IV. RESULTS AND DISCUSSION

The following results and discussion will include specific and interaction effects of two factors i.e., a) rootstocks type (Bitter almond and Nemagurd peach) and b) irrigation regime (100%, 75 %, 50 % and 25 % of field capacity) on some growth measurements, leaf and root mineral content as well as anatomical study of Ne plus ultra almond transplants.

IV.I. Vegetative growth measurements.

IV.I.1- Net increase shoot length.

Data obtained during 2008 and 2009 seasons concerning the specific and interaction effects of the two investigated factors on net increase shoot length (cm.) of Ne plus ultra almond are tabulated in **Table (2)**.

A. Specific effect:

Regarding the specific effect of rootstock type on net increase shoot length data presented in **Table (2)** revealed that, Nemagurd peach rootstock was better than the other investigated rootstock (Bitter almond) in this respect where the former one significantly increased Ne plus ultra almond net increase shoot length. Concerning the specific effect of the different irrigation regime (100 % 75 %, 50 % and 25 % of field capacity) on Ne plus ultra almond net increase shoot length, data tabulated in **Table (2)** revealed that, water addition through irrigation with full field capacity (control) was superior in this respect where it was able to increase significantly net increase shoot length as compared with the different investigated irrigation regime (100 %, 75 %, 50 % and 25 % of field capacity) during both seasons of study. Irrigation with 75 % of field capacity came in the second rank, we can concluded that, there was positive relation between net

shoot number/transplant and number of leaves/transplants were statistically increased when the transplants were irrigated with the highest rate irrigation (75 %) of field capacity as compared with the other irrigation regime during both seasons of study. The third investigated parameter (shoot diameter) was enhanced statistically when the transplants were irrigated with 100 % of field capacity (control) during both seasons of study.

B. Interaction effect:

Dealing with the interaction effect of the two investigated factor i.e., rootstock type and the different irrigation regime (100%, 75 %, 50 % and 25 % of field capacity) on shoot number/ transplants, shoot diameter and number of leaves/transplants of Ne plus ultra almond grafted on Bitter almond and Nemaguard peach rootstocks, data presented in **Tables (2 and 3)** cleared that the maximum improvement in both shoot number/ transplant and number of leaves/transplant parameters was noticed with such combined of Bitter almond rootstock irrigated with 75 % of field capacity while the same rootstock (Bitter almond) irrigated with 100 % of field capacity (control) gave the highest value of Ne plus ultra almond shoot diameter. On the other hand, the lowest decrease in shoot number/ transplant and shoot diameter of Ne plus ultra almond was obtained when Nemaguard peach used as rootstocks and the transplants were irrigated with 25 % of field capacity in both seasons of study. On the contrary, Bitter almond rootstock had the highest depressive effect on number of leaves of Ne plus ultra almond transplant when it was used as rootstock and the transplants were irrigated with 25 % of field capacity during both seasons of study.

These results go in line with that reported by **El-Kassas (1975); Draz (1986); Mass and Vander (1996) and Egea *et al.*, (2010).**

increase shoot length of increment Ne plus ultra almond and amount of water through irrigation.

B. Interaction effect:

Regarding the interaction effect of the two investigated factors i.e., rootstock type and different irrigation regime (100 %, 75 %, 50 % and 25 % of field capacity) on Ne plus ultra almond net increase shoot length, data presented in **Table (2)** show a considerable and statistically effect in both seasons of the study, where the highest net increase shoot length was obtained with the combination between Nemaguard peach rootstock irrigated with 100 % of field capacity (control), however the lowest decrease in net increase shoot length was noticed by Ne plus ultra almond grafted on Bitter almond rootstocks and irrigated with 25 % of field capacity as compared with the other two irrigation regime and control during the two seasons of study.

This results is agreement with that reported by **Chapoman (1973); Badizadegan (1975); Heweit and Cassidy (1978); Yoon *et al.*, (1996)** and **El-Moshtohrey (1999).**

IV.I.2- Total number of shoot/transplant, shoot diameter and total number of leaves/transplant.

A. Specific effect:

Dealing with the specific of the two factors involved in this study i.e., rootstock type and the different irrigation regime on shoot number/ transplants, shoot diameter and number of leaves/transplant of the Ne plus ultra almond, data obtained in **Tables (2 and 3)** show that Bitter almond rootstock was better than Nemaguard peach rootstock in this respect, where it improved statistically the three investigated parameter for both seasons of study. With respect to the different irrigation regime on shoot number/transplant, shoot diameter and number of leaves/ transplant, data tabulated in **Tables (2 and 3)** revealed that both

Table (2): Effect of different irrigation regime on average shoot length, total number of shoot/transplant and shoot diameter for Ne plus ultra almond grafted on both Bitter almond and Nemagurd peach rootstocks during 2008 and 2009 seasons.

Characters	Net increase shoot length (cm)			Total number of shoot/transplant			Shoot diameter (mm.)		
Rootstocks	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean
Treatments	1st season								
Control (100 % F.C.)	18.79b	23.36a	**21.08A**	8.88a	8.52b	**8.70A**	9.47a	8.50b	**8.96A**
75 % F.C.	15.31c	19.87b	**17.59B**	7.82c	7.35e	**7.59B**	8.27b	7.40c	**7.83B**
50 % F.C.	10.46d	14.51c	**12.48C**	7.57d	6.95f	**7.26C**	6.32d	6.28d	**6.30C**
25 % F.C.	5.22e	10.38d	**7.80D**	6.41g	5.99h	**6.20D**	5.29e	4.29f	**4.79D**
Mean	**12.45B**	**17.03A**		**7.58A**	**7.29B**		**7.34A**	**6.62B**	
2nd season									
Control (100 % F.C.)	15.53b	21.44a	**18.49A**	7.96a	7.40b	**7.68A**	9.60a	7.72b	**8.66A**
75 % F.C.	12.13cd	20.56a	**16.34B**	7.24b	5.68e	**6.46B**	6.50c	6.39c	**6.45B**
50 % F.C.	9.90d	13.31bc	**11.61C**	6.79c	5.94e	**6.37B**	5.22d	5.24d	**5.23C**
25 % F.C.	6.05e	7.20e	**6.63D**	6.25d	4.55f	**5.40C**	4.35e	3.30f	**3.83D**
Mean	**10.90B**	**15.63A**		**7.06A**	**5.89B**		**6.42A**	**5.66B**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

Table (3): Effect of different irrigation regime on number of leaves/transplant and leaf area for Ne plus ultra almond grafted on both Bitter almond and Nemagurd peach rootstocks during both 2008 and 2009 seasons.

Characters	Total number of leaves/transsplant			Average leaf area (cm^2)		
Rootstocks	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean
Treatments	1st season					
Control (100 % F.C.)	29.44b	35.40a	**32.42A**	4.76b	6.67a	**5.71A**
75 % F.C.	28.80bc	30.42b	**29.61B**	4.05c	6.23a	**5.14B**
50 % F.C.	26.16c	28.89bc	**27.52C**	3.25d	4.57b	**3.91C**
25 % F.C.	20.75d	18.30d	**19.52D**	2.30e	3.80c	**3.05D**
Mean	**26.28B**	**28.25A**		**3.59B**	**5.32A**	
2nd season						
Control (100 % F.C.)	33.78a	34.36a	**31.51B**	5.38ab	5.55a	**5.46A**
75 % F.C.	30.80b	32.21ab	**34.07A**	5.00b	5.43ab	**5.22A**
50 % F.C.	26.73c	29.53b	**28.13C**	3.45c	3.48c	**3.47B**
25 % F.C.	18.78e	22.24d	**20.51D**	2.63d	2.93d	**2.78C**
Mean	**27.52B**	**29.59A**		**4.12A**	**4.35A**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

IV.I.3- Average leaf area (cm^2)

The average leaf area of Ne plus ultra almond was estimated in cm^2 in relation to the specific effect of rootstock type and the different irrigation regime, in addition to the interaction effect of their combination.

A. Specific effect:

Regarding the specific effect of the rootstock type (Bitter almond and Nemaguard peach) and different irrigation regime (100 %, 75 %, 50 % and 25 %) beside the control (100 % of field capacity) on the average leaf area (cm^2) of Ne plus ultra almond, data in **Table (3)** revealed that Nemaguard peach rootstock had a greater value of leaf area than the other investigated rootstock (Bitter almond) during both seasons of study.

Regarding the specific effect of different irrigation regime on average leaf area (cm^2), data presented in **Table (3)**, indicated that all the investigated irrigation regime significantly decreased average leaf area (cm^2) of Ne plus ultra almond as compared with control which was irrigated with 100 % of field capacity. Control irrigation treatment gave the highest value of the average leaf area (cm^2).

B. Interaction effect:

Concerning the interaction effect of the two investigated factors i.e., rootstock type (Bitter almond and Nemaguard peach) and different irrigation regime (100 %, 75 %, 50 % and 25 %) on average leaf area (cm^2) of Ne plus ultra almond transplant presented in **Table (3)** showed variable response of the two rootstocks to the different combination of irrigation regime.

