

Response of Manfalouty Pomegranate Transplants to Foliar Spray and Soil Drench Applications with Some Natural Extracts

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Abstract: This experimental was carried out on 1-year old ‘Manfalouty’ pomegranate transplants grown in the Research Station Farm of National Research Center, at El Nobarya district, El Behera Governorate, Egypt, through two successive seasons (2014 and 2015). The main goal of this study improving vegetative growth and the nutrition statuses of ‘Manfalouty’ pomegranate transplants at early growth stage by using some natural extracts at different concentrations as single treatment or in combinations. The used extracts were applied in the following treatments, Moringa leaves extract (MLE) at 1.25, 2.5 and 5%, Active dry yeast extract (ADYE) at 0.2, 0.5 and 0.8% as solely or combined with MLE. Such treatments were added as foliar spray or soil drench application and repeated three times with two month interval. Generally, different treatments of the two used extracts had a positive effects on increasing vegetative growth parameters [transplant height (cm), shoot length (cm), leaves number per shoot and leaf area (cm²)] as well as total leaf chlorophyll content (SPAD units) and leaves mineral content (NPK) in relative to the control treatment. Foliar spray application significantly improved transplant height (cm), shoot length (cm), leaves number/shoot, total leaf chlorophyll (SPAD units) and phosphorus content than those obtained from soil drench and the insignificant differences were observed with the remaining parameters. A significant higher transplant was produced with treatments of ADYE at 0.5% as soil drench in compared with control treatment. A significant increment in shoot length and number of leaves/shoot was attributed to foliar spray of 1.25% MLE solely or in combination with 0.2%ADYE as soil drench compared with the control ones. In both seasons, spraying MLE at 1.25% enhanced leaf area while such treatment as soil drench application recorded the highest values of total leaf chlorophyll content in comparison with other remaining treatments. Transplants treated with foliar spray of ADYE (0.8%) solely or in combination with 5% MLE exhibited a significant higher content of N and K in relative to control treatment. While, leaves of transplants treated with MLE at 1.25% as soil drench exhibited the highest P (%) compared with control transplants leaves. The present study strongly recommend the use of foliar as well as soil applications with moringa leaves extract (MLE) at 1.25% as solely or combined with active dry yeast extract (ADYE) at 0.2% to improve vegetative growth, total leaf chlorophyll as well as mineral content of recently planted ‘Manfalouty’ pomegranate cultivar.

Key words: Moringa leaves extract • Active dry yeast extract • Vegetative growth • Leaves mineral content • Manfalouty pomegranate transplants

INTRODUCTION

Pomegranate (*Punica granatum* L.) is one of the oldest known edible fruit trees belonging to Punicaceae family and it is a major fruit crop recommended for new reclaimed soils in Egypt. Several areas produce pomegranate fruits such as Iran, India, Egypt, Spain, France, USA, Oman, Tunisia, Italy and South Africa [1, 2]. Pomegranate fruits provide a rich with antioxidant

polyphenols, vitamin C, K, fiber and low in calories [3, 4]. An adequate nutrition is important during the first years of fruit trees growth to development its root system and canopy structures and stimulate a fast vegetative growth. In recent years, the world aimed to reduce the use of synthetic compounds in crop production and to minimize environmental pollution and human health impacts. Using some natural extracts which non toxic, environmentally friendly, organic and costless are very

importance. *Moringa oleifera* is a highly nutritional valued plant and had several of medicinal uses [5]. In addition, *M. oleifera* contains seven ones more vitamin C than orange, ten ones vitamin A than carrot, seventeen ones Ca than milk, fifteenth times K than bananas, twenty five times Fe than spinach and nine times proteins than yogurt [6]. Also, plants contain amino acids, fatty acids, phenolics and its leaves contains high zeatin and cytokinin [6-9].

