Response of Rooted Olive Cuttings to Mineral Fertilization and Foliar sprays with Urea and Gibberlline

Shereen, A. Shaheen and Aly A. A.
Olive & Semiarid Zone Fruits Res. Dept.,
Hort. Res. Institute, Agric. Res. Centre, Giza, Egypt

Corresponding author: *Sheerenatef@yahoo.com*

Abstract: The efficacy of foliar application with urea at 1% and gibberellic acid at 200 ppm either alone or in a combination with two N, P, K soil fertilizers (19 – 19 – 19) or (5 – 0 – 45) at 1 gm/pot as soil application on growth vigor and leaf NPK content of Coratina and Maraki olive transplants(rooted cuttings) was studied during two successive seasons of 2006 and 2007. The present investigation was conducted at the experimental form of the Horticulture Research Institute, Giza, Egypt. The obtained data indicated that, there were a markable effect of spraying urea plus gibberellins weekly on vegetative growth estimated as stem length, diameter, number of leaves and shoots, fresh and dry weight of stem and roots. Soil fertilizer with (19 – 19 – 19) was superior on increasing stem diameter, shoot number of Coratina Cv. and number of leaves than Maraki Cv., while soil fertilizer with (5 – 0 – 45) had a positive effect on stem diameter, shoot number of Coratina Cv. and number of leaves in Maraki Cv. Soil application of N, P, K (5 – 0 – 45) to Coratina Cv. exhibited the maximum stem length and No. of leaves ,as well as, stem and roots fresh and dry weight of olive cultivars. With regard to leaf NPK content data showed that, all plants sprayed with urea weekly contained higher level of leaf N content, over the control. However, plants sprayed with urea + GA_3 weekly contained higher leaf phosphorus content. It is also obvious that spraying urea solely or in a combination with GA_3 weekly caused a significant increase in leaves potassium content than other treatments in both studied seasons, however, no statistical difference was observed between two soil fertilizer forms and cultivars in leaf content of phosphor and potassium. *Thus,* it can be concluded from the above results that application of urea plus gibberellins could be benefit to reach to the suitable size in an earlier age and shorting this time would benefit by reducing various production in pots and their costs than normal

[Shereen, A. Shaheen and Aly A. A. **Response of Rooted Olive Cuttings to Mineral Fertilization and Foliar sprays with Urea and Gibberlline.** Nature and Science 2011;9(9):76-86]. (ISSN: 1545-0740). http://www.sciencepub.net.

Keywords: *Olive transplants, Coratina , Maraki Foliar sprays and Mineral Fertilization*

Introduction

Olive (*Olea europaea L.*) is one of the oldest agricultural tree crops of remarkable cultural and economic importance in the Mediterranean basin and it also represents a widely distributed fruit tree in the world (**F.A.O, 2008).** Current Olive groves are estimated at approximately 960 million olive trees, of which some 945 million (98% of the total) are found in the Mediterranean basin countries where they cover approximately 9.3 million hectares ***(Civantos, 2008)***. Olive trees have been traditionally cultivated in dry conditions as it is a crop very well adopted to Mediterranean dry land ***(Fanei et al., 2009)***. Olive tree has a high economic value and many countries such as Iran and Mediterranean countries use its oil and conserved fruits. Some cultivars of olive transplants such as Maraki is slow, it requires long time for growing to reach a suitable size, shorting this time would benefit by reducing various production in pots and their costs. There are two methods of applyimg nutrients; first mainly through soil, its dressing application for give plant requirements, and then the plant absorb their needed gradually and slowly during the growing ***(Soad, 2005).*** Urea is an ideal N carrier for foliar application because it contains high percentage of N, uptake, metabolism and translocation is rapid following application. It was used by many fruit seedlings at 1% solution during the growing season and enhanced most of the growth parameters **(*Said, 1989)*** on pecan seedlings, ***(Georgeous, 1991)*** on olive transplants and **(*EL-Din et al., 1993)*** on pomegranate seedlings .

The simulative response of gibberllic acid (GA_3), which known to be one of the endogenous growth regulator could be attributed to its unique roles in plant growth and development as reported by ***(Leopold & Kriedmann, 1975 ;Bartolini & Ministro 1981).*** GA_3 has the capability of modifying the growth pattern of treated plants by affecting the DNA and RNA levels, cell division, cell elongation, protein, carbohydrates and photosynthesis pigments. **(*Soad,* 2005)** on Jojoba plants and ***(Khalil et al., 1983;Youssef & Abo-Taleb, 1996)*** on pecan. Thus, the present investigation was planned to study the effect of soil addition (N, P, K) and foliar application of Urea and Gibberllic acid either solely or combination on growth of Coratina and Maraki olive transplants in order to produce vigorous plants to accomplish growth as early as possible .

2. Material and Methods

2.1.Materials:

2.1.1. The experimental transplants :

A pot experiment was carried out during two successive seasons of (2006 & 2007*)* in the Experimental Station of the Horticulture Research Institute of Giza Governorate, Egypt on Coratina and Maraki Olive transplants (rooted cuttings) approximately the same length. Transplants were almost uniform in growth, free disease and good physical condition.

The experimental transplants of both cultivars were originated from rooted cuttings under mist for 2 ½ months, then transplanted in 30 cm diameter pot (1 transplant/pot) in a mixture of clay loam and sand (1-1 V).

2.1.2. treatments :

In a Complete Randomized Block Design, each treatment was replicated three times with seven plants in each replicate. Thirty days after transplanting, soil and foliar application treatments were applied as follows:-

1- Control N, P, K.
2- Urea (1%) weekly.
3- Urea (1%) every 2 weeks.
4- GA_3 (200 ppm) weekly
5- GA_3 (200 ppm) every 2 weeks .
6- Urea + GA_3 weekly.
7- Urea + GA_3 every 2 weeks.

