RESULTS AND DISCUSSION

IV-RESULTS AND DISCUSSION

IV.I. IRRIGATION OF MATURE OLIVE TREES :

This study was undertaken to investigate the response of fruitful olive trees to specific and interaction effects of irrigation rates (60, 90 & 120liter/tree) ; water resource (well & sewage) ; mulching with rice straw ;olive cultivar (Aggizi, Koroneiki, Picual and Manzanillo) and their combinations .

IV.I.I. Vegetaive growth ; flowering and fruiting :

IV.I.I.1. Increasing rate of shoot length (%):

Data obtained during both 2000 and 2001 growing seasons, are presented in Table, (5).

A. Specific effect:

As for the specific effect of water levels, the 120 L./tree increased significantly the rate of shoot growth compared to both lower levels(60 & 90 L / tree) during the two growing seasons (2000 & 2001).

As related to the source of water, the sewage water effect surpassed significantly the wells water in the increasing of the shoot growth percentage in both seasons.

Mulching olive trees (with rice straw) increased significantly of shoot length percentage compared to the unmulched one during two seasons of study.

Concerning the affected varieties under study, "Koroneiki cv. showed the best rate of shoot length compared with other varieties. "Picual cv. was the least cultivar in shoot length ratio during the two growing seasons. In the same time, Manzanillo and Aggizi cvs. were intermediate, however the for cultivar surpassed statistically the liter one in this concern.

Table (5): Mean response of the increasing rate (%) in shoot length of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	8.14w	13.57no	11.27t	12.42qr	11.97C	9.99]	11.76z[	12.56vw	14.37s	12.90C
	Koroneiki	11.22t	12.64pq	14.01n	15.58lm		12.02x-z	13.76t	15.49qr	17.13lm	
	Picual	9.07v	12.23u	11.04t	12.34qr		9.72]	10.55	11.89y-[	12.49w	
	Manzanillo	11.20t	11.64st	13.36no	13.86n		12.19w-y	12.36wx	14.67s	15.42qr	
90 L	Aggizi	12.63pq	13.17op	13.16op	16.22l	15.03B	13.10u	14.58s	15.72pq	19.07j	16.43B
	Koroneiki	15.10m	16.89k	16.93k	20.93ef		16.10op	17.94k	19.17j	22.59f	
	Picual	10.37u	11.93rs	12.24q-s	16.03l		11.55[	12.92uv	13.75t	16.98mn	
	Manzanillo	13.96n	15.25m	16.14l	19.47g		14.64s	16.29o	17.43l	20.99h	
120 L	Aggizi	15.25m	17.73ij	18.34hi	23.19c	20.27A	16.69n	18.92j	20.66h	25.11d	21.91A
	Koroneiki	20.67ef	22.73c	20.90ef	27.18a		21.84g	23.75e	26.43c	29.72a	
	Picual	14.04n	17.68j	19.67g	21.59d		15.25r	16.79mn	19.28j	23.55e	
	Manzanillo	18.43h	20.42f	21.13de	25.35b		19.69i	21.60g	23.90e	27.39b	
Specific effect of	Mulching	Unmulched 14.51B		Mulched 17.00A			Unmulched 15.99B		Mulched 18.17A		
	Water resource	Well 14.33B		Sewage 17.18A			Well 15.17B		Sewage 18.99A		
	Olive Cultivars	Aggizi 14.59C	Koroneiki 17.90A	Picual 13.85D	Manzanillo 16.69B		Aggizi 16.05C	Koroneiki 19.66A	Picual 14.56D	Manzanillo 18.05B	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

Regarding their response to the aforementioned levels and water sources and mulching managements.

B. Interaction effect:

According to the four investigated factors, the interaction effect in the increase of shoot length percentage was clear significantly with Koroneiki cv. trees receiving 120L./tree level of sewage water in mulched soil with rice straw during both seasons. Meanwhile, Aggizi cv. has the lowest values significantly when irrigated with 60L./tree of wells water and unmulched in the first season however, both Aggizi and Picual had the same trend in the second season. These results coincide with **Abd El-Rahman and El-Sharkwi, (1974); Sole Riera, (1988); Deidda *et al.*, (1992) and Magliulo *et al.*, (1999). Meantime, Laz *et al.*, (1999).** They reported that the tested cultivars showed a wide variations in response to different water levels. This variation may be due to the different heritability of each cultivar. The increase of shoot length in different olive cvs., might be attributed to the improved soil characteristics, water availability and the improvement of soil nutrient content **(Toscano *et al.*, 1999 and Briccoli *et al.*, 2002).**

IV.I.2. Sex expression (%):

Data in Table (6) indicated that, perfect flower percentage of the four olive cultivars as affected by the water levels (60, 90 &120L./tree), source of irrigation water(sewage&wells) and mulching (mulched &unmulched) during the two growing seasons 2000 and 2001.

A. **Specific effect:**

It is clear that, the irrigation level of 120L./tree gave the highest perfect flower percentage of olive cultivars compared to

Table (6): Mean response of sex expression (%) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	29.92m	30.68l	38.42e	39.16d	25.76C	37.01m	39.29i-k	44.65e	45.51d	32.19C
	Koroneiki	17.55[	17.50[	24.00st	23.93t		26.31w	26.64w	33.68p	33.81op	
	Picual	17.60[	17.76[	21.09x	21.12x		21.77[	22.64z	23.92y	24.41y	
	Manzanillo	24.80q	26.46o	30.95kl	31.26k		32.89q	33.00q	34.03op	35.40n	
90 L	Aggizi	33.92i	37.85f	38.72e	41.94c	28.34B	41.52g	42.83f	47.74b	49.68a	36.15B
	Koroneiki	19.61z	20.39y	24.39rs	25.30w		28.99v	31.51rs	36.66m	37.23lm	
	Picual	19.30z	21.76w	21.95w	23.50u		25.58x	29.85u	26.66w	29.70u	
	Manzanillo	27.43n	30.78l	32.03j	34.56h		34.36o	38.88k	37.64l	39.59ij	
120 L	Aggizi	37.64f	38.46e	43.10a	42.71b	31.13A	44.98de	47.01c	50.42a	50.24a	39.18A
	Koroneiki	22.88v	23.93t	26.60o	27.44n		33.01q	34.11op	38.84k	39.07jk	
	Picual	23.36u	24.09st	24.32r-t	24.63qr		31.07st	32.04r	30.78t	31.30st	
	Manzanillo	31.92j	33.55i	36.75g	36.77g		40.40h	41.99g	39.75i	42.09g	
Specific effect of	Mulching	Unmulched 27.84B		Mulched 28.98A			Unmulched 35.10B		Mulched 36.58A		
	Water resource	Well 26.22B		Sewage 30.61A			Well 34.07B		Sewage 37.61A		
	Olive Cultivars	Aggizi 37.71A	Koroneiki 22.79C	Picual 21.71D	Manzanillo 31.44B		Aggizi 45.06A	Koroneiki 33.32C	Picual 27.48D	Manzanillo 37.50B	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

the 60 and 90L/tree levels during the two growing seasons of study. Irrigation with sewage water and mulching significantly favored the production of perfect flower than the wells water regardless of mulching during the two seasons.

Concerning the cultivars under study as affected by the aforementioned specific factors, the data reveal that, these cultivars can be arranged in a descending order as follows: Aggizi, Manzanillo, Koroneiki and Picual, i.e Aggizi was the superior cv. in perfect flower percentage during the two growing seasons.

B. **Interaction effect:**

As a matter of fact, Aggizi cv. was influenced significantly during the first season when irrigated with 120L./tree of sewage water and without mulching then others cultivars . On the contrary, Koroneiki and Picual cvs. exhibited the least values of perfect flower percentage as irrigated by 60L./tree wells water for both mulched and unmulched trees.

Whereas, during the second growing season, Aggizi cv. surpassed other cultivars significantly in the same parameter when irrigated with sewage water irrigation (120L/tree) either mulched or unmulched. In reverse direction, Picual cv. was the least cv. in perfect flower percentage when irrigated with 60L/tree wells water and unmulched. Like wise **Mathioudi *et al.*, (1985) and Utsnomiya N *et al.*, (1995)** reported that the number of pistillate flowers per inflorescence and flowering period increased by irrigation compared with non-irrigated trees. (**Toscano *et al.*, 1999**) reveald that, grass cover increased flower differentiation of olive cvs.

IV.I.I.3. Fruit set and retention percentage (%):

In regard to the effect of different water regime, water sources and mulching on fruit set and retention percentage of the four olive cultivars under study, Table, (7 & 8) indicate both the specific and the interaction effect as follow:

A. Specific effect:

It is clear that, as the level of water increased the fruit set and retention percentages were increased in all cvs.. Meantime, the sewage water and mulching gave better values in comparison with the wells' water and unmulched olive trees in both seasons.

As for various cultivars, Koroneiki olive cv. showed the highest values in fruit set and retention percentages through the two seasons of growth, followed by Aggizi cv.. then Picual and the least was Manzanillo. However, Picual and Manzanillo had the least values during the second season especially for the fruit retention character.

B. Interaction effect:

As related to the interaction effects of the four factors: water levels, water source and mulching on olive cultivars on fruit set and retention percentage, Koroneiki showed the highest significant values as irrigated with 120L/tree sewage water under mulching in both seasons for both characters.

In contrast, it was so obvious to be noticed that, Aggizi and Manzanillo achieved the least values during the first season of fruit set% when irrigated with 60L/tree wells water without mulching.

Table (7): Mean response of fruit set (%) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	12.12xy	13.73v	15.85s	16.70qr	15.11C	20.14xy	21.12w	21.97u	24.43r	22.36C
	Koroneiki	15.87s	17.90no	17.35op	18.21n		25.57pq	26.78n	25.99op	27.83kl	
	Picual	13.06w	16.23rs	13.88v	15.22t		20.10xy	21.75uv	20.46x	21.98u	
	Manzanillo	11.73y	12.41x	14.93tu	16.50q-s		17.14[	18.51z	21.08w	22.84t	
90 L	Aggizi	15.18t	17.07pq	18.40mn	20.34i	17.95B	22.65t	25.16q	26.18o	28.28jk	25.71B
	Koroneiki	19.18kl	21.98e	19.99ij	21.17fg		28.35jk	29.18hi	29.69gh	31.18cd	
	Picual	16.24rs	17.77no	16.44q-s	17.43op		24.06rs	25.49pq	23.51s	25.40q	
	Manzanillo	13.52vw	14.54u	18.36mn	19.60jk		19.83y	21.37vw	24.20r	26.84n	
120 L	Aggizi	19.28kl	21.22fg	21.62e-g	23.98b	21.11A	25.71o-q	27.09mn	30.04fg	31.50c	29.18A
	Koroneiki	22.91d	23.82bc	23.23cd	25.26a		30.27ef	30.99cd	33.29b	35.64a	
	Picual	18.92lm	20.50hi	19.27kl	20.37i		27.71l	29.20hi	27.44lm	29.05i	
	Manzanillo	16.13rs	18.32mn	21.03gh	21.82ef		23.53s	26.07op	28.48j	30.79de	
Specific effect of	Mulching	Unmulched 17.27B		Mulched 18.84A			Unmulched 24.89B		Mulched 26.60A		
	Water resource	Well 17.07B		Sewage 19.04A			Well 24.49B		Sewage 27.00A		
	Olive Cultivars	Aggizi 17.96B	Koroneiki 20.57A	Picual 17.11C	Manzanillo 16.57D		Aggizi 25.36B	Koroneiki 29.56A	Picual 24.68C	Manzanillo 23.39D	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

Table (8): Mean response of fruit retention (%) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	12.31_	12.82]^	17.27qr	18.51mn	16.55C	16.13yz	15.94z	20.65o	26.06h	19.27C
	Koroneiki	15.39wx	20.81jk	24.47g	25.62f		19.31s	19.34s	27.27f	26.50g	
	Picual	13.26\]	12.41^_	15.63vw	17.25qr		16.48xy	16.91x	17.41w	18.42tu	
	Manzanillo	11.49`	12.27_	16.80rs	18.53mn		14.23\	15.06[	18.75t	19.82qr	
90 L	Aggizi	13.88z[	17.63pq	19.88l	21.77i	19.03B	16.40yz	16.90x	23.86l	25.25jk	21.60B
	Koroneiki	17.57pq	17.58pq	27.94d	30.19c		20.71o	22.31m	28.56e	32.16c	
	Picual	14.33yz	15.13x	18.64m	19.98l		18.08uv	19.61rs	20.30op	21.90mn	
	Manzanillo	13.65[\	14.55y	19.59l	22.11i		16.10yz	17.68vw	21.91mn	23.84l	
120 L	Aggizi	16.14tu	18.12no	23.60h	26.23e	21.73A	18.50tu	19.70rs	27.34f	29.55d	24.90A
	Koroneiki	19.55l	21.00j	30.88b	32.52a		23.60l	24.86k	34.59b	37.18a	
	Picual	16.03uv	17.84op	20.51k	23.73h		20.35op	21.47n	23.84l	25.73hi	
	Manzanillo	15.74u-w	16.57st	23.51h	25.68f		18.85t	20.15pq	25.37ij	27.35f	
Specific effect of	Mulching	Unmulched 18.25B		Mulched 19.95A			Unmulched 21.19B		Mulched 22.65A		
	Water resource	Well 15.67B		Sewage 22.53A			Well 18.69B		Sewage 25.15A		
	Olive Cultivars	Aggizi 18.18B	Koroneiki 23.63A	Picual 17.06C	Manzanillo 17.54D		Aggizi 21.36B	Koroneiki 26.37A	Picual 20.04C	Manzanillo 19.93C	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

During the second season, the Manzanillo cv. showed the leas values of both fruit set and fruit retention percentages when trees irrigated with 60L/tree wells water unmulched during the two growing seasons. **Agabbio, (1979); Sole Riera, (1988) and Siadat *et al.*, (1997)** revealed that the increase of water levels improved fruit set and fruit retention percentage in olive cvs. In the same time the mulching improved fruit set % of olive cvs.(**Toscano *et al.*, 1999**).

IV.I.I.4. Total fruit drop percentage.

Table, (9) showed the response of four olive cultivars fruit drop (%) to the three levels of irrigation water (60L.,90L.and120L./tree), two sources of water and mulching (mulched &unmulched).

A. Specific effect:

It is obvious that, the highest fruit drop percentage was noticed when the trees were irrigated with 60L./tree from the wells, source in unmulched soil. On the other hand, the trees irrigated with 120L./tree from sewage water and mulched showed the least fruit drop percentage. Meantime, the trees irrigated with 90L./tree from both sources gave an intermediate value during the two growing seasons.

In regard to the specific effect, of olive cultivar Picual trees exhibited significantly the highest fruit drop percentage during the first growing season (2000), whereas, Picual and Manzanillo were higher in fruit drop percentage in 2001 season. The least fruit drop appeared in Koroneiki cv. in both seasons.

B. Interaction effect:

Concerning to the interaction of four specific factors, Manzanillo cv. was surpassed in fruit drop percentage when

Table (9): Mean response of total fruit drop (%) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	87.69b	87.18bc	82.73k-m	81.49op	83.45A	83.87cd	84.06c	79.35n	73.94u	80.73A
	Koroneiki	84.61hi	79.19s	75.53v	74.38w		80.69j	80.66j	72.73w	73.50v	
	Picual	86.74cd	87.59b	84.37hi	82.75k-m		83.52de	83.09e	82.59f	81.58hi	
	Manzanillo	88.51a	87.73b	83.21j-l	81.47op		85.77a	84.93b	81.25i	80.18kl	
90 L	Aggizi	86.12d-f	82.37mn	80.12qr	78.22t	80.97B	83.60cd	83.10e	76.14q	74.75rs	78.40B
	Koroneiki	82.43l-n	82.42l-n	72.06x	69.81y		79.29n	77.69p	71.44x	67.84z	
	Picual	85.67ef	84.87gh	81.36p	80.03qr		81.92gh	80.39jk	79.70mn	78.10p	
	Manzanillo	86.35de	85.45fg	80.41q	77.89t		83.90cd	82.32fg	78.09p	76.16q	
120 L	Aggizi	83.86ij	81.88n-p	76.40u	73.77w	78.27C	81.50hi	80.30jk	72.65w	70.45y	75.10C
	Koroneiki	80.45q	79.00s	69.13y	67.48z		76.40q	75.14r	65.41[	62.82\	
	Picual	83.97ij	82.16m-o	79.49rs	76.27u		79.65mn	78.53o	76.16q	74.27tu	
	Manzanillo	84.26hi	83.43jk	76.49u	74.32w		81.15i	79.85lm	74.63st	72.65w	
Specific effect of	Mulching	Unmulched 81.75A		Mulched 80.05B			Unmulched 78.81A		Mulched 77.35B		
	Water resource	Well 84.33A		Sewage 77.47B			Well 81.31A		Sewage 74.85B		
	Olive Cultivars	Aggizi 81.82C	Koroneiki 76.37D	Picual 82.94A	Manzanillo 82.46B		Aggizi 78.64B	Koroneiki 73.64C	Picual 79.96A	Manzanillo 80.07A	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

irrigated with 60L./tree wells water and unmulched soil in both seasons. The reverse was true for the Koroneiki olive cv. irrigated with sewage water and planted in mulched soil. These results agree with those of, **Agabbio, (1979), Bini *et al.* (1997) and Inglese *et al.*, (1997)**.

IV.I.I.5. Fruit retention/fruit drop (%).

Ratio values of fruit retention (%) and fruit drop (%) in olive cultivars as affected by the aforementioned different water levels moreover, two sources of water (wells & sewage) and soil mulching are presented in **Table (10)**.

A. Specific effect:

Obviously, the 120L./tree irrigation water for olive cvs. gave the highest fruit retention /fruit drop(%) during the two growing seasons. As for water source, the irrigation with sewage water exceeded the wells water in the same parameter. Like wise, mulching of the soil had significantly better effect.

Koroneiki cv. exhibited the highest significant values in fruit retention/ fruit drop(%) in both seasons. Reversely, Manzanillo cv. showed the least values during the two growing seasons wheras, Picual cv. was the least one in 2001 season.

B. Interaction effect:

Considering the interaction effect of the four investigated factors, Koroneiki olive cv. showed the highest values of the ratio of fruit retention /fruit drop% when, irrigated with 120L./tree sewage water in mulched soil during both seasons. The reverse was true, for Manzanillo cv. trees irrigated with 60L./tree wells' water in unmulched soil in the 2000 and 2001seasons. It is suffice to say that, fruit retention/fruit drop, fruit set percentage

Table (10): Mean response of fruit retention/ fruit drop (%) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	14.11^	14.75]	20.91s	22.75p	20.21C	19.26\]	18.97]	26.04o	35.26h	24.20C
	Koroneiki	18.22xy	26.33kl	32.45g	34.53f		23.93st	24.01rs	37.54f	36.07g	
	Picual	15.37\	14.24^	18.59wx	20.91s		19.75z-\	20.41yz	21.09xy	22.58uv	
	Manzanillo	13.07_	14.05^	20.22t	22.79p		16.63_	17.75^	23.10u	24.73qr	
90 L	Aggizi	16.19[	21.44r	24.84mn	27.87j	23.98B	19.63[-]	20.34z[	31.34l	33.79jk	27.98B
	Koroneiki	21.39rs	21.38rs	38.85d	43.40c		26.14o	28.73m	40.01e	47.46c	
	Picual	16.75z	17.86y	23.00p	25.03m		22.11vw	24.42rs	25.48op	28.07mn	
	Manzanillo	15.84[	17.07z	24.40no	28.44i		19.21\]	21.50wx	28.06mn	31.35l	
120 L	Aggizi	19.28u	22.15q	30.92h	35.61e	28.36A	22.72uv	25.56q-s	37.64f	41.97d	33.88A
	Koroneiki	24.31o	26.63k	44.70b	48.22a		30.90l	33.10k	52.91b	59.22a	
	Picual	19.15uv	21.76qr	25.89l	31.18h		25.57op	27.36n	31.31l	34.65hi	
	Manzanillo	18.72vw	19.88t	30.78h	34.61f		23.24tu	25.25pq	34.01ij	37.66f	
Specific effect of	Mulching	Unmulched 22.83B		Mulched 25.54A			Unmulched 27.40B		Mulched 29.97A		
	Water resource	Well 18.75B		Sewage 29.62A			Well 23.15B		Sewage 34.22A		
	Olive Cultivars	Aggizi 22.57B	Koroneiki 31.70A	Picual 20.81C	Manzanillo 21.66D		Aggizi 27.63B	Koroneiki 36.67A	Picual 25.23C	Manzanillo 25.21C	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

and the minimizing of fruit drop% in olive cultivars under study might be highly related to the decrease in the percentage of ovary abortion according to (**Iannatta *et al.*, 1998).**

IV.I.II. Fruit characters.

IV.I.II.1. Fruit length and diameter (cm).

The effect of aforementioned different water levels of irrigation, sources of water and mulching on the fruit length and fruit diameter (cm) of the four olive cultivars under study presented in Table, (11&12).

A. Specific effect:

As a matter of fact, fruit length and diameter (cm) of olive cultivars under study responded significantly to the higher level of irrigation (120L./tree) in comparison with the other two levels during the two growing seasons. Both sewage water and mulching the soil increased significantly fruit length and diameter compared to other source of water and nonmulched soil during 2000 & 2001 seasons.

Meantime, Aggizi olive trees achieved the highest fruit length and diameter values in contrast to Koroneiki during the two growing seasons of study.

