.99 and 5.40g) in the first and second season respectively was obtained by dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree followed by dry yeast extract at 40g/ L/tree (4.81 and 4.78g) in both seasons respectively. Meanwhile the lowest fruit flesh weight was obtained from the control trees (3.07 and 3.20g) in both two seasons respectively. With respect to seed weight, the control gave the heaviest seed weight 1.70 g in the 1st and 2nd seasons, whereas dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree gave the lightest seed weight (1.01 and 1.10g) in the first and second season respectively. Dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree gave the highest significant fruit moisture content (74.33 and 75.24%) in both seasons respectively (Table 7), whereas the control gave the lowest fruit moisture content (60.30 and 64.05%) during 2013 and 2014 seasons respectively. Fruit oil percentage was significantly affected by different treatments comparison with the control during the 1st and 2nd seasons. Dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree gave the highest significant fruit oil percentage (20.52 and 19.67%) in both seasons respectively, whereas the control gave the lowest fruit oil percentage (17.67 and 17%) during 2013 and 2014 seasons respectively (Table 7).

DISSCUSSION AND CONCLUSIONS

The results of experimentation natural source of biostimulants i.e. dry yeast extract on Manzanillo olive and the comparison of its effects with that of synthetic plant growth regulators benzyladenine indicated that application of dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree followed by dry yeast extract at 40g/L/tree leads to increase leaf area, leaf dry weight, specific leaf weight dry and total chlorophyll of Manzanillo olive (Table 2). Also, leaf macro and micro elements content (Table 3, 4) as well as the flowering density, perfect flowers and fruit set percentage were increased (Table 5). Moreover, yield, fruit physical properties (fruit weight, length, diameter, fruit flesh weight, pulp/seed ratio and fruit moisture content) and fruit oil content were increased, but seed weight was reduced compared to the control (Table 6, 7). This could be attributing to the role of these materials as a stimulate dry mass production through enhancement of cell division and chlorophyll accumulation which leads to higher photosynthetic activity and accumulation of soluble sugar [21]. This in turn was reflected on the increasing in translocation and accumulation of certain microelements in plant organs and subsequently on their growth characteristics. Results are in line with those reported by [22] on Grand Nain banana and [23] on mango and [10] on Washington Navel orange, [8] on Aggizy olive and [9] on Coronaki, Chemlaly and Quartina olive oil cvs. recorded that application of dry yeast increased leaf area, leaf fresh and dry weights, total chlorophyll contents and leaf mineral content (N, P, K, Fe, Zn and Mn) compared with control without dry yeast treatment. In addition, Abou Aziz et al. [24] recorded that application of benzyladenine on Manzanillo olive caused significant improvement in leaf area, leaf dry weight, specific leaf weight dry, photosynthetic pigments and leaf mineral content (N, P, K and Mg).

Improving flowering density, perfect flowers and fruit set than untreated trees could be also interpreted to benzyladenine as exogenous growth regulator which play an important role on flower formation in olive during the induction and initiation periods [25]. Probably delayed the senescence stages of buds and increased the entrance of photosynthetic compounds, hormones and other metabolites to inflorescence buds, which are so important for preventing bud abscission and increased the fruit set [26]. The results are in agreement with those obtained by [24] who recorded that application of benzyladenine increase number of inflorescences/m, percentage of perfect flowers and percentage of initial and final fruit set of Manzanillo olive trees as well as percentage of sex expression and pollen grains germination of Egazy Shami olive trees [27].

The increase in the yield recorded in this investigation could be a reflection of the effect of benzyladenine and dry yeast extract on growth and development; it might be due to either marked increase in the number of branches/tree which gave a chance to the tree to carry more flowers and increase fruit set, fruit retention and yield in Kg/tree. Moreover, fruit growth after bloom is dependent in large part on photosynthesis supplied by spur leaves [28] in addition to the increase of the sink ability in fruit through increasing the level of endogenous phytohormones. This could be interpreted on basis that increasing both mineral uptake endogenous regulators in fruits act through mobilization of nutrients and other substances vitamins and phytohormones from the source (leaves) to sink (fruit) [29, 30, 31], leading to increase fruit size and fruit dry matter [32, 33].

The essential oil percent increased by all treatments compared to the control. However, dry yeast extract at 40g/L + benzyladenine at 60 ppm/tree produced the highest percentage. Therefore, it could be suggested that synthetic plant growth regulator (benzyladenine) and production of fermentation dry yeast

which were used in this study controlled the biosynthesis of essential oil through the main metabolic pathway. In support of this suggestion, Cseke and Kaufmann [34] concluded that the control of biosynthetic pathways leading to the production of specific metabolites as essential oils are controlled by enzymes, which in turn are mainly effected by growth regulators. In addition, Heldt [35, 36, 37, 38] mentioned that auxins, cytokinins, vitamin B and enzymes produced from fermentation dry yeast regulate the physiological processes through enzymatic reactions, cell structure, nucleic acids synthesis and consequently other metabolic pathways. These results are in harmony with those obtained by [24] on Manzanillo olive and [27] on Egazy Shami olive, who reported that fruit oil content increased by benzyladenine treatments. Fayed [5] on Roghiani olive and [8] on Aggizy olive, who recorded that application of yeast increased fruit flesh oil content compared to the control. This approach is very important because there are many cautions about using such synthetic substances on fresh marketable vegetable and fruits used for human consumption. In addition, an individual synthetic plant growth regulator is likely to have some favorable influence and others that are unfavorable [39]. Therefore, we compared different effects of using dry yeast extract with those of benzyladenine and concluded that spray Manzanillo olive trees twice at full bloom stage and two weeks later with dry yeast extract at 40g/ L + benzyladenine at 60 ppm/tree or dry yeast extract at 40g/ L/tree for improving and enhancing growth vigorous, nutrition status, flowering, yield/tree and fruit quality of Manzanillo olive trees, besides their safety for either environment or human health.

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