

# **4- RESULTS and DISCUSSION**

Part I: Experiment I: Effect of organic manure source, method of organic manure application and biofertilizers on tree growth, leaf mineral content, tree fruiting and fruit quality of Balady mandarin.

### 4.1. Tree growth

The effect of organic manure sources namely cattle, poultry and sheep, method of organic manure application *i.e.* surface and trench and biofertilization namely Rhizobacterien and Nitrobien as well as their combination on tree growth of Balady mandarin trees during 2000 and 2001 seasons expressed as growth cycles (duration and intensity), increase in shoot length during different growth cycles, increase in number of leaves in each growth cycle and some leaf parameters *i.e.* surface area, leaf shape index, leaf chlorophyll (a) & (b) and leaf dry weight is presented in **Tables (5-27)**.

# 4.1.1. Growth cycles duration

Data reported in **Tables** (5 & 6) show the effect of organic manure source, method of organic manure application and biofertilization as well as their interactions on the growth cycles of Balady mandarin trees during 2000 and 2001 seasons.

Generally, under conditions of Kalubia Governorate, growth of Balady mandarin trees commenced on March, 15<sup>th</sup> and March, 6<sup>th</sup> in 2000 and 2001 seasons, respectively.

Furthermore, tree growth occurred in four distinctive and consecutive cycles i.e. one in spring, two during summer and

Table (5): Effect of organic manure source.

(	Application { N-fixing cycle c		Spring growth	owth		ă 7	Summer growth cycle	growth c	усіе		Þ	Ħ	Autumn growth
source m	method bacteria)	0	сусте			1 <sup>st</sup> cycle	ycle		2 <sup>nd</sup> cycle	cle	1	2	
		Į C	End	Duration (days)	Beg.	End		Beg.	End	Duration	Beg.	End	-
7	Surface-> Nitrobien	15/3	2/5	49 b	25/6	21/7	(udys)			(days)			
Ψ	Rhizobacterien	15/3	2/5	49 5	2/2/2	5 7	2/6	1/8	16/8	16 b	15/9	8/10	
manure	/	15/3	O In		0/07	7117	27 b	1/8	16/8	16 b	17/9	8/10	
Irer	Irench →	Ç	0/7	49 b	25/6	28/7	34 a	1/8	16/0	)		0	
	Knizobacterien	15/3	2/5	49 b	25/6	28/7	ω . Α	1 6	10/0	0	17/9	8/10	
•	Surface-> Nitrobien	15/3	6/5	53 a	25/6	21/7	27 5	5 0	16/8	16 b	12/9	8/10	27 a
manure	Rhizobacterien	15/3	6/5	53 a	25/6	21/7	275	òòò	16/8	16 b	17/9	8/10	24 c
Trench →	nch → Nitrobien	15/3	2/5	49 b	18/6	217	) (	5 0	16/8	60	17/9	11/10	24 c
		15/3	2/5	49 b	18/6	21/7	0 0 0 0	òòò	19/8	20 a	17/9	8/10	24 c
Sheen Surface	W	15/3	2/5	49 b	25/6	21/7	27 6	1/0	8/61	20 a	15/9	8/10	23 d
→ →	terien	15/3	2/5	49 b	18/6	21/6	) C	òòò	16/8	16 b	17/9	8/10	24 c
Trench	Nitrobien	15/3	2/5	49 b	18/6	21/7	) 0 7 1	òòò	16/8	100 0	15/9	11/10	25 b
	Rhizobacterien	15/3	2/5	49 5	3/8		a 0 (	-/α	19/8	20 a	15/9	8/10	24 c
alls within each	Tically Within each collimp followed by	de de	*******			1111	120	1/8	19/8	20 a 1	15/9	8/10	2

Table (6): Effect of organic manure source, method of application and biofertilization on growth eycles of Balady mandarin

01000		Diofortilizor	Sp	Spring growth	wth		S	Summer growth cycle	owth cyc	<u>a</u>		An	Autumii giowai		
Organic		פוסופו מווידק	7	م مرد			1st cycle	<b>a</b> .		2 <sup>nd</sup> cycle	a)		cycle		growth
manure ⊅	Application	fulxII-N }		2000	C.	20	Fnd	Duration	Beg.	End	Duration	Beg.	End	Duration	(days)
source	method	bacteria}	Beg.	Ena	Dalation	j	i i	(2/5/)	Ē		(days)			(days)	
					(days)	C. C.	77	(26 h)	3177	18/8	19 b	6/2	2/10	26 b	117 f
		►Nitrobien	6/3	23/4	4/ C	20/0	- ! - (	) (	7110	18/8	9	6/2	2/10	26 b	124
Cattle	Surface	Rhizobacterien	6/3	23/4	47 c	20/6	7/1/2	32 a	20	5	2 .		0170	37 3	130 d
1		4014004	6/3	23/4	47 c	13/6	14/7	32 a	31/7	18/8	19 b	20	017	, or	9 (
manure 🕨	Trench →	- NICLODICII	5 6	NEC	17 C	13/6	14/7	32 a	31/7	18/8	19 b	1/9	2/10	32 a	130 a
		Rhizobacterien	5/0	100	ν τ Σ	13/6	14/7	32 a	31/7	18/8	19 b	6//	2/10	26 b	133 c
70	Surface		6/3	3074	, n	9/00	14/7	32 8	31/7	18/8	19 b	6/1	2/10	26 b	133 c
Poultry		▼Rhizobacterien	6/3	4/05	2 .	0 0	. [		317	22/8	23 a	1/9	2/10	32 a	141
manure	→ Nitrobien	→ Nitrobien	6/3	2/2	54 b	13/6	//4/	22	2 0	) (		0/1	2/10	32 a	141
	Trench →	Rhizobacterien	6/3	30/4	54 b	13/6	14/7	32 a	31//	8/77		2 1	1 0	ן ני	124
			70	23/4	47 c	20/6	14/7	32 a	31/7	18/8	19 b	6//	01/2	0 07	7
9	Surface→		2 0	7760		13/6	14/7	32 a	31/7	18/8	19 b	6/2	2/10	26 b	136
Sheep	•11	Rhizobacterien	5/0	1000	2 4	13/6	14/7	32 a	31/7	22/8	23 a	1/9	2/10	21 a	141
manure	. Trench →	Trench → Trenchion	6/3	30/4	54 b	13/6	14/7	32 a	31/7	22/8	23 a	1/9	2/10	32 a	141

in autumn. The spring growth cycle of poultry manured one trees fertilized superficially and inoculated with Rhizobacterien and Nitrobien started on March, 15th and continued till May, 6th the first seasons about (53 days duration), followed descendingly by poultry manured trees applied in surface and trenches and inoculated with Rhizobacterien and Nitrobien started on March, 6th and continued till April, 30th and May, 5th in the second season, about 54 days duration. On the other hand, cattle and sheep manured trees, fertilized superficially and in trenches and inoculated with Rhizobacterien commenced spring growth cycle on March, 15th and continued till May,2nd in 2000 (about 49 days duration). Cattle manured trees, fertilized superficially or in trenches and inoculated with Rhizobacterien and Nitrobien commenced spring growth cycle on March, 6th, and continued till April 23rd in 2001 season (about 47 days duration). Besides, sheep manured trees, fertilized superficially or in trenches and inoculated with Rhizobacterien and Nitrobien commenced spring growth cycle on March, 15th and continued till May, 2<sup>nd</sup> in the second season, followed descendingly by sheep manure x superficial application x Rhizobacterien and manure x trench application x (Rhizobacterien or Nitrobien ) which commenced spring growth cycle on March, 6th and continued till April, 23rd, April, 30th about 59 and 54 days duration respectively.

On the other hand, the new growth of the first summer growth cycle of poultry manure applied in trenches provided with Rhizobacterien and Nitrobien, followed descendingly by sheep manure x trenches inoculated with Rhizobacterien or

Nitrobien and sheep manure x surface application supplemented with Rhizobacterien peeped out on June, 18<sup>th</sup> and ceased on July, 21<sup>st</sup> in the first seasons (about 34 days duration). On the contrary, cattle manured trees applied in superficially or in trenches inoculated with Rhizobacterien or Nitrobien peeped out on June, 25<sup>th</sup> and ceased on July, 21<sup>st</sup> or July, 28<sup>th</sup> in the second season (about 27or 28 days duration), respectively.

Moreover, the growth of the first summer in the second season cycle began on June, 13<sup>th</sup> for those trees fertilized with poultry manure applied in trenches and /or sheep manure applied in trenches and enriched with Rhizobacterien and ceased on July, 14<sup>th</sup>, about 32 and 32 days duration, respectively.

Moreover, the growth of the second summer cycle began on August, 1<sup>st</sup> and July, 31<sup>st</sup> for those trees fertilized with poultry manure applied in trenches and provided with Rhizobacterien and ceased on August, 19<sup>th</sup> and August, 22<sup>nd</sup> with duration of about 20 and 23 days for the first and second seasons, respectively. On the contrary, cattle manured trees, fertilized with superficially and inoculated with Nitrobien recorded the shortest duration for the second summer growth cycle (16 and 19 days) in 2000 and 2001 seasons, respectively.

The growth of autumn cycle of poultry manured trees, fertilized in trenches and inoculated with Rhizobacterien began on September, 15<sup>th</sup> and September, 1<sup>st</sup> and ceased on October, 8<sup>th</sup> and October, 2<sup>nd</sup> with duration of about 24 and 32 days for the first and second seasons, respectively. On the contrary, the shortest autumn growth cycle duration was shown on cattle manured trees, fertilized superficially and inoculated with Nitrobien (about 24 and 26 days) in the first and second seasons, respectively. Other tested interactions showed comparatively

inbetween values regarding autumn growth cycle duration (24 – 26 days).

In summary, poultry manure applied in trenches and supported with Rhizobacterien prolonged the annual growth cycle (127 and 141 days), followed descendingly by poultry manured trees, fertilized in trenches and inoculated with Nitrobien (126 and 141 days) in the first and second seasons, respectively. On the contrary, cattle manured trees, fertilized superficially and inoculated with Nitrobien recorded the shortest annual growth (116 and 117 days) in the first and second seasons, respectively. The other studied combinations scored similar values of annual growth cycle (127 – 141 days).

The obtained results of growth cycles of Balady mandarin trees in the present study go in line with the findings of **Helail** and **Awad** (1993) and **Moustafa** (2002). They mentioned that under conditions of Kalubia Governorate, growth of Washington navel orange trees commenced on January, 31<sup>st</sup> and 29<sup>th</sup> and ceased on October, 25<sup>th</sup> and 21<sup>st</sup> in 1990 and 1991 seasons, respectively. They added that tree growth occurred in four distinctive cycles *i.e*, one in spring, two during summer and one in autumn.

### 4.1.2. Growth intensity (No. of shoots/branch)

The effect of organic manure source, method of organic manure application and biofertilization as well as their interaction on growth intensity (No. of shoots/branch) of growth cycles of Balady mandarin trees during 2000 and 2001 seasons is reported in **Tables (7-11)**.

It is quite clear from Table (7) that fertilizing Balady mandarin with poultry manure significantly increased growth intensity of spring growth cycle (30.1 shoots/branch), first summer growth cycle (15.9 shoots/branch), second summer growth cycle (12.9 shoots/branch) and autumn growth cycle (7.2 shoots/branch) with grand average (16.5 shoots/branch) against (24.5, 11.9, 8.6 and 5.2 shoots per branch for spring, first and second summer and autumn growth cycles of cattle manured trees, respectively, with grand average (12.5 shoots/branch). On the other hand, sheep manured trees scored 28.0, 13.9, 10.9 and 5.8 shoots/branch for spring, first and second summer growth respectively with grand cycles and autumn growth cycle, average (14.6 shoots/branch). However, differences between the three studied organic manure sources regarding No. of shoots/branch of different growth cycles were more obvious to reach the significance level at 5% level.

Furthermore, the application of organic manure in trenches surpassed the surface application regarding the number of produced shoots per branch of first and second summer and autumn growth cycles during 2000 and 2001 seasons (**Table, 7**).

In addition, it is obvious from **Table (7)** that biofertilizing Balady mandarin trees with Rhizobacterien significantly enhanced growth intensity of different growth cycles (second summer and autumn) as compared with the analogous ones inoculated with Nitrobien.

On the other hand, **Table (8)** demonstrates that fertilizing Balady mandarin trees with poultry manure firstly in trenches and secondly superficially induced the highest stimulative effect on growth intensity of spring, first and second summer and

**Table (7):** Specific effect of organic manure source, application method and biofertilization on number of shoots per branch of Balady mandarin trees(2000 and 2001 seasons).

					No.	No. of Shoots per branch	ts per	branch					
Factor	Sp	Spring growth	owth		Su	Summer growth cycle	rowth c	cycle		Aut	Autumn ar	rowth	Grand
					1 <sup>st</sup> cycle	е		2 <sup>nd</sup> cycle	е				Average
	(2000)	(2001)	Average	(2000)	(2001)	(2001) Average	(2000)		(2001) Average	(2000)	(2001)	Average	Č
					a E	a. Effect of organic manure source	rganic r	nanure	source				
Cattle manure	24.0 c	26 B c	245b	1136	124b	11 9 b	81c	90c	8 6 c	4.9.c	51 c	5.2 b	12.5 c
Poultry manure	28 6 a	31 6 a	30 1 a	153a	16 4 a	15 9 a	125a	13 3 a	12.9a	70a	ر س س	722	בל ה ה א
Sheep manure	26.5 b	295b	28 O a	133ab	14.4 ab	13.9 ab	10.5 b	11.46	109b	556	585	585	0)
				2	ь.	Effect of application method	applica	tion me	thod		9		
Surface	25.8 a	28 8 a	26 7 a	129a	14 0 a	13 4 a	985	107ь	1025	53 a	σ σ	546	1395
Trench	27 0 a	29 9 a	28 4 a	13 8 a	14 9 a	1438	109a	11 8 a	11 4 a	න ආ ධා	ත ආ බ	65a	152a
						c. Effect of biofertilization	of biofe	rtilizatio	ň				
Nitrobien	257 a	28 6 a	27 2 a	1298	14 0 a	13.5 a	80 80 90	107ь	103b	566	A 8 G	57b	142b
Rhizobacterien	27 0 a	30 0 a	27 9 a	13 7 a	4 8 9	142a	109a	1182	 သ စ	60a	ත යා ස	ත ය ෂ	14.9
Means within each column, followed by the same letter(s) are not significantly different at 50% level	olumn, fo	ollowed t	y the san	ne letter	(s) are r	not signifi	Cantly di	fferent :	1 50% love				

Table (8): Effect of interaction between organic manure source and application method on number of shoots per branch of Balady mandarin trees(2000 and 2001 seasons).

				1		No. of	No. of Shoots per branch	s per b	ranch					,
Organic #	Organic Application	Spi	Spring growth	owth		Sur	Summer growth cycle	owth c)	/cle		Autı	Autumn growth	owth	Grand
manure	method		Cycle			1st cycle	a	. 4	2nd cycle	е		cycle		Average
		(2000)	(2001)	(2001) Average (2000)		(2001)	(2001) Average (2000)	(2000)	(2001)	Average (2000)	(2000)	(2001)	Average	
•	Surface	23.25	26.2 c	22.9b	10.8 d	119d	11.4 d	7.61	8.5 f	8.1 f	45f	47f	4.5 f	11.7e
Cattle 🕂	▼ Trench	24.7 ab	27.4 bc	26.0 ab	11.8 cd	129 cd	12.4 od	8 9 6	95e	9 1 9	534	5.6 d	5.8 d	13.2d
•	◆ Surface	28.1 a	31.1 ab	29.6a	14 9 ab	16 0 ab	15.5 ab	11 85 b	12.7 b	12.36	685	7.0 b	9.9	16.1 ab
Poultry→	► Trench	29.2 a	32.2a	307a	15.7 a	168a	163a	132a	140a	13.6 a	73a	7.6a	7.4 a	17 0 a
	→ Surface	26.0 ab	29 0 abc	27 5 ab	12.9 bod	14 0 bod	13.4 bod	10.0d	10.9d	10,4 d	48e	5.0 e	4.9 e	14100
Sheep →	Trench	27 1 ab	31.1 abc	28.6 a	13.0 abc	13.0 abc 14.9 abc	14 3 abc	110c	1190	11.5 c	630	6.5 c	6.4 c	152bc
1	level (1978) and the followed by the same letter(s) are not significantly different at 5% level	follow.	4 74 70	al ames at	ttar(c) a	re not si	onificantly	v differe	nt at 5%	laval d				1

autumn growth cycles. On the contrary, cattle manured trees particularly those fertilized superficially exerted the lowest positive effect in this concern. Besides, sheep manured trees with the superiority to those trenchly fertilized occupied an intermediate position between the previously two mentioned categories. However, differences between all the tested combinations were significant in the side of poultry manure and trench application.

Moreover, Table (9) indicates that in both seasons, the application method in trenches provided by Rhizobacterien proved to be the most effective combinations in enhancing growth intensity of the second summer and autumn growth cycles. On the contrary, biofertilizing with Nitrobien when interacted with surface method of organic manure application gave comparatively the lowest values of growth intensity of the second summer and autumn growth cycles. However, significant differences were obvious between the different studied combinations.

Additionally, the interaction between organic manure source and biofertilization shows that in both seasons the highest values of growth intensity (number of shoots per branch) of spring, first and second summer and autumn growth cycles were shown in descending order with the studied combinations as follows: (poultry manure x Rhizobacterien), (poultry manure x Nitrobien), (sheep manure x Rhizobacterien), (sheep manure x Nitrobien), (cattle manure x Rhizobacterien) and (cattle manure x Nitrobien) (Table, 10).

Table (9): Effect of interaction between application method and biofertilization on number of shoots per branch of Balady mandarin trees(2000 and 2001 seasons).

						No.	No. of Shoots / branch	ts / bra	anch					
Method of	Riofertilizer	Spr	Spring growth	wth		Sur	Summer growth cycle	owth c	/cle		Aut	Autumn growth	owth	Grand
application			Cycle			1st cycle	е	.,	2nd cycle	Ф		cycle		Average
		(2000)	(2001)	Average	(2000)	(2001)	(2001) Average (2000)	(2000)	(2001)	Average	(2000)	(2001)	Average	
Confin	→ Nitrobien	25.0a	280a	26.5 a	125a	136a	130a	930	102c	98c	5.1 c	53d	52c	136€
oui lace	→ Rhizobacterien	26 6 a	29 6 a	269a	13.2a	143a	138a	10 3 b	1126	10 7 b	55c	58c	5613	14.3 bc
, 1	→ Nitrobien	26.5 a	29.2 a	27.8 a	13.4 a	14.5 a	139a	10 4 b	11.3b	10.8 b	615	636	626	14.7 b
l rencu	- Rhizobacterien	275a	30.5 a	29.0 a	14.2a	153a	147a	115a	123a	11 ga	65a	68a	69a	156a
Means with	Means within each column, followed by the same letter(s) are not significantly different at 5% level	ollowed	by the s	ame letter	(s) are	not signi	ficantly di	fferent	it 5% le	vel.				

**Table (10):** Effect of interaction between organic manure source and biofertilization on number of shoots per branch of Balady mandarin trees(2000 and 2001 seasons).

Biofertilizer Spring growth Summer growth cycle	Summer growth cycle	Autumn growth	rowth Grand
Cycle 1 <sup>st</sup> cycle 2 <sup>nd</sup> cycle	2 <sup>nd</sup> cvcle	Cycle	۰.
verage (2000)	(2000)	(2000) (2001)	Average
	- 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
	0.0	44C 46C	4.5 c 12 1
► Rhizobacterien 247 cd 277 cd 244 b 118 cd 129 cd 123 cd 87 d 96 d 91 d 53 b	96d	53b 56b	58b 128
1.000	12.85	69a 71a	71a 161
Rhizobacterien 294a 324a 3098a 157a 168a 162a 131a 139a 135a 72a	13 9 a	72a 75a	7.3 a 170
Nitrobien 261bcd 291bc 276ab 130bcd 141bcd 135bcd 101c 110c 105c 55b	11 0 c	55b 57b	56h 143
Rhizobacterien 270abc 300abc 285a 139abc 148abc 142abc 109bc 118bc 114bc 56b	1 850	n n n	475

Furthermore, the interaction between organic manure method of organic manure application and source, manured trees, biofertilization demonstrates that poultry fertilized in trenches firstly or superficially and inoculated with Rhizobacterien recorded the highest values of growth intensity (number of shoots per branch of different growth cycles). Besides, trees fertilized with poultry manure applied in trenches or superficially and inoculated with Nitrobien and those manured with sheep manure applied in trenches and fertilized with Rhizobacterien exerted positive effect in this respect. On the contrary, cattle manured trees applied superficially and fertilized with Nitrobien or Rhizobacterien exerted the lowest positive effect in this concern. Other studied combinations occupied an intermediate position between the previously mentioned categories regarding their effect on growth intensity (number of shoots per branch) of the different growth cycles, (Table, 11).

### 4.1.3. Shoot length increase

Tables (12-16) show the effect of organic manure source (cattle, poultry and sheep), method of organic manure application (surface and trench) and biofertilization (Rhizobacterien and Nitrobien) as well as their combinations on shoot length increase of spring, summer and autumn growth cycles of Balady mandarin trees during 2000 and 2001 seasons.

It is quite clear that poultry manured trees produced the longest shoots during spring, summer and autumn growth cycles as compared with those resulted from cattle or sheep manured trees. In other words, the shortest shoots of the different studied

Table (11): Effect of interaction between organic manure source, application method and biofertilization on number of shoots per branch of Balady mandarin trees(2000 and 2001 seasons)

		)												
Organic Application	ion Biofertilizer	JS.	Spring growth	wth			Summer growth cycle	wth cycle			AL	Autumn growth	wth	
method	d {N-fixing		Cycle			1 <sup>st</sup> cycle			2 <sup>nd</sup> cycle			cycle		Grand
	bacteria}	2000	2001	Average	2000	2001	Average	2000	2001	Average	2000	2001	Average	200
Surface	Nitrobien	22.2 d	25 2 d	237œ	10 4 d	11.5 d	10.9 d	719	8.0g	7.59	40f	24f	4.1 c	11 57 f
↓ →	Rhizobacterien	24.3 00	27 3 cd	221 d	1138	12400	1 8 8	8.2 fg	9.1 fg	8.6 fg	49e	52e	50c	11 9 f
+ Trench→	→ Nitrobien	24.3 cd	26 6 cd	25 4 bod	1148	12.5 cd	11.9 cd	8.1 fg	9.0 fg	55fg	4.9 e	51 e	50c	12.7 ef
	Rhizobacterien	25.2 bod	28.2 bod	26 7 abcd	123bcd	13 4 bod	12.8 bcd	9.2 ef	10.1 ef	9 6 ef	58d	6) 1 Q	66ab	13.7 de
Surface	→ Nitrobien	27 3 abc	30 3 abc	28 8 abc	14 4 abc	15.5 abc	14 9 abc	11 3 bod	12.2 bcd	11.7 bod	67 abc	6.9 bc	68 ab	15.5 bc
<b>'</b>	Rhizobacterien	29 0 ab	32 0 ab	30 5 ab	155ab	16 6 ab	160 ab	12 4 ab	13.3 ab	12 8 ab	69 abc	7.2 abc	7.0 ab	16 6 ab
+ Trench→	Nitrobien	28 5 abc	31 5 ab	30 0 ab	156 ab	16 7 ab	16 1 ab	125 ab	13 4 ab	12 9 ab	72 ab	7.4 ab	73 ab	16 6 ab
	Rhizobacterien	29 9 a	32 9 a	314a	159a	17 O a	164a	139a	146a	142a	75a	78a	76a	1748
Surface	→Nitrobien	25 6 abcd	28 6 bod	27 1 abcd	12 8 abcd	13 9 abcd	13.3 abcd	9.6 def	10.5 def	10 1 def	4 00 0	50e	490	13 8 de
,	Rhizobacterien	26 5 abod	29 5 abc	28 0 abc	13 0 abcd	14 1 abcd	13.5 abcd	10 4 ode	11 3 cde	10 8 cde	4 00 0	Ф Ф	490	14 4 8
Trench→	Nitrobien	26 7 abod	29 7 abc	28 2 abc	13 2 abcd	14 3 abcd	13 7 abcd	10 5 ode	11.5 ade	11 0 ade	62 cd	5100	53 55	14.8
	Rhizobacterien	27 5 abc	30.5 abc	29 0 abc	14 4 abc	15 5 abc	14 9 abc	11 5 bc	12.4 bc	11 9 bc	200	5752	5) Ju	15.65.6

growth cycles were shown on cattle manured trees. Besides, shoots of sheep manured trees scored intermediate length values during spring, summer and autumn growth cycles. Generally, differences between the three studied organic manure sources in shoot length increase of the different growth cycles were remarkable to be significant (Table, 12).

It is obvious from **Table (12)** that the application of organic manure in trenches exerted higher positive effect on shoot length increase of spring growth cycles than surface application method. The differences in shoot length increase of the different growth cycles between the two organic manure application methods and sources were obvious to reach significance level.

Furthermore, fertilizing with Rhizobacterien enhanced shoot length increase than did Nitrobien fertilization during spring, summer and autumn growth cycles. However, the superiority of Rhizobacterien in this concern was remarkable to be significant.

Table (13) reveals that the interaction between organic manure source and organic manure application method exerted that poultry manure applied firstly in trenches and secondly superficially proved to be the most effect combinations in enhancing shoot length of different growth cycles of Balady mandarin trees. On the contrary, cattle manure whether applied in trenches or superficially gave similarly the lowest values of shoot length increase during the different growth cycles. Besides, sheep manure when applied in trenches produced longer shoots than surface application.

**Table (12):** Specific effect of organic manure source, application method and biofertilization on shoot length increase of Balady mandarin trees(2000 and 2001 seasons).

ő	)				,								Grand
Factor	Spr	Spring growth	UIWC		Su	Summer growth cycle	rowth c	ycle		Aut	Autumn gr	rowth	(
1		cycle			1 <sup>st</sup> cycle	е		2 <sup>nd</sup> cycle	e		cvcle		Average
	(2000)	(2001)	(2001) Average	(2000)	(2001)	(2001) Average	(2000)	(2001)	(2001) Average	(2000)	(2001)	Average	
				a. Effe	ct of or	a. Effect of organic manure source	nure so	urce					
Cattle manure	6.0 c	6.9 c	6.4 c	4.6 c	5.5 c	5.0 c	5.2 c	5.7 c	5.7 c	5.5 c	2.1 c	2.3 c	22c
Poultry manure	8.7 a	9.6 a	9.2 a	6.2 a	7.1 a	6.7 a	6.7 a	7.2 a	7.2 a	7.0 a	3.4 a	3.7 a	n
Sheep manure													0.0
	7.2 b	8.2 b	7.7 b	5 6 b	6.5 b	6.2 b	6.0 b	6.5 b	6.5 b	6.6 b	3.8 b	3.0 ь	00 (
	7.2 b	8.2 b	7.7 b	5.6 b	6.5 b	6b 6.5b 6.2b 6.0b 6	6.0 b	6.5 b	6.5 b	6.6 b	3.8 b	0	00 (
	7.2 b	8.2 b	7.7 b	5.6 b b. E1	6.5 b fect of a	6.2 b application	6.0 b on meth	6.5 b	6.5 b	6 6 6 b	3.8 b	9 0	00 00 0
	7.2 b 7.1 b	8.2 b	7.7 b	5.6 b b. m	6.5 b fect of a 6.3 a 6.4 a	6.2 b application	6.0 b on meth 5.9 a 6.0 a	6.5 b	6 6 5 b	6.6 6.3 8 8 6	3.8 b	0 0	0 00 00
	7.2 b 7.1 b 7.5 a	8.0 b	7.7 b	5.6 b b. m 5.4 a 5.5 a	6.5 b fect of a 6.3 a 6.4 a Effect of	6.5 b 6.2 b 6.0 b  fect of application meth 6.3 a 5.9 a 5.9 a 6.4 a 6.0 a 6.0 a  Effect of biofertilization	6.0 b n meth 5.9 a 6.0 a lization	6.5 b	5 5 5 5 4 5 8 8 5	0 0 0 0 4 ω 0 α α	3.8 b	0 9 0	ပ် ထုံ ထုံ
5	7.2 b 7.1 b 7.5 a	8.2 b 8.0 b 8.4 a	7.5 b 7.5 b	5.6 b 5.4 a m	6.5 b 6.3 a 6.4 a Effect of	6.2 b application 5.9 a 6.0 a of biofert	6.0 b 5.9 a 6.0 a llization	6.5 b 6.4 a 6.5 a	6         6         6         6           3         5         4         5           5         a         a         b	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	3.8 b 2.7 a	0 0 0	7 8 8 6 0

Table (13): Effect of interaction between organic manure source and application method on shoot length increase of Balady mandarin trees(2000 and 2001 seasons).

					17.15.	Shoots	Shoots length increase (cm	increa	se (cn	(L				(
Organic	Organic Application	Spi	Spring growth	wth		Su	Summer growth cycle	owth c	/cle		Autı	Autumn growth	owth	Grand
manire	method	i.	cycle			1st cycle	e	•	2nd cycle	е		cycle		Average
2		(0000)	(2001)	Average	(2000)	(2001)	Average	(2000)	(2001)	Average	(2000)	(2001)	Average	
	- Surface	5.8 e		62e	45d	5.4 d	5.0 d	52c	57c	57b	5.6 c	210	23c	22c
Cattle →	- Trench	6.1 d	72d	P 29	46d	5.5 d	51d	52c	57c	97b	55c	210	23c	22c
	-► Surface	8.5 b	9 4 b	906	6.2 ab	7.1 ab	6.6 ab	66a	7.1a	71a	59a	3.4 a	36a	35a
Poultry →	Trench	8.9 a	989	9 4 a	6.3 a	72a	67 a	6.8 а	73a	73a	7.1 a	3.5 a	3.7 a	3.5 a
	- Surface	710	80c	75c	5.7 bc	6.6 bc	910	909	6.5 b	6,5 ab	6.8 ab	38b	306	285
Sheep →	Trench	74c	830	79c	560	65c	6.2 bc	909	656	65ab	6.4 b	385	3.0 b	29b
Means withi	Means within each column, followed by the same letter(s) are not significantly different at 5% level.	followed	by the s	same lette	er(s) are	not sigr	ificantly o	lifferent	at 5% l	evel.				

Additionally, the interaction between organic manure source and biofertilization induced similar trend to that of interaction between organic manure source and method of application, where poultry manured trees supported with Rhizobacterien fertilizer gave significantly the longest shoots of all studied growth cycles, followed descendingly by the analogous ones manured with poultry and enriched with Nitrobien fertilizer. On the contrary, cattle manure whether provided with Rhizobacterien or Nitrobien gave similarly and comparatively the shortest shoots during the different growth cycles. Besides, sheep manure provided with Rhizobacterien or Nitrobien induced similarly an intermediate positive effect on shoot length of different growth cycles, (Table, 14).

As for the interaction between method of organic manure application and biofertilization, **Table (15)** declares that out of all tested combinations, the interaction between trench method of organic manure application and Rhizobacterien gave the highest values of shoot length increase of spring, summer and autumn growth cycles. Other tested interactions showed fluctuated trend in shoot length increase of the different growth cycles of Balady mandarin trees.

Finally, the interaction between the three studied factors *i.e.* organic manure source, method of organic manure application and biofertilization, **Table (16)** demonstrates that poultry manure applied in trench and supported with Rhizobacterien significantly increased shoot length of different growth cycles, followed descendingly by those manured with

Table (14): Effect of interaction between organic manure source and biofertilization on shoot length increase of Balady mandarin trees(2000 and 2001 seasons).

						Shoot	Shoot length increase (cir.	ncreas	( CIII)		44	2	hith	Grand
Organic	Diafortilizar	Sp	Spring growth	wth		Sur	Summer growth cycle	owth cy	ycle	0	Antr	Autumii giowiii cycle	200	Average
manure			cycle			-	יש	10000	(2004)	Average	(2000)	(2001)	Average	
5		(2000)	(2001)	Average	(2000)	(2001)	Average (2000)	- 1	(2001)	282			,	c
	Nitrobien	56e		909	44e	5.3 e	48d	90g	55e	55d	5.4 d	20d	211	202
Cattle→	This protection	6 4	734	634	4.8 d	57 d	5.2 c	55d	90 g	60 cd	5.7 d	22d	2.4 e	23c
34	Killzobackerich	, a	944	9	6.1 ab	70 ab	6.5 ab	6.5 ab	70 ab	7.0 ab	6.8 b	33p	3.5 b	3.4 a
Poultry→	→ Nitroblen	0 0		6 40	6. 6.	73a	68a	693	74a	74a	72a	3.6 a	3.9 a	3.7 a
	► Rhizobacterien	0 0 0	n n	3 + (	5 ( 5 L	(I	.c.	590	64c	6 4 bc	6.8 ab	260	28d	2.7 b
10000	→Nitrobien	72c	8 0	0 0 /	ာ ဂ	) ;	0 G	, d	e G	999	5.4 c	3.0 b	32c	305
Succh	- Rhizobacterien	73c	830	78c	5.8 bc	9 / 90	2 2	30 - 0	21 %02 40					
Means wi	Means within each column, followed by the same letter(s) are not significantly different at 3.00 to 5.00 to 5.	follower	d by the	same lett	er(s) are	not sign	) LICAUTIN	ווווייייי	20,000					

Table (15): Effect of interaction between application method and biofertilization on shoot length increase of Balady mandarin trees(2000 and 2001 seasons).

ofertilizer	Spi	ing gro	owth		Su	mmer ar	owth c	vcle		Δut	mn ar	owth	Grand
		cycle			1st cyc	e		2 <sup>nd</sup> cvc	e		cvcle		Averag
	(2000)	(2001)	Average	(2000)	(2001)	Average	(2000)	(2001)	Average	(2000)	(2001)	Average	(
Nitrobien	6.85	7.7 c	726	545	635	580	5.8 b	636	63a	65a		285	276
Rhizobac.erien	75a	8.3 ab	79a	5.5 ab	6 4 ab	60 ab	61 ab	6 6 ab	6 6 a	63 ab	28 ab	3 1 a	21 ab
Nitrobien	73a	82b	78a	53b	626	50 0 0	586	63b	63a	61 b	250	27b	266
Rhizobacterien	76a	87a	82a	57a	රා භ	62a	62a	67 a	67a	р Сл	30 a	32a	ω 
	Biofertilizer  Nitrobien Rhizobac.erien Nitrobien Rhizobacterien	75 75	r Spring gracycle (2000) (2001) 68b 77c 75a 83ab 73a 82b 76a 87a	Spring gracycle (2000) (2001) 68b 77c 75a 83ab 73a 82b 76a 87a	r Spring growth cycle (2000) (2001) Average (2000) 54b  75a 83ab 79a 55ab  73a 82b 78a 53b  76a 87a 82a 57a	r Spring growth cycle (2000) (2001) Average (2000) 54b  75a 83ab 79a 55ab  73a 82b 78a 53b  76a 87a 82a 57a	r Spring growth cycle (2000) (2001) Average (2000) 54b  75a 83ab 79a 55ab  73a 82b 78a 53b  76a 87a 82a 57a	Spring growth   Summer growth   Cycle   1st cycle   (2000) (2001)   Average (2000) (2001)   Average (2000)   Average (2000)   S8b   58b   75a   83ab   79a   55ab   64ab   60ab   61ab   75a   82b   78a   53b   62b   58b   58b   76a   87a   82a   57a   66a   62a   62a   62a	Spring growth   Summer growth cycle   1st cycle   2000)   (2001)   Average   (2000)   (2001)   Average   (2000)	Spring growth   Summer growth cycle   1st cycle   2nd cycle   2nd cycle   2000)   (2001)   Average   (2000)   (2	Spring growth   Summer growth cycle   Cycle   1st cycle   2nd cycle   2000)   (2001)   Average   (2000)   (2001)   Avera	Spring growth         Summer growth cycle         Autumn growth cycle         Autumn growth cycle         Autumn growth cycle         Cycl	Spring growth   Summer growth cycle   1st cycle   2nd cycle   C2000   C2001   Average   C2000

Table (16): Effect of interaction between organic manure source, application method and biofertilization on shoot length increase of Balady mandarin trees(2000 and 2001 seasons).

													1	4	
O inco		Biofertilizer	Spr	Spring growth	٧th		SL	ımmer gr	Summer growth cycle	e		Autr	Autumn growtn	vtn	Grand
Organic		C N fixing		elovo			1st cycle		Lacosti.	2nd cycle			cycle		Average
manure Application source method	pplication	bacteria}	(2000)	(2001)	Averag	(2000)	(2001)	Averag	(2000)	(2001)	Averag	(2000)	(2001)	Averag	
		Toldoring A	7 1	600	co o	4.4 e	5.3 e	4.8 d	5.0 f	5.5 f	5.5 d	5.8 d	2.0 gh	2.2 hi	2.1 ef
£ .	↑ 000gm3	Phizobacterien	65 G	7.2 f	6.8 d	4.7 e	5.6 e	5.1 d	5.5 ef	6.0 ef	6.0 cd	5.7 d	2.2 fgh	2.4 ghi	2.3 def
٨		Mitrobien	6 t	701	6.5 d	4.4 e	5.3 e	4.8 d	5.0 f	5.5 f	5.5 d	5.2 d	1.9 h	2.1 1	2.0 f
manure	↑ honor	Phizobacterien	62.6	7.5 ef	6.8 d	4.9 e	5.8 e	5.3 d	5.5 ef	6.0 ef	6.0 cd	5.7 d	2.3 fgh	2.5 gh	2.4 def
=		Mitzobion	, «	9.7 bc	8.7 b	6.1 abc	7.0 abc	6.5 abc	6.5 abcd	7.0 abcd	7.0 ab	5.7 bc	3.3 bc	2.5 bc	3.4 ab
<u>←</u> 1	1	Valuable!!	ο α ο α ο τ	9.7 ab	9.2 ab	6.3 ab	7.2 ab	6.7 ab	6.8 ab	7.3 ab	7.3 ab	7.0 ab	3.5 ab	3.8 ab	3.7 ab
Poultry Surface	uriace	Milizobion	2 5 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	, o	9.1 ab	6.1 abc	7.0 abc	6.5 abc	6.6 abc	7.1 abc	7.1 ab	6.8 abc	3.3 bc	3.5 bc	3.4 ab
manure T.	1	Nitrobien	0 C C C	10.1 a	e 96	6.5 a	7.4 a	6.9 a	7.1 a	7.6 a	7.6 a	7.3 a	3.8 a	4.0 a	3.7 a
	rencii	Knizobactenen	7.107	, o	7.5 c	5.7 cd	6.6 cd	6.1 c	9.0 cde	6.5 cde	6.5 bc	7.2 ab	2.7 def	2.9 ef	2.8 cd
<b>+</b>	1	Phizohacterien	7.10	8.1 de	7.6 c	5.7 cd	6.6 cd	6.1 c	6.1 cde	9.6 cde	6.6 bc	6.3 c	2.9 def	3.1 de	2.8 cd
Sneep → Sullace	al lace	Nitrobion	202	8.2 de	7.7 c	5.4 d	6.3 d	6.1 c	5.9 de	6.4 de	6.4 bcd	6.4 c	2.5 efg	2.7 fg	2.6 de
manure T	Trench	Rhizobacterien	7.5 c	8.5 cd	8.0 c	5.9 bcd	6.8 bcd	6.3 bc	6.2 bcd	6.7 bcd	6.7 abc	6.4 c	3.1 bcd	3.3 cd	3.2 bc

poultry applied in trenches and provided with Nitrobien fertilizer. Besides, poultry manure, applied superficially and fertilized with Rhizobacterien surpassed the corresponding ones provided with Nitrobien in enhancing shoot length of different growth cycles. The combinations of sheep manure surpassed the corresponding ones of cattle manure in the same pattern of poultry manure interactions, regarding shoot length increase of spring, summer and autumn growth cycles of Balady mandarin trees.

