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STUDIES OF "KALAMATA" OLIVE CULTIVAR GRAFTED ONTO DIFFERENT ROOTSTOCKS AND FOLIAR GA_3

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ABSTRACT

This work was conducted at the experimental farm of the Horticultural Research Institute, Giza governorate during the two growing seasons (2002 and 2003), to study the effect of Kalamata top grafting on three olive rootstocks (koroneiki, Manzanillo and Picual cvs.) and to investigate the efficiency of foliar application of GA_3 with regard to dose and time of treatment on the grafted Kalamata plants - GA_3 at (100, 200 & 300 ppm) was applied at three dates (Mide May, June and July). Data revealed that, Kalamata scion cv. grafted on Manzanillo olive rootstock surpassed other rootstock cvs. in the scion growth and grafting survival percentage in both seasons. Whereas, Kalamata scion cv. grafted on Manzanillo olive rootstock sprayed with 300 GA_3 three doses performed the highest significant values in the root length, root and shoot dry weight compred to other treatments during the two growing seasons. Whileas, Kalamata scion cv. grafted on Picual olive rootstock cv. sprayed with water one dose (mide May) performed the highest significant value in No. of roots in both seasons. Kalamata scion cv. grafted on Picual rootstocks and sprayed three doses with 300 ppm GA_3 gave the highest No. of leaves and leaf area during 2002 growing season. Meantime, Kalamata scion cv. grafted on Manzanillo and sprayed two doses with 200 ppm GA_3 gave the superior No. of leaves compared to the other values during the second one. Grafting Kalamata cv. on Koroneiki rootstock plants which sprayed two doses with 100 ppm GA_3 influenced significantly shoot/ root ratio compared to the other treatments in the interaction effect during the two growing seasons. Kalamata scion cv. grafted on Picual and Koroneiki rootstock plants sprayed one dose with 300 ppm GA_3 surpassed the other treatments in number of branches in the first and second ones, respectively. Kalamata scion cv. grafted on Koroneiki rootstock cv. sprayed with 300 ppm GA_3 one and three doses gave the highest graft length during 2002 and 2003 growing seasons, respectively. Kalamata scion cv. grafted on Picual rootstock cv. sprayed three doses with 200 ppm GA_3 gave the best graft thickness in both seasons. Complete healing was noticed in Kalamta scion cv. grafted on the three rootstock/scion of Koroneiki, Manzanillo and Picual cvs. without any gap or split. The recommended rootstocks for Kalamata grafting can be arranged in descending order as follow Manzanillo, Koroneiki and Picual rootstocks besides, spraying it with 300 ppm GA_3 concentration, three doses during the two growing seasons.

Keywords: Grafting, Olive, Kalamata, Rootstocks, GA_3, sprays.

INTRODUCTION

Olive (*Olea europaea L.*) is a major crop in many countries of the Mediterranean areas. The olive tree has been cultivated in Egypt for thousands years (Anagnostopoulas 1951). Olive production plays an important role in the economy of many countries, Kalamata olive which considers the best black table cv. In Greece. The importing of olive cultivars is subjected to different ecological and agro ecosystems resulting in positive or negative mutations under different conditions (Weiying *et al.*, 1998). The heterogeneity of the olive species avoids the direct use of seed for

propagating varieties (Caballero, 1997). So, seedlings must be grafted to the desired variety. Grafting is used in very few and restricted cases especially in very difficult-to-root varieties (Rno, *et al.,* 1988). Growth cultivar mechanisms differ in different stock–scion growth combinations and interrelationship that has been an important role in coordinating activities in the plant (Wareing 1977, Michael and Mary 2002 and Laz (2005). The importance of gibberellins in the growth and metabolism of the plants is well established (Graebe and Roeper, 1978 and Goodwin et al, 1978).

The objective of this work is to investigate the effect of three rootstocks (Manzanillo, Picual & Koroneiki cvs.) on Kalamata scion and the response of the plants to GA_3 foliar application (100,200 & 300 ppm) and time of sprayings.

MATERIAL AND METHODS

This investigation was executed in the experimental farm of the Horticulture Research Institute, Giza, Governorate, Egypt during 2002 and 2003 growing seasons to study the response of grafting Kalamata scion cv. (the best black table cv.) to different olive rootstocks (Koroneiki, Manzanillo & Picual cvs.) and different GA_3 concentrations as foliag application on three dates (Mide , May , June & July). One-year old homogeneous 500 different rootstock transplants were chosen of about 80-100cm in lenth and the thickness of 5-7mm. The rootstock plants were cut to 25 cm length for grafting leaving a side branch to feed the rootstock. The Kalamata scion grafts with about three nods were prepared at 10cm length and thickness suitable for each rootstock. Grafting started at March, 15th using top grafting then the plants were put under tight plastic tunnels in a shade place after irrigation.

After one month the plastic tunnels were removed gradually, then eradicating lateral branches under the graft-union except the leaves. The percentage of successful grafting and survival after one and two months of grafting for each rootstock were taken, respectively. Each grafted Kalamata plant received 0.5 g ammonium sulphate every 15 days.

After that, the similar grafted plants of each rootstock were chosen and arranged in 10 groups, each group contains 5 replicates and each replicate include 7 plants sprayed with GA_3 three doses at May, 15th , June, 15th & July, 15th with 100, 200 & 300 ppm concentrations. The treatments were arranged as follows:

1-Control (sprayed with tap water).
2- Foliar application of 100 ppm GA_3 at May, 15th.
3- Foliar application of 100 ppm GA_3 at May, 15th + June, 15th.
4- Foliar application of 100 ppm 15th at May, 15th + June, 15th + July, 15th 5- Foliar application of 200 ppm GA_3 at May, 15th.
6- Foliar application of 200 ppm GA_3 at May, 15th + June, 15th.
7- Foliar application of 200ppm GA_3 at May, 15th + June, 15th + July, 15th.
8- Foliar application of 300 ppm GA_3 at May, 15th.
9- Foliar application of 300 ppm GA_3 at May, 15th + June, 15th.
10- Foliar application of 300ppm GA_3 at May, 15th + June, 15th + July, 15th.

