

Response of Four Olive Cultivars to Common Organic Manures in Libya

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Abstract: Twenty years old "Endory, Frantoyo, Shemlaly and Zafaraney" olive cultivars, grown in Gherian region at El-Gabal El-Gharby's Highland, Libya were conducted in this investigation. Three sources of organic fertilizers: camel, sheep and chicken manures were used beside control trees "without manure". All vegetative growth characteristics, nutrients content, pigments content, C/N ratio, flowering, fruit set, yield, fruit physical and chemical characteristics and oil properties were significantly increased affected by organic manures applications during the two seasons. Chicken manure gave the highest values of all vegetative growth parameters including growth rate of trunk diameter (cm/year), number of the newly formed shoots per twig and its length (cm), number of leaves/shoot, leaf area (cm²), leaf contents of N, P and Ca %, fruit physical characteristics (length (cm), diameter (cm), weight (g), volume (cm³), flesh weight (g) and moisture content (%). However, applying sheep manure was superior for increasing all flowering parameters (average number of inflorescences/twig, flowering density, average number of flowers/inflorescences, number of perfect flowers/inflorescence and sex ratio), fruit set and yield, flesh oil and total carbohydrates, leaf contents of K, Fe, Mg and pigments, bud content of carbohydrates and C/N ratio. Moreover, application of camel manure gave the highest values of leaf Ca, Z and Mn contents, oil acidity, iodine and peroxide values in all cultivars under study.

Key words: Olive • Organic • Manures • Sheep • Camel • Chicken

INTRODUCTION

Organic farming is a new system for agriculture production to avoid the use of chemical and synthetic fertilizers. Environmental effects on human health promoted growers to convert to organic production [1]. Soil erosion is one of the most important environmental problems in the world causing the greatest losses every year as well as affecting sustainable economic development [2].

Olive (*Olea europaea* L.) is an important perennial crop in many agricultural regions of the Mediterranean countries, as it is the most important olive growing region. Generally, geomorphic processes associated with erosion sedimentation have caused substantial changes in soil properties along the slopes of these areas [3]. Leaf-nutrient analysis is the best method for diagnosing tree nutritional status and represent an important tool for determining future fertilization requirements. Presently, the use of leaf analysis as a guide for olive fertilization is still infrequent in Mediterranean countries [4].

Organic matter is not only necessary for plant nutrition as slow release fertilizers but also essential for efficient plant production system [5]. Sheep and chicken manures were more efficient in improving soil physical and chemical characteristics and enhancing growth of olive trees. Therefore, these media are recommended for olive cultivation under the arid and semi-arid regions, which are limited in water resources, especially sandy soil [6].

Olive trees when fertilized with organic manure gave the higher leaf content of a and b chlorophylls, N, P, K, Ca, Mg, Fe, Zn and Mn [7-9]. Organic manures applied to olive trees produced an increase in number of inflorescences per shoot and number of flowers per inflorescence [10,11].

Organic fertilization maintains adequate mineral content in leaves during growth cycles of the olive trees for having economical yield, also increases fruit set percentage, reduces fruit dropping weaves and improves oil properties [11]. Organic virgin olive oil was superior qualities compared to the conventional virgin olive oil i.e. lower acidity value, lower peroxide index, higher stability and higher organoleptic scoring [12,13].

The target of this investigation was to evaluate four olive cultivars: Endory, Frantoyo, Shemlaly Safaks and Zafaraney parameters under using local organic sources of camel, sheep and chicken manures under Libyan conditions.

MATERIALS AND METHODS

The present study was carried out during the two successive seasons (2007/2008 and 2008/2009) on olive orchard in Gherian region at El-Gabal El-Gharby's highland, Libya (835 m above sea level and about 149 Km from Tripoli). Twenty years old trees common olives cultivars were conducted in this study, spaced 10 meters apart (100 trees/hectare) grown in sandy soil (Table 1).

This study was conducted in an orchard depending on the efficient use of rainfall for their productivity and sustainability without additional irrigation system. The average annual rainfall in this area was about 472.5 and

335 mm in the first and the second seasons, respectively concentrated in the Autumn and Winter periods. Four common olive cultivars were employed in this study: Endory, Frantoyo, Shemlaly, Safaks and Zafaraney. Three local organic manures treatments: camel, sheep and chicken manures were used in this experiment for each cultivar at 90.42, 62.69 and 35.60 kg/tree, respectively beside control (organic free). The chemical composition of the tested organic fertilizers is shown in Table 2 and the component of each dose was estimated on basis of 1000 g N/ tree [14] as shown in Table 3. Each treatment conducted three trees; each tree was treated as a replicate. The organic fertilizers treatments were added to the soil at the second week of December in both seasons (20 cm depth).

The Following Parameters Were Recorded

Vegetative Characteristics: The growth rate of trunk diameter (GRTD) of each tree, at 20 cm above soil surface, was estimated according to the following equation:

Table 1: Some physical and chemical characteristics of sandy soil used for the present study

Parameters	Value	Parameters	Value
Particle- size distribution		Soluble cations, meq/l	
Sand (%)	81.7	Ca ²⁺	4.12
Silt (%)	15.8	Mg ²⁺	2.51
Clay (%)	2.5	Na ⁺	7.32
Textural class	Sand	K ⁺	0.85
Bulk density (mg/ m ³)	1.69	Soluble Anions, meq/l	
Saturation water content (cm ³ /cm ³)	0.378	CO ₃ ²⁻	-
Field capacity (cm ³ / cm ³)	0.43	HCO ₃ ⁻	2.40
Paramount wilting point cm ³ /cm ³)	0.064	Cl ⁻	6.95
Available water (cm ³ / cm ³)	0.079	SO ₄ ²⁻	4.92
Organic matter (%)	1.33	Available nutrients (mg/kg)	
Calcium carbonates (%)	10.71	N	12.2
pH	8.8	P	16.3
EC (dS/m)	4.53	K	162.1
		Fe	4.3
		Mn	5.6
		Cu	0.8
		Zn	1.5

Table 2: Some chemical characteristics of the used organic manures

Parameters	Organic manures		
	Camel	Sheep	Chicken
Cubic meter weight (Kg)	611	483	535
Moisture (%)	9.36	10.41	12.52
Organic matter (%)	39.12	46.81	52.60
Organic carbon (%)	26.82	29.51	34.70
pH	7.42	7.31	7.12
EC (dS/m)	8.9	6.4	5.61
C/N ratio	21.98	16.57	10.80
Total N (%)	1.22	1.78	3.21
Total P (%)	0.46	0.73	0.95
Total K (%)	0.95	1.11	1.19
Total Ca (%)	1.82	1.35	2.15
Total Mg (%)	0.65	0.96	1.21
Total Fe (ppm)	244	266	210
Total Mn (ppm)	671	137	51
Total Zn (ppm)	302	82	46

Table 3: The calculated total amounts of macro elements of different organic sources in the two seasons

Macro elements composition per organic dose per tree							
Manure source	FW (kg)	DW (kg)	N (g)	P (g)	K (g)	Ca (g)	Mg (g)
Camel	90.42	81.96	1000	377.01	532.74	1491.67	506.15
Sheep	62.69	56.17	1000	410.04	623.48	758.29	548.83
Chicken	35.60	31.15	1000	295.92	607.42	669.72	376.21

GRTD = final trunk diameter in September (cm) – initial trunk diameter in March (cm). Then, 9 vegetative branches, aged one year old, were randomly chosen and marked per tree at the beginning of growth (early March) to determine the number of newly formed shoots per twig and its length (cm) and number of leaves per shoot at the end of each season (first of September). Also, the average of leaf area (6 mature leaves sample for each replicate at sixth nodes from the base of current grown shoots) was estimated in July using Laser Area Meter CI-202, U.S.A.

Leaf Contents of Macro and Micro Elements and Pigments: Macro and micro elements were determined in dry leaves samples collected at the 1st week of July of each season. Nitrogen (%) was determined by Micro-Kjeldahl according to Pregel [15], Phosphorus (%) as described by Chapman and Pratt [16] and potassium (%) as adopted by Brown and Lilleland [17]. Also, Ca and Mg percentage as well as Fe, Mn, Zn (ppm) were determined using Perkins Elmer Atomic Absorption Spectrophotometer (Model, Sepectronic 21 D) as described by Jackson [18]. In addition, chlorophyll a and b (mg/g FW) were colorimetrically determined in fresh leaf samples according to Wettstein [19].

Buds Contents of Total Carbohydrates (%), Nitrogen and C/N ratio: Buds samples and nodal tissues were taken at 1st week of July, in the two seasons and dried to determine the total nitrogen, according to Pregel [15] and total carbohydrates, as described in A.O.A.C. [20]. Finally, C/N ratio was calculated.

Flowering Characteristics: At full bloom stage (first week of April), average number of inflorescences per twig, flowering density (number of inflorescences per meter), average number of flowers per inflorescence, average number of perfect flowers per inflorescence and sex ratio were estimated.