Its effects on growth and yield of some crops such as onions, bell pepper, soya beans, sorghum, coffee, tea, chili, melon, maize, rocket plants and pear trees were investigated [6, 10, 11]. Foliar application of moringa leaf extract (MLE) at 30 times diluted enhanced the growth and crop parameters of tomato compared with soil application [12]. Furthermore, rocket plants treated with aqueous extracts of *M. oleifera* leaves (1, 2 and 3%) increased measured growth including plant height, chlorophyll a, b and leaf NPK content [10]. Active dry yeast is a natural safety biofertilizers and considered as a natural source of cytokinins which simulates cell division and enlargement as well as the synthesis of protein, nucleic acid synthesis, B-vitamin and chlorophyll formation and improve net photosynthesis [13-15]. In addition, active dry yeast are used to improve growth, nutrition status and fruit quality of some fruit trees as well as apple, banana, Navel orange and olive seedling [16-19].

From this view of reports, it can be hypothesized that moringa leaf and active dry yeast extracts have some plant growth promoters, mineral nutrients and different vitamins which may be beneficial for pomegranate at early vegetative growth stage. Consequently, this investigation was conducted to accelerate vegetative growth and improve leaves mineral content of young 'Manfalouty' pomegranate transplants by using moringa leaves extract as a single treatment or combined with active dry yeast at different concentrations.

MATERIALS AND METHODS

This investigation was carried out at the Research Station Farm of National Research Center, El Nobarya district, El Behera Governorate, Egypt, during 2014 and 2015 seasons on 1-year old 'Manfalouty' pomegranate

plants. The soil texture grade was sandy (Table 1) and drip irrigation system was applied by using river Nile water. The transplants were uniform in vigor and planted at 3×5 meters apart and all experimental plants received the recommended agricultural practices as recommended.

The following treatments were applied as foliar spray or soil drench thrice with two month interval (1st week of May, July and September): Moringa leaves extract (MLE) 1.25%, Moringa leaves extract (MLE) 2.5%, Moringa leaves extract (MLE) 5%, Active dry yeast extract (ADYE) 0.2%, Active dry yeast extract (ADYE) 0.5%, Active dry yeast extract (ADYE) 0.8%, 1.25% MLE+0.2% ADYE, 2.5% MLE+0.5% ADYE, 5% MLE+0.8% ADYE and Control (water only).

Leaves powder of *Moringa oleifera* were obtained from the unit of moringa production at National Research Center, Giza, Egypt and different concentrations of aqueous extracts were prepared by blending 12.5, 25 and 50g of powder in one liter of water and left for one hour then filtered by wringing using a mutton cloth [20]. Active dry yeast extract (ADYE) solutions were prepared before spraying by dissolving the define amount of active dry yeast [commercial product called Al-Danamaya produced by Angel Yeast (Egypt) Company, which contains yeast (*Saccharomyces cerevisiae*), sorbitan monostearate (E491) and ascorbic acid (E300)] in warm water (38°C) followed by the addition of 0.3% Egyptian treacle (as a source of sugar) overnight to active the reproduction of yeast [21]. All treatments were applied at the rate of one liter/plant.

The following parameters were measured at the end of each growing season (October):

Vegetative Growth: Expressed as transplant height (cm), shoot length (cm), number of leaves per transplant and leaf area (cm²).

Leaf area (cm²) was measured by using the following equation as mentioned by Ahmed and Morsy [22].

$$LA = 0.41 (L \times W) + 1.83.$$

where, LA=leaf area (cm²) L= Length of leaf (cm) and W= Width of leaf (cm).

Table 1: Physical and chemical properties of the experimental soil

Particle size distribution (%)			Soil Texture	Ec dsm ⁻¹	pH	Available nutrients (Cation)					Available nutrients (Anion)			
Sand	Silt	Clay				N%	P%	K%	Ca meg/l	Mg meg/l	CO ₃	HCO ₃	Cl ⁻	SO ₄
90	5	5	Sandy	1.5	8.2	Trace	0.44	0.57	2.65	2.40	-	3.85	53	55.65

Total Leaf Chlorophyll Content (SPAD): By using Minolta meter SPAD-502.

Leaf Mineral Content (NPK): At the end of the investigation season, twenty leaves per plant were collected and prepared for analyzing of NPK as described by Cottenie *et al.* [23].