B. Interaction effect:

Aggizi olive cv. when, irrigated with 120L./tree sewage water in the mulched soil yielded the largest fruits length and diameter in both seasons. Reversely, Koroneiki cv. trees irrigated with 60L./tree wells water and planted in unmulched soil showed the minimized values during 2000 and 2001seasons. The response of the four olive trees under study to different water levels of irrigation was in agreement with **Agabbio (1979); D`andfia *et al.*, (1997)** and **Goldhamer, (1999).**

Table (11): Mean response of average fruit length (cm) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	2.53u	2.83k	2.71o	3.12f	2.44C	2.45pq	2.76h	2.61k-m	3.02e	2.35C
	Koroneiki	1.77]	1.85]	1.89]	1.98		1.74z	1.82y	1.86y	1.98wx	
	Picual	2.48w	2.66q	2.52u	2.70o		2.42qr	2.53n	2.47op	2.63kl	
	Manzanillo	2.40x	2.49vw	2.50v	2.56t		2.23u	2.36s	2.29t	2.38rs	
90 L	Aggizi	3.05g	3.22e	3.22e	3.47c	2.63B	3.02e	3.33c	3.17d	3.45b	2.61B
	Koroneiki	1.92-	2.03]	1.95-	2.13z		1.97wx	2.02w	1.96x	2.10v	
	Picual	2.57st	2.70o	2.67pq	2.80l		2.60lm	2.69ij	2.63kl	2.73hi	
	Manzanillo	2.50v	2.61r	2.60r	2.70o		2.37rs	2.51no	2.60lm	2.56mn	
120 L	Aggizi	3.42d	3.52b	3.47c	3.69a	2.81A	3.38c	3.62a	3.34c	3.60a	2.78A
	Koroneiki	2.05	2.14z	2.11	2.30y		2.10v	2.13v	2.30t	2.22u	
	Picual	2.68p	2.87j	2.73n	3.00h		2.70ij	2.84g	2.77h	2.89f	
	Manzanillo	2.58s	2.77m	2.70o	2.88i		2.57mn	2.66jk	2.61k-m	2.76h	
Specific effect of	Mulching	Unmulched 2.57B		Mulched 2.68A			Unmulched 2.53B		Mulched 2.62A		
	Water resource	Well 2.54B		Sewage 2.71A			Well 2.51B		Sewage 2.65A		
	Olive Cultivars	Aggizi 3.19A	Koroneiki 2.01D	Picual 2.70B	Manzanillo 2.61C		Aggizi 3.15A	Koroneiki 2.02D	Picual 2.66B	Manzanillo 2.49C	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

Table (12): Mean response of average fruit diameter (cm) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	2.15k	2.26i	2.27i	2.49g	1.75C	2.10j	2.30i	2.30i	2.48g	1.68C
	Koroneiki	0.99^	1.08[	1.02]	1.07[		0.93-	1.03^	1.01-	1.08]	
	Picual	1.74v	1.78u	1.78u	1.86r		1.53x	1.75s	1.63v	1.78qr	
	Manzanillo	1.83s	1.89pq	1.83s	1.96o		1.60w	1.74s	1.72t	1.84p	
90 L	Aggizi	2.41h	2.58f	2.62e	2.83b	1.89B	2.37h	2.70e	2.63f	2.80c	1.84B
	Koroneiki	1.06\	1.11z	1.09[	1.18x		1.03^	1.10\	1.07]	1.17[	
	Picual	1.78u	1.84s	1.81t	1.95o		1.70u	1.80q	1.80q	1.90o	
	Manzanillo	1.90p	2.05m	2.00n	2.10l		1.78r	1.84p	1.84p	1.97n	
120 L	Aggizi	2.76d	2.77d	2.79c	2.84a	1.99A	2.64f	2.88b	2.78d	3.01a	1.98A
	Koroneiki	1.11z	1.14y	1.13y	1.26w		1.04^	1.21z	2.17[	1.23y	
	Picual	1.89pq	1.90p	1.87qr	2.00n		1.80q	1.90o	1.90o	2.03l	
	Manzanillo	2.06m	2.09l	2.08l	2.20j		1.90o	2.02m	2.06k	2.10j	
Specific effect of	Mulching	Unmulched 1.84B		Mulched 1.92A			Unmulched 1.78B		Mulched 1.89A		
	Water resource	Well 1.83B		Sewage 1.93A			Well 1.76B		Sewage 1.90A		
	Olive Cultivars	Aggizi 2.56A	Koroneiki 1.10D	Picual 1.85C	Manzanillo 2.00B		Aggizi 2.58A	Koroneiki 1.09D	Picual 1.79C	Manzanillo 1.87B	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

IV.I.II.2. Fruit and seed weights (gm).

The specific and the interaction response of fruit and seed weight olive cultivars to different water levels, source of water and mulching presented in Tables, (13&14).

A. Specific effect:

Generally, the irrigation of olive trees with120L./tree sewage water and planted in mulched soil surpassed other treatments in fruit and seed weight during both seasons. As for the specific effect of cultivar, Aggizi cv. exhibited the highest fruit and seed values followed by Picual, Manzanillo and Koroneiki in a descending order in both seasons.

B. **Interaction effect:**

Irrigating the trees with 120L./tree from either sewage or wells' water, combined with soil mulching, increased significantly the fruit and seed weights of Aggizi cv. during the two growing seasons.

The reverse was true for Koroneiki cv. when irrigated with 60 & 90L./tree from wells' or sewage water, mulched or unmulched. These results go in line with **Michelakis, (1992)** and **serrano, (1999).**

IV.I.II.3. Fruit pulp weight (gm) and volume (cm^3).

Data related to the specific effect of water levels, sources and mulching on fruit pulp and volume of olive cultivars are shown in Tables, (15&16).

A. Specific effect:

Generally, the use of 120L./tree irrigation water from sewage source with mulching the soil highly increased the fruit pulp weight and size compared to the other treatments

Table (13): Mean response of average fruit weight (gm) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	6.46m	7.94i	7.27j	9.70h	4.88C	6.04jk	6.81i	7.59h	9.61f	4.58C
	Koroneiki	0.98^	1.10]	1.10]	1.17\]		0.89[	1.04z[	1.04z[	1.15x-z	
	Picual	5.26st	5.62r	5.28st	5.71qr		4.78tu	4.89s-u	5.05q-s	5.16qr	
	Manzanillo	4.94v	5.18tu	5.11u	5.32s		4.66u	4.82s-u	4.87s-u	4.93r-t	
90 L	Aggizi	9.71h	11.70f	11.40g	13.42e	6.23B	9.34g	10.88e	11.55d	13.24c	5.88B
	Koroneiki	1.22[\	1.31z[	1.28z[	1.38yz		1.14yz	1.21w-z	1.25v-z	1.30v-y	
	Picual	5.76pq	6.07o	6.06o	6.30n		5.25o-q	5.46n-p	5.47no	5.68mn	
	Manzanillo	5.75pq	6.13o	5.84p	6.26n		5.22pq	5.42op	5.72lm	5.86k-m	
120 L	Aggizi	1.367d	14.38c	14.54b	14.98a	7.19A	13.07c	13.56b	13.72b	14.44a	6.78A
	Koroneiki	1.42y	1.46xy	1.53wx	1.61w		1.39v-x	1.44vw	1.41vw	1.48v	
	Picual	6.25n	6.63l	6.30n	6.80k		5.91k-m	5.77lm	6.09jk	6.18j	
	Manzanillo	6.11o	6.57l	6.12o	6.65l		5.94j-l	5.96j-l	6.07jk	6.06jk	
Specific effect of	Mulching	Unmulched 5.90B		Mulched 6.30A			Unmulched 5.56B		Mulched 5.93A		
	Water resource	Well 5.81B		Sewage 6.39A			Well 5.46B		Sewage 6.04A		
	Olive Cultivars	Aggizi 11.21A	Koroneiki 1.30D	Picual 6.00B	Manzanillo 5.83C		Aggizi 10.82A	Koroneiki 1.23C	Picual 5.47B	Manzanillo 5.46B	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

Table (14): Mean response of average seedt weight (gm) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	0.93k-n	1.05ij	1.14g	1.36e	0.83C	0.89j-m	1.20d	1.11de	1.31c	0.82C
	Koroneiki	0.27s	0.29rs	0.32p-s	0.31q-s		0.25p	0.25p	0.29n-p	0.31n-p	
	Picual	1.05ij	1.00jk	1.09g-I	1.05h-j		1.03e-I	0.98f-j	1.05e-h	1.02e-I	
	Manzanillo	0.83o	0.85no	0.88l-o	0.86m-o		0.82m	0.87k-l	0.85lm	0.84m	
90 L	Aggizi	1.44d	1.27f	1.49cd	1.54bc	0.96B	1.39c	1.31c	1.48b	1.51b	0.94B
	Koroneiki	0.33p-s	0.34p-s	0.35p-s	0.37p-r		0.31n-p	0.32n-p	0.34n-p	0.35n-p	
	Picual	1.09g-I	1.15g	1.11g-I	1.14g		1.06ef	1.08e	1.08e	1.10e	
	Manzanillo	0.92k-n	0.96kl	0.96kl	0.95kl		0.91j-m	0.95g-k	0.94i-l	0.95h-l	
120 L	Aggizi	1.58b	1.82a	0.96kl	1.81a	1.00A	1.50b	1.79a	0.89j-m	1.72a	0.97A
	Koroneiki	0.37p-r	0.37pr	0.39pq	0.40p		0.36no	0.37n	0.39n	0.39n	
	Picual	1.09g-I	1.09g-I	1.13g-I	1.14gh		1.05e-h	1.05e-h	1.09e	1.10e	
	Manzanillo	0.94k-m	0.95kl	1.00jk	0.98jk		0.95g-k	0.95g-k	0.97f-k	0.95g-k	
Specific effect of	Mulching	Unmulched 0.90B		Mulched 0.96A			Unmulched 0.88B		Mulched 0.94A		
	Water resource	Well 0.92B		Sewage 0.95A			Well 0.90B		Sewage 0.92A		
	Olive Cultivars	Aggizi 1.37A	Koroneiki 0.34D	Picual 1.09B	Manzanillo 0.92C		Aggizi 1.34A	Koroneiki 0.33D	Picual 1.06B	Manzanillo 0.91C	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

Table (15): Mean response of pulp weight (gm) of olive trees to specific and interaction effects of olive cultivars; water resources;irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	5.53g-i	6.22f	6.76e	8.34d	4.05C	5.15i	5.61h	6.48g	8.30e	3.77C
	Koroneiki	0.71u	0.80tu	0.78tu	0.85s-u		0.64w	0.79u-w	0.75vw	0.84t-w	
	Picual	4.21pq	4.28oq	4.53n-p	4.65m-o		3.75s	3.91q-s	4.00q-s	4.14o-q	
	Manzanillo	4.11q	4.26pq	4.30pq	4.45op		3.84rs	3.95q-s	4.02q-s	4.09p-r	
90 L	Aggizi	8.26d	10.16c	10.21c	11.88b	5.26B	7.95f	9.58d	10.07c	11.73b	4.93B
	Koroneiki	0.89r-u	0.94r-u	0.96r-u	1.01r-u		0.83t-w	0.89t-w	0.91t-w	0.95t-v	
	Picual	4.67m-o	4.91k-m	4.96j-m	5.16j-l		4.19o-q	4.37no	4.39no	4.58l-n	
	Manzanillo	4.83l-n	4.88k-m	5.17j-l	5.31h-j		4.31n-p	4.47mn	4.77j-l	4.91i-k	
120 L	Aggizi	12.09b	12.06b	13.42a	13.17a	6.15A	11.56b	11.77b	12.83a	12.72a	5.81A
	Koroneiki	1.04r-u	1.16rs	1.07r-t	1.21r		1.04t-v	1.07tu	1.02t-v	1.09t	
	Picual	5.16j-l	5.21i-k	5.50g-i	5.67g		4.86i-k	4.72k-m	5.00ij	5.08i	
	Manzanillo	5.17j-l	5.17j-l	5.57gh	5.67g		4.98i-k	5.01ij	5.10i	5.10i	
Specific effect of	Mulching	Unmulched 5.00B		Mulched 5.31A			Unmulched 4.69B		Mulched 4.99A		
	Water resource	Well 4.86B		Sewage 5.44A			Well 4.55B		Sewage 5.12A		
	Olive Cultivars	Aggizi 9.84A	Koroneiki 0.95C	Picual 4.91B	Manzanillo 4.91B		Aggizi 9.48A	Koroneiki 0.90D	Picual 4.42C	Manzanillo 4.55B	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

Table (16): Mean response of fruit volume (cm^3) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	6.33lm	6.82k	7.43j	10.06h	4.78C	5.93i	6.62h	7.03g	9.96e	4.56C
	Koroneiki	1.00y	1.18xy	1.00y	1.11xy		1.00v	1.17uv	1.00v	1.01uv	
	Picual	5.03u	5.10u	5.39st	5.52rs		4.74r	4.87qr	4.96p-r	5.43l-o	
	Manzanillo	5.03u	5.13u	5.10u	5.22tu		4.64r	4.87qr	4.88qr	4.88qr	
90 L	Aggizi	9.50i	11.80g	12.36f	14.07d	6.19B	9.94f	12.29c	11.84d	13.42b	5.90B
	Koroneiki	1.24w-y	1.16xy	1.30wx	1.36wx		1.31t-v	1.16uv	1.02uv	1.03uv	
	Picual	5.53rs	5.83o-q	5.94n-p	6.08no		5.22n-p	5.52k-o	5.54k-n	5.71i-l	
	Manzanillo	5.63q-s	5.73p-r	5.72p-r	5.84o-q		5.17o-q	5.32m-o	5.30m-p	5.56j-n	
120 L	Aggizi	13.83e	14.63b	14.37c	14.88a	7.10A	12.52c	14.43a	14.32a	14.47a	6.75A
	Koroneiki	1.44v	1.76v	1.72v	1.88v		1.37s-u	1.54st	1.53st	1.67s	
	Picual	5.96n-p	6.04no	6.39lm	6.51l		5.69i-l	5.74i-l	5.92ij	5.94i	
	Manzanillo	5.98n-p	6.00no	6.18mn	6.05no		5.80i-l	5.82i-k	5.67i-m	5.54k-n	
Specific effect of	Mulching	Unmulched 5.81B		Mulched 6.24A			Unmulched 5.47B		Mulched 6.00A		
	Water resource	Well 5.74B		Sewage 6.31A			Well 5.49B		Sewage 5.99A		
	Olive Cultivars	Aggizi 11.34A	Koroneiki 1.35D	Picual 5.78B	Manzanillo 5.63C		Aggizi 10.98A	Koroneiki 1.24D	Picual 5.44B	Manzanillo 5.29C	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

levels of irrigation and wells in unmulched soils during the two growing seasons.

Aggizi cv. exhibited the highest values in reverse to Koroneiki in both seasons. Meantime, Picual and Manzanillo were in between.

B. Interaction effect:

Concerning pulp weight (gm), Aggizi olive cv. irrigated with 120L./tree sewage water (mulched or unmulched) gave the highest significant values in both seasons. In the contrary, Koroneiki when irrigated with 120L./tree wells water and unmulched had the lowest significance. And so far, as irrigated with 60 and 90L./tree with both sewage and wells water (mulched & unmulched gave the least significance in both seasons.

As for fruit volume, during the first season (2000) Aggizi olive cv. irrigated with 120L./tree sewage water and in mulching soil had the superior values in comparison with 60 & 90L./tree irrigated with wells water and unmulched. However, in the second season (2001) the same cv. surpassed other varieties as irrigated with 120L./tree sewage in mulched & unmulched soil and wells water (mulched only). On the other hand, Koroneiki cv. showed the least values as irrigated with 60L./tree wells and sewage water (mulched&unmulched). Moreover, 90L./tree wells water mulched and unmulched had the same trend in 2000 season. However, Koroneiki gave the least values when irrigated with 60 and 90L./tree sewage and well water (mulched &unmulched) during 2001 season.

The fruit pulp weight and volume of different olive cultivars and their response to different water levels in olive trees were coincide with **Deidda *et al.* 1990 and Michelakis, 1992**).

IV.I.II.4.Fruit moisture content and yield/tree.

Tables, (17&18) show the specific effect of water levels (60,90,&120L./tree), the source of water (wells& sewage) and mulching on fruit moisture content (%) and fruit yield (Kg)/tree.

A. Specific effect:

As refer to, fruit moisture content and fruit yield/tree were increased significantly with the 120L./tree level, sewage irrigation water and mulched soil compared to other treatments in both years.

The specific effect of cultivars exhibited that, fruit moisture and yield/tree of Aggizi olive cv. highly responds significantly to the treatments under study during the two growing seasons. On the other hand, Manzanillo cv had the least values of fruit moisture content, whereas, Picual was the least values of fruit yield/tree.

B. **Interaction effect:**

As regard to Aggizi cv. was the superior in its moisture content and yield /tree as irrigated with the highest level of sewage water (120L./tree) and mulched in both growing seasons. Moreover, for fruit yield/tree only Aggizi had the highest values with 120 L./tree of sewage water for both mulched and unmulched in the second season only.

On the reverse direction, Manzanillo was the lowest values in fruit moisture when irrigated with 60L./tree wells water and unmulched in both seasons. As for yield/tree, Koroneiki and Picual were the least values when irrigated with 60L./tree wells water and unmlched in the first growing season. Meanwhile,

Table (17): Mean response of fruit miosture content (%) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	63.97k	66.66i	74.38e	75.24d	58.53C	64.46h	67.98g	70.87f	72.84e	57.66C
	Koroneiki	52.76[	55.20x	57.12s-u	58.26r		52.99tu	55.70op	56.23no	58.53l	
	Picual	54.00yz	54.36y	55.43wx	56.59uv		52.56uv	53.65st	53.27s-u	55.03pq	
	Manzanillo	51.93\	52.94[	53.53z[	54.33y		50.55w	51.93v	52.48uv	53.55st	
90 L	Aggizi	69.67g	72.88f	76.65c	76.69c	62.08B	70.40f	72.37e	77.30d	79.14c	61.38B
	Koroneiki	54.64xy	56.94s-v	63.07lm	64.19k		52.31uv	55.93n-p	60.85jk	62.44i	
	Picual	56.12vw	57.50r-t	59.86pq	60.98no		55.21pq	56.28no	58.54l	59.94k	
	Manzanillo	54.23y	54.71xy	56.89s-v	58.25r		52.99tu	54.08rs	56.71mn	57.57m	
120 L	Aggizi	75.62d	78.15b	78.15b	79.60a	65.23A	73.05e	76.54d	80.27b	81.53a	64.08A
	Koroneiki	59.37q	61.12n	65.80j	68.37h		54.66qr	55.40o-q	63.21i	65.23h	
	Picual	57.62rs	61.05no	62.35m	63.21l		59.90k	60.36jk	61.26j	63.11i	
	Manzanillo	56.42uv	56.72t-v	59.76pq	60.28op		55.50o-q	56.28no	58.97l	60.02k	
Specific effect of	Mulching	Unmulched 61.22B		Mulched 62.68A			Unmulched 60.19B		Mulched 61.89A		
	Water resource	Well 59.78B		Sewage 64.12A			Well 58.80B		Sewage 63.29A		
	Olive Cultivars	Aggizi 73.97A	Koroneiki 59.74B	Picual 58.26C	Manzanillo 55.82D		Aggizi 73.90A	Koroneiki 57.79B	Picual 57.43C	Manzanillo 55.05D	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

Table (18): Mean response of yield (Kg)/tree of olive trees to specific and interaction effects of olive cultivars; water resources;irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	11.67uv	14.67rs	19.00k-m	21.17j	13.88C	16.17uv	17.83st	27.00kl	30.50fg	19.35C
	Koroneiki	8.67x	12.00uv	15.83p-r	17.17no		12.33x	15.17vw	22.50no	23.00no	
	Picual	8.67x	10.17w	11.00vw	12.67tu		10.50y	15.17vw	18.17r-t	18.83rs	
	Manzanillo	11.67t	13.33o-q	15.83p-r	18.50lm		13.93w	16.83tu	25.17m	26.50k-m	
90 L	Aggizi	16.17o-q	20.17jk	26.33ef	29.50cd	19.22B	20.33pq	23.50n	34.67de	39.00b	25.20B
	Koroneiki	11.67uv	17.83mn	21.33ij	24.50gh		16.17uv	20.67pq	30.83f	34.00e	
	Picual	12.17st	13.67o-q	15.17qr	17.17no		15.83uv	18.33rs	21.83op	23.33n	
	Manzanillo	16.00o-q	19.17kl	21.17j	25.50fg		18.67rs	20.50pq	29.83f-h	35.67cd	
120 L	Aggizi	20.50j	24.67gh	30.50bc	32.67a	24.56A	27.17kl	29.17g-l	41.83a	41.83a	31.73A
	Koroneiki	21.00j	24.00h	29.17d	31.50b		23.50n	25.83lm	39.17b	40.33b	
	Picual	17.00n-p	18.83lm	19.17kl	21.00j		19.67qr	21.83op	27.50jk	28.83h-j	
	Manzanillo	22.33i	24.50gh	26.83e	29.33d		26.83kl	28.00i-k	36.50c	39.17b	
Specific effect of	Mulching	Unmulched 17.87B		Mulched 20.57A			Unmulched 24.00B		Mulched 26.41A		
	Water resource	Well 16.27B		Sewage 22.17A			Well 19.75B		Sewage 30.67A		
	Olive Cultivars	Aggizi 22.24A	Koroneiki 19.56C	Picual 14.72D	Manzanillo 20.35B		Aggizi 29.08A	Koroneiki 25.29B	Picual 19.99C	Manzanillo 26.47B	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

Picual only gave the least significant values as irrigated with 60L. wells water and unmulched. These results were in agreement with **Psyllakis, (1977); Chartzoulakis *et al.*, (1993); Bini *et al.* (1997);** and **Patumi, *et al.*,(2000).** They reported that as water level increase moisture content and yield was increased. **Milella and Dettori, (1987)** reveald that the increase in yield reached 60%.**Toscano *et al.*, (1999)** showed that, although the cover under olive trees reduced growth, the yield was increased significantly.

Generally, although we noticed that using of high levels of sewage water irrigation increased Aggizi olive fruit yield (41.83 Kg/tree) compared to other cultivars, the increase in fruit moisture content (81.83%) was extremely high in comparison with the increase in other cultivars. However, the increase in yield in Koroneiki and Manzanillo was close to Aggizi (40.33&39.17 Kg/tree respectively) eventhough, the corresponding moisture content was not as high as Aggizi.

IV.I.III. Chemical constituent.

The specific effect of different water levels, sources of water and mulching on chemical constituents of different olive cultivars includes, photosynthetic pigments, oil %, macro and micro elements in leaves besides heavy metals in fruits.

IV.I.III.1. Leaf Photosynthetic pigments.

Data concerning chlorophyll A, B & carotene (%) in the leaves are presented in Tables, (19,20 & 21).These data show the effect of water levels, sources of water and mulching on different olive cultivars.