Fruiting Calculations: Initial and final fruit set percentage were calculated in relation to the total number of flowers on the same twig after 21 and 60 days from full bloom, respectively [21]. The yield per tree was measured at

maturity stage (September, 2nd week). For fruit quality, thirty fruits per replicate were randomly picked to determine fruit size (cm³), fruit length (cm), fruit diameter (cm), fruit shape (L/D ratio), fruit weight (g) and flesh weight (g). Also, fruit flesh contents of oil, total carbohydrates, moisture (%), oil acidity value, oil peroxide number and oil iodine value were determined according to A.O.A.C. [20].

Statistical Analysis: The obtained data were tabulated and statistically analyzed as split plot design and the means of results were compared using LSD method at 5 % level [22]. The percentages were transformed to arcsine to find the binomial percentages according to Steel and Torrie [23].

RESULTS AND DISCUSSION

Vegetative Characteristics: Tabulated results in Tables 4 and 5 illustrate that vegetative growth parameters (growth rate of trunk diameter (GRTD), number of new shoots per twig, new shoots length, number of leaves per shoot and leaf area) were significantly increased by different organic manure sources in the four olive cultivars in the two seasons. Within each type of organic manures, all vegetative growth parameters were, in general, increased with the successive application from the first till the second season.

In addition, Endory olive trees formed the highest GRTD and new shoot length followed in a descending order by Shemlaly, Frantoyo and Zafaraney cultivars. Whereas, Shemlaly olive trees produced the highest number of new shoots/twig, number of leaves/shoot and leaf area (cm²) followed in a descending order by Endory, Frantoyo and Zafaraney olive cultivars. However, chicken manure gave the highest values in this respect, followed in a descending order by sheep, camel manures and control treatment (organic free). Concerning the interaction between seasons, cultivars and treatments, Endory or Shemlaly cultivars fertilized with chicken manure gave the best vegetative growth parameters in the second season compared with other interactions in this respect.

Table 4: Effect of some organic manures on some vegetative growth characteristics of four olive cultivars (2007/08 and 2008/09)

		Growth rate of trunk diameter "GRTD"(cm/year)			No. of new shoots / twig			New shoots length (cm)		
Treatments		Seasons			Seasons			Seasons		
Cultivars	Manures	2007/08	2008/09	Av.	2007/08	2008/09	Av.	2007/08	2008/09	Av.
Endory	Camel	1.07	1.22	1.14	5.15	5.99	5.57	8.54	11.86	10.20
	Sheep	1.13	1.48	1.30	5.44	7.26	6.35	9.03	14.22	11.62
	Chicken	1.19	1.81	1.50	5.74	8.88	7.31	9.52	17.40	13.46
	Control	1.06	1.03	1.04	5.10	4.96	5.03	8.46	8.23	8.34
	Average	1.11	1.38	1.24	5.35	6.77	6.06	8.88	12.92	10.90
Frantoyo	Camel	0.98	1.09	1.03	4.72	5.35	5.03	7.83	10.59	9.21
	Sheep	1.09	1.33	1.21	5.25	6.53	5.89	8.71	12.92	10.81
	Chicken	1.15	1.62	1.38	5.54	7.95	6.74	9.19	15.66	12.42
	Control	0.93	0.92	0.92	4.48	4.43	4.45	7.43	7.35	7.39
	Average	1.03	1.24	1.13	4.99	6.06	5.52	8.29	11.63	9.96
Shemlaly	Camel	0.99	1.20	1.09	4.77	5.89	5.33	7.91	11.60	9.75
	Sheep	1.03	1.43	1.23	4.96	7.02	5.99	8.23	13.82	11.02
	Chicken	1.13	1.75	1.44	5.55	8.58	7.06	9.21	16.93	13.07
	Control	0.98	0.99	0.98	4.63	4.71	4.67	7.68	7.81	7.74
	Average	1.03	1.34	1.18	6.22	6.55	6.38	8.25	12.54	10.39
Zafarany	Camel	0.96	1.12	1.04	4.52	5.51	5.01	7.50	10.85	9.17
	Sheep	0.98	1.35	1.16	4.70	6.64	5.67	7.80	13.08	10.44
	Chicken	1.03	1.66	1.34	4.91	8.16	6.53	8.15	16.07	12.11
	Control	0.95	0.95	0.95	4.35	4.58	4.46	7.22	7.60	7.41
	Average	0.98	1.27	1.12	4.62	6.22	5.42	7.66	11.90	9.78
General Average		1.03	1.30	1.16	5.29	6.40	5.84	8.27	12.24	10.25
Average of Manure Sources	Camel	1.00	1.15	1.08	4.79	5.68	5.23	7.94	11.22	9.58
	Sheep	1.05	1.39	1.22	5.08	6.86	5.97	8.44	13.51	10.97
	Chicken	1.12	1.70	1.41	5.43	8.39	6.91	9.01	16.51	12.76
	Control	0.98	0.97	0.97	4.64	4.67	4.65	7.69	7.74	7.72
LSD at 5%										
Season (A)			0.02			0.02			0.29	
Cultivars (B)			0.02			0.03			0.45	
A x B			0.03			0.13			0.56	
Manures (C)			0.02			0.03			0.16	
A X B			0.04			0.06			0.43	
B x C			0.04			0.06			0.43	
A x B x C			0.05			0.15			0.59	

Table 5: Effect of some organic manures on some vegetative growth characteristics of four olive cultivars (2007/08 and 2008/09)

		No. of leaves / shoot			Leaf area (cm ²)		
Treatments		Seasons			Seasons		
Cultivars	Manures	2007/08	2008/09	Av.	2007/08	2008/09	Av.
Endory	Camel	8.79	11.14	9.96	3.13	3.57	3.35
	Sheep	9.30	13.36	11.33	3.31	4.33	3.82
	Chicken	9.80	16.35	13.07	3.48	5.30	4.39
	Control	8.75	8.44	8.59	3.10	3.09	3.09
	Average	9.16	12.32	10.73	3.25	4.07	3.65
Frantoyo	Camel	9.00	9.74	9.37	2.87	3.19	3.03
	Sheep	10.01	11.88	10.94	3.19	3.89	3.54
	Chicken	10.56	14.40	12.48	3.36	3.95	3.65
	Control	8.54	8.36	8.45	2.69	2.65	2.67
	Average	9.52	11.09	10.31	3.03	3.42	3.22

Table 5: Continued

Shemlaly	Camel	9.95	10.78	10.36	3.90	4.51	4.20
	Sheep	10.36	12.85	11.60	4.10	5.18	4.64
	Chicken	10.59	15.74	13.16	4.31	5.53	4.92
	Control	8.83	8.51	8.67	3.87	3.81	3.84
	Average	9.93	11.97	10.95	4.04	4.75	4.39
Zafaraney	Camel	8.62	10.08	9.35	2.81	3.51	3.16
	Sheep	8.97	12.16	10.56	2.87	3.75	3.31
	Chicken	9.37	15.53	12.45	3.01	3.96	3.48
	Control	8.33	8.20	8.26	2.78	2.55	2.66
	Average	8.82	11.49	10.15	2.86	3.44	3.15
General Average		9.35	11.71	10.53	3.29	3.92	3.60
Average of Manure Sources	Camel	9.09	10.43	9.76	3.17	3.69	3.43
	Sheep	9.66	12.56	11.11	3.36	4.28	3.82
	Chicken	10.08	15.50	12.79	3.54	4.68	4.11
	Control	8.61	8.37	8.49	3.86	3.02	3.44
LSD at 5%							
Season (A)			0.10	0.02			
Cultivars (B)			0.25	0.02			
A x B			0.33	0.03			
Manures (C)			0.31	0.04			
A X B			0.26	0.06			
B x C			0.26	0.06			
A x B x C			0.32	0.09			

Table 6: Effect of some organic manures on some leaf mineral contents of four olive cultivars (2007/08 and 2008/09)