The most increment of leaf area per transplant was that combination between Nemaguard peach rootstock and the highest irrigation rate (100 % of filed capacity, control). On the other

hand, the most depressive in the average of leaf area value was detected by Ne plus ultra almond grafted on Bitter almond rootstock and irrigated with 25 % of filed capacity during both seasons of study. The other combinations were in between.

These results are in general agreement with findings of **Damatta *et al.*, (1993); Vitale *et al.*, (1995) and El-Moshtohrey (1999).**

IV.I.4- Top fresh weight, root fresh weight and top/root ratio.

Data presented in **Table (4)**, reflect the effect of rootstock type i.e., (Bitter almond and Nemaguard peach) and different irrigation regime (100% 75 %, 50 % and 25 %) on top fresh weight of Ne plus ultra almond, root fresh weight of the two investigated rootstocks and top/root ratio during 2008 and 2009 seasons.

A. Specific effect:

Concerning the specific effect of the two investigated factors i.e., rootstock type (Bitter almond and Nemaguard peach) and the different irrigation regime on top fresh weight of Ne plus ultra almond, root fresh weight of the two investigated rootstocks (Bitter almond and Nemaguard peach), data presented in **Table (4)** indicated that Bitter almond rootstock gave the highest values of three investigated parameters (top fresh weight, root fresh weight and top/root ratio) as compared with the other investigated rootstock (Nemaguard peach) during the two seasons of study.

Regarding the specific effect of different irrigation regime (100 %, 75%, 50 % and 25 % of field capacity) on top fresh weight, root fresh weight and top/root ratio, data presented in **Table (4)** revealed that two investigated parameters (top fresh weight of Ne plus ultra almond and top/root ratio) took the same trend where their values were significantly increased when the transplants were irrigated with 75 % of field capacity during to

2008 and 2009 seasons. The third investigated parameter (root fresh weight) of the two rootstocks (Bitter almond and Nemaguard peach) took the other way around where the highest root fresh weight value was achieved when the transplants were irrigated with 100 % of field capacity (control) during both seasons of study.

B. Interaction effect:

Concerning the interaction between rootstock type (Bitter almond and Nemaguard peach) and different irrigation regime (100 %, 75 %, 50 % and 25 %) on top fresh weight (Ne plus ultra almond), root fresh weight of the two investigated rootstocks (Bitter almond and Nemaguard peach) and top/root ratio, data are recorded in **Table (4)** it is quite clear from data that, the best result regarding top fresh weight and top/root ratio parameters was obtained with Bitter almond rootstock combined with irrigation rate at 75 % of field capacity during both seasons of study.

On the other hand, the maximum root fresh weight was noticed when the Ne plus ultra almond transplants were grafted on Bitter almond rootstock and received much that irrigation with 100 % of field capacity (control) significantly increased root fresh weight of Bitter almond rootstock. The most value decrement of both top fresh weight and top/ root ratio parameters was recorded with Nemaguard peach rootstock watered with 25 % of field capacity.

The combination between Nemaguard peach rootstock and the irrigation at 75 % of field capacity had a depressive effect regarding root fresh weight during both seasons of study.

These results were in agreement with those reported by **Chapoman (1973); Nasr *et al.*, (1977); Safaa (1994) and Conejero *et al.*, (2011).**

Table (4): Effect of different irrigation regime on Top fresh weight (gm.), root fresh weight and top/root ratio for Ne plus ultra almond grafted on both Bitter almond and Nemagurd peach rootstocks during both 2008 and 2009 seasons.

Characters	Top fresh weight (gm.)			Root fresh weight (gm.)			Top/root ratio		
Rootstocks	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean
Treatments	1st season								
Control (100 % F.C.)	163.1a	149.2b	**156.2A**	148.9a	130.2d	**139.6A**	1.15f	1.15cd	**1.12B**
75 % F.C.	143.1c	147.2b	**145.1B**	142.0b	122.3e	**132.1B**	1.01h	1.20b	**1.11B**
50 % F.C.	151.1b	137.1d	**144.1B**	135.1c	118.0f	**126.6C**	1.12e	1.16c	**1.14A**
25 % F.C.	137.6d	132.8e	**135.2C**	130.1d	108.3G	**119.2D**	1.06g	1.23a	**1.14A**
Mean	**148.7A**	**141.6B**		**139.0A**	**119.7B**		**1.07B**	**1.18A**	
2nd season									
Control (100 % F.C.)	152.4a	136.9cd	**144.6A**	139.6b	142.7a	**141.1A**	1.09b	0.96e	**1.03C**
75 % F.C.	142.2b	133.9d	**138.1B**	127.4d	135.5c	**131.4B**	1.12a	0.99d	**1.05B**
50 % F.C.	138.4c	130.2e	**134.3C**	125.0e	121.1f	**123.0C**	1.11a	1.08bc	**1.09A**
25 % F.C.	134.0d	120.0f	**127.0D**	120.4f	112.6g	**116.5D**	1.11a	1.07c	**1.09A**
Mean	**141.8A**	**130.3B**		**128.1A**	**128.0B**		**1.11A**	**1.02B**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

IV.II. Effect of rootstock type and different irrigation regime on some chemical constituents:

IV.II.1- Effect on leaf chlorophyll a and b contents.

Dealing with the specific and interaction effects of the two investigated factors (rootstock type and the different irrigation regime 100% 75 %, 50 % and 25 % of field capacity) on leaf chlorophyll a and b contents of Ne plus ultra almond transplants, related data are tabulated in **Table (5)**.

A. Specific effect:

Regarding the specific effect of the two investigated factors on leaf chlorophyll a and b contents, data presented in **Table (5)**, reflected that Nemaguard peach rootstock had a higher value of chlorophyll a than the other investigated rootstock (Bitter almond) during 2008 and 2009 seasons. Such trend was true for leaf chlorophyll b and total chlorophyll a and b contents, whereas the difference between the two investigated rootstocks were more pronounced.

Concerning the specific effect of the different irrigation regime on leaf chlorophyll a, b and total chlorophyll contents of Ne plus ultra almond, data presented in **Table (5)**, indicate that the three investigated irrigation regime (100 %, 75 %, 50 % and 25 % of filed capacity) lead to decrease chlorophyll a, b and total chlorophyll contents in the leaves of Ne plus ultra almond which were grafted on the two investigated rootstocks during both seasons of study. This decrement was significant as compared with those irrigated with 100 % of field capacity (control). There was statistically differences between the three investigated irrigation regime when leaf chlorophyll a, b and total chlorophyll contents were concerned.

Table (5): Effect of different irrigation regime on chlorophyll (a), (b) and total chlorophyll (a+b) (mg./g. F.w.) for Ne plus ultra almond grafted on both Bitter almond and Nemagurd rootstocks during both 2008 and 2009 seasons.

Characters	Chlorophyll (a)			Chlorophyll (b)			Total chlorophyll		
Rootstocks	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean
Treatments	1st season								
Control (100 % F.C.)	1.15b	1.87a	**1.51A**	1.05b	1.28a	**1.16A**	2.20b	3.15a	**2.68A**
75 % F.C.	1.09c	1.15b	**1.12B**	0.96c	1.09b	**1.03B**	2.05c	2.24b	**2.15B**
50 % F.C.	1.06c	1.11b	**1.09C**	0.78d	1.07b	**0.93C**	1.84d	2.18b	**2.01C**
25 % F.C.	0.78e	1.01de	**0.90D**	0.71d	0.99c	**0.85D**	1.49e	2.00c	**1.75D**
Mean	**1.02B**	**1.29A**		**0.88B**	**1.11A**		**1.90B**	**2.39A**	
	2nd season								
Control (100 % F.C.)	1.50b	1.82a	**1.66A**	1.02c	1.31a	**1.17A**	2.52b	3.13a	**2.83A**
75 % F.C.	1.14d	1.35c	**1.25B**	0.99c	1.12b	**1.06B**	2.13c	2.47b	**2.30B**
50 % F.C.	1.09e	1.24d	**1.17C**	0.85d	1.04c	**0.95C**	1.94d	2.28bc	**2.11C**
25 % F.C.	0.87f	1.11e	**0.99D**	0.69e	1.00c	**0.84D**	1.56d	2.11c	**1.84D**
Mean	**1.15B**	**1.38A**		**0.89B**	**1.12A**		**2.04B**	**2.50A**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

B. Interaction effect:

Dealing with the interaction effect between rootstock type and the different irrigation regime (100 %, 75 %, 50 % and 25 % of field capacity) on leaf chlorophyll a, b and total chlorophyll of Ne plus ultra almond, data presented in **Table (5)** showed that the combination between Ne plus ultra almond grafted on Nemaguard peach rootstock and irrigated with 100 % of field capacity (control) greatly enhanced the investigated parameters, whereas this combination statistically maximized the values of leaf chlorophyll a, b and total chlorophyll content during 2008 and 2009 seasons.

On the other hand, the least values of leaf chlorophyll a, b and total chlorophyll contents were noticed in the leaves of Ne plus ultra almond grafted on Bitter almond rootstock and received 25 % of water field capacity during both seasons of study. It could be concluded that photosynthetic pigment (chlorophyll a and b) formation could be enhanced in the leaves of Ne plus ultra almond grafted on Nemagurad peach rootstock when the transplants irrigated with 100 % of field capacity.