N, P, K (control) was applied in two different forms (F_1 or F_2) as (19 - 19-19) or (5 – 0 – 45) and were applied to all treatments from (2 to7) as soil application (1 gm/liter). Urea and GA_3 and their combination treatments were added as foliar application in early morning. The previously mentioned treatments were applied on two olive cultivars (Coratina and Maraki) during the period from April to October through the two studied seasons (2006 & 2007).

Thus, this experiment included 28 treatments (7 treatments × 2 N,P,K forms × 2 cultivars).

2.2.Methods:

2.2.1.The following data were recorded:

2.2.1.I- Vegetative growth:

Plant height (cm), stem diameter (mm), number of branches / plant, number of leaves / plant were recorded at the begging (April) and end (October) of the experiment and rate of increasing were determined by calculating at the difference between them.

2.2.1.II- Plant organs fresh and dry weights:

- Fresh and dry weight of stem, leaves and root (gm) were determined at the end of investigation.
-

2.2.1.**III- Leaf minerals content:**

The fresh leaf samples were collected from treated transplants at the end of investigation and dried at 70 ^{0}C until constant weights were reached then grounded. Total nitrogen, phosphorus and potassium were determined according to the method described by ***(Pregl, 1945; Brown & Lilleland, 1946*** **;** ***Murphy, & Riely 1962*****)** respectively, then leaves N. P and K content were calculated.

2.2.3.Statistical analysis:

The obtained data was subjected to Analysis of Variance (Anova) according to ***(Snedecor and Cochran, 1980)***. Differences between treatments and cultivars were compared by ***(Waller and Duncan's1969*) .**

3.Results and discussion

3.1.IVegetative growth:

- **Stem length:**

The obtained data in Table (1) revealed that, generally foliar application of GA_3 and urea and their combination to N,P,K increased stem length as compared to N,P,K alone. The rate of increase reached to maximum (33.61 & 40.12 cm.) by spraying weekly with urea plus GA_3 followed by urea sprayed weekly and urea + GA_3 sprayed every2 weeks. However, no differences between two soil fertilizers (5 – 0 – 45) or (19-19-19) in both studied seasons, while Coratina Cv had longer plants32.65& 39.19 cm.) than Maraki Cv. (26.54& 29.03 cm.) and Coratina Cv. with soil application (5-0-45) and foliar sprays with urea + GA_3 weekly gave the highest plant length (45.75&51.17 cm.) in both studied seasons

The obtained results are in a harmony with (***Corrales et al., 1993 and Ashraf, 2010)*** they pointed out that, potassium application plays an active role in enhancing the absorption and translocation of other nutrients, especially nitrogen. Coratina Cv. with regards to the interaction foliar application had a stimulus effect of either urea solely or combined with GA_3 weekly and N, P, K (5-0-45) addition.

However, the effect of the control of both cultivars on stem length took the other way around in the first season.

It is clear in Table (2) that, the greater in the rate of increase of stem diameter were obtained with sprayed weekly with Urea + GA (0.329 & 0.338 mm) respectively, compared with other treatments, while control treatments was the least one (0.213& 0.208 mm) in both studied seasons. The differences between both N, P, K forms were insignificant in both seasons, however, it is a clear significant differences between both cultivars ,where , Coratina produced wider steams (0.335&0.332) than Maraki (0.217 & 0.224 mm) in both seasons respectively. In addition, the interact

between soil fertilizers and cultivars was obviously in Coratina Cv. with (19 – 19 – 19) soil fertilizer and urea + GA_3 sprayed weekly followed by urea only (1st season) and urea only (2nd season). The promoting effect on stem diameter due to urea and GA_3 was previously investigated by (*Said 1989, Georgeous, 1991 and El-Din et al., 1993)*. GA_3 has the capability of modifying the growth pattern of treated plants by affecting the DNA and RNA levels, cell division, cell elongation, protein, carbohydrates and photosynthesis pigments.*(Soad, 2005)* Stem diameter.

Leaf number:

The rate of increase of the average leaf number obtained in Table(3) from the treatment urea + GA_3 sprayed weekly (147.3 & 153.8), while the control treatment gave the least average of leaf number (111.1 & 115.5), respectively in both studied seasons. No statical differences between two soil fertilizers was observed in Both seasons. As for the interaction effect, the highest No. of leaves was obtained when N,P,K (5-0-45) was supplemented by urea + GA_3 (1st season) either weekly (166.3) or every 2 weeks (165.0) and sprayed Maraki transplants, the same mentioned treatment showed the best results in the 2nd season when N,P,K (5-0-45) was replaced by (19-19-19). However, the least values was recorded when Coratina transplants was sprayed with GA_3 at 200 ppm plus N,P,K (19-19-19) as it recorded 95.00, this was true in the first season of study. The previously treatment had the same effect in the second season when N,P,K (19-19-19) was replaced by (5-0-45). While Maraki Cv. observed superiority compared with Coratina Cv. in both studied seasons. *(Abo-taleb, 1987)* on olive seedlings and (*El-Din et al., 1993)* on pomegranate transplants. Urea is an ideal N carrier for foliar application because it contains high percentage of N, uptake, metabolism and translocation are rapid following application.

Table (1): Effect of Urea, Gibberellins spraying and mineral fertilizations on the rate of increase of plant height(cm) in transplants of olive cvs .(2006 / 2007 season)