Treatments		N %			P %			K %		
		Seasons			Seasons			Seasons		
Cultivars	Manures	2007/08	2008/09	Av.	2007/08	2008/09	Av.	2007/08	2008/09	Av.
Endory	Camel	1.229	1.707	1.468	0.132	0.173	0.153	0.695	0.876	0.785
	Sheep	1.300	2.047	1.673	0.149	0.177	0.163	0.781	0.933	0.857
	Chicken	1.370	2.505	1.937	0.163	0.189	0.176	0.677	0.825	0.751
	Control	1.218	1.185	1.201	0.126	0.134	0.130	0.644	0.652	0.648
	Average	1.279	1.861	1.569	0.143	0.168	0.155	0.699	0.821	0.760
Frantoyo	Camel	1.127	1.524	1.325	0.136	0.173	0.154	0.765	0.936	0.850
	Sheep	1.254	1.860	1.557	0.152	0.174	0.163	0.786	0.959	0.872
	Chicken	1.232	2.255	1.743	0.168	0.185	0.176	0.731	0.822	0.776
	Control	1.069	1.061	1.065	0.137	0.135	0.136	0.657	0.663	0.660
	Average	1.171	1.675	1.423	0.148	0.166	0.157	0.734	0.845	0.789
Shemlaly	Camel	1.139	1.670	1.404	0.158	0.171	0.164	0.666	0.791	0.728
	Sheep	1.185	1.990	1.584	0.152	0.177	0.164	0.772	0.945	0.858
	Chicken	1.326	2.255	1.790	0.166	0.185	0.175	0.761	0.802	0.781
	Control	1.105	1.124	1.115	0.133	0.125	0.129	0.635	0.642	0.638
	Average	1.188	1.759	1.473	0.152	0.164	0.158	0.708	0.795	0.751
Zafaraney	Camel	1.081	1.562	1.321	0.146	0.176	0.161	0.655	0.771	0.713
	Sheep	1.123	1.883	1.503	0.158	0.177	0.167	0.788	0.992	0.885
	Chicken	1.173	2.314	1.743	0.163	0.185	0.174	0.741	0.853	0.797
	Control	1.039	1.094	1.066	0.134	0.132	0.133	0.632	0.646	0.639
	Average	1.104	1.713	1.408	0.150	0.167	0.158	0.704	0.815	0.759
General Average		1.185	1.752	1.468	0.148	0.166	0.157	0.711	0.819	0.765
Average of Manure Sources	Camel	1.144	1.615	1.379	0.143	0.173	0.158	0.695	0.843	0.769
	Sheep	1.215	1.945	1.579	0.152	0.176	0.164	0.781	0.957	0.868
	Chicken	1.275	2.332	1.803	0.165	0.186	0.175	0.727	0.825	0.776
	Control	1.107	1.116	1.111	0.133	0.131	0.132	0.642	0.651	0.646
LSD at 5%										
Season (A)			0.021	0.004				0.021		
Cultivars (B)			0.032	N.S				N.S		
A x B			0.042	N.S				N.S		
Manures (C)			0.033	0.013				0.022		
A X B			0.055	0.022				0.036		
B x C			0.055	0.022				0.036		
A x B x C			0.084	0.031				0.058		

Table 7: Effect of some organic manures on some leaf mineral contents of four olive cultivars (2007/08 and 2008/09)

Treatments		Ca %			Mg (ppm)			Fe (ppm)		
		Seasons			Seasons			Seasons		
Cultivars	Manures	2007/08	2008/09	Av.	2007/08	2008/09	Av.	2007/08	2008/09	Av.
Endory	Camel	0.735	0.863	0.799	35.00	38.66	36.83	131.00	141.00	136.00
	Sheep	0.666	0.752	0.709	38.33	44.66	41.49	141.33	163.66	152.50
	Chicken	0.762	0.841	0.802	33.66	36.00	34.83	139.00	158.66	148.83
	Control	0.533	0.483	0.508	25.66	25.33	25.49	111.66	115.33	113.50
	Average	0.674	0.735	0.705	33.16	36.16	34.66	130.75	144.66	137.70
Frantoyo	Camel	0.715	0.882	0.798	34.33	39.33	36.83	133.00	146.66	139.83
	Sheep	0.593	0.773	0.683	37.66	44.66	41.16	149.33	165.33	157.33
	Chicken	0.750	0.875	0.812	31.00	35.66	33.33	136.66	157.66	147.16
	Control	0.531	0.564	0.547	24.66	24.00	24.33	109.00	103.33	106.16
	Average	0.641	0.774	0.710	31.91	35.91	33.91	132.00	143.25	137.62
Shemlaly	Camel	0.774	0.866	0.820	33.33	40.66	37.00	130.66	148.66	139.66
	Sheep	0.652	0.791	0.721	37.00	44.33	40.67	132.33	159.33	145.83
	Chicken	0.763	0.868	0.816	31.66	36.66	34.16	144.66	162.66	153.66
	Control	0.491	0.480	0.486	24.00	24.66	24.33	132.33	153.00	142.66
	Average	0.670	0.751	0.711	31.50	36.57	34.04	135.00	155.91	145.45
Zafaraney	Camel	0.731	0.853	0.792	29.00	37.33	33.16	129.33	143.66	136.50
	Sheep	0.688	0.768	0.729	37.00	43.66	40.33	147.33	160.00	153.66
	Chicken	0.721	0.857	0.789	28.66	35.66	32.16	130.00	154.00	142.00
	Control	0.471	0.462	0.467	23.33	23.00	23.16	113.00	119.33	116.16
	Average	0.653	0.735	0.694	29.50	34.91	32.20	129.92	144.24	137.08
General Average		0.659	0.749	0.704	31.52	35.89	33.70	131.91	147.02	139.46
Average of Manure Sources	Camel	0.738	0.866	0.802	32.91	39.00	35.95	131.00	145.00	138.00
	Sheep	0.649	0.771	0.710	37.49	44.32	40.91	142.58	162.08	152.33
	Chicken	0.749	0.860	0.804	31.24	36.00	33.62	137.58	158.24	147.91
	Control	0.506	0.497	0.502	24.41	24.24	24.33	116.49	122.74	119.62
LSD at 5%										
Season (A)			0.019			0.94			1.33	
Cultivars (B)			N.S			N.S			1.42	
A x B			N.S			N.S			1.55	
Manures (C)			0.036			1.05			1.15	
A X B			0.058			1.22			1.95	
B x C			0.058			1.22			1.95	
A x B x C			0.096			2.35			2.37	

Table 8: Effect of some organic manures on some leaf mineral contents of four olive cultivars (2007/08 and 2008/09)

Treatments		Zn (ppm)			Mn (ppm)		
		Seasons			Seasons		
Cultivars	Manures	2007/08	2008/09	Av.	2007/08	2008/09	Av.
Endory	Camel	39.33	46.66	43.00	22.66	25.33	24.00
	Sheep	33.00	40.00	36.50	20.00	24.33	22.16
	Chicken	28.33	35.33	31.83	19.00	20.00	19.50
	Control	25.66	26.00	25.83	15.00	16.00	15.50
	Average	31.58	36.99	34.29	19.16	21.41	20.29
Frantoyo	Camel	40.66	46.00	43.33	21.33	25.66	23.50
	Sheep	34.33	41.33	37.83	19.66	23.33	21.50
	Chicken	27.00	33.66	30.33	16.00	21.00	18.50
	Control	26.33	27.00	26.66	15.00	15.00	15.00
	Average	32.08	36.99	34.53	17.99	21.24	19.62
Shemlaly	Camel	38.33	46.00	42.16	22.33	24.66	23.50
	Sheep	33.00	40.33	36.66	20.66	23.33	22.00
	Chicken	28.66	31.33	30.00	16.00	20.00	18.00
	Control	26.33	26.66	26.50	14.33	14.66	14.50
	Average	31.58	36.08	33.83	18.33	20.66	19.50

Table 8: Continued

Zafaraneý	Camel	39.33	46.00	42.66	21.66	25.33	23.50
	Sheep	33.66	40.00	36.83	20.00	24.33	22.16
	Chicken	28.33	32.33	30.33	18.00	22.00	20.00
	Control	27.33	27.66	27.50	15.33	15.66	15.50
	Average	32.16	36.50	34.33	18.74	21.83	20.29
General Average		31.85	36.64	34.24	18.55	21.28	19.92
Average of	Camel	39.41	46.16	42.78	21.99	25.25	23.62
Manure	Sheep	33.50	40.42	36.95	20.08	23.83	21.95
Sources	Chicken	28.08	33.16	30.62	17.25	20.75	19.00
	Control	26.41	26.83	26.62	14.91	15.33	15.12
LSD at 5 %							
Season (A)			0.62			0.31	
Cultivars (B)			N.S			N.S	
A x B			N.S			N.S	
Manures C			0.92			0.54	
A X B			1.03			0.99	
B x C			1.03			0.99	
A x B x C			2.11			1.33	

Table 9: Effect of some organic manures on leaf pigments content of four olive cultivars (2007/08 and 2008/09)

		Chlorophyll a (mg.g ⁻¹ FW)			Chlorophyll b (mg.g ⁻¹ FW)		
Treatments		Seasons			Seasons		
Cultivars	Manures	2007/08	2008/09	Av.	2007/08	2008/09	Av.
Endory	Camel	1.682	1.955	1.818	1.841	2.140	1.990
	Sheep	1.631	1.915	1.773	1.785	2.096	1.940
	Chicken	1.546	1.851	1.698	1.688	2.026	1.857
	Control	1.522	1.519	1.520	1.666	1.663	1.664
	Average	1.595	1.810	1.702	1.745	1.981	1.863
Frantoyo	Camel	1.665	1.942	1.803	1.823	2.126	1.974
	Sheep	1.622	1.909	1.765	1.776	2.090	1.933
	Chicken	1.582	1.844	1.713	1.732	2.019	1.875
	Control	1.561	1.523	1.542	1.709	1.667	1.688
	Average	1.607	1.804	1.705	1.760	1.975	1.867
Shemlaly	Camel	1.623	1.930	1.776	1.829	2.115	1.972
	Sheep	1.615	1.895	1.755	1.732	2.075	1.903
	Chicken	1.593	1.812	1.702	1.744	1.984	1.864
	Control	1.556	1.549	1.552	1.703	1.694	1.698
	Average	1.597	1.796	1.696	1.752	1.967	1.859
Zafaraneý	Camel	1.672	1.963	1.817	1.830	2.149	1.989
	Sheep	1.616	1.886	1.751	1.769	2.065	1.917
	Chicken	1.555	1.775	1.665	1.702	1.943	1.822
	Control	1.533	1.532	1.532	1.678	1.677	1.677
	Average	1.594	1.789	1.691	1.744	1.958	1.851
General Average		1.598	1.799	1.698	1.750	1.970	1.860
Average of	Camel	1.660	1.947	1.803	1.830	2.132	1.981
Manure	Sheep	1.621	1.901	1.761	1.765	2.081	1.923
Sources	Chicken	1.569	1.820	1.694	1.716	1.993	1.854
	Control	1.543	1.530	1.536	1.689	1.675	1.682
LSD at 5 %							
Season (A)			0.021			0.033	
Cultivars (B)			0.033			N.S	
A x B			0.046			N.S	
Manures (C)			0.035			0.046	
A X B			0.041			0.064	
B x C			0.041			0.064	
A x B x C			0.077			0.088	

These results are in disagreement with Abdel-Nasser and Harash [6], who found that sheep manure were more efficient in improving soil physical and chemical characteristics and enhancing growth of olive trees compared to olive pomace and chicken manure, therefore this manure is recommended for olive cultivation under arid and semi-arid regions that are limited in water resources, especially sandy soil.