Statistical Analysis: Randomized complete block design as two-factor. Factorial experiment was used for treatments arrangement and each treatment was represented in three replicates with one seedling per a replicate. The least significant difference test (L.S.D) at 5% level was used to differentiate means according to Snedecor and Cochran [24] using statistical software MSTATC [25].

RESULTS AND DISCUSSION

Vegetative Growth: Effects of two used natural extracts, application method and their interactions on vegetative parameters such as transplant height (cm), shoot length (cm), leaves number/shoot and leaves area (cm²) of 'Manfalouty' pomegranate plant will be the subject of discussion as follows:

Transplant Height (cm): Data regarding the effect of different extract concentrations (on the average) during

two seasons as shown in Table (2) indicated that both extracts as alone or in combined at different concentrations had a positive effect on transplant height (cm) when compared with the control. In this respect, treatments of active dry yeast extract (ADYE) at 0.5% and moringa leaves extract (MLE) at 5% were the most effective recording the tallest transplant compared with control treatment for the both seasons, respectively. Concerning the effect of application method, is clear from the data given that, the tallest 'Manfalouty' pomegranate transplants were observed with foliar spray application in both seasons and there were significant differences among two methods in the 2nd season only. The interaction between extracts treatments and method of application had a clear effect on transplant height (cm) as compared with control one, it was noticed that, the tallest transplant was produced with treatments of ADYE at 0.5% as soil drench (155 and 147.67 cm in the 1st and 2nd seasons, respectively) compared with control treatment (94.50 and 101.40 cm in the 1st and 2nd seasons, respectively) and significant differences were observed.

Shoot Length (cm): According to Table (3), it is evidenced that, using extract types at different concentrations had a significant effect on increasing shoot length (cm) on the average compared with control treatment during 2014 and 2015 seasons. Since, plants treated with 1.25% MLE solely had higher significant

Table 2: Effect of some natural extracts, application method and their interaction on transplant height (cm) of 1-year old 'Manfalouty' pomegranate throughout the seasons of 2014 and 2015

Treatments (A)	Transplant height (cm)					
	Season, 2014			Season, 2015		
	Application method (B)			Application method (B)		
	Spray	Drench	Mean (A)	Spray	Drench	Mean (A)
Control (Water only)	86.50	94.50	90.50	96.47	101.40	98.93
1.25% MLE*	127.00	102.00	114.50	130.67	107.23	118.95
2.5% MLE	123.50	131.50	127.50	127.80	134.73	131.27
5% MLE	134.00	130.50	132.30	141.43	135.17	138.30
0.2%ADYE**	100.20	116.00	108.10	110.00	115.83	112.92
0.5%ADYE	115.50	155.00	135.25	135.70	147.67	141.68
0.8%ADYE	135.50	96.50	116.00	142.00	99.35	120.68
1.25%MLE+0.2%ADYE	102.50	127.50	115.00	106.33	130.00	118.17
2.5%MLE+0.5%ADYE	133.00	104.00	118.50	138.73	108.67	123.70
5%MLE+0.8%ADYE	125.50	120.00	122.75	130.87	126.60	128.73
Mean (B)	118.30	117.80	-	126.00	120.67	-
L.S.D at 5%	A=9.50 B=N.S. AB=13.44			A= 8.64 B=3.86 AB=12.22		

*MLE= Moringa leaves extract **ADYE=Active dry yeast extract.

Table 3: Effect of some natural extracts, application method and their interaction on shoot length (cm) of 1-year old 'Manfalouty' pomegranate transplants throughout the seasons of 2014 and 2015

Treatments (A)	Shoot length (cm)					
	Season, 2014			Season, 2015		
	Application method (B)			Application method (B)		
	Spray	Drench	Mean (A)	Spray	Drench	Mean (A)
Control (Water only)	11.47	12.92	12.19	15.45	14.48	14.97
1.25% MLE*	19.03	15.68	17.36	25.40	16.87	21.13
2.5% MLE	14.50	13.50	14.00	19.37	17.40	18.39
5% MLE	15.55	12.15	13.85	18.22	15.45	16.83
0.2%ADYE**	13.08	13.68	13.38	16.97	18.55	17.76
0.5%ADYE	11.97	14.75	13.36	15.10	16.82	15.96
0.8%ADYE	14.53	16.08	15.31	15.57	18.02	16.79
1.25%MLE+0.2%ADYE	12.92	19.72	16.32	14.97	22.38	18.68
2.5%MLE+0.5%ADYE	16.50	11.33	13.92	19.17	13.05	16.11
5%MLE+0.8%ADYE	17.12	14.85	15.98	19.27	15.95	17.61
Mean (B)	14.67	14.47	-	17.95	16.90	-
L.S.D at 5%	A=1.58 B=N.S. AB=2.23			A= 1.90 B=0.53 AB=1.68		