Season	2006					2007				
Treatments	Coratina cultivar		Maraki cultivar		Mean	Coratina		Maraki cultivar		Mean
	F1	F2	F1	F2		F1	F2	F1	F2	
control	18.67 kl	24.20 j	19.39 k	19.80 k	**20.65 d**	38.33 f	28.97 lm	34.27 h	29.40 i	**32.74 cd**
Urea weekly	32.93 cd	45.39 a	26.27 h- j	24.53 j	**32.28 ab**	27.07 n-p	25.67 pq	22.20 r	22.67 r	**24.40 a**
Urea after two weeks	32.87 cd	37.08 b	26.07 h-j	26.37 h-j	**30.60 a-c**	32.50 ij	44.37 d	27.67 m-o	24.80 q	**33.33 d**
GA_3 weekly	27.50 gh	34.05 c	30.80 ef	25.07 j	**29.35 bc**	36.63 g	47.07 bc	33.53 hi	29.03 lm	**36.57 b**
GA_3 after two weeks	27.33 g-i	26.09 h-j	30.67 ef	25.27 ij	**27.34 c**	44.97 e	46.83 c	30.37 l-n	26.20 o-q	**37.09 b**
Urea+ GA_3 weekly	31.93 de	45.75 a	28.77 fg	28.00 gh	**33.61 a**	50.03 b	51.17 a	30.83 g	30.80 k	**40.12 a**
Urea+ GA_3 after two weeks	36.60 b	36.68 b	29.27 fg	30.73 ef	**33.32 ab**	31.83 jk	48.23 b	34.03 h	27.57m-o	**35.42 bc**
Mean F	**28.54 A**		**30.64 A**			**33.73 A**		**34.48 A**		
Mean Var.	**32.65 A**		**26.54 A**			**39.19 A**		**29.03 B**		

F1:soil fertilizer(19-19-19) . **F2**: soil fertilizer

Table (2): Effect of sprays of Urea, Gibberellins and mineral fertilizations on the rate of increase of stem diameter(mm) in transplants of olive cvs .(2006 / 2007 season) .

Season	2006					2007				
Treatments	Coratina		Maraki		Mean	Coratina		Maraki		Mean
	F1	F2	F1	F2		F1	F2	F1	F2	
control	0.255j-l	0.236i-k	0.203 m	0.183 n	**0.213 G**	0.203 jk	0.200 k	0.207 k	0.220 j	**0.208 E**
Urea weekly	0.380bc	0.300 f	0.266 gh	0.264 i	**0.313 B**	0.427 a	0.403 b	0.280 g	0.237 i	**0.337 A**
Urea after two weeks	.0350 d	0.343 d	0.206 m	0.150 o	**0.263 E**	0.343 d	0.320 e	0.200 k	0.163 l	**0.257 D**
GA_3 weekly	0.343 d	0.346 d	0.223j-l	0.240 ij	**0.288 C**	0.323 e	0.350cd	0.193 k	0.207 k	**0.268 C**
GA_3 after two weeks	0.320 e	0.336 de	0.220k-m	0.126 p	**0.251 F**	0.323 e	0.343 d	0.190 k	0.163 l	**0.255 D**
Urea+ GA_3 weekly	0.410 a	0.370 c	0.283 fg	0.253 i	**0.329 A**	0.387 b	0.333de	0.363 c	0.264 g	**0.338 A**
Urea+ GA_3 after two weeks	0.396ab	0.340 d	0.216 lm	0.220 k-m	**0.279 D**	0.390 b	0.300 f	0.243 h	0.200 k	**0.283 B**
Mean F	**0.289 A**		**0.263 A**			**0.291 A**		**0.265 A**		
Mean Var.	**0.335 A**		**0.217 B**			**0.332 A**		**0.224 B**		

F1:soil fertilizer(19-19-19) . **F2**: soil fertilizer (5-0-45) .

Table (3): Effect of sprays of Urea , Gibberellins and mineral fertilizations on the rate of increase of leaf number in transplants of olive cvs .(2006 / 2007 season) .

Season	2006					2007				
Treatments	Coratina		Maraki		Mean	Coratina		Maraki		Mean
	F1	F2	F1	F2		F1	F2	F1	F2	
control	109.3 l	105.7 m	133.3 f	114.0 ij	**111.1 D**	112.0 n	102.0 p	139.7 g	120.3 l	**115.5 D**
Urea weekly	128.3 g	135.3 ef	140.0 d	115.7 k	**129.8 B**	123.7 jk	128.3 hi	150.0 e	124.0 j	**131.5 B**
Urea after two weeks	109.3 l	118.0 j	124.3 h	150.7 b	**125.6 B**	123.3 j-l	116.0 m	121.0 l	161.0 b	**130.3 B**
GA_3 weekly	105.0 m	103.7mn	135.7 ef	115.3 k	**114.9 C**	114.3mn	109.0 o	138.7 g	121.3 kl	**120.8 C**
GA_3 after two weeks	95.0 o	101.0 no	143.3 c	127.3 g	**116.7 C**	102.7 p	99.0 q	142.3 f	127.7 i	**117.9 C**
Urea+ GA_3 weekly	136.7 e	134.0 ef	152.0 b	166.3 a	**147.3 A.**	142.3 e	132.3 g	181.0 a	159.7 c	**153.8 A**
Urea+ GA_3 after two weeks	122.7 hi	100.0 n	111.3 l	165.0 a	**125.3 B**	130.7 h	104.3 p	129.3 hi	154.7 d	**129.8 B**
Mean F	**124.8-A**		**125.6-A**			**132.0-A**		**126.0-A**		
Mean Var.	**114.6-B**		**135.8-A**			**117.1-B**		**141.0-A**		

F1:soil fertilizer(19-19-19). **F2**: soil fertilizer (5-0-45).

-Shoot number:

Average shoot number presented in Table (4) showed that, urea + GA_3 sprayed weekly gave the highest shoot number (9.788 & 9.246), respectively, in two studied seasons compared with the control treatments (7.012 & 6.557). The interaction between studied treatments and cultivar observed that, Coratina Cv. gave the highest number of shoots by soil fertilizer (19 – 19 – 19) application and sprayed with Urea + GA_3 or urea only weekly (12.45 & 10.45) respectively, in both seasons, while control treatment gave the least shoot number ***(Youssef & Abo-Table, 1996 ;Wiggans, & Martin, 1961).*** With regard to specific effect of the studied treatments, it can be generally noted that, all foliar applications enhanced the investigated growth parameters as compared with adapted fertilization program (control) only. This might be due to the fact that GA_3 cause stimulatory effect on plant length, which is a result of stem elongation caused by cell elongation rather by increasing cell division ***(Stowe and Yamaki, 1959)***. Nitrogen in the form of urea contains high percentage of N uptake, and absorption the cations and photosynthetic energy which devoted to produce growth. ***(Kim et al., 2002 and El-Shazly, 1981).***

Table (4): Effect of sprays of Urea , Gibberellins and mineral fertilizations on the rate of increase of shoot number in transplants of olive cvs .(2006 / 2007 season).

