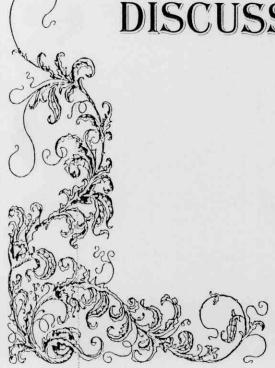


# RESULTS AND DISCUSSION



## 4. RESULTS AND DISCUSSION

# 4.1. Rooting of olive cuttings:

## 4.1.1. Rooting Percentage:

The specific effect of cultivars (Manzanillo – Picual), collecting date, shading, IBA preplanting treatment and their interaction on rooting percentage of olive cutting during 2000–2001 and 2001–2002 seasons is presented in Tables (1-a, b, c, d and e).

As for the specific effect of cultivars (Manzanillo – Picual), data in Table (1-a) showed clearly that cuttings taken from Manzanillo cv. was significant higher in rooting percentage (29.09 and 32.83%), as compared with that of Picual cv. gave lower percentage (23.63 and 27.94%) in both seasons of study, respectively.

These results are in parallel with the findings of Nahlawi et al. (1975 c) and Hartmann & Kester (1978), who indicated that various olive cultivars were shown to have different rooting potentials. Similarly, Battaglini et al. (1975), who worked on 34 olive cultivars, recorded good rooting percentage for 19 cultivar (more than 60%) medium percentage for 9 cultivar (40% to 60%) and poor results for 6 cultivaes (less than 40%). Also, El-Said (1986) found that cuttings of cv. Wetaken rooted easily (more than 70%), while rooting was poor (less than 45%) in Dermlali, Khoderi and Souri and intermediate in Frantoio, Coronaiki, Mission and Picual. In addition, Rio et al. (1986 a,b) mentioned that rooting percentage was higher in Picual than in Gordal sevillana cuttings.

Concerning the specific effect of collecting date at which shoots were excised for preparing cuttings, data presented in Table (1–b) indicated that cuttings prepared from shoots collected in June showed the highest rooting percentage (38.1 and 40.44%) followed in descending order by October (24.75 and 30.11%). On the contrary, cuttings taken in February gave the lowest percentage (16.32 and 20.62%) in the two seasons, respectively. The differences between them were highly significant (at 1% level).

These obtained results are in harmony with Gellini (1965) who found that the best rooting of apical olive cuttings in spring, apical and middle cuttings in summer and basal in early April. Accordingly, Hartmann and Loreti (1965 a, b) also mentioned that the maximum rooting of Ascolano variety was obtained in May, June and July. Similarly, Casini and Falusi (1966) showed that the summer cuttings were the more readily rooted for 13 varieties of olive. Also, Porlingis and Therios (1976) reported that with adult olive cuttings the maximum rooting percentage occurred in summer, whereas the minimum was in autumn and winter. Vlasica (1977) found that cuttings taken at the end of June rooted most readily than those taken in March, July and September.

El Said (1986) and Laz (1986) found that cuttings taken during the summer gave the highest rooting percentage, while those taken during winter gave the lowest percentage. On the other hand, cuttings collected in autumn and spring gave an intermediate value of rooting percentage. Also, Usta et al.

(1999) reported that rooting rates increased from April to September in olive cv. Domat.

With respect to the specific effect of shading, the results presented in Table (1-c) revealed that cuttings taken from shaded mother trees gave the highest significant rooting percentage (31.13 and 34.00%) as compared with those collected from unshaded mother trees (control) (21.57 and 25.57%) in both seasons of study, respectively.

These obtained results are in line with the findings of Ryan (1969), who indicated that cuttings taken from etiolated tissue of various species rooted more readily than those from tissue exposed to light. Also, Bid and Mukherjee (1972) and Reddy et al. (1975) on mango cuttings reached the same conclusion. Similarly, Nouman (1982) who worked on Chemlali olive cuttings, found that the best rooting was obtained when IBA was applied on girdled and etiolated cuttings rather than on non- girdled and non-etiolated ones. Moreover, Pannelli and Fillipucci (1982) stated that the proportions of cuttings forming roots were highest when cuttings taken from mother plants given 50% shade with olive Frantoio ev., and on Gemlik olive variety, Celik et al. (1994) reported that the rooting percentage was highest in the shaded tunnel as compared with the cuttings in the greenhouse. Furthermore, Voltolini and Fachinello (1997) who worked on guava, found that the rooting potential from stock plant grown under (70%) shade was increased as compared without shading.

Regarding the specific effect of preplanting treatment of IBA at (2000, 4000 and 6000 ppm), data in Table (1-d) reported

Table (1): Specific effect of cultivars (Manzanillo - Picual) (a), collecting date (b), Shading (c) and IBA preplanting treatments (d), on rooting percentage of olive cuttings during 2000-2001 and 2001-2002 seasons.

Season	Manzanillo	Picual	L.S.D		
	manzamino	anzanillo Picual		1%	
2000 - 2001	29.09	23.63	0.52	0.68	
2001- 2002	32.83	27.94	0.65	0.85	

# (b) Specific effect of collecting date

Season	February	June	October	L.S.D		
	· oz.uu.y	ounc	October	5%	1%	
2000 - 2001	16.23	38.10	24.75	0.64	0.84	
2001- 2002	20.62	40.44	30.11	0.80	1.04	

## (c) Specific effect of shading

Season	Control	Shading	L.S.D		
	Johnson	Onading	5%	1%	
2000 - 2001	21.57	31.13	0.52	0.68	
2001- 2002	25.57	34.00	0.65	0.85	

# ( d ) Specific effect of IBA preplanting treatments

Season	Control	I.B.A	I.B.A	I.B.A	L.S	S.D
	30111101	2000	4000	6000	5%	1%
2000 - 2001	6.25	25.46	34.64	39.09	0.74	0.97
2001- 2002	9.28	31.00	39.53	41.75	0.92	1.20

that in both seasons all tested IBA concentrations significantly increased the rooting percentage as compared with the control. Using IBA at 6000 ppm gave the highest rooting percentage (39.09 and 41.75%) followed by 4000 ppm (34.64 and 39.53%) and then 2000 ppm IBA treatment.

The obtained results of IBA are in harmony with the findings of Casini and Falusi (1966), who mentioned that olive cuttings were poor in rooting without the application of growth substances, Hartmann & Kester (1978) mentioned that IBA is the most widely used among the root promoting chemical because it is nontoxic over a wide range of concentrations. Furthermore, the present results revealed that (4000 – 6000 ppm) IBA were much more satisfactory for rooting cuttings.

These results agreed with those previously reported by Tombesi (1967 a,b), Ezzat and Neguib (1969), Nahlawi et al. (1975 a,b,c), Caballero (1981), Nouman (1982), Laz (1986), Diana (1987) and Gautam and Chauchan (1991) on different olive cvs.

Considering the interaction effect of cultivars (Manzanillo – Picual) × preparing of date cutting × shading × IBA preplanting treatments, data obtained in Table (1–e) showed that, in the first season the highest rooting percentage of cuttings resulted from shaded mother trees of Manzanillo cv. which collected and planted in June and treated with IBA at 4000 ppm (60.83), followed by these cuttings taken from shaded or unshaded (control) mother trees which planted in June and dipped in IBA at 6000 ppm. In the second season, the rooting percentage was significantly higher in cuttings collected from

Table (e): Interaction effect of different combinations between (cultivars (Manzanillo-Picual) x collecting date x shading x IBA preplanting treatments), on rooting percentage of olive cuttings in the two seasons.

ń	Tres			ollins	znsM			lsu	oiq I		Cultivar	
Season	Treatments		Control	1BA 2000 PPM	IBA 4000 PPM	IBA 6000 PPM	Control	IBA 2000 PPM	IBA 4000 PPM	IBA 6000 PPM	Cultivar xdate xshading x IBA	
		February	0.00	11.66	17.58	22.49	0.00	8.14	13.33	20.83	lina x IBA	,
	Control	June	11.66	35.83	49.17	51.67	8.33	26.17	40.83	46.66	L.S.	
2000 - 2001		October	4.16	21.32	30.00	37.16	0.00	14.66	20.83	24.99	L.S.D 5%	
- 2001		February	0.00	20.83	29.41	38.67	0.00	19.17	24.83	32.50	L.S.D 1%	
	Shade	June	16.66	47.67	60.83	54.16	16.67	39.08	53.33	50.83	1%	
		October	10.00	34.16	44.66	48.33	7.49	26.58	30.83	40.83		
		February	0.00	15.83	20.83	28.33	0.00	11.58	18.58	22.50		
	Control	June	14.99	40.83	53.33	50.83	10.83	30.83	46.66	50.83	L.S.	
2001		October	8.33	26.58	35.83	40.66	3.33	20.00	27.50	33.83	L.S.D 5%	
2001 - 2002		February	-	30.00	33.33	42.33	99.9	25.83	30.83	35.83	L.S.D 1%	
	Shade	$\perp$		50.83	62.50	47.67	17.25	43.83	54.16	51.67	1%	
		October	11.66	41.66	50.83	53.33	10.83	34.16	40.00	43.16		

June shaded mother trees and received the preplanting application of IBA at 4000 ppm (62.50). Then, June unshaded (control) cuttings which dipped in IBA at 4000 ppm and October shaded cuttings which treated at 6000 ppm, gave the same rooting percentage (53.33). While October shaded cuttings which received IBA at 4000 ppm gave also the same rooting percentage as June unshaded cuttings which treated at 6000 ppm (50.83).

As for Picual cv., it is clear that in the two seasons (2000–2001 and 2001–2002), June shaded cuttings dipped in IBA solution at 4000or 6000 ppm increased the rooting percentage, followed by June cuttings collected from mother trees (control) which treated with IBA at 6000 ppm, and then those treated at 4000 ppm. On the contrary, the lowest rooting percentage was obtained by those taken from shaded or control mother trees of Manzanillo and Picual cvs. and untreated with any concentration of IBA during three times (February – June – October) in the two seasons of study.