At mid-October the following measurements were taken:

Length and number of roots, area and number of leaves, shoot and root dry weight and root/shoot ratio, number and length of branches, graft length and thickness.

Histological studies:

Samples were taken for anatomical examenation 210 days after grafting and healing of stock/scion union were studied in stem segments containing the graft union and collected at random from the original grafted plants. The samples were killed and fixed in FAA (formalin-acetic acid-50% ethyle alcohol 5: 5:90, respectively, v/v/v). Transverse sections were taken and cut at 25U on hand fed sliding microtome. Double stained and mounted according to (Johansone, 1940).

Statistical analysis: According to Snedecor and Cochrian (1980), differences between treatments were compared by Duncans multiple range test described in the SAS program (SAS).

RESULTS AND DISCUSSION

scion success and survival (%):

The percentage of scion growth success and survival is shown in Table (1). It is obvious that, Kalamata scion cv. grafted on Manzanilo rootstock surpassed other rootstock cvs. in the scion growth and grafting survival (%) during both seasons (2002 &2003). On the contrary, Picual and Koroneiki rootstock were the least in the same characters in the first and second seasons,respectively. These results coincide with those of Sotomayor-Leon and Caballero (1994) and Laz (2005) on olive and Grauke and Barr (1996) on pecan.

Table (1): Percentage of scion growth and survival of Kalamata olive cv. Scion grafted on three olive rootstocks (Koroneiki, Manzanillo and Picual cvs.) during 2002 and 2003 seasons.

Rootstock cultivars	Scion success (%)		Grafting survival (%)	
	2002	2003	2002	2003
Koroneiki	56.82 C	69.84 B	52.53 B	55.55 B
Manzanillo	77.76 A	91.11 A	68.48 A	65.39 A
Picual	63.56 B	65.08 B	58.41 B	55.23 B

Means followed by the same letters within the same column are not significantly different P =0.05.

Root growth:

The effect of GA_3 foliar application on Kalamata" olive cv. grafted onto three olive rootstocks (Koroneiki, Manzanillo & Picual) on root growth during 2002 and 2003 growing seasons is shown in (Table 2). Data revealed that, there was no significant difference between the three cvs. in the root growth in the 1st season. Whereas, Koroneiki rootstock gave the highest significant difference compared to other cvs. followed by Picual and Manzanillo rootstocks in the second one. The achieved results go in harmony with Tattini *et al.*, (1994) who indicated that root vigor was positively related to cultivar vigor.

Generally, the highest GA_3 (300ppm) concentration followed by 100ppm surpassed the other concentrations in the root length. Reversely the

control was the least one in both seasons. As for the No. of doses the three doses surpassed the other treatments during 2002 &2003 seasons.

The interaction effect indicated that, Kalamata scion cv. grafted on Manzanillo olive rootstock sprayed with 300ppm three doses GA_3 gave the highest significant value in the root length compared to other treatments during the two growing seasons. On the contrary, Kalamata scon cv. grafted on Picual rootstock without GA_3 spraying showed the least value in the 1st season, meantime grafting on Manzanillo rootstock gave the analogous effect as sprayed with two doses of 100ppm GA_3.

Concerning the effect of GA_3. on No. of roots (Table 3), showed non significant differences between the three rootstock cvs. as treated with GA_3 sprayings in the 1st season. Whileas, Kalamata scion cv. grafted on Picual olive rootstock surpassed in the second one. As for the concentration, the control and 200 ppm treatments significantly increased this character compared to other concentrations. On the other hand, the plants sprayed with 100 ppm concentration showed the lowest No. of roots. As related to the effect of No. of doses, there wasn't any significant differences between treatments in both seasons.

Picual olive rootstock cv. sprayed with water one dose gave the highest significant value in No. of roots in both seasons. On the contrast, Kalamata scion cv. grafted on Picual and Manzanillo rootstock sprayed with 100ppm GA_3 three doses performed the least significant value in 2002 and 2003 seasons, respectively. The obtained results go in harmony with Tattini *et al.*, (1994) who indicated that root vigor was positively related to cultivar vigor. Rootstocks may be able to convert gibberellins into a more active or less active form. Shoot growth is dependent on root-synthesized gibberellins (Carr and Reid 1968). Plants can metabolize gibberellins when they are applied exogenously (Yamane *et al.*, 1979).

Leaf characteristics:

It can be observed from Tables (4&5) that, there weren't any significant differences when Kalamata scion was grafted onto the studied olive rootstocks (Koroneiki, Manzanillo &Picual) on No. of leaves and leaf area. Spraying the grafted Kalamata plants with GA_3 at different concentrations (control, 100, 200 &300ppm) and sprayed 1, 2 & 3 doses have the same analogous effect during 2002 and 2003 growing seasons.

Concerning the interaction effect, Kalamata grafted on Picual rootstocks and sprayed three doses with 300 ppm GA_3 gave the highest No. of leaves and leaf area during 2002 growing season. Whereas, that grafted on Manzanillo rootstock and sprayed with two doses with 200ppm gave the superior No. of leaves compared with the other interaction values during the second one. Meantime, Kalamata grafted on Picual rootstocks sprayed with water one dose showed the highest leaf area during the same season followed by that grafted on Koroneiki rootstock and sprayed with 300ppm GA_3 three doses.

Table (2): The effect of GA3 concentrations and number of sprays on the root length of grafted Kalamata plants. during 2002 and 2003 seasons.