# 4.1.4. No. of leaves/shoot

The effect of organic manure source, method of organic manure application and biofertilizers as well as their combinations on number of leaves per shoot of spring, summer and autumn growth cycles of Balady mandarin trees during 2000 and 2001 seasons is reported in **Tables (17-21).** 

It is obvious from **Table** (17) that shoots of poultry manured trees had significantly higher number of leaves of spring (3.9 & 4.2), summer (4.4 & 4.7) and autumn (2.6 & 2.8), whereas, those of sheep manured trees recorded (3.6 & 3.9) for spring, (3.9 & 4.2) for summer and (2.2 & 2.4) for autumn growth cycles in 2000 and 2001 seasons, respectively. On the contrary, shoots of cattle manured trees recorded the lowest number of leaves for spring (3.4 & 3.7), summer (3.3 & 3.6) and autumn (2.0 & 2.2) in the first and second seasons, respectively.

Furthermore, the application of organic manure either superficially or in trenches induced similar effect on number of developed leaves per shoot of spring growth cycle. Meanwhile,

Table (17): Specific effect of organic manure source, application method and biofertilization on number of leaves per shoot of Balady mandarin trees(2000 and 2001 seasons).

Ĺ	Circo	14	No. or lea	No. of leaves / shoot		
ractor		Cycle	Means of su	Means of summer growth cycles	Autumi	Autumn growth
	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
		a. Effect of	a. Effect of organic manure source	source		
Cattle manure	3.4 c	3.7 c	3.3 c	3.6 €	2.0 €	2.2 c
Poultry manure	3.9 a	4.2 a	4.4 a	4.7 a	2.6 a	2.8 a
Sheep manure	3.6 b	3.9 b	3.9 b	4.2 b	2.2 b	2.4 b
		b. Effect	b. Effect of application method	ethod		
Surface	3.6 a	3.9 a	3.7 b	4.0 b	2.2 b	2.4 b
Trench	3.7 a	4.0 a	3.9 a	4.2 a	2.3 a	2.5 a
		c. Effec	c. Effect of biofertilization	uo		
Nitrobien	3.6 a	3.9 a	3.7 a	4.1 a	2.2 a	2.4 a
Rhizobacterien 3.6a 4.0a 3.9a 4.2a 2.3a	3.6 a	4,0 a	3.9 a	4.2 a	2.3 a	25.2

trench application of organic manure surpassed surface application in enhancing number of produced leaves per shoot of summer and autumn growth cycles.

Moreover, the biofertilizers induced similar effect on number of leaves per shoots of spring, summer and autumn growth cycles. (Table, 17).

Regarding the interaction between organic manure source and method of application, **Table (18)** shows that organic manure source exerted dominant influence on the net of interaction between organic manure source and method of application. Thereupon, the two methods of application of poultry manure showed comparatively similar and higher values of number of leaves per shoot of spring, summer and autumn, followed descendingly and typically by those of sheep and finally by the corresponding ones of cattle manure.

In addition, **Table (19)** reveals that the interaction between organic manure source and biofertilization took the same trend to that of organic manure source x method of application, hence the combinations of two biofertilizers with poultry manure scored similarly and higher values of number of leaves per shoot of spring, summer and autumn growth cycles, followed descendingly in the same trend by the combinations of sheep manure and lastly by the interactions of cattle manure.

Table (20) demonstrates that the interaction between method of organic manure application and biofertilization failed to induce a distinctive effect on number of developed leaves per shoot of most studied growth cycles of Balady mandarin trees in 2000 and 2001 seasons.

Table (18): Effect of interaction between organic manure source and application method on number of leaves per shoot of Balady mandarin trees(2000 and 2001 seasons).

				No. or lea	No. of leaves / shoot		
manure	Application method	Spring	Spring growth Cycle	Means of su	Means of summer growth	Autum	Autumn growth
27		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Cattle	→ Surface	3.3 b	3.6 €	3.2 d	3.4 d	2.0 d	2.2 d
	▼ Trench	3.4 b	3.7 bc	3.4 d	3.7 d	2.0 d	2.2 d
Poultry +	→ Surface	3.8 a	4.1 a	4.3 ab	4.6 ab	2.4 b	2.6 b
í mas	<b>→</b> Trench	3.9 a	4.2 a	4.5 a	4.8 a	2.7 a	2.9 a
Choon	→ Surface	3.6 ab	3.9 abc	3.8 €	4.1 c	2.1 cd	2.3 cd
dealle	<b>→</b> Trench	3.7 ab	4.0 ab	4.0 bc	4.3 bc	2.3 bc	2.5 bc

Table (19): Effect of interaction between organic manure source and biofertilization on number of leaves per shoot of Balady mandarin trees(2000 and 2001 seasons).

Organic				No. of lea	No. of leaves / shoot		
Organic	Riofortilizar	Spring	Spring growth	Means of su	Means of summer growth	Autumn growth	growth
SOURCE OF THE PARTY OF THE PART	מוסוכו נוווגכו	c)	cycle	су	cycles	cycle	cle
Source		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	Nitrobien	3.3 b	3.6 b	3.2 c	3.5 c	1.9 с	2.1 c
Carrie	Rhizobacterien	3.4 b	3.7 b	3.3 c	3.6 c	2.1 bc	2.3 bc
	Nitrobien	3.8 a	4.1 a	4.3 ab	4.6 ab	2.5 ab	2.7 ab
Poultry	Rhizobacterien	3.9 a	4.2 a	4.5 a	4.8 a	2.7 a	2.9 a
P V	Nitrobien	3.6 ab	3.9 ab	3.8 bc	4.1 bc	2.2 abc	2.4 abc
sneep	+ Rhizobacterien	3.6 ab	4.0 a	4.0 ab	4.3 ab	2.3 abc	2.5 abc
the same	Manager of the control of the contro			,			

Table (20): Effect of interaction between application method and biofertilization on number of leaves per shoot of Balady mandarin trees(2000 and 2001 seasons).

				No. of leaves / shoot	es / shoot		
Application method	Biofertilizer	Spring	Spring growth	Means of summer growth	summer vth	Autumn	Autumn growth
		cy	cycle	cycles	les	δ	cycle
		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Curt	→ Nitrobien	3.5 a	3.8 a	3.6 a	3.9 a	2.0 a	2.2 a
on lace	- Rhizobacterien	3.6 a	3.9 a	3.8 a	4.1 a	2.3 a	2.5 a
Tronch	→ Nitrobien	3.6 a	3.9 a	3.9 a	4.2 a	2.3 a	2.5 a
<u> </u>	<ul> <li>Rhizobacterien</li> </ul>	3.7 a	4.0 a	4.0 a	4.3 a	2.4 a	2.6 a
Means within e	Means within each column, followed by the same letter(s) are not significantly different at 5% level	the same letter	s) are not sinnif	cantly different a	1 5% level		

As for the interaction between the three studied factors namely organic manure source, method of organic manure application and biofertilization, **Table (21)** demonstrates that organic manure source had the upper hand on interaction net, where all combinations of poultry manure produced nearly similar and higher positive effect on number of developed leaves per shoot of spring, summer and autumn growth cycles followed descendingly in typical manner by those of sheep manure and finally by the corresponding ones of cattle manure.

# 4.1.5. Leaf parameters

Tables (22 - 26) show the response of some leaf parameters of Balady mandarin trees, *i.e.* leaf surface, leaf shape index, leaf chlorophyll (a & b) and leaf dry weight to organic manure source, method of organic manure application and biofertilization as well as their interactions during 2000 and 2001 seasons.

### 4.1.5.1. Leaf surface area

It is clear from **Table (22)** that poultry manured trees produced more expanded leaves as compared with those given by cattle or sheep manured ones. However, the differences between cattle and sheep manure in this respect were so small to reach the significance level.

Moreover, trench manured-orange trees produced more expanded leaves than superficially manured ones.

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Table (21): Effect of interaction between organic manure source, application method and biofertilization on number of leaves per shoot of Balady mandarin trees(2000 and 2001 seasons).

					No. of le	No. of leaves/shoot		
		Riofertilizer	Sprin	Spring growth	Mean of	Mean of summer	Autun	Autumn growth
Organic	ī	N-fixing		cycles	growt	growth cycles	O	cycles
manure	nollialli	hacteria	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
sonice		Nitrobien	3.3 d	3.6 d	3.1 e	3.4 e	1.8 c	2.0 c
	Surface →	Rhizobacterien	3.4 cd	3.7 cd	3.2 de	3.5 de	2.2 abc	2.4 abc
Caune		▼ Nitrobien	3.4 bcd	3.7 bcd	3.4 cde	3.7 cde	2.0 bc	2.2 bc
Manure	Trench →	Rhizobacterien	3.5 bcd	3.8 bcd	3.5 bcde	3.8 bcde	2.1 abc	2.3 abc
	4	→ Nitrobien	3.8 abc	4.1 abc	4.2 abc	4.5 abc	2.3 abc	2.5 abc
	→ Surface →	Phizohacterien	3.9 ab	4.2 ab	4.4 ab	4.7 ab	2.6 ab	2.8 ab
Poultry		Nitrobien	3.9 ab	4.2 ab	4.4 ab	4.7 ab	2.7 ab	2.9 ab
manure	Trench →	Rhizobacterien	4.0 a	4.3 a	e 9.4	4.9 a	2.8 a	3.0 a
	ý		3.6 abcd	3.9 abcd	3.7 abcde	4.0 abcde	2.1 abc	2.3 abc
1	<b>Surface</b> →	Phizohacterien	3.6 abcd	4.0 abcd	3.9 abcde	4.2 abcde	2.2 abc	2.4 abc
neep	_	Nitrobien	3.7 abcd	4.0 abcd	3.9 abcde	4.2 abcde	2.3 abc	2.5 abc
Hanure	Trench →	Rhizobacterien	3.7 abcd	4.0 abcd	4.1 abcd	4.4 abcd	2.4 abc	2.6 abc
3	millon done side	followed by the same letter(s) are not significantly different at 5% level.	e same letter(s	;) are not signif	icantly different	at 5% level.		

**Table (22):** Specific effect of organic manure source, application method and biofertilization on some leaf parameters of Balady mandarin trees(2000 and 2001 seasons).

	Leaf sur	Leaf surface area	Leaf shape	shape	Lea	af chloro	Leaf chlorophyll (mg/L)	<u></u>	Leaf dry	Leaf dry weight
Factor	(c	(cm <sup>2</sup> )	index (L/W)	(LW)	(a)	<u></u>	(d)	٥	<u> </u>	(q) (q)
	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
				a. Effec	a. Effect of organic manure source	c manure	source			
Cattle manure	4.40 c	4.42 b	2.81 a	2.83 a	57.70 b	59.70 b	32.97 c	30.92 c	0.109 a	0.113 a
Poultry manure	4.56 a	4.58 a	2.84 a	2.82 a	63.25 a	65.25 a	39.40 a	37.15 a	0.120 a	0.123 a
Sheep manure	4.45 b	4.48 b	2.82 a	2.81 a	60.08ab	61.99ab	36.45 b	34.62 b	0.114 a	0.118 a
				b. Effe	b. Effect of application m :thod	cation m	thod			
Surface	4 44 b	4 47 b	2.83 a	2 82 a	58.47 a	61.41 a	35.49 a	33.30 b	0.112 a	0.116 a
Trench	4.50 a	4.52 a	2.83 a	2 83 a	61.22 a	63.22 a	37.05 a	35.16 a	0.117 a	0.121 a
				c. El	Effect of biofertilization	ofertilizati	on			
Nitrobien	4.45 b	4 48 b	2.83 a	2.82 a	59.68 a	61 63 a	35.92 a	33.92 a	0 112 a	0.115 a
Rhizobacterien	4 49 a	4.51 a	2.83 a	2.82 a	61.00 a	63.00 a	36.63 a	34.54 a	0.117 a	0.121 a
Means within each column, followed by the same letter(s) are not significantly different at 5% level.	mn, followe	ed by the sa	me letter(s	) are not	significantl	y different	at 5% levi	<u>.</u>		

Furthermore, Rhizobacterien-inoculated trees produced more expanded leaves as compared with those resulted from Nitrobien-inoculated ones.

On the other hand, the interaction between organic manure and method of organic manure application reveals that poultry manure applied particularly in trenches or superficially exerted the highest positive effect on leaf surface area of Balady mandarin trees in both seasons, (Table, 23). Other studied interactions gave nearly more or less similar values in this respect.

In addition, **Table (24)** illustrates that the interaction between organic manure source and biofertilization took nearly the same trend of interaction between organic manure source and method of organic manure application, hence poultry manured trees, inoculated with Rhizobacterien, followed descendingly by poultry manured, inoculated with Nitrobien produced the most expanded leaves. Combination of cattle and sheep manure induced statistically similar effect in this respect, except for cattle manure applied superficially which showed the lowest leaf surface area values from the statistical standpoint.

Furthermore, trench application of organic manure associated with Rhizobacterien-inoculation exerted the highest stimulative effect on leaf surface area, followed descendingly by those provided with Nitrobien (**Table, 25**). Besides, the application of organic manure superficially and supporting with Rhizobacterien enhanced leaf surface area rather than the association with Nitrobien inoculation.

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other

**Table (23):** Effect of interaction between organic manure source and application method on some leaf parameters of Balady mandarin trees(2000 and 2001 seasons).

Organic	Application	Leaf sur	Leaf surface area	Leaf shape	shape	_	Leaf chlorophyll (mg/L)	phyll (mo	[]	Leaf dr	Leaf dry weight
manure	method	(c	(cm*)	index (L/W	(LW)		(a)		(b)		G)
source		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Cattle →	Surface	4.38 d	4.41 e	2.83 a	2.83 a	56.85 c	58.85 d	32.18 d	30.10 d	0.105 b 0.108 a	0.108 a
	Trench	4.42 cd	4.44 de	2.83 a	2.84 a	58.55 bc	60.55 cd	33.75 cd	31.75 cd	0.114 ab	0.118 ab
Poultry	Surface	4.51 b	4.53 b	2.85 a	2.81 a	C2.00 ab	64.00 ab	38.65 ab	36.15 ab	0.119 ab 0.102 ab	0.102 ab
	* Trench	4.61 a	4.63 a	2.84 a	2.83 a	64.50 a	66.50 a	4.015 a	38.15 a	0.122 a 0.124 a	0.124 a
Sheep ->	→ Surface	4.44 c	4 47 cd	2.83 a	2.81 a	59,55 bc	61.38 bcd 35.65 bcd	35.65 bcd	33.65 bc	0 113 ab	0.117 ab
	* Trench	4.46 c	4.49 c	2.82 a	2.82 a	60.60 b	62 60 bc 37.25 abc	37.25 abc	35.58 ab	0116 ab 0119 ab	0 119 ab
Means within each column, followed by the same letter(s) are not significantly different at 5% level.	ach column follo	A STATE OF THE PERSON AND ADDRESS OF THE PERSON ADDRESS OF THE PERSON AND ADDRESS OF THE PERSON									

Table (24): Effect of interaction between organic manure source and biofertilization on some leaf parameters of Balady mandarin trees(2000 and 2001 seasons).

							100			1 ant dry waight	woight
0.11		l eaf surf	l eaf surface area	Leaf shape	hape	rea	Leaf chlorophyll (mg/L)	nyll (mg/l	(-)	Leal aly	weighte
Organic	1.11.	(cm <sup>2</sup> )	2,1	index (I M)	(W)	(a)		(q)	_	(B)	
manure	Biorertilizer	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Source	→ Nitrobien	4.39 e	4.42 e	2.83 a	2.83 a	57.30 b	59.30 b	32.60 c	30.60 c	0.104 b	0.107 b
Cattle →	- Rhizobacterien	4,41 de	4.43 de	2.82 a	2.84 a	58.10 b	60.10 b	33.33 bc 31.25 bc	31.25 bc	0.115 ab	0.119 ab
	→ Nitrobien	4.53 b	4.56 b	2.84 a	2.88 a	62.25 ab	64.25 ab	39.15 a	37.15 a	0.119 a	0.122 a
Poultry →	- Rhizobacterien	4.59 a	4.61 a	2.84 a	2.82 a	64.25 a	66.25 a	39,65 a	37.15 a	0.122 a	0.124 a
	• Nitrobien	4.44 cd	4.47 cd	2.82 a	2.82 a	59.50 ab	61.33 ab	36.0 abc	36.0 abc 34.00 ab	0.113 ab 0.116 ab	0.116 ab
Sheep →	- Rhizobacterien	4.47 c	4.49 c	2.83 a	2.81 a	60.65 ab	62.65 ab	36.90 ab 35.23 a	35.23 a	0.116 ab	0.116 ab 0.120 ab
Means within	Means within each column, followed by the same letter(s) are not significantly different at 5% level.	wed by the	same lette	r(s) are no	t significa	ntly differer	nt at 5% le	vel.			

Table (25): Effect of interaction between application method of organic manure and biofertilization on some leaf parameters of Balady mandarin trees(2000 and 2001 seasons).

Application	Biofertilizer	Leat su	Leaf surface area	Leaf	Leaf shape	Le	Leaf chlorophyll	ohyll (mg/L)	/L)	Leaf dry weight	/ weight
method	0.0101		cm)	index (L/W	(LW)	<u>.</u>	(a)	(1	(b)	<u> </u>	(a)
		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000) (2001	(2001)
ı.	* Nit-						-	1	12001	(2000)	(1007)
Surface->	Nitropien	4.43 c	4.46 c	2.83 a	2.82 a	59.00 a	59.00 a 60.89 a	35.00 a 33.00	33.00 a	0.108 a 0.111 a	0.111 a
	Rhizopacterien	4.46 bc	4.48 bc	2.84 a	2 82 a	50 93 a	61 03 3	37 00 0			)
								0	0	0.120	0
Trench →	Nitrobien	4.48 b	4.50 ab	2.83 a	2.83 a	60.37 a	62.37 a	36.83 a	34.83 a	0.116a 0.119a	0.119 a
	- Rhizobacterien	4.52 a	4.54 a	2.82 a	2.83 a	)	62 07 2	37 27 a	35 49 2	01192 01332	
Means within each column, followed by the same letter(s) are not significantly different at 50% level						62.07 a	0 10		0.000		111

combinations (cattle and sheep) in enhancing leaf surface area with the superiority of trench application on the expense of surface application and Rhizobacterien inoculation on the expense of Nitrobien inoculation. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 26).

#### 4.1.5.2. Leaf shape index

It is clear from **Tables** (22 – 26) that neither the three tested factors (organic manure sources, method of organic manure application and biofertilizer) levelly nor their different combinations succeeded in exerting a distinctive effect on leaf shape index of Balady mandarin trees.

### 4.1.5.3. Leaf chlorophyll (*a* & *b*)

Table (22) shows that leaves of poultry manured trees had the highest values of chlorophyll *a* & *b*, followed descendingly by those of sheep manured ones and finally those of cattle manured trees. However, the differences between the three organic manure sources in this respect were obvious to be significant at 5% level.

Furthermore, method of organic manure application failed to induce and positive effect on leaf chlorophyll *a* & *b* of Balady mandarin trees in both seasons.

Additionally, biofertilization failed to induce any positive effect on leaf chlorophyll a & b of Balady mandarin trees in both seasons.

Table (26): Effect of interaction between organic manure source, application method of organic manure and biofertilization on some leaf parameters of Balady mandarin trees(2000 and 2001 seasons).

Organic	Applicati	Biofertilizer	Leaf s	Leaf surface	Leaf shape	hape		Leaf chlorophyll (m	opnyli (mg/L)		Leai ui y	real dry weight
manure	on	N-fixing	area	area (cm²)	index (L/W)	(L / W)	(a)	-	(b)	٥	(g)	-
source	method	bacteria	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
		† Nitrobien	4.37 q	4.40 g	2.83 a	2.82 a	56.50 b	58.50 b	31.70 d	29.70 e	0.095 b	0.098 b
Cattle	-Surface →	Rhizobacterien	4.40 fg	4.42 fg	2.83 a	2.83 a	57.20 b	59.20 b	32.67 cd	30.50 de	0.115 a	0.119 a
A Carrier		Pilitobio	A A1 of	4 44 efg	2 84 a	2.84 a	58.10 ab	60.10 ab	33.50 bcd	31.50 cde	0.114 a	0.117 a
Illallule	*Trench →	Midobion				0	50 00 25	61 00 ah	34 00 hod	32 00 cde	0.115 a	0.119 a
		KUIZODACIEIIEII	Figure Ct.	1.10								
		<ul> <li>Nitrobien</li> </ul>	4.49 cd	4.52 cd	2.85 a	2.81 a	61.50 ab	63.50 ab	38.30 ab	36.30 abc	0.118 a	0.121 a
Poultry	-Surface →	Rhizobacterien	4.53 bc	4.55 bc	2.84 a	2.82 a	62.50 ab	64.50 ab	39.00 ab	36.00 abc	0.120 a	0.124 a
manure	1	Nitrobien	4.58 b	4.60 b	2.84 a	2.83 a	63.00 ab	65.00 ab	40.00 a	38.00 ab	0.120 a	0.123 a
	Trench >	Rhizobacterien	4.65 a	4.67 a	2.84 a	2.83 a	66.00 ab	68.00 a	40.00 a	38.30 a	0.125 a	0.125 a
	1	Nitrobien	4.43 defa	4.46 defg	2.82 a	2.82 a	59.00 ab	60.67 ab	35.00 abcd	33.00 bcde	0.112 ab	0.115 ab
Sheen	*Surface→	* Rhizobacterien	4.46 cdef	4,48 cdef	2.84 a	2.80 a	60.10 ab	62.10 ab	36.30 abcd	34,30 abcde	0.115 a	0.119 a
manure		♦ Nitrobien	4.45 def	4.48 cdef	2.83 a	2.81 a	60.00 ab	62.00 ab	37.00 abcd	35.00 abcd	0.115 a	0.118 a
	*Trench →	Rhizobacterien	4.48 cde	4.50 cde	2.81 a	2.83 a	61.20 ab	63.20 ab	37.50 abc	36.17 abc	0.117 a	0.121 a

On the other hand, **Table (23)** reveals that poultry manure when applied in trenches gave the highest values of leaf chlorophyll a & b, followed by superficial application. Besides, the combinations of sheep manure surpassed cattle manure in enhancing leaf chlorophyll a & b with the superiority to trench application.

Furthermore, **Table (24)** shows that poultry manure provided with Rhizobacterien proved to be the most efficient interaction in improving leaf chlorophyll a & b, followed by poultry manure supported with Nitrobien. Besides, sheep manure combinations surpassed cattle manure combination with the superiority to Rhizobacterien inoculation.

On the other hand, trench application of organic manure provided with Rhizobacterien or Nitrobien exerted more positive effect on leaf chlorophyll *a* & *b* than did surface application supported with Rhizobacterien or Nitrobien inoculation (**Table**, 25).

Finally, the interaction between the three studied factors (Table, 26) demonstrates that the combinations of poultry manure gave the highest values of leaf chlorophyll a & b with the superiority in the side of trench application and Rhizobacterien inoculation. Besides, the interactions of sheep manure surpassed the corresponding ones of cattle manure with the superiority to trench and Rhizobacterien inoculation.

### 4.1.5.4. Leaf dry weight

It is clear that leaves of poultry and sheep manured trees had similarly higher values of dry weight than those produced by cattle manured ones, (Table, 22).

Furthermore, neither the method of organic manures application (trench and surface) nor the biofertilization type (Rhizobacterien and Nitrobien) induced distinctive and remarkable effect on leaf dry weight of Balady mandarin trees.

As for the interaction between organic manure source and method of organic manure application, Table (23) reveals that the combination of poultry in trenches exerted higher positive effect on leaf dry weight as compared with those arised from cattle manure applied superficially. Besides, sheep manure combination had intermediate values between other testes of study.

Furthermore, the interaction between organic manure source and biofertilization illustrates that poultry manured trees provided with Rhizobacterien and Nitrobien gave similar and higher values of leaf dry weight as compared with cattle manure x Nitrobien in both seasons of study. Besides, sheep manure combination had intermediate values between other tested interaction, (Table, 24).

Additionally, **Table (25)** reveals that when the method of organic manure application interacted with biofertilization, it failed to add an additional remarkable effect on leaf dry weight of Balady mandarin trees.

Finally, the interaction between the three studied factors (organic manure source, method of organic manure application and biofertilization) reveals that all studied interactions induced nearly similar and higher values of leaf dry weight as compared with cattle manure applied superficially and supported with Rhizobacterien in both seasons of study (Table, 26).

Conclusively, poultry sheep manure proved to be the most efficient organic manure source in enhancing tree growth of

Balady mandarin trees expressed as the longest growth cycles duration, the highest growth cycles intensity, the longest shoots of different growth cycles, the highest number of leaves per shoot of different growth cycles, the largest leaf surface area, the richest leaves in chlorophyll (a & b) content and the heaviest leaf dry weight. Cattle manure induced the least positive effect, whereas sheep manure exerted intermediate effect in this concern.

Moreover, trench application of organic manure surpassed surface application in improving the previously mentioned tree growth parameters.

Furthermore, Rhizobacterien-inoculated trees showed better growth and higher values of the studied growth parameters as compared with Nitrobien-inoculation.

The enhancement in tree growth due to organic manure in general and poultry manure in particular, may be attributed to the fact that manures often improve the structure of soil; they may do this directly through their action as bulky diluents in compacted soils, or indirectly when the waste products of animals or microorganisms cement soil particles together. These structural improvements increase the amount of water useful to crops that soils can hold; they also improve aeration and drainage and encourage good root growth by providing enough pores of the right sizes and preventing the soil becoming too rigid when dry or completely waterlogged and devoid of air when wet. Consequently, the positive effects of organic manure on growth may be due to: (1) its prospective physical effects on soil conditions, (2) the nutrients it supplies and (3) the way it supplies the nutrients. Besides, poultry manure is characterized by containing twice as much nitrogen as

farmyard manure, they are much richer in phosphorus and contains as much potassium as farmyard manure, (Cooke, 1982). Moreover, Li et al. (1998) pointed out that organic manure increased the soil content of IAA and cytokinins and stimulated plant growth.

On the other hand, the enhancement of tree growth due to trench application of organic manure rather than surface application may be due to the fact that the uric acid in fresh manure is decomposed by micro-organisms to give ammonia, which is easily lost if the manure is exposed (Cooke, 1982). Losses of nitrogen by volatilization, of course, will still unless the manure is plowed under or disked in immediately (Tisdale and Nelson, 1956).

Furthermore, the improvement of tree growth as a result of biofertilization may be due to the production of growth regulators as well as to N-fixation (Rao and Dass, 1989).

The results of organic manure source in enhancing tree growth are confirmed by the findings of Mukherjee et al. (1983) on jack fruit, Sekiya et al. (1983) on apple, Darfeld and Lenz (1985) on pear, Pil'Shchikov (1986) on apple, Villasurda and Baluyut (1990) on guava, Awad et al. (1993) on olive, Li et al. (1993) on pummelo, Smith (1994) on banana, Abou-Sayed-Ahmed (1997) on pear, Li et al. (1998) on apple, Takahashi et al. (1998) on mulberry, Ashinov and Bekanov (1999) on plum, cherry, peach, apricot and wild cherry, El-Kobbia (1999) on Balady mandarin, Grassi et al. (1999) on Rangpur lime seedlings and recently Moustafa (2002) on Washington navel orange trees. They concluded that leaf surface area, leaf fresh and dry weights as well as photosynthetic pigment content, i.e. chlorophyll a and b, total chlorophyll and carotene were superior with organic manure particularly poultry and cattle manure.

On the other hand, the results of organic manure application method in this respect go in line with the reports of **Makhmadbekov** *et al.* (1984) on lemon and **Fisun and Kodzokov** (1991) on plum and **Moustafa** (2002) on Washington navel orange.

Furthermore, positive effect of tested biofertilizers on tree growth are in harmony with the findings of Ball et al. (1983) on groundnut, Nagarajan et al. (1989) on mulberry, Haggag and Azzozy (1996) on mango, Ahmed et al. (1997) on grapevines, Sharma and Bhutani (1998) on apple, Fernandez et al. (1998) on banana, Mansour (1998) on Anna apple, Wange and Ranawade (1998) on grape, Mahmoud and Mahmoud (1999) on peach and Moustafa (2002) on Washington navel orange. They showed that biofertilizers, i.e. Rhizobacterien and Nitrobien caused material improvement in shoot length, leaf-area and cane thickness.

## 4.2. Leaf mineral content

Leaf mineral content (N, P, K, Ca, Mg, Fe, Zn, Mn and Cu) of Balady mandarin trees during 2000 and 2001 seasons in response to organic manure source (cattle, poultry and sheep), method of organic manure application (surface and trench) and biofertilization (Rhizobacterien and Nitrobien) as well as their interactions is reported in **Tables (27 -36).** 

## 4.2.1. Nitrogen

It is clear from **Table (27)** that leaves of poultry manured trees had higher values of nitrogen content (2.68 & 2.67%) as compared with those manured with cattle (2.44 & 2.40%) in the first and second seasons, respectively. Besides, leaves of sheep

manured trees scored inbetween values of nitrogen content (2.56 & 2.54%) in 2000 and 2001 seasons, respectively. Anyhow, the differences between the three studied organic manure sources in this regard were obvious to be significant.

In addition, the application of the three studied organic manure sources in trenches induced higher positive effect on leaf nitrogen content rather than superficial application (Table,27).

Furthermore, fertilizing Balady mandarin trees with Rhizobacterien improved leaf nitrogen content rather than the inoculation with Nitrobien.

Moreover, the interaction between organic manure source and method of organic manure application demonstrates that leaf nitrogen content showed more response to organic manure source rather than to method of organic manure application, hence poultry manure applied firstly in trenches and/or secondly superficially induced the highest positive effect on leaf nitrogen content, followed descendingly by the combinations of sheep manure and lastly by the interactions of cattle manure (Table, 28).

Additionally, **Table (29)** indicates that leaf nitrogen content responded largely to organic manure source rather than biofertilizers, where poultry manured trees supported firstly with

Table (27): Specific effect of organic manure source, application method and biofertilization on leaf N, P, K, Ca and Mg content of Balady mandarin trees(2000 and 2001 seasons).

			Fleme	ents con	centratic	Elements concentration in dried leaves (%)	ed leave	(%) s		
Factor	Nitro	Nitrogen	Phosphorus	horus	Potassium	sium	Calcium	ium	Magnesium	sium
	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
				a. Effect	of organi	a. Effect of organic manure source	source			
Cattle manure	2.44 c	2.40 c	0.135 a	0.136 a	0.745 c	0.750 c	3.1 c	3.10	0.33 c	0.35 c
Poultry manure	2.68 a	2.67 a	0.141 a	0.141 a	1.029 a	1.037 a	4.0 a	4.2 a	0.52 a	0.53 a
Sheep manure	2.56 b	2.54 b	0.140 a	0.139 a	0.892 b	0.905 b	3.4 b	3.4 b	0.43 b	0.45 b
				b. Effe	ect of appl	b. Effect of application method	ethod			
Surface	2.55 b	2.52 b	0.138 a	0.138 a	0.871 b	0.876 b	3.4 b	3.4 b	0.41 b	0.42 b
Trench	2.58 a	2.56 a	0.139 a	0.140 a	0.906 a	0.917 a	3.6 a	3.7 a	0.45 a	0.46 a
				ပ	ffect of b	c. Effect of biofertilization	ion			
Nitrobien	2.53 b	2.51 b	0.138 a	0.138 a	0.867 b	0.876 b	3.3 b	3.4 b	0.41 b	0.43 b
Rhizobacterien	2.59 a	2.57 a	0.140 a	0.140 a	0.910 a	0.918 a	3.6 a	3.7 a	0,45 a	0.46 a
Means within each column, followed by the same letter(s) are not significantly different at 5% level.	olumn, follo	owed by th	e same let	ter(s) are I	not signific	antly differ	ent at 5%	o level.		

Table (28): Effect of interaction between organic manure source and application method on leaf N, P, K, Ca and Mg content of Balady mandarin trees(2000 and 2001 seasons).

Application   Nitrogen   Phosphorus   Potassium   Calcium   Mac				D	† at 50% lev	ly differen	significant	(s) are not	same letter	d by the	column, followe	min each	Ligal is Wi
Application   Nitrogen   Phosphorus   Potassium   Calcium	0.44 c	0	3 5 c	3.4 bc	0.935 c	0.915 c	0.140 a	0.140 a	2.56 c	2.28 c	Trench	5	3
Nitrogen   Phosphorus   Potassium   Calcium	42 d	0	3.5 c	3.4 bc				0.140 a	2.53 d	2.55 c	* Surface	<b>↓</b>	Shee
Application   Nitrogen   Phosphorus   Potassium   Calcium	15 a	0,4	4.5 a	4.3 a	1.048 a				2.70 a	2.71 a	* Trench		
Application method         Nitrogen (2000)         Phosphorus (2001)         Potassium (2000)         Calcium (2001)           Surface         2.44 d         2.39 f         0.136 a         0.135 a         0.725 f         0.770 e         3.1 c         3.2 d         0.201           Trench         2.44 d         2.42 e         0.135 a         0.138 a         0.765 e         0.770 e         3.1 c         3.2 d         0.0	90 9	0.5	4.0 b	3.8 ab	1.025 b		0.141 a	0.140 a	2.64 b	2.66 b	* Surface	ry -→	Poul
Application method         Nitrogen (2000)         Phosphorus (2001)         Potassium (2000)         Calcium (2001)           Surface         2.44 d         2.39 f         0.136 a         0.135 a         0.725 f         0.730 f         3.1 c         3.0 d         0	0.35 e	0.3	3.2 d	3.1 c	0.770 e	0.765 e	0.138 a	0.135 a	2.42 e	2.44 d	* Trench	ŕ	
ApplicationElements concentration in dried leaves (%)methodNitrogenPhosphorusPotassiumCalcium(2000)(2001)(2000)(2001)(2001)(2000)(2001)	0.31 f	0		3.1 c	0.730 f	0.725 f	0.135 a	0.136 a		2.44 d	- эипасе	ttle→	C
Application Elements concentration in dried leaves (%)  method (2000) (2001) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2000) (2	(2000)	(2)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	- 1	,	Cd		
Application	Magnesium		ium	Calc	sium	Potas	Onorus	(2000)	(2001)	(2000)	method	rce	nos
			s (%)	ed leave	on in drie	centrati	ents cor	Elem	200	Nit	Application	ure	mar

Table (29): Effect of interaction between organic manure source and biofertilization on leaf N, P, K, Ca and Mg content of Balady mandarin trees(2000 and 2001 seasons).

Organic	U			Elem	Elements concentration in dried leaves (%)	centrati	on in drie	ed leave	s (%)		
manure	Biofertilizer	Nitro	Nitrogen	Phosp	Phosphorus	Potas	Potassium	Calcium	ium	Magn	Magnesium
source		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	- Nitrobien	2.43 d	2.39 e	0.135 a	0.135a 0.136a 0.720 c	0.720 c	0.725 c	3.0 e	3.0 f	0.31 f	0.33 f
Cattle →	- Rhizobacterien	2.45 d	2.42 e	0.136 a	0.136 a 0.770 c	0.770 c	0.775 c	3.1 de	3.2 e	0.35 e	0.37 e
	→ Nitrobien	2.64 b	2.62 b	0.140 a	0.140 a 0.140 a 1.003 a	1.003 a	1.008 a	3.8 b	4.0 b	0.50 b	0.52 b
Poultry→	→ - Rhizobacterien	2.73 a	2.71 a	0.143 a	0.143 a . 0.143 a	1.055 a	1.065 a	4.3 a	4.4 a	0.55 a	0.56 a
	→ Nitrobien	2.54 c	2.52 d	0.140 a	0.138 a	0.880 b	0.895 d	3.3 cd	3.4 d	0.42 d	0.44 d
Sheep →	→ Rhizobacterien	2.59 bc	2.57 c	2.57 c 0.140 a 0.140 a 0.905 b 0.915 b	0.140 a	0.905 b	0.915 b	3.4 c	3.5 c	0.44 c	0.46 c

Rhizobacterien or secondly with Nitrobien scored the highest values of leaf nitrogen content, followed descendingly by those of sheep manure and lastly by the combinations of cattle manure.

Moreover, **Table (30)** reveals that the application of organic manure in trenches and Rhizobacterien fertilization proved to be most efficient interaction in enhancing leaf nitrogen content of Balady mandarin trees. Other tested combinations induced similar effect on leaf nitrogen content from the statistical standpoint.

Finally, the interaction between organic manure source, method of organic manure application and biofertilization shows that the interactions of poultry manure, particularly when poultry manure applied in trenches and supported with Rhizobacterien induced the highest positive effect on leaf nitrogen content. On the contrary, the combinations of cattle manure exerted the least positive effect on leaf nitrogen content. Besides, the combinations of sheep manure occupied inbetween positions in this respect (Table, 31).

## 4.2.2. Phosphorus

Table (27-31) demonstrates that the three studied factors *i.e.* organic manure source (cattle, poultry and sheep), method of organic manure application (surface and trench) and biofertilization alone or in different combinations failed to show any distinctive effect on leaf phosphorus content of Balady mandarin trees during 2000 and 2001 seasons.

Table (30): Effect of interaction between application method of organic manure and biofertilization on leaf N, P, K, Ca and Mg content of Balady mandarin trees(2000 and 2001 seasons).

Application	u m			Elem	Elements concentration in dried leaves (%)	centrati	on in drie	ed leave	(%) s		
method	Biofertilizer	Nitro	Nitrogen	Phos	Phosphorus	Potas	Potassium	Calcium	ium	Magnesium	esium
		(2000)	(2001)		(2000) (2001)	(2000)	(2000) (2001) (2000)	(2000)	(2001)	(2000)	(2001)
Surface	- Nitrobien	2.53 b	2.50 c	0.138 a	2.50 c 0.138 a 0.137 a 0.856 b 0.866 c	0.856 b	0.866 c	3.3 c	3.3 c	0.396 c 0.413 c	0.413 c
	- Rhizobacterien	2.57 b	2.55 b	J.138 a	U.138a 0.138a 0.886b 0.886b	0.886 b	0.886 b	3.5 b	3.6 L	0.432 b 0.450 b	0.450 b
Tranch	→ Nitrobien	2.54 b	2.52 bc	0.137 a	2.52 bc 0.137 a 0.138 a	0.878 b	0.885 b	3.5 b	3.6 b	0.426 b 0.450 b	0.450 b
	- Rhizobacterien	2.61 a		0.141 a	2.60a 0.141a 0.141a 0.933a 0.950a	0.933 a	0.950 a	3.7 a	3.9 a	0.463 a 0.474 a	0.474 a
Means within ea	Means within each column, followed by the same letter(s) are not significantly different at 5% level.	by the sar	ne letter(s	) are not s	ignificantly	different	at 5% level				

Table (31): Effect of interaction between organic manure source, application method and biofertilization on leaf N, P, K, Ca and Mg content of Balady mandarin trees(2000 and 2001 seasons).