*MLE= Moringa leaves extract **ADYE=Active dry yeast extract.

value (17.36 and 21.13 cm for the 2014 and 2015 seasons respectively) in relative to the control treatment (12.19 and 14.97cm for the seasons of 2014 and 2015 respectively). Regardless concentration of extracts foliar spray significantly increased shoot length than that obtained from soil drench application. Interaction data showed the significant increment in shoot length was attributed to treatment of soil drench of 1.25%MLE+0.2%ADYE in the 1st season and treatment of 1.25% MLE solely as foliar spray in the 2nd season comparing with control plants.

The stimulation effects of moringa leaves extract (MLE) and active dry yeast extract (ADYE) on seedling height and shoot length might be attributed to it is considered as a natural source of crude proteins (essential for the protoplasm formation) and plant growth hormones such as cytokinins in the forms of zeatin, which stimulates cell multiplication and enlargement [5-7, 9]. The present results are in agreement with those obtained by Muhamman *et al.* [26] on tomato plants that 3% aqueous extract of moringa was more effective to increase plant height compared with other concentrations (0, 4 and 5%). In addition, Abdalla [10] on rocket plants disclosed that 2% aqueous extracts of *M. oleifera* leaves (1, 2 and 3%) increased measured growth such as plant height. In addition, the yeast extract enhancing vegetative growth of Grand Nain banana cv., Navel orange trees, Sweet ananas melon plant and seedling of Quartina, Koroneiki and Chemlali olive cvs. [17-19, 27].

Number of Leaves/Shoot: Results presented in Table (4) cleared that, on the average, different concentrations of MLE and ADYE increased leaves number/shoot through 2014 and 2015 seasons compared with the control. Where, 1.25% MLE as single treatment followed by 1.25%MLE+0.2% ADYE were the most effective treatments to achieve significant higher values in both seasons. The results regarding the method of applications as show in Table (4) revealed that, in the 1st season of study, foliar spray insignificantly increased the number of leaves in relative to soil drench. Meanwhile, in the 2nd season, the opposite trend was observed. Taking the interaction treatments effects into consideration, the recorded data disclosed that, foliar spray of 1.25% MLE alone in 2014 season and 1.25% MLE+0.2%ADYE as soil drench in 2015 season significantly increased the number of leaves/shoot compared with the control ones.

Leaf Area (cm²): As regard to the effect of the different concentrations of the two used extracts treatments on leaf area (cm²) during both seasons as present in Table (5), it is appeared that average leaf area of treated plants with 1.25% MLE solely disclosed the highest value of average leaf area (4.39 and 4.71 cm² in the 1st and 2nd season, respectively). The differences among the two methods of applications did not attain the significant level, however foliar spray enhanced leaf area compared with soil drench. Considering the main effect due to the interaction

Table 4: Effect of some natural extracts, application method and their interaction on number of leaves/shoot of 1-year old 'Manfalouty' pomegranate transplants throughout the seasons of 2014 and 2015