These results are in harmony with those reported by **Ahmed-Rokaia (1990); El-Khateeb, (1996); Gowda (1998) and Laz *et al.*, (1999)**.

IV.II.2- Total carbohydrates.

Total carbohydrates content in shoot dry matter of Ne plus ultra almond transplants as affected by specific and interaction effects of rootstock type and the different rates of irrigation (100%, 75 %, 50 % and 25 % of field capacity) and their combinations were investigated. Data obtained during both 2008 and 2009 seasons are presented in **Table (6)**.

A. Specific effect:

Regarding the specific effect of rootstock type on shoot dry matter carbohydrates content, **Table (6)** displays that total carbohydrates of Ne plus ultra almond grafted on Nemaguard peach rootstock were significantly higher than those grafted on Bitter almond rootstock during 2008 and 2009 seasons.

With regard to specific effect of different irrigation regime (100 %, 75 %, 50 % and 25 % of field capacity) on carbohydrates content of Ne plus ultra almond shoot dry matter, data in **Table (6)** display that irrigation with 100 % of field capacity (control) the best irrigation treatment whereas it increased significantly stem total carbohydrates as compared with the other investigated irrigation regime during the first and second seasons of study. Moreover, differences with irrigation regime were statistically significant. The least stem carbohydrates content was detected when the transplants were irrigated with 25 % of field capacity.

B. Interaction effect:

Concerning the interaction effect of the two investigated factors i.e., rootstock type and the different irrigation regime (100 %, 75 %, 50 % and 25 % of field capacity) on stem total carbohydrates of Ne plus ultra almond, data presented in **Table (6)** showed obviously that the interaction between the two investigated factors had significant effect on carbohydrates content of Ne plus ultra almond stem during 2008 and 2009 seasons. The highest stem carbohydrates content was detected with that combination between Nemaguard rootstock and the irrigation at 100 % of field capacity (control) during both seasons of study. On the other hand, the transplants which were grafted on Bitter almond rootstock and watering with 25 % of field capacity appeared to be contain the minimum value of stem carbohydrates during both seasons of study. The other combinations were in between the abovementioned two extents as shoot carbohydrates was concerned.

These results are in general agreement with **El-Hefnawi (1986); Ahmed-Rokaia (1990); El-Khateeb, (1996) and Osman (2004).**

IV.II.3- Leaf proline content.

Data obtained regarding leaf proline content of Ne plus ultra almond transplants as affected by rootstock type (Bitter almond and Nemaguard peach) and different irrigation regime (100 %, 75 %, 50 % and 25 % of field capacity) during 2008 and 2009 seasons are presented in **Table (6)**.

A. Specific effect:

Concerned the specific effect of rootstock type and the different irrigation regime on leaf proline content, data presented in **Table (6)** show that the investigated rootstock type took on opposite trend regarding leaf proline content as compared with its effect on leaf chlorophyll a, b, total chlorophyll and shoot dry matter carbohydrate content. Consequently, Bitter almond rootstock was more effective than the other investigated rootstock (Nemaguard peach rootstock) in this respect.

Referring the specific effect of different irrigation regime on leaf proline content, **Table (6)** reveals that the level of leaf proline content was gradually increased by decreasing the amount of water irrigation. Anyhow, the highest level of leaf proline content regarding water regime (100 %, 75 %, 50 % and 25 % of field capacity) was associated with the addition of water at 25 % of field capacity during both seasons of study.

B. Interaction effect:

As for the interaction effect of the two investigated factors i.e., rootstock type and the different irrigation regime (100 %, 75 %, 50 % and 25 % of field capacity) on leaf proline content of Ne plus ultra almond,

Table (6): Effect of different irrigation regime on carbohydrates and proline for Ne plus ultra almond grafted on both Bitter almond and Nemagurd rootstocks during both 2008 and 2009 seasons.

Characters	Carbohydrates (dry weight) %			Proline mg/100 g. F.w.		
Rootstocks	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean
Treatments	1st season					
Control (100 % F.C.)	63.75a	60.26ab	**62.00A**	0.23c	0.16d	**0.20D**
75 % F.C.	58.41b	42.21e	**50.31B**	0.30b	0.23c	**0.27C**
50 % F.C.	51.09c	47.90csd	**49.49B**	0.34b	0.30b	**0.32B**
25 % F.C.	47.21cd	45.03de	**46.12C**	0.41a	0.34b	**0.38A**
Mean	**55.12A**	**48.85B**		**0.32A**	**0.26B**	
	2nd season					
Control (100 % F.C.)	61.74ab	63.96a	**62.85A**	0.25c	0.13d	**0.19D**
75 % F.C.	58.00bc	62.43a	**60.22A**	0.32b	0.19d	**0.25C**
50 % F.C.	51.89d	56.53c	**54.21B**	0.39a	0.25c	**0.32B**
25 % F.C.	48.07d	51.26d	**49.67C**	0.43a	0.30bc	**0.37A**
Mean	**54.93B**	**58.54A**		**0.35A**	**0.22B**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

data obtained in **Table (6)** showed obviously the variable reverse of almond transplants to the different combinations used during 2008 and 2009 seasons. The higher value increase in leaf proline content of Ne plus ultra almond transplants was detected by that combination between Bitter almond rootstock and the irrigation with 25 % of field capacity, whereas the lowest value of leaf proline content was detected by those of Nemaguard peach rootstock irrigated with 100 % of field capacity during both seasons of study. Moreover, the other combinations were in between the aforesaid two extents.

The present results are in general agreement with the findings of **Verranjaneyulu and Kumari (1989); El-Said *et al.*, (1993); El-Khateeb (1996) and Osman (2004).**

IV.III. Effect of rootstock type and different irrigation regime on leaf and root mineral composition:

Leaf and root nitrogen, phosphorus and potassium contents in response to specific and interaction effects of (Bitter almond and Nemaguard peach) and the different irrigation regime (100 %, 75 %, 50 % and 25 % of field capacity) and their possible combinations were investigated. Data obtained during both 2008 and 2009 seasons are presented in **Tables (7, 8 and 9)**.

IV.III.1- Leaf and root nitrogen content.

A. Specific effect:

Table (7) displays that leaf and root N content did not response specifically to the investigated rootstock type. Hence, the statistically differences were in between the two investigated rootstocks (Bitter almond and Nemaguard peach) when leaf and root N contents were concerned.

Table (7): Effect of different irrigation regime on (leaf and root) nitrogen % for Ne plus ultra almond grafted on both Bitter almond and Nemagurd rootstocks during both 2008 and 2009 seasons.

Characters	Nitrogen (%)					
	Leaf			Root		
Rootstocks	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean
Treatments	1st season					
Control (100 % F.C.)	2.41a	2.36ab	**2.39A**	2.38a	2.19c-e	**2.29A**
75 % F.C.	2.29bc	2.31b	**2.30B**	2.22b-d	2.28b	**2.25A**
50 % F.C.	2.28bc	2.28bc	**2.28B**	2.17de	2.24bc	**2.21B**
25 % F.C.	2.18d	2.21cd	**2.20C**	2.14e	2.19c-e	**2.17C**
Mean	**2.29A**	**2.29A**		**2.23A**	**2.23A**	
	2nd season					
Control (100 % F.C.)	2.73a	2.61bc	**2.67A**	2.61a	2.59ab	**2.60A**
75 % F.C.	2.66ab	2.52cd	**2.59B**	2.52bc	2.51bc	**2.52B**
50 % F.C.	2.60bc	2.44de	**2.52B**	2.40de	2.43cd	**2.42C**
25 % F.C.	2.50cd	2.34e	**2.42C**	2.31f	2.33ef	**2.32D**
Mean	**2.62A**	**2.48B**		**2.46A**	**2.47A**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

With respect to the specific effect of the different irrigation regime on leaf and root N content, data presented in **Table (7)** revealed that both leaf and root nitrogen content decreased significantly with decreasing the level of water irrigation during both seasons of study. On the contrary, the control treatment (irrigation with 100 % of field capacity) increased significantly N % in both leaves and roots during the two seasons of study.

B. Interaction effect:

Regarding the interaction effect of the two investigated factors i.e., rootstock type and the different rates of irrigation on leaf and root N content, data presented in **Table (7)** clear obviously that the most stimulative combination enhanced both leaf and root N contents was that combination between Bitter almond rootstock and the irrigation with 100 % of field capacity during the two seasons of study. Moreover, the lowest decrease in both leaf and root N content was detected by Bitter almond rootstock irrigated with 25 % of field capacity during 2008 and 2009 seasons. On the other hand, other combinations treatments were in between in this respect.

Such results in general agreement with those previously reported by **Gowda (1998); Hassan (1998); Laz *et al.*, (1999) and Osman (2004).**

IV.III.2- Leaf and root phosphorus content.