Concentrations	Number of spring	2002 K	2002 M	2002 P	2002 Mean	2003 K	2003 M	2003 P	2003 Mean
Control	1	20.33 mn*	18.33 o	14.83 p	18.00 C	23.17 m	19.33 o	17.83 pq	20.11 C
	2	20.33 mn	18.33 o	14.83 p		23.17 m	19.33 o	17.83 pq	
	3	20.33 mn	18.33 o	14.83 p		23.17 m	19.33 o	17.83 pq	
100 ppm	1	27.83 ef	22.83 jk	43.67 b	27.57 AB	26.00 jk	24.83 l	43.50 b	28.35 A
	2	40.33 c	16.00 p	21.83 j-l		41.67 c	17.17 q	23.17 m	
	3	26.67 fg	23.17 ij	25.83 g		30.17 f	21.00 n	27.67 gh	
200 ppm	1	33.17 d	23.17 ij	21.17 lm	25.15 B	31.17 ef	22.67 m	22.50 m	24.76 B
	2	28.67 e	20.50 l-n	22.83 jk		22.50 kl	18.33 op	26.67 h-j	
	3	33.00 d	19.50 no	24.33 hi		32.00 de	17.67 pq	26.33 i-k	
300 ppm	1	21.50 k-m	32.17 d	20.33 mn	29.41 A	23.17 m	32.67 d	22.50 m	30.26 A
	2	25.50 gh	18.17 o	20.33 mn		27.17 g-i	19.00 o	22.83 m	
	3	28.33 e	55.83 a	42.50 b		28.17 g	54.33 a	42.50 bc	
Mean Varity		27.17 A	23.99 A	23.94 A		27.88 A	23.81 B	25.93 AB	
Mean spraing		24.99 AB	22.35 B	27.76 A		25.78 AB	23.49 B	28.35 A	

Table (3): The effect of GA3 concentrations and number of sprays on the number of roots of of grafted Kalamata plants cvs. during 2002 and 2003 seasons.

Concentrations	Number of spring	2002 K	2002 M	2002 P	2002 Mean	2003 K	2003 M	2003 P	2003 Mean
Control	1	8.00 d*	5.00 ij	12.67 a	8.56 A	10.00 b	5.00 kl	11.00 a	8.67 A
	2	8.00 d	5.00 ij	12.67 a		10.00 b	5.00 kl	11.00 a	
	3	8.00 d	5.00 ij	12.67 a		10.00 b	5.00 kl	11.00 a	
100 ppm	1	5.33 hi	7.00 e	5.00 ij	5.78 B	5.33 jk	6.00 hi	5.33 jk	5.48 C
	2	6.33 f	7.00 e	6.00 fg		5.67 ij	5.67 ij	5.67 ij	
	3	5.67 gh	5.00 ij	4.67 j		5.00 kl	4.67 l	6.00 hi	
200 ppm	1	7.33 e	6.00 fg	5.67 gh	7.70 A	7.33 fg	6.00 hi	5.00 kl	7.56 AB
	2	5.33 hi	10.00 b	8.00 d		6.33 h	9.33 c	8.00 de	
	3	9.00 c	8.00 d	10.00 b		7.67 ef	8.33 d	10.00 b	
300 ppm	1	5.67 gh	6.33 f	8.00 d	6.11 B	5.67 ij	5.67 ij	10.00 b	6.52 BC
	2	5.00 ij	5.00 ij	5.00 ij		5.67 ij	6.00 hi	5.67 ij	
	3	6.00 eg	7.00 e	7.00 e		5.67 ij	7.33 fg	7.00 g	
Mean Varity		6.64 A	6.36 A	8.11 A		7.03 AB	6.17 B	7.97 A	
Mean spraing		6.83 A	4.94 A	7.33 A		6.86 A	7.00 A	7.30 A	

Means followed by the same letters within the same column are not significantly different P =0.05. K= koroneiki, M=Manzanillo, P=Picual

Table (4): The effect of GA3 concentrations and number of sprays on the number of leaves of grafted Kalamata plants. during 2002 and 2003 seasons.

Concentrations	Number of spring	2002 K	2002 M	2002 P	2002 Mean	2003 K	2003 M	2003 P	2003 Mean
Control	1	57.00 h-k*	50.00 k-m	54.67 i-l	53.89 A	48.33 ij	68.00 cd	87.00 b	67.78 A
	2	57.00 h-k	50.00 k-m	54.67 i-l		48.33 ij	68.00 cd	87.00 b	
	3	57.00 h-k	50.00 k-m	54.67 i-l		48.33 ij	68.00 cd	87.00 b	
100 ppm	1	62.00 e-i	57.67 g-j	56.00 i-k	60.19 A	32.00 k	57.67 e-h	47.33 ij	52.56 A
	2	42.67 n	64.00 d-h	70.67 b-d		48.33 ij	60.00 d-g	58.33 e-g	
	3	34.33 0	77.67 b	76.67 b		48.67 ij	61.67 d-f	59.00 e-g	
200 ppm	1	48.33 l-n	58.00 g-j	64.67 c-g	56.70 A	43.33 j	64.33 c-e	47.67 ij	65.74 A
	2	34.33 o	60.00 g-i	68.67 c-e		61.33 d-e	96.67 a	60.00 d-g	
	3	61.00 f-i	43.33 mn	72.00 bc		71.33 c	95.67 a	51.33 g-j	
300 ppm	1	68.00 c-f	67.67 c-f	77.67 b	70.26 A	58.67 e-g	48.00 ij	49.67 h-j	60.04 A
	2	65.00 c-g	52.00 j-l	68.00 c-f		55.00 f-i	63.67 c-f	61.33 d-f	
	3	55.67 i-l	76.33 b	102.00 a		55.67 e-i	61.67 d-f	86.67 b	
Mean Varity		53.53 A	85.89 A	68.36 A		51.61 A	67.78 A	65.19 A	
Mean spraing		60.14 A	57.25 A	63.39 A		54.33 A	64.00 A	66.25 A	

Table (5): The effect of GA3 concentrations and number of sprays on the leaf area of of grafted Kalamata plants. during 2002 and 2003 seasons.