Many studies reported that fertilizing power of organic fertilizers is due to their content of stabilized organic matter and due to their component of nutrient elements [24]. These results are in accordance with those obtained by El-Morshedy [25], who found that, chicken manure increased shoot growth rate, leaf area and percentage of leaves and dry weight of sour orange seedlings. The results also agree with Helail *et al.* [26], who reported that fertilization with poultry manure increased shoot length and number of leaves per shoot on different growth cycles of Washington navel orange.

Leaf Contents of Macro, Micro Elements and Pigments:

Data depicted in Tables 6, 7, 8 and 9 indicate that all leaf mineral contents (N, P, K, Ca, Mg, Fe, Zn and Mn) and pigments (chlorophyll a and b) were significantly affected by different organic treatments and olive cultivars during the two seasons. All leaf mineral contents were increased in the second season than in the first season. The effect of olive cultivars on leaf mineral contents and pigments was not significant except with contents of N, Fe and chlorophyll (a and b). Endory cultivar recorded the highest N, Fe and chlorophyll a in both seasons.

Concerning the organic manure effect, chicken manure supplementation increased some leaf mineral contents (N and P), while sheep manure application increased other leaf mineral contents (K, Mg and Fe and chlorophyll a and b). Moreover, Camel manure gave the highest values of leaf Ca, Zn and Mn contents.

Leaf nutrient analysis is the best method for diagnosing the tree nutritional status and represents an important tool for determining future fertilization requirements. The use of leaf analysis as a guide for olive fertilization is still infrequent in Mediterranean countries [4]. The improvement of the nutritional status may be attributed to increasing exchanges and water holding capacity of the soil. Improving tree performance was probably due to improving utilization of applied manures to trees such as poultry manure [27].

These findings are in accordance with those obtained by Abdel-Nasser and Harash [6] who stated that sheep manure increased olive leaf K, Mg and Fe contents.

El-Hady *et al.* [7] found that fertilizing olives with organic manure gave the higher contents of chlorophyll a and b, N, P, K, Ca, Mg, Fe, Zn and Mn. Increases in leaf nutrients content may be attributed to increasing soil nutrients in the root zone that retained against leaching in deep layers resulting in more available nutrients to plant uptake [14].

Also, El-Morshedy [25] found that leaf N, Fe, Zn and Mn contents of sour orange seedlings were increased by chicken manure. Helail *et al.* [26] reported that poultry manure enhanced leaf Mg, Fe, Zn and Mn contents of Washington navel orange. Also, such increase may be due to decomposition of organic materials by micro organisms and subsequent release of their nutrient [28].

Organic manure significantly increased leaf contents of chlorophyll a and b, such increases may be due to improving tree growth that resulted from the high water absorption and more uptakes of N, Mg and Fe as such elements have close association in chlorophyll a and b biosynthesis [11, 29].

Bud Contents of Total Carbohydrates (%), N (%) and C/N ratio:

Data presented in Table 10 pointed out that percentage of total carbohydrates, total nitrogen and C/N ratio of buds plus nodal tissues were significantly increased in the second season in the four olive cultivars receiving different organic sources compared to the first season. Moreover, application of sheep manure gave the highest level of total carbohydrates and C/N ratio followed by olive trees received camel manure then olive trees without organic manures. But, chicken manure application gave the highest level of nitrogen in all olive cultivars under study compared to camel manure application. Concerning the interaction between cultivars, seasons and organic treatments, Shemlaly cultivar treated by sheep manure in the second season recorded the highest bud contents of total carbohydrates and C/N ratio comparing to other interactions in this respect.

These results are in parallel with Hegazi *et al.* [11] and Lopez-Granados *et al.* [14] on olive trees. Mohammed *et al.* [30] recorded the stimulating effect of using organic fertilizers on total carbohydrates, N and C/N ratio.

Flowering Characteristics: Average number of inflorescences per twig, average number of flowers per inflorescence and number of perfect flowers per inflorescence of the four studied olive cultivars were significantly affected by the organic manure application during the two seasons (Tables 11 and 12). Generally, Shemlaly olive cultivar recorded the highest values in this

Table 10: Effect of some organic manures on some bud chemical contents of four olive cultivars (2007/08 and 2008/09)

		Total carbohydrates %			N %			C/N ratio		
Treatments		Seasons			Seasons			Seasons		
Cultivars	Manures	2007/08	2008/09	Av.	2007/08	2008/09	Av.	2007/08	2008/09	Av.
Endory	Camel	13.56	23.71	18.63	1.363	1.816	1.589	9.95	13.06	11.50
	Sheep	16.28	28.00	22.14	1.425	1.925	1.675	11.43	14.55	12.99
	Chicken	15.78	26.10	20.94	1.482	1.975	1.728	10.65	13.22	11.94
	Control	12.00	12.05	12.02	1.248	1.236	1.242	9.62	9.75	9.67
	Average	14.40	22.46	18.43	1.379	1.738	1.558	10.41	12.63	11.52
Frantoyo	Camel	14.11	22.87	18.49	1.346	1.808	1.577	10.49	12.65	11.57
	Sheep	16.48	27.57	22.02	1.419	1.942	1.680	11.62	14.20	12.91
	Chicken	15.82	27.17	21.50	1.472	1.965	1.718	10.75	13.83	12.29
	Control	12.92	12.89	12.90	1.266	1.258	1.262	10.21	10.25	10.23
	Average	14.83	22.62	18.72	1.375	1.743	1.559	10.76	12.73	11.74
Shemlaly	Camel	15.45	25.54	20.50	1.336	1.863	1.599	11.57	13.71	12.64
	Sheep	18.43	28.55	23.49	1.420	1.923	1.671	12.98	14.85	13.91
	Chicken	17.86	27.90	22.88	1.435	1.985	1.710	12.45	14.06	13.25
	Control	12.67	12.97	12.82	1.225	1.218	1.221	10.35	10.65	10.50
	Average	16.10	23.74	19.92	1.354	1.747	1.550	11.83	13.31	12.57
Zafaraneey	Camel	14.10	21.94	18.02	1.350	1.852	1.601	10.45	11.85	11.15
	Sheep	17.01	26.42	21.71	1.432	1.956	1.694	11.88	13.45	12.66
	Chicken	16.76	24.20	20.48	1.516	1.966	1.741	11.06	12.31	11.68
	Control	11.59	11.69	11.64	1.223	1.228	1.225	9.48	9.52	9.50
	Average	14.86	21.06	17.96	1.380	1.750	1.565	10.71	11.78	11.25
General Average		15.04	22.47	18.76	1.372	1.744	1.558	10.92	12.61	11.77
Average of Sources	Camel	14.30	23.51	18.91	1.349	1.834	1.591	10.61	12.81	11.71
	Sheep	17.05	27.63	22.34	1.424	1.936	1.680	11.97	14.26	13.11
	Chicken	16.55	26.34	21.45	1.476	1.973	1.724	11.23	13.35	12.29
	Control	12.29	12.40	12.35	1.241	1.235	1.238	9.92	10.04	9.98
LSD at 5%										
Season (A)			0.36			0.041			0.33	
Cultivars (B)			0.44			N.S			0.48	
A x B			0.53			N.S			0.55	
Manures (C)			0.41			0.043			0.32	
A X B			0.65			0.077			0.53	
B x C			0.65			0.077			0.53	
A x B x C			1.11			0.093			0.74	

Table 11: Effect of some organic manures on some flowering characteristics of four olive cultivars (2007/08 and 2008/09)