Season	2006					2007				
Treatments	Coratina		Maraki		Mean	Coratina		Maraki		Mean
	F1	F2	F1	F2		F1	F2	F1	F2	
control	7.603 j	8.128 hi	6.217 o	6.073 p	**7.012 E**	6.650 p	8.187 h	5.373 v	6.020 s	**6.557 F**
Urea weekly	8.80 e	9.37 d	8.003 i	8.757 e	**8.734 B**	10.45 a	9.723 d	8.387 g	7.977 i	**7.034 B**
Urea after two weeks	8.517 f	8.247 h	6.930 mn	8.380 g	**8.018 CD**	7.547 k	5.513 k	5.277 v	7.500 k	**6.959 D**
GA_3 weekly	10.06 c	8.857 e	7.083 kl	7.213 k	**7.802 D**	7.117 m	6.783 o	6.750 o	6.967 n	**6.904 D**
GA_3 after two weeks	7.148 kl	6.167 op	5.857 q	8.520 f	**6.923 E**	6.410 r	5.620 t	5.450 u	8.493 f	**6.643 E**
Urea+ GA_3 weekly	12.45 a	10.11 c	8.210 e	8.383 g	**9.788 A**	9.727 d	10.36 b	7.903 j	9.070 e	**9.265 A**
Urea+ GA_3 after two weeks	10.28 b	7.043 lm	8.023 c	7.150 l	**8.124 C**	10.23 c	6.483 q	7.947 ij	7.327 l	**7.996 C**
Mean F	**8.227-A**		**7.886-A**			**7.515-B**		**7.702-A**		
Mean Var.	**8.627-A**		**7.486-B**			**8.057-A**		**7.160-B**		

F1: soil fertilizer(19-19-19). **F2**: soil fertilizer (5-0-45).

3.1.II. Plant organs fresh and dry weights:

With respect to response of leaves fresh and dry weight to foliar applications with two soil fertilizers, data in Tables (5&6) indicate that, urea application sprayed weekly caused higher significant foliage's fresh & dry weight through two studied seasons, followed by the combination between urea and GA_3 as compared with other foliar. The opposite was obtained when the control (N,P,K only) was applied.

Moreover, leaves fresh & dry weight responded significantly to cultivar, where, Moraki Cv. showed better results (16.2.&16.37 gm) in fresh weight and (7.39& 6.69) in dry weight.However, Carotina Cv. recorded (14.34&13.18 gm) in fresh leaves weight and (5.32& 4.87 gm) in leaves dry weight in both seasons of study. With respect to N,P,K source effect, the highest records of leaves fresh weight (14.95 gm) in the 2nd season, and dry weight (6.709 gm) in the 1st season were resulted of from N,P,K in the (5-0-45) form. Referring the interaction between treatments, the highest fresh weight of leaves were recorded when Maraki transplants were fertilized with N,P,K (19-19-19) and sprayed with urea + GA_3 weekly (1st season), while, the reverse was true when the last mentioned treatment was applied on Coratina transplants and N,P,K (5-0-45) was added.

Table (5): Effect of sprays of Urea , Gibberellins and mineral fertilizations on fresh leaves weight (gm) in transplants of olive cvs .(2006 / 2007 season)

Season	2006					2007				
Treatments	Coratina		Maraki		Mean	Coratina		Maraki		Mean
	F1	F2	F1	F2		F1	F2	F1	F2	
control	19.46 c	15.54 hi	15.30 i	13.45 l	**15.94 C**	10.68 m	10.74 m	14.72 i	15.57 h	**12.93 F**
Urea weekly	18.83 d	17.54 f	16.37 g	19.76 bc	**18.12 A**	15.88 g	15.49 h	21.91 b	20.13 c	**18.35 A**
Urea after two weeks	14.14 l	14.47 k	15.31 i	15.17 i	**14.27 D**	12.46 l	12.52 kl	16.44 f	12.79 jk	**13.55 DE**
GA_3 weekly	13.54 m	12.67 n	15.95 gh	14.67 j	**14.21 D**	12.93 j	12.49 kl	20.09 c	16.62 f	**15.53 C**
GA_3 after two weeks	12.86 mn	10.78 o	14.43 jk	15.11 i	**13.30 E**	10.83 m	10.55 m	12.86 j	18.73 c	**13.24 EF**
Urea+ GA_3 weekly	17.20 f	10.70 o	20.50 a	20.13 b	**17.13 B**	17.51 e	17.54 e	14.50 i	18.89 c	**17.11 B**
Urea+ GA_3 after two weeks	12.51 n	12.47 n	18.19 e	12.53 n	**13.93 DE**	22.47 a	22.46 a	16.26 f	14.77 i	**13.99 D**
Mean F	**16.04 A**		**14.50 A**			**14.77 B**		**14.95 A**		
Mean Var.	**14.34 B**		**16.20 A**			**13.18 B**		**16.73 A**		

F1:soil fertilizer(19-19-19). **F2**: soil fertilizer (5-0-45).

Table (6) Effect of sprays of Urea , Gibberellins and mineral fertilizations on dry leaves weight(gm) in transplants of olive cvs .(2006 / 2007 season) .