Organic	ADDICATION											
maniire	method		Nitr	Nitrogen	Phosphorus	horus	Potas	Potassium	Calc	alcium	Magn	Magnesium
Source		bacteria	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
		Nitrobien	2.43 g	238f	0.136 a	0.136 a	0.700 f	0.7101	3.0 f	2.9 f	0.291	0.301
Cattle T	Surface -	Rhizobacterien	2.44 q	2.41f	0.136 a	0.133 a	0.750 ef	0.750 h	3.1 ef	3.1 f	0.34 h	0.36 h
manure		Nitrobien	2.42 g	2.40 f	0.133 a	0.136 a	0.740 ef	0.740 h	3.1 ef	3.1 f	0.34 h	0.37 gh
	Trench	Rhizobacterien	2.47 fg	2 44 f	0.136 a	0.140 a	0.790 de	0.800 g	3.2 def	3.3 e	0.37 g	0.38 g
		Nitrobien	2.63 bcd	2.61 cd	0.140 a	0.140 a	1.000 ab	1.010 c	3.6 c	3.8 c	0.49 c	0.51 c
Doultry [	Surface -	Rhizobacterien	2.69 b	2.67 b	0.140 a	0.143 a	1.040 a	1.040 b	4.0 b	4.2 b	0.52 b	0.54 b
manure		→ Nitrobien	2.65 bc	2.64 bc	0.140 a	0.140 3	1.007 ab	1.007 c	4.0 b	4.2 b	0.51 b	0.53 b
!	*Trench	Rhizobacterien	277a	2.76 a	0.146 a	0.143 a	1.070 a	1.090 a	4.5 a	4.7 a	0.57 a	0.57 a
		Nitrobien	2.53 ef	2.51 e	0.140 a	0.136 a	0.870 cd	0.880 f	3.3 cdef	3.4 de	0.41f	0.43 f
Sheep	Surface -	Rhizobacterien	2.58 cde	2.56 de	0.140 a	0.140 a	0.870 cd	0.870 f	3.4 cde	3.5 de	0.43 e	0.45 e
manure →		Nitrobien	2.55 def	2.53 e	0.140 a	0.140 a	0.890 c	0.910 e	3.3 cdef	3.4 de	0.43 e	0.45 e
	*Trench	→ Rhizohacterien	251 bade	2.59 cd	0.140 a	0.140 a	0.940 bc	0.960 d	3.5 cd	3.6 d	0.45 d	0.47 d

#### 4.2.3. Potassium

It is clear that fertilizing Balady mandarin trees with poultry manure enriched leaf potassium content (1.02 & 1.03%) as compared with those manured with sheep (0.89 & 0.90%) and cattle manured trees (0.74 & 0.75%) in 2000 and 2001 seasons, respectively. Anyhow, the differences between the three organic manure sources in this respect were obvious to be significant, (Table, 27).

Furthermore, the application of the three studied organic manure sources in trenches induced higher positive effect on leaf potassium content rather than superficial application (**Table, 27**).

Moreover, **Table (27)** reveals that fertilizing Balady mandarin trees with Rhizobacterien improved leaf potassium content rather than Nitrobien fertilization.

Furthermore, **Table (28)** shows that leaf potassium content responded largely to organic manure source rather than method of organic manure application, when their interactions were concerned, thereupon poultry manure whether applied superficially or in trenches induced similarly higher positive effect on leaf potassium content followed descendingly by the combinations of sheep manure and lastly the corresponding ones of cattle manure in both seasons of study.

In addition, the interaction between organic manure source and biofertilization demonstrates that the upper hand for the effect on leaf potassium content was organic manure source rather than biofertilization. Thereupon, poultry manured trees supported with Rhizobacterien or Nitrobien induced statistically

similar and higher positive effect on leaf potassium content, followed descendingly by those of sheep manure and lastly the interactions of cattle manure (Table, 29).

On the other side, **Table (30)** reveals that out of interactions between method of organic manure application and biofertilization. Trench application x Rhizobacterien scored statistically higher values of leaf potassium content. Other tested combinations produced similar effect on leaf potassium content from the statistical stand point in both seasons of study.

Finally, the interaction between the three studied factors *i.e.* organic manure source, method of organic manure application and biofertilization demonstrates that the interactions of poultry manure exerted similarly higher positive effect on leaf potassium content of Balady mandarin trees, followed descendingly by those of sheep manure, and lastly, the interactions of cattle manure in the first and second seasons (**Table, 31**).

#### 4.2.4.Calcium

It is obvious from **Table (27)** that leaves of poultry manured trees had higher values of calcium (4.0 & 4.2%), followed by those manured with sheep (3.3& 3.4%) and lastly those of cattle manured trees (3.1 & 3.1 %) in 2000 and 2001 seasons, respectively. The differences between the three studied organic manure sources, regarding leaf calcium content were remarkable to be significant at 5% level.

In addition, the application of the three studied organic manure source in trenches induced higher positive effect on leaf nitrogen content rather than superficial application (**Table,27**).

Furthermore, inoculating Balady mandarin trees with Rhizobacterien enriched leaf calcium content rather than the inoculation with Nitrobien.

As for the interaction between organic manure source and application method of organic manure, **Table (28)** reveals that poultry manure applied firstly in trenches and secondly superficially showed to be the most efficient combinations in enhancing leaf calcium content. Bedsides, the interactions of sheep manure surpassed the corresponding ones of cattle manure in improving leaf calcium content of Balady mandarin trees in both seasons.

Regarding the interaction between organic manure source and biofertilization, **Table(29)** demonstrates that Rhizobacterien combinations surpassed Nitrobien followed descendingly by those manured with the same organic manure source and provided with Nitrobien. Besides, the combinations of sheep manure took not only the same trend, but also surpassed the analogous ones of cattle manure.

Furthermore, **Table (30)** shows that the application of organic manure in trenches provided with Rhizobacterien inoculation enhanced leaf calcium content, followed descendingly by surface application supported with Rhizobacterien. On the other hand, trench application of organic manure associated with Nitrobien inoculation surpassed surface application provided with the same biofertilizer in enhancing leaf calcium content.

Finally, Table (31) illustrates that the interaction between the three studied factors i.e. organic manure source, application method of organic manure and biofertilization on leaf calcium content. Briefly, poultry manure x trench application x Rhizobacterien, followed by poultry manure x trench or surface application x Rhizobacterien or Nitrobien gave the highest values of leaf calcium content. On the other side, the combinations of sheep manure surpassed the corresponding ones of cattle manure in improving leaf calcium content of Balady mandarin trees.

#### 4.2.5. Magnesium

Table (27-31) shows that the specific effect of organic manure source, application method of organic manure and biofertilization (Table, 27), the interaction effect between organic manure source and application method (Table, 28), the interaction effect between organic manure source and biofertilization (Table, 29), the interaction effect between method of organic manure application and biofertilization (Table, 30) and the interaction effect between the three studied factors, i.e. organic manure source, method of application and biofertilization, (Table, 31) took nearly similar trend to that of leaf calcium content of Balady mandarin trees in 2000 and 2001 seasons.

#### 4.2.6. Iron, Manganese and Zinc

It is obvious from **Table (32)** that leaves of poultry manured trees had the highest values of leaf Fe, Mn and Zn

Table (32): Specific effect of organic manure source, application method and biofertilization on leaf Fe. Mn. Zn. and Cu content of Balady mandarin trees(2000 and 2001 seasons).

		100	onte con	centration	Floments concentration in dried leaves (ppm)	eaves (p	- 1	
		LIEI	ווחס כווום	000	Zinc	U	Copper	per
Factor	=	Iron	Manganese	nese	10000	120041	(2000)	(2001)
Lactor	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2002)	
			a. Effec	ct of organi	a. Effect of organic manure source	ource		
	8	67 c	500	o 64	41 c	43 c	5 a	6 a
Cattle mailui e	. 6	87 a	73 a	74 a	68 a	70 a	5 a	6 a
Poultry manure	81 b	78 b	63 b	65 b	26 b	58 b	5 a	6 a
Silech illanais			ъ.	ffect of app	b. Effect of application method	thod		
	d 67	75 b	58 b	61 b	53 b	54 b	Sa	6 а
Surface	82 a	79 a	63 a	65 a	58 a	60 a	5 a	6 a
			0	Effect of	c. Effect of biofertilization	no		
	78 5	75 b	57b	28 b	53 b	25 b	5 a	6 a
Nitrobien	2 88	79 a	64 a	67a	58 a	59 a	5 a	6 a
Rhizobacterien	3			a not signifi	level.	ent at 5%	evel.	

Means within each column, followed by the same letter(s) are not significantly different at 5%

content, followed descendingly by those of sheep manured ones lastly those fertilized with cattle manure. However, the differences between the three tested organic manure source in this concern were remarkable to be significant.

Furthermore, the application of organic manure in trenches enhance leaf Fe, Mn and Zn content rather than surface application.

Moreover, inoculating Balady mandarin trees with Rhizobacterien exerted more positive effect on leaf Fe, Mn and Zn rather than Nitrobien inoculation.

Additionally, **Table (33)** reveals that the application of poultry manure firstly in trenches and secondly superficially exerted the highest stimulative effect on leaf Fe, Mn and Zn content. On the contrary, the application of cattle manure either in trenches or superficially induced the lowest values in this respect. The interactions of sheep manure occupied an intermediate position inl this sphere.

Table (34) shows that the interaction between organic manure source and biofertilization took the same trend of interaction between organic manure source and method of organic manure application regarding leaf Fe, Mn and Zn content. Thereupon, leaves of poultry manured trees in general, manured in trenches in particular or superficially were the richest ones in their content of Fe, Mn and Zn. Besides, the combinations of sheep manure induced higher positive effect on leaf Fe, Mn and Zn content as compared with those of cattle manure.

It is quite evident from **Table (35)** that the application of organic manure in trenches, provided with Rhizobacterien

Table (33): Effect of interaction between organic manure source and application method on leaf Fe, Mn, Zn, and Cu content of Balady mandarin trees(2000 and 2001 seasons).

			Elem	nents con	centratio	Elements concentration in dried leaves (ppm)	leaves (p	pm)	
Organic manure	Application	14	Iron	Manganese	anese	Zinc	51	Copper	per
source	method	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	*Surface	5 89 c	9 g	‡ ~	46 d	38 f	8 a	5 a	ба
Cattle manure →	Trench	71 c	P 89	46 e	52 c	45 e	99 9	5 a	6 а
	→ Surface	89 a	84 b	9 69 p	73 a	99 99	q 89	S a	6 а
Poultry manure→	Trench	93 a	90 a	77 a	75 a	71 a	72 a	S a	6 a
	→ Surface	80 b	77 c	61 d	64 b	54 d	P 99	Sa	6 a
Sheep manure	Trench	82 b	29 6	65 c	67 b	59 c	61 c	Sa	6 а
Means within each colum	column, followed by the same letter(s) are not significantly different at 5% level.	same letter	(s) are not	significantly	different at	5% level.			

Table (34): Effect of interaction between organic manure source and biofertilization on leaf Fe, Mn, Zn, and Cu content of Balady mandarin trees(2000 and 2001 seasons).

			Elen	nents con	centratio	Elements concentration in dried leaves	leaves (	opin)	
Organic manure	Riofertilizer	Iron	ň	Manganese	anese	Zinc	ถ	Cop	per
source		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	Nitrobien	67 d	64 c	43 f	45 d	38 e	ф д	co Co	6 a
Cattle manure→	Rhizobacterien	72 d	69 с	50 e	54 c	45 d	8° c	OJ OJ	б а
	Nitrobien	д 38	85 a	69 b	67 b	66 Ь	68 a	5 a	б в
Poultry manure	Rhizobacterien	92 a	89 a	77 a	81 a	71 a	72 a	Б	6 a
	Nitrobien	80 c	77 b	61 d	63 b	55 c	57 b	5 a	6 a
Sheep manure	Rhizobacterien	82 c	79 b	65 c	d 83	58 c	60 Ь	55 a	0
Means within each column, followed by the same letter(s) are not significantly different at 5% level	n, followed by the s	same letter	(s) are not	significantly	different at	5% level.			

Table (35): Effect of interaction between organic manure application method and biofertilization on leaf Fe. Mn, Zn, and Cu content of Balady mandarin trees(2000 and 2001 seasons).

10n (2000) (20 77 77 80 b 77 79 b 77 79 b 77 79 67 77 79 67 77 79 67 79 69 69 69 69 69 69 69 69 69 69 69 69 69				Elem	nents con	centration	Elements concentration in dried leaves (ppm)	leaves (p	- 1	
Nitrobien (2000)  Rhizobacterien 80 b  Nitrobien 79 b	ication	Diofortilizar	1		Mang	Manganese	Zinc	JC	Copper	per
Nitrobien 77 b Rhizobacterien 80 b Nitrobien 79 b	ethod		(0000)		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
<ul><li>Rhizobacterien 80 b</li><li>Mitrobien 79 b</li></ul>	1	Nitrobien	77 b	74 b	55 c	58 c	51 c	52 c	5 a	6 a
Nitrobien 79 b	→ →	Rhizobacterien	80 P	76 b	61 b	64 b	55 b	. q 95	5 a	6 a
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Ł	Nitrobien	79 b	76 b	9 p	58 c	55 b	57 b	5a	6 a
<ul> <li>Rhizobacterien 85 a</li> </ul>	† †	Rhizobacterien	85 a	82 a	67 a	71 a	61 a	62 a	5 a	6 a
Means within each column. followed by the same letter(s) are not significantly different at 5% level.	the orthin	rolumn. followed by th	e same letter	(s) are not	significantly	different at	5% level.			

inoculated recorded the highest values of leaf Fe, Mn and Zn content. Moreover, trench application of organic manure supported with Rhizobacterien exerted similar positive effect on leaf Fe, Mn and Zn content to that of surface application of organic manure associated with Nitrobien inoculation. On the contrary, trees manured superficially and inoculated with Nitrobien had the lowest leaf Fe, Mn and Zn content.

Lastly, the interaction between organic manure source, method of organic manure application and biofertilization, (Table, 36) reveals that the poultry manured trees, inoculated with Rhizobactrien and fertilized in trenches in particular and/or superficially followed descendingly by the corresponding ones inoculated with Nitrobien and manured firstly in trenches and secondly superficially showed the highest values of leaf Fe, Mn and Zn content. Besides, the combinations of sheep manure proved to be more efficient in enhancing leaf Fe, Mn and Zn content than the analogous of cattle manure.

## 4.2.7. Copper

It is clear from **Table (32-36)** that the three studied factors, i.e. organic manure source, method of organic manure application and biofertilization whether concerned lonely or in their different studied combination failed to induce a distinctive effect on leaf copper content of Balady mandarin trees during 2000 and 2001 seasons.

Abstractly, poultry manure proved to be the superior organic manure source in enhancing leaf N, K, Ca, Mg, Fe, Mn and Zn content. Besides, the application of organic manure in

Table (36): Effect of interaction between organic manure source, application method and biofertilization on leaf Fe. Mn. Zn and Cu content of Balady mandarin trees(2000 and 2001 seasons).

manure Application source method				Elements o	concentrat	on in dried	Elements concentration in dried leaves (PPM)	-	
method	(N-fixing		Iron	Man	Manganese		Zinc		
	bacteria}	(2000)	(2001)	(0000)	,,,,,,,		2	Copper	ber
NI:		1	(100-)	(5000)	(2001)	(2000)	(2001)	(2000)	(2001)
Surface > Introblen	opien	66 g	63 g	41 g	42 f	37 g	38.9	S) B	n CC
	Rhizobacterien	71 fg	68 fg	47 f	51 ef	40 a	42.0	ע	
manure   Trench    → Nitrobien	obien	69 fg	66 fg	45 fg	48 ef	40 d	e C7		
+ Rhiz	Rhizobacterien	74 ef	71 ef	53 e	57 de	50 f	50 f	η σ Ω	n m D Q
* Surface →	obien	88 pc	85 bc	67 bc	70 bc	64 bc	99 pc		
	► Rhizobacterien	91 ab	84 bc	72 b	76 b	69 ab	70 ab		
manure   Trench	obien	88 pc	87 b	72 6	64 cd	69 ab	70 ah		
	<ul> <li>Rhizobacterien</li> </ul>	98 a	95 a	82 a	87.3	2 2 2	, v		D Q
Surface	bien	79 de	76 de	59	7 7	ט כ	. t	o a	/ a
١	- Rhizobacterien	81 cde	78 cde	5 69		12 C	54 eT	Sa	6 а
manure Trench → Nitrobien	pien	81 cde	78 cde	63 cd	64 cd	Sp det	58 de		6 6
	Rhizobacterien	84 pcd	81bcd	67 bc	70 bc	61 cd	93 CG	е ( С	o c

trenches exerted more positive effect on leaf Ca, Mg, Fe, Mn and Zn than surface application. Moreover, Rhizobacterien inoculation surpassed Nitrobien inoculation in improving leaf N, K, Ca, Mg, Fe, Mn and Zn content.

The improvement in leaf nutrient content due to poultry manure may be explained by the fact that it induced positive effect on physical condition of the soil; creates favourable conditions for root growth and nutrients absorption; it supplies much nutrients, and it facilitates the absorption of fixed nutrients by tree roots. Besides, poultry manure contains twice as much nitrogen as farmyard manure, they are much richer in phosphorus and contain as potassium as farmyard manure (Cook, 1982).

Furthermore, the enhancement of leaf nutrient content due to trench application of organic manure, may be due to the fact that the incorporation of manure in the soil provided a protection against nutrients losses (Cook, 1982).

Briefly, the results of leaf mineral content due to organic manure source are in accordance with the findings of Sekiya et al. (1993) on Satsuma mandarin, Kalu-Singh et al. (1984) on mango. Noack (1984) on apple, Darfeld and Lenz (1985) on pear, Umemiya and Sekiya (1985) on persimmon, Villasurda and Baluyut (1990) on guava, Ben-Ya-Acov et al. (1992) on avocado, Awad et al. (1993) on olive, Alvarez etal. (1993) on pinapple, Smith (1994) on banana, Abu-Sayed Ahmed (1997) on Balady mandarin El-Kobbia (1999) on Balady mandarin and Moustafa (2002) on Washington navel orange. They reported

that organic manure, particularly, poultry manure enhanced leaf mineral content.

Besides, the obtained results of leaf mineral content attributed to the effect of method of organic manure application are in harmony with the findings of Thachuk (1983) on apple, Bhangoo et al. (1988) on grape, Goede (1993) on mango and Moustafa (2002) on Washington navel orange. Moreover, the results of biofertilization regarding leaf mineral content are in agreement with the findings of Pmares et al. (1983) on oranges, Chokha et al. (1993) on orange, Haggag and Azzazy (1996) on mango, Ahmed et al. (1997) on grape, Awashi et al. (1998) on peach, Fernandez et al. (1998) on banana, Mansour (1998) on Anna apple, Mahmoud and Mahmoud (1999) on peach Tiwary et al. (1999) on banana and Moustafa (2002) on Washington navel orange. They mentioned that Rhizobacterien enhanced most leaf mineral content.

#### 4.3. Tree fruiting

Data presented in **Tables** (37 – 47) show the effect of organic manure sources, *i.e.* cattle, poultry and sheep, methods of organic manure application (surface and trench) and biofertilization (Rhizobacterien and Nitrobien) as well as their interactions on tree fruiting parameters *i.e.*, fruit set, fruit drop percentages, number of fruits per tree, yield (kg/tree) and biennial bearing index of Balady mandarin trees during 2000 and 2001 seasons.

## 4.3.1. Fruit set percentages

It is quite evident from **Table (37)** that poultry and sheep manured-Balady mandarin trees set higher percentages of fruits (26.92 & 24.04) and (26.92 & 24.10) respectively, and finally cattle manured (26.15 & 23.18) in 2000 and 2001 seasons, respectively. However, the differences between poultry manure and cattle manure in this respect were obvious to be significant at 5% level. On the other hand, the differences between sheep manure and both poultry and cattle manure in this concern were so small to reach the significance level.

Furthermore, the application of organic manures method in trenches surpassed superficially to set higher percentage of fruit of Balady mandarin trees in both seasons of study (Table, 37).

In addition, biofertilization failed to induce any significant effect on fruit set of Balady mandarin trees in both seasons.

As for the effect of interaction between organic manure source and method of application on fruit set percentages of Balady mandarin trees, **Table (38)** demonstrates that in both seasons of study, poultry manure applied in trenches gave the highest values on fruit set percentage, followed descendingly by sheep manure in trenches. On the contrary, cattle manure applied on the surface gave the lowest values in this concern.

The interaction between organic manure source and biofertilization, (Table, 39) failed to induce a pronounced effect on fruit set percentage from the statistical standpoint in both seasons.

Table (37): Specific effect of organic manure source, application method and biofertilization on fruit set and fruit shedding percentage of Balady mandarin trees(2000 and 2001 seasons).

	Fruit set	set			Fruit shedding(%)	(%) Buipt		- 1		1.0
Factor	(%)		May, 1st-May,31th	May,31th	June, 1st - July. 1st	-July.1st	July, 2nd -Augsut, 1st		August, 2nd - September, 1st	eptember,1si
	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(1007)
				a. Effe	ct of orga	a. Effect of organic manure source	e source			
Cattle manure	26.15 b	23.18 b	55.21 a	53.07 a	18.74 a	15.64 a	12.70 a	10.59 a	4.69 a	4.47 a
Poultry manure	26.92 a	24.04 a	52.94 b	50.81 b	18.38 b	15.28 b	12.30 b	10.22 b	4.30 b	4.09 b
Sheep manure	26.92 a	24.10 a	52.97 b	50.78 b 18.38 b	18.38 b	15.29 b	12.27 b	10.25 b	4.30 b	4.10 b
				b. Ef	ffect of ap	<ul> <li>b. Effect of application method</li> </ul>	nethod			
Surface	26.23 b	23.33 b	54.38 a	52.15 a	52.15 a 18.63 a	15.53 a	12.56 a	10.45 a	4.58 a	4.36 a
Trench	27.09 a	24.22 a	53.13 b		50.90 b 18.38 b	15.28 b	12.28 b	10.26 b	4.28 b	4.08 b
				ij	. Effect of	c. Effect of biofertilization	ation			
Nitrobien	26.04 a	23.09 a	55.12 a	52.92 a	18.59 a	15.49 a	12.46 a	10.37 a	4.46 a	4.24 a
Rhizobacterien	27.28 a	24.46 a	52.29 b	50.18 b	18.41 b	15.32 b	12.38 a	10.34 a	4.39 a	4.20 a

Table (38): Effect of interaction between organic manure source and application method on fruit set and fruit shedding percentage of Balady mandarin trees(2000 and 2001 seasons).

1	Frui	set			Fruit she	edding(%)				
ICALIOII	3	6)	May, 1st	May,31th	June,1s	-July.1st	July, 2nd -	Augsut, 1st	August.2nd -	September
niod	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Surface	25.89 b	22.90 b	55.68 a	53.55 a	18.83 a	15.73 a	12.77 a	10.63 a	4.76 a	4.54 a
* Trench	26.40 ab	23.47 ab	54.73 ab	52.59 ab	18.66 b	15.56 ь	12.63 a	10.55 ab	4.62 ab	4.40 b
Surface	25.40 ab	23.47 ab	53.58 bc	51.47 bc	18.52 b	15.47 b	12.48 a	10.39 bc	4.49 b	4.27 c
	27.40 ab 27.44 a	23.47 ab 24.61 a	53.58 bc 52.31 c	51.47 bc 50.15 c	18.52 b 18.24 c	15.47 b	12.48 a 12.11 b	10.39 bc 10.06 e	4.49 b	4.27 c
to (p	25.40 ab 27.44 a 26.40 ab	23.47 ab 24.61 a 23.62 ab	53.58 bc 51.47 bc 52.31 c 50.15 c 53.58 bc 51.43 bc	51.47 bc 50.15 c 51.43 bc	18.52 b 18.24 c 18.52 b	15.4° b 15.14 c 15.43 b	12.48 a 12.11 b 12.43 ab	10.39 bc 10.06 e 10.32 cd	4.49 b 4.11 c 4.48 b	4.27 c 3.91 d 4.28 c
	Application method Surface Trench	d (200 e 25.89 26.40	ruit (%) (2000) (%) (%) (%) (%) (%) (%) (%) (%) (%) (%	Fruit set  (%)  (2000)  (2001)  (2000)  (2001)  (2000)  (2000)  (2000)  (2000)  (2000)  (2000)  (2000)  (2000)  (2000)  (2000)	Fruit set  (%)  (2000)  (2001)  (2000)  (2000)  (2000)  (2000)  (2000)  (2000)  (2000)  (2000)  (2000)  (2000)  (2000)	Fruit set  (%)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)	Fruit set    Fruit set   Fruit shed	Fruit set  (%)  (%)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)  (2001)	Fruit set  (%)  (%)  (%)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)  (2001)  (2000)	Fruit set  (%)  (%)  (%)  (%)  (%)  (%)  (%)  (%

Table (39): Effect of interaction between organic manure source and biofertilization on fruit set and fruit shedding percentage of Balady mandarin trees (2000 and 2001 seasons).

O. in Child		Frui	Fruit set			Fruit shedding (%)	ding(%)				
Organic	Riofortilizar	0	(%)	May, 1st-May,31th	May,31th	June, 1st - July, 1st	-July.1st	July, 2nd -4	\ugsut,1⁵¹	August, 2nd	July, 2nd -Augsut, 1st August, 2nd -September, 1st
Source		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	→ Nitrobien	25.59 a	22.55 a	56.71 a	56.71 a 54.57 a 18.85 a	18.85 a	15.76 a	12.74 a	10.64 a	4.73 a	4.51 a
Cattle →	> Rhizobacterien	26.70 a	23.85 a	53.71 ab	51.57 ab	53.71 ab 51.57 ab 18.63 ab	15.52 ab	12.66 a	10.54 a	4.65 ab	4,43 a
9	→ Nitrobien	26.26 a	23.38 a	54.31 ab	54.31 ab 52.10 ab 18.46 bc	18.46 bc	15.36 bc	12.34 a	10.26 a	4.33 bc	4.10 b
Poultry→	→ Rhizobacterien	27.58 a	24.69 a	51.58 b	49.52 b	18.30 c	12.20 c	12.26 a	10.19 a	4.27 c	4.08 b
	→ Nitrobien	26.26 a	23.35 a	54.35 ab	52.10 ab	54.35 ab 52.10 ab 18.46 bc	12.36 bc	12.31 a	10.23 a	4.34 bc	4.12 b
Sheep →	→ Rhizobacterien	27.58 a	24.86 a	51.59 b	51.59 b 49.47 b 18.30 c	18.30 c	15.22 c	12.22 a	10.28 a	4.26 c	4.08 b
Means within	Means within each column, follo	wed by the	same lette	er(s) are no	t significar	followed by the same letter(s) are not significantly different at 5% level	it at 5% lev	/el.			

Regarding the effect of interaction between method of organic manure application and biofertilization, failed to induce a pronounced effect on fruit set percentage from the statistical standpoint in both seasons, (Table, 40).

Regarding the interaction between organic manure source, method of organic manure application and biofertilizers, **Table** (41) indicates that nearly all the studied combinations failed to induce a pronounced effect on fruit set percentage of Balady mandarin trees from the statistical standpoint in both seasons.

# 4.3.2. Fruit drop percentages

Table (37) reveals that in both seasons cattle manured trees recorded higher percentages of fruit dropping during May,  $1^{st}$  – May,  $31^{st}$ , June,  $1^{st}$  – July,  $1^{st}$ , July,  $2^{nd}$  – August,  $1^{st}$  and August,  $2^{nd}$  – September,  $1^{st}$  as compared with those fertilized with poultry or sheep manure. Besides, poultry and sheep manured trees shed lesser percentages of fruits during May,  $1^{st}$  – May,  $31^{st}$ , June,  $1^{st}$  – July,  $1^{st}$ , July,  $2^{nd}$  – August,  $1^{st}$  and August,  $2^{nd}$  – September,  $1^{st}$ .

Furthermore, the application of organic manures in trenches succeeded in reducing fruit shedding during the fourth studied periods of fruit dropping, *i.e.* May,  $1^{st}$  – May,  $31^{st}$ , June,  $1^{st}$  – July,  $1^{st}$ , July,  $2^{nd}$  – August,  $1^{st}$  and August,  $2^{nd}$  – September,  $1^{st}$  as compared with surface application in both seasons.

Additionally, biofertilization in the form of Rhizobacterien surpassed Nitrobien in reducing fruit shedding

Table (40): Effect of interaction between application method of organic manure and biofertilization on fruit set and fruit shedding percentage of Balady mandarin trees(2000 and 2001 seasons).

September,1st	July, 2 <sup>nd</sup> - Augsut, 1 <sup>nd</sup> Augus, 2001) (2001)	12.58 a 10,47 a 4.60 a	12.53 a 10.42 a 4.56 a	12.34a 10.27a 4.33ab 4.10b	12.22 a 10.25 a 4.23 b 4.65 b	level.	
(%) Duippe to *:7	May, 1st-May, 31th June, 1st - July, 1st	(2000) (2001) (2000) (2001)	22.62a 55.15a 53.01a 10.00 22.62a 55.15a 15.45ak	24.03 a 53.42 ab 51.23ab	23.57 a 55.09 a 52.84 a 10.45 a 15.18 c	rien 27.73 a 24.80 a 51.16 b 49.08 b 10.25 c 27.73 a 24.80 a 51.16 b 49.08 b 10.25 c 27.73 a 24.80 a 51.16 b 49.08 b 10.25 c 27.73 a 24.80 a 51.16 b 49.08 b 10.25 c 27.73 a 24.80 a 51.16 b 49.08 b 10.25 c 27.73 a 24.80 a 51.16 b 49.08 b 10.25 c 27.73 a 24.80 a 51.16 b 49.08 b 10.25 c 27.73 a 24.80 a 51.16 b 49.08 b 10.25 c 27.73 a 24.80 a 51.16 b 10.25 c 27.73 a 24.80 a 2	(s) ale 100 sign
ruit sucading pere-	F.	(2000)	25.63 a 22.62 a	26.33 a	26.45 a 23.57 a	en 27.73 a 24.80 a	followed by the same letter
Iruit suc		Application Biofertilizer method	Nitrobien	Surface > Rhizobacterien	→ Nitrobien	a)	Means within each column, f

Table (41): Effect of interaction between organic manure source, application method of organic manure and biofertilizer on fruit set and fruit shedding percentage of Balady mandarin trees(2000 and 2001 seasons).

			1 771								
SOURCE ON	{N-fixing	(2000)	(2004)	may, 1	may, 1%-May,31th	June, 1	June,1st -July,1st	July,2nd	July,2nd -Augsut,1st	August, 2nd -September 1st	-Septemb
Herhod	bacteria}	1-1-00)	12001)	(בחחח)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
-Surface →	Nitrobien	25.28 a	22.13 a	57.20 a	55.07 a	18 95 2	4n on 1				1
Came	Rhizobacterien	26.50 a	23.67 a	£4.46 2F		0	13.85 a	12.81 a	10.67 a	4.81 a	4.59 a
•	Nitrobio		2	of lo ab	52.03 ab	18.70 abc	15.60 abc	12.72 a	10.59 a	477 36	
Trench →	Nitroblen	25.90 a	22.97 a	56.21 ab	54.07 ah	18 76 ak	0		0.00	4.12 ab	4.50 a
	Rhizobacterien	26 90 a	23 07 2	)	0.07	10.76 ab	15.66 ab	12.67 a	10.60 a	4.65 ab	4.43 a
		0	10.01 d	53.25 ab	51.10 ab	18.55 bc	15.45 bc	10 59 3	10 10		: ::
Surface →	Nitrobien	25.80 a	22.87 a	54.12 ab	51 93 ah	10 67 6	i :	2	10.40 a	4.59 abc	4.37 a
Poultry	Rhizobacterien	27.00 a	24 07 3	D 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		10.07 DC	15.47 bc	12.49 a	10.39 a	4.49 abc	4.28 ab
	Vitrobian	200		00.00 AD	51.00 ab	18.48 bcd	15.38 bcd	12.46 a	10.38 a	4 50 abo	2 2 2
Trench ->		70.17 0	23.90 a	54.49 ab	52.27 ab	18.35 cd	15 25 64				T.27 dD
24	Rhizobacterien	28.15 a	25.32 a	50 10 5	2		0.4.0	12.18 a	10.12 a	4.18 bc	3.93 b
,	Nitrobien	25 00 5			48.03 b	18.12 d	15.02 d	12.05 a	10.00 a	4.05 c	3 90 5
Sheen Surface	į	10.00	22.8/ a	54.12 ab	52.03 ab	18.57 bc	15.47 bc	12 45 5		}	0.00
<b>V</b> _	Rhizobacterien	27.00 a	24.37 a	53 05 ah	20 02 25			1.10	10.35 a	4.50 abc	4.30 ab
manure	Nitrobien	26 72 a			00.00 AD	18.48 bcd	15.38 bcd	12.40 a	10.30 a	4.47 abc	4.27 ah
rench →		1	P CO.C7	54.5/ ab	52.17 ab	18.35 cd	15.25 cd	12 18 5			
	Rhizobacterien	28.15 a	25.35 a	50 12 h	40 40 5		0	14. 10 d	- I C B	4.18 bc	3.95 b
Means within each column, followed by the same later (1) 18.12 d 15.0	in, followed by	<b>F</b> 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Otto (a)		6. 10	18.12 d	7 d	12.03 a	10.27 a	4.05 c	3 90 5
		200		DOT CODE	200						0.00

during the May, 1<sup>st</sup> – May, 31<sup>st</sup> and June, 1<sup>st</sup> – July, 1<sup>st</sup> of fruit dropping in 2000 and 2001 seasons (**Table, 37**).

Concerning the effect of interaction between organic manure source and method of application, **Table (38)** demonstrates that in general, the application of poultry and sheep manure either superficially or in trenches induced nearly similar and negative effect on fruit dropping during May,  $1^{st}$  – May,  $31^{st}$ , June,  $1^{st}$  – July,  $1^{st}$ , July,  $2^{nd}$  – August,  $1^{st}$  and August,  $2^{nd}$  – September,  $1^{st}$  as compared with cattle manure when applied superficially in both seasons.

As for the effect of interaction between organic manure source and biofertilization, it is clear from **Table (39)** that in both seasons cattle manured trees whether inoculated with Rhizobacterien and Nitrobien shed comparatively higher percentages of fruits as compared with other tested combinations during May, 1<sup>st</sup>, May, 31<sup>st</sup>, June, 1<sup>st</sup>, July, 1<sup>st</sup>, July, 2<sup>nd</sup> – August, 1<sup>st</sup> and August, 2<sup>nd</sup> – September, 1<sup>st</sup>. On the other hand, other tested interactions induced relatively similar effect in this respect during most studied periods.

Table (40) shows that the interaction between method of organic manure application and biofertilization failed to induce an obvious trend regarding their effect on fruit drop percentage during May, 1<sup>st</sup> – May, 31<sup>st</sup>, June, 1<sup>st</sup> – July, 1<sup>st</sup>, July, 2<sup>nd</sup> – August, 1<sup>st</sup> and August, 2<sup>nd</sup> – September, 1<sup>st</sup> in both seasons of study.

Additionally, the interaction between organic manure source, method of organic manure application and biofertilization shows that cattle manured-trees applied superficially or in trenches and supported with Rhizobacterien or

Nitrobien recorded higher values of fruit shedding during the three studied periods *i.e.* May,  $1^{st}$  – May,  $31^{st}$ , June,  $1^{st}$  – July,  $1^{st}$ , July,  $2^{nd}$  – August,  $1^{st}$  and August,  $2^{nd}$  – September,  $1^{st}$ . Besides, other tested combinations namely, poultry and sheep manure whether applied superficially or in trenches and supported with Rhizobacterien or Nitrobien exerted nearly similar effect on fruit shedding during the studied *i.e.* periods May,  $1^{st}$  – May,  $31^{st}$ , June,  $1^{st}$  – July,  $1^{st}$ , July,  $2^{nd}$  – August,  $1^{st}$  and August,  $2^{nd}$  – September,  $1^{st}$ .

# 4.3.3. No. of fruits/tree

Table (42) indicates that in both seasons, the three studied organic manure sources *i.e.* cattle, poultry and sheep exerted statistically similar effect on number of produced fruits per tree.

Furthermore, application method of organic manure in trenches gave the highest remarkable positive effect on number of produced fruit per tree in the second season (2001).

Moreover, biofertilization exerted statistically similar effect on number of produced fruits per tree in both seasons of study.

Furthermore, **Table (43)** shows that out of all interactions between organic manure source and method of organic manure application, poultry manure applied in trenches gave the highest remarkable positive effect on number of produced fruits/tree in the second season (2001).

In addition, **Table (44)** reveals that the interactions between organic manure source and biofertilization failed to show a distinctive trend in number of fruits/tree in both seasons.

Table (42): Specific effect of organic manure source, application method and biofertilization on fruiting of Balady mandarin trees(2000 and 2001 seasons).

Factor (2000)  Cattle manure 349 a	No. of fruits/ tree         Yielc           00)         (2001)         (2000)           a. Effect of organic manure source         49.33 b	Yield (kg)/ tree (2000) (2 (2000) (2 (2000) (2 (2000) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (2 (2000)) (	(2001)
	a. Effect of organi 141 a	(2000) ic manure source 49.33 b	(2001)
	a. Effect of organi 141 a	io manure source 49.33 b	
	141 a	49.33 b	
			19.41 D
	162 a	54.25 a	24.25 a
Sheep manure 354 a	154 a	51.69 ab	22.11 ab
	b. Effect of app	b. Effect of application method	
Surface 349 a	148 b	51.02 a	21.08 b
Trench 351a	156 a	52.49 a	22.76 a
	c. Effect of b	c. Effect of biofertilization	
Nitrobien 347 a	146 a	50.90 a	20.90 a
Rhizobacterien 357 a	158 a	52.61 a	22.94 a

Means within each column, followed by the same letter(s) are not significantly different at 5% level.

**Table (43):** Effect of interaction between organic manure source and application method on some fruiting parameters of Balady mandarin trees (2000 and 2001 seasons).

Organic manure	Application	No. of fruits/ tree	its/ tree	Yield (kg)/ tree	g)/ tree
source		(2000)	(2001)	(2000)	(2001)
Cattle	Surface	350 a	143 cd	19. 59 с	49.39 b
manure	Trench	347 a	139 d	19.26 с	49.26 b
Poultry	Surface	346 a	150 bc	22.01 Ь	52.01 b
manure	* Trench	363 a	174 a	26.48 a	56.48 a
Sheep ->	* Surface	350 a	152 bc	21.67 b	51.67 b
	* Tronch	357 a	156 b	22.35 b	51.72 b

Table (44): Effect of interaction between organic manure source and biofertilization on some fruiting parameters of Balady mandarin trees(2000 and 2001 seasons).

					77
Organic		No. of fruits/ tree	its/ tree	Yield (kg)/ tree	)/ rree
manure	Biofertilizer			(0000)	(2001)
source		(2000)	(2001)	(2002)	7
	noid outilder	342 a	132 a	48.22 b	18.22 D
Cattle	- Niti Obieii			50.43 ab	20.60 ab
manure	Rhizobacterien	355 a	ד+ת פ		-
		350 a	155 a	53.01 ab	23.01 ab
Poultry	1	250	169 a	55.48 a	25.48 a
manure	-Rhizobacterien	B 600		r r	21 48 ab
	Mitrohien	350 a	151 a	51.4/ ab	
Sheep	1	C L	157 a	51.91 ab	22.74 ab
manure	Rhizobacterien	358 a	1	-	

Means within each column, followed by the same letter(s) are not significantly different at 5% level.