A. Specific effect:

Regarding the specific effect of the two investigated factors involved in this study i.e., rootstock type and the different irrigation regime on leaf and root phosphorus contents. The result presented in **Table (8)** clearly show that the leaves of Ne plus ultra almond grafted on Nemaguard peach rootstock were richer

in their phosphorus content as compared with those grafted on Bitter almond rootstock. In this respect, root phosphorus content of Nemaguard peach rootstock was highly significant than those detected in the roots of Bitter almond rootstock during both seasons of study. It could be concluded from the abovementioned result that phosphorus content was highly enhanced in both the leaves of Ne plus ultra almond as a scion and in the roots of Nemaguard peach as a rootstock.

With respect to the specific effect of the different irrigation regime on leaf and root phosphorus content, data presented in **Table (8)** revealed that as the rate of irrigation decreased, both leaf and root phosphorus content decreased during both seasons of study.

B. Interaction effect:

Results tabulated in **Table (8)** show the effect of the interaction between rootstock type and the different irrigation regime on leaf and root phosphorus contents. These results revealed that leaf and root phosphorus was significantly affected by the interaction between the two investigated factors involved in this study. On the other hand, the highest value of leaf and root phosphorus content was that combination between Nemaguard peach rootstock and irrigation with 100 % of field capacity, whereas the most depressive effect on leaf and root phosphorus content was detected with Bitter almond rootstock combined with irrigation with 25 % of field capacity. Moreover, other combinations were in between in this respect.

These results are in congeniality with the findings previously detected by **Iobishvili and Mikautadye (1984); Youssef (1990); Abd EI-Samed (1995) and Osman (2004).**

Table (8): Effect of different irrigation regime on (leaf and root) phosphorus % for Ne plus ultra almond grafted on both Bitter almond and Nemagurd rootstocks during both 2008 and 2009 seasons.

Characters	Phosphorus (%)					
	Leaf			Root		
Rootstocks	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean
Treatments	1st season					
Control (100 % F.C.)	0.62ab	0.67a	**0.65A**	0.61a	0.63a	**0.62A**
75 % F.C.	0.53bc	0.61ab	**0.57AB**	0.50b	0.58a	**0.54B**
50 % F.C.	0.42cd	0.59ab	**0.51B**	0.41c	0.49b	**0.45C**
25 % F.C.	0.31d	0.44c	**0.38C**	0.31d	0.35d	**0.33D**
Mean	**0.47B**	**0.58A**		**0.46B**	**0.51A**	
	2nd season					
Control (100 % F.C.)	0.54b	0.62a	**0.58A**	0.51b	0.57a	**0.54A**
75 % F.C.	0.48bc	0.54b	**0.51B**	0.47b	0.49b	**0.48B**
50 % F.C.	0.39d	0.45cd	**0.42C**	0.41c	0.41c	**0.41C**
25 % F.C.	0.30e	0.39d	**0.35D**	0.33d	0.34d	**0.34D**
Mean	**0.43B**	**0.50A**		**0.43A**	**0.45A**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

IV.III.3- Leaf and root potassium content.

Results of the two seasons as shown in **Table (9)**, show the effect of rootstock type and the different irrigation regime on leaf and root potassium contents of Ne plus ultra almond grafted on both Nemaguard peach and Bitter almond rootstocks during 2008 and 2009 seasons.

A. Specific effect:

It is obvious from the data presented in **Table (9)** that neither leaf potassium content of Ne plus ultra almond nor root potassium content affected by both investigated rootstocks (Nemaguard peach and Bitter almond) involved in this study during both seasons of study. In another word, there was no significantly difference between the two investigated rootstocks on either leaf or root potassium content during two seasons of study.

Concerning the specific effect of the different irrigation regime on leaf and root potassium contents, data tabulated in **Table (9)**, revealed that irrigation with 100 % or 75 % of field capacity were the best in this respect, whereas they were able to achieve the maximum level of both leaf and root potassium content, followed in a descending order by irrigation with 50 % and 25 % of field capacity during both seasons of study.

B. Interaction effect:

As for the interaction effect between the two investigated factors involved in this study i.e., rootstock type (Nemaguard peach and Bitter almond) and the different irrigation regime (100 %, 75 %, 50 and 25 % of field capacity) on leaf and root potassium contents, data presented in **Table (9)** showed that interaction had significant effect on potassium

Table (9): Effect of different irrigation regime on (leaf and root) potassium % for Ne plus ultra almond grafted on both Bitter almond and Nemagurd rootstocks during both 2008 and 2009 seasons.

Characters	Potassium (%)					
	Leaf			Root		
Rootstocks	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean
Treatments	1st season					
Control (100 % F.C.)	2.03a	2.09a	**2.06A**	1.98a	2.09a	**2.04A**
75 % F.C.	1.91ab	1.94ab	**1.93AB**	1.84a	1.23b	**1.49B**
50 % F.C.	1.50b	1.62b	**1.56B**	1.09c	0.94c	**1.02C**
25 % F.C.	1.33c	1.13c	**1.23C**	0.90c	0.77d	**0.79C**
Mean	**1.69A**	**1.70A**		**1.45A**	**1.26A**	
	2nd season					
Control (100 % F.C.)	1.99a	2.25a	**2.12A**	2.20a	2.16a	**2.18A**
75 % F.C.	2.01a	2.11a	**2.06AB**	1.48b	1.02c	**1.25B**
50 % F.C.	1.49b	1.49b	**1.49B**	0.89c	0.79d	**0.90C**
25 % F.C.	0.98c	1.11c	**1.05C**	0.67e	0.80d	**0.74C**
Mean	**1.62A**	**1.74A**		**1.27A**	**1.19A**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

content in the leaves of Ne plus ultra and in the roots of both investigated rootstocks during 2008 and 2009 seasons. On the other hand, the combination between Bitter almond rootstock and the irrigation with 100 % of field capacity as well as the combination between Nemaguard peach rootstock and irrigation with 100 % of field capacity had the same trend and the highest value of potassium content in the leaves of Ne plus ultra almond during 2008 and 2009 seasons. The same trend was true when root potassium content was concerned. In contrast, the combination between Bitter almond rootstock and the irrigation with 25 % of field capacity had the least value of potassium content in both the leaves of Ne plus ultra almond as a scion and the root of Bitter almond rootstock during both seasons of study. The other combinations were in between in this respect.

The present results regarding the influence of irrigation regime on leaf K % content is in magnitude with the findings of **Nomir (1994); Laz *et al.*, (1999) and Osman (2004)**.

IV.III.4- Leaf and root calcium content.

A. Specific effect:

Regarding the specific effect of rootstock type and irrigation regime (100 %, 75 %, 50 % and 25 % of field capacity) on leaf calcium content of Ne plus ultra almond and root calcium content of both investigated rootstocks, data in **Table (10)** clearly show that there was no significant differences in leaf calcium content of Ne plus ultra either grafted on Bitter almond or Nemaguard peach rootstocks. The opposite was true regarding root calcium content whereas the roots of Nemaguard peach rootstock was richer in their calcium as compared with Bitter almond rootstock during both seasons of study.

Table (10): Effect of different irrigation regime on (leaf and root) calcium % for Ne plus ultra almond grafted on both Bitter almond and Nemagurd rootstocks during both 2008 and 2009 seasons.

Characters	Calsium (%)					
	Leaf			Root		
Rootstocks	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean
Treatments	1st season					
Control (100 % F.C.)	2.43e	2.13f	**2.28D**	0.81f	0.74g	**0.78D**
75 % F.C.	2.61d	2.59d	**2.60C**	0.89e	0.98d	**0.94C**
50 % F.C.	2.98c	3.10b	**3.04B**	1.31c	1.36c	**1.34B**
25 % F.C.	3.10b	3.34a	**3.22A**	1.43b	1.52a	**1.48A**
Mean	**2.78A**	**2.79A**		**1.11B**	**1.15A**	
	2nd season					
Control (100 % F.C.)	2.27f	2.21f	**2.24D**	0.80f	0.79f	**0.80D**
75 % F.C.	2.48e	2.61d	**2.54C**	0.94e	0.98e	**0.96C**
50 % F.C.	3.19c	3.28b	**3.24B**	1.39d	1.48c	**1.44B**
25 % F.C.	3.34b	3.49a	**3.41A**	1.54b	1.98a	**1.76A**
Mean	**2.82B**	**2.90A**		**1.17B**	**1.31A**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

Regarding the specific effect of the irrigation regime on leaf and root calcium content, data presented in **Table (10)** revealed that as the irrigation rate decrease both leaf and root calcium significantly increased during the two seasons of study.

B. Interaction effect:

As for the interaction effect of the two investigated factors i.e., rootstock type and the irrigation regime on leaf calcium content of Ne plus ultra as a scion and root calcium content of Bitter almond and Nemaguard peach rootstocks. Data tabulated in **Table (10)** obviously clear that the highest leaf and root calcium content was coupled with Nemaguard peach rootstock irrigated with 75 % of field capacity. On the contrary the lowest value of both leaf and root calcium content was detected by using Nemaguard peach as a rootstock watered with 100 % of field capacity during both seasons of study.

The present results are in partial agreement with the findings of **Kabeel (1985); El-Fakharani (1986), Marwad (1989) Nomir (1994) and Osman (2004).**

IV.III.5- Leaf and root magnesium content.