Season	2006					2007				
Treatments	Coratina		Maraki		Mean	Coratina		Maraki		Mean
	F1	F2	F1	F2		F1	F2	F1	F2	
control	5.827 k	4.613 n	7.227 f	6.143 j	**5.802 C**	6.923 e	3.403 v	5.870 k	5.527 m	**5.431 F**
Urea weekly	4.567 no	6.557 h	7.973 c	7.533 e	**6.658 A**	4.300 u	3.943 v	8.0503 b	7.697 c	**6.111 A**
Urea after two weeks	4.627 n	5.580 l	6.350 i	8.640 b	**6.229 B**	4.890 p	4.347 t	7.220 d	6.950 e	**5.852 C**
GA_3 weekly	4.593 no	6.097 j	6.430 i	7.807 d	**6.224 B**	6.600 g	4.577 q	6.183 i	5.173 o	**5.633 E**
GA_3 after two weeks	5.787 k	4.437 o	5.523 l	9.850 a	**6.399AB**	4.537 r	4.533 r	6.850 f	6.930 e	**5.713 D**
Urea+ GA_3 weekly	6.600 g	4.910 m	6.497 h	6.690 g	**6.672 A**	5.660 l	4.460 s	5.403 n	8.437 a	**5.990 B**
Urea+ GA_3 after two weeks	4.663 n	6.307 i	7.540 e	7.373 f	**6.463AB**	6.140 j	3.927 v	6.197 i	6.370 h	**5.748 D**
Mean F	**6.013 B**		**6.709 A**			**6.091 A**		**5.474 B**		
Mean Var.	**5.324 B**		**7.398 A**			**4.874 B**		**6.691 A**		

F1:soil fertilizer(19-19-19). **F2**: soil fertilizer (5-0-45)

The highest leaves dry weight was recorded from Maraki olive transplants which sprayed every 2 weekly with GA_3 at 200ppm (1st season) or urea + GA_3 weekly (2nd season) + N, P, K (5- 0- 45).

Referring to the response of stem fresh and dry weight to the different treatments, data obtained revealed in Tables (7&8) that the combination with Urea plus GA_3 sprayed weekly gave marked effects. However, the same data show nearly analogous trends to the previously obtained with stem length. This was true in both seasons, Coratina cultivar was the best in fresh and dry stem weight, while no differences between two soil fertilizers was observed.

Moreover, the interaction revealed that Coratina transplants sprayed with GA_3 weekly plus (5- 0- 45) soil N, P, K fertilizer produced the highest stem fresh and dry weight (except for fresh weight in 2nd season).

The least stem fresh weight were linked with Maraki cultivar fertilized with (5- 0- 45) and supplemented weekly with urea (1st season).

Table (7): Effect of sprays of Urea , Gibberellins and mineral fertilizations on fresh stem weight(gm) in transplants of olive cvs .(2006 / 2007 season) .

Season	2006					2007				
Treatments	Coratina		Maraki		Mean	Coratina		Maraki		Mean
	F1	F2	F1	F2		F1	F2	F1	F2	
control	12.69 jk	16.03 bc	15.49c-e	13.60 cd	**12.95 B**	12.67 u	13.42 s	14.45 n	15.48 i	**14.01 F**
Urea weekly	15.96 bc	18.72 a	13.47 gh	10.08 l	**14.56 A**	12.72 w	17.61-b	14.43 o	16.56-f	**15.83 B**
Urea after two weeks	12.23 k	14.91 ef	13.37 hi	15.56 cd	**14.02AB**	15.88 h	15.00 l	14.28 p	15.26 j	**15.10 D**
GA_3 weekly	12.75i-k	18.00 a	12.45 k	12.74 i-k	**13.98AB**	16.84 d	16.14 g	14.71 m	13.80 r	**15.38 C**
GA_3 after two weeks	12.42 k	17.95 a	12.28 k	15.86 bc	**14.63 A**	12.30 x	17.32-c	14.45 n	15.8 h	**14.97 E**
Urea+ GA_3 weekly	12.75i -k	15.12d f	16.41 b	15.87 bc	**15.04 A**	17.80 a	15.13-k	15.43 i	16.78-e	**16.29 A**
Urea+ GA_3 after two weeks	12.32 k	12.77i- k	13.23h	13.61 g	**12.98 B**	13.15 u	14.19 q	12.45-v	13.38-t	**13.29 G**
Mean F	**13.42-A**		**15.20-A**			**14.54 B**		**15.42 A**		
Mean Var.	**14.33-A**		**14.29-A**			**15.01 A**		**14.95 A**		

F1:soil fertilizer(19-19-19). **F2**: soil fertilizer (5-0-45) .

As for root fresh and dry weight, it can be noticed in Tables (9&10) that all applications increased the root weight over the control. This increment was highly significant with urea plus GA_3 sprayed weekly. Coratina Cv. and soil fertilizer (19 – 19 – 19) gave the higher fresh weight (14.42& 13.89) in both studied seasons, while there was no affect from cultivar and soil fertilizer & foliar applications on dry root weight.

The minimum root fresh weight was recorded in Maraki Cv. received N,P,K (5- 0- 45) only, while the reverse was recorded in Maraki cultivar sprayed with urea + GA_3 weekly + (19- 19- 19) soil fertilizer this was true in both seasons. The highest dry root weight (6.67& 6.63) was parallel to Coratina that fertilized with (19- 19- 19) and supplemented with urea + GA_3 weekly.

The beneficial effect of urea solely or plus GA_3 are in agreement with those obtained by ***Khalil et al., (1983)*** and ***Said (1989)*** on Pecan; ***El-Din et al., (1993)*** on pomegranate and ***Ahmed & Khan, (1964)*** on citrus seedling.

Leaf analysis:

The overall tendency in the effects of tested treatments on leaf NPK percentage are presented in Table (11).The trend indicated that, an increase in all treatments was observed in the percentage of leaf over the control. Generally speaking treatment with urea (1st season) and urea + GA_3 (2nd season) sprayed weekly increased leaf nitrogen content than other treatments, whereas the control treatments was the least in leaf nitrogen content. Concerning specific effects, soil fertilizer with (5- 0- 45) was higher in leaf nitrogen, as well as, Maraki cultivar than soil fertilizer with (19- 19- 19) and Coratina cultivar. Regarding leaf phosphorous content in Table (12) data obtained indicated that, the amount of this nutrient positively affected by different treatments than control. However, plants sprayed with urea + GA_3 weekly contained higher leaf phosphorous content, followed by urea sprayed weekly while no difference was observed between two soil fertilizer and cultivars.