## 4.1.2. Number of roots/cutting:

The specific effect of cultivars (Manzanillo - Picual), date of cuttings (June - October - February), shading treatment, preplanting treatments with IBA at (2000, 4000 and 6000 ppm) and their combinations on the average number of developed roots per cutting during the two seasons (2000–2001 and 2001–2002), is reported in Tables (2–a, b, c, d and e).

As for the specific effect of cultivars (Manzanillo – Picual) on the number of roots per cutting, it is noticed that

Manzanillo cuttings gave a significant higher number of roots per cutting as compared with those of Picual cv. in Table (2-a). While Manzanillo cuttings gave (4.84 and 5.47 roots/cutting), Picual cv. produced (4.23 and 4.81 roots/cutting) in 2000–2001 and 2001–2002 seasons, respectively.

Regarding the specific effect of collecting date (June – October – February), the data in Table (2–b) showed that collecting cuttings in June gave a significant higher number of roots per cutting (6.97 and 7.62 roots /cutting) followed in descending order by collecting in October (4.17 and 4.47 roots/cutting), while collecting on February had the lowest number of roots (2.49 and 3.06 roots/cutting) in both seasons, respectively.

The obtained results are in harmony with those reported by Casini and Falusi (1966), Porlingis and Sfariolakies (1969), Porlingis and Therios (1976) and Gautam and Chauhan (1991), who mentioned that summer was the best collecting time of cuttings for maximizing root number per cutting, whereas the minimum was in autumn and winter collecting times.

Considering the specific effect of shading on number of roots per cuttings, data in Table (2–c) declared that cuttings taken from shaded mother trees had a significant higher number of roots (4.74 and 5.32 roots /cutting) in comparison to those of unshaded mother trees (control) (4.33 and 4.96 roots/cutting) in the two seasons, respectively.

Table (2): Specific effect of cultivars (Manzanillo - Picual) (a), collecting date (b), Shading (c) and IBA preplanting treatments (d), on number of roots of olive cuttings during 2000-2001 and 2001-2002 seasons.

Season	Manzanillo	Picual	L.S.D		
	Wanzaniio	ricuai	5%	1%	
2000 - 2001	4.84	4.23	0.12	0.15	
2001- 2002	5.47	4.81	0.11	0.14	

## (b) Specific effect of collecting date

Season	February	June	October	L.S.D		
	rebruary	June	October	5%	1%	
2000 - 2001	2.49	6.97	4.17	0.14	0.21	
2001- 2002	3.06	7.62	4.74	0.13	0.20	

#### (c) Specific effect of shading

Season	Control	Shading -	L.S.D		
Season	Control	Shaumy	5%	1%	
2000 - 2001	4.33	4.74	0.12	0.15	
2001- 2002	4.96	5.32	0.11	0.14	

#### (d) Specific effect of IBA preplanting treatments

Casasa	Control	Control I.B.A		I.B.A	L.S.D	
Season	Control	2000	4000	6000	5%	1%
2000 - 2001	1.00	3.85	5.99	7.32	0.16	0.21
2001- 2002	1.49	4.35	6.67	8.06	0.16	0.20

Similar findings were obtained by Hartmann and Kester (1978), Nouman (1982) and Pannelli and Fillipucci (1982) on olive.

Concerning the specific effect of different concentration of IBA on the number of roots per cutting, the data presented in Table (2–d) showed that cuttings treated with IBA at 6000 ppm gave a significant higher number of roots per cuttings (7.32 and 8.06 roots/cutting), followed by IBA at 4000 ppm (5.99 and 6.67 roots/cutting), while untreated cuttings (control) produced a few number of roots per rooted cuttings (1.00 and 1.49 roots/cutting).

The obtained results go in line with the findings of Nahlawi et al. (1975 b,c),Laz (1986), Daoud et al. (1989), Gautam and Chauchan (1991), Wiesman and Lavee (1995) and Khattak et al. (1999), who showed that the number of roots per cutting was increased with increasing of IBA concentrations.

As for the interaction between (cultivars × collecting date × shading x different concentration of IBA) on number of roots developed per cutting, Table (2-e) showed clearly that, in the first season (2000–2001), cuttings collected from shaded or unshaded (control) mother trees of Manzanillo – Picual in June and dipped IBA solution at 6000 ppm, had a significant greater number of roots, followed in descending order by shaded cuttings taken in June and treated with IBA at 4000 ppm, then those collected from mother trees (control) in June and treated with IBA at 4000 ppm. In the second season, cuttings prepared from mother trees (control) which planted in June and received the preplanting treatment of IBA at 6000 ppm, significantly had a higher number of roots, followed in descending order by IBA

Table (3): Specific effect of cultivars (Manzanillo - Picual) (a), collecting date (b), Shading (c) and IBA preplanting treatments (d), on average root length (cms) of olivecuttings during 2000-2001 and 2001-2002 seasons.

Season	Manzanillo	Picual	L.S.D		
Jeason	Wanzanino	Ficual	5%	1%	
2000 - 2001	4.07	3.69	0.12	0.16	
2001- 2002	4.75	4.26	0.13	0.17	

#### (b) Specific effect of collecting date

Season	February	June	October	L.S.D		
Jeason	rebruary	June	October	5%	1%	
2000 - 2001	2.59	5.12	3.94	0.15	0.20	
2001- 2002	3.33	5.75	4.43	0.16	0.21	

#### (c) Specific effect of shading

C	Control	Chadina	L.S.D		
Season		Shading -	5%	1%	
2000 - 2001	3.14	4.62	0.12	0.16	
2001- 2002	3.72	5.28	0.13	0.17	

## (d) Specific effect of IBA preplanting treatments

		I.B.A	I.B.A	I.B.A	L.S	S.D
Season	Control	2000	4000	6000	5%	1%
2000 - 2001	1.51	3.87	4.72	5.42	0.17	0.23
2001- 2002	2.35	4.41	5.20	6.07	0.19	0.24

(control) decreased the length of root (3.14 and 3.72 cm.) in the two seasons (2000–2001 and 2001–2002).

These obtained results go in line with **Nouman (1982)** who worked on Chemlali and **Pannelli and Fillipucci (1982)** on Frantoio cv.

With respect to the specific effect of IBA preplanting treatments (2000, 4000 and 6000 ppm) data in Table (3-d) cleared that all different concentrations of IBA significantly increased the length of roots (cm.) on cutting in comparison to those untreated (control) in the two seasons of study.

The results revealed that the longest roots among all treated cuttings were obtained after treating the cuttings with IBA at 6000 ppm (5.42 and 6.07 cm.). Then IBA at 4000 ppm was more effective in initiating longer roots (4.72 and 5.20 cm.) than that at 2000 ppm, and finally the untreated cuttings (control) which ranked last as representative the inferior one (1.51 and 2.35 cm).

The response of length of initiated roots to IBA coincided with the findings of Laz (1986), working on olive cv. Wetaken, indicated that the highest IBA at (6000 ppm and 8000 ppm) concentration increased root length on rooted cuttings.

As for the response of root length per cutting to the interaction between cultivars × planting dates × shading × IBA preplanting treatments, Table (3-e) indicated that cuttings taken from shaded mother trees of Manzanillo and Picual which received the preplanting application of dipping in IBA at 6000 ppm in June, possessed significantly the tallest roots, followed by cuttings prepared from shaded mother trees in June and

Table (e): Interaction effect of different combinations between (cultivars (Manzanillo- Picual) x collecting date x shading x IBA preplanting treatments), on root length (cms) of olive cuttings in the two seasons.

In	Season			2000	2000 - 2001					2001 - 2002	- 2002	Chado	
1			Control			Shade			Control			Shade	
ē	reatments	February	June	October	February	June	October	February	June	October	February	June	October
	Control	00.00	2.50	1.66	00.00	3.75	2.83	0.00	2.97	1.87	2.50	4.81	3.57
	IBA 2000 PPM	2.27	4.28	2.93	3.66	6.00	4.78	3.13	5.14	3.63	4.35	6.50	5.02
	1BA 4000 PPM	3.82	5.45	3.88	4.13	7.06	5.72	3.75	90.9	4.33	4.90	7.39	6.28
	IBA 6000 PPM	3.77	6.04	4.43	4.75	8.00	6.81	4.28	6.75	5.17	5.63	8.64	7.46
	Control	00.00	2.00	0.00	0.00	3.13	2.31	0.00	2.25	1.61	2.00	3.60	3.00
-	IBA 2000 PPM	2.02	3.95	2.89	3.19	5.51	5.00	2.53	4.79	3.16	3.75	6.34	4.65
	IBA 4000 PPM	2.88	4.83	3.60	3.81	6.60	5.60	3.31	5.55	4.06	4.40	6.84	5.50
	IBA 6000 PPM	3.38	5.53	4.13	4.56	7.29	6.49	3.79	6.47	4.82	90.9	7.94	6.81
1			L.S	L.S.D 5%	L.S.D 1%	1%			L.S	L.S.D 5%	L.S.D 1%	1%	
٧a	Cultivar xdatex shadingx IBA	adingx IBA		09.0	0.79	6			<u> </u>	0.64	0.84	4	

dipped in IBA at 4000 ppm and October cuttings treated with IBA at 6000 ppm, which gave the same effectiveness, then June and October cuttings which collected from shaded mother trees and dipped in 2000 and 4000 ppm, respectively as well as unshaded (control) cuttings taken in June and treated at 6000 ppm, gave the same result.

On the other hand, the shortest root length was significantly initiated on the unshaded cuttings prepared in any date with the two cultivars during the two seasons.

# 4.1.4. Survival percentage:

The specific effect of cultivars, collecting dates (February – June – October), shading treatment, IBA preplanting treatments and their combinations on the survival percentage of olive cuttings during (2000–2001 and 2001–2002) seasons, is presented in Tables (4–a, b, c, d, and e).

As for the specific effect of the two cultivars (Manzanillo – Picual) on survival percentage, data in Table (4–a) revealed that cuttings taken from Manzanillo cv. gave higher value of survival percentage of rooted cuttings as compared with that of Picual cv. in the both seasons of study.

Concerning the specific effect of collecting date (February – June – October), data in Table (4-b) declared that, in both seasons 2000–2001 and 2001–2002, cuttings prepared in June had the highest survival percentage (56.89 and 59.38%) while cuttings collected in February showed obviously the lowest survival percentage (28.80 and 34.54%) whereas October was moderately reacted. The differences among them were significantly at 1 % level.