A. Specific effect:

Referring the specific effect of rootstock type on leaf and root Mg content of Ne plus ultra almond as a scion and the two investigated rootstocks respectively, data obtained in **Table (11)** clearly show that leaf Mg content was not affected by any of the two investigated rootstocks during both seasons of study. Whereas root Mg content was greatly affected by rootstock type. Root Mg content of Bitter almond rootstock was statistically higher than that recorded with Nemaguard peach rootstock.

Table (11): Effect of different irrigation regime on (leaf and root) magnesium % for Ne plus ultra almond grafted on both Bitter almond and Nemagurd rootstocks during both 2008 and 2009 seasons.

Characters	Magnesium (%)					
	Leaf			Root		
Rootstocks	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean
Treatments	1st season					
Control (100 % F.C.)	0.94a	0.93a	**0.94A**	0.64bc	0.71a	**0.68A**
75 % F.C.	0.82b	0.80bc	**0.81B**	0.59cd	0.65b	**0.62B**
50 % F.C.	0.73cd	0.69d	**0.71C**	0.48e	0.55d	**0.52C**
25 % F.C.	0.60e	0.51f	**0.56D**	0.39f	0.41f	**0.40D**
Mean	**0.77A**	**0.73A**		**0.53B**	**0.58A**	
	2nd season					
Control (100 % F.C.)	0.98a	0.99a	**0.99A**	0.73a	0.62b	**0.67A**
75 % F.C.	0.80b	0.78b	**0.79B**	0.61b	0.50c	**0.55B**
50 % F.C.	0.71c	0.66c	**0.69C**	0.54c	0.44d	**0.49C**
25 % F.C.	0.53d	0.51d	**0.52D**	0.31e	0.30e	**0.31D**
Mean	**0.76A**	**0.74A**		**0.55A**	**0.47B**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

As for the specific effect of the irrigation regime on leaf and root Mg content, data presented in **Table (11)** revealed that both leaf and root Mg content took the same trend, whereas the highest leaf and root Mg content was remarked with the transplants irrigated with 100 % of field capacity. Meanwhile, the lowest value of Mg content in both leaves and roots was associated with the irrigation with 75 % of field capacity during 2008 and 2009 seasons.

B. Interaction effect:

As for the interaction effect of the two investigated factors i.e., rootstock types and the irrigation regime on leaf and root Mg content, data tabulated in **Table (11)** showed obviously the variable response to the different combinations during 2008 and 2009 seasons. Bitter almond rootstock combined with control treatment (irrigation with 100 % of field capacity) was the best combination where it raised leaf and root Mg content to the maximum level as compared with the other tested combinations during both seasons of study. On the other hand, leaf and root Mg content reached the minimum value when Nemaguard peach watering as rootstock and with 75 % of field capacity. The other combinations were in between during both seasons of study.

These results are in general agreement with **El-Fakharani (1986), Nomir (1994) and Osman (2004).**

IV.III.6- Leaf and root chloride content.

A. Specific effect:

Regarding the specific effect of rootstock type and the irrigation regime on leaf and root Cl content, data presented in **Table (12)** clearly show that leaves of Nemaguard peach rootstock surpassed the leaves of the other investigated rootstock (Bitter almond in their Cl content. Meanwhile, root Cl content

was equal in both investigated rootstocks during both seasons of study.

As for the specific effect of irrigation regime on leaf and root Cl content, data presented in **Table (12)** revealed that as the field capacity increase from 25 % to 75 % of field capacity leaf and root Cl contents increase during 2008 and 2009 seasons.

B. Interaction effect:

Regarding the interaction effect of the two investigated factors i.e., rootstock type and the irrigation regime on leaf and root Cl content, data in **Table (12)** revealed that the highest leaf content was detected by the combination between Nemaguard peach rootstock and the irrigation with 75 % of field capacity, while the lowest leaf Cl content was obtained by Bitter almond rootstock irrigated with 100 % of field capacity.

The following two combinations:

a. Nemaguard peach rootstock x 75 % of field capacity and

b. Bitter almond rootstock x 75 % of field capacity gave the highest root Cl content. On the other hand, the lowest value of root Cl content was detected with Nemaguard peach rootstock irrigated with 100 % of field capacity during both seasons of study. The other combinations were in between.

Such results are in general agreement with **El-Gazzar *et al.*, (1979); Salem (1981); Garaecia and Charbaji (1989) and Ali (2005).**

IV.III.7- Leaf and root iron, zinc and manganese contents.

A. Specific effect:

Concerning the specific effect of rootstock type and irrigation regime on both leaf and root Fe, Zn and Mn contents, data obtained as shown from **Tables (13, 14 and 15)** revealed that

Table (12): Effect of different irrigation regime on (leaf and root) chloride for Ne plus ultra almond grafted on both Bitter almond and Nemagurd rootstocks during both 2008 and 2009 seasons.

Characters	Chloride (ppm)					
	Leaf			Root		
Rootstocks	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean
Treatments	1st season					
Control (100 % F.C.)	0.54e	0.61e	**0.57D**	0.32d	0.30d	**0.31D**
75 % F.C.	0.69d	0.75d	**0.72C**	0.47c	0.46c	**0.47C**
50 % F.C.	0.91c	0.94c	**0.93B**	0.61b	0.59b	**0.60B**
25 % F.C.	1.31b	1.48a	**1.39A**	0.79a	0.81a	**0.80A**
Mean	**0.86B**	**0.94A**		**0.55A**	**0.54A**	
	2nd season					
Control (100 % F.C.)	0.59f	0.66ef	**0.63D**	0.28d	0.25d	**0.27D**
75 % F.C.	0.74de	0.80d	**0.77C**	0.37c	0.40c	**0.39C**
50 % F.C.	0.96c	1.12b	**1.04B**	0.59b	0.61b	**0.60B**
25 % F.C.	1.22b	1.39a	**1.30A**	0.77a	0.76a	**0.76A**
Mean	**0.88B**	**0.99A**		**0.50A**	**0.51A**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

Bitter almond rootstock surpassed the other investigated rootstock (Nemaguard peach). Whereas the level of the elements (Fe, Zn and Mn) in the leaves of Bitter almond rootstock were significantly higher than that recorded in the leaves of Nemaguard peach rootstock. The same trend was true with root Fe and Mn content, while root Zn content took the other way around. In this regard root Zn content was not statistically affected by any of the two investigated rootstocks during both seasons of study.

As for the specific effect of irrigation regime on leaf and rot Fe, Zn and Mn contents, data in **Tables (13, 14 and 15)** shows that leaf and root contents of the three nutrient elements took the same trend when irrigation regime is concerned. It was remarkable clear that both leaf and root Fe, Zn and Mn contents significantly decreased gradually by increasing the irrigation regime from 25 % of field capacity passing through 50 % and finally terminated by 75 % of field capacity. The maximum level of leaf and root Fe, Zn and Mn content was achieved when the transplants were irrigated with 100 % of field capacity during both seasons of study.

B. Interaction effect:

Dealing with the interaction effect of the investigated factors i.e., rootstock type and the irrigation regime on both leaf and root Fe, Zn and Mn contents, data presented in **Tables (13, 14 and 15)** showed that the combination between Bitter almond rootstock and the irrigation with 100 % of field capacity maximized both leaf and root Fe, Zn and Mn contents. On the other hand the combination between Nemaguard peach rootstock and the irrigation with 75 % of field capacity minimized leaf and root Fe, Zn and Mn contents during both seasons of study. The other combinations were in between.

The present results goes generally with findings of **Shahin (1989); Abd EL-Ghani (1990); Nomir (1994) and Osman (2004).**

Table (13): Effect of different irrigation regime on (leaf and root) iron (ppm) for Ne plus ultra almond grafted on both Bitter almond and Nemagurd rootstocks during both 2008 and 2009 seasons.

Characters	Iron (ppm)					
	Leaf			Root		
Rootstocks	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean
Treatments	1st season					
Control (100 % F.C.)	218.7a	219.3a	**219.0A**	221.0a	215.0c	**218.0A**
75 % F.C.	213.0b	210.0c	**211.5B**	218.0b	213.0c	**215.5B**
50 % F.C.	208.3c	203.0de	**205.7C**	207.0d	204.0e	**205.5C**
25 % F.C.	203.7d	201.0e	**202.3D**	203.0e	200.0f	**201.5D**
Mean	**210.9A**	**208.3B**		**212.3A**	**208.0B**	
	2nd season					
Control (100 % F.C.)	211.0a	207.0b	**209.0A**	213.0a	209.3b	**211.2A**
75 % F.C.	204.0c	199.3d	**201.7B**	204.7c	200.0d	**202.3B**
50 % F.C.	200.0d	190.0e	**195.0C**	201.0d	190.7f	**195.8C**
25 % F.C.	199.7d	189.7e	**194.7C**	194.0e	190.0f	**192.0D**
Mean	**203.7A**	**196.5B**		**203.2A**	**197.5B**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

Table (14): Effect of different irrigation regime on (leaf and root) zinc (ppm) for Ne plus ultra almond grafted on both Bitter almond and Nemagurd rootstocks during both 2008 and 2009 seasons.