Table (19): Mean response of leaf chlorophyll (A) content (%) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	0.596s-u	0.579tu	0.683o-q	0.775mn	0.668C	0.635y	0.688w	0.732uv	0.773t	0.805C
	Koroneiki	0.620r-t	0.647p-s	0.645p-s	0.709o		0.808s	0.839r	0.842r	0.943o	
	Picual	0.542u	0.549u	0.725no	0.776mn		0.601z	0.658x	0.887q	0.953o	
	Manzanillo	0.678o-r	0.798lm	0.645p-s	0.723no		0.744u	0.813s	0.947o	1.017mn	
90 L	Aggizi	0.686o-q	0.736no	0.870ij	0.964fg	0.826B	0.742u	0.852r	0.892q	1.014n	0.947B
	Koroneiki	0.697op	0.734no	0.808k-m	0.986ef		0.883q	0.956o	1.032lm	1.090hi	
	Picual	0.631q-t	0.703op	0.859i-k	1.024de		0.717v	0.800s	1.059jk	1.166f	
	Manzanillo	0.821j-m	0.866ij	0.886hi	0.945fg		0.878q	0.938op	1.053k	1.075ij	
120 L	Aggizi	0.776mn	0.821j-l	1.040de	1.053d	1.024A	0.952o	1.060jk	1.197e	1.192e	1.129A
	Koroneiki	0.804k-m	0.872ij	1.164c	1.229b		1.044kl	1.102h	1.292a	1.274b	
	Picual	0.837i-l	0.872ij	1.216bc	1.302a		0.925p	1.022mn	1.225d	1.284ab	
	Manzanillo	0.929gh	0.963fg	1.199bc	1.303a		1.017mn	1.105h	1.131g	1.249c	
Specific effect of	Mulching	Unmulched 0.807B		Mulched 0.872A			Unmulched 0.927B		Mulched 0.994A		
	Water resource	Well 0.740B		Sewage 0.939A			Well 0.866B		Sewage 1.055A		
	Olive Cultivars	Aggizi 0.798C	Koroneiki 0.826B	Picual 0.836B	Manzanillo 0.896A		Aggizi 0.894D	Koroneiki 1.009A	Picual 0.941C	Manzanillo 0.997B	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

Table (20): Mean response of leaf chlorophyll (B) content (%) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	0.294tu	0.300s-u	0.323o-s	0.341l-o	0.325C	0.334x	0.354w	0.418st	0.462op	0.418C
	Koroneiki	0.331n-q	0.335m-p	0.339l-o	0.352k-n		0.375v	0.391uv	0.428rs	0.444qr	
	Picual	0.222w	0.254v	0.306q-u	0.358k-m		0.317y	0.300z	0.407tu	0.481mn	
	Manzanillo	0.304r-u	0.409g-I	0.340l-o	0.396hi		0.397u	0.472no	0.555e-g	0.548g-I	
90 L	Aggizi	0.285u	0.297s-u	0.359k-m	0.394ij	0.379B	0.395u	0.419st	0.496lm	0.552f-h	0.487B
	Koroneiki	0.330n-r	0.328n-r	0.365kl	0.404g-I		0.418st	0.448pq	0.494lm	0.473no	
	Picual	0.283u	0.319o-t	0.411g-I	0.482c		0.325xy	0.390uv	0.514k	0.572c-e	
	Manzanillo	0.409g-I	0.422f-h	0.447ef	0.532b		0.532ij	0.587bc	0.569c-f	0.600b	
120 L	Aggizi	0.310p-u	0.331n-q	0.436ef	0.457de	0.447A	0.473no	0.504kl	0.534ij	0.569c-f	0.543A
	Koroneiki	0.345l-o	0.371jk	0.490c	0.486c		0.497lm	0.533ij	0.520jk	0.554e-g	
	Picual	0.407g-I	0.403g-I	0.541b	0.582a		0.443qr	0.558d-g	0.573cd	0.567d-f	
	Manzanillo	0.428fg	0.471cd	0.546b	0.549b		0.575cd	0.535h-j	0.625a	0.634a	
Specific effect of	Mulching	Unmulched 0.367B		Mulched 0.399A			Unmulched 0.467B		Mulched 0.498A		
	Water resource	Well 0.341B		Sewage 0.247A			Well 0.441B		Sewage 0.525A		
	Olive Cultivars	Aggizi 0.344D	Koroneiki 0.373C	Picual 0.381B	Manzanillo 0.438A		Aggizi 0.469C	Koroneiki 0.465B	Picual 0.454D	Manzanillo 0.552A	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

Table (21): Mean response of leaf caroten content (%) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	0.249pq	0.262op	0.306i	0.330h	0.262C	0.213s	0.274q	0.249r	0.304op	0.294C
	Koroneiki	0.227rs	0.239qr	0.272l-o	0.286k-m		0.279q	0.296p	0.329k-n	0.344jk	
	Picual	0.200u	0.224rs	0.205tu	0.300i-k		0.225s	0.243r	0.407g	0.356h-j	
	Manzanillo	0.309i	0.301i-k	0.220st	0.267m-o		0.245r	0.273q	0.316no	0.353ij	
90 L	Aggizi	0.260op	0.265n-p	0.343gh	0.381f	0.322B	0.315no	0.330k-n	0.335k-m	0.330k-n	0.353B
	Koroneiki	0.269l-o	0.275l-o	0.331h	0.381f		0.297p	0.395g	0.368hi	0.359h-j	
	Picual	0.235q-s	0.269l-o	0.342gh	0.412de		0.273q	0.325k-n	0.406g	0.429ef	
	Manzanillo	0.349g	0.381f	0.308i	0.350g		0.317m-o	0.323l-n	0.398g	0.442d-f	
120 L	Aggizi	0.276l-o	0.287j-l	0.427cd	0.454b	0.391A	0.371hi	0.396g	0.427f	0.482b	0.425A
	Koroneiki	0.305ij	0.331h	0.459ab	0.472a		0.341j-l	0.511a	0.441d-f	0.474bc	
	Picual	0.283k-n	0.301i-k	0.459ab	0.474a		0.359h-j	0.373h	0.433ef	0.451d	
	Manzanillo	0.403e	0.409e	0.442bc	0.476a		0.368hi	0.447de	0.469bc	0.459cd	
Specific effect of	Mulching	Unmulched 0.312B		Mulched 0.339A			Unmulched 0.341B		Mulched 0.374A		
	Water resource	Well 0.288B		Sewage 0.362A			Well 0.325B		Sewage 0.390A		
	Olive Cultivars	Aggizi 0.320B	Koroneiki 0.321B	Picual 0.309C	Manzanillo 0.351A		Aggizi 0.336C	Koroneiki 0.370A	Picual 0.357B	Manzanillo 0.368A	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

A. Specific effect:

In general olive trees irrigated with sewage water especially at 120L./tree gave the highest chlorophyll (A&B) and well as carotene. Mulching of the soil also exhibited the highest significant values of chlorophyll (A,B) & C in both seasons.

Manzanillo cv., yielded the superior values of chlorophyll A, in contrast to Aggizi cv. in the first season. On the second season, Koroneiki exhibited the highest values of chlorophyll A, and Aggizi cv. was the least in chlorophyll content.

Chlorophyll B in Manzanillo cv. surpassed in both seasons then others cultivars . However, Aggizi and Picual cvs. scored the reduced values.

Manzanillo gave the highest values in carotene content in the first season. Meanwhile, Manzanillo and Koroneiki had the highest values during the second growing season.

B. Interaction effect:

As for chlorophyll (A) in the interaction effect, Picual and Manzanillo irrigated with 120L./tree sewage water and mulched soil showed the highest values in the first season. Also, Koroneiki and Picual irrigated with the same level and source of water in unmulched soils for the first cv. and mulched for the second one in the second season.

On the other hand, Picual and Aggizi cvs. irrigated with 60L./tree wells water in mulched soil in addition, Picual irrigated with the same level and source in unmulched soil contains the least values during the first season. Moreover, Picual irrigated with 60 L./tree unmulched was exhibited the same trend.

Chlorophyl B, Picual gave the highest values as irrigated with120 L./tree sewage water and in mulched soil in the first season. However, Manzanillo irrigated with 120 L./tree sewage water mulched and unmulched scored the highest significant values in the

second season. Meanwhile, Picual irrigated with 60 L./tree wells water in mulched soil exhibited the least values during the two growing seasons.

As for carotene, during the first season Picual and Koroneiki irrigated with 120L./tree sewage water either in mulched or unmulched soil contain the superior values, besides Manzanillo, irrigated with the same level of water and mulched only gave the same significant value.

Whereas, in the second season Koroneiki irrigated with 120L./tree wells water in mulched soil surpassed other cvs. On the contrary, Picual irrigated with 60L./tree level either from sewage or wells water in unmulched soil showed the least significance in the first season. Besides Aggizi and Picual irrigated with 60L./tree wells water in unmulched soil was poor in carotene content. These results are in harmony with **Abd El-Samed 1995); Hassan (1998) and Laz *et al.*, 1999)**

IV.I.III.2. Fruit oil (%) of dry and fresh weight.

Data dealing the effect of the specific factors (water levels, source of water and mulching) on fruit oil (%) of dry and fresh weight in the four olive cultivars are presented in Tables, (22& 23).

A. Specific effect:

Trees irrigated with 120L./tree from sewage water grown in unmulched soil showed the highest values of fruit oil percentage in dry weight of the four olive cvs. during the first season. Whileas, 90 & 120L./tree levels of irrigation water and sewage in unmulched soil increased significantly oil percentage of dry weight in the second season.

As for olive oil percentage of fresh weight, 60L./tree sewage water irrigation in unmulched soil had the highest values compared to other treatments during two seasons of study. Concerning, the

varieties, Koroneiki cv was the highly significant response compared to the cultivars under study. Reversely, Aggizi was the highly reduced values in both dry and fresh weight in both seasons.

B. Interaction effect:

Koroneiki trees irrigated with 120L/tree of sewage water in mulched and unmulched soil indicated the highest values of oil (%) of dry weight during the two growing seasons (2000& 2001). At the same time, Aggizi irrigated with 60 and 120L/tree wells water in mulched and unmulched soil exhibited less significance in oil dry weight percentage. In addition Aggizi irrigated with 90L./tree wells water unmulched take the same trend in the first season. Reversely, Aggizi cv irrigated with 60, 90 and 120L./tree wells water in mulched and unmulched soils performed a negative trend. As for fresh weight, Koroneiki irrigated with 60L./tree sewage water in mulched or unmulched soil confirmed the highest values in the first season. On the other side, Koroneki trees irrigated with 60L/tree sewage water in unmulched soil achieved the highest oil percentage in the second season. Aggizi irrigated with 120L./tree wells water in soil mulched and unmulched during both season of study showed the least oil percentage of fresh and dry weight. The aforementioned resuls were go in harmony with **Brighigna *et al.*, 1990 Michelakis, 1992); Lavee and Wodner, (1992b); Chartzoulakis *et al.*, (1993). However, Fandi, (1989);** indicated that olive oil content (%) not affected by irrigation levels. Despite, the oil content % as fresh weight was reduced as the level of water increased, the oil content as dry weight was behave in reverse direction. This contradiction might be attributed to the difference in moisture content and confirmed with **Motilva *et al.*, (1999)** who approved that oil and moisture content of olive fruits didn't differ between the irrigation treatments. **Briccoli *et al.* (2002)** reported

Table (22): Mean response of fruit oil content (%) (dry weight) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	15.13s	14.88s	27.02q	28.04pq	38.09C	13.41w	13.64w	26.96v	27.18v	38.43B
	Koroneiki	42.71i-k	41.87jk	54.78c	55.10bc		44.79h-j	45.70h	55.02d	50.36e	
	Picual	44.59gh	36.40n	44.34gh	45.26fg		40.34op	39.25pq	47.73g	47.66g	
	Manzanillo	37.38n	36.84n	41.93jk	43.22h-j		37.00r	37.07r	44.23h-k	44.52h-j	
90 L	Aggizi	17.13r	14.95s	29.15p	30.65o	39.00B	14.50w	13.94w	29.92u	30.23tu	39.62A
	Koroneiki	43.62hi	42.88i-k	55.50bc	56.14b		43.75jk	44.05i-k	57.12c	58.05bc	
	Picual	40.10m	39.51m	46.23ef	47.21de		42.17l-n	39.85op	48.41fg	49.32ef	
	Manzanillo	36.51n	36.47n	43.80hi	44.11g-I		37.27r	37.45r	44.86h-j	42.99k-m	
120 L	Aggizi	15.19s	14.74s	30.71o	31.18o	39.51A	13.22w	13.98w	31.37st	29.22u	39.31A
	Koroneiki	43.32hi	41.54kl	57.59a	58.76a		43.43j-l	41.78mn	60.02a	58.93ab	
	Picual	40.40lm	39.67m	47.00de	47.99d		41.08no	38.31qr	49.97e	49.97e	
	Manzanillo	37.22n	36.48n	44.32gh	45.97ef		37.16r	32.16s	45.43hi	42.87k-m	
Specific effect of	Mulching	Unmulched 38.99A		Mulched 38.74B			Unmulched 39.55A		Mulched 38.69B		
	Water resource	Well 33.73B		Sewage 44.00A			Well 33.55B		Sewage 44.68A		
	Olive Cultivars	Aggizi 22.40D	Koroneiki 49.49A	Picual 43.23B	Manzanillo 40.35C		Aggizi 21.46D	Koroneiki 50.25A	Picual 44.51B	Manzanillo 40.25C	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

Table (23): Mean response of fruit oil content (%) (fresh weight) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	5.45s	4.96s	6.92qr	6.94qr	16.30A	4.77x	4.37xy	7.85t	7.38tu	16.85A
	Koroneiki	20.18bc	18.77d	23.49a	22.99a		21.06de	20.24f-h	24.09a	20.88d-f	
	Picual	20.51b	16.61l-n	19.76c	19.65c		19.14j-l	18.19mn	22.30b	21.43cd	
	Manzanillo	17.97e-h	17.33i-k	19.57c	19.74c		18.29mn	17.82no	21.02de	20.68e-g	
90 L	Aggizi	5.19s	4.05t	6.80qr	7.14q	15.25B	4.29xy	3.85yz	6.79uv	6.31v	15.89B
	Koroneiki	19.79c	18.47de	20.50b	20.10bc		20.86d-f	19.41i-k	22.37b	21.80bc	
	Picual	17.58h-j	16.79k-m	18.55de	18.42d-f		18.89k-m	17.42o	20.07g-l	19.76h-j	
	Manzanillo	16.71l-n	16.51mn	18.88d	18.42d-f		17.52o	17.19o	19.42i-k	18.24mn	
120 L	Aggizi	3.70tu	3.22u	6.71qr	6.36r	14.25C	3.56z	3.28z	6.19v	5.40w	14.70C
	Koroneiki	17.60h-j	16.15no	19.70c	18.59d		19.69h-j	18.63lm	22.08bc	20.49e-g	
	Picual	17.12j-l	15.45p	17.69g-j	17.65h-j		16.48q	15.19r	19.36jk	18.43mn	
	Manzanillo	16.22m-o	15.79op	17.83f-l	18.26d-g		16.54pq	14.06s	18.64lm	17.14op	
Specific effect of	Mulching	Unmulched 15.60A		Mulched 14.93B			Unmulched 16.30A		Mulched 15.32B		
	Water resource	Well 14.26B		Sewage 16.28A			Well 14.61B		Sewage 17.01A		
	Olive Cultivars	Aggizi 5.62D	Koroneiki 19.69A	Picual 17.98B	Manzanillo 17.77C		Aggizi 5.34D	Koroneiki 20.97A	Picual 18.89B	Manzanillo 18.05C	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

that the grass cover of soil under olive trees improved water regime and increased olive oil yield in rainy seasons. Reversly, in our work the oil content in olive cultivars was increased (as percentage) in bare soil in the expense of the mulched one. Meantime, the increase in fruit yield/tree with the increase of irrigation levels in mulched soils may reflected on the increase in oil production per tree.

IV.I.III.3. Nutrient elements.

IV.I.III.3.1. Macroelemets.

Macroelements content (%) of different olive cvs. as affected by three water levels (60, 90 & 120L./tree); water sources (sewage &wells) and soil mulching (mulched &unmulched).

IV.I.III.3.1.1. Leaf nitrogen content.

The specific and interaction effect of three water levels (60, 90 & 120L./tree); water sources (sewage &wells) and soil mulching (mulched &unmulched) on nitrogen leaf (%) in olive cvs. are shown in Table (24).

A. Specific effect:

It is clear that, as water level increased leaf nitrogen decreased significantly in different olive cultivars during the two growing seasons. The 120L./tree level of water gave the least values of nitrogen content.

As for the sources of water, irrigation with sewage water in unmulched soil increased significantly nitrogen percentage of in both seasons. Olive cultivars, can be arranged in its nitrogen content in descending order, Picual, Aggizi, Manzanillo and Koroneiki in the first season. Whereas, in the second season it is

arranged Aggizi and Picual have the same significant values followed by Manzanillo and Koroneiki, ascendingly.

B. Interaction effect:

During the first season (2000), the trees of Aggizi olive cv. which irrigated with 60L./tree sewage water and unmulched has the highest nitrogen values whileas, Koroneiki cv irrigated with 60 L./tree wells water and mulched takes the same trend in the second season.

On the contrary Aggizi olive cv. irrigated with 120L./tree wells water either mulched or unmulched in the first season and the trees in the second season irrigated with either sewage or wells water in unmulched soils have the least values in N content.

Moreover, Koroneiki mulched only and irrigated with the same level of wells water during the first season behave the same as Aggizi. In the same time trees irrigated with 90L./tree level of irrigation water with the two sources and mulching was intermediate in nitrogen level. This work go in line with **El-Khoreily and Salem 1989 Laz *et al.* 1999). EL-Gazzar and Shehata 1982). Moustafa 2002.**

Table (24): Mean response of leaf nitrogen content (%) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	1.39vw	1.32y	2.98a	2.84b	2.08A	1.35x	2.57e	1.31y	2.53f	2.06A
	Koroneiki	1.55q	1.47t	2.53e	2.53e		1.54r	2.91a	153r	2.86b	
	Picual	1.68m	1.57p	2.68c	2.69c		1.49s	2.59e	1.41uv	2.58e	
	Manzanillo	1.42u	1.41v	2.61d	2.60d		1.44t	2.70c	1.40vw	2.67d	
90 L	Aggizi	1.24[	1.16^	2.34f	2.27g	1.74B	1.23[\	2.27h	1.19]	2.22i	1.80B
	Koroneiki	1.36x	1.31y	2.10j	2.03k		1.39w	2.40g	1.33x	2.25h	
	Picual	1.51rs	1.45t	2.19h	2.12i		1.39vw	2.21i	1.24[	2.17j	
	Manzanillo	1.35x	1.25[	2.12i	2.09j		1.51s	2.25h	1.42u	2.26h	
120 L	Aggizi	1.10`	1.07-	1.52r	1.50s	1.35C	1.09-	1.73o	1.07-	1.66p	1.46C
	Koroneiki	1.19]	1.10`	1.42u	1.39w		1.26z	1.76mn	1.20]	1.60q	
	Picual	1.29z	1.22\	1.66n	1.59o		1.22\	1.85k	1.12^	1.75n	
	Manzanillo	1.20]	1.12_	1.70l	1.52r		1.19]	1.83l	1.26z	1.77m	
Specific effect of	Mulching	Unmulched 1.76A		Mulched 1.69B			Unmulched 1.80A		Mulched 1.74B		
	Water resource	Well 1.32B		Sewage 2.13A			Well 1.32B		Sewage 2.23A		
	Olive Cultivars	Aggizi 1.73B	Koroneiki 1.66D	Picual 1.80A	Manzanillo 1.70C		Aggizi 1.69C	Koroneiki 1.84A	Picual 1.75C	Manzanillo 1.81B	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

IV.I.III.3.1.2. Leaf phosphorus content.

Table (25) shows the effect of different water levels (60, 90 &120L./tree), two source of water (sewage& wells) and mulching on phosphorus content (%) of olive cvs.

A. Specific effect:

Different irrigation water levels, 120L./tree level and sewage water in mulched soils increased significantly phosphorus content in olive trees under study in both seasons.

Koroneiki cv. has the highest phosphorus content during the two growing seasons followed by other cultivars. In the contrary, Aggizi cv. has the least significant values in the second season.

B. Interaction effect:

Irrigation with 120L./tree sewage water and mulching influenced more significantly phosphorus content of Aggizi and Koroneiki olive trees in the first and second seasons respectively, than other cultivars.

On the other hand, all cultivars except Koroneiki during the first season and all cultivars under study in the second season when irrigated with 60L./tree in unmulched soil have the least significant values of phosphorus. These results coincide with those **EL-Gazzar and Shehata 1982 Zahran *et al.* 1987). Laz *et al.* 1999) and Moustafa 2002.**

Table (25): Mean response of leaf phosphorus content (%) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	0.156z	0.179xy	0.260l-n	0.245n-q	0.202C	0.162y	0.192x	0.209u-w	0.232o-s	0.204C
	Koroneiki	0.176xy	0.198u-w	0.212s-u	0.240o-r		0.169y	0.201v-x	0.241o-q	0.256l-o	
	Picual	0.164yz	0.183wx	0.207t-v	0.225rs		0.168y	0.188x	0.216s-v	0.238p-r	
	Manzanillo	0.159z	0.178xy	0.214s-u	0.233qr		0.169y	0.197wx	0.201v-x	0.221s-u	
90 L	Aggizi	0.191v-x	0.208tu	0.274j-l	0.304fg	0.248B	0.214t-v	0.228q-t	0.273g-k	0.288e-g	0.258B
	Koroneiki	0.236qr	0.246n-q	0.272j-l	0.293gh		0.221s-u	0.253m-p	0.297e	0.317d	
	Picual	0.202t-v	0.215st	0.255m-o	0.276i-k		0.212t-w	0.240o-q	0.277f-j	0.296e	
	Manzanillo	0.202t-v	0.245n-q	0.268k-m	0.287h-j		0.222r-u	0.243n-q	0.259k-n	0.283e-h	
120 L	Aggizi	0.232qr	0.243o-q	0.345bc	0.375a	0.297A	0.263i-m	0.279f-l	0.336c	0.358b	0.310A
	Koroneiki	0.292g-l	0.303f-h	0.322de	0.357b		0.264i-m	0.297e	0.367b	0.391a	
	Picual	0.236qr	0.256m-o	0.312ef	0.343bc		0.262j-m	0.271h-l	0.336c	0.360b	
	Manzanillo	0.238p-r	0.253m-p	0.314ef	0.334cd		0.272g-l	0.289ef	0.317d	0.338c	
Specific effect of	Mulching	Unmulched 0.239B		Mulched 0.259A			Unmulched 0.246B		Mulched 0.269A		
	Water resource	Well 0.216B		Sewage 0.282A			Well 0.228B		Sewage 0.287A		
	Olive Cultivars	Aggizi 0.251B	Koroneiki 0.262A	Picual 0.240B	Manzanillo 0.244B		Aggizi 0.253D	Koroneiki 0.270A	Picual 0.255C	Manzanillo 0.251B	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

IV.I.III.3.1.3. Leaf potassium content.