		Av. No. of inflorescence / twig			Av. No. of flowers / inflorescence			Flowering density (No. inflorescences/ m)		
Treatments		Seasons			Seasons			Seasons		
Cultivars	Manures	2007/08	2008/09	Av.	2007/08	2008/09	Av.	2007/08	2008/09	Av.
Endory	Camel	6.11	7.82	6.96	12.97	15.57	14.27	25.29	37.61	31.45
	Sheep	6.19	9.61	7.90	13.14	17.39	15.26	25.62	43.22	34.42
	Chicken	5.38	7.35	6.36	11.42	14.63	13.02	22.27	35.35	28.81
	Control	4.25	4.53	4.39	9.02	9.25	9.13	17.59	18.75	18.17
	Average	5.48	7.32	6.40	11.63	14.21	12.92	22.69	33.73	28.21
Frantoyo	Camel	6.15	7.55	6.85	13.06	15.23	14.14	25.46	36.81	31.13
	Sheep	6.21	8.91	7.56	13.18	16.08	14.63	25.70	38.85	32.27
	Chicken	5.63	7.26	6.44	11.95	14.45	13.20	23.30	34.92	29.11
	Control	4.06	4.09	4.07	8.61	8.74	8.67	16.80	16.93	16.86
	Average	5.51	6.95	6.23	11.70	13.62	12.66	22.81	31.87	27.34

Table 11: Continued

Shemlaly	Camel	6.53	8.52	7.52	13.86	16.96	15.41	27.03	40.98	34.00
	Sheep	6.85	9.21	8.03	14.54	17.15	15.84	28.35	41.40	34.87
	Chicken	6.12	7.94	7.03	12.99	15.81	14.40	25.33	38.19	31.76
	Control	5.31	5.65	5.48	11.27	11.19	11.23	21.98	21.65	21.81
	Average	6.20	7.83	7.02	13.11	15.28	14.22	25.66	35.55	30.61
Zafaraney	Camel	6.24	7.35	6.79	13.25	14.57	13.91	25.83	35.38	30.60
	Sheep	6.18	8.21	7.19	13.12	16.26	14.69	25.58	39.49	32.53
	Chicken	5.61	7.11	6.36	11.91	14.09	13.00	23.22	34.19	28.70
	Control	3.20	3.26	3.23	10.37	10.16	10.26	15.36	18.21	16.78
	Average	5.30	6.48	5.89	12.16	13.77	12.96	22.49	31.81	27.15
General Average		5.62	7.14	6.38	12.16	14.22	13.19	23.41	33.24	28.33
Average of	Camel	6.26	7.81	7.03	13.28	15.58	14.43	25.90	37.69	31.79
	Sheep	6.35	8.98	7.66	13.49	16.72	15.11	26.31	40.74	33.52
Sources	Chicken	5.68	7.41	6.54	12.06	14.74	13.40	23.53	35.66	29.59
	Control	4.20	4.38	4.29	9.81	9.84	9.83	17.93	18.89	18.41
LSD at 5%										
Season (A)			0.13			0.15			0.52	
Cultivars (B)			0.15			0.25			0.73	
A x B			0.17			0.32			0.90	
Manures (C)			0.15			0.11			0.42	
A X B			0.16			0.13			0.65	
B x C			0.16			0.13			0.65	
A x B x C			0.21			0.47			1.53	

Table 12: Effect of some organic manures on some flowering characteristics of four olive cultivars (2007/08 and 2008/09)

Treatments		Av. No. of perfect flowers / inflorescence			Sex ratio %		
		Seasons			Seasons		
Cultivars	Manures	2007/08	2008/09	Av.	2007/08	2008/09	Av.
Endory	Camel	4.04	5.55	4.79	31.14	35.64	33.39
	Sheep	4.16	6.32	5.24	31.65	36.34	34.00
	Chicken	3.51	5.16	4.33	30.73	35.26	32.99
	Control	2.29	2.35	2.32	25.38	25.40	25.39
	Average	3.50	4.84	4.17	29.72	33.16	31.44
Frantoyo	Camel	4.91	5.81	5.36	37.59	38.14	37.86
	Sheep	5.33	6.57	5.95	40.44	40.85	40.64
	Chicken	4.25	5.17	4.71	35.56	35.77	35.67
	Control	2.86	2.91	2.88	33.21	33.29	33.25
	Average	4.33	5.11	4.72	36.70	37.01	36.86
Shemlaly	Camel	5.92	10.77	8.34	42.71	63.50	53.11
	Sheep	6.75	11.66	9.20	46.42	67.98	57.20
	Chicken	5.31	9.51	7.41	40.87	60.15	50.51
	Control	4.51	4.49	4.50	40.01	40.12	40.07
	Average	5.62	9.11	7.36	42.50	57.94	50.22
Zafaraney	Camel	3.19	3.81	3.50	24.07	26.14	25.11
	Sheep	3.54	4.94	4.24	26.98	30.38	28.68
	Chicken	2.77	3.50	3.13	23.25	24.84	24.05
	Control	2.39	2.33	2.36	23.04	22.93	22.98
	Average	2.97	3.64	3.30	24.34	26.07	25.21
General Average		4.11	5.67	4.89	33.32	38.54	35.93
Average of	Camel	4.51	6.49	5.50	33.87	40.85	37.36
	Sheep	4.94	7.37	6.16	36.37	43.89	40.13
Sources	Chicken	3.96	5.84	4.90	32.60	39.01	35.81
	Control	3.01	3.02	3.01	30.41	30.43	30.42
LSD at 5 %							
Season (A)			0.13			0.45	
Cultivars (B)			0.19			0.64	
A x B			0.20			0.77	
Manures (C)			0.15			0.48	
A X B			0.17			0.53	
B x C			0.17			0.53	
A x B x C			0.34			0.84	

respect compared to other cultivars under study. Concerning the organic manure sources, sheep manure recorded the highest values in this respect, followed in a descending order by camel manure, chicken manure and control treatment. Also, Fertilizing Shemlaly olive trees with sheep manure gave the highest values in the second season compared to other olive cultivars with or without camel or chicken manure applications in both seasons. These results are in agreement with these reported by Maksoud [10] and Hegazi *et al.* [11].

Several studies indicated that environmental factors during Winter have a role in flower induction and subsequent initiation [31-34]. The improvement in flowering, resulted by organic fertilization, may be attributed to the stimulation effect of the absorbed nutrients on photosynthesis process which certainly reflected positively on the flowering characteristics [35]. Also, the slow release nutrients resulting from the biodegradation of manure by soil microorganisms could explain the present results [36]. However, the enhancement of flowering characteristics could be attributed to the capability of soil microorganisms to produce growth regulators such as auxins, cytokinins and gibberellins which had a positive effect on flowering process and nutrients uptake [37].

Fruit Set and Yield: As shown in Table 13, data indicated that initial and final fruit set and yield were significantly affected by different olive cultivars and organic manures in both seasons. Shemlaly olive cultivar recorded the highest fruit set and yield followed by Frantoyo, Endory and Zafaranev cultivars, respectively. Also, sheep manure supplementation gave the best results followed by camel and chicken manures with the four studied cultivars. Moreover, Shemlaly olive trees treated with sheep manure recorded the highest results in the second season compared to other cultivars with or without other organic manures under study.

These results are in agreement with Abou El-Khashab *et al.* [9] and Hegazi *et al.* [11]. They found that the cultivar which had a higher number of fruit set and yield was also having a high sex expression ratio. Also, organic fertilization maintained adequate mineral contents in leaves during growth cycles of the olive trees for having economical yield; it also increased fruit set percentage and reduced fruit dropping waves.

Also, these results agree with previous studies on olive cultivars by Hartmann [38], who reported that there was a direct correlation between the percentage of perfect flowers and fruit setting. He found also that fruit set and yield differed from season to other.

Fruit Quality

Fruit Physical Characteristics: It is clearly noticed that fruit weight, flesh weight, volume, length and diameter of fruit were significantly increased continuously during the growing seasons affecting by cultivars and treatments (Tables 14 and 15). From the obtained results, higher values were recorded in Zafaranev olive cultivar compared to other cultivars under study. On the other hand Endory olive trees had the lowest average in both seasons and the other studied cultivars were in between. Moreover, chicken manure gave the highest level of all physical parameters except L/D ratio followed by sheep, camel manures and control trees. In other words, fruits of higher values were oblong shape, whereas those of lower shape index values appeared to be round shape.

Concerning interaction between seasons, cultivars and organic manures, Zafaranev olive trees treated with chicken manures in the second season recorded the higher fruit physical values, except fruit diameter, than other interactions in this respect.

These observations are in accordance with those obtained by Hegazi *et al.* [11]. They observed that poultry manures proved to be the most efficient manures sources in enhancing fruit physical properties of olive trees. Also, considering the differences between the studied cultivars, it may be concluded that olive cultivar of higher fruit weight had a higher flesh weight. These results are also in agreement with that obtained by Maksoud [10]. He reported that olive cultivars varied greatly in their flesh weight among cultivars affected by organic fertilization. He added that the higher percentage in this respect were valuable economically. Also, Hartmann and Whisler [33] mentioned that olive cultivars varied in their flesh/pith ratio which is an important index in determining fruit quality.