Characters	Zinc (ppm)					
	Leaf			Root		
Rootstocks	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean
Treatments	1st season					
Control (100 % F.C.)	139.0a	120.0c	**129.5A**	110.0a	107.0b	**108.5A**
75 % F.C.	128.0b	110.0d	**119.0B**	101.0c	101.0c	**101.0B**
50 % F.C.	119.0c	100.7e	**109.8C**	98.0c	99.0d	**98.5C**
25 % F.C.	100.3e	97.0f	**97.17D**	91.0e	90.0e	**90.5D**
Mean	**121.6A**	**106.2B**		**100.0A**	**99.3A**	
	2nd season					
Control (100 % F.C.)	135.0a	129.0b	**132.0A**	105.0b	108.0a	**106.5A**
75 % F.C.	124.7c	120.0d	**122.3B**	100.3c	102.0c	**101.2B**
50 % F.C.	104.0e	100.0f	**102.0C**	96.0d	97.0d	**96.5C**
25 % F.C.	97.0g	96.3g	**96.7D**	90.3e	88.0f	**89.2D**
Mean	**115.2A**	**111.3B**		**97.9A**	**98.8A**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

Table (15): Effect of different irrigation regime on (leaf and root) manganese (ppm) for Ne plus ultra almond grafted on both Bitter almond and Nemagurd rootstocks during both 2008 and 2009 seasons.

Characters	Manganese (ppm)					
	Leaf			Root		
Rootstocks	Bitter almond	Nemagurd peach	Mean	Bitter almond	Nemagurd peach	Mean
Treatments	1st season					
Control (100 % F.C.)	59.00a	56.00b	**57.50A**	58.00a	55.00ab	**56.50A**
75 % F.C.	54.00b	50.00c	**52.00B**	54.00b	50.00c	**52.00B**
50 % F.C.	44.00de	46.00d	**45.00C**	50.00c	48.00c	**49.00C**
25 % F.C.	40.33f	41.33ef	**40.83D**	43.00d	41.00d	**42.00D**
Mean	**49.33A**	**48.33A**		**51.25A**	**48.50B**	
	2nd season					
Control (100 % F.C.)	60.00a	50.00b	**55.00A**	59.00a	56.00b	**57.50A**
75 % F.C.	51.00b	47.00c	**49.00B**	51.00c	51.67c	**51.33B**
50 % F.C.	47.00c	44.00de	**45.50C**	46.00d	45.00d	**45.50C**
25 % F.C.	42.00de	41.00e	**41.50D**	40.33e	39.00e	**39.67D**
Mean	**50.00A**	**45.50B**		**49.08A**	**47.92B**	

Values within the same column and raw for any of two investigated factors were individually differentiated by capital letters, while for the interaction small letters were used, mean followed by the same letter/s were not significantly different.

6. Anatomical study:

Data in **Tables (16, 17 & 18)** show the effect of all applied treatments on the mean counts and measurements in microns of certain histological features of the new third lateral branch above grafting zone , leaves and roots of Nemaguard peach and bitter almond rootstocks grown in the pots under water stress conditions at the end of the second season .

6.1- Effect of water stress treatments on the root anatomy:

Table (16) and **Figs. (1 : 8)** show that different water stress levels decreased the root diameter compared with control. This decrease reached its maximum values with 25% F.C., 50% F.C. and 75% F.C. gave 1220, 1264 and 1410μ, respectively compared with the root diameter μ of the control of Nemagurad peach rootstock which was 3906. On the other hand its reached 1992 μ, 1928 μ and 2600 μ respectively compared with the stem diameter of the control of Bitter almond rootstock was 2640μ. Also, it could be noticed that decrease of the root diameter of root were reversed upon different tissues comprising the whole section. Epidermis, cortex and pith parenchyma layers, as well as the dimensions of vascular bundles. Moreover, thickness of phloem tissues, cambial region and of xylem tissue, number of xylem vessels /vascular bundle and diameter of the widest xylem vessel were greatly decreased compared with the control. Also, this decrease reached its maximum values with 25% F.C., 50% F.C. and 75% F.C., respectively compared with the control of both Nemagurad peach and bitter almond rootstocks.

Of interest to note that these positive responses of different anatomical aspects to water regime treatments were completely reversed upon vegetative and reproductive growth of treated

plants. So, present study revealed those increases of xylem tissue of control, i.e., the route of mineral nutrients and water translocation from roots to leaves and the phloem tissue i.e., the pathway of different assimilates from leaves to other plant sinks. Thereby, improvement of translocation events directly could be considered a direct reason for increment the final growth parameters.

In this respect, other studies reported nearly similar findings of these are.

In general, the inhibitor effects of applied treatments upon the anatomy features of treated plants could be attributed to the effect upon cambium activity. Decrement of cambium activity could mainly attributed to the decrease of endogenous hormones level especially cytokinins and auxins, **(Sotiropoulos *et al.*, 2002 and Ismaeil, 2005)**.

6.2- Effect of different water regime levels on the stem anatomy:

Table (17) and Figs. (1 : 8) show that different levels of water regime decreased the stem diameter compared with control. This decrease reached its maximum values with 25% F.C., 50% F.C. and 75% F.C. gave1806, 1868 and 2806μ, respectively compared with the stem diameter was 2928 μ of the control of Nemagurad peach rootstock. On the other hand it's reached 2120 μ, 2160 μ and 2880 μ respectively compared with the stem diameter was 2890μ of the control of Bitter almond rootstock. Also, it could be noticed that decrease of the stem diameter of stem were reversed upon different tissues comprising the whole section. Epidermis, cortex (collenchyma and parenchyma tissues) and pith parenchyma layers, as well as the dimensions of vascular bundles. Moreover, thickness of phloem tissues, cambial region

and of xylem tissue, number of xylem vessels /vascular bundle and diameter of the widest xylem vessel were greatly decreased compared with the control. Also, This decrease reached its maximum values with 25% F.C., 50% F.C. and 75% F.C., respectively compared with the control of both Nemagurad peach and bitter almond rootstocks.

Of interest to note that, the cuticle layer thickness was increased by increasing water stress level; this increase reached its maximum values with 25% F.C. The increasing of cuticle layer thickness during stem anatomy with some levels, clearly indicate the effect of water stress treatments upon alleviating such adverse effects of the water stress by inducing best anatomical performances (due to their ability to develop an internal protective mechanisms against such stress adverse effects).

In this respect, other studies reported nearly similar findings of these are.

In general, the inhibitor effects of applied treatments upon the anatomy features of treated plants could be attributed to the effect upon cambium activity. Decrement of cambium activity could mainly attributed to the decrease of endogenous hormones level especially cytokinins and auxins, **(Sotiropoulos *et al.*, 2002 and Ismaeil, 2005)**.

6.3- Effect of water sterss treatments on Ne plus ultra leaf anatomy:

Data in **Table (18)** and **Figs. (1 : 8)** clearly indicate the effect of water stress treatments on different anatomical features of Ne plus ultra leaves which grafted on Nmaguard peach or Bitter almond rootstocks . In this respect, most of the studied features of leaf anatomy were decreased with different water

stress levels. Among these anatomical features were the most important ones, i.e., thickness of midrib, length & width of vascular bundle, phloem & xylem tissues and number of xylem vessels in vascular bundle as well as the leaf blade thickness. This decrease reached its maximum values with 25% F.C., 50% F.C. and 75% F.C., respectively compared with the control

With regard to the blade thickness, it was decreased with different used treatments to reach its maximum value (128 μ) with 25% F.C., (153 μ) with 50% F.C. and (194 μ) with 75% F.C. treatment. That represent of the control value (204μ). Also, the thickness of each of upper and lower epidermis, were also increased with all water regime levels. Also it could be noticed that increase ratio was higher of upper epidermis than that of the lower one as well as the findings of the present study.

With regard to cuticle layer thickness **Antonio *et al.*, (2005)** reported that, most epidermal cells of the aerial parts of higher plants (such as leaves, fruits, and non woody stems), as well as some bryophytes, are covered by a continuous extra cellular membrane of soluble and polymerized lipids called the cuticle or cuticular membrane (CM). The structure and composition of the CM varies among plants, organs, and growth stages. A suite of physical, chemical, mechanical, and morphological properties gives the plant CM the characteristics of a unique and complex biopolymer. Since vascular plants managed to establish themselves on dry land a physiological point of view, the main function ascribed to the CM is to minimize water loss. However, from a more general point of view, this role in the regulation of plant water loss is accompanied by other important functions: the CM limits the loss of substances from plant internal tissues, protects the plant against physical, chemical, and

biological attacks and protects the plant against the external environment stress. The cuticular membrane in association with the epidermis is the morphological structure that confers the main mechanical strength to plant organs, as well as the findings of the present study.

Of interest, to note that mesophyll decrease belongs to that, decrease of each of palisade and converted spongy tissue thickness. Since, the two components were decreased with all water stress treatments compared with control of both the two rootstocks but reached their maximum with 25% F.C.