Table (26). shows the specific and interaction effect of three water levels, two sources of water and mulching on potassium (K) content (%) of four olive cvs.

A.Specific effect:

It is indicated that, 120L./tree level and sewage irrigation water in mulched soil increased significantly K content in leaves of olive cvs.

As related to cultivar effect, Koroneiki was the highest significant value during the first season, whereas Aggizi cv. has the same behavior in the second season. Reversely, Picual and Aggizi cvs. have the least significant values in the 2000 growing season and Manzanillo in the 2001 season.

B.Interaction effect:

Irrigation with 120L./tree, sewage water and mulching influenced more significantly K content of Koroneiki and Aggizi olive cvs. in the first and second seasons respectively, than other cultivars under study.

In the contrary, during the first season Aggizi olive trees as irrigated with 60L./tree of both sewage and wells water in unmulched soil gave the least significant values of K content. Meantime, Manzanillo trees irrigated with 60L./tree of wells water in mulched and unmulched soils take the same trend during the second season. These data consistent with, **EL-Gazzar and Shehata (1982); Zahran *et al.* (1987); Laz *et al.* (1999) and Moustafa 2002**.

Table (26): Mean response of leaf potassium content (%) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	0.720]	0.917v	0.750\	0.943u	0.905C	0.908_	0.926]^	0.946[\	1.025t-v	0.961C
	Koroneiki	0.977st	1.053op	1.007r	1.040pq		0.947[\	0.964z	0.952z-\	1.056qr	
	Picual	0810z	0.887wx	0.927z	0.970t		0.936\]	0.958z[	1.029s-u	1.066pq	
	Manzanillo	0.780[	0.967t	0.813z	1.027q		0.868`	0.883`	0.915^_	1.004wx	
90 L	Aggizi	0.817z	1.303i	0.850y	1.397h	1.087B	0.959z[	0.983y	1.431e	1.534c	1.160B
	Koroneiki	1.063o	1.123m	1.097n	1.223k		1.015u-w	1.045rs	0.919^_	1.329i	
	Picual	0.880x	1.183l	0.903vw	1.270j		0.984y	1.039st	1.147l	1.301j	
	Manzanillo	0.843y	1.233k	0.897wx	1.303i		0.917^_	0.952z-\	1.258k	1.415f	
120 L	Aggizi	0.937u	1.463f	0.980st	1.560c	1.275A	1.034st	1.065pq	1.619b	1.671a	1.284A
	Koroneiki	1.133m	1.677b	1.117m	1.700a		1.077op	1.130m	1.527c	1.616b	
	Picual	0.947u	1.423g	0.990rs	1.517e		1.088o	1.111n	1.356h	1.380g	
	Manzanillo	0.950u	1.473f	1.007r	1.533d		0.991xy	1.010vw	1.440de	1.451d	
Specific effect of	Mulching	Unmulched 1.065B		Mulched 1.113A			Unmulched 1.107B		Mulched 1.163A		
	Water resource	Well 0.921B		Sewage 1.258A			Well 0.990B		Sewage 1.280A		
	Olive Cultivars	Aggizi 1.053C	Koroneiki 1.184A	Picual 1.051C	Manzanillo 1.069B		Aggizi 1.175A	Koroneiki 1.159B	Picual 1.116C	Manzanillo 1.090D	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

IV.I.III.3.1.4. Leaf Calcium content.

Table, (27) reveals the specific and interaction effect of three water levels, two sources of water and mulching on Calcium (Ca) content (%) in four olive cvs.

A.Specific effect:

Generally, 120L./tree level of irrigation water, wells irrigation water and mulched increased significantly Ca content of different olive cvs. under study during the two growing seasons.

Concerning the olive cvs., Koroneiki olive cv. has the highest values of Ca content during the two growing seasons. Reversely, Manzanillo has the least significant values in both seasons whereas, Picual cv. has the least value in the second season only.

B.Interaction effect:

As related to the interaction effect 120L./tree sewage water in unmulched soil influenced more significantly Koroneiki olive trees during the two growing seasons than other cvs.. whileas, the Picual cv. has the least significant value of Ca content as irrigated with 60 L./tree for both sewage and wells water in mulched soil in both seasons and Manzanillo only in the first season. **EL-Gazzar and Shehata 1982)** reported that as the levels of irrigation with sewage water increased Ca leaf content increased **and Moustafa 2002** on water levels showed the same results.

IV.I.III.3.1.5. Leaf magnesium content (%).

The specific and interaction effect of three water levels (60, 90 & 120L./tree); water sources (sewage &wells) and soil mulching (mulched &unmulched) on magnesium (Mg) content (%) in olive cvs. showed in Table (28).

Table (27): Mean response of leaf calcium content (%) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	1.295n	0.984v	1.320m	0.992uv	1.144C	1.313l	1.046tu	1.334jk	1.068s	1.171C
	Koroneiki	1.335lm	1.027t	1.350j-l	1.057s		1.326kl	1.032uv	1.358hi	1.051t	
	Picual	1.293n	0.936y	1.301n	0.942y		1.292m	0.976y	1.310l	0.984xy	
	Manzanillo	1.285n	0.943y	1.300n	0 948xy		1.318kl	0.987xy	1.346ij	0.994x	
90 L	Aggizi	1.366ij	1.032t	1.384gh	1.040t	1.194B	1.370h	1.138q	1.398g	1.151o-q	1.239B
	Koroneiki	1.377hi	1.105r	1.398fg	1 125pq		1.420f	1.121r	1.440f	1.160op	
	Picual	1.336lm	0.992uv	1.343kl	0.995uv		1.344ij	1.033t-v	1.369h	1.037tu	
	Manzanillo	1.335lm	0.961wx	1.354jk	0.968w		1.388g	1.013w	1.424ef	1.018vw	
120 L	Aggizi	1.439c	1.137p	1.457b	1.142p	1.269A	1.470d	1.162op	1.508bc	1.168o	1.314A
	Koroneiki	1.443bc	1.165o	1.475a	1.175o		1.511bc	1.200n	1.535a	1.207n	
	Picual	1.387gh	1.115qr	1.408ef	1 124pq		1.430ef	1.141q	1.464d	1.149pq	
	Manzanillo	1.419de	0.991uv	1.432cd	1.003u		1.494c	1.034t-v	1.517b	1.040tu	
Specific effect of	Mulching	Unmulched 1.196B		Mulched 1.210A			Unmulched 1.232B		Mulched 1.251A		
	Water resource	Well 1.368A		Sewage 1.037B			Well 1.403A		Sewage 1.080B		
	Olive Cultivars	Aggizi 1.216B	Koroneiki 1.253A	Picual 1.181C	Manzanillo 1.162D		Aggizi 1.261B	Koroneiki 1.280A	Picual 1.211C	Manzanillo 1.215C	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

Table (28): Mean response of leaf magnesium content (%) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	0.283gh	0.113r-t	0.296f-h	0.117q-t	0.205C	0.293k	0.123w	0.313ij	0.123w	0.215C
	Koroneiki	0.290f-h	0.125o-t	0.308f	0.131p-r		0.307i-k	0.130vw	0.317i	0.133u-n	
	Picual	0.278f	0.107t	0.293f-h	0.111st		0.297jk	0.117w	0.303i-k	0.123w	
	Manzanillo	0.287gh	0.123o-t	0.298fg	0.126q-s		0.303i-k	0.123w	0.313ij	0.127w	
90 L	Aggizi	0.330e	0.148p	0.349d	0.148p	0.252B	0.347h	0.147t-v	0.373f	0.150s-u	0.266B
	Koroneiki	0.351d	0181m-o	0.374c	0.189m		0.367fg	0.193n-p	0.380f	0.193n-p	
	Picual	0.330e	0.129q-s	0.350d	0 135pq		0.337h	0.163r-t	0.353gh	0.167q-s	
	Manzanillo	0.331e	0.166o	0.345de	0.169no		0.353gh	0.177p-r	0.377f	0.183o-q	
120 L	Aggizi	0.396b	0.198lm	0.403b	0.207l	0.312A	0.413de	0.190n-p	0.433bc	0.200no	0.326A
	Koroneiki	0.423a	0.248ij	0.439a	0.253i		0.450ab	0.260l	0.453a	0.263l	
	Picual	0.392b	0.185mn	0.400b	0 193lm		0.397e	0.220m	0.410de	0.223m	
	Manzanillo	0.385bc	0.229k	0.402b	0.253jk		0.427cd	0.203n	0.437a-c	0.237m	
Specific effect of	Mulching	Unmulched 0.251B		Mulched 0.261A			Unmulched 0.264B		Mulched 0.274A		
	Water resource	Well 0.347A		Sewage 0.165B			Well 0.365A		Sewage 0.174B		
	Olive Cultivars	Aggizi .249C	Koroneiki 0.276A	Picual .242D	Manzanillo 0.258B		Aggizi 0.259C	Koroneiki 0.287A	Picual 0.259C	Manzanillo 0.272B	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

A. Specific effect:

As for 120L./tree level of water and wells irrigation source in mulched soil increased more significantly Mg content of different olive cvs. under study than other levels during the two growing seasons.

Concerning the olive cvs., Koroneiki olive cv. has the highest values of Mg content during the two growing seasons. Reversely, Picual has the least significant values in both seasons Meantime, Aggizi cv. has the least value in the second season only.

B. Interaction effect:

With regard to, Koroneiki olive trees irrigated with 120L./tree sewage and wells water in unmulched soil has the highest Mg content during the two growing seasons than other cvs.. Moreover, Manzanillo irrigated with the same level of sewage water in unmulched soil in the second season only gave the same trend.

On the other hand, during the two growing seasons all varieties under study irrigated with 60L./tree wells water in mulched soil in addition to, Aggizi and Picual as irrigated with 60L./tree sewage water in mulched soil have the least values of Mg content. Besides, Manzanillo cv as irrigated with 60 L./tree sewage water in mulched soil takes the same trend in the second season only. The response of magnesium to different levels of irrigation are in agreement with **EL-Gazzar and Shehata (1982) and Moustafa 2002**

IV.I.III.3.2. Microelemets.

IV.I.III.3.2.1. Leaf iron content (ppm).

Concerning the specific and interaction effect of three water levels from two sources of water and planted in mulched and unmulched soils on iron (Fe) leaf content of four olive cvs.. showed in Table, (29).

A. Specific effect:

Trees receiving the 120L./tree irrigation water rate showed the least significant value of Fe leaf content in different olive cvs. under study. Reverse to, olive cvs. trees irrigated with 60L./tree in both seasons. However, trees irrigated with 90L./tree level of irrigation was intermediate in leaves Fe content.

As referring to source of water, olive trees irrigated with sewage water showed higher Fe content in comparison with those receiving wells water during the two growing seasons.

Olive trees in unmulched soils exhibited high values of Fe in 2000 & 2001 seasons.

Picual cv. was the most significant in Fe leaf content during the two growing seasons of study. The reverse was true for Manzanillo cv., it was the least in Fe leaf content besides, Koroneiki cv. was the least value in the second season only.

B. Interaction effect:

Irrigation of Picual olive cv. with 60L./tree sewage water and planted in unmulched soil increased significantly Fe content in leaf during the two growing seasons. In addition to Aggizi and Koroneiki had the highest values of leaf Fe content in the second season only. On the contrary, Aggizi and Manzanillo irrigated with 120L./tree wells water in mulched

Table (29): Mean response of leaf iron content (ppm) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	83.85pq	83.28qr	95.17cd	94.83de	89.37A	83.47q	83.07r	94.92a-c	94.55de	88.71A
	Koroneiki	83.71p	83.33qr	95.25c	94.73e		83.08r	82.47st	95.19a	94.77b-d	
	Picual	83.41p-r	83.08r	95.98a	95.11cd		82.21tu	81.99u	95.06ab	94.67cd	
	Manzanillo	84.58o	83.46pq	95.60b	94.69e		83.07r	82.46s	94.30e	93.97f	
90 L	Aggizi	81.03tu	80.45v	92.31g	90.19i	86.54B	81.01v	80.31w	93.17g	91.43ij	86.04B
	Koroneiki	81.18t	80.70uv	92.44g	92.10gh		80.53w	79.93x	92.39h	91.55i	
	Picual	81.71s	81.31t	93.23f	92.09gh		79.96x	79.43y	91.63i	91.21j	
	Manzanillo	81.13t	80.48v	92.40g	91.84h		80.28w	79.74x	92.36h	91.71i	
120 L	Aggizi	78.35x	77.85z	88.36m	87.79n	83.54C	78.07[	77.49\	89.44l	89.16lm	84.72C
	Koroneiki	78.75w	78.37x	89.31j	88.75kl		78.56z	77.37\	88.97mn	88.78n	
	Picual	79.09w	78.22xy	89.33j	88.87k		87.55o	87.23p	89.22lm	88.89mn	
	Manzanillo	78.20x-z	77.92yz	88.92k	88.51lm		78.05[	77.63\	89.84k	89.31l	
Specific effect of	Mulching	Unmulched 86.80A		Mulched 86.17B			Unmulched 86.76A		Mulched 86.22B		
	Water resource	Well 80.97B		Sewage 91.99A			Well 81.05B		Sewage 91.94A		
	Olive Cultivars	Aggizi 86.11C	Koroneiki 86.55B	Picual 86.79A	Manzanillo 86.48D		Aggizi 86.34B	Koroneiki 86.13C	Picual 87.42A	Manzanillo 86.08C	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

soils behave the opposite and showed the minimized values of leaf Fe content in both seasons. Moreover, Manzanillo irrigated with the same level and source of water in the unmulched soil in the first season, besides Koroneiki in mulched soils in the second season had the same response. The response of magnesium to different levels of irrigation are in agreement with. These results go in line with **Mohamed (1998), Abd El-Azeem (1999) and Moustafa 2002**

IV.I.III.3.2.2. Leaf manganese content (ppm).

The specific and interaction effect of different water levels, two sources of water and mulching on manganese (Mn) of four olive cvs. displays in Table, (30).

A. Specific effect:

It is clear, that leaf Mn content was reduced as water level was increased in both 2000 & 2001 seasons. Yet, the olive trees irrigated with sewage water was significantly better than trees irrigated with wells water in both seasons. Planting in unmulched soil enabled olive trees to have more Mn content in both seasons.

As for cultivars, Picual and Koroneiki olive trees had the extreme significant values in its Mn content in the first season only. Whileas, Koroneiki trees exhibited an increase in Mn in the second season. Aggizi and Manzanillo shown the least significant values whereas, Aggizi only takes the same trend in the second season .

B. Interaction effect:

As related to the interaction effect, leaf Mn content of Koroneiki cv. trees irrigated with 60L./tree sewage water and planted in unmulched soil surpassed other varieties under study

Table (30): Mean response of leaf manganese content (ppm) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	38.07o	37.18qr	46.09cd	45.83d	41.96A	36.27t	35.98u	46.24de	46.05e	41.74A
	Koroneiki	38.25o	37.75p	47.48a	46.16c		37.84o	37.43p	48.31a	47.21b	
	Picual	37.45q	37.31q	46.68b	46.20c		37.17q	36.72r	47.07b	46.73c	
	Manzanillo	37.28q	36.99r	46.52b	46.04cd		36.66rs	36.13tu	46.27d	45.68f	
90 L	Aggizi	35.21uv	35.08v	44.00hi	43.51j	40.00B	34.61xy	34.16z	43.43jk	43.31k	39.89B
	Koroneiki	36.28s	35.47tu	45.32ef	44.71g		36.51s	36.19t	46.10de	45.61f	
	Picual	36.21s	35.73t	45.50e	45.08f		35.98u	35.61v	44.84g	44.55h	
	Manzanillo	35.33uv	34.79w	44.08h	43.75ij		35.04w	34.70xy	44.08i	43.53j	
120 L	Aggizi	33.72z[	33.51[	41.90m	41.40n	38.26C	33.39\	33.09]	42.37m	42.13n	38.63C
	Koroneiki	34.31xy	34.09y	43.23k	42.56l		35.23w	34.80x	44.40h	44 04i	
	Picual	34.57wx	33 81z	44.49g	43.08k		34.55y	34.19z	43.56j	43.48jk	
	Manzanillo	34.36x	33.63z[	42.00m	41.53n		33.89[	33.84[	42.75l	42.29mn	
Specific effect of	Mulching	Unmulched 40.35A		Mulched 39.80B			Unmulched 40.27A		Mulched 39.90B		
	Water resource	Well 35.68B		Sewage 44.46A			Well 35.42B		Sewage 44.75A		
	Olive Cultivars	Aggizi 39.62B	Koroneiki 40.47A	Picual 40.51A	Manzanillo 39.69B		Aggizi 39.25D	Koroneiki 41.14A	Picual 40.37B	Manzanillo 36.57C	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

in its Mn content during the two growing seasons. The reverse was true for Aggizi olive cv. irrigated with wells water either mulched or unmulched and irrigated with 120L./tree wells water in the first season and mulched only in the second one was poor in Mn contnent. Moreover, leaf Mn content was reduced in Manzanillo cv. irrigated with 120L./tree wells water and mulched in the first season. These data consistent with **Mohamed (1998) and Abd El-Azeem (1999)**.

IV.I.III.3.2.3. Leaf zinc content (ppm).

Table, (31) shows the effect of different water levels, source of water and mulching on zinc (Zn) content of different olive cultivars.

A. Specific effect:

Referring to the specific effect of different water levels (60, 90,&120L./tree) on Zn content trees receiving the lower levels of water showed the highest Zn values in their leaves during the two growing seasons.

As related to source of water irrigation sewage water showed superior effect on Zn content in both growing seasons.

Concerning the mulching of the soil the leaves of plants in unmulched soils had higher values of Zn content than the mulched one during the two seasons.

Koroneiki olive cv. had the most significant value in Zn content in olive cvs during the two growing seasons. Reversely, Aggizi cv. was the least significant values in Zn content in both seasons.

Table (31): Mean response of leaf zinc content (ppm) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	26.73m	25.85o	31.64f	30.53h	29.83A	25.75q	25.36r	363.51e	33.29f	30.00A
	Koroneiki	28.75i	28.31j	33.33a	32.72c		26.93m	26.49n	34.92a	34.05c	
	Picual	28.27j	27.57k	32.93b	32.32d		26.55n	25.97p	34.57b	33.87d	
	Manzanillo	27.53k	27.28l	31.99e	31.44g		26.20o	25.71q	33.72d	33.16f	
90 L	Aggizi	21.01v	20.60w	26.47n	26.28n	24.18B	20.19z	19.52[	27.81k	27.45l	24.51B
	Koroneiki	22.33p	21.53s-u	28.41j	27.30l		21.67v	21.03x	30.17g	29.53h	
	Picual	22.00q	21.33u	27.55k	26.77m		20.89x	20.50y	29.05i	28.11j	
	Manzanillo	21.57r-t	20.91v	26.47n	26.31n		20.53y	20.09z	28.21j	27.45l	
120 L	Aggizi	16.97[	16.54\	21.33u	20.91v	19.38C	16.27^-	15.77-	22.02u	21.45w	19.19C
	Koroneiki	17.55x	17.27yz	22.17pq	21.68rs		16.85\	16.55]	22.67s	22.18tu	
	Picual	17.43xy	17.08z[	22.05q	21.39tu		16.69]	16.35^	22.21t	21.49w	
	Manzanillo	17.28yz	17.24yz	21.77r	21.48s-u		16.63]	16.15-	22.09tu	21.59vw	
Specific effect of	Mulching	Unmulched 24.73A		Mulched 24.19B			Unmulched 24.84A		Mulched 24.30B		
	Water resource	Well 22.04B		Sewage 26.89A			Well 21.03B		Sewage 28.11A		
	Olive Cultivars	Aggizi 23.74D	Koroneiki 25.11A	Picual 24.72B	Manzanillo 24.27C		Aggizi 24.03D	Koroneiki 25.25A	Picual 24.69B	Manzanillo 24.29C	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

B- Interaction effect:

Generally, the interaction effect of different factors on olive cvs. revealed that leaf of Koroneiki cv. irrigated with 60L./tree sewage water and unmulched exhibited the highest Zn value during the two growing seasons. On the contrary Aggizi olive cv. showed the least Zn in leaf content when irrigated with 120 L./tree wells water in mulched soil in both seasons and in leaf of olive trees planted in unmulched soil only in the second year. Meantime, Manzanillo cv behave just like Aggizi in mulched soil irrigated with same level of water from the same source during the second season only. The response of magnesium to different levels of irrigation are in agreement, with **(Mohamed (1998) and Abd El-Azeem (1999). Moustafa (2002)** they reported that the increase in moisture content in the soil was corresponding with the decrease of Zn leaf content.

IV.I.III.3.2.4. Leaf copper content (ppm).

The effect of different water levels, source of water and mulching on different soil cvs copper content ((Cu) during the two growing seasons exhibited in Table, (32).

A. Specific effect:

The specific effect of olive cvs irrigation with 60L./tree gave the superior value of Cu leaf content during the two growing seasons.

As for source of water, the leaves taken from olive trees irrigated with sewage water had the highest content in Cu in both seasons.