Moreover, spraying Coratina Cv. with urea + GA_3 weekly + (19- 19- 19) produced the richest leaves with P content, conversely Maraki cultivar subjected to the control (5- 0- 45) only. It is obvious from data given in Table (13) that, spraying urea solely or combined with GA_3 weekly caused a significant increase in leaves than other treatments in both studied seasons.

No difference was observed in statically analysis between two soil fertilizer and cultivars. The highest values of leaf K content were in concomitant to Maraki cultivar subjected to N, P, K (5- 0- 45) + spraying urea (1%) weekly. The present data were partially in harmony with those obtained by ***Chal, (1985)***; ***Georaeous (1991), Cakmak, (2005)*** on olive seedlings; ***El-Din et al., (1993)*** on Pomegranate seedlings ***and Taylor***, ***(1972)*** on pecan seedlings.

Finally, it can be concluded from the present study that, under the same conditions of our study foliar applications with urea plus gibberellins could be benefit on vegetative growth (longer with thickness stem and number of leaves and shoots / plant) and plant organ fresh and dry weight of Coratine and Maraki olive cultivars to reach a suitable size for selling in an earlier age than normal.

Table (8): Effect of sprays of Urea , Gibberellins and mineral fertilizations on dry stem weight (gm in transplants of olive cvs .(2006 / 2007 season) .

Season	2006					2007				
Treatments	Coratina		Maraki		Mean	Coratina		Maraki		Mean
	F1	F2	F1	F2		F1	F2	F1	F2	
control	5.353 n	5.437 n	6.380 j	5.913 l	**5.896 E**	6.133 o	5.350 r	6.523 l	6.110 o	**6.029 E**
Urea weekly	7.517 f	7.753 e	6.653 i	8.427 bc	**7.937 B**	7.830 f	7.513 g	7.517 g	7.153 h	**7.501 B**
Urea after two weeks	6.200 k	7.510 f	5.597 m	6.333 j	**6.410 D**	6.133 o	6.900 j	6.883 j	6.317 n	**6.558 D**
GA_3 weekly	7.310 g	8.770 a	6.980 h	8.327 c	**7.847AB**	6.130 o	8.863 a	6.530 l	8.317 d	**7.460 B**
GA_3 after two weeks	6.180 k	8.510 b	6.350 j	7.847 e	**7.222 C**	5.547 q	8.387 c	6.347 n	7.953 e	**7.058 C**
Urea+ GA_3 weekly	7.710 e	8.887 a	6.863 h	7.687 f	**7.937 A**	8.760 b	8.840 a	7.980 f	6.920 j	**7.900 A**
Urea+ GA_3 after two weeks	5.893 l	8.077 d	5.557 m	6.410 j	**6.484 D**	5.547 q	6.587 k	5.780 p	6.413 m	**6.082 E**
Mean F	**6.461 B**		**7.585 A**			**6.666 B**		**7.216 A**		
Mean Var.	**7.258 A**		**6.788 A**			**6.994 A**		**6.889 A**		

F1:soil fertilizer(19-19-19) . **F2**: soil fertilizer (5-0-45) .

Table (9): Effect of sprays of Urea , Gibberellins and mineral fertilizations on fresh roots weight(gm) in transplants of olive cvs .(2006 / 2007 season) .

Season	2006					2007				
Treatments	Coratina		Maraki		Mean	Coratina		Maraki		Mean
	F1	F2	F1	F2		F1	F2	F1	F2	
control	15.54 d	12.63 k	12.22mn	9.77 r	**12.54 E**	12.99 n	12.15 s	12.15 s	11.49 v	**12.19 F**
Urea weekly	17.68 c	13.07 j	13.32 i	11.67 o	**13.94 B**	18.07 b	15.58 c	12.43 p	13.42 i	**14.88 B**
Urea after two weeks	14.21 f	12.26 lm	12.38 l	9.917 q	**12.19 F**	13.26 l	12.40 q	12.26 r	11.09 v	**12.25 E**
GA_3 weekly	14.09 g	15.00 d	12.26 lm	12.17mn	**13.38 C**	14.64 f	13.21 m	13.36 j	12.14 t	**13.34 D**
GA_3 after two weeks	13.18 ij	14.63 e	10.65 p	10.69 p	**12.27 EF**	15.16 d	14.65 f	12.34 r	12.82 o	**13.74 C**
Urea+ GA_3 weekly	18.81 b	13.05 j	20.84 a	10.63 p	**15.83 A**	13.24 k	14.53 g	18.61 a	15.02 e	**15.25 A**
Urea+ GA_3 after two weeks	13.05 j	12.09 n	13.18 ij	13.55 h	**12.97 D**	11.88 u	13.91 h	13.34-k	18.08 b	**13.30 D**
Mean F	**14.38 A**		**12.22 B**			**13.84-A**		**13.22-B**		
Mean Var.	**14.24 A**		**12.37 B**			**13.98-A**		**13.18-B**		

F1:soil fertilizer(19-19-19). **F2**: soil fertilizer (5-0-45) .

Table (10): Effect of sprays of Urea , Gibberellins and mineral fertilizations on dry roots weight(gm) in transplants of olive cvs .(2006 / 2007 season) .