It is obvious from **Table (45)** that all interactions between method of organic manure application and biofertilization failed to induce any positive effect on number of fruits/tree in both seasons.

Table (46) demonstrates that the interaction between organic manure source, method of organic manure application and biofertilization failed to induce any positive effect on number of fruits/tree in both seasons.

## 4.3.4. Yield (kg)/tree

It is quite evident from **Table (42)** that poultry manure resulted in increasing tree yield as compared with those manured with cattle manure in 2000 and 2001 seasons. Besides, sheep manure induced an intermediate values in this respect.

Moreover, trench application of organic manure surpassed the superficial in enhancing yield in both seasons of study.

Furthermore, the application of the two studied biofertilizers namely Rhizobacterien and Nitrobien scored statistically similar values of tree yield in the first and second seasons.

In addition, the interaction between organic manure source and method of organic manure reveals that out of all studied interactions poultry manure applied in trenches showed distinctive and higher values of tree yield in both seasons. On the contrary, cattle manure whether applied in trenches or superficially recorded the lowest values of tree yield. The

Table (45): Effect of interaction between application method of organic manure and biofertilization on some fruiting parameters of Balady mandarin trees(2000 and 2001 seasons).

Application method	Biofertilizer	No. of fru	No. of fruits/ tree	Yield (k	Yield (kg)/ tree
		(2000)	(2001)	(2000)	(2001)
Surface +	Nitrobien	342 a	т40 а	49.88 a	19.88 a
	· Rhizobacterien	356 a	157 a	52.17 a	22.28 a
Trong	- Nitrobien	352 a	152 a	51.92 a	21.92 a
Ť	- Rhizobacterien	359 a	160 a	53.05 a	23.61 a
Means within each col	column, followed by th	e same letter(s) are no	umn, followed by the same letter(s) are not significantly different at 5% level.	5% level.	

**Table (46):** Effect of interaction between organic manure source, application method and biofertilization on fruiting of Balady mandarin trees(2000 and 2001 seasons).

				No of fruit / tree	Yiel	Yield (Kg) / tree
Organic	method	(N-fixing bacteria) (2000)	(2000)	(2001)	(2000)	(2001)
		Nitrobien	342 a	133 a	48.27 b	18.27 b
Cattle	Surface ->	Rhizobacterien	358 a	153 a	50.51 ab	20.84 ab
maniire		Nitrobien	342 a	132 a	48.16 b	18.16 b
	→ Trench →	Rhizobacterien	353 a	146 a	50,36 ab	20.36 ab
		→ Nitrobien	340 a	142 a	50.65 ab	20.65 ab
Poultry	Surface >	Rhizobacterien	353 a	159 a	50.37 ab	23.37 ab
manure +		Nitrobien	360 a	168 a	55.37 ab	25.37 ab
ŧ	Trench →	Rhizobacterien	366 a	180 a	57.60 a	27 50 a
		Nitrobien	344 a	145 a	50.71 ab	20.71 ab
Sheep	Surface →	4	357 a	159 a	52 62 ab	22.62 ab
manure		→ Nitrobien	355 a	157 a	52.24 ab	22.24 ab
	Trench →	Rhizobacterien	358 a	155 a	51.19 ab	22 86 ab
which part rolling followed by the same letter(s) are not significantly different at 5% level						

combinations of sheep manure showed inbetween values in this respect (Table, 43).

Table (44) demonstrates that the interaction between organic manure source and biofertilization exerted that poultry manure provided with Rhizobacterien proved to be the most effective combination in enhancing tree productivity of Balady mandarin. On the contrary, cattle manure interactions showed to be the lowest effective combination in this concern. Besides, other studied interactions produced an intermediate effect on tree yield in both seasons of study.

It is obvious from **Table (45)** that out of all interactions between method of organic manure application and biofertilization failed to induce any positive effect on tree yield in both seasons.

Finally, the interaction between organic manure source, method of application and biofertilization, indicates that out of the tested combinations, poultry manure applied in trenches and supported with Rhizobacterien showed a remarkable and higher positive effect on number of produced fruits per tree compared with cattle manure applied in (surface or trench) supported with Nitrobien. Other tested interactions gave statistically similar values in this respect.

Abstractly, poultry manure proved to be the most efficient organic manure source in enhancing tree fruiting of Balady mandarin trees, hence it increased fruit set percentage, reduce fruit dropping waves and improved tree yield (No. of fruits/tree and yield (kg)/tree). Besides, trench application of organic manure reduced the waves of fruit dropping as compared with

surface application. Moreover, Rhizobacterien inoculation enhanced fruit set percentage and reduced fruit shedding percentage as compared with Nitrobien inoculation.

The enhancement of tree productivity as a result of using organic manure in general and poultry manure in particular may be due to the following facts (1) manure improves soil physical conditions, (2) it creates more favourable conditions for plant growth and nutrient absorption, (3) it supplies much higher nutrient elements with poultry manure, (4) it releases much more or less available elements (particularly, P, Fe, Zn, and Mn), (5) it increases the soil content of IAA and cytokinins (Li et al, 1998).

In addition the improvement of tree fruiting as a result of biofertilization may be due to the production of growth regulators as well as N-fixation (Rao and Dass, 1989).

The results of tree fruiting induced by organic manure source are emphasized by the findings of Bach and Abo-Hassan (1983) on date palm, Marecek and Moravek (1983) on apple, Mukherjee et al. (1983) on jack fruit. Sekiya et al (1983) on Satsuma mandarin, Tanas'ev and Balan (1983) on apple, Gasanor (1984) on persimmon, Kalu-singh et al (1984) on mango. Kopytko (1984) on apple. Motskobili (1984) on Tanas'ev (1984) on apple, Darfeld and Lenz (1985) Satsuma, on pear, Pil'Shchikov (1986) on apple, Bussi and Defrance (1987) on peach, Gadelha and Vieira (1988) on pineapple, Piatkowski et al. (1990) on apple, Villasurda and Baluyut (1990), Davitaze (1991), Wang et al. (1991) on grape, Ben-Ya-Acov et al.(1992) on avocado, Bussi et al. (1992) on peach, Gouda et al (1992) on grape, Alvarez et al (1993) on pineapple, Rabeh et al (1993) on Balady mandarin, Prabhuram and

Sathiamoorthy (1993) on banana. Li et al (1997) on pear, Song et al. (1999) on apple and Ye-Jianwin et al. (1999) on pummelo. In this respect, Ben-Ya-Acov et al. (1992) mentioned that the combination of the better rootstock and organic manure application increased yield by 135 % compared with the other rootstocks without organic manure application. Besides, Gouda et al. (1992) reported that the best result of combines treatments on yield were poultry manure and cattle manure at 3.5 and 12 t/fed, respectively. Recently, Moustafa (2002) on Washington navel orange, realized the highest yield was produced by rabbit manure.

The obtained results regarding the effect of organic manure application method on tree fruiting go in line with those mentioned by Tsipko (1982) on apple, Tkachuk (1983) on apple, Bhangoo et al. (1988) on grape, Fisun and Kodzokov (1991) on plum and Goede (1993) on mango.

In addition, tree fruiting results produced by biofertilizers are in harmony with the findings of Ball et al(1983) on groundnut, Chang (1983) on peanuts, Pomares et al (1993) on orange, Akl et al (1997), Fernandez et al (1998), Mansour (1998) on apple and Moustafa (2002) on Washington navel orange.

## 4.4.1. Fruit physical properties

The effect of organic manure source, method of organic manure application and biofertilization as well as their interactions on fruit physical properties expressed as fruit weight, length, diameter, juice weight and peel thickness of

Balady mandarin trees during 2000 and 2001 seasons is reported in Tables (47-51).

# 4.4.1.1. Fruit weight

It is clear from **Table (47)** that poultry manured trees produced heavier fruit (152.5 & 148.8 g) than those produce by sheep manure ones (148.0 &143.0 g) and finally those produce by cattle manured trees (141.5 & 137.3 g) in 2000 and 2001 seasons, respectively. The difference between the three studie organic manure sources were obvious to be significant.

In addition, fertilizing Balady mandarin trees with Rhizobacterien significantly increased fruit weight than fertilizing with Nitrobien.

Furthermore, the interaction between organic manure source and method of organic manure application reveals that poultry manure applied in trenches proved to be the most effective interaction in enhancing fruit weight of Balady mandarin trees. On the contrary, cattle manure whether applied in trenches or superficially proved to be the least effective interaction in enhancing fruit weight. Other combinations induced intermediate effect in this concern (Table, 48).

Moreover, the interaction between method of organic manure application and biofertilization shows that out of all studied interactions, the application of organic manure in trenches and supporting with Rhizobacterien induced the highest positive effect on fruit weight. Other combinations induced statistically similar effect in this concern (Table,49).

In addition, Table (50) demonstrates that out of all interactions between organic manure source and biofertilization,

Table (47): Specific effect of organic manure source, application method and biofertilization on fruit physical properties of Balady mandarin trees(2000 and 2001 seasons).

				Fr	Fruit characteristics	cteristic	S			
Factor	Weight (a)	ht (a)	Length (cm)	(cm)	Diameter (cm)	er (cm)	Peel thickness(cm)	ness(cm)	Juice weight (g)	ight (g)
V.	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
				a. Effect	a. Effect of organic manure source	c manure	source			
Cattle manure	141 c	137 c	4.62 a	4.72 a	5.05 a	5.15 a	0.18 a	0.18 a	26.50 b	28.50 b
Poultry manure	152 a	148 a	4.65 a	4.75 a	5.05 a	5.15 a	0.18 a	0.18 a	28.83 a	30.75 a
Sheep manure	148 b	143 b	4.63 a	4.72 a	5.05 a	5.15 a	0.18 a	0.18 a	26.50 b	28.50 b
				b. Effe	b. Effect of application method	lication m	ethod			
Surface	146 b	141 b	4.60 b	4.70 b	5.05 a	5.15 a	0.18 a	0.18 a	26.89 a	28.83 a
Trench	149 a	145 a	4.67 a	4.76 a	5.05 a	5.15 a	0.18 a	0.18 a	27.67 a	29.67 a
				o u	c. Effect of biofertilization	iofertilizat	ion			
Nitrobien	146 b	142 b	4.55 b	4.65 b	5.03 a	5.13 a	0.18 a	0.18 a	26.00 b	28.00 b
Rhizobacterien	148 a	144 a	4.72 a	4.81 a	5.06 a	5.16 a	0.18 a	0.18 a	28.56 a	30.50 a
Means within each column, followed by the same letter(s) are not significantly different at 5% level.	lumn, follo	wed by th	e same lett	er(s) are r	ot signific	antly diffe	ent at 5%	level.		

**Table (48):** Effect of interaction between organic manure source and application method on fruit physical properties of Balady mandarin trees(2000 and 2001 seasons).

Organic manure	Application	Weig	Weight (g)	Lengt	Fr Length (cm)	Fruit characteristics Diameter (cm) F	t characteristic Diameter (cm)	Peel thic	CS Peel thickness(cm) Juice weight (g)	Jui
source	mediod	(2000)	(2001)	(2000)	(2001)	(2000)		(2000)	(2001)	(2000)
Cattle	*Surface	141 c	136 d	4.60 c	4.70 c	5.05 a	5.15 a	0.18 a	0.18 a	25.50 b 27.50 b
manure	Trench	142 c	138 d	4.65 b	4.75 b	5.05 a	5.15 a	0.18 a	0.18 a	27.50 ab
Poultry	Surface	150 b	146 b	4.60 c	4.70 c	5.05 a	5.15 a	0.18 a	0.18 a	28.17 ab
manure	Trench	155 a	152 a	4.70 a	4.80 a	5.05 a	5.15 a	0.18 a	0 18 a	29.50 a
Sheep	Surface	147 b	142 c	4 60 c	4.70 c	5 05 a	5.15 a	0 18 a	0 18 a	27 00 ab
manure	Tronch		144 bc	4 66 24	4 75 h		ת ה ה	0 18 a	0 18 a	26 00 b

Table (49): Effect of interaction between application method and biofertilization on fruit physical properties of Balady mandarin trees(2000 and 2001 seasons).

Annication					Fru	iit chara	Fruit characteristics	S			
mothod	Biofertilizer	Weig	Weight (g)	Length (cm)	ի (cm)	Diamet	Diameter (cm) Peel thickness(cm) Juice weight (g)	Peel thick	(ness(cm)	Juice w	eight (g)
Political		(2000)	(2001)	(2000)	(2001)	(2000)	(2000) (2001)	(2000)	(2000) (2001)	(2000)	(2001)
,	► Nitrobien	145 b	141 b	4.50 b	4.60 b	5.03 a	5.13 a	0.18 a	0.18 a	25.67 c	27.67 c
Surrace —	Rhizobacterien	146 ab	142 b	4.70 a	4.80 a	5.06 a	5.16 a	0.18 a	0.18 a	28.11 ab	28.11 ab 30.00 ab
-	→ Nitrobien	147 ab	142 b	4.60 ab	4.70 ab	5.03 a	5.13 a	0.18 a	0.18 a	26.33 bc	28.33 bc
l rench	- Rhizobacterien	150 a	146 a	4.74 a	4.83 a	5.06 a	5.16 a	0.18 a	0.18 a	29.00 a	31.00 a
Means within	Means within each column, followed by the same letter(s) are not significantly different at 5% level	ed by the	same letter	(s) are not	significantly	/ different	at 5% lev	ie :			

**Table (50):** Effect of interaction between organic manure source and biofertilization on fruit physical properties of Balady mandarin trees(2000 and 2001 seasons).

maniire	Riofortilizat				Fru	it chara	Fruit characteristics	5			
SOURCE OF THE PROPERTY OF THE	מיסיכו נווולפן	Weight (g)	ht (g)	Lengt	Length (cm)	Diamet	Diameter (cm)	Peel thickness!	(pass(cm)		
and co		(2000)	(2001)	(2000)	(2004)	(2000)	- 1		111000	(ciii) Juice weight (g)	eignt (g)
	- L.		1.5.5.7	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Cattle	Nitropien	141 d	137 d	4.55 b	4.65 b	5.03 a	5.13 a	0.18 a	0.18 a	25.50 b 27.50 b	27.50 b
	Rhizobacterien	142 cd	137 d	4.70 ab	4.80 ab	5.06 a	5.16 a	0 18 2	0 18 2	27 50 5	50
	Nitrobien	151 05	147 04	1	ı						0.00
manure -		90	14/ ab	4.55 b	4.65 b	5.03 a	5.13 a	0.18 a	0.18 a	27.00 ь	29.00 ь
	Rhizobacterien	154 a	150 a	4.75 a	4.85 a	5,06 a	5.16 a	0.18 a	0.18 a	30.67 a	32 50 a
Sheen	Nitrobien	147 bc	141 0	A	000	0	6			10	0
1					00.00	5.03 a	5.13 a	0.18 a	0.18 a	25.50 b	27.50 b
	Rhizobacterien	149 ab	144 bc	4.71 ab	4 80 ab	5.06 a	5.16 a	O 188	0 18 2	27 50 5 20 50 5	20 50
rived is within each column, followed by the same letter(s) are not significantly different at 5% level	each column, follow	red by the	SAME SECURIOR SECURIO							100000000000000000000000000000000000000	000

poultry manure supported with Rhizobacterien proved to be the most efficient interaction in enhancing fruit weight. On the contrary, the interactions of cattle manure gave the lowest values of fruit weight. Besides, the combinations of sheep manure exerted an intermediate effect in this respect.

As for the interaction between the three studied factors namely organic manure source, method of organic manure application and biofertilization reveals that out of all interactions poultry manure applied in trenches provided with Rhizobacterien proved to be the most effective interaction in enhancing fruit weight. On the other hand, all combinations of cattle manure induced the lowest values of fruit weight. Besides, other tested combinations exerted an intermediate effect in this respect.

### 4.4.1.2. Fruit length

It is clear that organic manure source i.e. cattle, poultry and sheep failed to exert a distinctive effect on fruit length of Balady mandarin trees (Table, 47).

Furthermore, the application of organic manure in trenches surpassed superficial application in enhancing fruit length of Balady mandarin during both seasons of study.

Moreover, Rhizobacterien inoculated trees produced longer fruits as compared with Nitrobien inoculated ones.

Furthermore, the interaction between organic manure source and method of organic manure application reveals that poultry manure applied in trenches proved to be the most effective interaction in enhancing fruit length of Balady mandarin trees. On the contrary, cattle manure whether applied

superficially or in trenches proved to be the least effective interactions in enhancing fruit length. Other combinations induced an intermediate effect in this concern (Table, 48).

Additionally, the interaction between method of organic manure application and biofertilization shows that Balady mandarin trees manured in trenches or superficially and inoculated with Rhizobacterien produced the longest fruits. On the contrary, fruits of Balady mandarin trees manured superficially and inoculated with Nitrobien had the lowest values of fruit length. Other combinations produced intermediate values of fruit length, (Table, 49).

In addition, **Table** (50) demonstrates that out of all interactions between organic manure source and biofertilization, poultry manure supported with Rhizobacterien proved to be the most efficient interaction in enhancing fruit length. On the contrary, the interactions of cattle manure gave the lowest values of fruit length. Besides, the combinations of sheep manure exerted an intermediate effect in this respect.

As for the interaction between the three studied factors namely organic manure source, method of organic manure application and biofertilization reveals that out of all interactions (poultry, sheep and cattle manure) applied in trenches or superficially provided with Rhizobacterien proved to be the most effective interactions in enhancing fruit length. On the other hand, all combinations of (poultry, sheep and cattle manure) applied superficially provided with Nitrobien induced the lowest values of fruit length.

### 4.4.1.3. Fruit diameter

Table (47-51) demonstrates that the three studied factors i.e. organic manure source (cattle, poultry and sheep), method of organic manure application (surface and trench) and biofertilization alone or in different combinations failed to show any distinctive effect on fruit diameter of Balady mandarin trees during 2000 and 2001 seasons.

### 4.4.1.4. Peel thickness

Table (47-51) reveals that the three studied factors i.e. organic manure source (cattle, poultry and sheep), method of organic manure application (surface and trench) and biofertilization alone or in different combinations failed to show any distinctive effect on fruit diameter of Balady mandarin trees during 2000 and 2001 seasons.

### 4.4.1.5. Juice weight

It is clear that organic manure source i.e. poultry manure exert a distinctive positive effect on juice weight of Balady mandarin trees. Besides, sheep manure and cattle manure showed similar effect on juice weight, (Table, 47).

Furthermore, the application of organic manure superficially or in trenches failed to induce any positive effect on juice weight of Balady mandarin trees.

Moreover, Rhizobacterien inoculated trees enhanced fruit juice content as compared with the analogous ones inoculated with Nitrobien.

Table (51): Effect of interaction between organic manure source, application method and biofertilization on fruit physical properties of Balady mandarin trees(2000 and 2001 seasons).

manure	method	(N-fixing					Fruit cha	Fruit characteristics	s			
source		bacteria)	×	Weight (g)		Length	Dia	Diameter	- 1	Peel thickness	Juice	Juice weight
			(2000)	(2004)	2000	(0111)	(0	(cm)	0)	(cm)		<u>a</u>
et.	Cirtan	Nitrobien	141 d	107 -6	(2000)	(1007)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Cattle	- Soul lace	Rhizobacterien		0	4.50 b	4.60 b	5.03 a	5.13 a	0.18 a	0 18 2	25.	3 3
nanuro			1410	136 f	4.70 ab	4.80 ab	7 06 5	1	( )		700	4/ 0
Trench	Trench →	Nitrobien	141 d	137 ef	4 60 ah	4 70 05	0.00	5.16 a	0.18 a	0.18 a	26 bc	28 ь
		→ Rhizobacterien	143 cd	139 of	4 70 55	1.70 40	5.03 a	5.13 a	0.18 a	0.18 a	26 bc	28 Ь
		Nitrobien	149ahcd	à n	200	4.80 ab	5.06 a	5.16 a	0.18 a	0 18 a	29 ahc	3
Poultry		Rhizobacterien	151 a F		d 00.4	4.60 b	5.03 a	5.13 a	0.18 a	0.18 a	27 hc	5 .
manure		Nitrobios		147 00	4.70 ab	4.80 ab	5.06 a	5.16 a	0 10 5		1	
1	Trench →	+ Miti objeti	154 ab	150 ab	4.60 ab	4 70 ah	h 0	1	0.00	0.18 a	29 ab	31 ab
		*Rhizobacterien	157 a	153 a	4 80 2	2 2	0.03 a	5.13 a	0.18 a	0.18 a	27 bc	29 Ь
,	Surface	Nitrobien	147 bcd	142 040		B 06.4	5.06 a	5.16 a	0.18 a	0.18 a	32 a	ω 4
Sheep		Rhizobacterien	147 500		4.00	4.60 b	5.03 a	5.13 a	0.18 a	0.18 a	25 c	27 5
manure 💂	e + T	Nitrobien	147 604	- 2	4.70 ab	4.80 ab	5.06 a	5,16 a	0.18 a	0.18 a	3	2 1
	V		200	141 def	4.60 ab	4.70 ab	5.03 a	5.13 a	0 18 3	i g	(	0 0
		Milizopacterien	151 abc	147 bc	4.73 ab	4 80 ah	D 00	) (	. Io d	U. 18 a	26 bc	28 b
							redis Within each column, followed by the same letter(s)	6 a	0.18 a	0.18 a	26 bc	28 Ь

As for the interaction between organic manure source and method of organic manure application, **Table (48)** shows that poultry manure applied in trenches proved to be the most effective interaction in enhancing fruit juice content of Balady mandarin trees, compared with cattle manure applied superficially in both seasons.

Additionally, the interaction between method of organic manure application and biofertilization shows that Balady mandarin trees manured in trenches and / or superficially and inoculated with Rhizobacterien enhanced fruit juice content. On the contrary, fruits of Balady mandarin trees manured superficially and / or in trenches and inoculated with Nitrobien had the lowest values of fruit juice content, (Table, 49).

In addition, **Table (50)** demonstrates that the interaction between organic manure source and biofertilization, poultry manure supported with Rhizobacterien proved to be the most efficient interaction in enhancing fruit juice content. On the other hand, poultry manure supported with Nitrobien and (sheep and cattle manure) supported with Rhizobacterien and Nitrobien had similar fruit juice content from the statistical standpoint.

Finally, the interaction between the three studied factors, i.e. organic manure source, method of organic manure application and biofertilization reveals that out of these studied combination poultry manure x trench application x Rhizobacterien induced the most pronounced distinctive effect on fruit juice content of Balady mandarin trees in both seasons of study (Table, 51).

Abstractly, fruit weight and juice weight were only the parameter out of all studied fruit physical characteristics (fruit length, diameter and peel thickness) that positively responded to poultry manure. Moreover, trench application of organic manure enhanced fruit weight and fruit length as compared with surface application. Also, Rhizobacterien inoculation improved fruit weight, length and juice weight as compared with Nitrobien.

# 4.4.2. Fruit chemical properties

Tables (52-56) show the effect of organic manure (cattle, poultry and sheep), method of organic manure application (surface and trench) and biofertilization (Rhizobacterien and Nitrobien) as well as their interactions on some fruit chemical properties *i.e.* total soluble solids (TSS) percentage total acidity. TSS:acid ratio and ascorbic acid of Balady mandarin trees during 2000 and 2001 seasons.

# 4.4.2.1. Total soluble solids (TSS)

It is quite evident that poultry manured trees produced fruits richer in their total soluble solids content (12.93 & 12.85%) as compared with those produced by sheep manured trees (12.60 & 12.40%) and cattle manured trees (12.50 & 12.35%) in 2000 and 2001 seasons, respectively. However, the differences between the three organic manure sources in this respect were obvious to be significant (**Table, 52**).

Furthermore, the application of organic manure in trenches succeeded in enhancing fruit content of total soluble

Table (52): Specific effect of organic manure source, application method and biofertilization on fruit chemical properties of Balady mandarin trees(2000 and 2001 seasons).

			L	ruit char	Fruit characteristics			
Factor	T.S	T.S.S.	Total	Total acidity	T.S.S.: acid	: acid	Ascorb	Ascorbic acid
	6)	(%)	6)	(%)	rat	ratio	mg/10(	mg/100 juice
	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
			a. Effe	ct of organ	a. Effect of organic manure source	ource		
Cattle manure	12.50 b	12.35 b	1.013 a	1.014 a	12.35 b	12.18 c	47 b	45 b
Poultry manure	12.93 a	12.85 a	1.011 a	1.013 a	12.79 a	12.69 a	53 a	51 a
Sheep manure	12.60 b	12.40 b	1.013 a	1.011 a	12.44 b	12.26 b	49 b	47 ab
			b. Ef	fect of app	b. Effect of application method	poq		
Surface	12.64 a	12.43 b	1.014 a	1.012 a	12.47 b	12.29 a	49 a	47 a
Trench	12.71 a	12.63 a	1.010 a	1.013 a	12.59 a	12.46 a	50 a	48 a
			ပ်	Effect of bi	c. Effect of biofertilization	ū		
Nitrobien	12.68 a	12.50 a	1.013 a	1.014 a	12.51 a	12.32 a	49 a	47 a
Rhizobacterien	12.68 a	12.57 a	1.011 a	1.011 a	12.55 a	12.43 a	50 a	48 a

Means within each column, followed by the same letter(s) are not significantly different at 5% level.

solids than the application of organic manure superficially in the second season (2001) (Table, 52).

In addition, the type of biofertilizer *i.e.* Rhizobacterien or Nitrobien failed to induce a pronounced effect on fruit total soluble solids content in both seasons of study.

Additionally, **Table (53)** demonstrates that poultry manure applied superficially or in trenches produced not only similar but also higher positive effect on fruit total soluble solids content, followed descendingly by sheep manure whether applied superficially or in trenches. Lastly, cattle manure applied in trenches or superficial induced similarly the lowest positive effect on fruit total soluble solids content of Balady mandarin trees.

On the other side, **Table (54)** reveals that organic manure source showed to be more effective in enhancing fruit total soluble solids content rather than biofertilizer type, where poultry manure whether provided with Rhizobacterien or Nitrobien induced nearly similar and higher positive effect on fruit total soluble solids content, followed descendingly by sheep manure either supported with Rhizobacterien or Nitrobien and lastly cattle manure whether enriched with Rhizobacterien or Nitrobien.

On the other hand, the interaction between organic manure application method and biofertilization showed that the application of organic manure in trenches and fertilizing with Rhizobacterien proved to be the most efficient interaction in enhancing fruit total soluble solids content. On the contrary, superficial application of organic manure and fertilizing with

Table (53): Effect of interaction between organic manure source and application method on fruit chemical properties of Balady mandarin trees(2000 and 2001 seasons).

Organic				F	Fruit characteristics	teristics			
O gallic	Application	T.S.S.	S.	Total	Total acidity	T.S.S.: acid	: acid	Ascorbic acid	ic acid
illaliu c	method	(%)	(9)	(%)	(9)	ratio	0	mg/100 juice	) juice
aonos		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Cattle	Surface	12.40 c	12.20 d	1.013 a	1.012 a	12.24 c	12.06 c	47 c	45 d
marure	Trench	12.60 b	12.50 pc	1.012 a	1.017 a	12.46 b	12.29 bc	47 c	46 cd
Poultry	Surface	12.93 a	12.70 b	1.012 a	1.013 a	12.78 a	12.53 ab	51 b	20 2
manure	Trench	12.93 a	13.00 a	1.010 a	1.012 a	12.80 a	12.85 a	54 a	52 a
Sheep	Surface	12.60 b	12.40 cd	1.017 a	1.010 a	12.39 b	12.27 bc	- 6 <del>0</del>	47 c
manure	Trench	12.60 b	12.40 cd	1.008 a	1.012 a	12.49 b	12.24 bc	50 bc	47 c
Means within each	Means within each column, followed by the same letter(s) are not significantly different at 5% level	the same lette	r(s) are not s	significantly	different at	5% level.			

Table (54): Effect of interaction between organic manure source and biofertilization on fruit chemical properties of Balady mandarin trees(2000 and 2001 seasons).

220				Fruit characteristics	cteristics	
manure Biofertilizer		[.S.S.	Total	Total acidity	T.S.S.: acid	: acid
	(2000)			(%)	Ratio	tio
	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Cattle Nilroblen	12.50 b	12.30 Ь	1.015 a	1.015 a	12.32 b	12.12 b
Rhizobacterien	ien 12.50 b	12.40 Ь	1.010 a	1.013 a	12.38 b	12.23 b
Poultry → Nitrobien manure →	12.93 a	12.80 a	1.012 a	1.015 a	12.78 a	12.61 a
Rhizobacterien	ien 12.93 a	12.90 a	1.010 a	1.010 a	12.81 a	12.77 a
Sheep Nitrobien	12.60 Ь	12.40 Ь	1.013 a	1.012 a	12.43 b	12.24 ь
Rhizobacterien 12.60 b 12.40 b 1.012 a 1.010 a 12.45 b	en 12.60 b	12.40 b	1.012 a	1.010 a	12.45 b	12 27 h

Nitrobien took the other way around. Other studied interactions took an intermediate position between the previously two mentioned categories during the second season, (Table, 55).

On the other hand, the interaction between organic manure source, method of organic manure application and biofertilization exerted that the application of poultry manure in trenches or superficially and provided with Rhizobacterien and/or Nitrobien gave the highest values of fruit total soluble solids content. On the contrary, cattle manure whether applied in trenches or superficially and supported with Rhizobacterien or Nitrobien produced the lowest values of fruit total soluble solids content. Other studied combinations of sheep manure showed inbetween values in this respect.

### 4.4.2.2. Total acidity

Table (52-56) demonstrated that the three studied factors i.e. organic manure source (cattle, poultry and sheep), method of organic manure application (surface and trench) and biofertilization alone or in different combinations failed to show any distinctive effect on fruit total acidity content of Balady mandarin trees during 2000 and 2001 seasons.

### 4.4.2.3 TSS:acid ratio

It is obvious from **Table (52)** that fruits produced by poultry manured trees had higher TSS:acid ratio (12.79 & 12.69)

Table (55): Effect of interaction between method of application and biofertilization on fruit chemical properties of Balady mandarin trees(2000 and 2001 seasons).

Application Method	Biofertilizer	T.S	T.S.S.	Total	Fruit characteristics	cteristics			
, icelion	<u>.</u>	•	(%)	(9)	(%)	T.S.S.: acid	: acid	Ascorbic acid	oic ac
		(2000)	(2001)	(2000)		ratio	10	mg/10	0 juice
,	Nitrobien	10 64 5	;	(2000)	(2001)	(2000)	(2001)	(2000)	(200
Surface →		E +0.21	12.40 b	1.017 a	1.012 a	12.44 a	12.25 b	49 2	47 -
Ŧ	Rhizobacterien	12.64 a	12.47 ab	10115				í	0 /1
7	Nitrobios			7.077	1.011 a	12.51 a	12.33 ab	49 a	47 a
Trench $\rightarrow$	Aut opiett	12.71 a	12.60 ab	1.010 a	1.016 a	12.58 a	12 40 ah	40	ì
f	Rhizobacterien	12.71 a	12.67 a	1010				12 0	4/8
Means within each o	olumn followed by			010	1.011 a	12.59 a	12.53 a	51 a	40 2
evel.	The second secon	ic salle letter							

followed descendingly by the corresponding ones resulted from sheep manured trees (12.44 & 12.26) and lastly those produced by cattle manured trees (12.35 & 12.18) in 2000 and 2001 seasons, respectively. The differences between the three studied organic manure sources were more obvious to be significant.

Moreover, the application of organic manure in trenches succeeded in improving fruit TSS:acid ratio rather than the application of organic manure superficially.

Furthermore, **Table (52)** demonstrates that in both seasons biofertilizers failed to show any distinctive effect on fruit TSS:acid ratio of Balady mandarin trees.

On the other side, **Table (53)** shows that the effect of organic manure source predominated the effect of method of application regarding fruit TSS:acid ratio, hence poultry manure whether applied in trenches or superficially induced the highest positive effect in this concern, followed descendingly by sheep manure applied either superficial or in trenches and lastly cattle manure applied in trenches or superficially.

Furthermore, **Table (54)** reveals that in both seasons, the effect of organic manure source predominated the effect of biofertilizers hence poultry manure whether provided with Rhizobacterien or Nitrobien produced nearly a similar and higher positive effect on fruit TSS:acid ratio, followed descendingly by sheep manure whether supported with Rhizobacterien or Nitrobien and lastly, cattle manure enriched with Rhizobacterien or Nitrobien.

In addition, the interaction between the method of organic manure application and biofertilization indicates that fruit TSS:acid ratio responded mainly to biofertilizer type rather than the method of organic manure application, hence fertilizing Balady mandarin trees with Rhizobacterien and whether the organic manure was added superficially or in trenches gave the highest values of fruit TSS:acid ratio rather than inoculating the soil with Nitrobien, regardless whether the organic manure was added superficially or in trenches in the second season (2001), (Table, 55).

As for the interaction between organic manure source, method of organic manure application and biofertilization, **Table** (56) demonstrates that poultry manure combinations in general and those applied in trenches or superficially and inoculated with Rhizobacterien in particular recorded the highest values of fruit TSS/acid ratio. Other tested combinations of cattle and sheep manure gave nearly more or less similar effect in this respect.

### 4.4.2.4. Ascorbic acid

It is quite evident from **Table (52)** that in both seasons, poultry manured trees produced fruits richer in their ascorbic acid content (53 & 51 mg/100 ml juice) as compared with those resulted from sheep (49 & 47 mg/100 ml juice) and cattle manured trees (47 & 45 mg/100 ml juice) in 2000 and 2001 seasons, respectively. The differences between cattle and sheep manure in this respect were lacking from the statistical standpoint.

Table (56): Effect of interaction between organic manure source, application method and biofertilization on fruit chemical properties of Balady mandarin trees(2000 and 2001 seasons).

Organic			Biofertilizer								
manure	Application	ion	(N-fixing	ï	T.S.S.	Total	Total acidity	T.S.S	T.S.S.:acid	Ascorbic	rbic
source	method	ס	bacteria}	ž,	(%)		(%)	ra	ratio	mg/100 juice	juice
				(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	Surface	Ž 1	→ Nitrobien	12.40 b	12.20 c	1.020 a	1.010 a	12.16 c	12.08 d	47 b	45 c
Cattle		<b>∝</b>	Rhizobacterien	12.40 b	12.20 c	1.007 a	1.013 a	12.32 c	12.04 d	47 b	45 c
manure	Trench	Ž 1	→ Nitrobien	12.60 ab	12.40 c	1.010 a	1.020 a	12.47abc	12.15 d	47 b	46 bc
		<u>∝</u>	Rhizobacterien	12.60 ab	12.60 bc	1.013 a	1.013 a	12.44abc	12.43bcd	48 b	46 bc
	Surface →	₹ ↑	→ Nitrobien	12.93 a	12.60 bc	1.010 a	1.017 a	12.80 a	12.39 cd	52 b	50 b
Poultry →		œ ∳	Rhizobacterien	12.93 a	12.80 ab	1.013 a	1.010 a	12.77 a	12.67abc	51 b	20 b
manure	Trench	<b>Z</b> ↑	→ Nitrobien	12.93 a	13.00 a	1.013 a	1.013 a	12.76 ab	12.83 ab	52 b	50 b
		æ ∮	Rhizobacterien	12.93 a	13.00 a	1.007 a	1.010 a	12.85 a	12.87 a	57 a	55 a
	Surface →	₹ ↑	▼ Nitrobien	12.60 ab	12.40 c	1.020 a	1.010 a	12.35 bc	12.28 cd	48 b	47 bc
Sheep		æ ∳	Rhizobacterien	12.60 ab	12.40 c	1.013 a	1.010 a	12.43abc	12.27 cd	50 b	48 bc
manure	Trench	Ž 1	→ Nitrobien	12.60 ab	12.40 c	1.007 a	1.013 a	12.58abc	12.21 d	49 b	47 bc
		₹	Rhizobacterien	12.60 ab	12.40 c	1.010 a	1.010 a	12.47abc	12.28 cd	50 b	48 bc
Means wit	thin each colu	oy 'umr	Means within each column, followed by the same letter(s) are not significantly different at 5% level.	ime letter(s)	are not sigr	nificantly dif	ferent at 5%	6 level.			

On the other hand, the method of organic manure application and biofertilization failed to induce a reasonable effect on fruit ascorbic acid content of Balady mandarin trees.

Additionally, the interaction between organic manure source and method of organic manure application reveals that poultry manure applied in trenches gave the highest ascorbic acid values as compared with those applied superficially, followed descendingly by sheep manure applied either superficially or in trenches and finally, cattle manure applied trenchly or superficially.

On the other side, **Table (54)** shows that the values of fruit ascorbic acid content resulted from interaction between organic manure source and biofertilization were attributed mainly the predominating effect of organic manure source rather than biofertilization. Thereupon, poultry manure supported with Rhizobacterien or Nitrobien scored the highest values of fruit ascorbic acid content, followed descendingly by the combinations of sheep manure and lastly by those of cattle manure.

In addition, it is clear from **Table (55)** that the interaction between method of organic manure application (surface and trench) and biofertilizers (Rhizobacterien and Nitrobien) failed to give an additive effect on fruit ascorbic acid content of Balady mandarin trees in 2000 and 2001 seasons.

In summary, the interactions between organic manure source, method of organic manure application and biofertilization show that poultry manure applied in trenches with Rhizobacterien gave the highest values followed descendingly by poultry manure applied in trenches provided

with Nitrobien and poultry manure applied superficially x (Rhizobacterien and Nitrobien) induced similarly higher positive effect on fruit ascorbic acid content of Balady mandarin trees in both seasons of study. Other studied combinations of sheep and cattle manure showed more or less similar effect in this respect, (Table, 56).

Part II: Experiment II: Effect of organic manure source, organic manure irradiation and method of organic manure application on growth and leaf mineral content of Sour orange and Volkamer lemon seedlings.

## 4.2.1. Sour orange seedlings

### 4.2.1.1 Plant growth parameters

Table (57-66) shows that growth parameters, i.e. seedling height, stem diameter, leaf chlorophyll (a & b), No. of leaves /seedling, leaf surface area, root length, No. of root /seedling, stem dry weight, leaves dry weight, root dry weight, total seedling dry weight and top /root ratio.

### 4.2.1.1.1. Seedling height

It is clear from **Table (57)** that poultry manured seedlings produced more height seedlings as compared with those arised from cattle manured ones in both seasons. On the contrary, cattle manured seedlings had the lowest values in this respect.