Table (4): Specific effect of cultivars (Manzanillo - Picual) (a), collecting date (b), Shading (c) and IBA preplanting treatments (d), on survival percentage of olive cuttings during 2000-2001 and 2001-2002 seasons.

Season	Manzanillo	Picual	L.S	S.D
Season	Wanzaniio	Picuai	5%	1%
2000 - 2001	44.50	39.97	0.82	1.06
2001- 2002	48.81	44.43	0.86	1.13

#### (b) Specific effect of collecting date

Season	February	luno	Octobor	L.S	S.D
Season	rebruary	June	October	5%	1%
2000 - 2001	28.80	56.89	41.01	0.99	1.30
2001- 2002	34.54	59.38	46.94	1.06	1.38

## (c) Specific effect of shading

Concon	Control	Shading	L.S	.D
Season	Control	Shaumg	5%	1%
2000 - 2001	40.72	43.75	0.82	1.06
2001- 2002	45.24	47.99	0.86	1.13

#### (d) Specific effect of IBA preplanting treatments

C	Control	I.B.A	I.B.A	I.B.A	L.S	S.D
Season	Control	2000	4000	6000	5%	1%
2000 - 2001	8.85	43.04	55.55	61.49	1.15	1.50
2001- 2002	13.54	47.85	60.54	64.54	1.22	1.59

The obtained results are in general agreement with that previously reported by Gautam and Chauhan (1991), who stated that the greatest survival percentage was achieved in summer.

Regarding the specific effect of cuttings taken from shaded mother plants on survival percentage, the data presented in Table (4–c) showed that, in both seasons, shading treatment significantly produced the highest survival percentage of the rooted cuttings (43.75 and 47.99) as compared with those collected from unshaded mother trees (control) (40.72 and 45.24) in both seasons, respectively.

Considering the specific effect of IBA on survival percentage of the rooted cuttings, the data obtained in Table (4-d) showed clearly that, in both seasons, all concentration of IBA (2000 – 4000 – 6000 ppm) significantly increased the survival percentage as compared with that in the control treatment (0.0 ppm of IBA). However, dipped cuttings in IBA at 6000 ppm tended to be more effective (61.49 – 64.54) than 4000 and 2000 ppm which gave (55.55 and 60.54) and (43.04 and 47.85%), respectively. Whereas those undipped in IBA solution (control) gave the lowest survival percentage during the two seasons of study.

Regarding the interaction effect of (cultivars × collecting date × shading treatment × IBA preplanting treatments) on the survival percentage, the data obtained in Table (4–e) showed that in the first season, cuttings taken from mother trees (control) of Manzanillo cv. in June and treated with IBA at 4000 or 6000 ppm and cuttings collected from shaded mother trees and planted

Table (e): Interaction effect of different combinations between (cultivars (Manzanillo- Picual) x collecting date x shading x IBA preplanting treatments), on survival percentage of olive cuttings in the two seasons.

2000 - 2001	Control	June October Feb	21.83 0.00 0	58.30 40.16 33	73.14 55.55 4!	76.85 63.75 56	0 0.00 0.00	54.25 40.37 26	68.39 52.02 38	73.32 58.61 44
01	Shade	February June	0.00 29.66	32.00 64.45	45.72 74.07	56.04 70.24	0.00 24.93	26.71 57.79	35.43 72.79	44.08 70.29
		October	9.83	46.81	58.63	67.32	0.00	45.29	56.88	60.33
		February	0.00	36.60	47.88	56.35	00.0	28.78	40.17	48.29
	Control	June	27.22	62.27	79.69	74.28	22.85	60.45	73.36	76.81
2001		October	12.50	45.79	58.27	68.83	0.00	41.81	57.82	65.77
2001 - 2002		February	10.99	40.18	52.27	58.98	00'0	32.28	46.17	53.63
	Shade	June	34.02	65.16	74.54	69.37	28.73	64.00	71.19	68.14
		October	14.13	50.21	63.72	67.94	11.87	46.60	61.39	66.15

L.S.D 1%

5.51

in June and dipped in 4000 ppm IBA gave the highest level of survival percentage, followed by June and October cuttings taken from shaded mother trees and treated with IBA at 6000 ppm. In the second season, June cuttings which collected from mother trees (control) of Manzanillo cv. increased the survival percentage after dipping in IBA solution at 4000 ppm, followed by June cuttings (control) dipped in 6000 ppm IBA and June cuttings which taken from shaded mother trees and treated at 4000 ppm and then june and October cuttings which collected from shaded mother plants and treated with IBA at 6000 ppm.

As for Picual cv., it is clear that, in the first season, June cuttings (control) treated with IBA at 6000 ppm and cuttings taken from shaded mother trees and planted in June and dipped in IBA at 4000 or 6000 ppm gave higher survival percentage, followed in descending order by June cuttings (control) preplanted dipping in IBA at 4000 ppm.

In the second season, June cuttings prepared from mother trees (control) which dipped in 6000 or 4000 ppm IBA were the best treatments which increased the survival percentage, followed by June cuttings which taken from shaded mother trees and treated with IBA at 6000 or 4000 ppm.

## 4.1.5. Number of shoots:

Number of shoots per cutting is a good parameter indication to the success of rooting cutting. The present results in Tables (5–a, b, c, d and e) showed the number of sprouted shoots per cutting of Manzanillo and Picual cvs. in 2000–2001 and 2001–2002 seasons.

Concerning the specific effect of Manzanillo – Picual cvs. on number of sprouted shoots per cutting, the data obtained in Table (5–a) indicated that cuttings taken from Manzanillo cv. gave a significant higher number of shoots (1.51 and 1.72), whereas those collected from Picual cv. gave lower number of sprouted shoots (1.23 and 1.40) in the first and second seasons, respectively.

These results are in parallel with the findings of **Hussein** et al. (1999), who worked on four olive varieties, Coratina, Manzanillo, Mission and Agizy, indicated that there is a wide variability in number of shoots of olive cultivars.

With respect to the specific effect of collecting date of cutting, results reported in Table (5–b) indicated that cuttings planted in June gave higher number of sprouted shoots (1.89 and 2.06) followed in descending order by those prepared on October. Anyhow, February planting date significantly induced the lowest number of shoots per cutting (0.83 and 1.02) in both seasons, respectively.

The obtained results are in general agreement with **Bakry** (1998) who found that cuttings taken from mango in May and June gave the greatest number of shoots.

Regarding the specific effect of shading on number of shoots, data in Table (5–c) indicated that cuttings prepared from shaded mother trees significantly produced a higher number of sprouted shoots per cutting as compared with those taken from unshaded mother trees (control) in both seasons of study.

These obtained results go in line with **Bakry (1998)** who worked on mango, showed that cuttings taken from etiolated

Table (5): Specific effect of cultivars (Manzanillo - Picual) (a), collecting date (b), Shading (c) and IBA preplanting treatments (d), on number of shoots of olive cuttings during 2000-2001 and 2001-2002 seasons.

Season	Manzanillo	Picual	L.S	S.D
	Manzannio	ricuai	5%	1%
2000 - 2001	1.51	1.23	0.12	0.16
2001- 2002	1.72	1.40	0.12	0.16

# (b) Specific effect of collecting date

Season	February	June	October	L.S	S.D
	· oblidally	ounc	October	5%	1%
2000 - 2001	0.83	1.89	1.39	0.15	0.19
2001- 2002	1.02	2.06	1.59	0.16	0.20

## (c) Specific effect of shading

Season	Control	Shading -	L.S	S.D
	Johnson	Shaumy	5%	1%
2000 - 2001	1.23	1.51	0.12	0.16
2001- 2002	1.48	1.64	0.12	0.16

# ( d ) Specific effect of IBA preplanting treatments

Season	Control	I.B.A	I.B.A	I.B.A	L.S	S.D
	Control	2000	4000	6000	5%	1%
2000 - 2001	0.35	1.35	1.79	1.98	0.17	0.22
2001- 2002	0.65	1.50	1.98	2.10	0.19	0.23

mother plants gave the greatest number of shoots as compared with mother plants (control).

Concerning the specific effect of indole butric acid (IBA) preplanting treatments (2000 - 4000 - 6000 ppm) on number of shoots on rooted cuttings, Table (5–d) showed that, in both seasons, the three concentration of IBA gave higher number of shoots per cuttings in comparison with the untreated cuttings (control).

In the first season, the results revealed that treating the cuttings with IBA at 6000 ppm resulted in a significant maximum number of sprouted shoots per cutting as compared with that of the other treatments.

In the second seasons the 6000 ppm concentration failed to add significant increment of number shoots than 4000 ppm. Any how, 4000 or 6000 ppm IBA were much more satisfactory concentration for sprouting shoots per cutting.

The obtained results of IBA are in harmony with the findings of El-Rawi (1976) and Dimassi et al. (1999) who worked on different olive cvs., indicated that IBA significantly increased the number of shoots per cutting.

As for the response of shoots number per cutting to the interaction between cultivars, planting dates, shading and IBA preplanting treatment, Table (5–e) indicated that the highest shoots number was obtained in the first season in June cuttings collected from mother trees (control) of Manzanillo cv. and dipped in IBA at 4000 or 6000 ppm, October cuttings (control) which treated with IBA at 6000 ppm and June and October

cuttings which taken from shaded mother trees and treated with IBA at 4000 or 6000 ppm .

In the second season, June cuttings which taken from shaded or unshaded mother trees and dipped in IBA solution at 6000, 4000 and 2000 ppm and October cuttings prepared from shaded or unshaded mother plants and treated with IBA at 6000, 4000 ppm gave the highest values in this respect.

Concerning Picual cv. cuttings collected from shaded or unshaded mother plants in June and treated with 4000 or 6000 ppm and October cuttings which taken from shaded mother plants and dipped in IBA at 4000 and 6000 ppm in the first season, produced the highest number of sprouted shoots.

In the second season, cuttings prepared from shaded or unshaded (control) mother trees in June and dipped in 6000, 4000, 2000 ppm IBA, October cuttings which taken from shaded mother trees and treated with IBA at 4000, 6000 ppm and cuttings collected from mother trees (control) in October and treated with IBA at 6000 ppm, gave the highest values in this respect.