Concentrations	Number of spring	2002 K	2002 M	2002 P	2002 Mean	2003 K	2003 M	2003 P	2003 Mean
Control	1	4.76 kl*	4.84 kl	6.15 ef	5.25 A	5.23 jk	4.12 op	7.96 a	5.77 A
	2	4.76 kl	4.84 kl	6.15 ef		5.23 jk	4.12 op	7.96 a	
	3	4.76 kl	4.84 kl	6.15 ef		5.23 jk	4.12 op	7.96 a	
100 ppm	1	4.78 kl	5.08 jk	5.72 h	5.57 A	4.69 lm	5.63 g-i	6.68 bc	5.63 a
	2	7.10 c	5.68 h	4.90 k		6.03 d-f	4.45 m-o	4.75 lm	
	3	4.29 m	6.95 c	5.66 h		5.38 ij	6.93 b	6.13 de	
200 ppm	1	6.61 d	6.38 de	5.11 jk	6.17 A	5.45 h-j	6.57 c	5.37 ij	5.95 A
	2	5.53 hi	5.28 ij	5.80 hi		4.95 kl	5.76 f-h	5.85 e-g	
	3	6.17 ef	7.80 b	7.09 c		6.70 bc	6.87 bc	6.03 d-f	
300 ppm	1	3.84 n	4.49 lm	5.70 h	5.94 A	3.34 q	4.26 no	4.57 mn	5.02 A
	2	5.80 gh	6.39 de	6.07 e-g		4.95 kl	4.63 lm	3.79 p	
	3	7.02 c	5.84 f-h	8.26 a		7.75 a	5.67 gi	6.21 d	
Mean Varity		5.45 A	5.70 A	6.05 A		5.41 A	5.26 A	6.10 A	
Mean spraing		5.29 A	5.67 A	6.24 A		5.32 A	5.20 A	6.25 A	

Means followed by the same letters within the same column are not significantly different P =0.05. K= koroneiki, M=Manzanillo, P=Picual

On the contrast, Kalamata grafted on Koroneiki rootstock and sprayed with 100 and 200 ppm GA_3 three and two doses, performed the lowest leaf area during 2002 season, respectively. Plants sprayed with 100 ppm one time during 2003 showed also the least significant differences in the leaf number. In addition, Koroneiki rootstock showed the same analogous effect on leaf area when sprayed with one dose 300 ppm GA_3 in both seasons. These results were coincide with the data of Michael and Mary (2002) and Laz (2005)

Dry weight:

Table, (6) showed that, the root dry weight of Manzanilo rootstock significantly increased compared to that of Koroneiki and Picual rootstocks as affected by GA_3 concentration and doses of sprays during 2002 and 2003 growing seasons. Meanwhile, 300 ppm concentration of GA_3 surpassed other concentrations in the same character in both seasons. Concerning the doses of sprays, the three doses gave the highest root dry weight during the two growing seasons.

Generally, Kalamata grafted on Manzanillo rootstocks and sprayed with 300 ppm GA_3, three doses performed the highest root dry weight value compared to other interactions in both seasons. Reversely, Kalamata grafted on Picual rootstock sprayed with 200 ppm GA_3 one dose and on Koroneiki rootstock one dose with 100 ppm two doses presents the least significant root dry weight during 2002 and 2003, respectively.

As for shoot dry weight (Table 7), Kalamata grafted on Picual rootstock surpassed in the first season, whileas Manzanillo rootstock surpassed in the second one. Meantime, the control of water spraying exceeds other concentrations of GA_3 in shoot dry weight in both seasons. Besides, three doses spraying gave the highest shoot dry weight during the two growing seasons.

Kalamata grafted on Manzanillo rootstock reflexes the highest shoot dry weight when sprayed with 300 ppm GA_3 three doses in 2002 & 2003 seasons. On the contrary, Kalamata grafted on Koroneiki rootstock showed the least significant value of shoot dry weight when sprayed with 200 ppm GA_3 one dose in both seasons.

As related to root/shoot ratio, Table (8) revealed that there wasn't any significant difference either between the Kalamata grafted on the three rootstocks or the different concentrations of GA_3 during the two growing seasons. Whereas, the spraying two doses surpassed other sprayings in root/shoot ratio in both seasons.

Kalamata grafted on Koroneiki rootstock which sprayed two doses with 100 ppm GA_3 influenced significantly root/shoot compared to other treatments in the interaction effect during 2002 and 2003 growing seasons. On the contrary, the same root stock cv. plants sprayed with 200 ppm GA_3 one dose performed the least root/shoot ratio in both seasons.

Table (6): The effect of GA3 concentrations and number of sprays on the dry weight of roots of of grafted Kalamata plants. during 2002 and 2003 seasons.

Concentrations	Number of spring	2002 K	2002 M	2002 P	2002 Mean	2003 K	2003 M	2003 P	2003 Mean
Control	1	6.73 h*	4.75 l	9.61 c	7.03 AB	6.47 h	4.89 k	9.87 c	7.08 AB
	2	6.73 h	4.75 l	9.61 c		6.47 h	4.89 k	9.87 c	
	3	6.73 h	4.75 l	9.61 c		6.47 h	4.89 k	9.87 c	
100 ppm	1	5.84 j	9.79 c	4.16 m	6.15 C	5.67 j	9.62 cd	3.73 n	6.06 C
	2	2.77 p	6.82 h	5.23 k		3.10 o	6.52 h	4.66 kl	
	3	9.03 d	7.47 g	4.27 m		9.41 d	7.07 g	4.77 kl	
200 ppm	1	6.74 h	8.66 e	3.55 o	6.53 BC	6.99 g	8.47 e	3.58 n	6.59 BC
	2	3.82 n	6.79 h	4.19 m		4.31 m	6.48 h	4.61 kl	
	3	5.78 j	8.66 e	10.55 b		5.58 j	8.73 e	10.54 b	
300 ppm	1	5.74 j	4.29 m	7.56f g	7.36 A	6.08 i	4.52 lm	7.82 f	7.56 A
	2	7.71 f	7.44 g	7.72 f		8.85 f	7.60 f	7.60 f	
	3	2.97 p	16.41 a	6.38 i		3.47 n	16.18 a	6.91 g	
Mean Varity		5.88 B	7.55 A	6.87 A		5.99 B	7.49 A	6.98 A	
Mean spraing		6.45 B	6.13 B	7.72 A		6.48 B	6.16 B	7.82 A	

Table (7): The effect of GA3 concentrations and number of sprays on the shoot dry weight of grafted Kalamata plants. during 2002 and 2003 seasons.