Table (32): Mean response of leaf copper content (ppm) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	28.20r	27.85s	34.09d	33.63e	31.28A	27.27u	27.18u	33.84g	33.83g	31.30A
	Koroneiki	28.95p	28.55q	35.18a	34.63c		29.23q	28.53r	36.27a	35.78b	
	Picual	28.55q	28.41q	34.58b	34.10d		28.27s	27.62t	35.17c	34.63e	
	Manzanillo	28.18r	27.89s	34.22cd	33.74e		27.77t	27.24u	34.37f	33.78g	
90 L	Aggizi	26.41w	26.30w	32.40i	31.99j	29.87B	26.31x	26.06yz	32.33k	32.10l	29.94B
	Koroneiki	27.90s	26.95u	33.70e	33.20g		27.71t	27.59t	34.83d	34.21f	
	Picual	27.31t	26.85u	33.40f	33.18g		27.29u	26.81v	33.44h	33.11i	
	Manzanillo	26.65v	26.28w	32.78h	32.56h		26.54w	26.04z	32.48k	32.13l	
120 L	Aggizi	25.28z	24.91[	30.79mn	30.20o	28.38C	25.49[\	25.39\	30.77p	30.73p	28.77C
	Koroneiki	26.07x	25.89xy	31.82jk	31.56l		26.63vw	26.30x	33.30hi	32.74j	
	Picual	25.85y	25 29z	32.73h	31.68kl		26.25xy	25.95z	31.59n	31.88m	
	Manzanillo	28.96p	24.83[	30.90m	30.76n		25.65[	25.64[	31.33o	30.69p	
Specific effect of	Mulching	Unmulched 30.07A		Mulched 29.62B			Unmulched 30.17A		Mulched 29.83B		
	Water resource	Well 26.87B		Sewage 32.82A			Well 26.87B		Sewage 33.14A		
	Olive Cultivars	Aggizi 29.34D	Koroneiki 30.34A	Picual 30.16B	Manzanillo 29.53C		Aggizi 29.28D	Koroneiki 31.09A	Picual 30.17B	Manzanillo 29.47C	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

Mulching of the soil increased significantly the Cu content of olive trees leaf in unmulched soils in comparison with mulched one during the two seasons.

Aggizi cv. was the least significant value in Cu content in both seasons. And the reverse was true, for Koroneiki olive cv. had the most significant in Cu content in olive cvs during the two growing seasons.

B. Interaction effect:

Concerning the combination of different water levels, source of water and mulching on four olive varieties, It is obvious that, Koroneiki olive cv. irrigated with 60 L./tree sewage water in unmulched soil extreme in Cu leaf content compared to other cvs. in both seasons. In the contrary, both Aggizi and Manzanillo cvs. irrigated with 120L./tree wells water in mulched soil exhibited the poor significance in values during both seasons. Moreover, Manzanillo as irrigated with the same level of water and planted in unmulched soil had the least value in the second season only. These results go in coincide with **Mohamed (1998) and Abd El-Azeem (1999)**.

IV.I.III.4. Fruit heavy metals content.

Data dealing with. heavy metals (Pb., Cd., Ni, Mn & Cu) fruit content (ppm) as affected by the irrigation with different levels (60,90 & 120L./tree) sewage and wells water, besides mulching.

IV.I.III.4.1. Fruit Lead content (ppm).

Data concerning the specific and the interaction effect of different irrigation water levels and sources besides, mulching on olive fruit lead (Pb) content are presented in Table, (33).

A. Specific effect:

Generally, the specific effect of different water levels, it is obvious that during the two growing seasons irrigation with the lowest level (60L./tree) of irrigation water accumulated the most significant value of Pb in fruits content.

However, irrigation with sewage water increased significantly the Pb fruit content in olive cvs. compared to wells water in the first and second seasons. Moreover, Pb fruit content in olive trees planted in unmulched soil was significantly increased also in both seasons.

Concerning cultivars, Aggizi cv. highly respond to the concentration of Pb in olive fruit content. Reversely, Picual cv. exhibited the least value of Pb fruit content during the 2000 & 2001season

B. Interaction effect:

With regard to the interaction of different factors under study, Aggizi cv. irrigated with 60L./tree sewage water in unmulched soil had the extreme values of Pb in fruits in both seasons. On the contrary, Aggizi irrigated with 120L./tree wells water in mulched soil had the least content of Pb in fruits in both seasons. In the second season Koroneiki irrigated with 120 wells water and mulched take the same trend. These results are in harmony with, **Dahdoh and Hassan (1997), Mohamed (1998) and Abd El-Azeem (1999)**, they reported that decreasing levels of sewage irrigation water reflected on the increase of lead accumulation in the fruits .

Table (33): Mean response of fruit lead content (ppm) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	0.300m	0.276no	0.628a	0.607b	0.370A	0.273m	0.248n	0.653a	0.629b	0.378A
	Koroneiki	0.238q-s	0.219t-v	0.533e	0.440gh		0.226o	0.215o	0.562d	0.478f	
	Picual	0.224s-u	0.218t-v	0.368j	0.350k		0.223o	0.218o	0.385i	0.363j	
	Manzanillo	0.211t-w	0.208u-w	0.564c	0.545de		0.191p-r	0.188qr	0.615b	0.588c	
90 L	Aggizi	0.229r-t	0.212t-w	0.556cd	0.448fg	0.301B	0.208op	0.188qr	0.582c	0.500e	0.306B
	Koroneiki	0.209u-w	0.188xy	0.397i	0.323l		0.195p-r	0.178r	0.408h	0.373ij	
	Picual	0.210u-w	0.188xy	0.320l	0.282n		0.198pq	0.185qr	0.337k	0.299l	
	Manzanillo	0.197wx	0.178yz	0.462f	0.426h		0.159s	0.142t	0.505e	0.444g	
120 L	Aggizi	0.131]^-	0.117-	0.398i	0.345k	0.211C	0.098u-w	0.080x	0.422h	0.382i	0.207C
	Koroneiki	0.157[\	0.142|	0.264op	0.203v-w		0.110u	0.088wx	0.299l	0.223o	
	Picual	0.168z[	0.153[\	0.249pq	0.240q-s		0.145st	0.133t	0.255n	0.246n	
	Manzanillo	0.135]^	0.118^-	0.313lm	0.246qr		0.107uv	0.092v-x	0.358j	0.279m	
Specific effect of	Mulching	Unmulched 0.311A		Mulched 0.278B			Unmulched 0.313A		Mulched 0.282B		
	Water resource	Well 0.193B		Sewage 0.396A			Well 0.170B		Sewage 0.424A		
	Olive Cultivars	Aggizi 0.354A	Koroneiki 0.276C	Picual 0.247D	Manzanillo 0.300B		Aggizi 0.355A	Koroneiki 0.280C	Picual 0.249D	Manzanillo 0.306B	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

IV.I.III.4.2. Fruit cadmium content (ppm).

Table, (34) present the specific and interaction effects of aforementioned three factors on cadmium (Cd) content in fruit of different olive cvs (Aggizi, Koroneiki, Picual and Manzanillo).

A. Specific effect:

During the 2000 & 2001 growing seasons fruits of olive cvs. showed the acute increase in Cd content as a result of irrigation with 60L./tree with sewage water irrigation as well as unmulching soil.

It is clear that, Aggizi cv. fruits contain the highest Cd value. Meanwhile, Koroneki, Picual and Manzanillo showed the least response to fruit Cd content in the first season. Although, Aggizi fruits have the highest values, Koroneiki and Manzanillo (cvs) exhibited the least Cd content in fruits during the second season.

B. Interaction effect:

According to the interaction effect, in the first season fruit Cd ($mgL.^{-1}$) content of different olive cultivars under study highly influenced by irrigation with 60L./tree sewage water either mulched or unmulched. In addition, Aggizi and Picual irrigated with 90L./tree with the same source of water and mulching, besides Manzanillo in unmulched soil and Aggizi irrigated with 120L./tree in unmulched soil behaved the same trend.

Meantime, in the second season, Aggizi and Picual irrigated with 60L./tree sewage water in mulched and unmulched soil contain the extreme levels of Cd in fruits. Moreover, Koroneiki irrigated with sewage in unmulched soil coupled with Aggizi irrigated with 90L./tree mulched and Unmulched and Picual in unmulched soil behave the same trend.

Table (34): Mean response of fruit cadmium content (ppm) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	0.015b-e	0.013c-f	0.020ab	0.020ab	0.015A	0.013d-f	0.013d-f	0.023ab	0.020a-c	0.016A
	Koroneiki	0.010e-h	0.010e-h	0.018a-c	0.018a-d		0.010e-g	0.010e-g	0.020a-c	0.018b-d	
	Picual	0.013c-f	0.010e-h	0.023a	0.020ab		0.012d-f	0.010e-g	0.025a	0.020a-c	
	Manzanillo	0.012d-g	0.011e-h	0.018a-d	0.018a-d		0.012d-f	0.010e-g	0.018b-d	0.018b-d	
90 L	Aggizi	0.013c-f	0.010e-h	0.020ab	0.018a-d	0.013AB	0.011e-g	0.010e-g	0.020a-c	0.020a-c	0.013AB
	Koroneiki	0.009e-h	0.008f-h	0.015b-e	0.015b-e		0.008f-h	0.008f-h	0.018b-d	0.015c-e	
	Picual	0.010e-h	0.008f-h	0.018a-d	0.018a-d		0.010e-g	0.008f-h	0.020a-c	0.018b-d	
	Manzanillo	0.009e-h	0.008f-h	0.018a-d	0.015b-e		0.008f-h	0.008f-h	0.018b-d	0.016c-e	
120 L	Aggizi	0.008f-h	0.006gh	0.018a-d	0.015b-e	0.010B	0.008f-h	0.005gh	0.018b-d	0.016c-e	0.010B
	Koroneiki	0.006gh	0.005h	0.013c-f	0.012d-g		0.005gh	0.003h	0.014c-e	0.013d-f	
	Picual	0.005h	0.005h	0.015b-e	0.013c-f		0.005gh	0.003h	0.016c-e	0.015c-e	
	Manzanillo	0.008f-h	0.005h	0.015b-e	0.013c-f		0.005gh	0.003h	0.015c-e	0.015c-e	
Specific effect of	Mulching	Unmulched 0.014A		Mulched 0.012B			Unmulched 0.014A		Mulched 0.012B		
	Water resource	Well 0.009B		Sewage 0.017A			Well 0.008B		Sewage 0.018A		
	Olive Cultivars	Aggizi 0.014A	Koroneiki 0.011B	Picual 0.013AB	Manzanillo 0.012B		Aggizi 0.015A	Koroneiki 0.012C	Picual 0.013AB	Manzanillo 0.012BC	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

On the other hand, the four olive cvs. under study irrigated with three levels of wells water either in mulched or unmulched soil showed the least significant values in the first season. Besides, the irrigation with 90 &120L./tree from the same source of water and growing in mulching or unmulching siol. The response of different olive cultivars fruits to sewage water cadmium content was coincide with **Mosalem (1997) and Mohamed (1998)**

IV.I.III.4.3. Fruit nickel content (ppm).

The specific and interaction effect of different levels and sources of irrigation water and soil mulching on four olive cultivars nickel (Ni) fruit content are shown in Table, (35).

A. Specific effect:

Irrigation with 60 L./tree increased significantly the Ni fruit content in four olive cvs.

Concerning the type of water, irrigation with sewage water surpassed the irrigation with wells water in Ni fruit content during the two growing seasons. Unmulching the soil also show the same trend.

As for cultivars, Aggizi and Manzanillo in the first season and Koroneiki and Picual in the second season contain the highest Ni in fruit. On the contrary, Koroneiki and Picual during the first season and Aggizi and Manzanillo during the second season showed the least Ni fruit content of the four cvs. under study.

B. Interaction effect:

As related to the interaction effect, the irrigation of four olive cvs. under study with 60L./tree sewage water in unmulched soil increased significantly Ni fruit content in both seasons.

Table (35): Mean response of fruit nickel content (ppm) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate; mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	0.080p-t	0.073p-w	0.238ab	0.213c-e	0.157A	0.080o-q	0.073q-s	0.248a	0.219b-d	0.158A
	Koroneiki	0.090n-p	0.077p-v	0.253a	0.223b-d		0.083o-q	0.075p-s	0.255a	0.228bc	
	Picual	0.090n-p	0.079p-u	0.255a	0.226bc		0.082o-q	0.078p-r	0.258a	0.232b	
	Manzanillo	0.083o-s	0.075p-v	0.244a	0.216c-e		0.080o-q	0.073q-s	0.250a	0.221b-d	
90 L	Aggizi	0.068r-x	0.059v-[	0.182g	0.137jk	0.118B	0.065q-t	0.057s-u	0.193f	0.145hi	0.122B
	Koroneiki	0.070q-x	0.063t-z	0.203ef	0.156hi		0.068q-t	0.060r-u	0.209d-f	0.168g	
	Picual	0.072p-w	0.063s-y	0.206de	0.163h		0.070q-s	0.063q-t	0.211c-e	0.172g	
	Manzanillo	0.068r-x	0.060u-[	0.187fg	0.141ij		0.065q-t	0.058s-u	0.200ef	0.151h	
120 L	Aggizi	0.044z[\]	0.033]	0.108lm	0.085n-r	0.074C	0.043u-w	0.030w	0.113k-m	0.093n-p	0.076C
	Koroneiki	0.052x-[\]	0.038\]	0.122kl	0.100m-o		0.050t-v	0.038vw	0.128i-k	0.104l-n	
	Picual	0.055w-[\	0.043[]	0.124j-l	0.102mn		0.050t-v	0.038vw	0.133ij	0.106l-n	
	Manzanillo	0.046y-[\]	0.035]	0.110lm	0.088n-q		0.044u-w	0.031w	0.116j-l	0.097m-o	
Specific effect of	Mulching	Unmulched 0.127A		Mulched 0.106B			Unmulched 0.129A		Mulched 0.109B		
	Water resource	Well 0.063B		Sewage 0.170A			Well 0.060B		Sewage 0.177A		
	Olive Cultivars	Aggizi 0.110A	Koroneiki 0.120B	Picual 0.123B	Manzanillo 0.113A		Aggizi 0.113B	Koroneiki 0.122A	Picual 0.124A	Manzanillo 0.115B	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

The reverse was true for the same olive cvs. irrigated with 120L./tree wells water exhibited the least significant values during the two seasons either mulched or unmulched except Koroneiki and Picual in unmulched siol during the second season. These results consistent with **Dahdoh and Hassan (1997) and Abd El-Azeem (1999)**

IV.I.III.4.4. Fruit manganese content (ppm).

Data dealing with the effect of irrigation with different water levels from sewage and wells water with mulching or without on the four olive cvs manganese (Mn) content are shown in Table, (36).

A. Specific effect:

Irrigating different olive cvs. with 60 L./tree irrigation level, using sewage water and unmulching soil significantly increased fruit Mn content during the two growing seasons.

Picual cv. exhibited the highest significant value of Mn in fruit content compared to the other cvs., on the contrary, Aggizi cv. contain the minimized level of Mn in fruit content. Meanwhile, the rest of olive cvs. under study showed the intermediate values of the element.

B- Interaction effect:

The interaction effect of irrigation with 60L./tree sewage water either in mulched or unmulched soil increased significantly Mn fruit content of Picual cv. during the two growing seasons. Reversely, the irrigation of Aggizi, Koroneiki and Manzanillo with120L./tree wells water either mulched or unmulched decreased significantly Mn in fruit content during the two growing seasons, besides Aggizi cv. irrigated with 90L./tree from the same source of water and mulching during the two growing seasons and 60L./tree

Table (36): Mean response of fruit manganese content (ppm) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001 season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	0.025u-z	0.025u-z	0.078j-m	0.028t-y	0.080A	0.024s-x	0.023t-x	0.085i-l	0.075k-n	0.093A
	Koroneiki	0.041q-v	0.038r-v	0118e-g	0.105gh		0.038q-t	0.037r-u	0.137de	0.131de	
	Picual	0.128d-f	0.118e-g	0.193a	0.180a		0.113fg	0.108i-h	0.213a	0.198a	
	Manzanillo	0.040r-v	0.038r-w	0.114fg	0.103gh		0.038q-t	0.037r-u	0.123ef	0.113fg	
90 L	Aggizi	0.023v-z	0.018x-z	0.059n-q	0.050o-s	0.069B	0.018u-y	0.015v-y	0.066m-o	0.056o-q	0.071B
	Koroneiki	0.035s-x	0.034s-x	0.083i-l	0.075k-n		0.035r-u	0.031r-v	0.098g-i	0.078j-n	
	Picual	0.099g-i	0.094h-j	0.162b	0.152bc		0.093h-k	0.091h-k	0.168b	0.154bc	
	Manzanillo	0.032s-x	0.028t-y	0.089h-k	0.080j-l		0.029r-w	0.025s-x	0.096g-j	0.082l-n	
120 L	Aggizi	0.010yz	0.006z	0.045p-t	0.039r-v	0.046C	0.008xy	0.003y	0.045p-r	0.043q-s	0.048C
	Koroneiki	0.018w-z	0.017x-z	0.047p-t	0.043p-u		0.013v-y	0.010xy	0.072l-o	0.063n-p	
	Picual	0.062m-p	0.040r-v	0.140cd	0.133de		0.046p-r	0.031r-v	0.143cd	0.136de	
	Manzanillo	0.012yz	0.008z	0.068l-o	0.056o-r		0.011w-y	0.006xy	0.074k-o	0.061n-p	
Specific effect of	Mulching	Unmulched		Mulched			Unmulched		Mulched		
		0.072A		0.063B			0.074A		0.067B		
	Water resource	Well		Sewage			Well		Sewage		
		0.041B		0.093A			0.037B		0.104A		
	Olive Cultivars	Aggizi	Koroneiki	Picual	Manzanillo		Aggizi	Koroneiki	Picual	Manzanillo	
		0.034C	0.054B	0.125A	0.055B		0.038C	0.062B	0.124A	0.058B	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

level in the first season only. Manganes accumulation in olive fruits was in agreement with **Abdou and El-Nennah, (1980). Dahdoh and Hassan (1997).**

IV.I.III.4.5. Fruit copper content (ppm).

Table, (37) show the specific and interaction effects of different levels of irrigation, two sources of water and mulching on fruit copper (Cu) content in different olive cvs.

A. Specific effect:

The irrigation with low level (60L./tree) from sewage water showed the highest values of Cu content in fruits in unmulched soil in both seasons.

Copper Fruit content of Koroneiki olive cv was increased significantly followed by Picual then Aggizi and later Manzanillo in descending order during both seasons.

B- Interaction effect:

Regarding to the interaction effect, Koroneiki cv. during the two growing seasons and Picual during the second season only exhibited the extremist values of Cu content in fruits when irrigated with 60L./tree sewage water either in mulched or unmulched soil. On the reverse direction, using wells water for irrigation with 120L./tree during the two growing seasons and 90L./tree in the second season only in both mulched and unmulched soil reduced significantly fruit Cu content in the four olive cvs. under study. In addition, Picual cv. showed the same minimized value when irrigated with 60L./tree wells water in mulched and unmulched in both seasons. **Dahdoh and Hassan 1997**) revealed that the irrigation with liquid sewage water increased the accumulation of Cu element in different olive cvs. fruits.

Table (37): Mean response of fruit copper content (ppm) of olive trees to specific and interaction effects of olive cultivars; water resources; irrigation rate;mulching and their combinations during both consecutive 2000 & 2001experimental seasons.

Irrigation rate (L/tree)	Cultivar	2000/ season					2001/ season				
		Water resource				Specific effect of irrigation rate	Water resource				Specific effect of irrigation rate
		Well		Sewage			Well		Sewage		
		Unmulched	Mulched	Unmulched	Mulched		Unmulched	Mulched	Unmulched	Mulched	
60 L	Aggizi	0.035k-r	0.033l-r	0.063f-h	0.060f-h	0.070A	0.028l-q	0.025m-r	0.097f	0.082fg	0.076A
	Koroneiki	0.037j-q	0.036k-q	0.170a	0.163ab		0.030l-p	0.029l-p	0.180a	0.174ab	
	Picual	0.023o-u	0.020p-u	0.155a-c	0.141cd		0.021m-s	0.020n-s	0.178a	0.168a-c	
	Manzanillo	0.031l-s	0.028m-t	0.065fg	0.058f-i		0.025m-r	0.021m-s	0.075g	0.065gh	
90 L	Aggizi	0.030l-s	0.027n-u	0.055f-j	0.048g-l	0.050B	0.022m-s	0.022m-s	0.058hi	0.052h-j	0.052B
	Koroneiki	0.033k-r	0.031l-s	0.154a-c	0.148bc		0.024m-r	0.023m-s	0.158bc	0.151cd	
	Picual	0.020p-u	0.018q-y	0.068f	0.034k-r		0.018n-s	0.015o-s	0.120e	0.040i-m	
	Manzanillo	0.019p-u	0.018q-u	0.053f-k	0.048g-m		0.018n-s	0.013p-s	0.056hi	0.049h-k	
120 L	Aggizi	0.015r-u	0.008u	0.044h-n	0.039j-p	0.034C	0.008rs	0.003s	0.045i-l	0.040i-m	0.034C
	Koroneiki	0.020p-u	0.012s-u	0.130d	0.099e		0.018n-s	0.006rs	0.138d	0.117e	
	Picual	0.015r-u	0.008u	0.028n-t	0.025n-u		0.011p-s	0.005rs	0.033k-o	0.025m-r	
	Manzanillo	0.012s-u	0.010tu	0.040i-o	0.035k-r		0.009q-s	0.008rs	0.044i-l	0.037j-n	
Specific effect of	Mulching	Unmulched 0.055A		Mulched 0.048B			Unmulched 0.059A		Mulched 0.049B		
	Water resource	Well 0.022B		Sewage 0.080A			Well 0.017B		Sewage 0.091A		
	Olive Cultivars	Aggizi 0.038C	Koroneiki 0.086A	Picual 0.046B	Manzanillo 0.035C		Aggizi 0.040C	Koroneiki 0.087A	Picual 0.054B	Manzanillo 0.035D	

values of specific or interaction effect followed by the same capital or small letters respectively are not significantly different at 5% level

IV.11. IRRIGATION OF ONE-YEAR-OLD TRANSPLANTS :

This experiment deals with investigating the response of one-year old olive transplants to the specific effect of three factors i.e., irrigation rate (0.5, 1.0 and 1.5L/ transplant), water resource (weels & sewage) and olive cultivar (Aggizi, Koroneiki, Picual and Manzanillo), as well as their combinations (interaction effect) grown in pots contained sandy loam soil .

IV.11.1. Vegetative growth

IV.11.1.1. Increasing stem length (%) and Average root length (cm).

Data obtained during both 2000 and 2001 experimental seasons in Table, (38) show the response of four olive cvs. to the different aforementioned water levels and two sources of water.

A- Specific effect

Irrigating the transplants with 1.5L./transplant of sewage water resulted in increasing stem length (%) and the average root length (cm) in different olive cvs., over the other treatments during the two seasons (2000 & 2001).

Concerning the affected varieties under study, Koroneiki cv. showed the greatest increase in stem length (%) and average root length (cm) compared with other cultivars in contrast to Aggizi cv. which was the least cultivar in increasing in stem length (%) and average root length (cm) during the two seasons (2000 & 2001).