Season	2006					2007				
Treatments	Coratina		Maraki		Mean	Coratina		Maraki		Mean
	F1	F2	F1	F2		F1	F2	F1	F2	
control	6.170 P	5.400 v	6.400 k	5.400 v	**5.842 F**	6.537 l	6.470 m	6.230 q	6.312 o	**6.387 D**
Urea weekly	8.610 bc	8.367 c	7.64 e	7.050 i	**7.918 B**	6.650 h	8.420 b	5.513 j	6.857 f	**7.360 B**
Urea after two weeks	5.963 s	6.117 r	6.347 m	5.520 u	**5.987 E**	5.133 u	6.540 l	6.210 s	6.050 s	**6.133 E**
GA_3 weekly	5.910 t	6.150 q	6.500 j	7.127 h	**6.422 D**	6.517 j	6.193 r	6.613 i	6.953 e	**6.569 C**
GA_3 after two weeks	5.520 u	5.537 u	4.400 w	6.297 o	**5.438 G**	5.713 v	5.900 t	6.320 o	6.273 p	**6.052 F**
Urea+ GA_3 weekly	8.088 d	8.873 a	7.820 d	7.447 g	**8.043 A**	6.710 g	8.513 a	7.843 c	7.413 c	**7.620 A**
Urea+ GA_3 after two weeks	6.317 n	6.447 k	7.573 f	6.393 l	**6.783 C**	6.347 i	6.623 c	5.720 vu	6.983 d	**6.418 D**
Mean F	**6.658-A**		**6.609-A**			**6.475 A**		**6.821 A**		
Mean Var.	**6.672-A**		**6.594-A**			**6.633 A**		**6.664 A**		

F1:soil fertilizer (19-19-19). **F2**: soil fertilizer (5-0-45) .

Table (11): Effect of sprays of Urea , Gibberellins and mineral fertilizations on leaf nitrogen content(%)in transplants of olive cvs .(2006 / 2007 season) .

Season	2006					2007				
Treatments	Coratina		Maraki		Mean	Coratina		Maraki		Mean
	F1	F2	F1	F2		F1	F2	F1	F2	
control	1.772 f	1.773 f	1.771 f	1.763 f	**1.769 F**	1.953 f	1.827 f g	1.723 g	1.794 g	**1.824 D**
Urea weekly	2.543 a	2.544 a	2.158 d	1.965 e	**2.303 A**	2.635 a	2.594 a	2.158 d	2.000 e	**2.346 A**
Urea after two weeks	2034 c	1.965 e	1.966 e	1.965 e	**2.059 B**	2.339 b	2.000 e	1.966 f	1.9600 f	**2.066 B**
GA_3 weekly	2.157 d	1.965e	1.580g	1.979 e	**1.920 D**	2.271 c	2.133 e	1.589 h	1.9780 f	**1.992 C**
GA_3 after two weeks	2.357 b	2.151 d	1.579 g	1.158 h	**1.811 E**	2.199 d	2.157 d	1.576 h	1.771 h	**1.925 C**
Urea+ GA_3 weekly	2.338 c	2.168 d	2.156 d	1.772 f	**2.109 B**	2.450 b	2.170 d-g	2.156 d	1.781 g	**2.139 B**
Urea+ GA_3 after two weeks	2.353 b	2.158 d	1.723 g	1.157 h	**1.848 D**	2.295 c	2.139 e	1.771 H	1.159 i	**1.841 D**
Mean F	**1.887 B**		**2.269 A**			**1.775 B**		**2.257 A**		
Mean Var.	**1.007 B**		**1.144 A**			**1.115 B**		**1.251 A**		

F1:soil fertilizer(19-19-19). **F2**: soil fertilizer (5-0-45) .

Table (12): Effect of sprays of Urea , Gibberellins and mineral fertilizations on leaf phosphor content(%)in transplants of olive cvs .(2006 / 2007 season) .

Season	2006					2007				
Treatments	Coratina		Maraki		Mean	Coratina		Maraki		Mean
	F1	F2	F1	F2		F1	F2	F1	F2	
control	0.165 jk	0.144 j	0.160 k	0.134 m	**0.150 G**	0.167 j	0.140 lm	0.151 m	0.130 o	**0.147 F**
Urea weekly	0.237 b	0.224 d	0.212 e	0.208 f	**0.220 B**	0.230 b	0.222 e	0.224 d	0.199 h	**0.218 B**
Urea after two weeks	0.230 c	0.144 j	0.182 h	0.195 g	**0.187 E**	0.224 d	0.144 l	0.195 hi	0.189 i	**0.188 D**
GA_3 weekly	0.223 d	0.224 d	0.195 g	0.160 k	**0.200 C**	0.220 f	0.226 c	0.175 k	0.165 l	**0.197 C**
GA_3 after two weeks	0.172 k	0.173 i	0.169 i	0.134 m	**0.162 F**	0.180 j	0.175 k	0.167 l	0.133 n	**0.163 E**
Urea+ GA_3 weekly	0.248 a	0.231 c	0.230 c	0.214 e	**0.237 A**	0.237 a	0.230 b	0.224 d	0.210 g	**0.225 A**
Urea+ GA_3 after two weeks	0.231 c	0.175 i	0.210 f	0.170 i	**0.196 D**	0.230 b	0.180 j	0.180 j	0.197 i	**0.196 C**
Mean F	**0.214 A**		**0.212 A**			**0.212 A**		**0.209 A**		
Mean Var.	**0.224 A**		**0.221 A**			**0.220 A**		**0. 215 A**		

F1:soil fertilizer(19-19-19). **F2**: soil fertilizer (5-0-45) .

Table (13): Effect of sprays of Urea, Gibberellins and mineral fertilizations on leaf Potassium content(%)in transplants of olive cvs .(2006 / 2007 season) .

Season	2006					2007				
Treatments	Coratina		Maraki		Mean	Coratina		Maraki		Mean
	F1	F2	F1	F2		F1	F2	F1	F2	
control	1.236 l	1.208 m	1.265 k	1.294 j	**1.250 F**	1.217 q	1.240 p	1.226 o	1.296 n	**1.253 G**
Urea weekly	1.409 f	1.466 d	1.552 a	1.553 a	**1.420 B**	1.410 g	1.469 d	1.455 e	1.550 a	**1.471 A**
Urea after two weeks	1.323 i	1.409 f	1.410 f	1.466 d	**1.402 C**	1.325 l	1.399 h	1.417 g	1.460 d	**1.400 C**
GA_3 weekly	1.295 j	1.323 i	1.351 h	1.379 g	**1.337 E**	1.300 n	1.320 l	1.350 k	1.380 i	**1.337 F**
GA_3 after two weeks	1.323 i	1.323 i	1.380 g	1.323 i	**1.337 E**	1.320 l	1.312 m	1.360 j	1.400 h	**1.348 E**
Urea+ GA_3 weekly	1.351 h	1.438 e	1.496 c	1.524 b	**1.452 A**	1.350 k	1.440 f	1.490 c	1.520 b	**1.450 B**
Urea+ GA_3 after two weeks	1.323 i	1.410 f	1.437 e	1.352 h	**1.380 D**	1.320 l	1.417 g	1.440 f	1.350 k	**1.381 D**
Mean F	**1.337 A**		**1.399 A**			**1.323 A**		**1.359 A**		
Mean Var.	**1.368 A**		**1.368 A**			**1.361 A**		**1.364 A**		

F1:soil fertilizer(19-19-19). **F2**: soil fertilizer (5-0-45) .