Concentrations	Number of spring	2002 K	2002 M	2002 P	2002 Mean	2003 K	2003 M	2003 P	2003 Mean
Control	1	2.39 f1*	9.47 kl	15.49 c	12.45 A	12.53 f	9.60 j	14.48 d	12.20 A
	2	12.39 f	9.47 kl	15.49 c		12.53 f	9.60 j	14.48 d	
	3	12.39 f	9.47 kl	15.49 c		12.53 f	9.60 j	14.48 d	
100 ppm	1	7.25 p	9.99 ij	6.52 r	8.55 D	7.40 o	10.30 1i	6.16 q	8.58 C
	2	8.97 m	8.97 m	8.20 o		9.26 jk	9.30 jk	7.74 n	
	3	8.47 no	9.92 ij	8.62 n		8.30 m	10.45 hi	8.28 m	
200 ppm	1	5.00 s	10.08 i	7.19 p	10.10 C	4.97 r	10.13 i	6.89 p	9.85 B
	2	7.38 p	11.20 h	9.38 l		7.61 no	11.23 g	8.77 l	
	3	9.75 jk	14.60 e	16.28 b		9.20 k	14.38 de	16.68 b	
300 ppm	1	6.49 r	8.25 o	11.68 g	11.52 B	6.16 q	9.01 kl	10.68 h	11.43 A
	2	11.16 h	14.97 d	14.91d		11.27 g	15.20 c	14.09 e	
	3	6.86 q	16.66 a	12.69 f		6.58 p	17.04 a	12.84 f	
Mean Varity		9.04 B	11.09 A	11.83A		9.03 B	11.32 A	11.30 A	
Mean spraing		9.15 B	11.04 A	11.77 A		9.03 B	10.92 A	11.70 A	

Means followed by the same letters within the same column are not significantly different P =0.05. K= koroneiki, M=Manzanillo, P=Picual

These results were consistent with those of Tattini et al., (994) and Laz (2005). Hartman and Kester (1968) showed that there are three approaches that could be put into consideration to explain the scion-rootstock relationship affecting plant growth, these approaches are: nutritional uptake utilization, translocation of nutrient water and alteration of endogenous growth factor. These factors generally affected growth of the scion expressed as dry weight.

Branches characteristics:

Concerning the dose and length of the branches data in tables Tables, 9 & 10 indicated that the differences between Kalamata grafted on the three rootstocks, the concentrations of GA_3 and the number of doses didn't show definite trend during the two growing seasons.

Kalamata grafted on Picual and Koroneiki rootstock sprayed one dose with 300 ppm GA_3 surpassed other treatments in number of branches in the first and second season, respectively. On the other hand, Kalamata grafted on Koroneiki sprayed two and one dose with GA_3 gave the least significant differences compared to other treatments during 2002 and 2003, respectively. Whereas, Kalamata grafted on Manzanillo rootstock plants which sprayed with 200 ppm GA_3 two and three doses gave the highest significant values of branches length compared to the other treatments during 2002 and 2003 growing seasons, respectively. These results go in harmony with Sotomayor-Leon and Caballero (1994). Goodwin *et al.*, (1978) reported that, Gibberellins are synthesized in shoots.

Grafts length:

Table (11) showed the effect of aforementioned GA_3 concentrations and dose of sprays on grafts length of Kalamata scion cv. on the three rootstcks cvs. under study. Data revealed that, there weren't any significant differences between concentrations, doses of sprays or rootstock cvs. in grafts length and thickness.

Kalamata grafted on Koroneiki rootstock cv. sprayed with 300 ppm GA_3 one and three doses gave the highest graft length during 2002 and 2003 growing seasons, respectively. On the contrary, Kalamata grafted on Picual rootstock sprayed with 200 ppm one dose and Kalamata grafted on Manzanillo sprayed with 100 ppm one dose or 300 ppm three doses during 2002 and 2003 seasons, respectively. These results were in agreement with Michael and Mary 2002 and Laz (2005)

Grafts region thickness:

Data in Table (12) performed that, there weren't any significant differences between Kalamata grafted on three rootstocks as affected by spraying with GA_3 or dose of sprays in both seasons. Whereas, 300 ppm GA_3 concentration surpassed other concentrations in the thickness of the graft region during 2002 and 2003 seasons. As for the dose of sprays, the three sprays showed the highest value of graft thickness compared to other dose of sprays.

Concerning the interaction, Kalamata grafted on Picual rootstock cv. sprayed three doses with 200 ppm GA_3 gave the highest graft thickness in both seasons. Whereas, Kalamata grafted on Koroneiki and Manzanillo rootstocks sprayed with 300 ppm GA_3 two and three doses, respectively gave the same analogous effect in the second one.

Table (8): The effect of GA3 concentrations and number of sprays on the shoot/root dry weight ratio of of grafted Kalamata plants during 2002 and 2003 seasons.