Treatments (A)	Number of leaves/shoot					
	Season, 2014			Season, 2015		
	Application method (B)			Application method (B)		
	Spray	Drench	Mean (A)	Spray	Drench	Mean (A)
Control (Water only)	19.50	20.00	19.75	21.50	22.67	22.09
1.25% MLE*	28.00	24.78	26.39	27.50	31.50	29.50
2.5% MLE	26.33	23.50	24.92	28.67	24.83	26.75
5% MLE	20.44	23.00	21.72	21.89	24.50	23.19
0.2%ADYE**	24.17	23.00	23.58	26.83	24.50	25.67
0.5%ADYE	21.67	21.00	21.33	20.17	23.00	21.58
0.8%ADYE	23.00	24.45	23.72	24.17	27.83	26.00
1.25%MLE+0.2%ADYE	23.17	27.50	25.33	24.67	33.17	28.92
2.5%MLE+0.5%ADYE	24.50	22.00	23.25	25.83	25.17	25.50
5%MLE+0.8%ADYE	24.78	25.00	24.89	26.22	28.50	27.36
Mean (B)	23.56	23.42	-	24.75	26.57	-
L.S.D at 5%	A=2.21 B=N.S. AB=3.13			A=2.06 B=0.92 AB=2.91		

*MLE= Moringa leaves extract **ADYE=Active dry yeast extract.

Table 5: Effect of some natural extracts, application method and their interaction on leaf area (cm²) of 1-year old 'Manfalouty' pomegranate transplants throughout the seasons of 2014 and 2015

Treatments (A)	Leaf area (cm ²)					
	Season, 2014			Season, 2015		
	Application method (B)			Application method (B)		
	Spray	Drench	Mean (A)	Spray	Drench	Mean (A)
Control (Water only)	3.98	3.48	3.73	4.32	4.22	4.27
1.25% MLE*	5.02	3.77	4.39	5.31	4.10	4.71
2.5% MLE	3.51	4.07	3.79	4.07	4.23	4.15
5% MLE	4.05	4.34	4.20	4.25	4.60	4.42
0.2%ADYE**	4.62	3.64	4.13	4.85	4.10	4.47
0.5%ADYE	3.28	4.79	4.03	3.55	4.90	4.23
0.8%ADYE	4.76	3.65	4.21	5.05	3.86	4.45
1.25%MLE+0.2%ADYE	3.74	4.24	3.99	4.10	4.51	4.31
2.5%MLE+0.5%ADYE	4.11	4.29	4.20	4.42	4.75	4.58
5%MLE+0.8%ADYE	3.65	3.67	3.66	3.99	4.01	4.00
Mean (B)	4.07	3.99	-	4.39	4.33	-
L.S.D at 5%	A=0.26 B=N.S. AB=0.37			A=0.26 B=N.S. AB=0.37		

*MLE= Moringa leaves extract **ADYE=Active dry yeast extract.

between different extract treatments and method of application, it is quite clear from the computed data (Table, 5) that, in both seasons, spraying MLE at 1.25% as solely recorded the highest values (4.39 and 4.71 cm² through 2014 and 2015 seasons, respectively) compared with other remaining interactions.

A possible explanation for the positive effects on number of leaves and average leaf area may be attribute to the foliar application of MLE stimulate earlier cytokinin formation thus preventing premature leaf senescence and

resulting in more leaf area with higher photosynthetic pigments [28]. Consistent results were mentioned that foliar spraying of lower moringa leaf extract concentration (2%) was more effective to raise leaves number and leaf area of sacred basil and senna plants than high concentration (4%) and the control plants [29, 30]. Our results are in agree with the conclusion given by Azra [12] who found that foliar application of Moringa leaf extract (20 and/or 30 times diluted MLE) enhanced the leaves number of tomato plants compared to control

Table 6: Effect of some natural extracts, application method and their interaction on total leaf chlorophyll (SPAD units) of 1-year old 'Manfalouty' pomegranate transplants throughout the seasons of 2014 and 2015

Treatments (A)	Total leaf chlorophyll content (SPAD units)					
	Season, 2014			Season, 2015		
	Application method (B)			Application method (B)		
	Spray	Drench	Mean (A)	Spray	Drench	Mean (A)
Control (Water only)	58.36	45.75	52.06	59.62	46.17	52.89
1.25% MLE*	67.20	69.88	68.54	67.33	70.88	69.11
2.5% MLE	59.80	65.28	62.54	60.50	65.62	63.06
5% MLE	63.85	67.40	65.63	64.58	67.57	66.08
0.2%ADYE**	60.53	51.59	56.06	60.65	52.13	56.39
0.5%ADYE	66.20	50.85	58.52	67.17	51.65	59.41
0.8%ADYE	63.53	54.50	59.02	64.08	55.17	59.63
1.25%MLE+0.2%ADYE	60.30	58.28	59.29	61.12	59.37	60.24
2.5%MLE+0.5%ADYE	64.95	53.62	59.29	65.48	54.23	59.86
5%MLE+0.8%ADYE	61.97	59.30	60.63	62.32	59.50	60.91
Mean (B)	62.67	57.65	-	63.29	58.23	-
L.S.D at 5%	A=2.31 B=1.04 AB=3.27			A=1.74 B=0.78 AB=2.46		