Chemical Fruit Characteristics

Flesh Oil, Total Carbohydrates (%) and Moisture (%): The concentration of flesh oil, total carbohydrates (%) and moisture (%) content were significantly affected by cultivars, treatments during the two seasons as shown in Table 16. Higher percentages of oil and carbohydrates as flesh dry weight were noticed in the second season in comparison with the first one. This is true for the four studied olive cultivars. In addition, the studied olive cultivars differed in their fruit oil content. Frantoyo fruits had the highest oil percentage followed by Shemlaly, Endory and Zafaranev cultivars, respectively. Meanwhile, fruit oil percentage was significantly affected by different manures application in both seasons. The highest fruit oil percentage was obtained by sheep manures in comparison with camel and chicken manures.

Table 13: Effect of some organic manures on fruit set and yield of four olive cultivars (2007/08 and 2008/09)

		Initial fruit set %			Final fruit set %			Yield (Kg/tree)		
Treatments		Seasons			Seasons			Seasons		
Cultivars	Manures	2007/08	2008/09	Av.	2007/08	2008/09	Av.	2007/08	2008/09	Av.
Endory	Camel	15.30	17.61	16.46	4.03	4.66	4.35	30.33	40.08	35.21
	Sheep	15.63	17.93	16.78	4.12	4.75	4.44	35.66	42.86	39.26
	Chicken	15.18	17.55	16.37	4.00	4.59	4.29	29.42	36.18	32.80
	Control	12.53	12.71	12.62	3.30	3.36	3.33	27.61	27.51	27.56
	Average	14.66	16.45	15.56	3.86	4.34	4.10	30.76	36.66	33.71
Frantoyo	Camel	18.56	18.97	18.77	5.55	5.67	5.61	41.65	43.73	42.69
	Sheep	19.97	20.34	20.15	5.95	6.08	6.02	44.25	48.32	46.29
	Chicken	17.66	17.75	17.70	5.26	5.33	5.30	35.11	40.81	37.97
	Control	16.43	16.47	16.45	4.89	4.93	4.91	31.06	31.15	31.11
	Average	18.16	18.38	18.27	5.41	5.50	5.46	38.02	41.00	39.51
Shemlaly	Camel	21.09	30.55	25.82	6.76	7.57	7.17	61.26	73.33	67.30
	Sheep	22.85	33.78	28.32	7.33	7.80	7.56	66.15	81.21	73.68
	Chicken	20.53	29.89	25.21	6.59	6.83	6.71	55.61	67.92	61.77
	Control	19.76	19.97	19.87	6.34	6.25	6.30	53.68	50.16	51.92
	Average	21.06	28.54	24.80	6.76	7.11	6.94	59.18	68.16	63.67
Zafaraney	Camel	11.89	12.93	12.41	3.53	3.86	3.70	20.35	25.52	22.94
	Sheep	13.42	15.08	14.25	3.98	4.25	4.12	23.48	27.36	25.42
	Chicken	11.57	12.32	11.94	3.44	3.63	3.54	19.61	24.33	21.97
	With out	11.40	11.37	11.38	3.35	3.39	3.37	18.62	17.20	17.91
	Average	12.07	12.93	12.50	3.58	3.78	3.68	20.52	23.60	22.06
General Average		16.49	19.08	17.78	4.90	5.18	5.04	37.12	42.35	39.73
Average of Manure Sources	Camel	16.71	20.02	18.36	4.97	5.44	5.20	38.40	45.67	42.03
	Sheep	17.96	21.78	19.87	5.35	5.72	5.54	42.38	49.93	46.16
	Chicken	16.24	19.38	17.81	4.82	5.09	4.96	34.94	42.31	38.63
	Control	15.03	15.13	15.08	4.47	4.48	4.48	32.74	31.51	32.13
LSD at 5%										
Season (A)			0.10		0.12			2.52		
Cultivars (B)			0.13		0.14			2.81		
A x B			0.37		0.15			2.93		
Manures (C)			0.11		0.14			2.21		
A X B			0.32		0.16			2.89		
B x C			0.32		0.16			2.89		
A x B x C			0.43		0.19			3.04		

Table 14: Effect of some organic manures on some physical fruit characteristics of four olive cultivars (2007/08 and 2008/09)

		Fruit length (cm)			Fruit diameter (cm)			Fruit shape index L/D ratio		
Treatments		Seasons			Seasons			Seasons		
Cultivars	Manures	2007/08	2008/09	Av.	2007/08	2008/09	Av.	2007/08	2008/09	Av.
Endory	Camel	1.603	1.733	1.668	0.919	1.003	0.961	1.744	1.885	1.815
	Sheep	1.666	1.795	1.731	0.933	1.055	0.994	1.785	1.701	1.743
	Chicken	1.692	1.831	1.762	0.952	1.131	1.042	1.777	1.618	1.698
	Control	1.512	1.516	1.514	0.888	0.866	0.877	1.702	1.750	1.726
	Average	1.618	1.719	1.669	0.923	1.014	0.968	1.752	1.739	1.745
Frantoyo	Camel	1.875	2.155	2.015	1.127	1.193	1.160	1.663	1.806	1.735
	Sheep	1.915	2.184	2.049	1.133	1.211	1.172	1.690	1.803	1.747
	Chicken	1.932	2.225	2.079	1.188	1.232	1.210	1.626	1.806	1.716
	Control	1.851	1.808	1.829	1.115	1.106	1.110	1.660	1.634	1.647
	Average	1.893	2.093	1.993	1.141	1.186	1.163	1.659	1.762	1.711

Table 14: Continued

Shemlaly	Camel	1.682	1.933	1.807	1.306	1.405	1.356	1.287	1.375	1.331
	Sheep	1.735	1.952	1.844	1.385	1.418	1.402	1.252	1.376	1.314
	Chicken	1.832	2.001	1.917	1.410	1.520	1.465	1.299	1.316	1.308
	Control	1.635	1.655	1.645	1.119	1.123	1.121	1.461	1.473	1.467
Average		1.721	1.885	1.803	1.305	1.367	1.336	1.325	1.385	1.355
Zafaraneý	Camel	2.328	2.653	2.491	1.133	1.273	1.203	2.054	2.084	2.069
	Sheep	2.416	2.725	2.571	1.162	1.295	1.229	2.079	2.104	2.092
	Chicken	2.651	2.815	2.733	1.191	1.303	1.247	2.220	2.160	2.190
	Control	2.111	2.132	2.122	1.009	1.003	1.006	2.092	2.125	2.109
Average		2.377	2.581	2.479	1.124	1.219	1.171	2.111	2.118	2.115
General Average		1.902	2.069	1.986	1.123	1.197	1.159	1.712	1.752	1.732
Average of Manure Sources	Camel	1.872	2.119	1.995	1.121	1.219	1.170	1.687	1.788	1.738
	Sheep	1.933	2.164	2.048	1.153	1.245	1.199	1.702	1.746	1.724
	Chicken	2.026	2.218	2.122	1.185	1.296	1.241	1.731	1.725	1.728
	Control	1.777	1.777	1.777	1.033	1.025	1.029	1.729	1.745	1.737
LSD at 5%										
Season (A)			0.016			0.012			0.011	
Cultivars (B)			0.019			0.013			0.012	
A x B			0.041			0.015			0.015	
Manures (C)			0.022			0.009			0.012	
A X B			0.051			0.010			0.016	
B x C			0.051			0.010			0.016	
A x B x C			0.076			0.026			0.019	

Table 15: Effect of some organic manures on some physical fruit characteristics of four olive cultivars (2007/08 and 2008/09)

Treatments		Fruit weight (g)			Fruit volume (cm ³)			Flesh weight (g)		
		Seasons			Seasons			Seasons		
Cultivars	Manures	2007/08	2008/09	Av.	2007/08	2008/09	Av.	2007/08	2008/09	Av.
Endory	Camel	0.792	0.861	0.827	0.675	0.734	0.705	0.653	0.696	0.675
	Sheep	0.819	0.882	0.851	0.698	0.752	0.725	0.667	0.705	0.686
	Chicken	0.835	0.891	0.863	0.712	0.761	0.737	0.664	0.702	0.683
	Control	0.731	0.725	0.728	0.623	0.618	0.621	0.596	0.598	0.597
Average		0.794	0.841	0.817	0.677	0.716	0.697	0.645	0.675	0.660
Frantoyo	Camel	0.874	1.065	0.969	0.760	0.926	0.843	0.613	0.784	0.699
	Sheep	0.995	1.121	1.058	0.865	0.975	0.920	0.720	0.891	0.806
	Chicken	1.108	1.130	1.119	0.964	0.983	0.974	0.826	0.897	0.862
	Control	0.855	0.803	0.829	0.743	0.698	0.721	0.640	0.590	0.615
Average		0.958	1.029	0.994	0.833	0.895	0.864	0.699	0.791	0.744
Shemlaly	Camel	1.555	1.981	1.768	1.430	1.822	1.626	1.309	1.731	1.520
	Sheep	1.736	2.010	1.873	1.597	1.849	1.723	1.487	1.755	1.621
	Chicken	1.825	2.033	1.929	1.679	1.870	1.764	1.574	1.758	1.666
	Control	1.445	1.491	1.468	1.329	1.371	1.350	1.202	1.251	1.227
Average		1.640	1.879	1.759	1.509	1.728	1.618	1.393	1.624	1.509
Zafaraneý	Camel	1.603	2.033	1.818	1.508	1.913	1.711	1.337	1.732	1.535
	Sheep	1.755	2.151	1.953	1.651	2.024	1.838	1.467	1.834	1.651
	Chicken	1.931	2.251	2.091	1.817	2.118	1.968	1.640	1.930	1.785
	Control	1.503	1.500	1.502	1.414	1.411	1.413	1.241	1.249	1.245
Average		1.698	1.984	1.841	1.597	1.866	1.732	1.421	1.686	1.554
General Average		1.273	1.433	1.353	1.154	1.301	1.227	1.039	1.194	1.116
Average of Manure Sources	Camel	1.205	1.485	1.345	1.093	1.348	1.221	0.978	1.236	1.107
	Sheep	1.326	1.541	1.434	1.202	1.400	1.301	1.085	1.296	1.191
	Chicken	1.425	1.576	1.500	1.293	1.433	1.363	1.176	1.322	1.249
	Control	1.134	1.129	1.132	1.027	1.024	1.026	0.919	0.922	0.921
LSD at 5%										
Season (A)			0.023			0.033			0.022	
Cultivars (B)			0.025			0.036			0.031	
A x B			0.037			0.042			0.042	
Manures (C)			0.026			0.030			0.030	
A X B			0.038			0.046			0.051	
B x C			0.038			0.046			0.051	
A x B x C			0.055			0.058			0.062	