Concentrations	Number of spring	2002 K	2002 M	2002 P	2002 Mean	2003 K	2003 M	2003 P	2003 Mean
Control	1	1.92 cd*	1.94 c	1.57 h	1.81 A	1.87 hi	2.02 d-f	1.52 lm	1.80 A
	2	1.92 cd	1.94 c	1.57 h		1.87 hi	2.02 d-f	1.52 lm	
	3	1.92 cd	1.91 c	1.57 h		1.87 hi	2.02 d-f	1.52 lm	
100 ppm	1	1.28 k	1.04 m	1.76 e-g	1.58 A	1.26 q	1.05 s	1.48 mn	1.59 A
	2	2.92 a	1.38 j	1.76 e-g		3.38 a	1.36 p	1.48 mn	
	3	0.90 n	1.40 j	1.81 ef		0.92 t	1.40 op	1.94 gh	
200 ppm	1	0.71 o	1.19 l	2.04 b	1.60 A	0.74 u	1.17 r	1.95 fg	1.61 A
	2	1.72 g	1.74 fg	2.05 b		2.00 e-g	1.65 jk	2.10 c	
	3	1.76 e-g	1.68 g	1.55 h		1.59 jk	1.66 j	1.58 kl	
300 ppm	1	1.09 m	1.83 de	1.50 hi	1.63 A	1.07 s	2.09 cd	1.42 n-p	1.69 A
	2	1.42 ij	1.99 bc	1.96 bc		1.46 m-o	2.05 c-e	1.82 i	
	3	2.00 bc	1.03 m	1.84 de		2.21 b	1.04 s	2.02 d-f	
Mean Varity		1.63 A	1.59 A	1.75 A		1.69 A	1.63 A	1.70 A	
Mean spraing		1.49 B	1.86 A	1.62 AB		1.47 B	1.89 A	1.65 B	

Table (9): The effect of GA3 concentrations and number of sprays on the graft branches number of of grafted Kalamata plants during 2002 and 2003 seasons.

Concentrations	Number of spring	2002 K	2002 M	2002 P	2002 Mean	2003 K	2003 M	2003 P	2003 Mean
Control	1	5.00 jk*	3.67 l	5.67 hi	4.78 B	4.67 ab	3.33 d	3.33 d	3.78 A
	2	5.00 jk	3.67 l	5.67 hi		4.67 ab	3.33 d	3.33 d	
	3	5.00 jk	3.67 l	5.67 hi		4.67 ab	3.33 d	3.33 d	
100 ppm	1	3.67 l	7.33 cd	7.00 de	6.00 AB	2.33 f	2.33 f	2.33 f	2.96 A
	2	6.33 fg	6.67 ef	7.33 cd		2.67 ef	3.00 de	3.00 de	
	3	5.00 jk	5.00 jk	5.67 hi		2.67 ef	4.33 bc	4.00 c	
200 ppm	1	4.67 k	4.67 k	5.33 ij	5.89 AB	2.33 f	3.00 de	2.67 ef	3.37 A
	2	3.00 m	6.00 gh	7.67 c		4.67 ab	4.33 bc	4.33 bc	
	3	7.00 de	8.33 b	6.33 fg		3.00 de	3.33 d	2.67 ef	
300 ppm	1	6.67 ef	6.00 gh	9.00 a	6.74 A	5.00 a	3.00 de	2.33 f	3.56 A
	2	5.00 jk	5.67 hi	8.67 ab		3.33 d	3.00 de	4.00 c	
	3	7.67 c	6.00 gh	6.00 gh		4.00 c	3.33 d	4.00 c	
Mean Varity		5.33 A	5.56 A	6.67 A		3.67 A	3.31 A	3.28 A	
Mean spraing		5.72 A	5.89 A	5.94 A		3.06 A	3.64 A	3.56 A	

*Means followed by the same letters within the same column are not significantly different P =0.05. K= koroneiki, M=Manzanillo, P=Picual

Table (10): The effect of GA3 concentrations and number of sprays on the graft branche's length of of grafted Kalamata plants.during 2002 and 2003 seasons.

Concentrations	Number of spring	2002 K	2002 M	2002 P	2002 Mean	2003 K	2003 M	2003 P	2003 Mean
Control	1	7.18 no*	11.67 e-i	7.03 no	8.64 A	3.65 n	7.29 g-l	8.63 d-f	6.52 A
	2	7.18 no	11.67 e-i	7.03 no		3.65 n	7.29 g-l	8.63 d-f	
	3	7.18 no	11.67 e-i	7.03 no		3.65 n	7.29 g-l	8.63 d-f	
100 ppm	1	7.79 mn	8.28 mn	9.87 j-l	9.86 A	3.84 n	8.33 d-h	8.58 d-f	7.00 A
	2	6.11 o	12.94 c-e	14.36 bc		6.03 lm	8.63 d-f	7.72 f-j	
	3	9.17 kl	11.04 g-j	9.16 k-m		4.74 n	7.21 h-l	7.95 e-i	
200 ppm	1	8.93 lm	10.67 h-k	7.88 mn	10.96 A	7.43 f-k	9.11 d-e	8.39 d-h	8.62 A
	2	8.75 lm	15.83 a	11.19 f-j		4.02 n	10.82 b	7.53 f-k	
	3	12.44 e-g	10.19 i-l	12.75 d-f		6.31 k-m	14.34 a	9.61 cd	
300 ppm	1	10.00 j-k	14.83 ab	14.05 b-d	12.18 A	5.86 m	7.28 g-l	8.33 d-h	8.05 A
	2	11.17 f-j	12.94 c-e	11.87 e-h		7.01 i-m	11.34 b	6.51 j-m	
	3	8.83 lm	12.92 c-e	12.97 c-e		7.01 i-m	8.55 d-g	10.54 bc	
Mean Varity		8.73 A	12.05 A	10.45 A		5.27 A	8.96 A	8.42 A	
Mean spraing		9.85 A	10.92 A	10.45 A		5.23 A	7.43A	7.99A	

Table (11): The effect of GA3 concentrations and number of sprays on the graft's length of of grafted Kalamata plants. during 02002 and 2003 seasons.