With regard to midrib anatomical features, could be noticed that decrement in the midrib thickness with different water stress treatments attributed to the decrease in many of its histological features such as thickness of both uppermost and lower most collenchyma tissues, lower most parenchyma tissue and dimensions of main vascular bundle as well as thickness of upper most & lower most phloem tissues, xylem tissue and also number and diameter of xylem vessels in the main vascular bundle. This decrease was more obvious with 25% F.C. The above mentioned results specially decrement of the conductive tissues (xylem & phloem) are also of great importance because they could be also involved in the interpretation about why vigorous growth and high yielded fruits was existed with control compared with the others water regime treatments .

Also, the previously mentioned and discussed results of Ne plus ultra leaf anatomy of treated plants reveal that decreasing of leaf anatomy features compared with control confirmed by weak growth of Ne plus ultra was positively correlated with mineral content (N, P K, Ca, Mg, Fe, Zn and Mn), photosynthesis pigments and carbohydrates content. This confirmed the

previously discussed results of anatomy growth, proved that the best morphological behavior of Ne plus ultra plant as affected by the water stress treatments was mainly due to their induceable best physiological and anatomical performances, also due to their ability to develop an internal protective mechanism against such stress adverse effects.

Of interest to note that these positive responses of different anatomical aspects to water regime treatments were completely reversed upon vegetative and reproductive growth of treated plants. So, present study revealed those increases of xylem tissue of control, i.e., the route of mineral nutrients and water translocation from roots to leaves and the phloem tissue i.e., the pathway of different assimilates from leaves to other plant sinks. Thereby, improvement of translocation events directly could be considered a direct reason for increment the final growth indicators.

Table (16): Mean counts and measurements of certain histological features of root affected by different levels of water stress and rootstocks.

Histological characteristics (Micron) / Treatments	Root diameter	Thickness of bark layer	Cambium at region thickness	Xylem thickness	Number of xylem rows/ Vascular cylinder	Number of xylem vessels / row	Diameter of the widest xylem vessel in V. cylinder	Thickness of phloem
Nemaguard control 100 % F.C.	3906	89	23	853	33	13	64	108
75 % F.C.	1410	81	30	405	20	8	63	67
50 % F.C.	1264	86	32	416	17	7	49	52
25 % F.C.	1220	81	28	406	13	6	43	50
Bitter almond control 100 % F.C.	2686	67	23	623	42	16	60	81
75 % F.C.	2600	57	29	553	35	12	62	74
50 % F.C.	1828	65	24	558	36	11	63	73
25 % F.C.	1192	72	26	446	23	7	59	70

Table (17): Mean counts and measurements of certain histological features of stem affected by different levels of water stress and rootstocks.

Histological characteristics (Micron) / Treatments	Stem diameter	Cuticle layer thickness	Epidermal thickness	Thickness of collenchyma layer	Thickness of parenchyma layers	Cambium at region thickness	Xylem thickness	Number of xylem rows/ Vascular cylinder	Number of xylem vessels / row	Diameter of the widest xylem vessel in V. cylinder	Thickness of phloem	Parenchymatous pith thickness
Nemaguard control 100 % F.C.	2928	16	18	61	301	24	601	146	19	45	205	895
75 % F.C.	2806	17	21	42	250	20	412	133	13	31	20	915
50 % F.C.	1886	18	16	38	217	20	164	86	5	31	128	719
25 % F.C.	1806	21	20	41	220	25	127	56	3	27	137	715
Bitter almond control 100 % F.C.	2890	15	15	87	198	30	420	141	15	33	205	918
75 % F.C.	2830	15	15	84	196	28	239	87	12	32	197	806
50 % F.C.	2160	17	19	37	228	22	203	87	7	34	147	908
25 % F.C.	2080	18	13	34	215	18	197	130	6	28	143	895

Table (18): Mean counts and measurements of certain histological features of leaf affected by different levels of water stress and rootstocks.

Histological characteristics (Micron) / Treatments	Thickness of upper epidermis cuticle layer	Thickness of lower epidermis cuticle layer	Upper epidermis thickness	Lower epidermis thickness	Thickness of blade	Thickness of collenchyma layers below the upper epidermis at midrib	Thickness of collenchyma layers above the lower epidermis at midrib	Thickness of phloem in the Vascular bundle	Thickness of xylem tissue	Number of xylem rows in the vascular bundle	Number of vessels in the xylem row	Thickness of widest xylem vessel in the vascular bundle	Length of midrib vascular bundle	Width of midrib vascular bundle	Thickness of leaf midrib
Nemaguard control 100 % F.C.	6	3	21	20	204	174	104	102	108	29	7	27	212	482	633
75 % F.C.	8	6	28	26	194	103	116	84	119	33	6	25	162	470	610
50 % F.C.	7	8	18	19	153	149	96	98	102	18	7	19	169	343	596
25 % F.C.	13	8	29	21	128	127	87	83	75	16	5	18	156	394	554
Bitter almond control 100 % F.C.	9	5	19	24	176	56	42	118	115	26	7	23	198	396	551
75 % F.C.	15	5	31	17	189	104	133	125	112	29	5	20	181	532	596
50 % F.C.	8	6	22	13	200	121	127	112	113	26	7	18	197	425	549
25 % F.C.	14	7	38	18	153	151	58	82	93	28	7	14	177	457	695

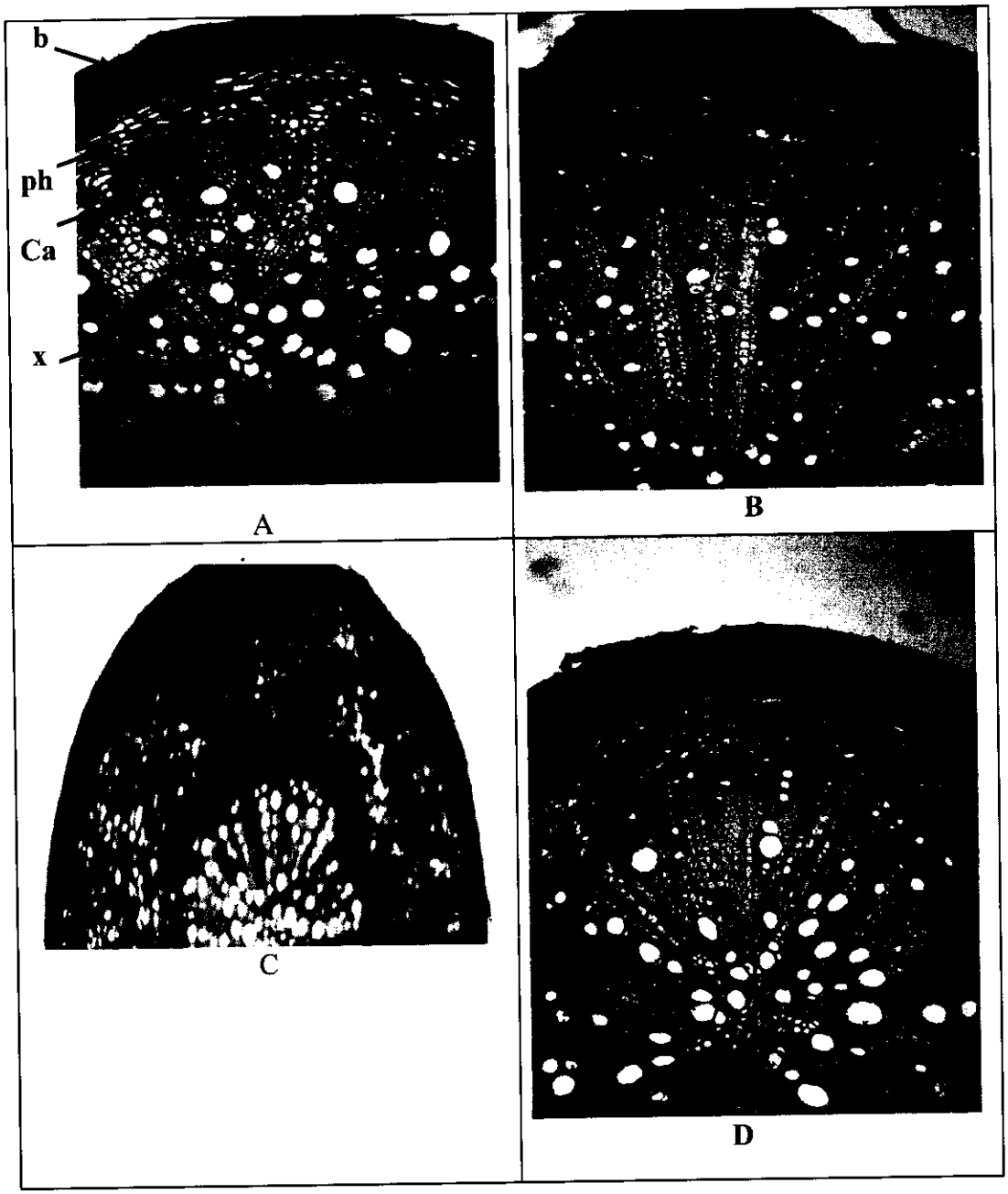

Fig. (1)

a- Cross section in root of Nemaguard peach rootstock 100 % F.C.
b- Cross section in root of Nemaguard peach rootstock 75 % F.C.
c- Cross section in root of Nemaguard peach rootstock 50 % F.C.
d- Cross section in root of Nemaguard peach rootstock 25 % F.C.