Table 16: Effect of some organic manures on dry flesh chemical contents of four olive cultivars (2007/08 and 2008/09)

		Total carbohydrates %			Oil percentage %			Moisture percentage %		
Treatments		Seasons			Seasons			Seasons		
Cultivars	Manures	2007/08	2008/09	Av.	2007/08	2008/09	Av.	2007/08	2008/09	Av.
Endory	Camel	12.51	14.32	13.42	32.61	34.88	33.75	69.12	53.83	61.47
	Sheep	12.72	14.60	13.66	33.26	35.56	34.41	70.66	55.45	63.05
	Chicken	12.35	14.17	13.26	32.98	33.31	33.15	73.61	58.81	65.91
	Control	10.20	10.21	10.20	32.37	32.45	32.41	52.38	52.35	52.36
	Average	11.95	13.33	12.64	32.81	34.05	33.43	57.25	54.87	56.06
Frantoyo	Camel	15.11	15.33	15.22	54.52	58.98	56.75	50.15	49.44	49.79
	Sheep	16.25	16.42	16.33	55.61	60.61	58.11	51.20	49.61	50.40
	Chicken	14.29	14.37	14.33	53.41	56.26	54.88	51.46	49.93	50.69
	Control	13.35	13.40	13.37	53.43	53.45	53.44	49.25	49.18	49.21
	Average	14.75	14.88	14.81	54.26	57.32	55.79	50.51	49.54	50.02
Shemlaly	Camel	17.16	23.52	20.34	41.21	34.58	42.39	56.36	54.81	55.58
	Sheep	18.66	24.32	21.49	41.65	34.81	42.73	58.55	54.89	56.72
	Chicken	16.42	21.18	18.80	40.83	42.27	41.55	59.67	55.42	57.54
	Control	16.08	16.12	16.10	40.25	40.41	40.33	54.41	54.36	54.38
	Average	17.08	21.28	19.18	40.98	42.51	41.75	57.25	54.87	56.06
Zafarany	Camel	9.67	10.50	10.09	23.95	26.61	25.28	66.33	60.06	63.19
	Sheep	10.84	12.21	11.53	24.13	27.52	25.83	67.21	62.35	64.78
	Chicken	9.34	10.00	9.67	23.93	24.82	24.37	69.95	66.28	68.12
	Control	9.22	9.25	9.24	23.91	23.66	23.78	56.17	55.36	55.76
	Average	9.77	10.49	10.13	23.98	25.65	24.81	64.91	61.01	62.96
General Average		13.39	14.99	14.19	38.00	39.88	38.94	59.77	55.09	57.43
Average of Manure Sources	Camel	13.61	15.91	14.76	38.07	41.01	39.54	60.49	54.53	57.75
	Sheep	14.62	16.89	15.75	38.66	41.87	40.27	61.90	55.57	58.75
	Chicken	13.10	14.93	14.02	37.78	40.25	38.48	63.69	57.46	60.57
	Control	12.21	11.25	12.23	37.49	37.48	37.49	53.02	52.81	52.93
LSD at 5%										
Season (A)			1.25			0.27			1.28	
Cultivars (B)			1.32			0.31			1.35	
A x B			1.44			0.46			1.47	
Manures (C)			1.31			0.43			1.22	
A X B			1.45			0.56			1.41	
B x C			1.45			0.56			1.41	
A x B x C			1.85			1.98			1.52	

Table 17: Effect of some organic manures on some oil chemical properties of four olive cultivars (2007/08 and 2008/09)

		Oil acidity (%)			Peroxide value (mg/ kg oil)			Iodine value		
Treatments		Seasons			Seasons			Seasons		
Cultivars	Manures	2007/08	2008/09	Av.	2007/08	2008/09	Av.	2007/08	2008/09	Av.
Endory	Camel	1.553	1.852	1.703	8.15	8.32	8.23	83.57	85.62	84.59
	Sheep	1.341	1.413	1.377	8.23	8.25	8.24	82.43	82.93	82.68
	Chicken	1.490	1.655	1.572	10.61	11.33	10.97	83.15	83.36	83.25
	Control	1.212	1.226	1.219	7.35	8.35	7.85	82.32	82.23	82.28
	Average	1.399	1.536	1.467	8.58	9.06	8.82	82.87	83.53	83.20
Frantoyo	Camel	1.381	1.903	1.642	8.31	9.42	8.86	83.56	85.83	84.69
	Sheep	0.964	1.653	1.309	8.56	8.25	8.40	81.42	82.62	82.02
	Chicken	1.152	1.731	1.442	8.63	9.48	9.05	82.73	83.25	82.99
	Control	0.955	0.926	0.941	7.35	7.27	7.31	81.12	81.39	81.25
	Average	1.113	1.553	1.333	8.21	8.60	8.40	82.21	83.27	82.74

Table 17: Continued

Shemlaly	Camel	1.628	1.931	1.779	8.58	9.66	9.12	84.52	85.37	84.95
	Sheep	1.291	1.354	1.322	8.24	8.81	8.52	81.61	83.43	82.52
	Chicken	1.339	1.631	1.485	9.92	10.63	10.27	82.36	84.55	83.46
	Control	1.233	1.214	1.224	7.24	7.51	7.37	82.73	82.33	82.53
	Average	1.373	1.533	1.453	8.49	9.15	8.82	82.81	83.92	83.37
Zafaraney	Camel	1.233	1.656	1.445	9.22	10.17	9.69	83.68	84.62	84.15
	Sheep	1.054	1.229	1.142	9.16	9.31	9.23	81.54	82.46	82.00
	Chicken	1.165	1.391	1.278	10.35	11.25	10.80	82.37	82.29	82.33
	Control	0.953	0.909	0.931	8.07	8.11	8.09	81.35	81.33	81.34
	Average	1.101	1.296	1.199	9.20	9.71	9.45	82.23	82.68	82.46
General Average		1.246	1.479	1.363	8.62	9.13	8.87	82.53	83.35	82.94
Average of		1.448	1.835	1.642	8.56	9.39	8.97	83.83	85.36	84.59
Manure	Sheep	1.163	1.412	1.287	8.54	8.65	8.59	81.75	82.86	82.30
Sources	Chicken	1.287	1.602	1.444	9.87	10.67	10.27	82.65	83.36	83.00
	Control	1.088	1.088	1.088	7.50	7.81	7.65	81.88	81.82	81.85
LSD at 5%										
Season (A)			N.S			0.22			0.12	
Cultivars (B)			N.S			0.54			0.14	
A x B			N.S			0.62			0.15	
Manures (C)			N.S			0.55			0.14	
A X B			N.S			0.71			0.16	
B x C			N.S			0.71			0.16	
A x B x C			N.S			0.93			0.19	

Concerning the interaction between seasons, cultivars and manures, fertilizing Frantoyo olive cultivar with sheep manure gave the highest oil content of flesh dry weight in the second season compared to other interactions conducted in the study. On the other hand, the obtained results concerning fruit moisture content showed significant differences between the studied olive cultivars, it can be noticed that fruits which is known to be lower oil content had higher moisture content.

Theses results agree with Hegazi *et al.* [11], who found that total carbohydrates were significantly affected by different organic fertilization treatments. In addition, organic manures gave the highest total carbohydrates compared to mineral fertilization treatment on olive trees.

Also, these results are in agreement with Hassan [39], who found that moisture content of olive fruits varied according to cultivars and seasons. Fouad *et al.* [40] reported that moisture content varied considerably in the different olive cultivars and had a general average of 63.28 and 61.54%. It can be also noticed that fruit which is known to be lower oil content, had higher moisture content.

Oil Chemical Properties: Table 17 showed that, peroxide and iodine values were significantly affected by cultivars and organic manures during the two seasons. Zafaraney olive oil had the highest significant peroxide value in comparison with other olive cultivars. However, in both

seasons, the highest peroxide was observed with olive trees supplemented with chicken manures, followed by camel and sheep manures then olive tree without any manures application (control). Also, the highest iodine value was obtained from the olive trees treated with camel manure, followed by chicken, sheep manures and control.