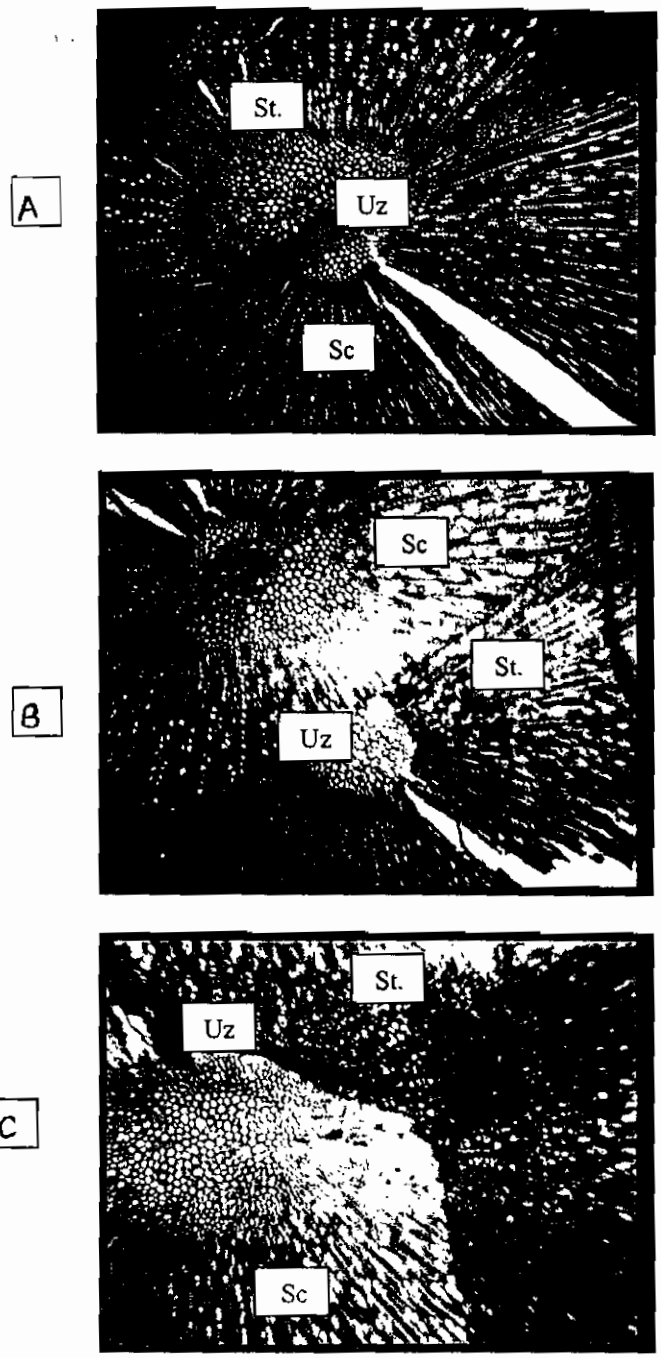
Concentrations	Number of spring	2002 K	2002 M	2002 P	2002 Mean	2003 K	2003 M	2003 P	2003 Mean
Control	1	14.00 bc*	11.00 ij	12.00 gh	12.33 A	13.67 b	10.17 d-g	9.00 jk	10.94 A
	2	14.00 bc	11.00 ij	12.00 gh		13.67 b	10.17 d-g	9.00 jk	
	3	14.00 bc	11.00 ij	12.00 gh		13.67 b	10.17 d-g	9.00 jk	
100 ppm	1	13.00 de	14.00 bc	14.00 bc	13.33 A	10.10 d-h	7.67 l	9.83 g-i	9.96 A
	2	13.67 bc	14.33 b	12.67 ef		10.07 e-h	9.83 g-i	9.83 g-i	
	3	12.00 gh	14.33 b	12.00 gh		9.77 g-j	10.67 c-f	10.00 f-h	
200 ppm	1	13.33 cd	14.00 bc	10.67 j	12.52 A	10.90 cd	10.67 c-f	10.83 c-e	10.83 A
	2	12.33fg	14.00 bc	12.00 gh		11.10 c	9.17 ij	11.33 c	
	3	12.00 gh	12.00 gh	12.33 fg		14.33 b	9.33 h-j	9.83 gi	
300 ppm	1	12.00 gh	13.00 de	12.00 gh	12.59 A	16.00 a	9.50 g-j	11.17 c	10.69 A
	2	13.00 de	14.00 bc	11.67 gh		8.33 kl	10.67 c-f	10.83 c-e	
	3	15.00 a	11.33 hi	11.33 hi		10.83 c-e	7.67 l	11.17 c	
Mean Varity		13.19 A	12.83 A	12.06 A		11.87 A	9.79 A	10.15 A	
Mean spraing		12.75 A	12.89 A	12.44 A		10.94 A	10.33 A	10.54 A	

Means followed by the same letters within the same column are not significantly different P =0.05. K= koroneiki, M=Manzanillo, P=Picual

Table (12): The effect of GA3 concentrations and number of sprays on the grafting zone thickness of of grafted Kalamata plants. during 2002 and 2003 seasons.

Concentrations	Number of spring	2002 K	2002 M	2002 P	2002 Mean	2003 K	2003 M	2003 P	2003 Mean
Control	1	7.50 hi*	6.67 k	8.83 d	7.67 B	7.17 g	6.50 h	10.17 b	7.94 AB
	2	7.50 hi	7.67 k	8.33 d		7.17 g	6.50 h	10.17 b	
	3	7.50 hi	7.67 k	8.83 d		7.17 g	6.50 h	10.17 b	
100 ppm	1	7.50 hi	7.50 hi	5.50 m	7.39 B	8.00 e	8.50 d	6.00 i	7.81 AB
	2	8.50 e	7.50 hi	6.00 l		9.50 c	7.50 f	6.50 h	
	3	8.00 f	8.50 e	7.50 hi		8.50 d	8.33 d	7.50 f	
200 ppm	1	6.00 l	6.67 k	6.00 l	7.41 B	6.50 h	6.00 i	6.67 h	7.41 B
	2	7.67 gh	7.50 hi	7.50 hi		7.50 f	7.50 f	7.50 f	
	3	7.00 j	7.33 i	11.00 a		7.50 f	7.00 g	10.50 a	
300 ppm	1	6.50 k	7.83 fg	8.50 e	8.61 A	6.00 i	7.17 g	7.50 f	8.30 A
	2	10.17 b	8.50 e	9.50 c		10.50 a	8.50 d	8.50 d	
	3	7.83 fg	10.17 b	8.50 e		7.50 f	10.50 a	8.50 d	
Mean Varity		7.64 A	7.62 A	8.04 A		7.75 A	7.54 A	8.31 A	
Mean spraing		7.08 B	7.99 AB	8.24 A		7.18 B	8.11 A	8.30 A	

Means followed by the same letters within the same column are not significantly different P =0.05. K= koroneiki, M=Manzanillo, P=Picual



(Fig.1): T. S. Through union zone examined 210 days after top grafting (A) Koroneiki (B) Manzanillo (C) Picual. (St.) stock (Sc) scion (Uz) union zone. X= 63.