*MLE= Moringa leaves extract **ADYE=Active dry yeast extract.

treatment. Moreover, foliar spray was the best than soil application. In addition, Abd El-Hamied and El-Amary [11] mentioned that, moringa leaves extract at (2 and 4%) significantly increased average leaf area compared with control trees of Le-Conte pear trees. On the other side, Abd El-Aal [27] reported that, the yeast extract at 100 ml/l increased the number of branches/plant of sweet ananas melon.

Total leaf chlorophyll content (SPAD units): Respecting to the effect of different extract concentrations on total leaf chlorophyll (SPAD units), results of the 2014 and 2015 seasons (Table 6) showed that leaves of plants treated with 1.25% MLE followed by 5% MLE as single treatments scored the highest content of total leaf chlorophyll than the rest treatments (68.54, 69.11 for 1.25% MLE in both seasons and 65.63, 66.08 for 5% MLE throughout the 1st and 2nd seasons, respectively). Foliar spray significantly enhanced total leaf chlorophyll content compared with soil drench application during both seasons, regardless extracts treatment. Results pertaining the effect of interaction among two extract treatments and application method on the total leaf chlorophyll content of 'Manfalouty' plants as shown in Table (6) disclosed that, soil drench of 1.25% MLE and 5% MLE recorded significant higher values of total leaf chlorophyll (SPAD units) (69.88, 70.88 and 67.40, 67.57 throughout the 1st and 2nd seasons) compared with control transplants.

A plausible explanation for increasing total leaf chlorophyll contents as results of applied moringa leaves extract might be attributed to it is considered as a natural source of some hormones which simulates the synthesis of chlorophyll formation [13, 14]. Moreover, its leaves contains high zeatin, a purine adenine derivative of plant hormone group cytokinin known for stay green [6-9]. The present results go in parallel with the findings of Azra [12] who mentioned that, moringa leaf extract (30 times diluted MLE) was found to be effective to increase chlorophyll contents of tomato leaves. Also, Abd El-Hamied and El-Amary [11] reported that, moringa leaves extract at (2 and 4%) significantly increased chlorophyll contents of Le-Conte pear trees compared with control. On other hand, Abd El-Aal [27] on sweet ananas melon plant disclosed that, the yeast extract at 100 ml/l increased the concentration of chlorophyll a and b compared with control treatment.

Leaf Mineral Content (NPK)

Leaf Nitrogen Content (%): From data in Table (7), it is noticed that different concentrations of MLE and ADYE increased the nitrogen content (%) on the average and levels of the significant were differed among treatments and control treatment. In this respect, treatment of 1.25% MLE solely exhibited the highest significant leaf N (1.28%) in the 1st season and in combination with 0.2% ADYE (1.28%) in the 2nd season in relative to control N leaves content (0.79 and 0.71% in in the 1st and 2nd

Table 7: Effect of some natural extracts, application method and their interaction on Nitrogen content (%) of 1-year old 'Manfalouty' pomegranate transplants throughout the seasons of 2014 and 2015