On the contrary, cuttings collected from shaded or unshaded (control) mother trees in any collecting dates and untreated with IBA resulted in the least number of sprouted shoots per cutting, while other treatments were in between two extremes.

Table (e): Interaction effect of different combinations between (cultivars (Manzanillo- Picual) x collecting date x shading x IBA preplanting treatments), on number of shoots of olive cuttings in the two seasons.

				2000	2000 - 2001					2001 - 2002	2002		
	Season		Joseph			Shade			Control			Shade	
F	othonto		COURTO					Loberton,	- Curi	October	February	June.	October
	Leanneine	February	June	October	February	June	October	repruary	aunc	OCIONEI	i con con	2	
	Control	0.00	0.75	0.00	0.00	1.25	1.00	0.00	1.25	1.00	0.50	1.50	1.00
ollin	IBA 2000 PPM	0.75	2.00	1.25	1.25	2.25	1.75	1.00	2.25	1.50	1.25	2.25	2.00
ezuey	IBA 4000 PPM	1.00	2.50	2.00	1.25	2.50	2.25	1.25	2.75	2.25	1.50	2.75	2.25
V	IBA 6000 PPM	1.25	2.75	2.25	1.50	2.50	2.25	1.50	2.75	2.50	1.75	2.25	2.25
	Control	0.00	0.50	0.00	00'0	0.75	0.00	0.00	0.75	0.00	0.00	1.00	0.75
lsi	IBA 2000 PPM	0.50	1.50	1.00	1.00	1.75	1.25	0.50	2.00	1.00	1.00	2.00	1.25
Pict	IBA 4000 PPM	0.75	2.00	1.50	1.25	2.50	2.00	1.25	2.25	1.75	1.50	2.25	2.00
	1BA 6000 PPM	1.25	2.25	1.75	1.50	2.50	2.00	1.50	2.50	2.00	1.75	2.50	2.00
			ڙو	L.S.D 5%	L.S.D 1%	1%			L.S	L.S.D 5%	L.S.D 1%	1%	
Cultiv	Cultivar xdatex shadingx IBA	adingx IBA		09.0	0.78	80				0.61	0.79	6	

# 4.1.6. Shoot length:

Concerning the specific effect of cultivars (Manzanillo – Picual), collecting date, shading treatment, preplanting treatments (dipping in IBA solution) and their combinations on the shoot length per each cutting, data obtained during two seasons of 2000–2001 and 2001–2002 are presented in Tables (6-a, b, c, d and e).

Regarding the specific effect of different cultivars (Manzanillo – Picual) on shoot length, Table (6-a) showed that in both seasons, Manzanillo cuttings had a significant higher value of stem length (4.18 and 5.41 cm.) as compared with that of Picual cv. in the two seasons of study.

These obtained results are in harmony with **Shahein et al.** (1982) who studied on 22 olive cultivars and **Hussein et al.** (1999) who worked on four olive cvs., showed that the average shoot length varied among these cultivars.

Considering the specific effect of the date of preparing cuttings on shoot length (cm/cutting), Table (6–b) showed that the greatest value of shoot length was obtained by June cuttings. Anyhow, June collecting date is the most appropriate time for collecting and planting (Manzanillo – Picual) cvs. olive cuttings, followed in descending order by October. While February induced statistically the shortest shoot length per cutting in 2000–2001 and 200–2002, respectively.

These obtained results go in line with **Bakry** (1998), who mentioned that May and June collected cuttings exhibited the maximum average shoot length.

Table ( 6 ): Specific effect of cultivars (Manzanillo - Picual ) (a), collecting date (b), Shading ( c ) and IBA preplanting treatments (d), on average shoot length (cms) of olive cuttings during 2000-2001 and 2001-2002 seasons.

			L.S	S.D
Season	Manzanillo	Picual	5%	1%
2000 - 2001	4.18	3.51	0.16	0.21
2001- 2002	5.41	4.33	0.17	0.22

# ( b ) Specific effect of collecting date

				L.S	S.D
Season	February	June	October	5%	1%
2000 - 2001	2.54	5.60	3.39	0.19	0.25
2001- 2002	3.50	6.77	4.33	0.21	0.27

# (c) Specific effect of shading

			L.S	S.D
Season	Control	Shading -	5%	1%
2000 - 2001	3.32	4.36	0.16	0.21
2001- 2002	4.06	5.68	0.17	0.22

# ( d ) Specific effect of IBA preplanting treatments

		I.B.A	I.B.A	I.B.A	L.S	S.D
Season	Control	2000	4000	6000	5%	1%
2000 - 2001	1.01	3.83	5.03	5.50	0.22	0.29
2001- 2002	1.77	4.56	6.21	6.94	0.24	0.31

As for the specific effect of shading treatment, Table (6-c) indicates that, in both seasons, shaded cutting gave a significant higher value of stem length as compared with that of unshaded (control) ones.

In general, shading treatment gave the longest shoot length (4.36 and 5.98 cm.) in comparison to unshaded (control) (3.32 and 4.06 cm.) in the first and second seasons, respectively.

These results are in parallel with the findings of **Peng et al.** (1998) who worked on citrus, showed that shading treatments gave higher shoot length as compared with unshaded treatments. Similar findings were obtained by **Bakry** (1998) who found that cuttings taken from etiolated mother plants of mango, gave the highest average shoot length in comparison to mother plants (control).

Regarding the specific effect of IBA treatments (2000 – 4000 - 6000 ppm), on shoot length per cutting Table (6-d) indicates that cuttings treated with IBA at any concentration significantly produced longer shoots per cutting than those untreated (control). Shortly, shoot length/ cutting was markedly increased as IBA concentration increased. The general averages for the studied concentration (2000, 4000 and 6000 ppm) were 3.83, 5.03 and 5.50 cm. in the first seasons and 4.56, 6.21 and 6.94 cm. in the second season, respectively. However, shoot length of untreated cuttings (control) was 1.01 and 1.77 cm. in the first and second seasons, respectively. The differences among them were significant at 1% level.

The present results revealed that IBA significantly increased the average shoot length per cutting. These results go

Table ( e ): Interaction effect of different combinations between (cultivars (Manzanillo- Picual) x collecting date x shading x IBA preplanting treatments ), on shoot length (cms) of olive cuttings in the two seasons.

				2000 - 2001	2001					2001	2001 - 2002		
	Season		Control			Shade			Control			Shade	
ř	Treatments		100	Octobor	Fahruary	enni.	October	February	June	October	February	June	October
		February	June	iadoloo	reninary	2							
	Control	0.00	2.50	00.0	0.00	3.12	2.00	0.00	2.75	2.00	2.50	4.25	2.50
ollin	IBA 2000 PPM	2.75	4.71	3.00	3.50	6.00	4.38	3.30	5.38	4.13	90.9	7.46	5.31
sznsN	IBA 4000 PPM	3.50	6.79	4.25	4.12	9.29	5.00	4.00	8.25	5.05	5.63	11.33	6.63
ı	IBA 6000 PPM	4.00	7.17	4.62	5.00	9.20	5.50	5.00	8.46	5.bJ	6.88	10.71	7.75
	Control	0.00	2.00	0.00	00.00	2.50	00.0	00.0	2.25	0.00	0.00	3.00	2.00
ls	IBA 2000 PPM	2.00	4.06	3.12	3.00	5.50	3.88	2.00	5.13	3.50	3.00	6.25	4.20
Picu	IBA 4000 PPM	2.50	5.50	3.92	3.25	7.33	5.00	3.55	6.88	3.75	4.50	8.99	6.00
	IBA 6000 PPM	3.00	5.96	4.38	4.06	7.92	5.25	4.63	7.46	4.42	6.00	9.83	6.50
			ڌ	L.S.D 5%	L.S.D 1%	0 1%			نڌ	L.S.D 5%	L.S.D 1%	1%	
Cultiv	Cultivar xdatex shadingx IBA	adingx IBA		0.77	1.01	5				0.83	1.07	70	

in line with El-Rawi (1976), Bartolini and Ministro (1981) and Dimassi et al. (1999) on different olive cvs.

Concerning the response of shoot length (cm.) to the interaction between cultivars (Manzanillo – Picual), collecting date, shading treatment and IBA preplanting treatments, Table (6–e) showed that, in both seasons (2000–2001 and 2001–2002), cuttings collected from shaded mother trees of Manzanillo and Picual cvs. in June and treated with IBA at 4000 or 6000 ppm, gave a significant longer average shoot length of cutting as compared with that of unshaded mother trees (control) in both seasons. On the contrary, untreated cuttings with IBA which were taken from shaded or unshaded mother trees (control) and planted in any of the three collection dates of this study showed the lowest average shoot length of cuttings. The other combinations had intermediate values between these two extremes.

# 4.1.7. Leaf area:

Referring the leaf area per rooted cutting in response to the different treatments investigated during both 2000–2001 and 2001–2002 seasons, data obtained are tabulated in Tables (7–a, b, c, d and e).

Concerning the specific effect of the two cultivars (Manzanillo – Picual) on leaf area per rooted cutting, Table (7-a) showed clearly that the leaf area of Picual cv. was significantly greater (2.79 and 3.04 cm<sup>2</sup>) than that of Manzanillo cv. (2.28 and 2.52 cm<sup>2</sup>) in both seasons, respectively.

These obtained results are in line with the findings of Shahein et al. (1982) who worked on 22 olive cultivars,

indicated that the leaf area of ten cultivars was large and two cultivars had the smallest leaf area. Whereas, the other varieties had the medium values and varied in their range. Also, **Hussein et al.** (1999) mentioned that wide differences were found in leaf area of olive cultivars.

Considering the specific effect of collecting date on leaf area, Table (7–b) indicated that cuttings taken in June had a signicant larger leaf area per rooted cutting (3.11 and 3.23 cm<sup>2</sup>) as compared with other collection dates (October – February) in both seasons (2000–2001and 2001–2002), respectively.

The obtained results of the dates are in harmony with the findings of **Ono and Iwagaki** (1987) who showed that leaf area increased in summer and autumn.