**Table (57):** Specific effect of organic manure source, irradiation and application method on some growth parameters. Sour

1	Seedlin	Seedling height	Stem c	Stem diameter						
Factor	(c) (2000)	(cm) (2001)	(2000)	(cm)	/20000	(a) (b)	ophyll (m	(b)	No. of leaves /seedling	leaves lling
			(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
				a. Effec	t of organ	a. Effect of organic manure source	source			
Cattle manure	52 c	49 c	0.66 c	0.62 c	6.43 b	6.38 b	277 h	2732	0	1
Poultry manure	87 2	75	)				!	1	000	100
	0	() ()	0.89 a	0.84 a	6.52 a	6.47 a	2.87 a	2.80 a	94 a	110 a
Sileep manure	67 b	59 b	0.79 b	0.72 b	6.47 ab	6.47 ab 6.42ab	282 25	7785	70	)
									Č	000
				ь	. Effect of	<ul> <li>Effect of Irradiation</li> </ul>	-			
Non-irradiation	64 b	57 b	0.75 b	0.70 a	6 35 b	2 2 2 2	۲ اور		1	
Irradiation	7/0	ר	)					0 1	000	900
	4	0.0 0.0	0.81 a	0.76 a	6.60 a	6.54 a	2.97 a	2.90 a	© 2 0	97 a
				c. Effe	ct of appli	c. Effect of application method	thod			
Soil application	72 a	63 a	0.80 a	0.75 a	6 55 a	6,49 a	2 90 a	) 83 9	70 5	)
Water extract	66 b	58 b	0.77 b	0716	0 4 7	) ) ) )	7 7 7	)	2	0
Means within each column, followed by the same letter/cl	nn, follower	by the car	no lottorio			0	1.100	1. / 0	0 4	9 68
	/ .0.0000000	טע טוב טמו	le letter(S	) are not o	Significant.	different	1+ 70/	-		

Moreover, irradiating organic manure surpassed nonirradiated organic manure to exert a distinctive positive effect on seedling height in both seasons.

Furthermore, soil application of organic manure succeeded to induce a distinctive effect on seedling height as compared water extract of organic manure in this respect.

In addition, **Table (58)** illustrates that the interaction between organic manure source and irradiating organic manure, reveals that irradiating poultry manure induced more positive effect on seedling height in both seasons descendingly by non-irradiation and / or irradiating cattle manure had the lowest distinctive effect in this respect.

On the other hand, the interaction between organic manure and method of organic manure application reveals that poultry manure applied particularly as soil application or secondly as water extract of organic manure exerted the highest positive effect on seedling height of Sour orange seedlings in both seasons, (Table, 59).

Furthermore, irradiating organic manure and application as soil application exerted the highest stimulative effect on seedling height, followed descendingly by those applied as water extract of organic manure. On the contrary, non-irradiation of organic manure, applied as soil application and / or as water extract had the lowest positive effect on seedling height in both seasons (Table, 60).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other combinations (cattle and sheep) in enhancing seedling height with the superiority of irradiating poultry manure on the

**Table (58):** Effect of interaction between organic manure source and irradiation on some growth parameters Sour orange seedlings (2000 and 2001 seasons).

organic	Seedling height	height	Stem	Stem diameter	-	26 26 25			1000	
manure Irradiation	()		0.01	rigilicici	Le	Lear chlorophyll (mg/L)	phyll (mo	//L)	No. of	No. of leaves
	(1117)		0	(cm)		(a)	,	(b)	/spedling	dling
Source	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(0000)	(2001)
Cattle→ Non-irradiation	49 f	46 e	0.63 f	0.59 d	6.35 d	6.30 c	2.62 d	2.57 a	56 f	71 f
→ Irradiation	56 e	52 d	0.69 e	0.66 cd	6.52 c	6.47 b	295	287 a	n n	700
Non-irradiation	82 b	70 b	0.36 b	0 82 25	2000	ກ ວ	7	1		0
Poultry						0.00	1.170	P /0.7	900	101 b
→ Irradiation	93 a	80 a	0.92 a	0.87 a	6.67 a	6.61 a	3.02 a	2.92 a	99 a	120 a
→ Non-irradiation	46 d	54 d	0,77 d	0.70 bcd	6.35 d	6.30 c	2.67 cd	2.97 a	73 d	84 d
→ Irradiation	72 c	63 c	0.82 c	0.75 abc	6.60 b	6 55 ah	297 24	000	70	3
Means within each column, followed by the same letter(s) are not significantly different at 5% level								ď		0

Table (59): Effect of interaction between organic manure source and application method on some growth parameters Sour orange seedlings (2000 and 2001 seasons).

Organic	A()	Seedling height	height	Stem di	Stem diameter	۲	eaf chlore	Leaf chlorophyll (mg/L)	/L)	No. of	No. of leaves
manure	Application	(cm)	(-	5)	(cm)		(a)	2	(p)	ees/	/seedling
Source	method	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
_	Soil application	54 e	51 d	0.68 c	0.64 c	6.50 bc	6.45abc	2.85 abc	2.80 ab	P 89	76 c
	Water extract	51 e	47 d	0.65 c	0.61 c	6.37 d	6.32 d	2.70 d	2.65 c	58 e	74 c
	<ul> <li>Soil application</li> </ul>	91 a	77 a	0.91 a	0.86 a	6.60 a	6.54 a	2.95 a	2.87 a	96 a	113 a
Poultry→	. Water extract	84 b	74 a	0.88 a	0.83 a	6.44 cd	6.40bcd	2.80 bcd	2.72 bc	93 a	107 a
	<ul><li>Soil application</li></ul>	70 c	63 b	0.81 b	0.74 b	6.55 ab	6.50 ab	2.90 ab	2.82 ab	79 b	91 b
	• Water extract	65 d	55 c	0.78 b	0.71 b	6.40 d	6.35 cd	2.75 cd	2.75 bc	73 c	98 b
Means within	Means within each column, followed by the same letter(s) are not significantly different at 5% level	ved by the	same letter	r(s) are no	t significar	ntly differe	nt at 5% le	evel.			

1 Table (60): Effect of interaction between Effect of interaction between irradiation and application method on growth parameters Sour orange seedlings (2000 and 2001 seasons).

	201									
Irradiation Application		Seedilig neight Stem diameter	Stem d	iameter	Lea	of chloro	Leaf chlorophyll (mg/L)	(L)	No of	2000
method		(cm)	6	(cm)	( )			- 1	TWO. OF TEAVES	CAVES
	(2000)	(2001)	(2000)	(2004)	(a)		(d)	ێ	/seedling	ling
		(2001)	(2000)	(2007)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Non-irradiation	tion 66 c	59 c	0.77 b	0.77 b 0.71 bc	6.40 c	6.35 c	2756	2 70 0	75	2001
Water extract	3								Č	0
1000	p 7g	45 d	074c	0.69 c	6.31 d	6.27 c	2.60 d	2.58 d	70 d	84 0
Soil application	ion 77 a	D 7	0000	0 10	)					
irradiation ->		2	000	0. / & a	6 70 a	6.64 a	3.05 a	2.96 a	83 a	100 a
₩ater extract	71 b	63 b	0.80 ab	0.74 b	6.50 b	0 45	200 5	000	1	
Means within each column, followed by the same letters:	wed by the ca	me lotter(e)		,		20		7.00	0 8	94 5
1000	TO VY CIC DO		are not si	つからなったい	A Francis	L 707				

expense of non-irradiated poultry manure applied as soil application on the expense of water extract application of organic manure. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 61).

### 4.2.1.1.2. Stem diameter

It is clear from **Table (57)** that poultry manured seedlings had the highest distinctive effect on stem diameter as compared with those arised from cattle manured ones in both seasons. On the contrary, cattle manured seedlings had the lowest values in this respect.

Moreover, irradiating organic manure surpassed nonirradiation organic manure to exert a distinctive effect on stem diameter in both seasons.

Furthermore, soil application of organic manure succeeded to induce a distinctive effect on stem diameter as compared water extract of organic manure in this respect.

In addition, **Table (58)** illustrates that the interaction between organic manure source and irradiating organic manure, reveals that irradiating poultry manure induced a distinctive effect on stem diameter in both seasons followed descendingly by non-irradiation and / or irradiating cattle manure had the lowest distinctive effect in this respect.

On the other hand, the interaction between organic manure and method of organic manure application reveals that poultry manure applied as soil application or water extract

exerted the highest positive effect on stem diameter of Sour orange seedlings, followed descendingly by sheep manure applied as soil application or water extract in both seasons, (Table, 59).

Furthermore, irradiating organic manure and application as soil application exerted the highest stimulative effects on stem diameter, followed descendingly by those applied as water extract. On the contrary, non-irradiating organic manure and applied as soil application or water extract of organic manure had the lowest positive effect on stem diameter in both seasons, (Table, 60).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other combinations (cattle and sheep) in enhancing stem diameter with the superiority of irradiating poultry manure on the expense of non-irradiating poultry manure applied as soil application on the expense of water extract application of organic manure. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 61).

## 4.2.1.1.3. leaf chlorophyll (a & b)

Table (57) shows that leaves of poultry manured seedlings had the highest values of chlorophyll (a) followed descendingly by those of sheep manured ones and finally cattle manured seedlings in both seasons .Besides, leaves of poultry manured seedlings had the highest values of chlorophyll (b)

followed descendingly by these of sheep manured ones and finally cattle manured seedlings in first season, only.

Moreover, irradiating organic manure surpassed nonirradiating organic manure in exerting a distinctive positive effect on chlorophyll (a) in both seasons. Besides, irradiating organic manure surpassed non-irradiating organic manure in inducing a distinctive positive effect on chlorophyll (b) in first season only.

Furthermore, soil application of organic manure succeeded to induce a distinctive stimulative effect on chlorophyll (a & b) as compared with water extract application of organic manure in this respect.

In addition, **Table (58)** illustrates that the interaction between organic manure source and irradiating organic manure reveals that irradiating poultry manure increased leaf chlorophyll (a) in both seasons followed descendingly by non-irradiation and / or irradiating cattle manure had the lowest distinctive effect in this respect. Besides, irradiating poultry manure induced more chlorophyll (b) in the first season followed descendingly by non-irradiation whereas irradiating cattle manure had the lowest positive effect in this respect.

On the other hand, the interaction between organic manure and method of organic manure application reveals that poultry manure applied particularly as soil application or secondly as water extract of organic manure exerted the highest positive effect on leaf chlorophyll (a & b) of Sour orange seedlings application in both seasons, (Table, 59).

Furthermore, irradiating organic manure and application as soil application exerted the highest stimulative effect on

chlorophyll a& b, followed descendingly by those applied in water extract. On the contrary, non-irradiating organic manure, applied as soil application and / or water extract had the lowest positive effect on chlorophyll (a & b) in both seasons (Table, 60).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other combination (cattle and sheep) in enhancing chlorophyll (a & b) with the superiority of irradiating poultry manure on the expense of non-irradiating poultry manure and applied as soil application on the expense of water extract of application. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 61).

### 4.2.1.1.4. No. of leaves/seedling

It is clear from **Table (57)** that poultry manured seedlings produced higher No. of leaves/seedling as compared with those arised from cattle manured ones in both seasons. On the contrary, cattle manured seedlings had the lowest values in this respect.

Moreover, irradiating organic manure surpassed nonirradiating organic manure to exerted a distinctive effect on No. of leaves/seedling in both seasons.

Furthermore, soil application of organic manure succeeded in inducing a distinctive positive effect on No. of leaves/seedling as compared water extract in this respect.

Table (61): Effect of interaction between organic manure source, irradiation and application method some growth parameters Sour orange scedlings (2000 and 2001 seasons).

re Irradiation method  ce  Non-irradiation Soil application water extract  Non-irradiation Soil application water extract  Soil application water extract  Water extract  Soil application Soil application Soil application			Otelli didilictel		Leaf chlord	Leaf chlorophyll (mg/L)	-	No. or	No. or leaves
Non-irradiation  Non-irradiation  Non-irradiation  Non-irradiation  Non-irradiation  Non-irradiation  Non-irradiation  Soil application  Water extract  Water extract  Soil application  Non-irradiation	(cm)	15)	(cm)		(a)	(p)	(0	/see	/seedling
Non-irradiation  Non-irradiation  Non-irradiation  Non-irradiation  Non-irradiation  Non-irradiation  Non-irradiation  Soil application  Water extract  Water extract  Water extract  Soil application		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Non-irradiation  Irradiation  Non-irradiation  Non-irradiation  Non-irradiation  Non-irradiation  Soil application  Water extract  Water extract  Soil application	48 f	0.65 gh	0.61 gh	6.40 efg	6.35 def	2.70 fghi	2.65 def	58 ij	73 gh
irradiation  Non-irradiation  Non-irradiation  Non-irradiation  Non-irradiation  Soil application  Water extract  Water extract  Soil application	45 f	0.62 h	0.58 h	6.30 g	6.25 f	2.55 I	2.50 f	54 j	70 h
irradiation  Non-irradiation  Non-irradiation  Non-irradiation  Non-irradiation  Non-irradiation	54 de	0.7.1 fg	0.68 ef	6.60 bc	6.55 bc	3.00 abc	2.95 au	68 gh	80 fg
Non-irradiation  Soil application  irradiation  Soil application  Non-irradiation		0.68 g	0.64 fg	6.45 def	6.40 cdef	2.85 cdef	2.80 bcd	62 hi	78 fgh
Non-irradiation  Non-irradiation  Non-irradiation	. 72 b	0.88 bc	0.83 bc	6.40 efg	6.35 def	2.80 defg	2.75 cde	92 pc	102 c
irradiation Soil application  Non-irradiation  Non-irradiation	q 69	0.85 cd	0.81 bc	6.33 fg	6.30 ef	2.65 ghi	2.60 ef	88 cd	100 c
irradiation   Water extract Soil application	82 a	0.94 a	0.89 a	6.80 a	6.733 a	3.10 a	3.00 a	100 a	125 a
Non-irradiation	79 a	0.91 ab	0.86 ab	6.55 cd	6.50 bcd	2.95 abcd	2.85 abc	98 ab	115 b
Non-irradiation	59 cd	0.79 de	0.71 e	6.40 efg	6.35 def	2.75 efgh	2.70 cde	76 ef	87 def
Shoon Water extract 60 d	50 ef	0.75 ef	0.69 ef	6.30 g	6.26 f	2.60 hi	2.65 def	70 fg	82 efg
Soil application	67 b	0.83 cd	0.78 cd	6.70 ab	6.65 ab	2.05 ab	2.95 ab	82 de	95 cd
irradiation > Water extract	o 09	0.81 d	0.73 de	6.50 cde	6.45 cde	2.90 bcde	2.85 abc	77 e	90 de

In addition, **Table (58)** illustrates that the interaction between organic manure source and irradiating organic manure, illustrates that irradiating poultry manure gave higher No. of leaves/seedling in both seasons, whereas non-irradiating or irradiating cattle manure had produced the lowest values in this respect.

On the other hand, the interaction between organic manure and method of organic manure application, declares that poultry manure applied as soil application or water extract exerted the highest positive effect on No. of leaves/seedling of Sour orange seedlings followed descendingly by sheep manure applied as soil application or water extract in both seasons, (Table, 59).

Furthermore, applying irradiating organic manure, as soil application exerted the highest stimulative effect on No. of leaves/seedling, followed descendingly by those applied as water extract. On the contrary, non-irradiating organic manure and applied as soil application or water extract had the lowest positive effect on No. of leaves/seedling in both seasons (**Table**, 60).

Finally, the interaction between the three studied factors indicates that the interaction of poultry manure surpassed the other tested combinations in enhancing No. of leaves/seedling with the superiority of irradiating poultry manure on the expense of nonirradiating poultry manure and applied as soil application on the expense of water extract of organic manure. Besides, sheep manure combinations surpassed cattle manure interactions

in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 61).

#### 4.2.1.1.5. Root length

It is clear from **Table (62)** that poultry manured seedlings produced longer as compared with those produced by cattle manured ones in both seasons.

Moreover, irradiating organic manure surpassed nonirradiating treatment in produced pronounced effect on root length in both seasons.

Furthermore, soil application of organic manure succeeded to induce a remarkable positive effect on root length as compared water extract application method.

In addition, **Table (63)** illustrates that the interaction between organic manure source and irradiating organic manure, declared that irradiating poultry manure produced longer roots in both seasons whereas by non-irradiating or irradiating cattle manure gave the lowest values in this respect.

On the other hand, the interaction between organic manure and method of organic manure application, shows that poultry manure applied as soil application or water extract exerted the highest positive effect on root length of Sour orange seedlings in both seasons, (Table, 64).

Furthermore, applying irradiated organic manure and as soil application exerted the highest stimulative effect on root length, followed descendingly by those applied as water extract. On the contrary, non-irradiating organic manure applied as

**Table (62):** Specific effect of organic manure source, irradiation and application method on leaf area, root length and No. of roots/seedling of Sour orange seedlings (2000 and 2001 seasons).

1	Leaf ar	Leaf area (cm²)	No. of roots/seeding	ts/seeding	Root length (cm)	gth (cm)
Factor	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
			a. Effect of organic manure source	ic manure source		
Cattle manure	16.22 a	16.42 a	1.90 b	2.01 a	15.6 b	15 4 c
Poultry manure	16.37 a	16.52 a	1.95 a	2.05 a	16.4 a	າ ກ າ
Sheep manure	16.30 a	16.50 a	1.93 ab	2.02 a	16 ab	15.7 b
			<ul> <li>b. Effect of irradiation</li> </ul>	irradiation		
Nonirradiation	15.96 b	16.16 b	1.83 a	1.93 b	15.0 b	1486
Irradiation	16.63 a	16.80 a	2.02 a	2.12 a	16.9 a	16.7 a
			c. Effect of application method	ication method		
Soil application	16.47 a	16.63 a	1.97 a	2.07 a	16.4 a	16.2 a
11/0+01 01/41/04	16.13 b	16 33 b	-1 -28 -28 -28 -28	100 5	15 5 b	100

Table (63): Effect of interaction between organic manure source and irradiation on leaf area, root length and No. of roots/seedling of Sour orange seedlings (2000 and 2001 seasons).

				. 2.	pripopolatore to all	pulpooding	Root len	Root length (cm)
Organic manu	ıre	Irradiation	Leaf area (cm²)	(2001)	(2000)	(2001)	(2000)	(2001)
	Ł	Non-irradiation	16.0 c	16.2 b	1.84 a	1.95 b	14.6 d	14.4 f
Cattle manure	<u></u>	Irradiation	16.45 b	16.65 a	1.97 a	2.07 a	16.5 b	16.3 c
	Ł	Non-irradiation	15.95 c	16.15 b	1.82 a	1.92 b	15.4 c	15.1 d
Poultry manure	<u> </u>	Irradiation	16.80 a	16.90 a	2.07 a	2.17 a	17.4 a	17.1 a
	Ł	Non-irradiation	15.95 c	16.15 b	1.82 a	1.92 b	15.0 cd	14.8 e
Sheep manure	<u></u>	Irradiation	16.65 ab	16.85 a	2.02 a	2.11 a	16.9 ab	16.6 b
Means within each o	column, f	Means within each column, followed by the same letter(s) are not significantly different at 5% level.	letter(s) are no	t significantly d	ifferent at 5%	evel.		

**Table (64):** Effect of interaction between organic manure source and application method on leaf area, root length and No. of roots/seedling of Sour orange seedlings (2000 and 2001 seasons).

Organic manure	Application	Leaf area (cm²)	ea (cm²)	No. of roo	No. of roots/seeding	Root length (cm)	gth (cm)
source	method	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	<ul> <li>Soil application</li> </ul>	16.40 ab	16.60 a	1.95 a	2.05 abc	16.0 bc	15.8 bc
Cattle manure ->	→ Water extract	16.03 b	16.25 a	1.86 a	1.975 с	15.1 d	14.9 d
I.	→ Soil application	16.55 a	16.65 a	2.00 a	2.1 a	16.9 a	16.6 a
Poultry manure →	→ Water extract	16.20 ab	16.40 a	1.90 a	2.0 bc	15.9 bcd	15.6 bc
2	<ul> <li>Soil application</li> </ul>	16.45 ab	16.65 a	1.97 a	2.07 ab	16.4 ab	16.2 ab
Sheep manure →	→ Water extract	16.15 ab	16.35 a	1.87 a	1.96 с	15.5 cd	15.2 cd
Means within each column, followed by the same letter(s) are not significantly different at 5% level.	on followed by the cam						

application or water extract had the least enhancing effect on root length in both seasons (Table, 65).

Finally, the interaction between the three studied factors indicates that the interaction of poultry manure surpassed the other combinations in enhancing root length with the superiority to irradiating poultry manure on the expense of non-irradiating poultry manure and applied as soil application on the expense of water extract of organic manure. Besides, sheep manure combination surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 66).

#### 4.2.1.1.6. No. of roots / seedling

It is clear from **Table (62)** that poultry manured seedlings produced higher No. of roots / seedling as compared with those produced by from cattle manured ones in the first season **(2000)**.

Moreover, irradiating organic manure surpassed nonirradiating treatment in producing to exerted a remarkable positive effect on No. of roots / seedling in the second season (2001).

Furthermore, soil application of organic manure succeeded in exerting a positive effect on No. of roots / seedling as compared with water extract application method in this respect in the second season (2001).

In addition, **Table (63)** illustrates that the interaction between organic manure source and irradiating organic manure, exerted that irradiating (poultry, sheep and cattle manure) induced higher No. of roots / seedling in the second season

(2001). On the contrary, non-irradiating poultry, sheep and cattle manure induced the lowest values in this respect in the second season (2001).

On the other hand, the interaction between organic manure and method of organic manure application, declared that application of poultry manure applied or water extract exerted the highest positive effect on No. of roots / seedling of Sour orange seedlings, in second season, (Table, 64).

Furthermore, irradiating organic manure and applied as soil application exerted the highest stimulative effect on No. of roots / seedling, followed descendingly by those applied as water extract. On the contrary, non-irradiating organic manure applied as soil application or water extract had the lowest values in both seasons (**Table**, 65).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other combinations in enhancing No. of roots / seedling with the superiority of irradiating poultry manure on the expense of non-irradiating poultry manure and applied as soil application on the expense of water extract application method. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in the second season, (Table, 66).

#### 4.2.1.1.7. Leaf area

It is clear from **Table (62)** that organic manure source failed to induce a distinctive effect on leaf area in both seasons.

Table (65): Effect of interaction between irradiation and application method of organic manure on leaf area, root length and No. of roots/seedling of Sour orange seedlings (2000 and 2001 seasons).

Mon-irradiation	Irradiation	Application	Leaf area (cm²)	a (cm²)	No. of roo	No. of roots/seeding	Root length (cm)	gth (cm)
Soil application         16.03 c         16.13 c         1.85 b         1.93 c         15.5 c           Water extract         15.90 c         16.10 c         1.81 b         1.91 c         14.5 d           Soil application         16.90 a         17.03 a         2.10 a         2.20 a         17.4 a           Water extract         16.37 b         16.56 b         1.95 ab         2.04 b         16.5 b	iii adidiio	method	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Water extract         15.90 c         16.10 c         1.81 b         1.91 c         14.5 d           Soil application         16.90 a         17.03 a         2.10 a         2.20 a         17.4 a           Water extract         16.37 b         16.56 b         1.95 ab         2.04 b         16.5 b	noiteiberri noiN	→ Soil application	16.03 c	16.13 c	1.85 b	1.93 c	15.5 c	15.3 c
- Soil application 16.90 a 17.03 a 2.10 a 2.20 a 17.4 a	voll-litadiation		15.90 c	16.10 c	1.81 b	1.91 c	14.5 d	14.3 d
► Water extract 16.37 b 16.56 b 1.95 ab 2.04 b 16.5 b	1000		16.90 a	17.03 a	2.10 a	2.20 a	17.4 a	17.1 a
	IIIaulatioii		16.37 b	16.56 b	1.95 ab	2.04 b	16.5 b	16.2 b

Table (66): Effect of interaction between organic manure source, irradiation and application method on leaf area, root length and No. of roots/seedling of Sour orange seedlings (2000 and 2001

( guille	Irradiation A	Application	paf a	100 (om 2)		The state of the s		
manure		method	1		No. of r	No. of roots/seeding	Root I	length (cm)
source			1000					
	1		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Cattle	Non-irradiation	our application	16.10 d	16.30 bc	1.85 a	1.95 ef	15 1 efa	44005
	→ Wa	* Water extract	15.90 d	16.10 c	1 83 2	3 00	· · ·	14.9 eIg
manure		Soil application	16 70 66	)	0	1.90 et	14.2 g	14.0 g
	III addiation	-	10.70 abc	16.90 ab	2.05 a	2.15 ahr	170060	)
	₩a	Water extract	16,20 cd	16 40 50		2	C apc	16./ abc
	Non-irradiation S			0.40	- 9U a	2.00 def	16.1 cde	72007
	<b>→</b>	+ Sui application	16.00 d	16.20 c	1 85 2	1 05 4	)	0
Fourtry -		* Water extract	15 90 4	1010		- 0	15 9 cde	15.7 de
manure			0	100	1.80 a	1 90 f	14.9 efa	14 6 6
	+ Irradiation → Soll	- soll application	17.10 a	17 10 a	2 15 0	)	C	Ċ
				1	0	P 7.7.7	7/9a	17.6 a
			מיטים מיטים	Ib /U abc	2 00 a	2 10 bcd	16.9 abo	187 250
	* Soll	* Soil application	16.00 d	16 20 c	מ תמ		1	- O - ADC
Sheep				1	0	1 95 et	15 5 def	15 3 def
		Avaict EXTINCT	D 90 G	16 10 c	1.80 a	1 90 f	14 B fo	)
	→ Irradiation → Soil	Soil application	16 90 ab	17 10 2	3		(C	00.4
	+			2	0	2.20 ab	17 4 ab	17 1 25
	PIPAA	vvaler extract	16 40 bcd	16.60 abc	1.95 a		)	
eans with	Means within each column, followed by the same letter(s)	V the same la	Tbr(0) , 100 )				DO DCd	16.2 bcd
		7	T	これのことにいい	7.00	1 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7		

Moreover, irradiating organic manure surpassed nonirradiating treatment in induced a pronounced positive effect on leaf area in both seasons.

Furthermore, soil application of organic manure succeeded to induce a remarkable enhancing effect on leaf area as compared water extract treatment in this respect.

In addition, **Table (63)** illustrates that the interaction between organic manure source and irradiating organic manure, demonstrated that irradiating poultry manure produced more expanded leaf in both seasons whereas non-irradiation or irradiating cattle manure gave the lowest values in this respect.

On the other hand, the interaction between organic manure source and method of organic manure application, declared that poultry manure applied either as soil application or water extract exerted the highest positive effect on leaf area of Sour orange seedlings, in the first season, (Table, 64).

Furthermore, applying irradiated organic manure and as soil application exerted the highest stimulative effect on leaf area, followed descendingly by those applied as water extract. On the contrary, non-irradiation of organic manure and applied as soil application or water extract induced the lowest positive effect on leaf area in both seasons (Table, 65).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other studied combinations in enriching leaf area with the superiority to irradiating poultry manure on the expense of non-irradiation of poultry manure and applied as soil application on the expense of water extract application method. Besides, sheep

manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 66).

### 4.2.1.1.8 Stem dry weight

It is clear from **Table (67)** that poultry manured seedlings had the highest values of stem dry weight as compared with those produced by from cattle manured ones in both seasons. Besides, sheep manured seedlings had intermediate values in this respect.

Moreover, irradiated organic manure surpassed non-irradiating organic manure in increasing stem dry weight in both seasons.

Furthermore, soil application of organic manure increased stem dry weight as compared water extract of organic manure in both seasons.

In addition, **Table (68)** illustrates that the interaction between organic manure source and irradiating organic manure, declared that irradiated poultry manure had the highest stem dry weight values in both seasons. Non-irradiation and irradiation of cattle manure had the lowest values in this respect.

On the other hand, the interaction between organic manure source and method of organic manure application, showed that poultry manure applied as soil application or water extract induced the highest positive effect on stem dry weight of Sour orange seedlings in both seasons, (Table, 69).

Furthermore, applying irradiating organic manure as soil application exerted the highest stimulative effect on stem dry

Table (67): Specific effect of organic manure source, irradiation and application method on plant dry weight parameters of Sour orange seedlings (2000 and 2001 seasons).

	Stem dry	dry	Leaves dry	s dry	Root dry	dry	Total seedling	edling aht (a)	Top :root Ratio	root
Factor	Weight (g)	nt (g)	weight (g)	t (g) (2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	(2007)	(1007)		a. Effect	a. Effect of organic manure source	c manure	source			
Cattle manure	3.57 c	3.44 c	3.20 c	3.55 c	3.58 c	3.70 c	10.36 c	11.02 c	1.88 b	1.96 b
Poultry manure	4.53 a	4.74 a	4.96 a	4.73 a	4.65 a	4.75 a	14.06 a	14.14 a	2.03 a	1.98 b
Sheep manure	44.26 b	4.50 b	4.42 b	3.36 b	4.19 b	4.28 b	12.86 b	13.15 b	2.06 a	2.06 a
				Д	b. Effect of Irradiation	Irradiatio	c			
Non-irradiation	3.89 b	4.12 b	3.96 b	4.02 b	3.97 b	4.07 b	11.76 b	12.17 b	1.96 b	1.99 b
Irradiation	4.34 a	4.55 a	4.43 a	4.40 a	4.31 a	4.41 a	13.10 a	13.37 a	2.02 a	2.02 a
				c. Eff	c. Effect of application method	lication m	ethod			
Soil application	4.22 a	4.44 a	4.32 a	4.33 a	4.22 a	4.33 a	12.77 a	13.05 a	2.01 a	2.01 a
Water extract	4.02 b	4.23 b	4.06 b	4.10 b	4.06 b	4.15 b	12.08 b	12.49 b	1.97 b	1.99 a
Means within each column, followed by the same letter(s) are not significantly different at 5% level.	column, follo	owed by th	ne same let	ter(s) are	not signific	antly diffe	rent at 5%	o level.		

Table (68): Effect of interaction between organic manure source and irradiation on plant dry weight parameters of Sour orange seedlings (2000 and 2001 seasons).

manure Irradiation	1929	Stem dry Weight (g)	Leav	Leaves dry	Root dry	dry	Total seedli	eedling	Top :root	root
	(2000)	(2001)	(2000)	(8)	Aveignt (g)	ut (8)	dry weight	ight (g)	Ratio	tio O
Non-in-			(2000)	(1007)	(2000)	(2001)	(2000)	(2001,	(2000)	(2001
Cattle ->	3.2/1	3.50 f	2.95 f	3.10 e	3.42 f	3.52 f	9.65 e	10 34 6	7 20	3
- Irradiation	3.87 e	4.05 e	3.45 e	3.79 d	3.74 e	3.87 e	11 07 d	7772	2	) (
- Non-irradia								1.10	. 80 C	2.07 c
Poultry ->	4.31 c	4.51 c	4.78 b	4.58 b	4.45 b	4.56 b	13.36 ь	13.48 b	2.04 b	1.99 d
- Irradiation	4.74 a	4.96 a	5 15 a	4.88 a	4.85 a	4.94 a	14.75 a	14 79 a	203 5	000
Sheep → Non-irradiation	tion 4.10 d	4.36 d	4.15 d	4.17 c	4.05 d	4 15 d	12 25 c	10 80 0		
- Irradiation	4.42 b	4 64 5	4.70 c	4.55 b	4 34 6	4410	13 17			0
4040 4040 4410		1.04							)	

Table (69): Effect of interaction between organic manure source and application method plant dry weight parameters of Sour orange seedlings (2000 and 2001 seasons).

Organic manure	Application	Stem dry	ı dry	Leaves dry	s dry	Root dry	dry	Total seedling	edling	Top:root Ratio	oot
source	method	Weig	Weight (g)	weight (g)	1t (g)	Weight (9)	(3004)	(0000)	(2001)	(2000)	(2001)
		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(5000)	()	,	(
	- Soil application	3.68 e	3.87 d	3.25 e	3.66 e	3.66 e	3.80 e	10.60 e	11.34 e	1.88 c	1.98 b
Cattle →	Water extract	3.46 f	3.67 e	3.15 f	3.43 f	3.51 f	3.60 f	10.14 f	10.71 f	1.88 c	1.95 b
	Soil application	4.62 a	4.84 a	5.08 a	4.83 a	4.75 a	4.83 a	14.44 a	14.32 a	2.03 b	1.98 b
Poultry →	TeW tem	4.43 b	4.64 b	4.85 b	4.63 b	4.55 b	4.67 b	13.67 b	13.95 b	2.03 b	1.98 b
are of	Soil application	4.35 c	4.61 b	4.65 c	4.49 c	4.27 c	4.37 c	13.27 c	13.48 c	2.09 a	2.07 a
→ daays	Water extract	4.17 d	4.39 c	4.20 d	4.23 d	4.12 d	4.19 d		12.44 d 12.82 d	2.03 b	2.05 a
Means within	Means within each column, followed by the same letter(s) are not significantly different at 5% level.	ed by the	same lette	r(s) are no	ot significal	ntly differe	nt at 5%	evel.			

weight, followed descendingly by those applied as water extract. On the contrary, non-irradiation of organic manure and applied as soil application and water extract had the lowest positive effect on stem dry weight in both seasons (Table, 70).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other combinations in enhancing stem dry weight with the superiority to irradiating poultry manure on the expense of non-irradiation treatment applied as soil application on the expense of water extract of organic manure. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 71).

## 4.2.1.1.9 Leaves dry weight

It is clear from **Table (67)** that poultry manured seedlings had the highest leaves dry weight as compared with those arised from cattle manured ones in both seasons. Besides, sheep manured seedlings came in between in this respect.

Moreover, irradiated organic manure surpassed nonirradiated ones in increasing leaves dry weight in both seasons.

Furthermore, soil application of organic manure succeeded to induce a positive effect on leaves dry weight as compared water extract of organic manure.

In addition, Table (68) illustrates that the interaction between organic manure source and irradiation of organic

 Table (70):
 Effect of interaction between irradiation and application method of organic manure on plant dry weight parameters of Sour orange seedlings (2000 and 2001 seasons).

	Application	Stem dry	dry .	Leaves dry	s dry	Root dry	dry	Total seedling	edling	Top :root Ratio	root
Irradiation	method	Weig	Weight (g)	weight (g)	ıt (g)	weignt (9)	(6)	ion (in	(2004)	(0000)	(2001)
	2011	(2000)	(2000) (2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2007)	
	Soil application	1	3.99 c 4.22 c	4.08 c	4.12 c	4.06 c	4.16 c	4.16c 12.13c 12.39c	12.39 c	1.97 c	1.99 ab
Non-irradiation			4 03 d	3.83 d	3.92 d	3.89 d	3.99 d	11.38 d 11.94 d	11.94 d	1.95 d	1.98 b
	► Water extract	00.00				(		13 41 2 13 70 3	4 2 70 2	2.04 a	2.03 a
	-Soil application	4.44 a	4.65 a	4.56 a	4.53 a	4.39 a	4.30 a		5		
rradiation	to cutor of the	4 24 b	4,44 b	4.30 b	4.28 b	4.23 b		4.31b 12.79b 13.05b	13.05 b	2.01 b	2.01 ab
	Water extract				11000	different a	P 50%   PVP				
thee gittim section	within each column followed by the same letter(s) are not significating unletering a construction	v the sam	e letter(s)	are not sig	gnincariuy	חוובובוורם					
Medils with the	Colonia de la co										

Table (71): Effect of interaction between organic manure source, irradiation and application method on plant dry weight parameters of Sour orange seedlings (2000 and 2001 se

Organic		Application										
manure	Irradiation	method	Ste	Stem dry	Leav	Leaves dry	Roo	Root dry	Total s	Total seedling	Top	Top:root
source			Wei	Weight (g)	weig	weight (g)	Weig	Weight (g)	dry we	weight (g)	. ער	Ratio
			(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
7	Non-irradiatiog	Soil application	3.401	3.601	3.00 j	3.46 j	3.52 k	3.62 k	9.921	10.68 j	1.81 g	1.94 de
Cattle →	•	<ul> <li>Water extract</li> </ul>	3.15 j	3.40 j	2.9 k	3.16 k	3.331	3.431	9.39j	9.99 k	1.81 g	1.91 e
manure _	→ Irradiation →	Soil application	3.97 g	4.15 g	3.50 h	3.87 h	3.801	3.981	11.27 g	12.00 h	1.96 e	2.01 bc
	f	Water extract	3.77 h	3.95 h	3.411	3.711	3.69 j	3.77 j	10.88 h	11.43	1.94f	2.00 bcd
•	Non-irradiation	<ul> <li>Soil application</li> </ul>	₫ 38 d	4.58 d	4.96 c	4.67 c	4.51 c	4.66 c	13.87 с	13.55 d	2.04 bc	1.97 bcd
Poultry ->	f	Water extract	4.25 ef	4.45 e	4.60 d	4.50 d	4.34 e	4.46 e	12.86 d	13.41 de	2.04 bc	2.01 bcd
manure	+Irradiation →	Soil application	4.87 a	5.10 a	5.20 a	5.00 a	4.94 a	5.00 a	15.01 a	15.09 a	2.03 c	2.00 bcd
	f	Water extract	4.62 b	4.83 b	5.10 b	4.72 b	4.77 b	4.89 b	14.49 b	14.49 b	2.03 c	1.96 cde
7	Non-irradiation	Soil application	4.20 f	4.50 de	4.30 f	4.25 f	4.10 g	4.20 g	12.60 e	12.95 f	2.05 ь	2.08 a
Sheep ->	•	Water extract	4.00 g	4.23 f	4.00 g	4.10 g	4.00 h	4.10 h	11.90 f	12.43 g	2.00 d	2.03 ab
manure	→ Irradiation →	<ul> <li>Soil application</li> </ul>	4.50 c	4.72 c	500 c	4.74 b	4.44 d	4.54 d	13.94 c	14.00 c	2.013 a	2.08 a
	. 7	Water extract	4.34 de	4.58 d	4.40 e	4.36 e	4.25 f	4.29 f	12.99 d	13.22 ef	2 05 b	2 07 a

manure, demonstrated that irradiating poultry manure gave the highest leaves dry weight in both seasons, whereas non-irradiation and irradiating cattle manure induced the least enhancing effect in this respect.

On the other hand, the interaction between organic manure source and method of organic manure application, showed that poultry manure applied particularly as soil application or water extract exerted the highest positive effect on leaves dry weight of Sour orange seedlings in both seasons, (Table, 69).

Furthermore, applying irradiated organic manure as soil application exerted the highest stimulative effect on leaves dry weight, followed descendingly by those applied as water extract. On the contrary, non-irradiation of organic manure applied as soil application and / or water extract had the lowest positive effect on leaves dry weight in both seasons (Table, 70).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other studied combinations in increasing leaves dry weight with the superiority of irradiating poultry manure on the expense of non-irradiation treatment and soil application on the expense of water extract of organic manure. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 71).

## 4.2.1.1.10 Root dry weight

It is clear from **Table (67)** that poultry manured seedlings produced heavier root dry weight as compared with that given by cattle manured ones in both seasons. Other side, sheep manured seedlings had intermediate values in this respect.

Moreover, irradiated organic manures surpassed nonirradiated ones in exerting a positive effect on root dry weight in both seasons.

Furthermore, soil application of organic manure succeeded to induce a pronounced positive effect on root dry weight as compared with water extract of organic manure.

In addition, **Table (68)** illustrates that the interaction between organic manure source and irradiation of organic manure, declared that irradiating poultry manure induced heavier root dry weight in both seasons. On the contrary, non-irradiation and irradiating cattle manure had the lowest values in this respect.

On the other hand, the interaction between organic manure and method of organic manure application, illustrated that poultry manure applied as soil application or water extract exerted the highest positive effect on root dry weight of Sour orange seedlings in both seasons, (Table, 69).