5. References

Abo-Taleb, S.A. (1987). Response of olive transplants to applications of nitrogen and growth regulators. M. Sc. Thesis, Fac. Of Agric. Cairo Univ.

Ahmed, S., and Khan, M.L (1964). Effect of gibberellic acid on the growth of citrus seedlings. Hort. Abs., 35: 8716.

Ashraf, M. Y. (2010). Improvement in yield and quality of Kinnow (Citrus Delicious x Citrus Nobilis) by potassium fertilization. J. Plant Nutrition, Vol. 33, pp. 1625-1637.

Bartolini, G. and Ministro, M. (1981). Effect of interaction of various growth regulators on the rooting and growth of olive in the nursery. Rivista della or to flora frutticoltura Italiana., 65: 451 – 462. (Hort. Abst., 52: 5796).

Brown, J.G. and Lilleland, O. (1946). Rapid determination of potassium and sodium of plant material and soil extract by flam photometer. Proc. Amer. Soc. Hort. Sci. 48: 341-346.

Cakmak, I (2005). The role of potassium in alleviating detrimental effect of a biotic stress in plants. J. plant Nut. Soil Sci 168: 521 – 530.

Chal, J. S. (1985). Growth Patterns of Seasonal changes in the chemical composition of leaves, shoots in seedless grapes induced by gibberllic acid. II. Seasonal change in chemical composition of leaves and shoots. Journal of the Korean Society for Horticultural Science, 25: 116 – 122. (Hort. Abst., 56: 4130).

Civantos S.L. (2008). la Olivicultura en murdo yen Espata .In: Barranco ,D., Publishers ,Murdi-Prensa.Junta de Andalucia ,Madrid ,pp:18-35 .

Corrales, I.; Cuerra, A.; Lopez, P. and Rodriguez, H. (1993). Response of guava trees to potassium fertilization in vertical camagency. Conference 11th Latin America Roule 3-fertilization, 11-17 March Havana,Cuba 3:77-779

El-Din, I. S.; Nouman, V.F. and Youssef N.F. (1993). Influence of spraying urea and Gibbrelic acid on pomegranate seedlings growth. Egypt J. Apple. Sci., 8(7): 571 – 582.

El-Shazly, S. A. M. (1981). Mineral element analysis of some citrus plants as affected by some foliar applications. Ph.D.Thesis Faculty of Agriculture, Ain Shams University.

Fanei, K.M.; Calari, M.; and Chanbari, B. A. (2009). Amelioration of water stress by potassium fertilizer in two oil seed species. Int. J. Olant Prod. 3:41-51.

F.A.O.(2008). The staticatical Database (FAOSTAT). Rome Italy: Food and Agriculture organization of the United Nations. Available in: http://faostat.fao.org [8 June, 2009].

Georgeous, K.G. (1991). Response of rooted cuttings of some olive varieties to urea and gibberelin sprays and mineral fertilization. M. Sc. Thesis Fac. Of Agric. Moshtohor, Zagazig Univ.

Khalil, F.A, Hamoda, A.M.; El-Din, I.S. and Noman, V.F. (1983). Influence of gibberellic acid on enhancing pecan seedlings growth. Annals, Agric. Sci. Fac. Agric., Ain Shams Univ. Cairo, Egypt, Vol. 28 (3): 1689 – 1698.

Kim, T.; Mills, H. M. and Wetzstein, H. Y. (2002). Studies on effect of nitrogen form on growth, development and nutrient uptake in pecan. J. of Plant Nutrition, 2:497-508

Leopold, A. C. and Kriedmann, P. E. (1975). Plant growth and development. Sec. Edit., Mcgrawittil Book, Co.

Murphy, J. and Riely, J. P. (1962). A modified single solution for the determination of the phosphate in natural water. Anal. Chem. Acta. 27: 31-36.

Pregl, F. (1945). Quantitative Organic Micro Analysis. 4th Ed. J. A. Churchill LTD. London, PP: 126 – 129.

Said, W.T. (1989). Study of some factors affecting growth of pecan seedlings. M.Sc. Thesis, Fac. Of Agric. Moshtohor, Zagazig University.

Snedecor, G. A. and Cochran, W. D. (1980). Statistical Methods. Oxford and J. B. H. Bub Com. 7th Edition.

Soad, M. M. Ibrahim (2005). Response of foliar application of Benzyl adenine and Gibberellic on growth and chemical composition of Jojoba seedlings. Ph. D. Thesis, fac. Of Agric. Minia Univ. Egypt.

Stowe, B. B. and Yamaki, T. (1959). Gibberellin stimulants of plant growth .Scince:129, 807 .

Taylor, R.M. (1972). Influence of gibberellic acid on pecan seedlings. J. Amer. Soc. – Hort. Sci., 7: 677 – 679.

Waller, P.A and D.B. Duncan,(1969) . Abays rule for the symmetric multiple comparison problem .Amer .Stat . Assoc. J., 1485-1503 **.**

Wiggans, S.c. and Martin, L. W. (1961). The effect of GA on germination and seedlings growth of pecan. Proc. Amer. Soc. Hort. Sci, 77: 293 – 300.

Youssef, N. F. and A bo-Taleb, S. A. (1996). Response of Desirablev pecan seedlings to foliar sprays with zinc sulphate, urea and gibberllic acid. Egypt J. Sci., 11(2).

8/13/2011