With regard to the specific effect of shading treatment on leaf area, Table (7-c) showed that in both seasons, the leaf area per shaded cuttings tended to be more greater than that of unshaded ones (control). The general averages obtained in the first and the second seasons, respectively were (2.60 and 2.00 cm<sup>2</sup>) for shaded cuttings and (2.47 and 2.66 cm<sup>2</sup>) for unshaded (control) ones.

These results are in line with the findings of El-Mahdy and Abdalla (1996), and Xie et al. (2001) who stated that artificial shading increased the leaf area.

Regarding the specific effect of different concentrations of IBA treatments, data in Table (7-d) reported that, in both seasons, all cuttings dipped in different concentration of IBA solution (2000-4000-6000 ppm) had a significant larger leaf area per rooted cuttings as compared with that of the (control)

Table (7): Specific effect of cultivars (Manzanillo - Picual) (a), collecting date (b), Shading (c) and IBA preplanting treatments (d), on leaf area (cm²) of olive cuttings during 2000-2001 and 2001-2002 seasons.

Season	Manzanillo	Picual	L.S	S.D
		ricuai	5%	1%
2000 - 2001	2.28	2.79	0.03	0.04
2001- 2002	2.52	3.04	0.03	0.04

# (b) Specific effect of collecting date

Season	February	June	October	L.S	S.D
		ounc	October	5%	1%
2000 - 2001	2.08	3.11	2.41	0.04	0.05
2001- 2002	2.32	3.23	2.79	0.04	0.05

# (c) Specific effect of shading

Season	Control	Shading	L.S	S.D
		onading	5%	1%
2000 - 2001	2.47	2.60	0.03	0.04
2001- 2002	2.66	2.90	0.03	0.04

# ( d ) Specific effect of IBA preplanting treatments

Season	Control	I.B.A	I.B.A	I.B.A	L.S	S.D
		2000	4000	6000	5%	1%
2000 - 2001	0.10	2.80	3.11	3.24	0.04	0.06
2001- 2002	1.60	2.96	3.23	3.33	0.05	0.06

cuttings. IBA at 6000 ppm was more effective (3.24 and 3.33 cm<sup>2</sup>) followed in descending order by 4000 ppm and then 2000 ppm in the two seasons, respectively. The differences among them were significant at 1 % level.

These results are in parallel with the findings of **Kim et al.** (1990) who worked on citrus and **Jawanda et al.** (1990) who worked on plum, showed that IBA treatments improved the leaf area per cutting.

Furthermore Table (7–e) indicated a significant effect as a result of the interaction between cultivars, mother trees treatment (shading), dates and preplanting treatments. Briefly, all combinations of IBA significantly increased leaf area of the two cultivars (Manzanillo-Picual) as compared with the control.

Generally, shaded or unshaded (control) cuttings taken from mother trees of Manzanillo and Picual cvs. which treated with IBA at (4000 or 6000 ppm) and planted in June had a significant larger leaf area per cutting, followed by those taken from October-shaded or unshaded mother trees of the two cultivars and received the preplanting application of dipping in 6000 ppm or 4000 ppm and were similar to those collected from June shaded and unshaded mother trees after treating cuttings with IBA at 2000 ppm.

Table (e): Interaction effect of different combinations between (cultivars (Manzanillo- Picual) x collecting date x shading x IBA preplanting treatments), on leaf area (cm²) of olive cultings in the two seasons.

	Season			2000	2000 - 2001					1000	0000		
Ļ	Trastmonte		Control			Shade			- Contract	1007	7007 - 1007		
	edullents	February		Octoboo	+		-		Control			Shade	
		, coldaly	aunc	October	repruary	June	October	February	June	October	February	June	October
	Control	0.00	2.10	00.0	0.00	2.20	2.00	0.00	2.25	2.00	1.93	2.25	2.10
ollina	1BA 2000 PPM	2.20	2.75	2.40	2.22	2.82	2.38	2.30	2.83	2.48	2.38	2.90	2.55
Manz	IBA 4000 PPM	2.36	3.07	2.70	2.45	3.10	2.75	2.58	3.14	2.75	2.60	3.05	2.87
	IBA 6000 PPM	2.60	3.10	2.82	2.75	3.03	2.86	2.73	3.13	2.90	2.80	3.00	2.95
	Control	0.00	2.78	0.00	00.0	2.81	0.00	0.00	2.90	0.00	00.0	3.00	2 83
leu	IBA 2000 PPM	2.83	3.35	3.12	2.81	3.48	3.30	2.98	3.68	3.25	3.05	3.71	3.40
oi9	IBA 4000 PPM	3.13	3.75	3.48	3.18	3.90	3.50	3.33	3.90	3.53	3.40	3 95	0 0 0
	IBA 6000 PPM	3.38	3.80	3.63	3.43	3.83	3.66	3.43	4.05	3.71	3.58	3.93	3.73
tiva	Cultivar xdatex shadingy IBA	Agi you	L.S.I	L.S.D 5%	L.S.D 1%	%			L.S.L	L.S.D 5%	L.S.D 1%	- %	
		VOI VA	0	0.15	0.20				0	0.16	0.21		

## 4.1.8. Leaf length:

The effect of the two cultivars, date of cuttings, shading treatment, IBA preplanting treatments and their interactions on leaf length per rooted cutting during 2000–2001 and 2001–2002 seasons, is presented in Tables (8– a, b, c, d and e).

Referring the specific effect of Manzanillo and Picual cvs. on leaf length, data in Table (8–a) showed that the average leaf length of Picual cv. was significantly longer (3.47 and 3.68 cm.) than that of Manzanillo cv. (3.11 and 3.43 cm.) in both seasons, respectively.

The results are in harmony with those reported by **Shahein et al. (1982)** and **Hussein et al. (1999)** who mentioned that wide variability was found in length of leaf blade of olive cultivars.

As for the specific effect of collecting date of cuttings (February – June – October) on leaf length, data in Table (8-b) declared that the rooted cuttings which planted in June gave an increase in the leaf length (3.98 and 4.06 cm.) while in February it was (2.79 and 3.00 cm.). Whereas the leaf length on rooted cutting which taken in October was intermediate in both seasons of study, respectively.

These results are in general agreement with **Ono and Iwagaki** (1987) who mentioned that leaf length increased in summer and autumn.

Regarding the specific effect of shading treatment on leaf length, the results obtained in Table (8–c) revealed that cuttings collected from shaded mother trees, gave a significant higher

Table (8): Specific effect of cultivars (Manzanillo - Picual) (a), collecting date (b), Shading (c) and IBA preplanting treatments (d), on leaf length (cms) of olive cuttings during 2000-2001 and 2001-2002 seasons.

Season	Manzanillo	Picual	L.S	S.D
Season	Iwanzanino	Picuai	5%	1%
2000 - 2001	3.11	3.47	0.05	0.06
2001- 2002	3.43	3.68	0.04	0.06

## (b) Specific effect of collecting date

Connen	Eabruary	luno	October	L.S	S.D
Season	February	June	October	5%	1%
2000 - 2001	2.79	3.98	3.12	0.06	0.07
2001- 2002	3.00	4.06	3.61	0.05	0.07

## (c) Specific effect of shading

Season	Control 3.21	Shading	L.S.D		
		Silading	5%	1%	
2000 - 2001		3.38	0.05	0.06	
2001- 2002	3.40	3.71	0.04	0.06	

#### (d) Specific effect of IBA preplanting treatments

Season	Control	I.B.A 2000	I.B.A 4000	I.B.A 6000	L.S.D	
					5%	1%
2000 - 2001	1.38	3.68	3.97	4.14	0.07	0.09
2001- 2002	2.23	3.76	4.00	4.32	0.06	0.08

value of leaf length (3.38 and 3.71 cm.) as compared with those taken from the unshaded (control) ones (3.21 and 3.40 cm.) in 2000–2001 and 2001–2002 seasons, respectively.

The obtained results are in harmony with **Xie et al. (2001)** who showed that shading treatments increased the leaf length.

With respect to the specific effect of IBA, data in Table (8-d) showed that the three concentrations of IBA (2000 – 4000 – 6000 ppm) increased leaf length on rooted cutting as compared with that of the untreated cuttings (control). Shortly, IBA at 6000 ppm significantly increased the leaf length followed by 4000 ppm and finally by IBA at 2000 ppm in both seasons of study, respectively.

These results go in line with **Kim et al. (1990)** who worked on citrus and **Jawanda et al. (1990)** who worked on plum, showed that IBA increased the leaf length.

As for the response of leaf length (cms) to the interaction between cultivars (Manzanillo – Picual), collecting date, shading and preplanting treatments of IBA, the data in Table (8-e) showed that the average leaf length of both cultivars was statistically longer in shaded mother trees when the cuttings collected in June and treated with 4000 and 6000 ppm of IBAas compared with those of unshaded mother trees or treated cuttings with 0.00 or 2000 ppm of IBA either the cuttings were collected in February, June, October in both seasons of study.

Table (e): Interaction effect of different combinations between (cultivars (Manzanillo-Picual) x collecting date x shading x IBA preplanting tretmeants), on leaf length (cms) of olive cuttings in the two seasons.