B. Interaction effect

The interaction effect of three investigated factors, in the increase of stem length percentage and average root length (cm) was significantly clear with Koroneiki cv.. Hence, it is responded to 1.5L./ transplant. of sewage water during both seasons.

Meanwhile, Aggizi cv. has the lowest values significantly when irrigated with 00.5L./transplant of wells water during the two

Table (38) Increasing rate (%) in stem length; average root length (cm) of olive transplants in response to specific effect and interaction effect of olive cultivars (4 cvs.); water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001experimental seasons.

Irrigation rate / transplant	Cultivar	Increasing rate (%) stem length				Average root length(cm)			
		2000/season		2001/season		2000/season		2001/season	
		Water resources				water resources			
		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
0.5 L	Aggizi	7.19m	43.27h	14.57q	47.56i	30.39r	45.61i	34.72s	37.94p
	Koroneiki	23.16k	38.65i	26.05n	38.04k	36.76m	55.00f	39.28o	56.33f
	Picual	16.15l	24.99k	19.31p	34.56l	32.94p	49.67h	34.00t	50.94h
	Manzanillo	16.50l	29.66j	22.12o	36.71kl	33.93o	53.28g	35.94r	53.94g
1.0 L	Aggizi	9.97m	60.60f	18.51p	61.14g	32.28q	49.44h	36.67q	41.61lm
	Koroneiki	37.80i	68.30de	38.50k	81.75d	41.11k	61.28e	41.94l	62.44e
	Picual	22.83k	65.26e	24.25no	70.29f	36.28m	55.33f	38.00p	55.94f
	Manzanillo	28.37j	70.09d	29.69m	72.40f	39.61l	57.67e	39.94n	59.94e
1.5 L	Aggizi	13.93l	79.44c	23.45o	75.08e	35.05n	53.28g	39.94n	46.94t
	Koroneiki	53.93g	105.70a	51.39h	109.10a	44.61j	66.00a	45.61j	67.44a
	Picual	36.97i	78.28c	41.64j	90.73c	39.44l	60.55d	41.28m	61.11d
	Manzanillo	40.29hi	87.69b	47.31li	98.19b	41.61k	63.33b	42.72k	65.28b
Specific effect of water resource		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
		25.59B	62.66A	29.73B	67.96A	36.99B	55.87A	39.17B	54.99A
Specific effect of cultrivars		Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
		35.75D	54.59A	40.75C	45.43B	40.05D	57.47A	46.80C	51.07B
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		24.95C	45.40B	62.03A		29.86C	49.57B	67.10A	

Aggizi	Koroneiki	Picual	Manzanillo
41.01D	50.78A	45.70C	48.24B
0.5L	1.0 L	1.5L	
42.19C	46.62B	50.49A	

Aggizi	Koroneiki	Picual	Manzanillo
39.64D	52.18A	46.88C	49.63B
0.5 L	1.0 L	1.5 L	
42.89C	47.06B	51.29A	

Values of either specific or interaction effect followed by the same capital or small letter/s; respectively are not significantly different at 5% level.

seasons (2000 & 2001) in the increase of stem length percentage. In the same time, Aggizi cv. (in the first season) and Picual cv. (in the second season) has the lowest values significantly when irrigated with the same level and source of water and during the two seasons in the average root length (cm). The increasing in stem length (%) and Average root length (cm) of different olive transplants cvs. and their response to different water levels in olive transplants were coincide with **Robinson, (1987),,El – Said *et al.* ,(1993) and Gowda , (1998)**

IV.11.1.2. Fresh and dry weight of stem (gm).

Data concerning the specific and interaction effects of different water levels and water sources (sewage and wells water) on stem (fresh and dry weight) of the four olives cultivars are shown in Table (39).

A- Specific effect

It is obvious that, the highest values of stem, fresh and dry weights were noticed in the transplants irrigated with 1.5L./transplant of sewage water. On the other hand the transplants irrigated with 0.5L./transplant had the lowest values. Whereas, the transplants irrigated with 1.0L./transplant from both sources, gave the intermediate value during the two growing seasons.

As regard to the specific variety effect, Koroneiki cv. was the best cultivar in fresh and dry weight of stem compared with other varieties. While as, Aggizi cv. was the least cultivar in stem fresh and dry weight during the two seasons.

Table (39) Mean stem and branches fresh and dry weight (gm) of olive transplants in response to specific effect and interaction effect of olive cultivars (4 cvs.); water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001exprimental seasons.

Irrigation rate / transplant	Cultivar	Main stem and branches fresh weight (gm)				Main stem and branches dry weight (gm)			
		2000/season		2001/season		2000/season		2001/season	
		Water resources				water resources			
		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
0.5 L	Aggizi	17.63q	32.87l	18.80p	36.00j	8.31n	14.79hi	8.73p	16.25hi
	Koroneiki	19.82op	35.97h	21.06mo	40.05g	9.01m	15.83g	10.00o	17.63g
	Picual	18.93p	33.46kl	19.87op	36.90ij	9.26lm	15.00h	9.50o	16.80h
	Manzanillo	20.17o	34.87i	21.53n	36.20j	9.60l	15.87g	10.00o	15.17j-l
1.0 L	Aggizi	25.20n	41.73f	25.63m	45.90f	11.27k	17.59f	11.17n	19.33f
	Koroneiki	28.32m	46.73d	29.57k	51.40d	12.59j	19.13d	12.90m	21.19d
	Picual	24.53n	43.67e	27.10l	48.90e	11.27k	18.18e	12.20m	20.37e
	Manzanillo	24.60n	45.95d	28.57k	50.43d	11.06k	18.87d	12.60m	21.30d
1.5 L	Aggizi	34.73ij	56.17c	35.97j	62.00c	15.05h	22.11c	14.93kl	24.48c
	Koroneiki	37.59g	62.87a	38.23hi	69.00a	15.82g	24.90a	15.51jk	26.54a
	Picual	33.83j-l	59.63b	38.77gh	65.46b	14.35i	23.60b	15.77ij	25.47b
	Manzanillo	34.40j-k	62.10a	36.33j	67.63a	14.55hi	24.89a	14.65l	26.34a
Specific effect of water resource		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
		26.65B	46.34A	28.45B	50.82A	11.84B	19.23A	12.33B	20.91A
Specific effect of cultivars		Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
		34.72D	38.55A	35.68C	37.01B	37.38D	41.55A	39.50C	40.12B	14.85D	16.21A	15.28C	15.81B	15.82C	17.30A	16.68B	16.68B
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		26.72C	35.09B	47.67A		28.80C	38.44B	51.67A		12.21C	15.00B	19.41A		13.01C	16.38B	20.46A	

Values of either specific or interaction effect followed by the same capital or small letter/s; respectively are not significantly different at 5% level.

B- Interaction effect

Concerning the interaction of three specific factors, Koroneki cv. was the superior in stem, fresh and dry weight when irrigated with 1.5L./transplant sewage water in both seasons. The reverse was true for the Aggizi olive cv. irrigated with wells water (0.5L./transplant) .These results were in agreements with **El-Said *et al* (1993) , Abo-Talb *et al* (1998) and Laz *et al* , (1999)** .

IV.11.1.3. Average number and length of branches.

Data of the average number and length of branches in the four olive cultivars as affected by the aforementioned different water levels and two sources of water (wells and sewage) are presented in Table, (40).

A- Specific effect

Increasing the water irrigation level for the transplants of olive cvs. gave the highest average branches number and length during two seasons.

In addition, irrigation of olive transplants, under study with sewage water significantly surpassed using wells water during 2000 & 2001 seasons.

In regards to the cultivars, Koroneiki cv. was the best cultivar in the average length and number of branches. While, Aggizi cv. was the least in both seasons.

Table (40) Average length and number of branches of olive transplants in response to specific effect and interaction effect of olive cultivars (4 cvs.); water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001 experimental seasons.

Irrigation rate / transplant	Cultivar	Average length of branches				Average number of branches			
		2000/season		2001/season		2000/season		2001/season	
		Water resources				Water resources			
		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
0.5 L	Agezzi	6.33o	9.17m	6.83p	10.83mn	1.89m	3.56j	3.00m	4.44k
	Koroneiki	10.50l	15.67cd	11.67k	16.67d	4.11i	8.00d	5.44i	9.45d
	Picual	8.17n	12.50h	9.17o	13.17l	2.11m	4.00i	3.33m	5.00j
	Manzanillo	9.50m	14.67e	10.67n	15.50f	3.00k	5.67g	4.56jk	6.78g
1.0 L	Agezzi	8.50n	11.00ik	8.83o	12.17j	2.67l	4.78h	3.78l	5.55i
	Koroneiki	14.00fg	17.00b	13.50i	17.33c	6.11f	10.56c	8.33f	12.22b
	Picual	11.33j	14.00fg	11.50kl	14.00h	3.11k	5.67g	4.89jk	6.33gh
	Manzanillo	12.50h	16.00c	13.17l	16.67d	4.22i	8.00d	6.22h	9.11de
1.5 L	Agezzi	10.83kl	11.83i	11.17lm	14.50g	3.56j	7.22e	6.11h	8.11f
	Koroneiki	14.33ef	18.50a	15.33f	19.83a	7.78d	14.22a	11.56c	15.45a
	Picual	12.83h	15.50d	13.50i	16.00e	4.11i	8.00d	6.55gh	9.34de
	Manzanillo	13.67g	17.33b	14.67g	18.33b	5.56g	11.11b	8.89e	12.45b
Specific effect of water resource		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
		11.04B	14.43A	11.67B	15.42A	4.02B	7.56A	6.06B	8.69A
Specific effect of cultivars		Agezzi	Koroneiki	Picual	Manzanillo	Agezzi	Koroneiki	Picual	Manzanillo	Agezzi	Koroneiki	Picual	Manzanillo
		9.61D	15.00A	12.39C	13.94B	10.72D	15.72A	12.89C	14.83B	3.94D	8.46A	4.50C	6.26B	5.17D	10.41A	5.91C	8.00B
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		10.81C	13.01B	14.35A		11.81C	13.40B	15.42A		4.04C	5.64B	7.71A		5.25C	7.06B	9.81A	

Values of either specific or interaction effect followed by the same capital or small letter/s; respectively are not significantly different at 5% level.

B- Interaction effect

As a matter of fact, average number and length of branches in Koroneiki cv influenced significantly by the higher level (1.5L./transplant) of irrigation water, with sewage water. The reverse was true, for Aggizi cv. irrigated with 0.5L./transplant wells water in both seasons (2000&2001).These results go in line with **Abd El-Samed (1995), Gowda (1998) and Hassan (1998).**

IV.11.1.4. Increasing stem diameter (%) and leaves dry weight in (gm).

Data in Table (41) indicate the increasing rate of stem diameter and leaves dry weight of four olive cultivars as affected by the water levels, source of irrigation during the two seasons of study (2000 &2001).

A- Specific effect

It is clear that, the irrigation level of 1.5L/transplant gave the highest increasing rate in stem diameter percentage and leaves dry weight of olive cultivars compared to the 0.5L./transplant and 1.0L./transplant levels during the two seasons of study.

The effect of sewage water was significantly higher in its effect on increasing stem diameter percentage and leaves dry weight (gm) than the wells water during both seasons.

Concerning the cultivars under study as affected by the aforementioned specific factors, data reveal that those cultivars can be arranged in descending order follows, Koronieki, Manzanillo, Picual and Aggizi i.e. Koronieki was the superior cv. in increasing stem diameter percentage and leaves dry weight in both seasons.

Table (41) Increasing rate (%) of stem diameter and leaves dry weight (gm) of olive transplants in response to specific effect and interaction effect of olive cultivars (4 cvs.); water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001exprimental seasons.

Irrigation rate / transplant	Cultivar	Increasing rate (%) stem diameter				Leaves dry weight (gm)			
		2000/season		2001/season		2000/season		2001/season	
		Water resources				water resources			
		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
0.5 L	Aggizi	21.26n	27.00m	21.48m	32.28l	3.71r	6.93jk	5.00q	8.92j
	Koroneiki	36.76k	44.98hi	43.01i-k	52.80fg	4.63o	7.37h	6.16o	10.35g
	Picual	28.77m	32.83l	26.37m	41.39jk	4.33p	7.12ij	5.63p	9.32i
	Manzanillo	33.55kl	47.92gh	31.65l	60.56c-e	4.11q	7.28hi	5.04q	9.76h
1.0 L	Aggizi	29.07m	41.09j	33.95l	43.81i-k	5.31n	8.77f	6.84n	11.25f
	Koroneiki	41.27j	65.24b	47.54i	74.89b	6.47l	9.47d	8.54k	12.51d
	Picual	36.91k	42.58ij	39.19k	47.46hi	6.20m	8.72f	7.60n	11.41f
	Manzanillo	45.40g-l	56.13e	42.64i-k	64.49c	6.80k	9.23e	8.04l	12.00e
1.5 L	Aggizi	36.82k	61.81c	51.11gh	62.38cd	7.39h	10.85c	9.50hi	14.20c
	Koroneiki	52.08f	85.48a	62.03c-e	86.82a	8.73f	11.64a	11.14f	15.31a
	Picual	45.08hi	57.94de	45.52ij	58.97de	8.20g	10.95c	9.63hi	14.25c
	Manzanillo	48.58g	60.70cd	56.85ef	88.99a	7.37h	11.33b	10.51g	14.83b
Specific effect of water resource		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
		37.97B	51.97A	41.78B	59.57A	6.11B	9.14A	7.80B	12.01A
Specific effect of cultivars		Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
		36.17D	54.30A	40.69C	48.72B	40.83D	61.18A	43.15C	57.53B
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		34.14C	44.71B	56.06A		38.69C	49.25B	64.08A	

Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
7.16D	8.05A	7.59C	7.69B	9.29D	10.67A	9.64C	10.03B
0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
5.69C	7.62B	9.56A		7.52C	9.77B	12.42A	

Values of either specific or interaction effect followed by the same capital or small letter/s; respectively are not significantly different at 5% level.

B- Interaction effect

According to the three investigated factors, interaction effect in the increase of stem diameter percentage and leaves dry weight was increased significantly with Koroneiki cv.. Hence, it is responded to 1.5L./transplant of sewage water during both seasons. Meanwhile, Aggizi cv. has the lowest values significantly as irrigated with 0.5L/transplant wells water during both seasons. The respons of increasing stem diameter (%) to different water levels of irrigation, the four olive trees under study was in agreements with **Draz ,(1986), Gowda ,(1998) and Magliulo *et al* (1999).** On reverse direction the leaves dry weight (gm) of different olive cultivars and their response to different water levels in 0live transplants were coincide with **El-Said *et al* , (1993) , Abo Talb ,(1998) and Laz *et al* , (1999) .**

IV.11.1.5. Leaves Average number and fresh weight (gm).

The specific and interaction response of olive cultivars average number of leaves and fresh weight (gm) to different water levels and source of water (wells and sewage) presented in Table (42)

A- Specific effect

Generally, indicate that irrigation of olive transplants with 1.5L./transplant surpassed other treatments in number of leaves and fresh weight (gm) during both seasons.

As for water source, irrigation with sewage water exceeded the wells water in number of leaves and fresh weight (gm) during two seasons (2000 & 2001).

Table (42) Average number of leaves and leaves fresh weight (gm) of olive transplants in response to specific effect and interaction effect of olive cultivars (4 cvs.); water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001exprimental seasons.

Irrigation rate / transplant	Cultivar	Average number of leaves / plant						Leaves fresh weight (gm)					
		2000 season			2001season			2000 season			2001season		
		Water resources			Water resources			water resources			water resources		
		Well	Sewage		Well	Sewage		Well	Sewage		Well	Sewage	
0.5 L	Aggezi	113.80lq	204.40hm		149.00s	219.00fp		11.90tr	25.78m		16.00v	33.69m	
	Koroneiki	156.60o	266.20g		218.60p	297.70j		15.05r	27.81j		19.99s	38.67i	
	Picual	133.90p	229.40j		182.00r	250.10n		14.00rs	26.60l		18.31t	35.18k	
	Manzanillo	150.60o	255.00h		206.90q	277.00lm		14.31s	27.07k		16.95u	34.60l	
1.0 L	Aggezi	134.80p	239.30i		178.90r	281.30l		17.95q	32.89g		23.34r	42.85h	
	Koroneiki	216.30k	364.30d		271.00m	413.40d		21.70m	36.60e		28.61o	49.08e	
	Picual	169.90n	277.10f		214.80p	321.10i		20.04p	33.10g		24.97q	44.00g	
	Manzanillo	197.00m	331.00e		247.10no	375.30f		21.00o	35.13f		27.85p	46.93f	
1.5 L	Aggezi	158.30o	328.10e		241.30o	397.60e		25.85m	41.01d		33.85m	53.15d	
	Koroneiki	277.10f	488.40a		367.30g	552.30a		29.90h	45.60a		38.76i	60.70a	
	Picual	206.90l	380.10c		290.70k	463.60c		27.93j	42.40c		32.97n	55.38c	
	Manzanillo	248.20h	455.60b		338.30h	511.80b		28.70i	43.50b		36.90j	56.91b	
Specific effect of water resource		Well	Sewage		Well	Sewage		Well	Sewage		Well	Sewage	
		180.28B	318.09A		242.16B	363.35A		20.69B	34.74A		26.54B	45.03A	
Specific effect of cultivars		Aggezi	Koroneiki	Picual	Manzanillo	Aggezi	Koroneiki	Picual	Manzanillo	Aggezi	Koroneiki	Picual	Manzanillo
		190.46D	294.83A	212.8C	272.56B	214.5D	353.39A	287.04C	326.07B	25.90D	29.34A	27.35C	28.28B	33.81D	39.30A	35.13C	39.69B
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		188.48C	241.22B	317.87A		225.03C	287.87B	395.36A		20.32C	27.23B	35.61A		26.67C	35.96B	46.08A	

Values of either specific or interaction effect followed by the same capital or small letter/s, respectively are not significantly different at 5% level.

According to the cultivars, Koronieki cv. was exhibited the highest number of leaves and fresh weight (gm) values in both seasons followed by Manzanillo, Picual and Aggizi in descending order in both seasons.

B- Interaction effect

As for number of leaves and fresh weight (gm) during the two seasons (2000&2001) Koroneiki olive cv. irrigated with 1.5L./transplant sewage water had the superior values in comparison with 0.5L./transplant and 1.0L./transplant. On the other hand, Aggizi cv. irrigated with 0.5L./transplant wells water showed the least values during 2000 and 2001 seasons. These results were in agreements with **Abd El-Rahman and El-Sharkowi (1974) and El-Sharkowi and El-Monayari (1976) , El-Said *et al*, (1993) ,Gowda (1998) ,Hassan (1998) and Laz *et al*, (1998) .**

IV.11.1.6. Branches and root moisture content (%)

As related to specific effect of water levels and source on branches and root moisture content percentage of olive cultivars are shown at Table (43).

A- Specific effect

It is cleared that, as water level increased branches and root moisture content percentage surpassed significantly in different olive cultivars during the two growing seasons. The 1.5L./transplant level of water gave the best values in branches and root moisture content percentage.

As for source of water, irrigation with sewage water increased significantly branches and root moisture content percentage in both seasons.

Table (43)Branches and root moisture content (%) of olive transplants in response to specific effect and interaction effect of olive cultivars (4 cvs.); water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001 exprimental seasons.

Irrigation rate / transplant	Cultivar	branches moisture content (%)				Root moisture content (%)			
		2000 season		2001/season		2000 season		2001/season	
		Water resources				water resources			
		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
0.5 L	Aggizi	52.87j	55.00g-i	53.58j	54.86hi	64.27j	68.81fg	66.36g-i	65.56hi
	Koroneiki	54.54hi	55.99ef	52.51k	55.97fg	66.73h	70.19de	66.50f-h	66.29hi
	Picual	51.06k	55.17f-h	52.18k	54.47ij	62.50k	66.70h	64.11j	65.27i
	Manzanillo	52.41j	54.49hi	53.56j	58.08c	65.69i	68.29g	65.75hi	66.51f-h
1.0 L	Aggizi	55.29f-h	57.84d	56.45f	57.88c	66.54hi	69.29ef	69.80a	67.47d-f
	Koroneiki	55.53fg	59.06bc	56.37f	58.78c-e	68.35g	70.55b-d	67.41e-g	68.05c-e
	Picual	54.08i	58.37cd	54.09g-i	58.35de	65.69i	66.73h	62.67k	66.44f-h
	Manzanillo	55.06f-h	58.94c	55.89f-h	57.76c	66.67h	70.42cd	66.28hi	67.50d-f
1.5 L	Aggizi	56.67e	60.63a	58.49de	60.51ab	69.46ef	71.11a-d	68.27c-e	69.63ab
	Koroneiki	57.92d	60.39a	59.45cd	61.53a	71.48ab	71.19a-c	68.57cd	69.47a
	Picual	57.59d	60.42a	59.33cd	61.09a	67.98g	61.08l	64.13j	68.18c-e
	Manzanillo	57.70d	59.92b	59.67bc	61.06a	68.33g	71.62a	68.00c-e	68.69bc
Specific effect of water resource		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
		55.06B	58.02A	56.04B	58.36A	66.97B	68.83A	66.49B	67.44A
Specific effect of cultivars		Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
		56.38B	57.42A	56.12B	56.42B	56.96B	57.14A	56.73B	57.67A
		Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
		68.25B	69.75A	65.11C	68.50B	67.85A	67.76A	65.13C	67.12B
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		53.94C	56.77B	58.91A		54.40C	57.06B	60.14A	
		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		66.65C	68.03B	69.03A		65.79C	66.95B	68.15A	

Values of either specific or interaction effect followed by the same capital or small letter/s, respectively are not significantly different at 5% level.

As for cultivars, Koroneiki transplants exhibited the highest moisture content (%) of branches values in both seasons besides, Manzanilla cv. in the second season only. Reversely, Aggizi, Picual and Manzanello were the least values in the first season. However, Aggizi and Picual cv. was the least values of branches moisture content percentage in the second season (2001).

Concerning root moisture content percentage Koroneiki cv. indicated the highest values in both seasons, in addition, Aggizi take the same trend in the second season. However, Picual cv. gave the least values in both seasons.

B- Interaction effect

As for branches moisture content (%) during the first season (2000) Aggizi, Koroneiki and Picual cv.. irrigated with 1.5L./transplant sewage water had the superior values. Meantime, the irrigation of the four olive cvs. under study with 1.5L./transplant sewage water showed the highest significant values in comparison with the same cultivars irrigated with other levels of water in the second season. On the other hand, Aggizi and Manzanillo cvs. gave the least values as irrigated with 0.5L./transplant wells water in the first season. However, the second season (2001) Koroneiki and Picual cv. showed also the least values as irrigated with 0.5L./transplant wells water.