Oil acidity was insignificantly affected by the tested treatments, whatever the camel manure treatment recorded the highest oil acidity value, followed by chicken, sheep manures and control treatment.

The present results are in agreement with those obtained by Hegazi *et al.* [11] who found that organic manure gave lower oil acidity value, peroxide index and iodine value compared with chemical fertilization in their study on olives. Also, Francisca *et al.* [12] reported that organic virgin oil was a superior quality as compared with the conventional virgin olive oil.

In conclusion: The positive effects of different organic manures used in improving the studied olive cultivars properties may be attributed to their high supply of nutrients and organic materials to olive trees. Also, it may be due to their efficiency in improving soil physical and chemical properties. Thus, this led to higher olive trees growth, nutrient content, C/N ratio, flowering characteristics, fruit set, yield, fruit properties and oil chemical properties. The highest vegetative growth and physical fruit properties of olive trees were obtained with chicken manure followed by sheep then camel manures.

Also, the highest yield, chemical fruit properties, fruit oil content and oil properties were obtained with sheep manure followed by camel then chicken manures.

REFERENCES

1. Fayed, T.A., 2005. Response of desert red peach trees to organic and some biofertilizers in comparison with chemical fertilizer. *Egypt. J. Appl. Sci.*, 20: 127-143.
2. Jianping, Z., 1999. Soil Erosion in Guizhou Province of China: a case study in Bijie prefecture. *Sil Use Mang.*, 15: 68-70.
3. Burke, T.H., 1984. Evaluating selecting soil morphological, classification, climatic and site variables that influence dry land small grain yield on Montana soils. M.Sc. Thesis. Montana State University, Bozeman, Montana, U.S.A.
4. Benton, J., 1985. Soil testing and plant analysis: guides to the fertilization of horticulture crops. *Hort. Rev.*, 7: 1- 68.
5. Steve, D., 2009. Sustainable farming compost tea. Cited in <http://www.soil soup.com>.
6. Abdel-Nasser, G. and M.M. Harash, 2001. Studies on some plant growing media for olive cultivation in sandy soils under Siwa oasis conditions. *J. Adv. Agric. Res.*, 6: 487-510.
7. El-Hady, O.A., A.H. Hanna and M.M. Kattab, 1991. Interaction of organic manures and bitumen emulsion on a sandy soil and the growth response on nutrient levels in the olive leaves. *Egypt. J. Soil Sci.*, 31: 65-88.
8. El-Kramany, M.F., M.K.A. Ahmed, A.A. Bahr and M.O. Kasber, 2000. Utilization of bio-fertilization in filed crop production. *Egypt. J. Appl. Sci.*, 15: 137-149.
9. Abou El-Khashab, A.M., S.A. Abou Taleb and T.S. Wafaa, 2005. Agezi and Koroneki olive trees as affected by organic and bio-fertilizers, calcium citrate and potassium. *Arab Univ. J. Agric. Sci.*, Ain shams Univ., 13: 419-440.
10. Maksoud, M.M., 2000. Response of growth and flowering of Manzanillo olive trees to different sorts of nutrients. *Egypt. J. Hort.*, 27: 513-523.
11. Hegazi, E.S., M.R. El-Sonbaty, M.A. Eissa, T.F.A. El-Sharony, 2007. Effect of organic and bio-fertilization on vegetative and flowering of Picual olive trees. *World J. Agric. Sci.*, 3: 210-217.
12. Francisca, G., T. Arnaud and M.M. Albi, 1999. Influences of ecological cultivation on virgin oil quality. *J. A.O.C.S.*, 76: 617-621.
13. Lavee, S. and M. Wonder, 1991. Factors affecting the manure of oil accumulation in fruit of olive cultivars. *J. Hort. Sci.*, 66: 583-591.
14. Lopez-Granados, F., M. Jurado-Exposito, S. Alamo and L. Garica-Torres, 2004. Leaf nutrients spatial variability and site-specific fertilization maps within olive (*olea europaea* L.) orchard. *Europ. J. Agronomy*, 21: 209-222.
15. Pregel, F., 1945. Quantitative Organic Microanalysis. 4th Ed. J. A. Churchill. Ltd., London, pp: 53.
16. Chapman, H.D. and P.E. Pratt, 1961. Methods of analysis for soil, plant and water. Davis Agric. Sci., Aric Pull Office, Calif. Univ., pp: 220-308.
17. Brown, J.D. and O. Lilleland, 1946. Rapid determination of potassium. *Proc. Amer. Soc. Hort. Sci.*, 48: 341-346.
18. Jackson, M.L., 1973. Soil Chemicals Analysis. Prentice-Hall, Inc., India, pp: 233.
19. Wettstien, V.D., 1957. Chlorophyll lethal unjjer sub mink rosk pische for minvechoel jer plastijen. *Exp. Cell Res.*, 12: 427-433.
20. A.O.A.C., 1995. Official Methods of Analysis. A.O.A.C. 14th Ed., Benjamin Franklin Station Washington DC, U.S.A., pp: 494-510.
21. Fernandez, E.R. and G.V. Gomez, 1985. Cross pollination in Gordal Sevillano olive. *Hort. Sci.*, 202: 191-192.
22. Snedecor, G.W. and W.G. Cochran, 1980. Statistical Methods. Oxford and J.B.H. Publishing Com. 7th Edition.
23. Steel, R.G.D. and J.H. Torrie, 1980. Reproduced from principles and procedures of statistics. Printed with the Permission of C.I. Blss, pp: 448-449.
24. Bevacqua, R.F. and V.J. Mellano, 1993. Sewage sludge compost accumulative effects on crop growth and soil properties. *Compost Sci. Util.*, 1: 34-37.
25. El-Morshedy, F.A., 1997. Organic manure and sulpher interaction influence vegetative growth and element concentration of sour orange seedlings. *J. Agric. Sci.*, Mansoura Univ., 22: 4599-4614.
26. Helail, B.M., Y.N. Gobran and M.H. Moustafa, 2003. Study on the effect of organic manure source, method of organic manure application and bio-fertilizers on 1- tree growth and leaf mineral content of Washington navel orange trees. *Egypt. J. Appl. Sci.*, 18: 297-320.
27. Kotez, W.A.G. and M. Joubert, 1992. Effect of different organic materials for soil improvement, mulching and fertilization on the performance of apricot trees. *J. Southern African Society for Hort. Sci.*, 2: 31-35.

28. Alexander, M., 1977. Introduction to soil microbiology. 2nd Ed., John Wiley and Sons. Inc., New York, pp: 467.
29. Hall, D.O. and K.K. Rao, 1996. Photosynthesis, 4th Ed. Cambridge Univ. Press, England, pp: 65-73.
30. Mohammed, S.M., T.A. Fayed, A.F. Esmail and N.A. Abdou, 2010. Growth, nutrient status and yield of Le-Conte pear trees as influenced by some organic and biofertilizer rates compared with chemical fertilizer. Bull. Fac. Agric. Cairo Univ., 61: 17-32.
31. Hackett, W.P. and H.T. Hartmann, 1967. The influence of temperature on floral initiation in the olive. Plant Physiol., 20: 430-436.
32. Badr, S.A. and H.T. Hartmann, 1971. Effect of diurnal fluctuating vs. constant temperatures on flower induction and sex expression in the olive. plant Physiol., 24: 40-45.
33. Hartmann, H.T. and J.E. Whisler, 1975. Flower production in olive as influenced by various chilling temperature regions. J. Amer. Soc. Hort. Sci., 100: 670-674.
34. Fernandez-Escobar, R., M. Benlloch, C. Navarro and G.C. Martin, 1992. The time of floral induction in olive. J. Amer. Soc. Hort. Sci., 117: 304 - 307.
35. Bhangoo, M.S., K.S. Day, V.R. Sualanagunta and V.E. Petrucet, 1988. Application of poultry manure influence on Thompson seedless grape production and soil properties. Hortscience, 23: 1010-1012.
36. Cole, C.V., J. Williams, M. Shaffer and J. Hanson, 1987. Nutrients and organic matters as components of agricultural production system models. SSSA Spec. Madison, WI, 19: 147-166.
37. Martin, P., A. Galatzly, W. Klob, H. Omayand and W. Shmidit, 1989. Nitrogen fixing bacteria in the rhizosphere quantification and hormonal effects on root development. Z. Pflanzenernahr Bodenk., 152: 237-245.
38. Hartmann, H.T., 1953. Effect of Winter chilling on fruit fullness and vegetative growth in the olive. Proc. Amer. Soc. Hort. Sci., 62: 184-190.
39. Hassan, L.H., 1980. Evaluation of some olive varieties in middle Egypt. M.Sc. Thesis, Fac. Agric., Al-Azhar Univ., Egypt.
40. Fouad, M.M., O.A. and M.E. El-Said, 1992. Comparative studies on flowering, fruit set and yield of some olive cultivars under Giza conditions. Egypt. J. Appl. Sci., 7: 630-644.