Furthermore, irradiated organic manure applied as soil application exerted the highest stimulative effect on root dry weight, followed descendingly by those applied as water extract. On the contrary, non-irradiating of organic manure applied as soil application or water extract had the lowest values of root dry weight in both seasons (**Table, 70**).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other tested combination in improving root dry weight with the superiority to irradiating poultry manure on the expense of non-irradiation treatment and soil application on the expense of water extract application method. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 71).

# 4.2.1.1.11. Total seedling dry weight

It is clear from **Table (67)** that poultry manured seedlings produced higher total seedling dry weight as compared with those produced by from cattle manured ones in both seasons.

Moreover, irradiating organic manures surpassed nonirradiating ones in increasing total seedling dry weight in both seasons.

Furthermore, soil application of organic manure succeeded to increase on total seedling dry weight as compared with water extract application method.

In addition, **Table (68)** illustrates that the interaction between organic manure source and irradiating organic manure, reveals that irradiating poultry manure induced higher total seedling dry weight in both seasons. On contrast non-irradiation and irradiating cattle manure gave the lowest values in this respect.

On the other hand, the interaction between organic manure source and method of organic manure application, shows

that poultry manure applied particularly as soil application or water extract exerted the highest positive effect on total seedling dry weight of Sour orange seedlings, in both seasons, (Table, 69).

Furthermore, applying irradiating organic manure as soil application exerted the highest stimulative effect on total seedling dry weight, followed descendingly by those applied as water extract. On the contrary, non-irradiation of organic manure applied as soil application and water extract had the lowest positive effect on total seedling dry weight in both seasons (Table, 70).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other tested combination in increasing total seedling dry weight with the superiority to irradiating poultry manure on the expense of non-irradiating treatment and applied as soil application on the expense of water extract of organic manure. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 71).

# 4.2.1.1.12. Top: root ratio

It is clear from **Table** (67) that sheep manured seedlings produced higher top: root ratio as compared with those given by cattle manured ones in both seasons. On the hand, sheep manured seedlings gave intermediate values in this respect.

Moreover, irradiating organic manure surpassed non-irradiating in enhancing top: root ratio in both seasons.

Furthermore, soil application of organic manure succeeded to significantly increase top: root ratio as compared water extract application method.

In addition, **Table (68)** illustrates that the interaction between organic manure source and irradiating organic manure, declared that irradiating sheep manure induced higher top: root ratio in both seasons whereas non-irradiation or irradiating cattle manure gave the lowest values in this respect.

On the other hand, the interaction between organic manure source and method of organic manure application, shows that sheep manure applied as soil application or water extract exerted the highest positive effect on top: root ratio of Sour orange seedlings in both seasons, (Table, 69).

Furthermore, applying irradiating organic manure as soil application exerted the highest stimulative effect on top: root ratio, followed descendingly by those applied as water extract. On the contrary, non-irradiation of organic manure, applied as soil application or water extract had the lowest positive effect on top: root ratio in both seasons (**Table, 70**).

Finally, the interaction between the three studied factors indicates that the interactions of sheep manure surpassed the other tested combination in enhancing top: root ratio with the superiority of irradiating sheep manure on the expense of non-irradiating sheep manure and soil application on the expense of water extract application method. Besides, poultry manure combination surpassed cattle manure interactions in this respect and took the same pattern of sheep manure combinations in both seasons, (Table, 71).

### 4.2.1.2. Leaf mineral content

Leaf mineral content (N, P, K, Ca, Mg, Fe, Zn and Mn) of Sour orange seedlings during 2000 and 2001 seasons in response to organic manure source (cattle, poultry and sheep), irradiation and/or non-irradiation of dry organic manner and method of organic manure application (soil application and water extract) as well as their interactions is reported in **Tables (72** - 81).

#### 4.2.1.2.1. Nitrogen

It is clear from **Table** (72) that leaves of poultry manured seedlings had higher values of nitrogen content (2.60 & 2.62%) as compared with those manured with cattle (2.43 & 2.48%) in the first and second seasons, respectively. Besides, leaves of sheep manured seedlings scored inbetween values of nitrogen content (2.53 & 2.52%) in 2000 and 2001 seasons, respectively. Anyhow, the differences between the three studied organic manure sources in this regard were obvious to be significant.

Furthermore, irradiation of dry organic manures enhanced leaf nitrogen content rather than non-irradiation of dry organic manuers.

In addition, the application of organic manure as soil application induced higher positive effect on leaf nitrogen content rather than water extract application method, (Table,72).

Furthermore, the interaction between organic manure source and irradiation of dry organic manure demonstrates that leaf nitrogen content showed more response to organic manure

Table (72): Specific effect of organic manure source, irradiation and application method on leaf N, P, K, Ca and Mg content of Sour orange seedlings (2000 and 2001 seasons).

			Fleme	ents con	centratic	Elements concentration in dried leaves (%)	d leaves	(%)		
10400	A ::   A	200	Phosphorus	horus	Potassium	sium	Calcium	mn	Magnesium	sium
Lacion	(2000)	00) (2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
				a. Effect	of organi	a. Effect of organic manure source	source			
Cattle manure	2.43 c	2.48 c	0.125 b	0.125 b	0.765 c	0.755 c	3.3 c	3.2 c	0.35 c	0.36 c
Poultry manure	2.60 a	2.62 a	0.145 a	0.145 a	0.978 a	0.980 a	4.3 a	4.3 a	0.54 a	0.54 a
Sheep manure	2.53 b	2.52 c	0.132 b	0.132 a	0.850 b	0.890 b	3.9 b	3.8 b	0.44 b	0.45 b
				ď	. Effect of	<ul><li>b. Effect of Irradiation</li></ul>	_			
Non-irradiation	2.49 b	2.49 b	0.130 a	0.130 b	0.820 b	0.827 b	3.7 b	3.5 b	0.43 a	0.44 a
Irradiation	2.55 a	2.58 a	0.138 a	0.138 a	0.908 a	0.923 a	4.1 a	4, a	0.45 a	0.46 a
				c. Effe	ect of app	c. Effect of application method	ethod			
Soil application	2.55 a	2.55 a	0.138 a	0.138 a	0.883 a	0.897 a	4.1 a	4.0 a	0.46 a	0.46 a
Water extract	2.50 b	2.52 a	0.130 b	0.130 b	0.845 b	0.853 b	3.7 b	3.7 b	0.42 b	0.43 b
Means within each column, followed by the same letter(s) are not significantly different at 5% level.	olumn, follo	owed by th	e same let	ter(s) are	not signific	antly differ	ent at 5%	level.		

source rather than to irradiation of dry organic manures, hence, irradiated poultry manure, non-irradiated poultry manure and irradiated sheep manure scored the highest values of leaf nitrogen content in descending order.

Moreover, the interaction between organic manure source and method of organic manure application demonstrates that leaf nitrogen content showed more response to organic manure source rather than to method of organic manure application, hence poultry manure applied as soil application or as water extract induced the highest positive effect on leaf nitrogen content, followed descendingly by the combinations of sheep manure and lastly by the interactions of cattle manure (**Table**, 74).

Moreover, Table (75) reveals that the interactions between irradiation of organic manure and method of organic manure application shows that interactions of irradiation of organic manure and soil application method enhanced leaf nitrogen content followed descendingly by irradiated organic manure applied as water extract.

Finally, the interaction between organic manure source, irradiation of organic manure and method of organic manure application reveals that the interactions of poultry manure, particularly when poultry manure irradiated and applied as soil application induced the highest positive effect on leaf nitrogen content. On the contrary, the combinations of cattle manure exerted the least positive effect on leaf nitrogen content. Besides,

Table (73): Effect of interaction between organic manure source and irradiation on leaf N, P, K, Ca and Mg content of Sour orange seedlings (2000 and 2001 seasons).

				Flem	Flements concentration in dried leaves (%)	centratic	on in drie	ed leave	(%) s		
Organic				Choch	Obosphorus	Potassium	wiiiw	Calcium	ium	Magnesium	sium
	Irradiation	(2000) (20	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Source	Non-irradiation	2.41 e	2.42 c	0.125 b	0.125 b 0.125 b 0.745 e	0.745 e	0.735 f	3.3 b	3.1 e	0.33 c	0.34 c
Cattle →	Irradiation	2.45 d	2.53 b	0.125 b	0.125 b 0.125 b	0.785 d	0.775 e	3.4 b	3.3 de	0.36 c	0.37 c
t	Non-irradiation	2.5E bc	2.56 b	0.135 b	0.135 b	0.925 b	0.935 c	4.2 a	4.0 c	0.53 a	0.52 a
Poultry→	Irradiation	2.65 a	2.67 a	0.155 a	0.155 a	1.030 a	1.025 a	4. a	4.6 a	0.55 a	0.55 a
t t	Non-irradiation	2.51 c	2.51 b	0.130 b	0.130 b	0.790 d	0.810 d	3.6 b	3.4 d	0.43 b	0.44 b
Sheep →	- Irradiation	2.56 b	2.53 b	0.135 b		0.135 b 0.910 c 0.970 b	0.970 b	4.3 a	4.3 b	0.45 b	0.46 b
o cittim socoM	Manage within each column. followed by the same letter(s) are not significantly different at 5% level.	ed by the s	same lette	r(s) are no	t significan	tly differen	it at 5% le	vel.			

Table (74): Effect of interaction between organic manure source and application method on leaf N, P, K, Ca and Mg content of Sour orange seedlings (2000 and 2001 seasons).

Organic	Application			Elem	ents cor	Centrati	Elements concentration in dried leaves (8/)	2 000	10/1		
manure		Zit	Nitrogen	0505	5			ים וכמעב	2 (10)		
Source	method	(2000)	0901	FIIOS	rnosphorus	Potassium	muiss	Calcium	m	Magnesium	esium
		(2000)	(L007)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Cattle →	<ul> <li>Soil application</li> </ul>	2.45 c	2.52 bc	0.130 bc	2.52 bc 0.130 bc 0.130 bc 0.780 d 0.765 d	0.780 d	0.765 d	3.5°c	3.3 d	0.37 e	0.37 e 0.38 d
	<ul><li>Water Extract</li></ul>	2.41 c	2.44 c	0.120 c	0.120 c 0.750 d		0.745 d	3.2 d	3.2 d	0.32 f	0.33 e
Poultry	Soil application	2.64 a	2.63 a	0.150 a	0.150 a 1.010 a		1.015 a	4.5 a	4.5 a	0.56 a	0.56 a
	<ul> <li>Water Extract</li> </ul>	2.56 b	2.60 ab	0.140 b	2.60 ab	0.945 ь	0.945 Ь	4 5	4 1 5	0 52 h	つ カント
Sheep	Soil application	2.55 b	2.52 bc	2.52 bc 0.135 b	0.135 b	0 860 c	0.910 b	4 7 0	400	0.45 c	0 45 c
f	Water Extract	2.52 b	2.52 bc	0.130 bc	2.52 bc 0.130 bc 0.130 bc 0.840 c 0.870 c	0.840 c	0.870 c	37c	37c	0 43 d	0 44 6
Means within 6	Means within each column, followed by the same letter(s) are not significantly different at 5% level.	ed by the	same letter	(s) are no	t significan	tly differen	t at 5% lev	<u>rè</u>			

 Table (75): Effect of interaction between irradiation and application method of organic manure on leaf N, P, K,

 Ca and Mg content of Sour orange seedlings (2000 and 2001 seasons).

	Annlication			Elem	Elements concentration in dried leaves (%)	ncentrat	ion in dr	ied leave	(%) se		
Irradiation	method	Nitr	Nitrogen	Phosp	Phosphorus	Potassium	sium	Calcium	inm	Magn	Magnesium
	nome	(2000)	(2001)	(2000)	(2001)	(2000)	(2000) (2001)	(2000)	(2001)	(2000)	(2001)
No.	Soil application 2.50 b 2.50 b 0.133 ab 0.133 ab 0.837 c 0.840 c	2.50 b	2.50 b	0.133 ab	0.133 ab	0.837 c	0.840 c	3.9 b	3.6 c	0.45 b	0.45 b
NOII-III adiatio	Water Extract	2.47 c	2.49 b	2.47 c 2.49 b 0,127 b 0.127 b 0.803 d 0.813 c	0.127 b	0.803 d	0.813 c	3.5 c	3.4 d	0.42 d	0.43 b
1	Soil application	2.58 a		2.61a 0.143a 0.143a 0.930a 0.953a	0.143 a	0.930 a	0.953 a	4.3 a	4.3 a	0.47 a	0.48 a
Irradiation	Water Extract	2.53 b	2.55 ab	2.53 b 2.55 ab 0.133 ab 0.133 ab 0.887 b 0.893 b	0.133 ab	0.887 b	0.893 b	3.8 b	3.9 b	0.43 c	0.44 b

the combinations of sheep manure occupied inbetween positions in this respect (Table, 76).

#### 4.2.1.2.2. Phosphorus

It is clear from **Table (72)** that leaves of poultry manured seedlings had higher values of phosphorus content (0.145 & 0.145%) as compared with those manured with cattle (0.125 & 0.125%) in the first and second seasons, respectively. Besides, leaves of sheep manured seedlings scored inbetween values of phosphorus content (0.132 & 0.132%) in 2000 and 2001 seasons, respectively. The differences between the three studied organic manure sources in this regard were remarkable to be significant.

Furthermore, irradiation of dry organic manures enhanced leaf phosphorus content rather than non-irradiation treatment.

In addition, the application of organic manure as soil application enhanced leaf phosphorus content rather than water extract application method, (Table,72).

Furthermore, **Table (73)** indicates that the interaction between organic manure and irradiation of dry organic manner source demonstrate that leaf phosphorus content showed more response to organic manure source rather than to irradiation of dry organic manures, hence, irradiated poultry manure followed by non-irradiated dry poultry manure and irradiated sheep manure scored the highest values of leaf phosphorus content.

Moreover, the interaction between organic manure source and method of organic manure application declared that leaf phosphorus content showed more response to organic manure source rather than to method of organic manure application,

Table (76): Effect of interaction between organic manure source, irradiation and application method on leaf N, P, K,

Organic		Application			Ш	ements co	Elements concentration in dried leaves (%)	on in drie	d leaves (	(%)		
manure	Irradiation	method	Nitro	Nitrogen	Phos	Phosphorus	Potas	Potassium	Calc	Calcium	Magn	Magnesium
source			(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
		Soil application	2.42 g	2.43 de	0.130 c	0.130 c	0.770 de	0.750 ef	3.5 efg	3.2 fg	0.36 g	0.37 fg
ا ا	Non-irradiation	Wat	2.40 g	2.42 €	0.120 c	0.120 c	0.720 e	0.720 f	3.19	3.1 g	0.301	0.32 g
Value +		Soil application	2.48 ef	2.61 abc	0.130 c	0.130 c	0.790 d	0.780 def	3.6 ef	3.4 fg	0.38 f	0.39 ef
	Irradiation	→ Water extract	2.43 fg	2.46 de	0.120 c	0.120 c	0.780 de	0.770 def	3.3 fg	3.3 fg	0.34 h	0.35 fg
		jog	2.58 bc	2.57 abcd	0.140 bc	0.140 bc	0.940 bc	0.950 bc	4.4 abc	4.2 bc	0.54 b	0.53 b
Poultry	Non-irradiation	Wat	2.52 cde	2.55 bcde	0.130 c	0.130 c	0.910 c	0.920 c	4.0 cd	3.8 de	0.52 c	0.52 bc
→ duna		Š	2.70 a	2.69 a	0.160 a	0.160 a	1.080 a	1.080 a	4.7 a	4.8 a	0.58 a	0.59 a
2	Irradiation	→ Water extract	2.61 b	2.65 ab	0.150 ab	0.150 ab	0.980 b	0.970 bc	4.2 bcd	4.5 ab	0.52 c	0.52 bc
		So	2.52 cde	2.52 bcde	0.130 c	0.130 c	0.800 d	0.820 d	3.8 de	3.5 ef	0.44 e	0.43 de
Sheen	Non-irradiation		2.50 de	2.50 cde	0.130 c	0.130 c	0.780 de	0.800 de	3.4 efg	3.4 fg	0.43 e	0.44 de
waniire +		Sol	2.58 bc	2.53 bcde	0.140 bc	0.140 bc	0.920 c	1.000 b	4.5 ab	4.6 a	0.46 d	0.47 cd
	Irradiation	→ Water extract	2.55 bcd	2.54 bcde	0.130 c	0.130 c	0.920 c	0.940 bc	4.1 bcd	4.0 cd	0.44 e	0.45 de

whereas poultry manure applied firstly as soil application followed by the analogous ones applied as water extract induced the highest positive effect on leaf phosphorus content, followed descendingly by the combinations of sheep manure and lastly by the interactions of cattle manure (Table, 74).

Moreover, Table (75) reveals that the interaction between irradiation of organic manure and method of organic manure application shows that interactions of irradiation of organic manure and soil application method improved leaf phosphorus content, followed descendingly by irradiation of organic manure interaction with water extract application method.

Finally, the interaction between organic manure source, irradiation of organic manure and method of organic manure application reveals that the interactions of poultry manure, particularly when poultry manure irradiated and applied as soil application induced the highest positive effect on leaf phosphorus content. On the contrary, the combinations of cattle manure exerted the least positive effects on leaf nitrogen content. Besides, the combinations of sheep manure occupied inbetween positions in this respect (Table, 76).

#### 4.2.1.2.3, Potassium

It is clear from **Table (72)** that fertilizing Sour orange seedlings poultry manure enriched leaf potassium content (0.978 & 0.980%) as compared with those manured with sheep (0.850 & 0.890%) and cattle manured seedlings (0.765 & 0.755%) in 2000 and 2001 seasons, respectively. Anyhow, the differences

between the three organic manure sources in this respect were obvious to be significant.

Furthermore, irradiation of dry organic manures enhanced leaf potassium content rather than non-irradiation treatment.

In addition, the soil application of organic manure enhanced leaf potassium content rather than water extract application method, (Table,72).

Moreover, **Table (73)** indicates that the interaction between organic manure and irradiation of dry organic manure demonstrated that leaf potassium content showed more response to organic manure source rather than to irradiation of dry organic manuers, where irradiated poultry manure and the secondly irradiated sheep manure recorded the highest values of leaf potassium content.

Furthermore, the interaction between organic manure source and method of organic manure application demonstrates that leaf potassium content showed more response to organic manure source rather than to method of organic manure application, hence poultry manure applied as soil application followed by water extract induced the highest positive effect on leaf potassium content, followed descendingly by the combinations of sheep manure and lastly by the interactions of cattle manure (Table, 74).

Moreover, **Table (75)** reveals that the interaction between irradiation of organic manure and method of organic manure application shows that interactions of irradiation of organic manure and soil application method enhanced leaf potassium content followed descendingly by irradiation of organic manure and water extract application.

Finally, the interaction between organic manure source, irradiation of organic manure and method of organic manure application shows that the interactions of poultry manure, particularly when poultry manure irradiated and applied as soil application induced the highest positive effect on leaf potassium content. followed descendingly by sheep manure irradiated and applied as soil application. On the contrary, the combinations of cattle manure exerted the least positive effects on leaf potassium content. Besides, the combinations of sheep manure occupied inbetween positions in this respect (Table, 76).

#### 4.2.1.2.4. Calcium

It is clear that fertilizing Sour orange seedlings poultry manure enriched leaf calcium content (4.3 & 4.3%) as compared with those manured with sheep (3.9 & 3.8%) and cattle manure (3.3 & 3.2%) in 2000 and 2001 seasons, respectively. Anyhow, the differences between the three organic manure sources in this respect were pronounced to be significant.

Furthermore, irradiation of dry organic manures enhanced leaf calcium content rather than non-irradiation treatment.

In addition, the soil application of organic manure source enhanced leaf calcium content rather than water extract application method, (Table,72).

Moreover, **Table (73)** indicates that the interaction between organic manure source and irradiation of dry organic manner demonstrated that leaf calcium content showed more response to organic manure source rather than to irradiation of dry organic manuers, where, irradiated poultry manure poultry

manure and the irradiated sheep manure gave the highest values in this respect.

Furthermore, the interaction between organic manure source and method of organic manure application declared that leaf calcium content showed more response to organic manure source rather than to method of organic manure application, hence soil application of poultry manure applied in soil application water extract induced the highest positive effect on leaf calcium content, followed descendingly by the combinations of sheep manure and lastly by the interactions of cattle manure (Table, 74).

Moreover, **Table (75)** reveals that the interaction between irradiation of organic manure source and method of organic manure application shows that interactions of irradiation of organic manure source and method of organic manure application as soil application enhanced leaf calcium content followed descendingly by irradiation of organic manure and water extract application method.

Finally, the interaction between organic manure source, irradiation of organic manure and method of organic manure application shows that the interactions of poultry manure, particularly when poultry manure irradiated and applied as soil application induced the highest positive effect on leaf calcium content. followed descendingly by sheep manure irradiated and applied as soil application. On the contrary, the combinations of cattle manure exerted the least positive effect on leaf calcium content. Besides, the combinations of sheep manure occupied inbetween positions in this respect (Table,76).

### 4.2.1.2.5. Magnesium

It is clear from **Table (72)** that leaves of poultry manured Sour orange seedlings had higher values of magnesium content (0.54 & 0.54%) as compared with those manured with cattle (0.35 & 0.36%) in the first and second seasons, respectively. Besides, leaves of sheep manured seedlings scored inbetween values of magnesium content (0.44 & 0.45%) in 2000 and 2001 seasons, respectively. Anyhow, the differences between the three studied organic manure sources in this regard were remarkable to be significant.

Furthermore, irradiation of dry organic manures enhanced leaf magnesium content rather than non-irradiation of dry organic manures.

In addition, the application method of organic manure failed to induce any positive effect on leaf magnesium content in both seasons (Table,72).

Furthermore, the interaction between organic manure source and irradiation of dry organic manure demonstrates that leaf magnesium content showed more response to organic manure source rather than to irradiation of dry organic manuers, hence, irradiated poultry manure, non-irradiated poultry manure and irradiated sheep manure showed the highest values in this respect.

Moreover, the interaction between organic manure source and method of organic manure application demonstrates that leaf magnesium content showed more response to organic manure source rather than to method of organic manure application, hence poultry manure applied firstly as soil application or water extract induced the highest positive effect on leaf magnesium content, followed descendingly by the combinations of sheep manure and lastly by the interactions of cattle manure (**Table**, 74).

Moreover, **Table (75)** reveals that the interaction between irradiation of organic manure and method of organic manure application shows that interactions of irradiation of organic manure and soil application method enhanced leaf magnesium content followed descendingly by irradiation of organic manure source and method of organic manure application in soil application of water extract.

Finally, the interaction between organic manure source, irradiation of organic manure source and method of organic manure application shows that the interactions of poultry manure, particularly when poultry manure irradiated and applied as soil application induced the highest positive effect on leaf magnesium content. On the contrary, the combinations of cattle manure exerted the least positive effect on leaf magnesium content. Besides, the combinations of sheep manure occupied inbetween positions in this respect (Table, 76).

# 4.2.1.2.6. Iron, Manganese and Zinc

It is obvious from Table (77) that leaves of poultry manured seedlings had the highest values of leaf Fe, Mn and Zn content, followed descendingly by those of sheep manured ones and lastly those fertilized with cattle manure. However, the differences between the three tested organic manure sources in this concern were remarkable to be significant.

**Table (77):** Specific effect of organic manure source, irradiation and application method on leaf Fe, Mn and Zn content of Sour orange seedlings (2000 and 2001 seasons).

י מכנטו	Iron		Manganese	anese		5
	(2000)	(2001)	(2000)	(2001)		1
Cattle manure	i i		a. Effect of organic manure source	c manure source	(2000)	(200
Poultry manure	94 a	73 c	48 c	46 c	440	43 c
Sheep manure	84 h	S 44	74 a	74 a	72 a	67 a
CHI		82 b	65 b	62 b	58 b	56 5
Non-irradiation	-		<ul> <li>b. Effect of irradiation</li> </ul>	irradiation		C
CH-11 adiation	82 b	81 b	59 b	57 b	נה	Ĝ
III adiation	86 a	84 a	66 a	65 d	51 D	52 b
•			c. Effect of application method	cation method	(	S S
du d	86 a	84 a	65 a	ກ ນ ນ		
7	82 b	80 ь	60 b	ת ס ד	<i>a</i> .	57 a
Water extract			1	Moderation	בל	1

Moreover, irradiation of organic manure enhanced leaf Fe, Mn and Zn content rather than non-irradiation of organic manure source.

Furthermore, the soil application of organic manure enhanced leaf Fe, Mn and Zn content rather than water extract application method.

Additionally, **Table (78)** reveals that the application of irradiated poultry manure and non-irradiated exerted the highest stimulative effect on leaf Fe, Mn and Zn content. On the contrary, the application of cattle manure either irradiated or non-irradiated induced the lowest values in this respect. The interactions of sheep manure occupied an intermediate position in this sphere.

Table (79) shows that the application of poultry manure as soil application and water extract exerted the highest stimulative effect on leaf Fe, Mn and Zn content. On the contrary, the application of cattle manure either as soil application or soil application water extract induced the lowest values in this respect. The interactions of sheep manure occupied an intermediate position in this sphere.

Table (80) shows that leaves of irradiated organic manure seedlings general manured superficial or water extract were the richest ones in their content of Fe, Mn and Zn as compared with those of non-irradiated manured seedlings.

Lastly, the interaction between organic manure source, irradiation of organic manure and method of organic manure application, (Table,81) reveals that the poultry manured

Table (78): Effect of interaction between organic manure source and irradiation on leaf Fe, Mn and Zn content of Sour orange seedlings (2000 and 2001 seasons).

CINCIPLIC SILES	(							
SOUTCE		Irradiation	Iron	on	Manganese	nese	Zir	ວເ
2001.00			(2000)	(2001)	(2000)	(2001)	(2000) (2	(2001)
	<b>/</b>	Non-irradiation	74 e	73 c	40 d	38 f	45 e	43 f
Carrie	t	Irradiation	75 e	73 c	49 с	49 e	52 d	50 e
Doubtry manus	\ 	Non-irradiation	92 b	91 a	70 a	64 b	71 b	69 b
Louid A manage	ţ \	Irradiation	97 a	95 a	74 a	70 a	78 a	78 a
	\	Non-irradiation	82 d	80 ь	56 в	54 d	63 c	60 d
Sirech mannie	t ,	Irradiation	87 c	84 b	60 ь	59 c	68 b	65 0

**Table (79):** Effect of interaction between organic manure source and application method on leaf Fe, Mn and Zn content of Sour orange seedlings (2000 and 2001 seasons).

	- Contraction		Elements concentration in dried leaves (ppm)	ncentration	in dried lea	ives (ppm)	
Organic manure	Application	Ire	Iron	Manga	Manganese	Zi	Zinc
source	method	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	- Soil application	P 8/2	76 d	51 e	49 e	48 d	45 e
Cattle manure	<ul> <li>Water extract</li> </ul>	71 e	70 e	46 f	4	8 9	42 e
	<ul> <li>Soil application</li> </ul>	97 a	95 a	77 a	77 a	73 a	e 69
Poultry manure →	<ul><li>Water extract</li></ul>	92 b	90 6	71 b	71 b	71 b	65 b
	<ul> <li>Soil application</li> </ul>	85 c	83 c	67 c	64 c	61 b	288
Sheep manure →	<ul><li>Water extract</li></ul>	84 c	81 c	63 d	61 d	55 c	25 d
Meson within social	Masses within each column followed by the same letter(s) are not significantly different at 5% level.	letter(s) are	not significantly	different at 5º	% level.		

**Table (80):** Effect of interaction between irradiation and application method of organic manure on leaf Fe, Mn and Zn content of Sour orange seedlings (2000 and 2001 seasons).

Irradiation	Application		Elements concentration in dried leaves	oncentratio	n in dried le	aves (ppm)	
	method	Iron		Managa		aves (ppill)	
	יייכנוסם	(2000)	(2004)	Manganese	nese	Zir	ĭĊ
	:	12000	(2001)	(2000)	(2001)	(2000)	(2001)
Non-irradiation-	Soil application	85 b	83 b	61 b	59 c	57 b	53 (
	* Water extract	000				100000	()
	sadici extract	80 c	29 0	57 c	55 d	54 c	7
Irradiation ->	<ul> <li>Soil application</li> </ul>	88 a	86 a	69 a	67 a		
ř	<ul> <li>Water extract</li> </ul>	84 5	51				Ø
Means within each col	ייייי ליווי	84 0	81 bc	63 b	62 b	57 b	57
warm cach column, followed by the same letter(s) are not significantly different at 50% local	Jillin, Tollowed by the s	ame letter(s) are	not significant	V different at E	02 1505		Ç
				T C C C C C C C C C C C C C C C C C C C	000		

Table (81): Effect of interaction between organic manure source, irradiation and application method on leaf Fe, Mn and Zn content of Sour orange seedlings (2000 and 2001 seasons).

	200							
o danie	Irradiation		-	Iron	Mang	Manganese	Z	Zinc
Source			(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
		Soil application	78 d	76 f	47 hi	45 h	42 fg	40 g
	Non-irradiation.	Non-irradiation	e 02	70 g	43	41	38 g	37 g
Cattile →		- Soil application	78 d	76 f	56 g	53 g	55 de	50 f
manure	Irradiation	Water extract	72 e	70 g	49 h	47 h	43 f	48 f
	noiteiberri nola-	Non irradiation Soil application	95 b	93 b	73 bc	72 c	71 b	65 bc
6	NOII-III adiano	→ Water extract	90 pc	89 pc	99 cde	p 29	70 b	64 bc
Poultry →		Soil application		98 a	82 a	82 a	76 a	73 a
manure	- Irradiation -	Viviator extract		92 b	74 b	75 b	72 ab	67 b
	Citolicani a cia	Soil application		80 ef	65 ef	61 f	29 cd	26 de
	NON-III adiano	Water extract		80 ef	61 f	59 f	54 e	52 ef
Sheep →	<b>^</b>	Soil application		86 cd	70 bcd	p 29	63 c	61 cd
manure	- Irradiation	→ Water extract		82 de	ep 99	64 e	97 de	28 d

seedlings, irradiated and manured superficial or as water extract followed descendingly by the corresponding ones non-irradiated and manured as soil application and water extract showed the highest values of leaf Fe, Mn and Zn content. Besides, the combinations of sheep manure proved to be more efficient in enhancing leaf Fe, Mn and Zn content than the analogous ones of cattle manure.

Briefly, the results of leaf mineral content due to organic manure source are in accordance with the findings of Sekiya et al. (1993) on Satsuma mandarin, Kalu-Singh et al. (1984) on mango. Noack (1984) on apple, Darfeld and Lenz (1985) on pear, Umemiya and Sekiya (1985) on persimmon, Villasurda and Baluyut (1990) on guava, Ben-Ya-Acov et al. (1992) on avocado, Awad et al. (1993) on olive, Alvarez etal. (1993) on pinapple, Smith (1994) on banana, Abu-Sayed Ahmed (1997) on Balady mandarin and El-Kobbia (1999) on Balady mandarin and Moustafa (2002) on Washington navel orange. They reported that organic manures particularly, poultry manure enhanced leaf mineral content.

Besides, the obtained results of leaf mineral content attributed to the effect of method of organic manure application are in harmony with the findings of Thachuk (1983) on apple, Bhangoo et al. (1988) on grape and Goede (1993) on mango. Moreover, the results of biofertilization regarding leaf mineral content are in agreement with the findings of Pmares et al. (1983) on oranges, Chokha et al. (1993) on orange, Haggag and Azzazy (1996) on mango, Ahmed et al. (1997) on grape, Awashi et al. (1998) on peach, Fernandez et al. (1998) on banana, Mansour (1998) on Anna apple, Mahmoud and

Mahmoud (1999) on peach Tiwary et al. (1999) on banana and Moustafa (2002) on Washington navel orange. They mentioned that Rhizobacterien enhanced most leaf mineral content.

## 4.2.2. Volkamer lemon seedlings

#### 4.2.2.1. Plant growth parameters

**Tables** (82-96) shows that growth parameters, i.e. seedling height, stem diameter, leaf chlorophyll (a & b), No. of leaves /seedling, leaf surface area, root length, No. of root /seedling, stem dry weight, leaves dry weight, root dry weight, total seedling dry weight and top:root ratio of Volkamer lemon seedlings in response to organic manure source irradiation and non-irradiation and method of organic manure application during 2000 & 2001 seasons.

#### 4.2.2.1.1. Seedling height

It is clear from **Table (82)** that poultry manured seedlings produced taller stem as compared with those arised from cattle manured ones in both seasons. On the other hand, sheep manured seedlings had intermediate values in this respect.

Moreover, irradiating organic manure surpassed nonirradiated ones in exerting a distinctive positive effect on seedling height in both seasons.

Furthermore, soil application of organic manure succeeded in inducing a distinctive effect on seedling height as compared water extract application of organic manure.

In addition, Table (83) illustrates that the interaction between organic manure source and irradiating organic manure,

Table (82): Specific effect of organic manure source, irradiation and application method on some growth parameters of leaves Volkamer lemon seedlings (2000 and 2001 seasons)

							bull (ma		No of loaves	oavos
Factor	Seedling neight	n) g neight	(cm)	(cm)	(6	(a)	(a) (b)	٢	/seedling	lling
	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
				a. Effect	a. Effect of organic manure source	c manure	source			
Cattle manure	42 c	41 c	0.61 c	0.72 c	6.08 b	6.13 b	2.57 b	2.52 a	78 c	67 c
Poultry manure	75 a	73 a	0.99 a	1.01 a	6.17 a	6.22 a	2.67 a	2.60 a	115 a	97 a
Sheep manure	o2 b	59 b	0.74 b	0.88 b	6.13 ab	6.17 ab	2.62 ab	2.58 a	92 b	83 b
				ь	b. Effect of Irradiation	Irradiatior	-			
Non-irradiation	56 b	52 b	0.74 b	0.84 b	6.01 b	6 05 b	2.47 b	2.44 b	87 b	78 b
Irradiation	64 a	63 a	0.82 a	0.89 a	6.25 a	630 a	277 a	2.70 a	103 a	87 a
				c. Effe	c. Effect of application method	cation me	thod			
Soil application	62 a	60 a	0.80 a	0 88 a	6.19 a	6 25 a	2.70 a	2.63 a	99 a	85 a
Water extract	58 b	55 b	0.76 b	0.85 b	6.06 b	6 10 b	2.55 b	251 6	91 6	79 b
Means within each column, followed by the same letter(s) are not significantly different at 5% level	nn, followe	ed by the s	ame letter(	s) are not	significant	dy differen	t at 5% lev	/el.		

Table (83): Effect of interaction between organic manure source and irradiation on some growth parameters of leaves Volkamer lemon seedlings (2000 and 2001 seasons).

Organic		Seedling height	height	Stem di	Stem diameter	Les	afchloro	Leaf chlorophyll (mg/L	/୮)	No. of	No. of leaves
manure	Irradiation	(cm)	) (u	5)	(cm)	(a)	<u>.</u>	(q)	<u>(</u>	/see	/seedling
source		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	- Non-irradiation	39 e	38 e	0.58 f	0.69 f	6.00 c	6.05 d	2.42 d	2.37 c	74 f	63 f
Cattle→	irradiation	46 d	45 d	0.63 e	0.74 e	6.17 b	6.22 c	2.72 b	2.67 a	82 e	71 e
	→ Non-irradiation	q 69	65 b	0.96 b	0.98 b	6.02 c	6.06 d	2.52 c	2.47 b	96 p	92 b
Poultry→	- irradiation	81 a	8 a	1.03 a	1.04 a	6.32 a	6.37 a	2.82 a	2.72 a	131 a	103 a
•	→ Non-irradiation	26 c	55 c	p 69.0	0.85 d	6.00 c	6.05 d	2.47 cd	2.47 b	P 68	p 6/
Sheep →	• irradiation	65 b	64 b	0.79 c	0.80 c	6.27 ab	6.30 b	2.77 ab	2.70 a	o 96	87 c
Means within	Means within each column, followed by the same letter(s) are not significantly different at 5% level	ved by the	same letter	(s) are not	t significan	tly differen	it at 5% le	vel.			

reveals that irradiating poultry manure induced more longer seedlings in both seasons followed descendingly by nonirradiating or irradiating cattle manure.

On the other hand, the interaction between organic manure and method of organic manure application, reveals that poultry manure applied particularly as soil application or secondly as water extract exerted the highest positive effect on seedling height of Volkamer lemon seedlings in both seasons, (Table, 84).

Furthermore, irradiating organic manure and manuring as soil application exerted the highest positive effect on seedling height, followed descendingly by those applied as water extract. On the contrary, non-irradiation of organic manure and applied as soil application or water extract induced the lowest positive effect on seedling height in both seasons (Table, 85).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other combinations (cattle and sheep) in enhancing seedling height with the superiority of irradiating poultry manure on the expense of non-irradiating poultry manure and applied as soil application on the expense of water extract of organic manure. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 86).

### 4.2.2.1.2. Stem diameter

It is clear from **Table (82)** that poultry manured seedlings had the highest stem diameter values as compared with those

Table (84): Effect of interaction between organic manure source and application method on some growth parameters of leaves. Volkamer lemon seedlings (2000 and 2001 seasons)

Organic	Application	Seedling height	) height	Stem d	Stem diameter	Les	if chloro	Leaf chlorophyll (mg/L)	/\r)	No. of leaves	eaves
manure	Application .	(cm)	(u	5)	(cm)	(a)	(1)	(q)	<u>(c</u>	/seedling	lling
Source	шешод	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	<ul> <li>Soil application</li> </ul>	44 d	43 d	0.63 e	0.73 c	6.15 abc	6.20 bc	2.65 abc	2.60 ab	81 e	70 e
Cattle	➤ Water extract	41 d	9 oc	0.59 f	0.70 c	6.02 c	6.07 d	2.50 d	2.45 c	75 f	64 f
=	Soil application	77 a	75 a	1.01 a	1.03 a	6.24 a	6.30 a	2.75 a	2.67 a	121 a	101 a
Poultry	<ul> <li>Water extract</li> </ul>	72 b	71 a	0.97 b	0.99 a	6.10 bc	6.14 cd	2.60 bcd	2.52 bc	109 b	94 b
<u></u>	<ul> <li>Soil application</li> </ul>	63 c	62 b	0.76 c	0.89 b	6.20 ab	6.25 ab	6.25 ab 2.70 ab	2.62 ab	95 c	85 c
daauc	→ Water extract	61 c	57 c	0.73 d	0.87 b	6.07 bc	6.10 d	2.55 cd	2.55 bc	P 06	81 d
Means within	Means within each column, followed by the same letter(s) are not significantly different at 5% level	wed by the	same letter	r(s) are no	t significa	ntly differer	nt at 5% l	evel.			