Concerning root moisture content percentage Manzanillo olive cv. irrigated with 1.5L./transplant sewage water gave the highest significant values in the first season. Meantime, the second season (2001) Aggizi and Koroneiki surpassed other varieties as irrigated with 1.5L./transplant sewage water.

In the contrary, Picual when irrigated with 0.5L./ transplant well water had the lowest significant values of root moisture content in both seasons (2000 & 2001).

IV. 11.1.7. Root fresh and dry weight (gm)

Data in Table (44) indicated to root fresh and dry weight (gm) of four olive cultivars as affected by the water levels and source of irrigation during the two seasons.

A- Specific effect:

It is obvious that, the highest root fresh and dry weight (gm) were noticed on the transplants irrigated with 1.5L./transplant during the two seasons. Moreover, the sewage water surpassed significantly the wells water in the root fresh and dry weight (gm) in both season.

As for Koroneiki cv. in first season and Manzanilla cv. in the second one were exhibited the highest root fresh weight (gm) values. However, root fresh weight (gm) Picual was the least values in the first season and Aggizi, Picual and Koroneiki cvs. in the second season .

Concerning root dry weight (gm) Picual cv. showed the highest values during two seasons (2000&2001) and Aggizi and Koroneiki cvs. gave the least values during both seasons (2000&2001) .

B- Interaction effect

Concerning the interaction of three specific factors, Aggizi and Manzanillo cv. was surpassed in root fresh weight (gm) when irrigated with 1.5L./transplant sewage water in the first season. However, in the second season (2001) Koroneiki and Picual cv. was the highest values in root fresh weight (gm) when irrigated with 1.5L./transplant sewage water.

Reversely Aggizi cv. (in the first season), Aggizi, Koroneiki, Picual and Manzanillo cv. (in the second season) when irrigated with 0.5L wells water showed the minimized values.

Table (44) Root fresh and dry weight (gm) of olive transplants in response to specific effect and interaction effect of olive cultivars (4 cvs.); water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001experimental seasons.

Irrigation rate / transplant	Cultivar	Root fresh weight (gm)				Root dry weight (gm)			
		2000/season		2001/season		2000/season		2001/season	
		Water resources				water resources			
		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
0.5 L	Aggizi	16.70n	30.67g	19.03k	30.20g	5.97n	9.57h	6.40n	10.40i
	Koroneiki	18.03lm	30.30g	19.60k	30.36g	6.00n	9.03i	6.57n	10.23ij
	Picual	17.60m	29.63hi	19.50k	30.90g	6.60l	9.87g	7.00m	10.73h
	Manzanillo	18.27l	30.20gh	19.25k	32.15f	6.27m	9.57h	6.59n	10.77h
1.0 L	Aggizi	22.62k	37.23d	26.93h	38.83c	7.57k	11.43e	8.13l	12.63f
	Koroneiki	23.80j	38.60c	25.17i	39.33de	7.53k	11.37e	8.20l	12.57f
	Picual	23.70j	35.97e	24.11j	40.03cd	8.13j	11.97d	9.00k	13.43d
	Manzanillo	23.00k	38.43c	24.50ij	40.31c	7.67k	11.37e	8.26l	13.10e
1.5 L	Aggizi	29.47i	48.80b	31.83f	51.70b	9.00i	14.10c	10.10j	15.70c
	Koroneiki	31.67f	50.57a	32.13f	52.44ab	9.03i	14.57b	10.10j	15.87c
	Picual	31.87f	38.47c	30.70g	52.90a	10.20f	14.97a	11.00g	16.83a
	Manzanillo	30.10gh	50.73a	32.10f	52.80a	9.53h	14.40b	10.27ij	16.53b
Specific effect of water resource		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
		23.90B	38.30A	25.40B	41.00A	7.79B	11.85A	8.47B	13.23A
Specific effect of cultrivars		Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
		30.91C	32.16A	29.54D	31.79B	33.09B	33.17B	33.02B	33.52A
		Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
		9.61C	9.59C	10.29A	9.80B	10.56C	10.59C	11.33A	10.92B
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		23.93C	30.42B	38.96A		25.12C	32.40B	42.08A	
		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		7.86C	9.63B	11.98A		8.59C	10.67B	13.30A	

Values of either specific or interaction effect followed by the same capital or small letter/s; respectively are not significantly different at 5% level.

Concerning root dry weight (gm), Picual olive cv. in both seasons (2000 & 2001) irrigated with 1.5L./transplant sewage water gave the highest significant values. In the contrary Aggizi and Koroneiki cv. when irrigated with 0.5L./transplant wells water had the lowest significance in the first season. Whereas, Aggizi, Koroneiki, Picual and Manganillo olive cv. irrigated with 0.5L./transplant wells water showed the minimized values in the second season. .The root and dry weight (gm) of different olive cultivars and their response to different water levels in olive transplants were coincide with **El-Said *et al* ,(1993) , Abo-Taleb *et al*, and Laz *et al*, (1999).**

II.11.1.8. Leaf moisture content (%)

The specific and interaction effect of three water levels (0.5, 1.0 and 1.5L./transplant); water sources (sewage and wells) on leaf moisture content (%) in olive cvs. showed in Table (45).

A- Specific effect

Data in Table (45) obviously indicate that the moisture (%) of different leaves olive cvs. under study increased significantly with raising the irrigation water level .

As referring to source of water, olive trees irrigated with sewage water was superior in leaf moisture content (%) in both season.

Concerning the olive cvs. manzanillo olive cv. has the highest values of leaf moisture content (%) reversely, Aggizi, Koroneiki, Picual and Manzanillo cvs. has no significant values of leaf moisture content (%) in the second season.

Table (45) Leaf moisture content (%) of olive transplants in response to specific effect and interaction effect of olive cultivars (4cvs.); water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001 experimental seasons.

Irrigation rate / transplant	Cultivar	2000 season		Specific effect of irrigation rate	2001 season		Specific effect of irrigation rate
		Water resource			Water resource		
		Well	Sewage		Well	Sewage	
0.5 L	Aggizi	68.80f	73.11c	71.41B	68.75g	73.53ab	71.19C
	Koroneiki	69.21f	73.51a-c		69.21fg	73.23b	
	Picual	69.04f	73.22c		69.23fg	73.52ab	
	Manzanillo	71.28d	73.11c		70.26d-f	71.79c	
1.0 L	Aggizi	70.42de	73.34bc	71.46B	70.69c-e	73.75ab	72.29B
	Koroneiki	70.19e	73.70a-c		70.17d-f	74.51ab	
	Picual	69.07f	73.65a-c		69.56e-g	74.08ab	
	Manzanillo	67.61g	73.72a-c		71.13cd	74.43ab	
1.5 L	Aggizi	71.40d	73.54a-c	72.91A	71.94c	73.28b	72.73A
	Koroneiki	70.79de	74.46a		71.26cd	74.78a	
	Picual	70.64de	74.17a-c		70.80c-e	74.26ab	
	Manzanillo	74.33ab	73.94a-c		71.53cd	73.95ab	
Specific effect of water resource		Well	Sewage		Well	Sewage	
		70.23B	73.63A		70.38B	73.76A	
Specific effect of cultivars		Aggizi	Koroneiki	Picual	Manzanillo		
		71.77B	71.98AB	71.63B	72.33A		
		Aggizi	Koroneiki	Picual	Manzanillo		
		71.99A	72.19A	71.91A	72.18A		

values of either specific or interaciton effect followed by the same capital or small letters ; respectively are not significantly different at 5% level

B- Interaction effect

According to the interaction effect in the first season leaf moisture content (%) of Koroneiki and Picual cv.) highly influenced by irrigation with 1.5L./transplant sewage water. Moreover Manzanillo irrigated with 1.5L./transplant either sewage or wells coupled with Koroneiki, Picual and Manzanillo irrigated with 1.0L./transplant sewage water gave the same trend.

Meantime, in the second season, Koroneiki, Picual and Manzanillo irrigated with 1.5L./transplant sewage water contain the extreme leaf moisture (%). Moreover, different olive cultivars under study irrigated with 1.0L./transplant sewage water coupled with Aggizi and Picual irrigated with 0.5L./transplant sewage water behave in the same trend.

The reverse was true for Manzanillo cv. irrigated with 1.0L./transplant wells water exhibited the least significant values in the first season. Meantime in the second season Picual cv. irrigated with 1.0L./transplant wells water contain the least levels of leaf moisture (%). Moreover, Aggizi, Koroneiki and Picual irrigated with 0.5L./transplant wells water gave the same values.

IV.11.11. Chemical constituent

The specific effect of different water levels and sources of water on chemical constituents of different olive cultivars referring to photosynthetic pigments, macro and micro elements in the leaves.

IV.11.11.1. Leaf photosynthetic pigments

Chlorophyll A, B (%) values presented in Tables (46) show the effect of water levels and sources of water on different olive cultivars.

A- Specific effect

Irrigation with 1.5L./transplant from the two water sources showed the highest chlorophyll A and B values in olive cultivars during the two seasons, yet sewage water had better effect on chlorophyll A and B in both seasons.

As for cultivars, chlorophyll, A gave superior values in Manzanillo cv. but, in Picual cv. chlorophyll A, was the least values in the first season. On the second season, Aggizi and Koroneiki exhibited the highest values of chlorophyll A, but Picual cv. was the least in chlorophyll A, content.

Whileas, chlorophyll B, in Koroneiki cv. surpassed in both seasons. Moreover, Manzanillo cv. in the first season was the highest values. However, Picual cv. recorded the reduced values of chlorophyll B, in the both seasons Moreover, Aggizi cv. in the second season.

B. Interaction effect.

As for chlorophyll (A) in the interaction effect Manzanillo cv. irrigated with 1.5L./transplant sewage water showed the highest values in the first season. Also Koroneiki and Manzanillo cvs. irrigated with 1.5L./transplant sewage water in the second season gave the same trend

On the other hand Picual cv. irrigated with 0.5L./transplant wells water respectively contains the least values in the first season. Moreover, Aggizi and Koroneiki cvs. irrigated with 0.5L./transplant wells water was the least significant values in the second season.

Table (46) Leaf chlorophyll (A) and (B) content (%) of olive transplants in response to specific effect and interaction effect of olive cultivars (4 cvs.) ; water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001 experimental seasons .

Irrigation rate / transplant	Cultivar	Leaf chlorophyll (A) content (%)						Leaf chlorophyll (B)content (%)					
		2000 season			2001season			2000 season			2001season		
		Water resources						water resources					
		Well	Sewage		Well	Sewage		Well	Sewage		Well	Sewage	
0.5 L	Aggezi	0.665l	0.849i		0.729l	0.907f		0.335l	0.354k		0.368lm	0.374kl	
	Koroneiki	0.643m	0.955de		0.744l	0.966d		0.320lm	0.393e-g		0.377jk	0.515de	
	Picual	0.560n	0.833i		0.677m	0.867g		0.180n	0.398e-g		0.300o	0.530c-e	
	Manzanillo	0.515o	0.961g		0.584n	0.906f		0.313m	0.391e-h		0.335n	0.508ef	
1.0 L	Aggezi	0.799j	0.960d		0.840h	0.968d		0.357jk	0.389g-i		0.474g	0.424i	
	Koroneiki	0.743k	0.970c		0.794j	0.984b		0.428b	0.408c-e		0.393j	0.546b-c	
	Picual	0.741k	0.990f		0.763k	0.956d		0.322lm	0.404d-f		0.320n	0.530b-d	
	Manzanillo	0.866h	0.954de		0.881g	0.960d		0.422i-d	0.404ef		0.429i	0.518c-e	
1.5 L	Aggezi	0.888g	1.032b		0.926e	1.061ab		0.367i-k	0.388f-h		0.496f	0.447h	
	Koroneiki	0.844i	1.021b		0.872g	1.076a		0.424bc	0.425bc		0.418i	0.545ab	
	Picual	0.805j	1.035b		0.821i	1.047b		0.373h-j	0.428b		0.345m	0.550a	
	Manzanillo	0.946e	1.062a		0.967d	1.074a		0.464a	0.427b		0.435hi	0.522c-e	
Specific effect of water resource		Well	Sewage		Well	Sewage		Well	Sewage		Well	Sewage	
		0.750B	0.958A		0.890B	0.984A		0.360B	0.416A		0.389B	0.499A	
Specific effect of cultivars		Aggezi	Koroneiki	Picual	Manzanillo	Aggezi	Koroneiki	Picual	Manzanillo	Aggezi	Koroneiki	Picual	Manzanillo
		0.862B	0.864B	0.817C	0.873A	0.905A	0.912A	0.854C	0.895B	0.363B	0.400A	0.353C	0.403A	0.429C	0.464A	0.428C	0.456B
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L		0.51 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		0.471C	0.894B	0.952A		0.797C	0.897B	0.980A		0.336C	0.391B	0.412A		0.410C	0.453B	0.470A	

Values of either specific or interaction effect followed by the same capital or small letter/s, respectively are not significantly different at 5% level.

Chlorophyll B, Manzanillo cv. gave the highest values as irrigated with 1.5L./transplant wells water in the first season However, Koroneiki and Picual cvs. irrigated with 1.5L./transplant sewage water scored the highest significant values in the second season. Meanwhile, Picual cv. irrigated with 0.5L./transplant, wells water exhibited the least values during both season. These results are in harmony with **Abd El-Samed 1995); Hassan (1998) and Laz *et al.*, 1999).**

IV.11.11.2. Leaf carotene content (%).

Carotene (%) presented in Table (47) show the effect of water levels (0.5, 1.0 and 1.5L./transplant) and sources of water (sewage and wells) on different olive cultivars.

A- Specific effect

Transplants irrigated with the high level of water gave the highest the leaf carotene (%) during both seasons though the sewage water had better effect than the wells' water during the two seasons.

As for cultivars, Manzanillo cv. gave the highest values in the first season in carotene content. Meantime, Aggizi had the highest values during second season. The reverse was true for Picual cv. performed the least values during both seasons.

B- Interaction effect

As for carotene, during the first season Aggizi, Koroneiki and Manzanillo irrigated with 1.5L./transplant sewage water contain the superior values. Whereas, in the second season Aggizi irrigated with 1.5L./transplant sewage water surpassed other cvs. On the contrary Picual cv. irrigated with 0.5L./transplant wells water showed the least significance in the first season. Besides Manzanillo cv, irrigated with 0.5L./transplant wells water gave the same significance. These results are in harmony with **Abd El-Samed (1995); Hassan (1998) and Laz *et al.*, 1999).**

Table (47) Leaf caroten content (%) of olive transplants in response to specific effect and interaction effect of olive cultivars (4cvs.); water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001 experimental seasons.

Irrigation rate / transplant	Cultivar	2000 seaon		Specific effect of irrigation rate	2001 season		Specific effect of irrigation rate
		Water resource			Water resource		
		Well	Sewage		Well	Sewage	
0.5 L	Aggizi	0.247ij	0.292ef	0.247C	0.267k	0.336ef	0.284C
	Koroneiki	0.203kl	0.352bc		0.276jk	0.350e	
	Picual	0.151n	0.247ij		0.242l	0.299hi	
	Manzanillo	0.174m	0.313d		0.192m	0.307g-i	
1.0 L	Aggizi	0.250ij	0.304de	0.281B	0.322fg	0.409c	0.336B
	Koroneiki	0.236j	0.367ab		0.312gh	0.390d	
	Picual	0.188lm	0.276fg		0.291ij	0.325fg	
	Manzanillo	0.289ef	0.336c		0.293ij	0.344e	
1.5 L	Aggizi	0.255hi	0.364ab	0.323A	0.344e	0.468a	0.378A
	Koroneiki	0.269gh	0.382a		0.339ef	0.434b	
	Picual	0.216k	0.353bc		0.326fg	0.352e	
	Manzanillo	0.381a	0.369ab		0.377d	0.384d	

Specific effect of water resource	Well	Sewage	Well	Sewage
	0.238B	0.330A	0.298B	0.367A

Specific effect of cultivars	Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
	0.285C	0.301B	0.238D	0.310A	0.357A	0.350B	0.305D	0.316C

values of either specific or interaciton effect followed by the same capital or small letters ; respectively are not significantly different at 5% level

IV.11.11.2. Macroelements

Macroelements (%) including: N, P, K, Ca and Mg in different olive cvs. as affected by three water levels (0.5, 1.0 and 1.5L./transplant); and water sources (sewage and wells)

IV.11.11.2.1. Leaf nitrogen content (%).

The specific and interaction effect of three water levels (0.5, 1.0 and 1.5L./transplant); and water sources (sewage and wells) on nitrogen content (%) in olive cvs. are presented in Table, (48).

A- Specific effect

Generally, trees irrigated with 1.5L./transplant had the least significant value of leaf N content regardless of olive cvs.. In contrast to, irrigation with 0.5L./transplant both seasons. However, transplants irrigated with 1.0L./transplant level of irrigation was intermediate in N content As for the source of water, irrigation with sewage water had better effect

Whileas, leaf N in Koroneiki cv. surpassed other cvs. in both seasons. Moreover, Aggizi cv. in the first season. However, Picual cv record the reduced values of nitrogen (N) in the first season. Moreover, Aggizi, Picual and Manzanillo in the second one.

B- Interaction effect

During the first season the transplants of Koroneiki olive cv. which irrigated with 1.0L./transplant sewage water has the highest nitrogen values. Whileas, Aggizi and Koroneiki irrigated with 0.5L./transplant sewage gave the same trend in the second season. On the contrary, Aggizi, Koroneiki, Picual and Manzanilo was the lowest significant values when irrigated with 1.5L./transplant wells water in both seasons Moreover, Aggizi, Koroneiki and Manzsanillo (in the first season) and Aggizi, Koroneiki and Picual

Table (48) Leaf nitrogen content (%) of olive transplants in response to specific effect and interaction effect of olive cultivars (4cvs.); water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001 experimental seasons.

Irrigation rate / transplant	Cultivar	2000 season		Specific effect of irrigation rate	2001 season		Specific effect of irrigation rate
		Water resource			Water resource		
		Well	Sewage		Well	Sewage	
0.5 L	Aggizi	1.10k-m	2.66b	1.86A	1.08hi	3.07a	2.03A
	Koroneiki	1.21ij	2.59b		1.24gh	3.15a	
	Picual	1.25i	2.30d		1.21g-l	2.82b	
	Manzanillo	1.16i-l	2.63b		1.16hi	2.53c	
1.0 L	Aggizi	1.07k-m	2.42c	1.77B	1.03i	2.53c	1.77B
	Koroneiki	1.14j-m	2.77a		1.16hi	2.41cd	
	Picual	1.17i-k	2.16e		1.14hi	2.26de	
	Manzanillo	1.06lm	2.37cd		1.37g	2.29d	
1.5 L	Aggizi	1.05m	2.31d	1.49C	1.02i	1.84f	1.48C
	Koroneiki	1.10k-m	1.90f		1.14hi	1.77f	
	Picual	1.15i-m	1.53h		1.13hi	1.75f	
	Manzanillo	1.05m	1.79g		1.09hi	2.10e	
Specific effect of water resource		Well	Sewage		Well	Sewage	
		1.13B	2.29A		1.15B	2.38A	
Specific effect of cultivars		Aggizi	Koroneiki	Picual	Manzanillo		
		1.77A	1.78A	1.59C	1.68B		
		Aggizi	Koroneiki	Picual	Manzanillo		
		1.76AB	1.81A	1.72B	1.76AB		

values of either specific or interaciton effect followed by the same capital or small letters ; respectively are not significantly different at 5% level

(in the second season) irrigated with 1.0L./transplant wells water in addition, Aggizi in both seasons when irrigated with 0.5L./transplant wells water gave the same trend. This work go in line with **El-Khoreily and Salem 1989 Laz *et al.* 1999. EL-Gazzar and Shehata 1982. Moustafa 2002.**

IV.11.11.2.2. Leaf phosphorus and potassium content

Data in Table, (49) show different water levels (0.5, 1.0 and 1.5L./transplant) and two sources of water (sewage and wells) on phosphorus and potassium content (%).

A- Specific effect

Referring to the specific effect of different water levels (0.5, 1.0 and 1.5L./transplant) on P, K content of olive cvs. the irrigation with 1.5L./transplant was the extreme values during two seasons.

As related to the source of water, leaf samples taken from trees irrigated with sewage water showed higher percentages of P & K in both seasons.

Concerning, cultivar effect Koroneiki cv. was the highest significant value during the first season in the P leaf content. Reversely Aggizi and Manzanillo cvs. have the least significant values in the same season. Whereas, all cultivars gave no significance during second season.

According to olive cultivar transplants, Koroneiki cv. contains the highest Potassium (K) content in in both seasons.
On the contrary, Manzanillo transplants were negatively affected in both seasons.

Table (49) Leaf phosphorus and potassium content (%) of olive transplants in response to specific effect and interaction effect of olive cultivars (4cvs.); water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001 experimental seasons.