Treatments (A)	Nitrogen content (%)					
	Season, 2014			Season, 2015		
	Application method (B)			Application method (B)		
	Spray	Drench	Mean (A)	Spray	Drench	Mean (A)
Control (Water only)	1.00	0.58	0.79	0.90	0.51	0.71
1.25% MLE*	1.00	1.56	1.28	1.10	1.36	1.23
2.5% MLE	0.75	0.89	0.82	0.78	0.91	0.85
5% MLE	0.70	0.98	0.84	0.80	1.00	0.90
0.2%ADYE**	0.80	0.79	0.80	0.84	0.82	0.83
0.5%ADYE	0.86	0.90	0.88	0.96	0.93	0.95
0.8%ADYE	1.70	0.77	1.24	1.42	0.82	1.12
1.25%MLE+0.2%ADYE	1.20	1.30	1.25	1.18	1.38	1.28
2.5%MLE+0.5%ADYE	0.90	0.84	0.87	0.97	0.93	0.95
5%MLE+0.8%ADYE	0.87	1.00	0.94	1.00	0.90	0.95
Mean (B)	0.98	0.96	-	1.00	0.96	-
L.S.D at 5%	A=0.117 B=N.S. AB=0.165			A=0.161 B=N.S. AB=0.228		

*MLE= Moringa leaves extract **ADYE=Active dry yeast extract.

Table 8: Effect of some natural extracts, application method and their interaction on Phosphorus content (%) of 1-year old 'Manfalouty' pomegranate transplants throughout the seasons of 2014 and 2015

Treatments (A)	Phosphorus content (%)					
	Season, 2014			Season, 2015		
	Application method (B)			Application method (B)		
	Spray	Drench	Mean (A)	Spray	Drench	Mean (A)
Control (Water only)	0.589	0.361	0.475	0.476	0.380	0.428
1.25% MLE*	0.413	0.875	0.644	0.436	0.805	0.621
2.5% MLE	0.481	0.410	0.446	0.465	0.450	0.458
5% MLE	0.373	0.450	0.412	0.435	0.500	0.468
0.2%ADYE**	0.639	0.485	0.562	0.682	0.504	0.593
0.5%ADYE	0.434	0.542	0.488	0.504	0.549	0.527
0.8%ADYE	0.645	0.393	0.519	0.656	0.393	0.525
1.25%MLE+0.2%ADYE	0.456	0.458	0.457	0.489	0.463	0.476
2.5%MLE+0.5%ADYE	0.475	0.548	0.512	0.523	0.574	0.549
5%MLE+0.8%ADYE	0.600	0.521	0.561	0.651	0.530	0.591
Mean (B)	0.511	0.504	-	0.532	0.515	-
L.S.D at 5%	A=0.064 B=N.S. AB=0.091			A=0.037 B=0.017 AB=0.052		

*MLE= Moringa leaves extract **ADYE=Active dry yeast extract.

seasons, respectively). Concerning used application method, regardless extract treatments, it is clearly that foliar spray enhanced N (%) compared to soil drench application during both seasons, however, the differences did not attain significant level. Throughout, 2014 and 2015 seasons, results of the interactions among different treatments exhibited that transplant treated with ADYE (0.8%) as foliar spray has the highest significant N content (1.70 and 1.42% in the 1st and 2nd seasons, respectively) in comparison to the control treatment (1.00 and 0.90 in the 1st and 2nd, respectively).

Leaf Phosphorus Content (%): Regardless the application methods, it is noticed from data in Table (8) that, trend of leaf P content (%) was similar to that of leaf nitrogen content. Whereas, treatment of 1.25% MLE alone showed the highest significant content of phosphorus (0.644 and 0.621%) in both seasons in relative to control leaf phosphorus content (0.475 and 0.428% during the 1st and 2nd seasons, respectively). Foliar spray treatment enhanced P content (%) compared with soil drench in both seasons with significant differences in 2nd season only. In both seasons of the current study, seedling

Table 9: Effect of some natural extracts, application method and their interaction on Potassium content (%) of 1-year old 'Manfalouty' pomegranate transplants throughout the seasons of 2014 and 2015