0.00         3.18         0.00         0.00         3.21         3.10         0.00         3.28         3.16         3.28         3.16         3.28         3.16         3.28         3.16         3.28         3.16         3.28         3.17         3.28         3.28         3.28         3.29         3.29         3.29         3.29         3.29         3.28         3.28         3.28         3.28         3.28         3.29         4.29         3.39         4.45         4.40         4.45         4.44         4.45         4.44         4.45         4.44         4.44         4.44         4.44         4.44         4.44         4.44         4.44         4.44 <th< th=""><th>3.38 3.22 3.58 3.51 3.77 3.70 0.00 0.00 3.87 3.68 4.28 3.95</th><th>L</th><th>Control February June</th><th>October Febru</th><th>February</th><th>Shade June C</th><th>October</th></th<>	3.38 3.22 3.58 3.51 3.77 3.70 0.00 0.00 3.87 3.68 4.28 3.95	L	Control February June	October Febru	February	Shade June C	October
3.62       3.36       3.46       3.33       3.77       3.46       3.33       3.77       3.46       3.33       3.77       3.82       3.82         3.81       3.58       3.51       3.83       3.62       3.50       3.94       3.62       3.50       3.88         3.88       3.77       3.70       3.94       3.53       4.05       3.83       3.66       3.96         4.21       3.50       0.00       0.00       3.61       0.00       3.61       0.00       4.74         4.63       4.28       3.93       4.69       4.31       3.87       4.75       4.28       3.90       4.80         4.74       4.45       4.45       4.45       4.45       4.45       4.53       4.59       4.50       4.80	3.38 3.22 3.58 3.51 3.77 3.70 0.00 0.00 3.87 3.68 4.28 3.95	_		3.16	3.03	3.50	3.20
3.81     3.58     3.51     3.82     3.50     3.94     3.62     3.94     3.62     3.59     3.88       3.88     3.77     3.70     3.94     3.75     3.53     4.05     3.83     3.66     3.96       3.50     0.00     0.00     3.60     0.00     0.00     3.61     0.00     4.37       4.21     3.87     4.29     3.93     3.62     4.23     3.91     3.66     4.74       4.63     4.28     3.95     4.69     4.31     3.87     4.75     4.28     3.90     4.80       4.74     4.45     4.45     4.45     4.82     4.37     4.45     4.53     4.54     4.80	3.58 3.51 3.77 3.70 0.00 0.00 3.87 3.68 4.28 3.95 4.45 4.40	-		3.46	3.38	3.82	3.52
3.88     3.77     3.94     3.76     3.53     4.05     3.83     3.66     3.96       3.50     0.00     0.00     3.60     0.00     0.00     3.61     0.00     4.37       4.21     3.87     4.29     3.93     3.62     4.23     3.91     3.66     4.74       4.63     4.28     3.95     4.69     4.31     3.87     4.75     4.28     3.90     4.80       4.74     4.45     4.46     4.82     4.37     4.45     4.79     4.63     4.54     4.80	3.77 3.70 0.00 0.00 3.87 3.68 4.28 3.95 4.45 4.40			3.62	3.50	3.88	3.63
3.50         0.00         0.00         3.61         0.00         0.00         3.61         0.00         4.37           4.21         3.87         3.68         4.29         3.93         3.62         4.23         3.91         3.66         4.74           4.63         4.28         3.95         4.69         4.31         3.87         4.75         4.28         3.90         4.80           4.74         4.45         4.40         4.82         4.37         4.45         4.79         4.53         4.54         4.80	3.87 3.68 4.28 3.95 4.45 4.40			3.83	3.66	3.96	3.86
4.21     3.87     3.68     4.29     3.93     3.62     4.23     3.91     3.66     4.74       4.63     4.28     3.95     4.69     4.31     3.87     4.75     4.28     3.90     4.80       4.74     4.45     4.45     4.82     4.37     4.45     4.79     4.63     4.54     4.80	3.87 3.68 4.28 3.95 4.45 4.40			0.00	0.00	4.37	3.50
4.63         4.28         3.95         4.69         4.31         3.87         4.75         4.28         3.90         4.80           4.74         4.45         4.46         4.82         4.37         4.45         4.79         4.63         4.54         4.80	4.28 3.95	-		3.91	3.66	4.74	4.01
4.74         4.45         4.40         4.82         4.37         4.45         4.79         4.63         4.54         4.80	4.45 4.40		-	4.28	3.90	4.80	4.40
				4.63	4.54	4.80	4.74
	0.23 0.30		J	0.21	0.27		

#### 4.1.9. Leaf width:

Concerning the specific effect of the two cultivars (Manzanillo – Picual), collecting date, shading, preplanting treatments (different concentrations of IBA) and their combinations on leaf width per rooted cutting, the data obtained during the two seasons of (2000–2001and 2001–2002) are presented in Tables (9– a, b, c, d and e).

Regarding the specific effect of different cultivars mentioned before on leaf width, data in Table (9–a) indicated that in both seasons the leaf width of Picual cv. was significantly wider than the leaf of Manzanillo cv.

Similar findings were obtained by **Shahein et al.** (1982) and **Hussein et al.** (1999) who stated that there were a wide differences in width of leaf blade of olive cultivars.

With respect to the specific effect of collecting date of cuttings on leaf width, data in Table (9-b) cleared that cuttings prepared in June gave the highest significant value of leaf width (1.09 and 1.10 cm.) in comparison with those prepared in February which had the lowest value of leaf width (0.77 and 0.83 cm.) during the two seasons of study, respectively.

These obtained results go in line with **Ono and Iwagaki** (1987) who stated that leaf width increased in summer and autumn.

Considering the specific effect of shading treatment on leaf width, the results obtained in Table (9–c) revealed that shaded cuttings gave a significant higher (wider) leaf width per

Table (9): Specific effect of cultivars (Manzanillo - Picual) (a), collecting date (b), Shading (c) and IBA preplanting treatments (d), on leaf width (cms) of olive cuttings during 2000-2001 and 2001-2002 seasons.

### (a) Specific effect of cultivars

Season	Manzanillo	Picual	L.S	S.D
	manzannio	ricuai	5%	1%
2000 - 2001	0.87	0.93	0.009	0.011
2001- 2002	0.95	0.98	0.009	0.011

## (b) Specific effect of collecting date

Season	February	June	October	L.S	S.D
		- Curic	october	5%	1%
2000 - 2001	0.77	1.09	0.84	0.011	0.014
2001- 2002	0.83	1.10	0.97	0.010	0.010

### (c) Specific effect of shading

Season	Control	Shading	L.S	S.D
	Control	Shauling	5%	1%
2000 - 2001	0.88	0.92	0.009	0.011
2001- 2002	0.92	1.01	0.009	0.011

# ( d ) Specific effect of IBA preplanting treatments

Season	Control	I.B.A	I.B.A	I.B.A	L.S	S.D
		2000	4000	6000	5%	1%
2000 - 2001	0.39	1.03	1.07	1.12	0.013	0.016
2001- 2002	0.60	1.03	1.10	1.14	0.013	0.016

rooted cutting in comparison with those taken from mother trees (control).

These results were agreed with Xie et al. (2001) who showed that shading treatments increased the leaf width.

Referring the specific effect of the application of the three concentrations of IBA (2000 – 4000 – 6000 ppm) on leaf width, data in Table (9-d) showed that different concentrations of IBA significantly increased the leaf width, particularly at 6000 ppm, which gave the greatest value of leaf width (1.12 and 1.14 cm.), followed by 4000 ppm and then 2000 ppm as compared with those untreated with IBA cuttings (control) during the two seasnos of study, respectively.

The obtained results are in harmony with **Kim et al.** (1990) who worked on citrus and **Jawanda et al.** (1990) who worked on plum, found that different concentrations of IBA increased the leaf width per cutting.

Regarding the response of leaf width (cm.) to the interaction between cultivars, collecting date, shading treatment and preplanting treatments of IBA, Table (9–e) indicated that, in both seasons (2000–2001 and 2001–2002), treated and untreated cuttings with shade from Manzanillo – Picual cvs. which planted in June and received the preplanting application of dipping in IBA at 4000 and 6000 ppm, showed highly increase in leaf width, followed by those taken from October shaded and (control) mother trees of the two cultivars which treated with IBA at (4000 or 6000 ppm) and June and February cuttings which dipped in IBA at 2000 and 6000 ppm, respectively, statistically gave the same effectiveness as compared to other.

Table (e): Interaction effect of different combinations between (cultivars (Manzanillo- Picual) x collecting date x shading x IBA preplanting treatments), on leaf width (cms) of olive cuttings in the two seasons.

			October	0.83	0.94	1.07	1.10	1.03	17	1.13	1.17
	Shade	H	aune	0.85	1.07	1.19	1.17	1.07	1.12	1.17	1.20
2002		Cobridge	reproduct	0.80	0.90	0.97	1.04	0.00	1.1	1.1	1.13
2001 - 2002		Octobor	-+	0.79	0.92	1.05	1.08	0.00	1.08	1.12	1.17
	Control	anii		0.83	1.01	1.18	1.19	1.06	1.12	1.18	1.23
		February		0.00	0.87	96.0	1.03	0.00	1.06	1.1	1.13
		October	+	0.88	96.0	1.01	1.05	0.00	1.11	1.15	1.16
	Shade	June		0.90	1.03	1.15	1.15	1.04	1.15	1.18	1.18
2001		February		0.00	0.92	0.94	1.08	0.00	1.06	1.08	1.15
7007 - 700		October		0.00	0.93	0.97	1.05	0.00	1.08	1.12	1.13
	Control	June	15.	0.87	1.03	1.16	1.14	1.03	1.12	1.18	1.18
		February	000	0.00	0.89	0.95	1.05	0.00	1.02	1.07	1.13
	Treatments		Contract	Control	1BA 2000 PPM	IBA 4000 PPM	IBA 6000 PPM	Control	1BA 2000 PPM	1BA 4000 PPM	1BA 6000 PPM
	-			1	ollins	znsM			lau	oiq	

L.S.D 5% L.S.D 1%	0.04 0.06
L.S.D 1%	90.0
L.S.D 5%	0.04
hadingx IBA	

# Rooting in relation to cutting contents of phenols and indoles:

#### **Total Phenols:**

Concerning the specific effect of the two cultivars, shading treatment, collected date and their interaction on total phenols content during the two seasons of study, is clearly shown in Tables (10– a, b, c and d).

As for the specific effect of the two cultivars (Manzanillo – Picual), Table (10-a) indicated that cuttings taken from Picual cv. had a significant higher content of total soluble phenols (73.46 and 70.12 mg/ 100gm D.wt) as compared with those of Manzanillo cv. in both seasons, respectively.

Regarding the specific effect of collecting date at which shoots were excised for preparing cuttings, the data presented in Table (10–b) indicated that in 2000–2001 and 2001–2002 seasons, the highest significant level of total phenols was detected in February (76.50 and 73.42 mg/100gm D.wt.) followed in descending order by October (71.15 and 68.20 mg/100mg D.wt.). While, the lowest significant content of total phenols was detected in cuttings collected in June of both seasons (68.75 and 64.42 mg/100gm D.wt. respectively).