On contrast, the same rootstock plants showed the least graft thickness when sprayed with water three doses in the first season.. Meantime, Kalamata grafted on Picual, Manzanillo and Koroneiki rootstocks sprayed one dose with 100, 200 and 300 ppm GA_3 showed the least significant values of graft thickness. Sotomayor-Leon and Caballero (1994) reported that, "Gordal Sevillana" nursery trees grafted onto Picual rooted cuttings were higher than the own rooting either the stock or the scion. Tubbs, (1980) reported that the effect of clonal tissue on tree size may be differing when used as stock or scion or stock-scion combinations. The mechanism involved in this influence on growth may be attributed to the coordinating role of the hormonal system or to what is called a growth substance interrelationship between root and shoot that has an important role in coordinating activities in the plant (Wareing 1977).

Histological observations:

As illustrated in fig. (1) examination of unions after 210 days revealed that, perfect graft union was observed and complete healing was noticed in Kalamata scion grafted on the three rootstock/scion of Koroneiki, Manzanillo and Picual cvs.. According to the pictures A, B &C there is no gap or air pockets to indicate any split or cleavage between scion and stock of the three rootstock cvs. Under complete union, the success of grafting depends (from histological point of view) on vascular differentiation at the healing union point (Funtanazza and Rugini, 1983). Rapid cambial activity played a rule in transformation and production of secondary tissues which joined the vascular tissues of both stock and scion (Othman, 1986).

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دراسات على تطعيم صنف زيتون الكلاماتا على أصول مختلفة والرش بالجبريللين

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أجرى هذا البحث بمزرعة معهد بحوث البساتين بالجيزة خلال موسمى النمو ٢٠٠٢ و ٢٠٠٣ وذلك بهدف دراسة أفضل أصول الزيتون التى يمكن تطعيم صنف زيتون الكلاماتا عليها بالقلم القمى، وقد استخدم ثلاثة أصول هى (كروناكى ، منزانيللو، بيكوال) وكذا دراسة مدى استجابة الشتلات الناتجة من التطعيم للرش بالجبريللين بتركيزات ١٠٠، ٢٠٠ ، ٣٠٠ جزء فى المليون بعدد ١ ،٢ ، ٣ مرات رش وذلك فى منتصف مايو و يونيو و يوليو وكانت أهم النتائج المتحصل عليها كالأتى:

لقد أعطت طعوم الكلاماتا على أصل المنزانيللو أعلى نسبة مئوية لنجاح و بقاء الطعم مقارنة بالطعوم على الأصول الأخرى خلال موسمى النمو ، بينما أعطى التطعيم على أصل الكروناكى أعلى طول لنمو الجذر مقارنة بالتطعيم على الأصول الأخرى ، فى حين أعطى أصل المنزانيللو أعلى زيادة فى الوزن الجاف للمجموع الجذرى مقارنة بالأصول الأخرى.

وبصفة عامة كان أعلى تركيز للجبريللين هو الأفضل لطول ووزن المجموع الجذرى الجاف وسمك منطقة التطعيم فى كلا موسمى النمو، كما أعطى التطعيم على أصل المنزانيللو الذى تم رشه بالجبريللين بتركيز ٣٠٠ جزء فى المليون بعدد ٣ مرات أعلى قيمة معنوية لطول الجذر والوزن الجاف للمجموع الجذرى والخضرى مقارنة بالمعاملات الأخرى خلال موسمى النمو وقد أظهر التطعيم على أصل البيكوال الذى تم رشه بالجبريللين بتركيز ٣٠٠ جزء فى المليون بعدد ٣ مرات أعلى قيم لعدد الأوراق والمساحة الورقية فى موسم النمو الأول وفى نفس الوقت أعطى التطعيم على أصل المنزانيللو الذى تم رشه بتركيز ٢٠٠ جزء فى المليون بعدد مرتان أعلى قيم لعدد الأوراق بالمقارنة بالمعاملات الأخرى خلال موسم النمو الثانى بينما أعطى التطعيم على أصل الكروناكى والذى تم رشه بتركيز ١٠٠ جزء فى المليون بعدد مرتان أعلى نسبة للوزن الجاف للمجموع الخضرى إلى الوزن الجاف للمجموع الجذرى مقارنة بالمعاملات الأخرى ، وقد تفوق التطعيم على أصلى البيكوال والكروناكى والذى تم رشهما مرة واحدة بتركيز ٣٠٠ جزء فى المليون جبريللين فى عدد الأفرع فى كلا موسمى النمو على التوالى ، بينما أعطى التطعيم على أصل لكروناكى الذى تم رشه ١، ٣ مرات بتركيز ٣٠٠ جزء أعلى قيم لطول الطعم خلال موسمى النمو بينما التطعيم على أصل البيكوال الذى تم رشه بتركيز ٢٠٠ جزء فى المليون أعلى قيم لسمك الطعم . ودلت الدراسة التشريحية ان هناك التحام كامل بين الطعم والأصول المستخدمة دون وجود أى ثغرات إنفصال.

وعلى ذلك يمكن التوصية بإستخدام هذه الأصول لتطعيم صنف زيتون الكلاماتا عليها على الترتيب الأتى: المنزنيللو ثم الكروناكى ثم البيكوال مع رش الجبريللين بتركيز ٣٠٠ جزء فى المليون بعدد ٣ مرات فى منتصف مايو ، يونيو ، يوليو.