Treatments (A)	Potassium content (%)					
	Season, 2014			Season, 2015		
	Application method (B)			Application method (B)		
	Spray	Drench	Mean (A)	Spray	Drench	Mean (A)
Control (Water only)	0.45	0.37	0.41	0.51	0.48	0.50
1.25% MLE*	0.31	0.58	0.45	0.41	0.71	0.56
2.5% MLE	0.49	0.43	0.46	0.57	0.55	0.56
5% MLE	0.31	0.38	0.35	0.45	0.43	0.44
0.2%ADYE**	0.59	0.48	0.54	0.68	0.59	0.64
0.5%ADYE	0.38	0.51	0.45	0.53	0.59	0.56
0.8%ADYE	0.63	0.56	0.60	0.76	0.68	0.72
1.25%MLE+0.2%ADYE	0.56	0.47	0.52	0.69	0.54	0.62
2.5%MLE+0.5%ADYE	0.38	0.42	0.40	0.45	0.63	0.54
5%MLE+0.8%ADYE	0.59	0.40	0.50	0.77	0.52	0.65
Mean (B)	0.47	0.46	-	0.58	0.57	-
L.S.D at 5%	A=0.083 B=N.S. AB=0.117			A=0.091 B=N.S. AB=0.128		

*MLE= Moringa leaves extract **ADYE=Active dry yeast extract.

treated with MLE at 1.25% as soil drench exhibited the highest leaf content of P (%) (0.875 and 0.805%) compared to control one (0.361 & 0.380% in both seasons, respectively).

Leaf Potassium Content (%): As regard to the data of extract treatments, regardless the method of application, it is appeared (Table, 9) that potassium content of 'Manfalouty' plants leaves as affected by 0.8% ADYE as alone contained high significant values of K content (0.60 and 0.72% for the 1st and 2nd seasons) compared with leaf potassium content in control (0.41 and 0.50% in both seasons). An insignificant statistical increasing of leaf K content was scored with foliar spray than soil drench during both seasons. As for the effect of interaction, results cleared that leaf K content was significantly increased with spraying of 0.8% ADYE solely (0.63%) in the 1st season and spray of 0.8% ADYE in combination with 5% MLE (0.77%) during 2nd season than that control leaf K content (0.45 and 0.51% during the 2014 and 2015 seasons, respectively).

The role of using natural extracts such as *Moringa oleifera* and yeast helps in availability of minerals and may be capable of producing growth regulating like auxins, cytokinins, GA₃ or vitamins and the earlier report indicated that plant growth hormone in small amounts modify a given physiological process and rarely act alone as the action of two or more are necessary to produce a physiological effect [19, 31-33]. The present results of 'Manfalouty' transplant NPK content as affected by

Moringa leaf extracts are in parallel with findings of Abdalla [10] on rocket plants that the content of NPK was increased by treated with *M. oleifera* (2%) extracts compared with (0, 1 and 3%). Also, Abd El-Hamied and El-Amary [11] reported that spraying pear trees with moringa extract at 4% had the higher leaf NPK content, while control trees were the lowest leaf nitrogen content in both seasons. Our present results are in compatible with that obtained by Hafez *et al.* [19] on three months old of Quartina, Koronaki and Chemlali olive cvs. They concluded that foliar spraying of 0.1% yeast enhanced seedling nutrition status (N, P, K, Fe, Zn and Mn) in compared with the control seedling. Furthermore, Fawzi *et al.* [34] on 'Superior' Grapevines found that 0.2% yeast spray alone or combined with urea and boric acid significantly improved NPK content in leaves compared with 0.1% yeast as alone or in combined with other treatments and control treatments.

CONCLUSION

Overall, based on the aforementioned results it can be concluded that different treatments of moringa leaves extract (MLE) and active dry yeast extract (ADYE) had a positive effect on enhancing 'Manfalouty' transplant height (cm), shoot length (cm), leaves number per shoot, leaf area (cm²), total leaf chlorophyll content (SPAD units) and improved leaf minerals content (NPK) in comparison with untreated treatment. Foliar spray application significantly improved transplant height (cm), shoot

length (cm), leaves number/shoot, total leaf chlorophyll (SPAD units) and phosphorus content than those obtained from soil drench application and the insignificant differences were observed with the remaining parameters. A significant higher transplant was produced with treatments of ADYE at 0.5% as soil drench in compared with control treatment. The present study strongly admit the use of foliar as well as soil applications with moringa leaves extract (MLE) at 1.25% as solely or combined with active dry yeast extract (ADYE) at 0.2% to improve vegetative growth, total chlorophyll as well as leaves mineral contents of 'Manfalouty' pomegranate transplants.

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