Anyhow, in both seasons, cuttings collected in February had the highest value of total phenols, whereas cuttings of June collecting date gave the lowest level. While, the cuttings of October collecting date had intermediate value in this respect. These results are in agreement with the findings of Fayek and Sweidan (1981 a,b) on Peach and Plum cultivars, Abou-Shanab

Table (10): Specific effect of cultivars (Manzanillo - Picual) (a), collecting date (b) and Shading treatment ( c ), on total phenols ( mg/100gm dry weight ) during two successive 2000-2001 and 2001-2002 seasons.

## (a) Specific effect of cultivars

Season	Manzanillo	Picual	L.S	S.D
	The state of the s	Ticual	5%	1%
2000 - 2001	70.81	73.46	1.26	1.67
2001- 2002	67.24	70.12	1.48	1.96

# (b) Specific effect of collecting date

Season	February	June	October	L.	S.D
	,	- June	October	5%	1%
2000 - 2001	76.50	68.75	71.15	1.58	2.04
2001- 2002	73.42	64.42	68.20	1.81	2.39

# ( c ) Specific effect of shading

Season	Control	Shading	L.S	S.D
1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	00111101	Onading	5%	1%
2000 - 2001	74.05	70.23	1.26	1.67
2001- 2002	69.99	67.37	1.48	1.96

Table (d): Interaction effect of different combinations between (cultivars (Manzanillo - Picual) x collecting date x shading treatment), on total phenols (mg/100gm dry weight) in the two seasons.

Tre. cultivars cultivars cultivars Co Picual Manzanillo		2000	2000 - 2001			2001	2007 - 2002	
	February	June	October	Mean	February	June	October	Mean
	77.23	69.42	72.82	73.16	73.15	63.42	68.38	68.32
	80.75	71.14	72.89	74.93	75.80	68.12	71.03	71.65
эе	71.33	66.13	67.91	68.46	70.43	62.22	65.81	66.15
Picual	76.69	68.31	70.96	71.99	74.28	63.92	67.56	68.59
	L.S.D 5%	%9 0	L.S.	L.S.D 1%	L.S.D 5%	.5%	L.S.I	L.S.D 1%
cultivar x dates xshading		3.08	4.	4.08	3.61	75	4	4.79

(1982), El-Said (1986) on olive cuttings, Yousery (1994) on plum and Sawasran (1996) on plum and annona, who concluded that high rooting percentage of cuttings was proportioned with the low concentration of phenol compounds.

Considering the specific effect of shading treatment, data in Table (10–c) showed that cuttings taken from unshaded mother trees (control) showed a significant higher content of total phenols (74.05 and 69.99 mg/100gm D.wt.) in the first and second season, respectively, as compared with those collected from shaded mother trees gave (70.23 and 67.37 mg/100gm D.wt. in the first and second season, respectively).

Regarding the interaction effect of cultivars × shading × dates of preparing cuttings, data obtained in Table (10-d) revealed obviously that the highest value of total soluble phenols was found in the cuttings collected from unshaded mother trees (control) of Picual cv. in February (80.75 and 75.80 mg/100gm D.wt.), while cuttings collected from shaded mother trees of Manzanillo cv. in June, gave the significant lowest value in this respect (66.13 and 62.22 mg/100gm D.wt.) in both seasons, respectively. Other treatments came in between the above mentioned two extremes during the two seasons of study.

### Total indoles:

Regarding the specific effect of the two cultivars (Manzanillo – Picual), shading, collecting date and their interaction on total indoles during 2000–2001 and 2001–2002 seasons, the data are presented in Tables (11–a, b, c and d).

As for the specific effect of cultivars (Manzanillo – Picual) on the content of total indoles, the data in Table (11-a)

Table (11): Specific effect of cultivars (Manzanillo - Picual) (a), collecting date (b) and Shading treatment (c), on total indoles (mg/100gm dry weight) during two successive 2000-2001 and 2001-2002 seasons.

### (a) Specific effect of cultivars

	1	DiI	L.S	.D
Season	Manzanillo	Picual	5%	1%
2000 - 2001	7.61	6.84	0.25	0.33
2001- 2002	8.98	8.00	0.20	0.26

### (b) Specific effect of collecting date

			0-4-6	L.S.D	
Season	February	June	October	5%	1%
2000 - 2001	6.80	7.63	7.24	0.30	0.40
2001- 2002	7.71	9.41	8.35	0.23	0.32

### (c) Specific effect of shading

		Chadina	L.S.D	
Season	Control	Shading	5%	1%
2000 - 2001	6.79	7.66	0.25	0.33
2001- 2002	8.20	8.78	0.20	0.26

showed that cuttings collected from Manzanillo cv. had higher value of total indoles (7.61 and 8.98 mg/100gm D.wt.) as compared with those of Picual cv. (6.84 and 8.00 mg/100gm D.wt.) in both seasons of study, respectively.

As for the specific effect of collecting date at which shoots were excised for preparing cuttings, data presented in Table (11-b) revealed that cuttings collected in June had the highest significant level of total indoles (7.63 and 9.4/mg/100gm D.wt.) followed in descending order by those prepared at October (7.29 and 8.35 mg/100gm D.wt.) on the other hand, the cuttings taken in February had the least contents (6.80 and 7.71 mg/100gm D.wt.) in both seasons, respectively.

These obtained results are in harmony with Preziosi (1967) who reported that rooting propensity of olive cuttings was found to be directly related to their content of endogenous IBA. Similar results were reported for cutting of other plant species Tizio (1967) and Fayek&Sweidan (1981 a,b). Also, Laz (1986) who worked on olive, indicated that cuttings planted in May-July, which rooted in the highest percentage had the highest indole content.

Concerning the specific effect of shading treatment, data in Table (11-c) indicated that cuttings prepared from shaded mother trees had the significant highest level of total indoles (7.66 and 8.78 mg/100gm D.wt.) in comparison with those collected from unshaded mother trees (control) (6.79 and 8.20 mg/100gm D.wt.) during the two seasons of study, respectively.

Table (d): Interaction effect of different combinations between (cultivars (Manzanillo - Picual) x collecting date x shading treatment), on total indoles (mg/100gm dry weight) in the two seasons.

	Concon		2000	2000 - 2001			2001	2001 - 2002	
,	Season	Echristy	- lune	October	Mean	February	June	October	Mean
ē.	cullivars	- coldaly	2					300	
lo	Manzanillo	6.63	7.71	7.00	7.11	8.00	9.32	8.59	8.64
onti	Picual	6.12	6.75	6.53	6.47	6.65	9.00	7.60	7.75
ə	Manzanillo	7.59	8.55	8.20	8.11	8.98	9.76	9.20	9.31
Shad	Picual	98.9	7.52	7.22	7.20	7.20	9.56	8.00	8.25
		L.S.D 5%	%9 (	L.S.I	L.S.D 1%	L.S.D 5%	.5%	L.S.I	L.S.D 1%
ulfivar	oultivar x dates xshading	0.61	15	0	08.0	0.48	8	0	0.64

With respect to the interaction effect between the cultivars (Manzanillo – Picual), shading treatment and dates of preparing cuttings, data obtained in Table (11–d) revealed obviously that the highest significant value of total indoles was induced by cuttings collected from shaded mother plants of Manzaillo cv. In June (8.55 and 9.76 mg/100gm D.wt.) in 2000–2001 and 2001–2002 seasons while the lowest values were detected in the cuttings collected in February of unshaded mother trees in both seasons of study. Similar trend was found for Picual cuttings but the values of total indoles were lower than that in Manzanillo cuttings in both seasons, respectively.

Other treatments came in between the above mentioned two extents during the two seasons of study.

#### Anatomical studies:

This study was carried out to investigate the anatomical structure of the subterminal cuttings of Manzanillo and Picual olive cvs., before planting and during the rooting period.

Fig. (1– a & b) show transverse sections made at the basal end of fresh prepared cuttings of Manzanillo and Picual. Various tissues are distinguished and clearly shown in these figures. The outer tissue, epiderm composed of several layers with variability in cell size. It is followed by the cortex which mainly consisted of about 8 to 12 regular layers of parenchymatous. Moreover, the pericycle in both cuttivars contains a slightly interrupted ring of sclerenchymatous cells, but Manzanillo cv. had more interrupted ring of scherenchymatous cells than Picual cv.

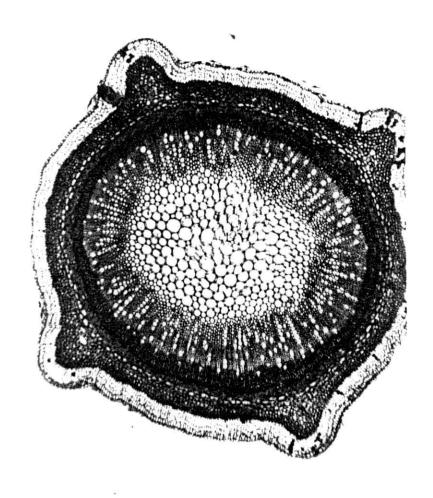


Fig. (1-a): Cross section of Manzanillo cutting showing the various tissues (x 90).



Fig. (1-b): Cross section of Picual cutting showing the various tissues (x 32).

RESULTS & DISCUSSION -----

Following the cortex, phloem and xylem tissues, in Picual cuttings appears to be more thick as compared with that of Manzanillo cultivars. Inside the xylem, the pith, seems to be of larger size in Manzanillo cuttings in comparison with that of Picual.

These results are in harmony with the findings of **El Nabawy et al. (1983)** who mentioned that the rooting percentage of Chemlali cv. is higher than Aghizi and Toffahi cvs. due to the anatomical structure of the cuttings.