Irrigation rate / transplant	Cultivar	Leaf phosphorus content (%)				Leaf potassium content (%)			
		2000 season		2001/season		2000 season		2001/season	
		Water resources				water resources			
		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
0.5 L	Aggezi	0.130l	0.193g	0.153m	0.193ef	0.767q	1.001hi	0.937hi	0.960gh
	Koroneiki	0.150k	0.197g	0.163lm	0.187jl	0.930l	1.037g	0.890i	0.795j
	Picual	0.150k	0.187g-l	0.160lm	0.183jl	0.867o	0.980j	0.913hi	0.943hi
	Manzanillo	0.123l	0.190gh	0.157m	0.177jl	0.820p	1.010h	0.737k	0.790j
1.0 L	Aggezi	0.163k	0.257e	0.260h-j	0.257e-e	0.807p	1.147e	1.080e	1.087e
	Koroneiki	0.170ij	0.263de	0.260h-j	0.250e-e	1.033g	1.150e	1.087e	1.333b
	Picual	0.173h-j	0.250e	0.217gh	0.247de	0.913m	1.050fg	1.013fg	1.057ef
	Manzanillo	0.163jk	0.253e	0.207hi	0.240ef	0.897n	1.003hi	0.820j	0.933hi
1.5 L	Aggezi	0.220f	0.297ab	0.227fg	0.297a	0.877o	1.530a	1.090e	1.660a
	Koroneiki	0.227f	0.310a	0.260h-d	0.267bc	1.180d	1.247b	1.167d	1.613a
	Picual	0.253e	0.277cd	0.260h-d	0.257c-e	0.990ij	1.227c	1.227c	1.143d
	Manzanillo	0.213f	0.283bc	0.250c-e	0.227fl	0.953k	1.143e	0.963gh	
Specific effect of water resource		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
		0.178B	0.246A	0.204B	0.236A	0.919B	1.132A	0.994B	1.161A
Specific effect of cultivars		Aggezi	Koroneiki	Picual	Manzanillo	Aggezi	Koroneiki	Picual	Manzanillo
		0.210BC	0.219A	0.215AB	0.204C	0.221A	0.221A	0.221A	0.218A
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		0.165C	0.212B	0.260A		0.172C	0.227B	0.262A	

Irrigation rate / transplant	Cultivar	Leaf potassium content (%)			
		2000 season		2001/season	
		water resources			
		Well	Sewage	Well	Sewage
0.5 L	Aggezi	0.767q	1.001hi	0.937hi	0.960gh
	Koroneiki	0.930l	1.037g	0.890i	0.795j
	Picual	0.867o	0.980j	0.913hi	0.943hi
	Manzanillo	0.820p	1.010h	0.737k	0.790j
1.0 L	Aggezi	0.807p	1.147e	1.080e	1.087e
	Koroneiki	1.033g	1.150e	1.087e	1.333b
	Picual	0.913m	1.050fg	1.013fg	1.057ef
	Manzanillo	0.897n	1.003hi	0.820j	0.933hi
1.5 L	Aggezi	0.877o	1.530a	1.090e	1.660a
	Koroneiki	1.180d	1.247b	1.167d	1.613a
	Picual	0.990ij	1.227c	1.227c	1.143d
	Manzanillo	0.953k	1.143e	0.963gh	
Specific effect of water resource		Well	Sewage	Well	Sewage
		0.919B	1.132A	0.994B	1.161A
Specific effect of cultivars		Aggezi	Koroneiki	Picual	Manzanillo
		1.021B	1.096A	1.004C	0.981D
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L	
		0.926C	1.007B	1.143A	

Irrigation rate / transplant	Cultivar	Leaf potassium content (%)			
		2000 season		2001/season	
		water resources			
		Well	Sewage	Well	Sewage
0.5 L	Aggezi	0.767q	1.001hi	0.937hi	0.960gh
	Koroneiki	0.930l	1.037g	0.890i	0.795j
	Picual	0.867o	0.980j	0.913hi	0.943hi
	Manzanillo	0.820p	1.010h	0.737k	0.790j
1.0 L	Aggezi	0.807p	1.147e	1.080e	1.087e
	Koroneiki	1.033g	1.150e	1.087e	1.333b
	Picual	0.913m	1.050fg	1.013fg	1.057ef
	Manzanillo	0.897n	1.003hi	0.820j	0.933hi
1.5 L	Aggezi	0.877o	1.530a	1.090e	1.660a
	Koroneiki	1.180d	1.247b	1.167d	1.613a
	Picual	0.990ij	1.227c	1.227c	1.143d
	Manzanillo	0.953k	1.143e	0.963gh	
Specific effect of water resource		Well	Sewage	Well	Sewage
		0.919B	1.132A	0.994B	1.161A
Specific effect of cultivars		Aggezi	Koroneiki	Picual	Manzanillo
		1.021B	1.096A	1.004C	0.981D
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L	
		0.926C	1.007B	1.143A	

Irrigation rate / transplant	Cultivar	Leaf phosphorus content (%)				Leaf potassium content (%)			
		2000 season		2001/season		2000 season		2001/season	
		Water resources				water resources			
		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
0.5 L	Aggezi	0.130l	0.193g	0.153m	0.193ef	0.767q	1.001hi	0.937hi	0.960gh
	Koroneiki	0.150k	0.197g	0.163lm	0.187jl	0.930l	1.037g	0.890i	0.795j
	Picual	0.150k	0.187g-l	0.160lm	0.183jl	0.867o	0.980j	0.913hi	0.943hi
	Manzanillo	0.123l	0.190gh	0.157m	0.177jl	0.820p	1.010h	0.737k	0.790j
1.0 L	Aggezi	0.163k	0.257e	0.260h-j	0.257c-e	0.807p	1.147e	1.080e	1.087e
	Koroneiki	0.170ij	0.263de	0.260h-j	0.250c-e	1.033g	1.150e	1.087e	1.333b
	Picual	0.173h-j	0.250e	0.217gh	0.247de	0.913m	1.050fg	1.013fg	1.057ef
	Manzanillo	0.163jk	0.253e	0.207hi	0.240ef	0.897n	1.003hi	0.820j	0.933hi
1.5 L	Aggezi	0.220f	0.297ab	0.227fg	0.297a	0.877o	1.530a	1.090e	1.660a
	Koroneiki	0.227f	0.310a	0.260h-d	0.267bc	1.180d	1.247b	1.167d	1.613a
	Picual	0.253e	0.277cd	0.260h-d	0.257c-e	0.990ij	1.227c	1.227c	1.143d
	Manzanillo	0.213f	0.283bc	0.250c-e	0.227fl	0.953k	1.143e	0.963gh	
Specific effect of water resource		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
		0.178B	0.246A	0.204B	0.236A	0.919B	1.132A	0.994B	1.161A
Specific effect of cultivars		Aggezi	Koroneiki	Picual	Manzanillo	Aggezi	Koroneiki	Picual	Manzanillo
		0.210BC	0.219A	0.215AB	0.204C	0.221A	0.221A	0.221A	0.218A
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		0.165C	0.212B	0.260A		0.172C	0.227B	0.262A	

Irrigation rate / transplant	Cultivar	Leaf potassium content (%)			
		2000 season		2001/season	
		water resources			
		Well	Sewage	Well	Sewage
0.5 L	Aggezi	0.767q	1.001hi	0.937hi	0.960gh
	Koroneiki	0.930l	1.037g	0.890i	0.795j
	Picual	0.867o	0.980j	0.913hi	0.943hi
	Manzanillo	0.820p	1.010h	0.737k	0.790j
1.0 L	Aggezi	0.807p	1.147e	1.080e	1.087e
	Koroneiki	1.033g	1.150e	1.087e	1.333b
	Picual	0.913m	1.050fg	1.013fg	1.057ef
	Manzanillo	0.897n	1.003hi	0.820j	0.933hi
1.5 L	Aggezi	0.877o	1.530a	1.090e	1.660a
	Koroneiki	1.180d	1.247b	1.167d	1.613a
	Picual	0.990ij	1.227c	1.227c	1.143d
	Manzanillo	0.953k	1.143e	0.963gh	
Specific effect of water resource		Well	Sewage	Well	Sewage
		0.919B	1.132A	0.994B	1.161A
Specific effect of cultivars		Aggezi	Koroneiki	Picual	Manzanillo
		1.021B	1.096A	1.004C	0.981D
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L	
		0.926C	1.007B	1.143A	

Values of either specific or interaction effect followed by the same capital or small letter/s, respectively, are not significantly different at 5% level.

B- Interaction effect

Phosphorus (P) in Aggizi and Koroneiki olive cvs. gave the highest values as irrigated with 1.5L./transplant sewage water in the first season. In the same time, Aggizi irrigated with 1.5L./transplant sewage water record the highest significant values in the second season.

On the contrary, Aggizi and Manzanillo contain the lowest values as irrigated by 0.5L./transplant wells water in the first season. Moreover, Aggizi, Koroneiki, Picual and Manzanillo in the second season irrigated with 0.5L./transplant wells water gave the same trend.

As for potassium (K), during the first season Aggizi transplants irrigated with 1.5L./transplant sewage water contain the superior values. Whereas, in the second season Aggizi, Koroneiki and Picual irrigated with 1.5L./transplant sewage water surpassed other cvs. On the contrary. Aggizi irrigated with 0.5L./transplant wells water showed the least significance in the first season. Also Manzanillo irrigated with 0.5L./transplant wells water was poor in Potassium (K) content in the second season. These data consistent with, **EL-Gazzar and Shehata (1982); Zahran *et al.* (1987); Laz *et al.* (1999) and Moustafa 2002**

IV.11.11.2.3. Leaf Calcium and Magnesium content (%)

Table, (50) reveals the specific and interaction effect of three water levels, two sources of water on calcium (Ca) and magnesium (Mg) content (%) in four olive cvs.

A- Specific effect

Generally, revel that the 1.5L./transplant level of irrigation water increased significantly Ca and Mg content in different olive cvs. under study during the two seasons.

Table (50) Leaf calcium and manganese content (%) of olive transplants in response to specific effect and interaction effect of olive cultivars (4cvs.); water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001 experimental seasons.

Irrigation rate / transplant	Cultivar	Leaf calcium content (%)				Leaf maganesium contet (%)			
		2000/season		2001/season		2000/season		2001/season	
		Water resources				water resources			
		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
0.5 L	Aggizi	1.223c	1.190e	1.243e	1.223f	0.241e	0.230e	0.257e	0.240f
	Koroneiki	0.987lm	0.983m	1.000m-o	0.983o	0.080f	0.080f	0.080g	0.080g
	Picual	1.240c	1.207d	1.253e	1.143g	0.247e	0.247e	0.293e	0.257e
	Manzanillo	1.043h	0.987lm	1.070j	0.987o	0.080f	0.080f	0.080g	0.080g
1.0 L	Aggizi	1.283b	1.283b	1.297d	1.287d	0.280cd	0.267d	0.287cd	0.273de
	Koroneiki	1.013i-k	1.003j-k	1.010lm	1.003l-n	0.080f	0.080f	0.080g	0.080g
	Picual	1.297b	1.283b	1.327c	1.313c	0.283cd	0.287c	0.293bc	0.297bc
	Manzanillo	1.070g	0.997k-m	1.090i	0.997m-o	0.080f	0.080f	0.080g	0.080g
1.5 L	Aggizi	1.343a	1.350a	1.367b	1.350b	0.307ab	0.293bc	0.310ab	0.307ab
	Koroneiki	1.030hi	1.020ij	1.037k	1.010lm	0.080f	0.080f	0.080g	0.080g
	Picual	1.357a	1.350a	1.387a	1.360b	0.313a	0.310a	0.320a	0.317a
	Manzanillo	1.100f	1.020ij	1.110h	1.020l	0.080f	0.080f	0.080g	0.080g
Specific effect of water resource		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
		1.165A	1.139B	1.183A	1.140B	0.179A	0.176B	0.184A	0.181B
Specific effect of cultrivars		Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
		1.278B	1.006D	1.289A	1.036C	1.294A	1.007C	1.297B	1.046C
		Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
		0.269B	0.080C	0.282A	0.080C	0.279B	0.080C	0.291A	0.080C
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		1.107C	1.154B	1.196A		1.113C	1.165B	1.205A	
		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		0.160C	0.180B	0.193A		0.167C	0.184B	0.197A	

Values of either specific or interaction effect followed by the same capital or small letter/s; respectively are not significantly different at 5% level.

As related to source of water leaf of olive transplants irrigated with wells water had the highest content in Ca and Mg in both seasons under study.

Concerning the olive cvs., Picual olive cv. has the highest values of Ca content in the first season. Meantime, Aggizi olive cv. gave the same trend in the second season. Reversly, Koroneiki has the least significant values in both seasons whereas, Manzanillo cv. has the least values in the second season only.

Eventually, Picual cv. was the highest significant value during both seasons in magnesium (Mg) leaf content. Reversly Koroneiki and Manzanillo cvs. have the least significant values in the same season.

B- Interaction effect

With regard to, Aggizi and Picual olive transplants irrigated with 1.5L./transplant both wells and sewage water has the highest calcium (Ca) content during first season than other cvs.. Moreover, Picual irrigated with the same level of wells water in the second season only gave the same trend. On the other hand, during the two seasons Koroneiki olive transplants irrigated with 0.5L./transplant both wells and sewage water have the least values of calcium (Ca) content. Moreover, Manzanillo irrigated with the same level of sewage water behave the same trend.

Irrigation of Aggizi olive cv. with 1.5L./transplant wells water and Picual irrigated with the same level of both wells and sewage water increased significantly magnesium (Mg) content in the first season. In addition, Aggizi and Picual irrigated with both wells and sewage water had the highest values of leaf magnesium (Mg) content in the second season. On the contrary, most treatments with all varieties under study showed the minimized values of leaf magnesium (Mg) content in both season. The

response of magnesium and calcium to different levels of irrigation are in agreement with **EL-Gazzar and Shehata (1982). Moustafa 2002**

IV.11.11.3. Microelements.

The different olive cvs. leaf microelements (ppm) (Fe, Cu, Mn & Zn) as affected by water levels (0.5, 1.0 and 1.5L./transplant), sources of water (sewage and wells).

IV.11.11.3.1. Leaf iron and copper content (ppm).

Concerning, the specific and interaction effect of three water levels and two sources of water on iron (Fe) and copper (Cu) leaf content of four olive cvs. showed in Table (51).

A- Specific effect

Generally, transplants watered with 0.5L./transplant irrigation water (loss level) had higher significant leaves values of Fe and Cu content in different olive cvs. under study. In contrast to, olive cvs irrigated with 1.5L./transplant (high level) which showed the least Fe and Cu value in both seasons. However, transplants irrigated with 1.0L./transplant level of irrigation intermediate in Fe and Cu content.

As referring to the source of water, olive trees irrigated with sewage water was superior in Fe and Cu content in comparison.

As for cultivars, Manzanillo and Koroneiki cvs. were the most significant in Fe leaf content,during the first and second season respectively. The reverse was true for Aggizi and Picual, it was the least values in Fe leaf content during the two seasons.

Table (51) Leaf iron and copper content (ppm) of olive transplants in response to specific effect and interaction effect of olive cultivars (4cvs.); water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001 experimental seasons.

Irrigation rate / transplant	Cultivar	Leaf iron content (ppm)				Leaf cupper content (ppm)			
		2000/season		2001/season		2000/season		2001/season	
		Water resources				water resources			
		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
0.5 L	Aggizi	79.56n	93.65e	76.33p	93.45f	26.62l	29.63g	26.30o	28.75h
	Koroneiki	82.60j	97.57a	79.88k	96.99b	29.69g	33.48a	29.69f	33.83a
	Picual	79.43n	93.93e	75.99q	93.97e	26.63l	29.82fg	26.79n	29.45g
	Manzanillo	82.74j	97.68a	79.05l	97.18a	30.00f	33.14b	30.63e	33.63b
1.0 L	Aggizi	78.20o	92.35g	74.76r	92.35h	25.39n	28.90h	24.94q	28.09jk
	Koroneiki	81.32l	96.53b	78.35m	95.85c	28.56i	32.35c	28.16j	32.43c
	Picual	77.69p	92.88f	74.43s	92.52g	24.74o	28.31ij	25.41p	28.46i
	Manzanillo	81.65k	96.91b	77.83n	95.88c	28.25j	30.90d	28.65h	32.29c
1.5 L	Aggizi	76.49q	90.77i	73.07t	90.89j	23.88p	27.13k	24.07r	26.95m
	Koroneiki	79.58n	94.69d	76.80o	94.19d	26.53l	30.63e	27.11l	31.28d
	Picual	76.11r	91.15h	72.94u	91.00i	23.91p	27.13k	23.94r	27.95k
	Manzanillo	80.01m	95.08c	75.93q	94.23d	26.17m	29.13h	27.25l	30.67e
Specific effect of water resource		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
		79.62B	94.41A	76.28B	94.04A	26.70B	30.05A	26.91B	30.13A
Specific effect of cultrivars		Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
		85.17C	88.72B	85.20C	88.96A	83.47C	87.01A	83.48C	86.69B
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		88.40A	87.08B	85.56C		86.61A	85.25B	83.63C	

Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
26.92C	30.21A	26.76D	29.60B	26.52D	30.42B	27.00C	30.52A

0.5 L	1.0 L	1.5 L	0.5 L	1.0 L	1.5 L
29.88A	28.42B	26.81C	29.88A	28.55B	27.40C

Values of either specific or interaction effect followed by the same capital or small letter/s; respectively are not significantly different at 5% level.

Koroneiki transplants had the extreme significant values in its Cu content in the first season. Meantime, Manzanillo gave the higher level in second season. The reverse was true for Picual (in the first season) and Aggizi (in the second season) were the least values in Cu leaf content.

B- Interaction effect

As for the interaction effect, irrigation of Koroneiki and Manzanillo olive cvs. with 0.5L./transplant sewage water increased significantly Fe content in leaf during the first season. Besides Manzanillo cv. gave the same significance of Fe content in leaf during the second season. In addition, Koroneiki cv was the most significant in Cu leaf content during the two seasons of study. The reverse was true for Fe and Cu, Picual cv, irrigated wth 1.5L./transplant wells water during the two seasons of study gave the least significant values. Besides, Aggizi cv (1.5 wells water) in Cu leaf content in the first season only. The response of iron to different levels of irrigation are agreement with **Mohamed (1998), Abd El-Azeem (1999) and Moustafa 2002 on the other hand the response of copper to different levels of irrigation are agreement with Mohamed (1998) and Abd El-Azeem (1999).**

IV.11.11.3.2. Leaf manganese and zinc content (ppm)

The specific and interaction effect of different water levels and two sources of water on manganese (Mn) and zinc (Zn) content of four olive cvs. displays in Table (52).

A- Specific effect

Referring to the specific effect of different water levels (0.5, 1.0 and 1.5L./transplant) on Mn and Zn content of olive

Table (52) Leaf manganese and zinc content (ppm) of olive transplants in response to specific effect and interaction effect of olive cultivars (4cvs.); water resources (well & sewage); irrigation rate (3 levels) and their combinations during two consecutive 2000 and 2001 experimental seasons.

Irrigation rate / transplant	Cultivar	Leaf manganese content (ppm)				Leaf zinc content (ppm)			
		2000/season		2001/season		2000/season		2001/season	
		Water resources				water resources			
		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
0.5 L	Aggizi	32.72k	40.73d	32.20o	39.84f	22.55ef	25.62c	23.16f	26.52c
	Koroneiki	35.79h	44.37a	35.63k	44.73a	21.18h	25.23c	22.47h	25.65d
	Picual	33.53j	40.72d	32.69n	40.35e	20.87h	27.88a	22.40h	27.46a
	Manzanillo	36.08h	43.84a	36.73j	44.73a	20.83h	27.41b	21.83i	26.80b
1.0 L	Aggizi	30.79m	39.80e	30.44r	38.69g	19.25j	22.16fg	19.92k	22.32h
	Koroneiki	33.76ij	42.55b	33.16m	42.63b	18.29k	22.03g	19.07m	21.55j
	Picual	31.64l	38.71f	31.31q	38.66g	18.18k	23.52d	19.28l	24.20e
	Manzanillo	34.29i	41.80c	34.75l	42.69b	18.17k	22.92e	18.71n	22.89g
1.5 L	Aggizi	29.28n	37.83g	29.37t	37.35i	16.16l	18.52k	15.94q	17.76o
	Koroneiki	31.40lm	41.23cd	32.11p	41.48c	15.15m	18.08k	15.35r	17.08p
	Picual	31.04lm	37.87g	29.84s	37.81h	15.89l	19.77i	15.83q	18.67n
	Manzanillo	32.83k	39.53e	33.15m	41.27d	15.44m	18.40k	15.21r	17.79o
Specific effect of water resource		Well	Sewage	Well	Sewage	Well	Sewage	Well	Sewage
		32.76B	40.75A	32.62B	40.85A	18.50B	22.63A	19.10B	22.39A
Specific effect of cultrivars		Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
		35.19C	38.18A	35.58B	38.06A	34.65D	38.29B	35.11C	38.89A
		Aggizi	Koroneiki	Picual	Manzanillo	Aggizi	Koroneiki	Picual	Manzanillo
		20.71B	19.99D	21.02A	20.53C	20.94B	20.19D	21.31A	20.54C
Specific effect of irrigation rates		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		38.47A	36.67B	35.13C		38.36A	36.54B	35.30C	
		0.5 L	1.0 L	1.5 L		0.5 L	1.0 L	1.5 L	
		23.95A	20.57B	17.18C		24.54A	20.99B	16.70C	

Values of either specific or interaction effect followed by the same capital or small letters; respectively are not significantly different at 5% level.

cvs., the irrigation with 0.5L./transplant was the extreme values during the two seasons of study. As related to source of water leaf of olive transplants irrigated with sewage water had the superior content in Mn and Zn in both seasons.

Koroneiki and Manzanillo olive cvs. had the most significant values in Mn content during the first season. Meantime, Manzanillo cv. only gave the same trend in the second season. Reversely, Aggizi cv. was the least significant values in Mn content in both seasons.

In addition to Picual olive cv. had the most significant value in Zn content in olive cvs. during the two seasons. Reversely Koroneiki cv. was the least significant values in Zn content in both seasons of study.

B- Interaction effect

Generally, the interaction effect of different factors on olive cvs. revealed that leaf of Koroneiki and Manzanillo cv. irrigated with 0.5L./transplant sewage water exhibited the highest Mn during the two seasons of study. Meantime Picual cv was the highest significant values in Zn content when irrigated with 0.5L./transplant sewage water in both seasons.

The reverse was true for Aggizi (in the first season) and Picual (in the second season) irrigated with 1.5L./transplant wells water was lowest in Mn content. Moreover, leaf Zn content was reduced in Koroneiki and Manzanillo cv irrigated with 1.5L./transplant wells water during the two seasons. These data consistent with **Mohamed (1998) and Abd El-Aze Mohamed (1998) and Abd El-Azeem (1999).**

As a conclusion, Though, the irrigation with sewage water improved the growth of different olive cvs. under study, fruit characters, production and yield of fruits and oil content in

comparison with wells water, we can't recommend sewage water for olive irrigation instead of wells water especially when we consider the suggesting of **Mark Morian and Russo, (2001)** in the olive care book which reported that the maximum permissible contaminants of lead (Pb) in olive fruits should not exceed 0.5mg Kg^{-1} and Cu 10 mg Kg^{-1}. It is obvious that, in our work Pb was more than this value, especially in Aggizi cv. when irrigated with 60L./tree sewage water, however the Cu content in olive fruits irrigated with the same level of water and the same source didn't exceed the permissible contaminants in olive fruits. For the rest of heavy metals in olive fruits content under study there were no available references about the permissible contaminants value.

Eventually, the different olive trees varieties cvs under study was highly responded to the 120 L/tree level of either sewage or wells water in the mulched soil.