Table (85): Effect of interaction between organic manure source and application method on some growth parameters

Application	Seedling	Seedling height Stem diameter	Stem di	ameter	Lea	af chloro	Leaf chlorophyll (mg/'_)	[/ <u>-</u> _)	No. of leaves	eaves
Irradiation ""	(cm	<u>n)</u>	(cm	<u>n)</u>	(a)	<u></u>	1)	(b)	/seedling	ling
	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001
Non-irradiation	56 c	55 c	0.76 c	0.85 bc	6.05 c 6.10 c	6.10 c	2.55 c	2.50 c	89 c	81 b
- Water extract	54 c	50 d	0.73 d	0.83 c	5.97 c	6.01 d	2 40 d	2.38 d	85 d	75 c
Trradiation Soil application	66 a	65 a	0.84 a	0.92 a	6.34 a	6.40 a	2.85 a	276 a	109 a	90 a
Water extract	61 b	61 6	0806	0 87 b	6.16 b	6.20 b	270 ь	2 63 b	97 b	84 5

Table (86): Effect of interaction between organic manure source, irradiation and application method on some growth parameters of leaves Volkamer lemon seedlings (2000 and 2001 seasons)

Irradiation   method   (cm)   (cm)	Irradiation   method   (cm)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2001)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)   (2000)	Organic	Application	Seedlin	Seedling height	Stem d	Stem diameter	Le	af chloro	Leaf chlorophyll (mg/L)		No. of	No. of leaves
Non-irradiation   Soil application   40 g   39 f   0.61 j   0.70 g   6.05 def   6.10 efg   2.50 fgh   2.45 def   78 g   71 h   0.56 k   0.68 g   5.95 f   6.00 g   2.35 l   2.30 f   71 h   71 h   70 c   68 b   0.97 b   6.05 def   6.10 efg   2.50 fgh   2.45 def   71 h   71 h   70 c   68 b   0.97 b   6.05 def   6.10 efg   2.55 cde   70 c   70 c	Non-irradiation   Soil application   40 g   39 f   0.61 j   0.70 g   6.05 def   6.10 efg   2.50 fgh   2.45 def   78 g   71 h	manure Irradiation	_	0	(m:	0)	m)	(а	•	q)		/see	dling
Non-irradiation         Soil application         40 g         39 f         0.61 j         0.70 g         6.05 def         6.10 efg         2.50 fgh         2.45 def         78 g           Non-irradiation         Water extract         48 f         48 e         0.65 j         0.77 f         6.25 bc         6.00 g         2.35 l         2.30 f         71 h           Non-irradiation         Soil application         70 c         68 b         0.98 c         0.99 b         6.05 def         6.10 efg         2.65 def         2.60 bcd         80 f           Non-irradiation         Soil application         85 a         82 a         1.05 a         1.07 a         6.20 bcd         6.05 def         2.55 efg         1.00 c           Non-irradiation         Soil application         85 a         82 a         1.05 a         1.02 ab         6.20 bcd         6.25 efg         2.55 efg         2.55 efg         1.00 c           Non-irradiation         85 a         82 a         1.00 b         1.02 ab         6.20 bcd         6.25 efg         2.55 efg         2.55 efg         9.0 e           Non-irradiation         86 bcd         52 bcd         0.71 g         0.85 bcd         6.00 gcd         6.00 gcd         2.45 bcf         88 de           Non-irradia	Non-irradiation         Soil application         40 g         39 f         0.61 j         0.70 g         6.05 def         6.10 efg         2.50 fgh         2.45 def         78 g           Non-irradiation         Soil application         48 f         48 e         0.65 i         0.77 f         6.25 bc         6.30 bc         2.30 f         71 h           Non-irradiation         Soil application         70 c         68 b         0.96 c         0.99 b         6.05 def         6.10 efg         2.45 ghi         2.40 ef         70 c           Non-irradiation         Soil application         85 a         82 a         1.07 a         6.05 def         6.05 def         6.05 def         2.45 ghi         2.40 ef         98 c           Non-irradiation         Soil application         85 a         82 a         1.07 a         6.05 def         6.05 def         2.45 ghi         2.45 def         98 c           Non-irradiation         5 soil application         85 a         2.0 c         0.95 c <th>source</th> <th></th> <th>(2000)</th> <th>(2001)</th> <th>(2000)</th> <th>(2001)</th> <th>(2000)</th> <th>(2001)</th> <th>(2000)</th> <th>(2001)</th> <th>(2000)</th> <th>(2001)</th>	source		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Non-irradiation         Water extract         38 g         37 f         0.56 k         0.68 g         5.95 f         6.00 g         2.35 l         2.30 f         71 h           Irradiation         Water extract         44 fg         42 f         0.65 l         0.77 f         6.25 bc         6.30 bc         2.80 abc         2.75 ab         85 ef           Non-irradiation         Water extract         68 c         0.98 c         0.99 c         0.90 bc         6.05 def         2.60 defg         2.55 cde         100 c           Non-irradiation         Water extract         68 c         62 cd         0.95 d         0.97 bc         6.00 ef         6.03 fg         2.45 ghi         2.40 ef         98 c           Irradiation         Water extract         77 b         80 a         1.00 b         1.02 ab         6.20 bcd         2.75 abcd         2.65 abc         120 b           Non-irradiation         60 de         58 e         52 e         0.68 h         0.85 e         5.96 f         6.00 g         2.75 abcd         2.55 abc         120 b           Non-irradiation         66 cd         67 bc         0.68 h         0.92 cd         6.25 ef         2.70 bcde         2.55 abc         100 c           Soil application         56 cd </td <td>  Non-irradiation   Water extract   38 g   37 f   0.56 k   0.68 g   5.95 f   6.00 g   2.35 l   2.30 f   71 h    </td> <td></td> <th>Soil application</th> <td>40 g</td> <td>39 f</td> <td>0.61 j</td> <td>0.70 g</td> <td>6.05 def</td> <td>6.10 efg</td> <td>2.50 fgh</td> <td>2.45 def</td> <td>78 g</td> <td>67 h</td>	Non-irradiation   Water extract   38 g   37 f   0.56 k   0.68 g   5.95 f   6.00 g   2.35 l   2.30 f   71 h		Soil application	40 g	39 f	0.61 j	0.70 g	6.05 def	6.10 efg	2.50 fgh	2.45 def	78 g	67 h
Firadiation   Soil application   48 f   48 e   0.651   0.77 f   6.25 bc   6.30 bc   2.80 abc   2.75 ab   85 ef     Non-irradiation   Soil application   Soil applic	Finalisation   Soil application   48 f   48 e   0.65   0.77 f   6.25 bc   6.30 bc   2.80 abc   2.75 ab   85 ef     Non-irradiation   Soil application   Soil applic		Water extract	38 g	37 f	0.56 k	0.68 g	5.95 f	6.00.9	2.35	2.30 f	71 h	109
Non-irradiation   Water extract   44 fg   42 f   0.62 j   0.72 fg   6.10 cdef   6.15 def   2.65 cdef   2.60 bcd   80 fg   90 fg	Non-irradiation   Water extract   44 fg   42 f   0.62 j   0.72 fg   6.10 cdef   6.15 def   2.65 cdef   2.60 bcd   80 fg   10 c c c c c c c c c c c c c c c c c c	1	Soil application	48 f	48 e	0.65	0.77 f	6.25 bc	6.30 bc	2.80abc	2.75 ab	85 ef	74 g
Non-irradiation         Soil application         70 c         68 b         0.98 c         0.99 b         6.05 def         6.10 efg         2.60 defg         2.55 cde         100 c           Irradiation         Soil application         85 a         82 a         1.05 a         1.07 a         6.43 a         6.50 a         2.90 a         2.80 a         142 a           Non-irradiation         Soil application         60 de         58 d         0.71 g         0.86 e         6.05 def         6.00 g         2.45 ghi         2.50 cde         98 c           Non-irradiation         Soil application         60 de         58 d         0.71 g         0.86 e         6.05 def         6.00 g         2.40 hi         2.45 def         90 de           Non-irradiation         66 cd         67 bc         0.88 e         6.96 f         6.00 g         2.40 hi         2.45 def         80 de           Irradiation         Soil application         65 d         67 bc         0.81 e         6.92 cd         6.35 ab         6.40 ab         2.75 ab         100 c           Asseries extract         64 cde         67 bc         0.78 f         0.89 de         6.18 bcde         2.70 bcde         2.75 ab         100 c	Non-irradiation radiation in each column, followed by the same letter (s) are restracted.         Soil application water extract soil application (e.g. of column). Followed by the same letter (s) are restracted.         0.98 cm (0.99 cm (0.97 bcm) (0.97 bc		Water extract	44 fg	42 f	0.62 j	0.72 fg	6.10 cdef	6.15 def	2.65 cdef	2.60 bcd	80 fg	68 h
Non-irradiation         85 a         82 a         1.05 a         1.07 a         6.43 a         6.50 a         2.45 ghi         2.40 ef         98 c           irradiation irradiation         Soil application         85 a         82 a         1.05 a         1.07 a         6.43 a         6.50 a         2.90 a         2.80 a         142 a           Non-irradiation irradiation         Soil application         60 de         58 d         0.71 g         0.85 e         6.05 def         6.10 efg         2.55 efg         2.50 de         90 de           Non-irradiation irradiation         66 d         67 bc         0.81 e         0.92 cd         6.35 ab         2.40 hi         2.45 def         88 de           Irradiation water extract         65 d         67 bc         0.81 e         0.92 cd         6.35 ab         6.40 ab         2.75 ab         100 c	Non-irradiation         Soil application         85 a         82 d         1.05 a         1.07 a         6.43 a         6.50 a         2.90 a         2.40 ef         98 c           Irradiation         Water extract         77 b         80 a         1.00 b         1.02 ab         6.20 bcd         6.25 cd         2.75 abcd         2.65 abc         120 b           Non-irradiation         Water extract         58 e         52 e         0.68 h         0.85 e         5.96 f         6.00 g         2.40 hi         2.45 def         80 de           Non-irradiation         66 cd         67 bc         0.81 e         0.92 cd         6.35 ab         2.40 hi         2.45 def         88 de           Irradiation         66 cd         67 bc         0.81 e         0.92 cd         6.35 ab         6.40 ab         2.85 ab         2.75 ab         100 c           Irradiation         4 cde         62 cd         67 bc         0.81 e         0.92 cd         6.18 bcde         6.40 ab         2.75 ab         100 c           Irradiation         4 cde         62 cd         67 cd         0.78 f         0.89 de         6.18 bcde         2.70 bcde         2.55 ab         92 d		► Soil application	70 c	68 b	0.98 c	9 66 O	6.05 def	6.10efg	2.60 defg	2.55 cde	100 c	95 bc
Soli application   Soli application   Solid	irradiation    Soil application    Water extract    Non-irradiation    Soil application    Soil applicatio	Non-irradiatic	Water extract	68 c	62 cd	0.95 d	0.97 bc	6.00 ef	6.03 fg	2.45 ghi	2.40 ef	98 c	90 cd
Materextract	Non-irradiation   Water extract   77 b   80 a   1.00 b   1.02 ab   6.20 bcd   6.25 cd   2.75 abcd   2.65 abc   120 b	nanure	► Soil application	85 a	82 a	1.05 a	1.07 a	6.43 a	6.50 a	2.90 a	2.80 a	142 a	107 a
Non-irradiation Soil application 60 de 58 d 0.71 g 0.86 e 6.05 def 6.10efg 2.55 efgh 2.50 cde 90 de 80 de 67 bc 0.81 e 0.92 cd 6.35 ab 6.40 ab 2.85 ab 2.75 ab 100 c irradiation Water extract 64 cde 62 cd 0.78 f 0.89 de 6.18 bcde 6.20 cde 2.70 bcde 2.65 abc 92 d	Non-irradiation Soil application 60 de 58 d 0.71 g 0.86 e 6.05 def 6.10efg 2.55 efgh 2.50 cde 90 de 5.25 efgh 2.50 cde 90 de 6.25 efgh 2.50 cde 90 de 6.25 efgh 2.50 cde 90 de	U	Water extract	77 b	80 a	1.00 b	1.02 ab	6.20 bcd	6.25 cd	2.75 abcd	2.65 abc	120 b	9 66
Non-irradiation  Water extract 58 e 52 e 0.68 h 0.85 e 5.96 f 6.00 g 2.40 hi 2.45 def 88 de  Soil application 66 cd 67 bc 0.81 e 0.92 cd 6.35 ab 6.40 ab 2.85 ab 100 c  water extract 64 cde 62 cd 0.78 f 0.89 de 6.18 bcde 6.20 cde 2.70 bcde 2.65 abc 92 d	Non-irradiation		<ul> <li>Soil application</li> </ul>	90 de	58 d	0.71 g	0.86 e	6.05 def	6.10efg	2.55 efgh	2.50 cde	90 de	82 ef
irradiation Soil application 66 cd 67 bc 0.81 e 0.92 cd 6.35 ab 6.40 ab 2.85 ab 2.75 ab 100 c	irradiation Soil application 66 cd 67 bc 0.81 e 0.92 cd 6.35 ab 6.40 ab 2.85 ab 2.75 ab 100 c within each column, followed by the same letter(s) are not significantly different at 5% level.		Water extract	58 e	52 e	0.68 h	85	5.96 f	6.00 g	2.40 hi	2.45 def	88 de	77 fg
▼ Water extract 64 cde 62 cd 0.78 f 0.89 de 6.18 bcde 6.20 cde 2.70 bcde 2.65 abc 92 d	20 cde 2.70 bcde 2.65 abc 92 d	1	Soil application	99 cd	67 bc	0.81 e	0.92 cd	6.35 ab	6.40 ab	2.85 ab	2.75 ab	100 c	89 d
	deans within each column, followed by the same letter(s) are not significantly different at 5% level.	irradiation	Water extract	64 cde	62 cd	0.78 f	0.89 de	6.18 bcde	6.20 cde	2.70 bcde	2.65 abc	92 d	85 de

arised from cattle manured ones in both seasons. On the other hand, sheep manured seedlings had intermediate values in this respect.

Moreover, irradiating organic manure surpassed nonirradiating organic manure to exert a distinctive positive effect on stem diameter in both seasons.

Furthermore, soil application of organic manure succeeded to induce a pronounced positive effect on stem diameter as compared with water extract of organic manure.

In addition, **Table (83)** illustrates that the interaction between organic manure source and irradiating organic manure, shows that irradiating poultry manure produced the highest stem diameter in both seasons whereas non-irradiating or irradiating cattle manure induced the lowest positive effect in this respect.

On the other hand, the interaction between organic manure and method of organic manure application, indicates that poultry manure applied particularly as soil application or secondly as water extract exerted the highest positive effect on stem diameter of Volkamer lemon seedlings in both seasons, (Table, 84).

Furthermore, irradiating organic manure and applied as soil application exerted the highest enhancing effect on stem diameter, followed descendingly by those applied as water extract. On the contrary, non-irradiating organic manure applied as soil application or water extract induced the lowest positive effect on stem diameter in both seasons (Table, 85).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other combinations (cattle and sheep) in enhancing stem diameter with the superiority of irradiating poultry manure on the expense of non-irradiating poultry manure and applied as soil application on the expense of water extract application of organic manure. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 86).

#### 4.2.2.1.3. leaf chlorophyll (a & b)

Table (82) shows that leaves of poultry manured seedlings had the highest values of chlorophyll (a) followed descendingly by those of sheep manured ones and finally of cattle manured seedlings in both seasons. Besides, leaves of poultry manured seedlings had the highest values of chlorophyll (b) followed descendingly by these of sheep manured ones and finally of cattle manured seedlings in the first season (2000).

Moreover, irradiating organic manure surpassed non-irradiating organic manure in enhancing leaf chlorophyll (a & b) in both seasons

Furthermore, soil application of organic manure succeeded to induce a pronounced effect on chlorophyll (a & b) as compared water extract application of organic manure.

In addition, Table (83) illustrates that the interaction between organic manure source and irradiation of organic manure, demonstrates that irradiating poultry manure

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significantly enhanced chlorophyll (a & b) in both seasons whereas non-irradiation or irradiating cattle manure showed the lowest positive effect in this respect.

On the other hand, the interaction between organic manure and method of organic manure application, illustrates that poultry manure applied as soil application or water extract exerted the highest positive effect on chlorophyll (a & b) of Volkamer lemon seedlings, in both seasons, (Table, 84).

Furthermore, irradiating organic manure and manuring as soil application exerted the highest stimulative effect on chlorophyll (a & b), followed descendingly by those applied as water extract. On the contrary, non-irradiation of organic manure and applied as soil application or as water extract had the lowest positive effect on chlorophyll (a & b) in both seasons (**Table**, 85).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other combination (cattle and sheep) in enhancing chlorophyll a& b with the superiority of irradiating poultry manure on the expense of non-irradiating poultry manure and applied as soil application on the expense of water extract of organic manure application. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 86).

#### 4.2.2.1.4. No. of leaves/seedling

It is clear from **Table (82)** that poultry manured seedlings produced higher No. of leaves/seedling as compared with those arised from cattle manured ones in both seasons. On the contrary, cattle manured seedlings had the lowest values in this respect.

Moreover, irradiating organic manure surpassed nonirradiating organic manure in exerting a distinctive effect on No. of leaves/seedling in both seasons.

Furthermore, Soil application of organic manure succeeded to induce a distinctive effect on No. of leaves/seedling as compared with water extract of organic manure in this respect.

In addition, **Table (83)** illustrates that the interaction between organic manure source and irradiating organic manure, reveals that irradiating poultry manure induced more No. of leaves/seedling in both seasons followed descendingly by non-irradiating and / or irradiating cattle manure had the lowest distinctive effect in this respect.

On the other hand, the interaction between organic manure and method of organic manure application, reveals that poultry manure applied in soil application and/or water extract exerted the highest positive effect on no. of leaves/seedling of Volkamer lemon seedlings followed descendingly by sheep manure applied in soil application and / or water extract, in both seasons, (Table, 84).

Furthermore, irradiating organic manure and applied in soil application exerted the highest stimulative effect on no. of leaves/seedling, followed descendingly by those applied in water extract. On the contrary, non-irradiating organic manure and applied in soil application and / or water extract had the lowest positive effect on no. of leaves/seedling in both seasons (Table, 85).

Finally, the interaction between the three studied factors indicates that the interaction of poultry manure surpassed the other combination (cattle and sheep) in enhancing no. of leaves/seedling with the superiority of irradiating poultry manure on the expense of non-irradiating poultry manure and applied in soil application on the expense of water extract of organic manure. Besides, sheep manure combination surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 86).

#### 4.2.2.1.5. Root length

It is clear from **Table (87)** that poultry manured seedlings produced longer roots length as compared with those arised from cattle manured ones in both seasons. Besides, sheep manured seedlings had intermediate values in this respect.

Moreover, irradiating organic manure surpassed nonirradiating organic manure in produced longer roots in both seasons.

Furthermore, soil application of organic manure succeeded to exert significantly positive effect on root length as compared with water extract application of organic manure.

In addition, Table (88) illustrates that the interaction between organic manure source and irradiation of organic manure, indicates that irradiating poultry manure enhanced root

Table (87): Specific effects of organic manure source, irradiation and application method on leaf area, root length and No. of roots/seedling of Volkamer lemon seedlings (2000 and 2001 seasons).

	Leaf are	Leaf area (cm²)	No. of roots/seeding	:s/seeding	Root length (cm)	th (cm)
Factor	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
			a. Effect of organic manure source	ic manure source		
Cattle manure	15.9 a	16.1 a	2.56 a	2.66 a	17.9 c	18.4 c
Poultry manure	16.1 a	16.2 a	2.66 a	2.76 a	18.8 a	19.1 a
Sheep manure	16.0 a	16.2 a	2.62 a	6.71 a	18.4 b	18.7 b
			b. Effect of	<ul><li>b. Effect of irradiation</li></ul>		
Non-irradiation	15.7 b	15.8 b	2.54 b	2.63 b	17.2 b	17.5 b
Irradiation	16.3 a	16.5 a	2.69 a	2.79 a	19.5 a	19.8 a
			c. Effect of app	c. Effect of application method		
Soil application	16.2 a	16.3 a	2.66 a	2.76 a	18.9 a	19.3 a
Water extract	15.8 b	16.0 b	2.56 b	2.66 b	17.8 b	18.1 b

Table (88): Effect of interaction between organic manure source and irradiation on leaf area, root length and No. of roots/seedling of Volkamer lemon seedlings (2000 and 2001 seasons).

Organic manue	Irradiation	Leat ar	Leat area (cm <sup>-</sup> )	No. of roots/seeding	s/seeding	Root length (cm	gth (cm)
source		(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	Non-irradiation	15.7 с	15.9 b	2.50 c	2.60 d	16.9 c	17.3 d
	Irradiation	16.1 b	16.3 a	2.62 abc	2.72 bc	19.0 b	19.4 b
South a manura	Non-irradiation	15.6 c	15.8 b	2.55 bc	2.65 cd	17.5 с	17.8 c
outer y manufacture	Irradiation	16.5 a	16.6 a	2.77 a	2.87 a	20.0 a	20.3 a
hoon manife	Non-irradiation	15.6 c	15.8 b	2.57 bc	2.65 cd	17.3 с	17.5 cd
oliceb manule	Irradiation	16.3 ab	16.5 a	2.67 ab	2.77 b	19.6 ab	19.8 b
Cattle manure       →       Non-irradiation       15.7 c       15.9 b       2.50 c         Poultry manure       →       Irradiation       16.1 b       16.3 a       2.62 abc       16.2 abc         Sheep manure       →       Irradiation       15.5 c       15.8 b       2.57 bc         Sheep manure       →       Irradiation       15.6 c       15.8 b       2.57 bc         Irradiation       16.3 ab       16.5 a       2.67 ab		15.7 c 16.1 b 15.6 c 16.5 a 15.6 c 16.3 ab	15.9 b 16.3 a 15.8 b 15.8 b 15.8 b	2.50 c 2.62 abc 2.55 bc 2.77 a 2.77 bc 2.67 ab	2.60 d 2.72 bc 2.72 cd 2.65 cd 2.87 a 2.65 cd	16.9 c 19.0 b 17.5 c 20.0 a 17.3 c 19.6 ab	

length in both seasons whereas non-irradiation and/ or irradiating cattle manure had the lowest stimulstive effect in this respect.

On the other hand, the interaction between organic manure and method of organic manure application, shows that poultry manure applied as soil application or water extract induced the highest positive effect on root length of Volkamer lemon seedlings, in both seasons, (Table, 89).

Furthermore, irradiating organic manure and application as soil application exerted the highest stimulative effect on root length, followed descendingly by those applied as water extract. On the contrary, non-irradiation of organic manure and applied as soil application or water extract had the lowest positive effect on root length in both seasons (Table, 90).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other combinations (cattle and sheep) in enhancing root length with the superiority to irradiating poultry manure on the expense of nonirradiating poultry manure and applied in soil application on the expense of water extract of organic manure. Besides, sheep manure combination surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 91).

### 4.2.2.1.6. No. of roots / seedling

It is clear from **Table (87)** that organic manure source failed to induce a distinctive effect on No. of roots/seedling in both seasons.

Table (89): Effect of interaction between organic manure source and application method on leaf area, root length and No. of roots/seedling of Volkamer lemon seedlings (2000 and 2001 seasons).

	Application	l eaf area (cm²)	(cm²)	No. of roots/seeding	s/seeding	Koot length (cm)	לווו (בווו)
nure	method	(ממממ)	(2001)	(2000)	(2001)	(2000)	(2001)
→ Soi	Soil application	16.1 ab	16.3 a	2.60 bc	2.70 bc	18.5 bc	18.9 ab
Cattle manure→	Water extract	15.7 b	15.9 a	2.52 c	2.62 c	17.4 d	17.8 b
	Soil application	16.2 a	16.3 a	2.72 a	2.82 a	19.4 а	19.7 a
Poultry manure	Water extract	15.9 ab	16.1 a	2.60 bc	2.70 bc	18.1 cd	18.4 ab
, So	Soil application	16.1 ab	16.3 a	2.67 ab	2.75 ab	19.0 ab	19.3 ab
Sheep manure	Water extract	15.8 ab	16.0 a	2.57 bc	2.67 bc	17.8 cd	18.1 b
followed by the same letter(s) are not significantly different at 5% level.	but the come	letter(s) are no	ot significantly	different at 5%	% level.		

 Table (90): Effect of interaction between irradiation and application method of organic manure on leaf area, root length and No. of roots/seedling of Volkamer lemon seedlings (2000 and 2001 seasons).

700	Application	leafarea (cm²)	a (cm²)	No. of roo	No. of roots/seeding	Root len	Root length (cm)
Irradiation	method	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	- Soil application	15.7 c	15.9 bc	2.55 b	2.63 b	17.7 c	18.1 bc
Non-irradiation	Water extract	15.6 c	15.8 c	2.53 b	2.63 b	16.7 d	17.0 e
	<ul> <li>Soil application</li> </ul>	16.6 a	16.7 a	2.78 a	2.88 a	20.2 a	20.5 a
Irradiation →	→ Water extract	16.1 b	16.2 b	2.60 b	2.70 b	18.8 b	19.2 b
Means within each	Means within each column, followed by the same letter(s) are not significantly different at 5% level.	same letter(s)	are not significa	intly different	at 5% level.		

**Table (91):** Effect of interaction between organic manure source, irradiation and application method on leaf area, root length and No. of roots/seedling of Volkamer lemon seedlings (2000). and 2001 seasons).

manure		method		- A			AND SECTION OF THE PROPERTY OF	9
source			(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Non-ir	Non-irradiation S	Soil application	15.8 d	16.0 bc	2.50 d	2.60 d	17.5 efgh	17.9 cdef
Cattle →		<ul> <li>Water extract</li> </ul>	15.6 d	15.8 c	2.50 d	2.60 d	16.4 h	16.7 f
manure Irradiation	<b>V</b>	<ul> <li>Soil application</li> </ul>	16.4 abc	16.6 ab	2.70 bc	2.80 bc	19.5 bc	20.0 abc
	,	*Water extract	15.9 cd	16.1 bc	2.55 cd	2.65 cd	18.5 cde	18.9 abcdet
→Non-ir	→Non-irradiation → S	- Soil application	15.7 d	15.9 c	2.55 cd	2.65 cd	18.0 def	18.3 bcdef
Poultry →	\ \ \	Water extract	15.6 d	15.8 c	2.55 cd	2.65 cd	17.1 fgh	17.4 def
manure +Irradiation	<b>V</b>	<ul> <li>Soil application</li> </ul>	16.8 a	16.8 a	2.90 a	3.00 a	20.9 a	21.2 a
	f	Water extract	16.2 bcd	16 4 abc	2.65 bcd	2.75 bcd	19.2 bc	19.5 abcd
Non-ir	Non-irradiation S	→ Soil application	15.7 d	15.9 c	2.60 bcd	2.66 cd	17.7 efg	18,1 cdef
Sheep →	<b>f</b> 5	* Water extract	156 d	158c	2.55 cd	2 65 cd	16.8 gh	17.0 ef
manure Irradiation	↓,	Soil application	16 6 ab	168a	2.75 ab	2 85 ab	20.3 ab	20.5 ab
	<b>*</b> 5	Water extract	16 1 bcd	16.3 abc	2 60 bcd	2 70 bcd	189cd	19.2 abcde

Moreover, irradiating organic manure surpassed nonirradiating organic manure in exerting a distinctive effect on no. of roots / seedling in both seasons.

Furthermore, soil application of organic manure succeeded to induce a distinctive effect on No. of roots / seedling as compared water extract. In addition, **Table (88)** illustrates that the interaction between organic manure source and irradiation of organic manure, demonstrates that irradiating poultry manure induced higher No. of roots / seedling in both seasons. On the contrary, non-irradiating or irradiating cattle manure induced the lowest enhancing effects in this respect.

On the other hand, the interaction between organic manure and method of organic manure application, indicates that poultry manure applied as soil application or water extract exerted the highest positive effect on No. of roots / seedling of Volkamer lemon seedlings, in both seasons, (Table, 89).

Furthermore, irradiating organic manure and applied as soil application exerted the highest stimulative effect on No. of roots / seedling, followed descendingly by those applied as water extract. On the contrary, non-irradiating organic manure, applied as soil application or water extract had the lowest positive effects on No. of roots / seedling in both seasons (**Table, 90**).

Finally, the interaction between the three studied factors indicates that the interaction of poultry manure surpassed the other combinations (cattle and sheep) in enhancing on No. of roots / seedling with the superiority of irradiating poultry manure on the expense of non-irradiating poultry manure, applied as soil application on the expense of water extract application. Besides, sheep manure combinations surpassed cattle manure interactions

in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 91).

### 4.2.2.1.7. Leaf area

It is clear from **Table (87)** that organic manure source failed to induce any significant effect on leaf area in both seasons.

Moreover, irradiating organic manure surpassed nonirradiating organic manure to exert a distinctive effect on leaf area in both seasons.

Furthermore, Soil application of organic manure succeeded to induce a positive effect on leaf area as compared with water extract.

In addition, **Table (88)** illustrates that the interaction between organic manure source and irradiating organic manure, shows that irradiating poultry manure produced more expanded leaves in both seasons. On the contrary, non-irradiating or irradiating cattle manure shows the lowest enhancing effect in this respect.

On the other hand, the interaction between organic manure and method of organic manure application, demonstrates that poultry manure applied as soil application or water extract caused the highest positive effect on leaf area of Volkamer lemon seedlings, in the first season, (Table, 89).

Furthermore, irradiating organic manure applied as soil application exerted the highest stimulative effect on leaf area, followed descendingly by those applied as water extract. On the contrary, non-irradiation of organic manure applied as soil

application or water extract gave the lowest positive effect on leaf area in both seasons (Table, 90).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other combination (cattle and sheep) in enhancing leaf area with the superiority of irradiating poultry manure on the expense of non-irradiation of poultry manure and applied as soil application on the expense of water extract of organic manure. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 91).

### 4.2.2.1.8 Stem dry weight

It is clear from **Table (92)** that poultry manured seedlings had the heaviest stem dry weight as compared with those arised from cattle manured ones in both seasons. Besides, sheep manured seedlings had the between values in this respect.

Moreover, irradiating organic manure surpassed nonirradiating organic manure in enhancing on stem dry weight in both seasons.

Furthermore, Soil application of organic manure succeeded to induce an enhancing effect on stem dry weight as compared with water extract.

In addition, **Table (93)** illustrates that the interaction between organic manure source and irradiation of organic manure, shows that irradiating poultry manure gave the heaviest stem dry weight in both seasons. On the contrary, non-

Table (92): Specific effect of organic manure source, irradiation and application method on plant dry weight parameters of Volkamer lemon seedlings (2000 and 2001 seasons).

Factor We	Stem dry Weight (g)	Leav	Leaves dry weight (g)	Roc	Root dry Weight (g)	Total s	Total seedling	Тор	Top :root
(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
			a. Effe	a. Effect of organic manure source	iic manur	e source			
Cattle manure 3,35 c	3.44 c	2.85 c	3.56 c	2.88 c	2.88 c	9.01 c	9.90 c	2.11 a	2.45 a
Poultry manure 4.37 a	4.59 a	4.95 a	4.85 a	4.73 a	4.87 a	14.06 a	14.32 a	2.04 a	1.93 b
Sheep manure 4 13 b	4 42 6	4.41 b	4.58 b	4.08 b	4.28 b	12.67 b	13.27 ь	2.10 a	)
	1,120								2.09
	71.1			b. Effect of Irradiation	Irradiatio	_			2.09
	3.85 b	3.80 b	4 14 b	3.74 b	Irradiatio	<b>n</b> 11.17 b	11.90 b	2.05 a	2.09
	3 85 b	3.80 b	4 14 b	3.74 b 4.05 a	3.92 b	<b>n</b> 11.17 b 12.65 a	11.90 b	2.05 a	2.05 b
ation	4 3 3 4 4 85 6	3.80 b	4 14 b 4 52 a c. Eff	b. Effect of Irradiation  114 b 3.74 b 3.92 b 11.1  52 a 4.05 a 4.11 a 12.6 c. Effect of application method	3.92 b 4.11 a ication m	n 11.17 b 12.65 a ethod	11.90 b 13.09 a	2.05 a	2.09 2.05 I 2.26
ation	4 4 3 5 5 5 6 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6	3.80 b	4.14 b 4.52 a c. Eff.	3.74 b 4.05 a ect of appl	3.92 b 4.11 a ication m	n 11.17 b 12.65 a ethod	11.90 b 13.09 a 12.90 a	2.05 a 2.12 a 2.09 a	2.05 b 2.26 a 2.28 a

Table (93): Effect of interaction between organic manure source and irradiation on plant dry weight parameters of Volkamer lemon seedlings (2000 and 2001 seasons).

Organic irradiation										1	
		Stem dry	dry	Leaves dry	s dry	Root dry	dry	Total seedling drv weight (g)	edling aht (a)	lop:root Ratio	root tio
000	ation	Weight (g)	nt (g)	(2000) (2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
sonice		(2000)	(1007)	(5000)	(5001)	(2004)				(	0
Non-irradiation	adiation	3.04 e	3.10 e	2.81 e	3.23 d	2.74 f	2.90 e	8,43 e	9.23 e	2.06 a	2.16 D
Cattle→	ion	3.67 d	3.78 d	2.89 e	3.90 €	3.03 e	2.96 e	9.59 d	10.57 d	2.16 a	2.74 a
Non-irradiation	adiation	4.08 bc	4.37 b	4.60 c	4.69 b	4.58 b	4.75 b	13.26 b	13.82 b	2.05 a	1.90 b
Poultry → Irradiation	ion	4.67 a	4.81 a	5.30 a	5.01 a	4.88 a	5.00 a	14.85 a	14.82 a	2.03 a	1.96 b
◆ Non-irra	-irradiation	3.93 c	4.07 c	3.98 d	4.52 b	3.90 d	4.10 d	11.82 c	12.66 c	2.03 a	2.09 b
Sheep →	ion	4.32 b	4.76 a	4.84 b	4.65 b	4.25 c	4.47 c	13.32 b	13.89 b	2.17 a	2.10 b
Means within each colum	mn, followe	ed by the s	ame letter	(s) are not	column, followed by the same letter(s) are not significantly different at 5% level.	dy differer	nt at 5% le	vel.			

irradiation or irradiating cattle manure had the lowest stimulative effect in this respect.

On the other hand, the interaction between organic manure and method of organic manure application, demonstrates that poultry manure applied as soil application or water extract induced the highest positive effect on stem dry weight of Volkamer lemon seedlings in both seasons, (Table, 94).

Furthermore, irradiating organic manure applied as soil application exerted the highest stimulative effects on stem dry weight, followed descendingly by those applied as water extract. On the contrary, non-irradiation of organic manure applied as soil application or water extract had the lowest positive effect on stem dry weight in both seasons (**Table, 95**).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other combination (cattle and sheep) in enhancing stem dry weight with the superiority to irradiating poultry manure on the expense of non-irradiating poultry manure applied in soil application on the expense of water extract of organic manure. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 96).

# 4.2.2.1.9 Leaf dry weight

It is clear from Table(92) that poultry manured seedlings had the highest leaf dry weight as compared with those arised

Table (94): Effect of interaction between organic manure source and application method on plant dry weight parameters of Volkamer lemon seedlings (2000 and 2001 seasons).

Organic         Application method         Stem dry (g) weight (g) weight (g) weight (g) (2001)         Root dry weight (g) (2001)         Total seedling (2001)         Total seedling (2001)         Total seedling (2001)         Proposition (2001)         Pation (2001)		weight parameters of comments									ŀ	+00.
pplication         Weight (g)         weight (g)         weight (g)         weight (g)         (2000)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)	Organic		Sterr	dry ,	Leave	s dry	Root	dry	Total se	edling aht (a)	Ra	root
method         (2000)         (2001)         (2000)         (2001)         (2000)         (2001)         (2000)         (2001)         (2000)         (2000)         (2001)         (2000)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)         (2001)<	manure	Application	Weig	ht (g)	weigi	(9)	(0000)	(2001)	(2000)	(2001)	(2000)	(2001)
ter extract         3.75 e         3.77 c         2.95 e         2.79 c         9.31 e         10.31 d         2.15 a           ter extract         3.10 d         3.12 f         2.94 d         3.36 d         2.81 f         2.98 c         8.71 f         9.49 e         2.07 a           I application         4.54 a         4.77 a         5.20 a         4.96 a         4.80 a         4.95 a         14.54 a         14.69 a         2.02 a           ter extract         4.21 b         4.41 c         4.70 b         4.74 a         4.66 b         4.80 a         13.58 b         13.95 b         2.06 a           I application         4.20 b         4.51 b         4.49 bc         4.84 a         4.15 c         4.36 b         12.94 c         13.72 b         2.11 a           Iter extract         4.06 b         4.32 c         4.33 c         4.33 b         4.00 d         4.21 b         12.40 d         12.84 c         2.09 a	source	method	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2007)			1 1
ter extract         3.10 d         3.12 f         2.94 d         3.36 d         2.81 f         2.98 c         8.71 f         9.49 e         2.07 a           lapplication         4.54 a         4.77 a         5.20 a         4.96 a         4.80 a         4.95 a         14.54 a         14.69 a         2.02 a           ter extract         4.21 b         4.41 c         4.70 b         4.74 a         4.66 b         4.80 a         13.58 b         13.95 b         2.06 a           lapplication         4.20 b         4.51 b         4.49 bc         4.84 a         4.15 c         4.36 b         12.94 c         13.72 b         2.11 a           ter extract         4.06 b         4.32 d         4.33 c         4.00 d         4.21 b         12.40 d         12.84 c         2.09 a           column, followed by the same letter(s) are not significantly different at 5% level.		- Soil application	3.60 c	3.75 e	3.76 d	3.77 c	2.95 e	2.79 c	9.31 e	10.31 d	2.15 a	Z./3 a
Lapplication         4.54a         4.77a         5.20a         4.96a         4.80a         4.95a         14.54a         14.69a         2.02a           ter extract         4.21b         4.41c         4.70b         4.74a         4.66b         4.80a         13.58b         13.95b         2.06a           lapplication         4.20b         4.51b         4.49bc         4.84a         4.15c         4.36b         12.94c         13.72b         2.11a           ter extract         4.06b         4.32d         4.33c         4.33b         4.00d         4.21b         12.40d         12.84c         2.09a           column, followed by the same letter(s) are not significantly different at 5% level.		Wa	3.10 d	3.12 f	2.94 d	3.36 d	2.81 f	2.98 c	8.71 f	9.49 e	2.07 a	2.16 b
ter extract         4.21 b         4.41 c         4.74 a         4.66 b         4.80 a         13.58 b         13.95 b         2.06 a           lapplication         4.20 b         4.51 b         4.49 bc         4.84 a         4.15 c         4.36 b         12.94 c         13.72 b         2.11 a           ter extract         4.06 b         4.32 d         4.33 c         4.33 b         4.00 d         4.21 b         12.40 d         12.84 c         2.09 a           column, followed by the same letter(s) are not significantly different at 5% level.		Soil application	4.54 a	4 77 a	5.20 a	4.96 a	4.80 a	4.95 a	14.54 a	14.69 a	2.02 a	1.96 bc
I application       4.20 b       4.51 b       4.49 bc       4.84 a       4.15 c       4.36 b       12.94 c       13.72 b       2.11 a	Poultry→	Mai	4.21 b	4.41 C	4.70 b	4.74 a	4.66 b	4.80 a	13.58 b	13.95 b	2.06 a	1.90 c
iter extract 4.06 b 4.32 d 4.33 c 4.33 b 4.00 d 4.21 b 12.40 d 12.84 c 2.09 a column. followed by the same letter(s) are not significantly different at 5% level.		Soil application	4.20 b	4.51 b	4.49 bc	4.84 a	4.15 c	4.36 b	12.94 c	13.72 b	2.11 a	2.14 bc
Means within each column, followed by the same letter(s) are not significantly different at 5% level.	Sheep →	Water extract	4.06 b	4.32 d	4.33 c	4.33 b	4.00 d	4.21 b	12.40 d	12.84 c	2.09 a	2.05 bc
	Means within	each column, follow	ed by the	same lette	r(s) are no	ot significar	ntly differe	nt at 5% l	evel.			