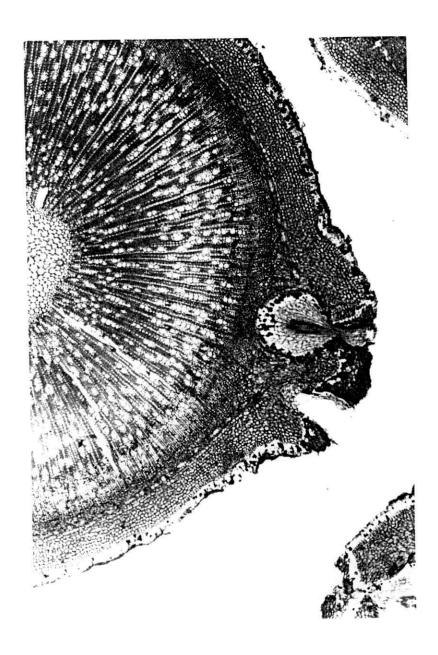
# The development of adventitious roots on Manzaillo and Picual cuttings.

It is clear from (Fig. 2–a & b) that cabium was activated by different concentrations of IBA, particularly 4000ppm for Manzanillo cv. and 6000 ppm for Picual cv. Moreover, the cambium appeared to be the only tissue that resumed its activity by cell division at the cambial zone in Manzanillo cv. (Fig. 3–a). On the other hand, the cambium and the pith appeared in Picual cv., which are shown in (Fig. 3-b).

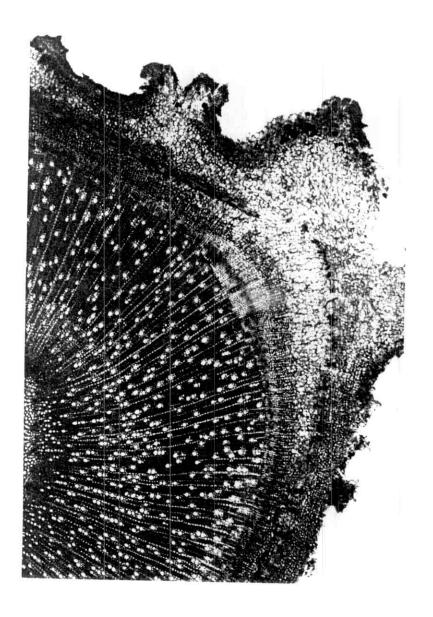
(Fig. 4–a) showed the early stage of root initiation in the cambium zone of Manzanillo cv. and (Fig. 4–b) showed the cambium and the pith of Picual cv. (Fig. 5,6–a&b) show the development of the adventitious root primordia through the phloem tissue, passing through the interrupted sclereids rings, through the cortex and the epiderm, after which it appears on the cutting surface, During these steps the vascular system of advaentitious root is developed and contact with the main vessels of the cutting.

These results are in harmony with the findings of Bakr et al. (1977), Abou shanab (1982), El-Said (1986), Youssef et al. (1991) and Ibrahim (1997).

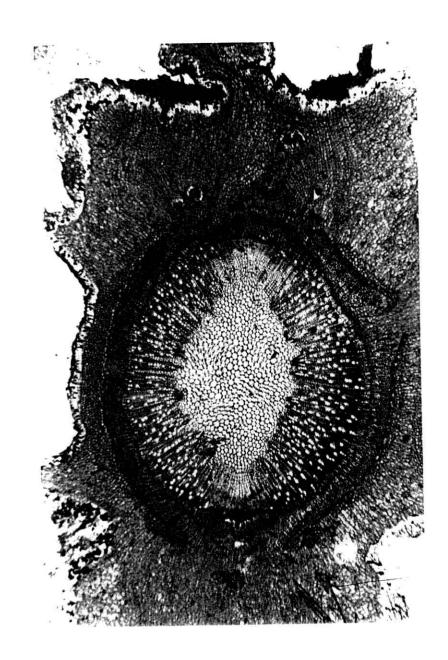
It is obvious that the sclerenchyma ring did not remain intact during the rooting period. This appears to be true in both cultivars. The rate of change in the intactness of the ring, however, was more rapid in Manzanillo than in Picual cvs.



**Fig. (2-a):** Cross section of Manzanillo cv. cutting revealing that cambium was activated by different concentrations of IBA, particulary 4000 ppm (x 55).



**Fig. (2-b):** Cross section of Picual cv. cutting revealing that cambium was activated by different concentrations of IBA, particulary 6000 ppm (x 45).



**Fig. (3-a):** Cross section of Manzanillo cv. cutting revealing only the active cambium (x 32).

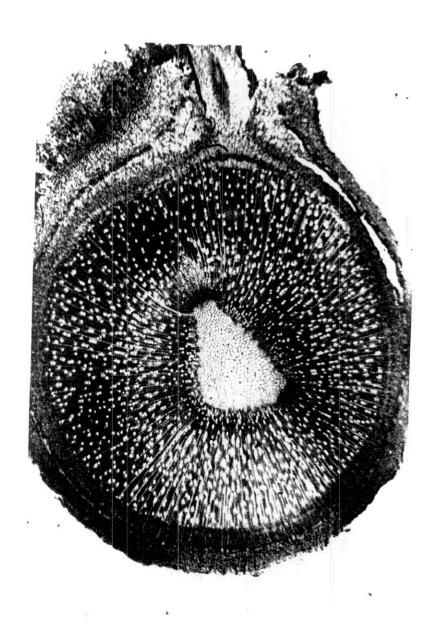
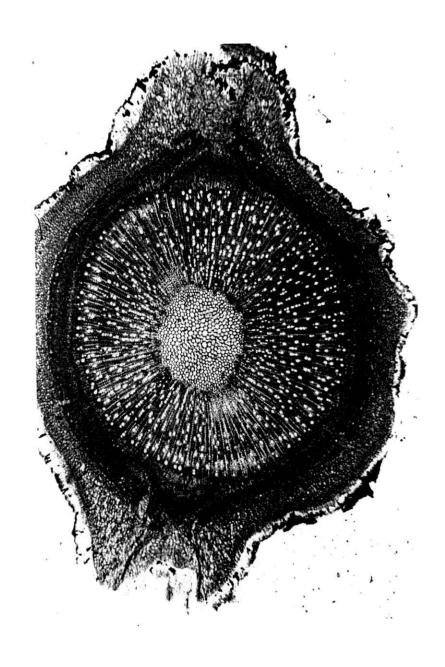
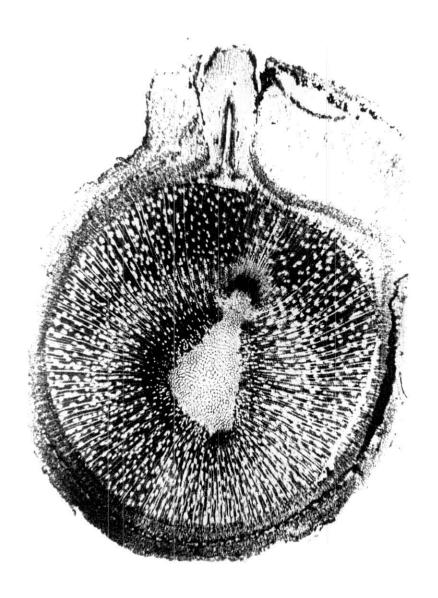


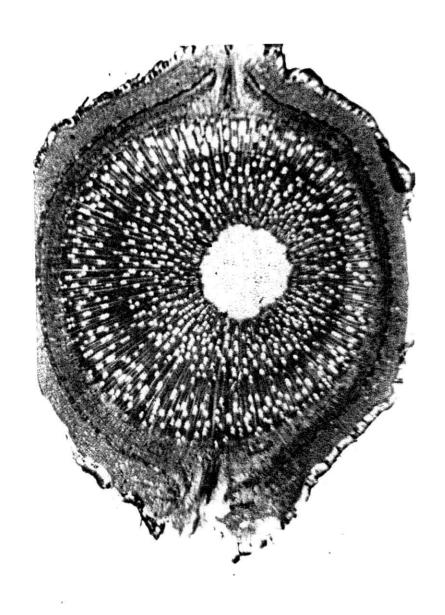
Fig. (3-b): Cross section of Manzanillo cv. cutting revealing the active cambium and pith (x 50).



**Fig. (4-a):** Cross section showing the early stages of root initiation in the cambium zone of Manzanillo cv. cutting (x 50).



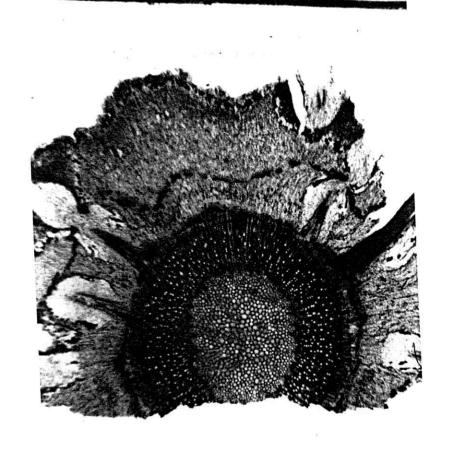
**Fig. (4-b):** Cross section showing the early stages of root initiation in the cambium zone and pith of Picual ev. cutting (x 45).



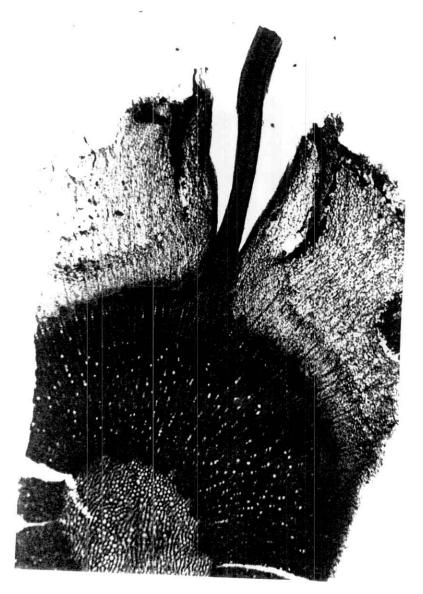
**Fig. (5-a):** Cross section showing the development of roots and its vascular system in contact with the main vessels of Manzanillo ev. (x 50).



Fig. (5-b): Across section showing the development of roots and its vascular system in contact with the main vessels of Picual ev. (x 32).



**Fig. (6-a):** Cross section showing the penetration of the development root primordium and its vascular system in contact with the main vessels through the cutting tissues of Manzanillo ev. (x 50).



**Fig. (6-b):** Across section showing the penetration of the development root primordium and its vascular system in contact with the main vessels through the cutting tissues of Picual ev. (x 50).