Table (95): Effect of interaction between irradiation and application method of organic manure on plant dry weight parameters of Volkamer lemon seedlings (2000 and 2001 seasons).

								,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	-/-		
Irradiation	Application method	Stem dry Weight (g)	ht (g)	Leav	Leaves dry weight (g)	Roo	Root dry Weight (a)	Total s	Total seedling	Top	Top :root
		(2000)	(2001)	(2000)	(2001)	(2000)	(6) 11.6	ary we	ary weight (g)	Z	Ratio
	Soil application			1000/	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001
Non-irradiation	3.88 ab 4.11 c	3.88 ab	4.11 c	3.91 6	4.39 b	3.82 c	4.00 ab	11.63 c	12516	3 00 0	2 45
	→ Water extract	7 a z	0	)					2.00 d	V. 00 d	2.156
		5	0.000	3 68 6	3.90 c	3.65 d	3.83 b	10.72 d	11.30 d	2 03 a	1 05
,	Soil application	4.34 a	4 58 a	4 30 2	000	i i					- 0
III adilation ->	* \\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \			0	0.00	4.17 a	4.06 a	12.91a	13.30 a	2.12 a	241
	Andrei extract	4.09 ab 432 b	4 32 b	4 30 a	4.38 b	3 99 6	7 7 7	)			
eans within each of	column, followed by	the came	0++0=/=/			1	5	0 000	12.89 b	2.12 a 2.12 bc	2.12 6
	eyel	e in builting	(c)(2)	DIS JOH P IN	uniticantly	different a	t 5% level				

Table (96): Effect of interaction between organic manure source, irradiation and application method on plant dry weight parameters of Volkamer lemon seedlings (2000 and 2001 seasons).

		Application	Sten	Stem dry	Leave	Leaves dry	Weight (a)	Koot ary Veight (a)	dry we	dry weight (g)	Ratio	Ratio
Organic	Citciporal	method	Meio	Weight (9)	N N	weighir (g)	10000	(1000/	(0000)	(2001)	(2000)	(2001)
manure	Irraulation		(2000)	(2001)	(2000)	(2001)	(2000)	(1007)	(2007)	1		
sonrce		9	377.0	4 49 6	2 89 of	3.56 d	2.81 k	3.00 gh	9.14 h	10.21 f	2.24 a	2.40 b
1	Jon-irradiation	Non-irradiation Soil application	3.441	0.00	5		125	2 84 hi	7.721	8.25 g	1.88 b	1.93 d
Cattle		<ul> <li>Water extract</li> </ul>	2.63 g	2.551	2.74†	u 167	7.07		40,00,0	10.40 e	2.05 ab	3.11 a
1		Coil application	3.76 ef	3.86 g	2.63 f	3.98 ef	3.101	7.58	9.43	2		- 00
manure 🕌	► Irradiation →	Tool application	2 58 of	3 70 h	3.15 e	3.82 fg	2.96 j	3.15 g	9.69 g	10.74 e	2.27 a	2.38 DC
		Water extract	2000		474 b	4.77 b	4.67 c	4.81 abc	13.63 c	14.13 b	1.91 ab	1.93 d
Ł	→Non-irradiation		4.20bca	0.00	444	4 61 bc	4.50 d	4.70 bcd	12.90 d	13.51 c	2.19 ab	1.87 d
Poultry		<ul> <li>Water extract</li> </ul>	3.96 de	4.20 e	i i	- 4	4 03 3	5 10 a	15.45 a	15.25 a	2.12 ab	1.98 d
		→ Soil application	4.88 a	5.00 a	5.64 a	D. 10 d	5			100	10124	193 4
mannie	◆ rradiation →	to cate of the	4 46 h	4 62 c	4.96 b	4.88 ab	4.83 b	4.90 ab	14.26 b	14.40 p		2
		Water extract		4150	410 d	4.84 b	4.00 g	4.20 ef	12.11 e	13.19 c	2.03 ab	2.13 bcd
ŧ	Non-irradiation	Soil application		2 2	2 27 4	4.20 de	3.80 h	4.00 f	11.54 f	12.14 d	2.03 ab	2.04 cd
Sheep →		Water extract		100.4	2.00.6	484 h	4.31 e	4.52 cde	13.78 c	14.24 b	2.19 ab	2.14 bcd
manure	1	<ul> <li>Soil application</li> </ul>	4.40 bc	4.88 0	i co	2			12 25 4	13 53 c	2.15 ab	2.05 bcd
•	+ Irradiation →	Water extract	4.25bcd	4.65 c	4.80 b	4.46 cd	4.20 f	4.42 de	13.63.0	3		
		who came letter(s) are not significantly different at 5% level.	same lett	er(s) are	not signific	cantly diffe	rent at 5%	, level.				

from cattle manured ones in both seasons. On the other hand, sheep manured seedlings had intermediate values in this respect.

Moreover, irradiating organic manure surpassed nonirradiating organic manure to exert a distinctive effect on leaves dry weight in both seasons.

Furthermore, soil application of organic manure succeeded to induce a positive effect on leaf dry weight as compared with water extract.

In addition, **Table (93)** illustrates that the interaction between organic manure source and irradiating organic manure, reveals that irradiating poultry manure had the highest leaves dry weight in both seasons whereas non-irradiating or irradiating cattle manure had the lowest distinctive effect in this respect.

On the other hand, the interaction between organic manure and method of organic manure application, inducates that poultry manure applied particularly in soil application or secondly + water extract exerted the highest positive effect on leaf dry weight of Volkamer lemon seedlings, in both seasons, (Table, 94).

Furthermore, application of irradiated organic manure as soil application exerted the highest stimulative effects on leaves dry weight, followed descendingly by those applied as water extract. On the contrary, non-irradiating organic manure applied as soil application or water extract had the lowest positive effect on leaves dry weight in both seasons (Table, 95).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other combinations of cattle and sheep in enhancing leaf dry weight with the superiority to irradiating poultry manure on the

expense of non-irradiating poultry manure applied as soil application on the expense of water extract of organic manure. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 96).

## 4.2.2.1.10 Root dry weight

It is clear from **Table (92)** that poultry manured seedlings had the highest root dry weight as compared with that arised from cattle manured ones in both seasons. Besides, sheep manured seedlings had inbetween values in this respect.

Moreover, irradiating organic manure surpassed non-irradiating organic manure in increasing root dry weight in both seasons.

Furthermore, soil application of organic manure succeeded to induce a positive effect on root dry weight as compared with water extract of organic manure in this respect.

In addition, **Table (93)** illustrates that the interaction between organic manure source and irradiating organic manure, demonstrates that irradiating poultry manure induced heavier root dry weight in both seasons. On the contrary, non-irradiating or irradiating cattle manure had the lowest enhancing effects in this respect.

On the other hand, the interaction between organic manure and method of organic manure application, shows that poultry applying manure as soil application or water extract exerted the highest positive effect on root dry weight of Volkamer lemon seedlings, in both seasons, (Table, 94).

Furthermore, applying irradiating organic manure as soil application exerted the highest stimulative effects on root dry weight, followed descendingly by those applied as water extract. On the contrary, non-irradiating organic manure applied as soil application or water extract had the lowest positive effect on root dry weight in both seasons (**Table, 95**).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other tested combinations in enhancing root dry weight with the superiority to irradiating poultry manure on the expense of non-irradiating poultry manure applied as soil application on the expense of water extract. Besides, sheep manure combination surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 96).

# 4.2.2.1.11. Total seedling dry weight

It is clear from **Table (92)** that poultry manured seedlings produced higher total seedling dry weight as compared with those arised from cattle manured ones in both seasons. Besides, sheep manured seedlings came inbetween in this respect.

Moreover, irradiating organic manure surpassed non-irradiating organic manure in increasing total seedling dry weight in both seasons.

Furthermore, soil application of organic manure succeeded to induce a positive effect on total seedling dry weight as compared with water extract.

In addition, **Table (93)** illustrates that the interaction between organic manure source and irradiating organic manure, indicates that irradiating poultry manure induced higher total seedling dry weight in both seasons. Besides, non-irradiating or irradiating cattle manure had the lowest pronounced effect in this respect.

On the other hand, the interaction between organic manure and method of organic manure application, declares that poultry manure applied as soil application or water extract induced the highest positive effect on total seedling dry weight of Volkamer lemon seedlings, in both seasons, (Table, 94).

Furthermore, applying irradiating organic manure as soil application exerted the highest enhancing effect on total seedling dry weight, followed descendingly by those applied as water extract. On the contrary, non-irradiating organic manure and applied as soil application or water extract had the lowest positive effect on total seedling dry weight in both seasons (Table, 95).

Finally, the interaction between the three studied factors indicates that the interactions of poultry manure surpassed the other tested combinations in increasing total seedling dry weight with the superiority of irradiating poultry manure on the expense to non-irradiating treatment and applied as soil application on the expense of water extract application. Besides, sheep manure combinations surpassed cattle manure interactions in this respect and took the same pattern of poultry manure combinations in both seasons, (Table, 96).

## 4.2.2.1.12. Top: root ratio

It is clear from **Table (92)** that cattle manured seedlings produced higher top: root ratio as compared with those given by cattle manured ones in second season. On the contrary, poultry and sheep manured seedlings gave the lowest values in this respect.

Moreover, irradiating organic manure surpassed non-irradiating in exerting a distinctive positive effects on top: root ratio in the second season, only.

Furthermore, soil application of organic manure succeeded to induce a positive effect on top: root ratio as compared with water extract application in the second season (2001).

In addition, **Table (93)** illustrates that the interaction between organic manure source and irradiating organic manure, declares that irradiating cattle manure induced higher top: root ratio in the second, only season (2001). Besides, non-irradiating or irradiating poultry and sheep manure produced the lowest positive effect in this respect.

On the other hand, the interaction between organic manure and method of organic manure application, shows that cattle manure applied as soil application or water extract induced the highest positive effect on top:root ratio of Volkamer lemon seedlings in both seasons, (Table, 94).

Furthermore, applying irradiated organic manure as soil application produced the highest stimulative effects on top: root ratio, followed descendingly by those applied as water extract. On the contrary, non-irradiating organic manure applied as soil

application or water extract induced the lowest positive effect on top: root ratio in the second season (Table, 95).

Finally, the interaction between the three studied factors indicates that the interaction of cattle manure surpassed the other combination (sheep and poultry) in enhancing top: root ratio with the superiority of irradiating cattle manure on the expense of non-irradiating cattle manure and applied in soil application on the expense of water extract of organic manure. Besides, sheep manure combination surpassed poultry manure interactions in this respect and took the same pattern of cattle manure combinations in both seasons, (Table, 96).

#### 4.2.2.2. Leaf mineral content

Leaf mineral content (N, P, K, Ca, Mg, Fe, Zn and Mn) of Volkamer lemon seedlings during 2000 and 2001 seasons in response to organic manure source (cattle, poultry and sheep), irradiation and/or non-irradiation of dry organic manure and method of organic manure application (soil application and soil application of water extract) as well as their interactions is reported in **Tables (97-106).** 

### 4.2.2.2.1. Nitrogen

It is clear from **Table (97)** that leaves of poultry manured seedlings had higher values of nitrogen content (2.64 & 2.62%) as compared with those manured with cattle (2.43 & 2.42%) in the first and second seasons, respectively. Besides, leaves of sheep manured seedlings scored inbetween values of nitrogen content (2.55 & 2.53%) in 2000 and 2001 seasons, respectively.

Table (97): Specific effect of organic manure source, irradiation and application method on leaf N, P, K, Ca and Mg content of Volkamer lemon seedlings (2000 and 2001 seasons).

Factor	Nitr	Nitrogen	Phos	Phosphorus Potassium Calcium	ncentrat	Potassium	ied leave	eaves (%)	2	
	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	2000) (2001)
				a. Effec	et of organ	a. Effect of organic manure source	source			
Cattle manure	2.43 c	2.42 c	0.122 b	0.125 ь	0.745 c	0.745 c	3.2 c	3.5 c	0.36 c	0 33 b
Poultry manure	2.64 a	2.62 a	0.145 a	0.145 a	0.963 a	0.963 a	4 ω	4. (7) (8)	0 53 2	O ກ່ ລ
Sheep manure	2.55 b	2.53 b	0.130 ь	0.132 b	0.902 ь	0.895 b	3.8 b	4.2 b	0.45 b	0.40 b
				ם	. Effect of	b. Effect of Irradiation	2			
Non-irradiation	2.51 b	2.49 b	0.128 b	0.130 b	0.830 b	0.822 b	3.5 b	3.9 b	0 43 b	0 40 2
Irradiation	2.58 a	2.56 a	0 137 a	0 138 a	0 910 2	0 913 2	7	)	ò	
					1	0	2	0	C.45 a	0.44 a
				c. Effe	ect of appl	c. Effect of application method	thod			
Soil application	2.56 a	2.54 a	0.137 a	0.138 a	0.897 a	0 888 a	ω Θ	4.2 a	0 44	0 42 2
Water extract	2.52 b	2.50 b	0.128 b 0.130 b		0 843 ь	0 847 b	36 b	3.9 b	O 44 a	0 41 a
										0.0000000000000000000000000000000000000

Anyhow, the differences between the three studied organic manure sources in this regard were pronounced to be significant.

Furthermore, irradiation of dry organic manures enhanced leaf nitrogen content rather than non-irradiation treatment.

In addition, the application of organic manure as soil application induced higher positive effect on leaf nitrogen content rather than water extract application method (Table,98).

Furthermore, the interaction between organic manure source and irradiation of dry organic manure reveals that leaf nitrogen content showed more response to organic manure source rather than to irradiation of dry organic manuers, hence, irradiated poultry manure, non-irradiated poultry manure and irradiated sheep manure recorded the highest values of leaf nitrogen content.

Moreover, the interaction between organic manure source and method of organic manure application demonstrates that leaf nitrogen content showed more response to organic manure source rather than to method of organic manure application, hence poultry manure applied as soil application as water extract induced the highest positive effects on leaf nitrogen content, followed descendingly by the combinations of sheep manure and lastly by the interactions of cattle manure (**Table, 99**).

Moreover, Table (100) reveals that the interactions between irradiation of organic manure source and method of organic manure application shows that interactions of irradiation

**Table (98):** Effect of interaction between organic manure source and irradiation on leaf N, P, K, Ca and Mg content Volkamer lemon seedlings (2000 and 2001 seasons).

Cigaria			Licit	CHICA COL	Inclinian	Figure concentration in affect traves (10)	CHICARC	2 (10)	
manure Irradiation	Nitr	Nitrogen	Phos	Phosphorus	Potas	Potassium	Calc	Calcium	
Source	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	1
Non-irradiation	n 2.42 e	2.41 c	0.125 b 0.125 b 0.735 e 0.725 e	0.125 b	0.735 e	0.725 e	3.1 b	3.4 e	
Cattle, Irradiation	2.45 d	2.43 c	0.120 b	0.120 b 0.125 b 0.755 e	0.755 e	0.765 e	3.3 b	3.7 d	0.38 d
Non-irradiation	n 2.58 b	2.56 b	0.135 b	0.135 b	0.135 b 0.910 c	0.910 c	4.2 a	4.3 b	0.52 a
Irradiation	2.71 a	2.68 a	0.155 a	0.155 a	1.015 a	1.015 a	4.5 a	4.6 a	0.53 a
Non-irradiation	2.52 c	2.50 b	0.125 b	0.125 b 0130 b	0 845 d	0.830 d	3 3 5	4.0 c	0.43 c
Sneep→ Irradiation	2.58 b	2.57 b	2.57 b 0.135 b	0 135 b	0.135 b 0.960 b	0.960 b	4. 3. a.	4.4 ab	0 46 b
Means within each column, followed by the same letter(s) are not significantly different at 5% level	and the thou	in latte	1/2/ 200		the different	- 1 702 to to	5		

Table (99): Effect of interaction between organic manure source and application method on leaf N, P, K, Ca and Mg content of Volkamer lemon seedlings (2000 and 2001 seasons).

Organic	10.00			Elem	Elements concentration in dried leaves (%)	centrati	on in dri	ed leave	(%) se		
manure	Application	Nitr	Nitrogen	Phosp	Phosphorus	Potassium	sium	Calcium	inm	Magnesium	sium
source	method	(2000)	(2000) (2001)	(2000)	(2000) (2001)	(2000) (2001)	(2001)	(2000)	(2001)	(2000)	(2000) (2001)
	- Soil application	2.45 d	2.43 d	2.45 d 2.43 d 0.125 cd 0.130 bc 0.765 d 0.760 d	0.130 bc	0.765 d	0.760 d	3.3 d	3.7 d	0.35 e	0.36 c
Cattle →	<ul> <li>Water extract</li> </ul>	2.42 d	2.41 d		0.120 d 0.120 c 0.725 e	0.725 e	0.730 d	3.2 d	3.4 e	0.37 d	0.31 c
_	- So∷ application	2.68 a	2.65 a	0.150 a	0.150 a	7.995 a	0.995 a	4.6 a	4.6 a	0.54 a	0.55
Poultry→	- Water extract	2.61 b	2.59 b		0.140 ab 0.140 ab	0.930 b	0.930 b	4.2 b	4.3 b	0.52 b	0.51 ab
L	<ul> <li>Soil application</li> </ul>	2.57 c	2.55 c		0.135 bc 0.135 b 0.930 b 0.910 bc	0.930 b	0.910 bc	4.1 b	4.4 b	0.45 c	0.37 c
→ deeds	- Water extract	2.54 c	2.52 c	2.52 c 0.125 cd 0.130 bc 0.875 c 0.880 c	0.130 bc	0.875 c	0.880 c	3.6 c	4.0 c	0.44 c	0.42 bc
Means within 6	Means within each column, followed by the same letter(s) are not significantly different at 5% level.	ed by the	same lette	er(s) are no	t significan	tly differe	nt at 5% le	vel.			

Table (100): Effect of interaction between irradiation and application method of organic manure on leaf N, P,

7	K, Ca and Mg content of Volkamer lemon seedlings (2000 and 2001 seasons).	ntent of \	/olkam	er lemor	า seedlin	gs (2000	) and 20	01 seas	ons).		
	Application			Elem	ents cor	ncentrati	Elements concentration in dried leaves (%)	ed leave	s (%)		
Irradiation	method	Nitrogen	gen	Phosp	Phosphorus Potassium	Potas	sium	Calcium	ium	Magne	nesium
		(2000)	(2001)	(2000)	(2000) (2001) (2000) (2001) (2000) (2001)	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Non-irradiation	→Soil application 2.52 bc 2.50 c 0.133 ab 0.133 ab 0.847 b 0.833 c 3.7 b	2.52 bc	2.50 c	0.133 ab	0.133 ab	0.847 b	0.833 c		4.1 b	0.42 c	0.39 a
	→ Water extract	2.50 c	2.48 c	0.123 ь	2.50 c 2.48 c 0.123 b 0.127 b 0.813 c 0.810 c	0.813 c	0.810 c	3.4 c	37c	0.43 c	0.41 a
readiation ->	*Soil application	2.61 a	2.59 a	0.140 a	2.61 a 2.59 a 0.140 a 0.143 a 0.947 a	0.947 a	0.943 a	4.3 a	4 4 a	0.47 a	0.46 a
a diagram	•Water extract	2.55 b	2.53 b	0 133 ab	255 b 253 b 0.133 ab 0.133 ab 0.873 b 0.883 b	0.873 b	0.883 b	3.8 b	4 5	0 45 ь	0.42 a

Means within each column, followed by the same letter(s) are not significantly different at 5% level.

of organic manure and soil application method enhanced leaf nitrogen content followed descendingly by irradiation of organic manure and water extract application.

Finally, the interaction between organic manure source, irradiation of organic manure and method of organic manure application shows that the interactions of poultry manure, particularly when poultry manure irradiated and applied as soil application induced the highest positive effect on leaf nitrogen content. On the contrary, the combinations of cattle manure exerted the least positive effect on leaf nitrogen content (Table, 101).

## 4.2.2.2.2. Phosphorus

It is clear from **Table (97)** that leaves of poultry manured seedlings had higher values of phosphorus content (0.145 & 0.145%) as compared with those manured with cattle (0.122 & 0.125%) in the first and second seasons, respectively. Besides, leaves of sheep manured seedlings scored inbetween values of phosphorus content (0.130 & 0.132%) in 2000 and 2001 seasons, respectively. Anyhow, the differences between the three studied organic manure sources in this regard were obvious to be significant.

Furthermore, irradiation of dry organic manures enhanced leaf phosphorus content rather than non-irradiation treatment.

In addition, the application of organic manure source as soil application enhanced leaf phosphorus content rather than soil application water extract application method (Table,97).

Table (101): Effect of interaction between organic manure source, irradiation and application method on leaf N, P, K, Ca and Mg content of Volkamer lemon seedlings (2000 and 2001 seasons). Application

manure	Irradiation	Application Elements concentration in dried le				Elements	Elements concentration in dried leaves (%)	ation in di	ried leaves (	s (%)		
source			Nitr	Nitrogen	Phos	Phosphorus	Pota	Potassium	Calcium	m	Magne	2
			(2000)	(2001)	(2000)	(2001)	(2000)	(2001)	(2000)	200		2
7	Non-irradiation	Soil application	243f	242 ~	0.430				(2000)	(1007)	(2000)	(2001)
Cattle	Kananama	10/2422		6 74.7	0.130 CD	0.130 c	0.150 g	0.740 fg	3.2 fg	3.6 f	0.31 a	0 35 04
4		vvaler extract	2.41 f	2.40 g	0.120 d	0 120 c	0 720 ~	2		7	C	0.000
manure		Soil application	2		1	0.120	6.720.9	0.770 g	3.0 g	3.2 g	0.36 f	0.30 d
1	- nonation ->	77	14.4	2.45 Tg	0.120 d	0.130 c	0.780 fg	0.780 ef	3.4 ef	38 ಶಿಕ್	0	2
	ñ	Water extrac.	2.44 f	2.42 g	0 120 d	0 130 6	0 70				0.00	0.37 000
55	•	* Soil application	3 60 6			0.120	0.75	0.750 tg	3.3 ef	3.7 ef	0.38 e	0.33 d
+	Non-irradiation	- on application	2.00 00	2.57 cd	0.140 bc	0.140 bc	0.920 cd	0.920 bc	44 hc	A 4 5 5 5		
<b>→</b>		Water extract	2.57 cd	2.55 cde	0 130 64	200	)		. 7 200	4.4 000	U.53 b	0.53 ab
manure		Coil application	,			0.130 C	0.900 cd	0.900 c	4.1 d	4.2 d	0.52 b	0.51 abc
	►Irradiation →	oon application	2.11.2	2.73 a	0.160 a	0.160 a	1.070 a	1.070 a	480	0	2	
		Water extract	2.65 b	2.640 b	0 150 25	0 150	)	1	1.0	4.0 d	U.55 a	0.57 a
		1	3 5 L		0.100 00	O. LOC AD	0.960 bc	0.960 bc	4.2 cd	4.5 bc	0.52 b	0.51 abc
Sheen	Non-irradiation	- 1	2.03 0	2.51 de	0.130 cd	0.130 c	0.870 de	0.840 d	ა.5 e	424	0 44 4	0 0 0 0
<b>V</b>		vvaler extract	2.52 de	2.50 ef	0 120 d	0 130 5				1		0.237.0
manure	7	Í			0.120 0	0.130 C	0.820 ef	0.820 de	3.2 fg	3.8 e	0.43 d	0.423 abcd
	▼Irradiation →		2.6   DC	2.60 bc	0.140 bc	0.140 bc	d 066'0	d 086 0	A 70 70 70 70 70 70 70 70 70 70 70 70 70		i	
		Water extract	2.56 cd	2.54 cde	0 130 cd	0 130 5		e e	1.0	4.0 ab	0.4/ c	0.45 abcd
	0		111		0.100 00	0.130 C	0.930 cd	0.940 bc	4.0 d	4.3 cd	0.46 c	0.43 abcd

Furthermore, **Table (98)** indicates that the interaction between organic manure source and irradiation of dry organic manure source exerted that leaf phosphorus content showed more response to organic manure source rather than to irradiation of dry organic manuers, hence, irradiated poultry manure, non-irradiated poultry manure and irradiated sheep manure scored the highest values of leaf phosphorus content in descending order.

Moreover, the interaction between organic manure source and method of organic manure application demonstrates that leaf phosphorus content showed more response to organic manure source rather than to method of organic manure application, hence poultry manure applied as soil application or as water extract induced the highest positive effect on leaf phosphorus content, followed descendingly by the combinations of sheep manure and lastly by the interactions of cattle manure (**Table**, 99).

Moreover, Table (100) reveals that the interactions between irradiation of organic manure source and method of organic manure application shows that interactions of irradiation of organic manure and soil application method enhanced leaf phosphorus content followed descendingly by irradiation of organic manure and in soil application of water extract application method.

Finally, the interaction between organic manure source, irradiation of organic manure and method of organic manure application shows that the interactions of poultry manure, particularly when poultry manure irradiated and applied as soil application induced the highest positive effect on leaf

phosphorus content. Besides, the combinations of cattle manure exerted the least positive effect on leaf nitrogen content. (Table, 101).

### 4.2.2.2.3. Potassium

It is clear from **Table (97)** that fertilizing Volkamer lemon seedlings with poultry manure enriched leaf potassium content (0.963 & 0.963%) as compared with those manured with sheep (0.902 & 0.895%) and cattle manured seedlings (0.745 & 0.745%) in 2000 and 2001 seasons, respectively. Anyhow, the differences between the three organic manure sources in this respect were obvious to be significant.

Furthermore, irradiation of dry organic manures enhanced leaf potassium content rather than non-irradiation treatment.

In addition, the application of organic manure source as soil application enhanced leaf potassium content rather than water extract application method (Table,97).

Moreover, Table (98) indicates that the interaction between organic manure source and irradiation of dry organic manner source exerted that leaf potassium content showed more response to organic manure source rather than to irradiation of dry organic manuers, hence, irradiated poultry manure followed secondly by irradiated sheep manure induced the highest positive effect in this respect.

Furthermore, the interaction between organic manure source and method of organic manure application demonstrates that leaf potassium content showed more response to organic manure source rather than to method of organic manure

application, hence poultry manure applied firstly in soil application and/or secondly soil application of water extract induced the highest positive effect on leaf potassium content, followed descendingly by the combinations of sheep manure and lastly by the interactions of cattle manure (**Table**, 99).

Moreover, **Table (100)** reveals that the interactions between irradiation of organic manure and method of organic manure application shows that interactions of irradiation of organic manure and soil application enhanced leaf potassium content followed descendingly by irradiation of organic manure source and water extract application method.

Finally, the interaction between organic manure source, irradiation of organic manure and method of organic manure application shows that the interactions of poultry manure, particularly when poultry manure irradiated and applied as soil application induced the highest positive effect on leaf potassium content. followed descendingly by irradiated sheep manure applied as soil application. On the contrary, the combinations of cattle manure exerted the least positive effects on leaf potassium content. (Table, 101).

#### 4.2.2.2.4. Calcium

It is clear that fertilizing Volkamer lemon seedlings with poultry manure enriched leaf calcium content (4.3 & 4.5%) as compared with those manured with sheep (3.8 & 4.2%) and cattle manured seedlings (3.2 & 3.5%) in 2000 and 2001 seasons, respectively. Anyhow, the differences between the three

organic manure sources in this respect were obvious to be significant.

Furthermore, irradiation of organic manures enhanced leaf calcium content rather than non-irradiation treatment.

In addition, the application of organic manure source as soil application enhanced leaf calcium content rather than water extract application (Table,97).

Moreover, **Table (98)** indicates that the interaction between organic manure source and irradiation of dry organic manure demonstrated that leaf calcium content showed more response to organic manure source rather than to irradiation of dry organic manuers, hence, poultry manure whether irradiated or non-irradiated showed the highest values of leaf calcium content.

Furthermore, the interaction between organic manure source and method of organic manure application demonstrates that leaf calcium content showed more response to organic manure source rather than to method of organic manure application, hence poultry manure applied as soil application or as water extract induced the highest positive effect on leaf calcium content, followed descendingly by the combinations of sheep manure and lastly by the interactions of cattle manure (Table, 99).

Moreover, **Table (100)** reveals that the interactions between irradiation of organic manure source and method of organic manure application shows that interactions of irradiation of organic manure source and method of organic manure application as soil application enhanced leaf calcium content

followed descendingly by irradiation of organic manure source and water extract application method.

Finally, the interaction between organic manure source, irradiation of organic manure and method of organic manure application shows that the interactions of poultry manure, particularly when poultry manure irradiated and applied as soil application induced the highest positive effect on leaf calcium content. followed descendingly by sheep manure irradiated and applied as soil application. On the contrary, the combinations of cattle manure exerted the least positive effect on leaf calcium content (Table, 101).

## 4.2.2.2.5. Magnesium

It is clear from **Table** (97) that leaves of poultry manured Volkamer lemon seedlings had higher values of magnesium content (0.53 & 0.53%) as compared with those manured with cattle (0.36 & 0.33%) in the first and second seasons, respectively. Besides, leaves of sheep manured seedlings scored inbetween values of magnesium content (0.45 & 0.40%) in 2000 and 2001 seasons, respectively. Anyhow, the differences between the three studied organic manure sources in this regard were obvious to be significant.

Furthermore, irradiation of dry organic manures enhanced leaf magnesium content rather than non-irradiation of dry organic manures.

In addition, the tested application methods of organic manure failed to induce any positive effect on leaf magnesium content in both seasons (Table,97).

Furthermore, the interaction between organic manure source and irradiation of dry organic manures demonstrated that leaf magnesium content showed more response to organic manure source rather than to irradiation of dry organic manuers, hence, poultry manure whether irradiated or non-irradiated gave the highest values of leaf magnesium content.

Moreover, the interaction between organic manure source and method of organic manure application demonstrates that leaf magnesium content showed more response to organic manure source rather than to method of organic manure application, hence poultry manure applied as soil application or as water extract induced the highest positive effect on leaf magnesium content, followed descendingly by the combinations of sheep manure and lastly by the interactions of cattle manure (Table, 99).

Moreover, **Table (100)** demonstrates that the interaction between irradiation of organic manure and method of organic manure application shows that interactions of irradiation of organic manure and soil application enhanced leaf magnesium content followed descendingly by irradiation of organic manure and method of organic manure application as water extract application.

Finally, the interaction between organic manure source, irradiation of organic manure and method of organic manure application shows that the interactions of poultry manure, particularly when poultry manure irradiated and applied as soil application induced the highest positive effect on leaf magnesium content. On the contrary, the combinations of cattle manure exerted the least positive effects on leaf magnesium

content. Besides, the combinations of sheep manure occupied inbetween positions in this respect (Table, 101).

## 4.2.2.2.6. Iron, Manganese and Zinc

It is obvious from **Table (102)** that leaves of poultry manured seedlings had the highest values of leaf Fe, Mn and Zn content, followed descendingly by those of sheep manured ones and lastly those fertilized with cattle manure. However, the differences between the three tested organic manure sources in this concern were remarkable to be significant.

Moreover, irradiation of the three organic manure sources enhanced leaf Fe, Mn and Zn content rather than non-irradiation treatment.

Furthermore, the application of organic manure as soil application enhanced leaf Fe, Mn and Zn content rather than water extract application.

Additionally, **Table (103)** reveals that the application of irradiated poultry manure in particular or non-irradiated exerted the highest stimulative effects on leaf Fe, Mn and Zn content. On the contrary, the application of cattle manure either irradiated or non-irradiated scored the lowest values in this respect. The interactions of sheep manure occupied an intermediate position in this sphere.

Table (104) shows that the application of poultry manure particularly as soil application or as water extract exerted the highest stimulative effect on leaf Fe, Mn and Zn content. On the contrary, the application of cattle manure either as soil application or water extract induced the lowest positive effect in

**Table (102):** Specific effect of organic manure source, irradiation and application method on leaf Fe, Mn and Zn content of Volkamer lemon seedlings (2000 and 2001 seasons).

1 2000	-	Iron	Manganese	Manganese	7	Zinc
	(2000)	(2001)	(2000)	(2001)	(2000)	/2001
			a. Effect of organic manure source	ic manure source		1200
Cattle manure	70 c	72 c	49 c	52 c	44 0	A N
rountry manure	92 a	94 a	75 a	77 a	73 n	7 6
oneep manure	79 b	81 b	d 99	67 b	57 h	2 7
•			<ul> <li>b. Effect of irradiation</li> </ul>	irradiation	S	
Non-irradiation	78 b	80 b	d 09	61 b	55 b	7.7 7
IIIadiation	82 a	85 a	67 a	69 a	0	מ מ
:			<ul> <li>c. Effect of application method</li> </ul>	cation method		1
soli application	82 a	84 a	66 a	68 a	) ) )	3
Water extract	79 a	81 b	61 b	D 22	n (	0 1

Table (103): Effect of interaction between organic manure source and irradiation on leaf leaf Fe, Mn and Zn content of Volkamer lemon seedlings (2000 and 2001 seasons).

				Flaments concentration in dried leaves (ppm)	centration	n dried lea	ves (ppm)	
Organic manur	re	1	_   _	Liements con	Manganese	nese	Zi	Zinc
source		III adianon	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	Ł	Non-irradiation	p 89	30 f	46 F	47 d	39 d	42 f
Cattle manure	1	Irradiation	D 27	74 e	53 e	57 c	49 c	49 e
	t	Non-irradiation	9 P	90 P	72 b	9 0	71 a	9 P
Poultry manure	1	Irradiation	% a	98 a	79 a	84 a	74 a	75 a
	Ł	Non-irradiation	5 6Z	P	64 d	67 b	26 b	29 d
Sheep manure	<u> </u>	Irradiation	30 c	83 c	ა 69	e7 b	28 b	63 c
of the citation	1	Mazze within each column followed by the same letter(s) are not significantly different at 5% level.	etter(s) are n	ot significantly d	ifferent at 5%	level.		

Table (104): Effect of interaction between organic manure source and application method on leaf leaf Fe, Mn and Zn content of Volkamer lemon seedlings (2000 and 2001 seasons).

Organic manure	Application -	Iron	Elements concentration in dried leaves on Manganese	ncentration in dri	in dried lea	ves (ppm)	3
oui cc	illetilot	(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
Cattle manure	<ul> <li>Soil application</li> </ul>	72 c	75 d	52 e	54 e	48 d	49 e
	<ul> <li>Water extract</li> </ul>	67 d	69 e	47 f	49 f	<b>4</b> 5 m	42 f
Poultry manure>	Soil application	92 a	95 a	78 a	79 a	74 a	74 a
+	Water extract	92 a	93 b	72 b	74 b	72 a	70 6
₹	Soil application	81 b	82 c	68 c	70 c	61 b	63 c
Sheep manure	Water extract	78 b	80 c	20	2	54 0	59 d

this respect. The interactions of sheep manure occupied an intermediate position in this sphere.

Table (105) shows that leaves of irradiated of organic manured seedlings manured superficially or as water extract were the richest ones in their content of Fe, Mn and Zn as compared with those of produced by non-irradiated organic manure.

Lastly, the interaction between organic manure source, irradiation of organic manure and method of organic manure application, (Table, 106) declares that irradiated poultry manured seedlings as soil application or water extract followed descendingly by the corresponding ones non-irradiated and manured as soil application and or water extract showed the highest values of leaf Fe, Mn and Zn content. Besides, the combinations of sheep manure proved to be more efficient in enhancing leaf Fe, Mn and Zn content than the analogous ones of cattle manure.

Briefly, the results of leaf mineral content due to organic manure source are in accordance with the findings of Sekiya et al. (1993) on Satsuma mandarin, Kalu-Singh et al. (1984) on mango. Noack (1984) on apple, Darfeld and Lenz (1985) on pear, Umemiya and Sekiya (1985) on persimmon, Villasurda and Baluyut (1990) on guava, Ben-Ya-Acov et al. (1992) on avocado, Awad et al. (1993) on olive, Alvarez etal. (1993) on pinapple, Smith (1994) on banana, Abu-Sayed Ahmed (1997) on Balady mandarin El-Kobbia (1999) on Balady mandarin and Moustafa (2002) on Washington navel orange. They reported that organic manure, particularly, poultry manure improved leaf mineral content.

Table (105): Effect of interaction between irradiation and application method of organic manure on leaf Fe, Mn and Zn content of Volkamer lemon seedlings (2000 and 2001 seasons).

prodiction	Application		Elements	concentrat	Elements concentration in dried leaves	eaves (ppm)	
Honarion	method	İr	Iron	Mand	Manganese	7;	5
		(2000)	(2001)	(2000)	(2001)	(0000)	(2004)
				(2000)	(2001)	(2000)	(2001)
Non-irradiation	Soil application	79 b	81 c	62 b	62 bc	57 b	d 35
	Water extract	77 b	78 d	58 c	60 с	50 c	55 c
Irradiation →	Soil application	84 a	87 a	70 a	73 a	65 a	66 a
+	Water extract	81 ab	83 b	24 6	65 b	56 bc	59 b
Means within each column followed by the same letter/s) are not similar to	to la	The second secon					

Table (106): Effect of interaction between organic manure source, irradiation and application method on seedlings (2000 and 2001 seasons).

Organic		Application		)	1153 001100			,
manure	Irradiation	method	Iron	no	Manganese	nese	Zinc	21
source			(2000)	(2001)	(2000)	(2001)	(2000)	(2001)
	100	No. indiation	70 efg	72 f	48 hi	50 gh	41 de	44 g
Cattle	Non-irradiation	Water extract	66 g	68 g	144	44 h	37 e	40 g
ø	•	→ Soil application	75 def	78 e	57 g	59 ef	29 c	55 f
	IIIaulauoii	→ Water extract	69 fg	71 fg	50 h	55 fg	43 d	44 g
	Non-irradiatio	Jon-irradiation - Soil application	88 bc	92 b	74 bc	70 cd	72 a	72 bc
Poultry →	4	→ Water extract	90 ab	9 p	70 cde	70 cd	71 a	68 cd
manure	, in the second	→ Soil application	97 a	99 a	82 a	89 a	76 a	77 a
	Irradiation	→ Water extract	95 ab	97 a	75 b	4 6Z	73 a	73 ab
	Non-irradiatio	on-irradiation - Soil application	81 cd	80 de	96 ef	68 cd	59 bc	e 09
Sheen		→ Water extract	77 de	79 de	62 f	99 cd	54 c	58 ef
manure		- Soil application	81 cd	84 c	71 bcd	72 c	63 b	p 99
	- Irradiation	→ Water extract	90 q	82 cd	67 de	63 de	54 c	61 e

Besides, the obtained results of leaf mineral content attributed to the effect of method of organic manure application are in line with the findings of Thachuk (1983) on apple, Bhangoo et al. (1988) on grape and Goede (1993) on mango. Moreover, the results of biofertilizer regarding leaf mineral content are in agreement with the findings of Pmares et al. (1983) on oranges, Chokha et al. (1993) on orange, Haggag and Azzazy (1996) on mango, Ahmed et al. (1997) on grape, Awashi et al. (1998) on peach, Fernandez et al. (1998) on banana, Mansour (1998) on Anna apple, Mahmoud and Mahmoud (1999) on peach Tiwary et al. (1999) on banana and Moustafa (2002) on Washington navel orange. They mentioned that Rhizobacterien enhanced most leaf mineral content.