b = bark
Ph = Phloem
Ca = Cambium region
x = Xylem

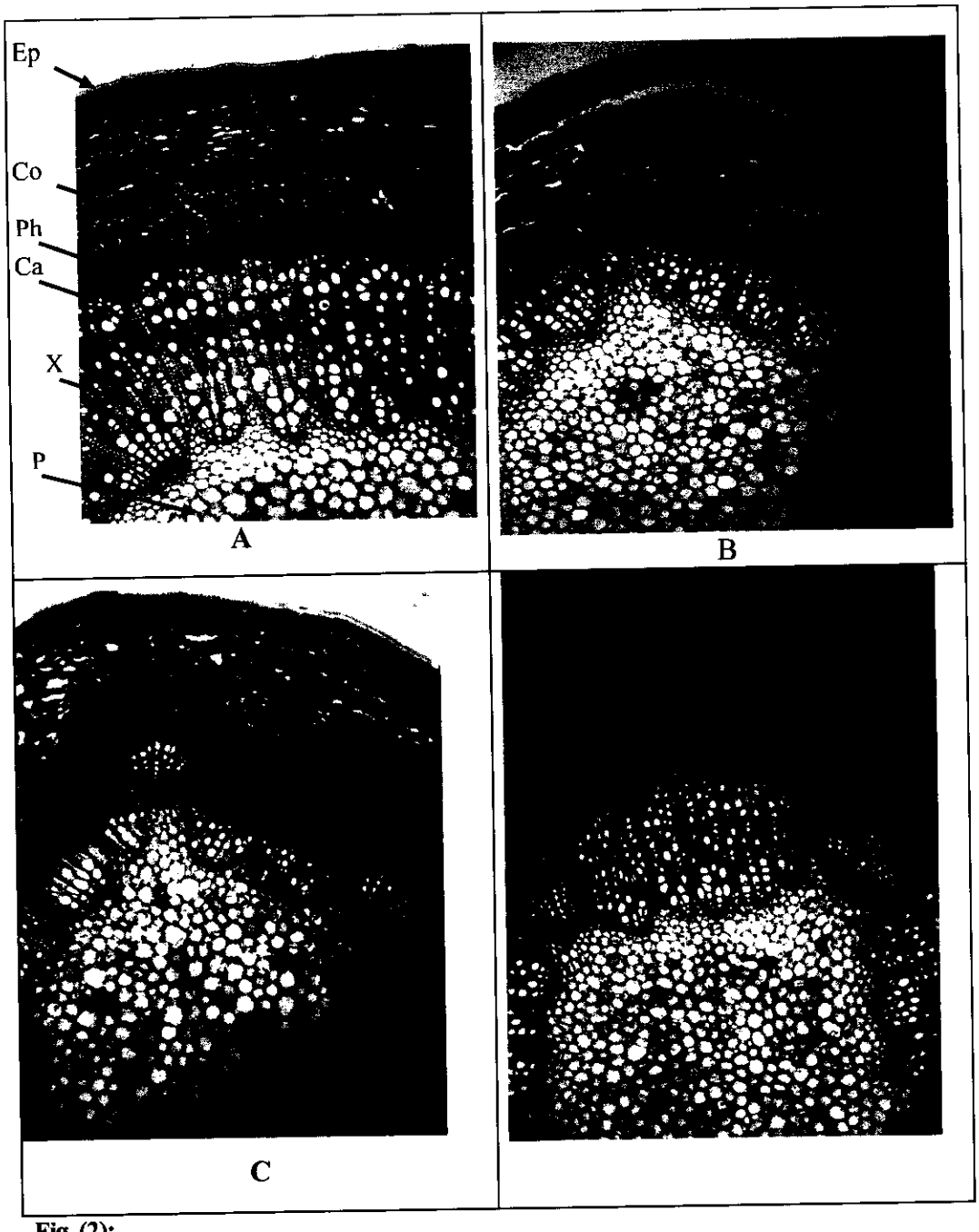

Fig. (2):

a- Cross section in stem of Ne plus ultra almond scion/Nemaguard peach rootstock 100 % F.C.
b- Cross section in stem of Ne plus ultra almond scion/Nemaguard peach rootstock 75 % F.C.
c- Cross section in stem of Ne plus ultra almond scion/Nemaguard peach rootstock 50 % F.C.
d- Cross section in stem of Ne plus ultra almond scion/Nemaguard peach rootstock 25 % F.C.

Ep. = Epidermis. Co. = Cortex. Ph = Phloem
Ca = Cambium region x = Xylem. P. = Pith.

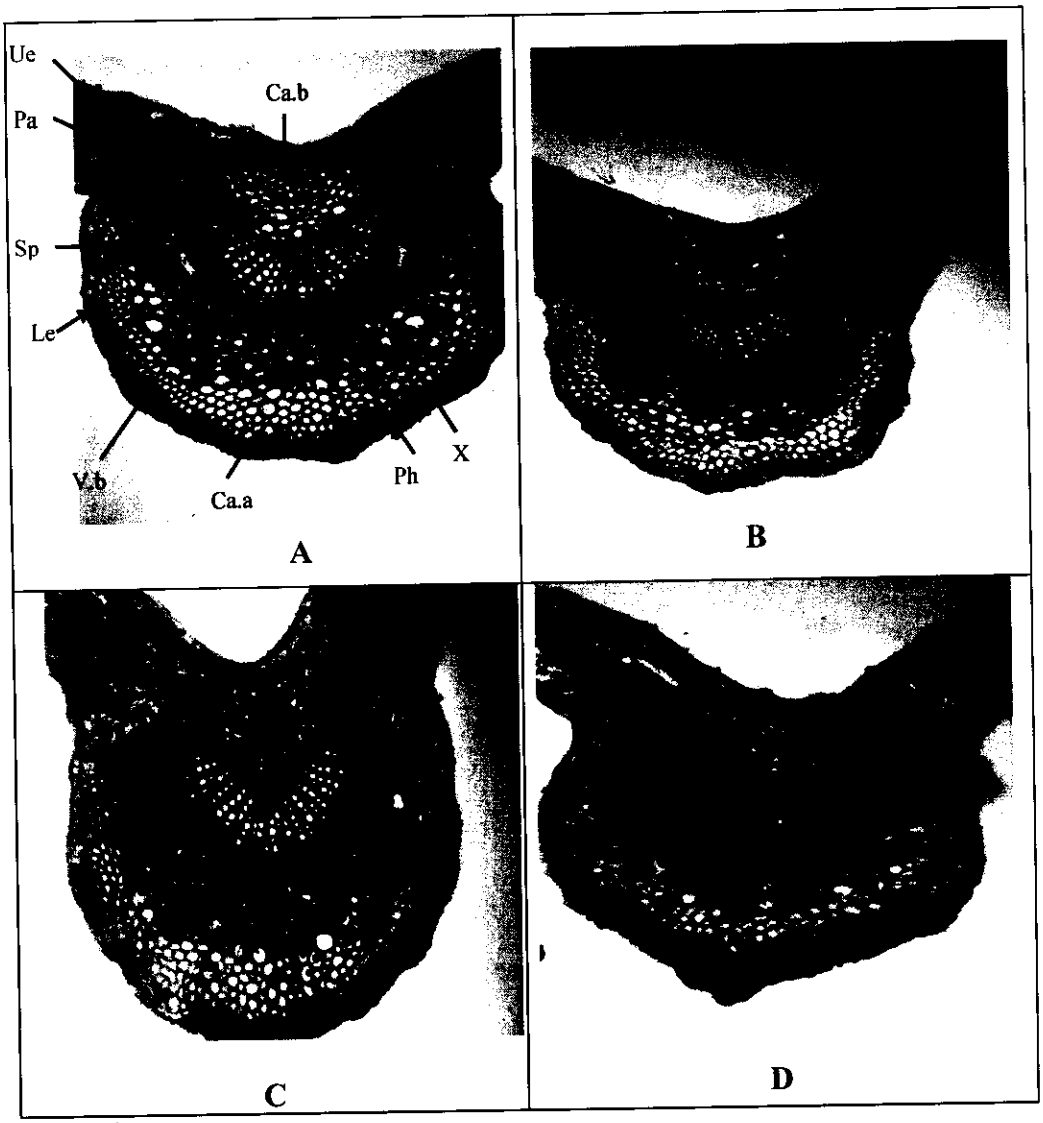

Fig. (3):

a- Cross section in leaf of Ne plus ultra almond scion/ Nemaguard peach rootstock 100 % F.C.
b- Cross section in leaf of Ne plus ultra almond scion/ Nemaguard peach rootstock 75 % F.C.
c- Cross section in leaf of Ne plus ultra almond scion/ Nemaguard peach rootstock 50 % F.C.
d- Cross section in leaf of Ne plus ultra almond scion/ Nemaguard peach rootstock 25 % F.C.

Ue = upper epidermis. Pa = Palisade tissue.
Sp = Sponngy tissue. Le = Lower epidermis.
V.b = Vascular bundle. X = xylem. Ph = Phloem.
Ca.b = Collenchyma below the upper epidermis
Ca.a = Collenchyma above the lower epidermis

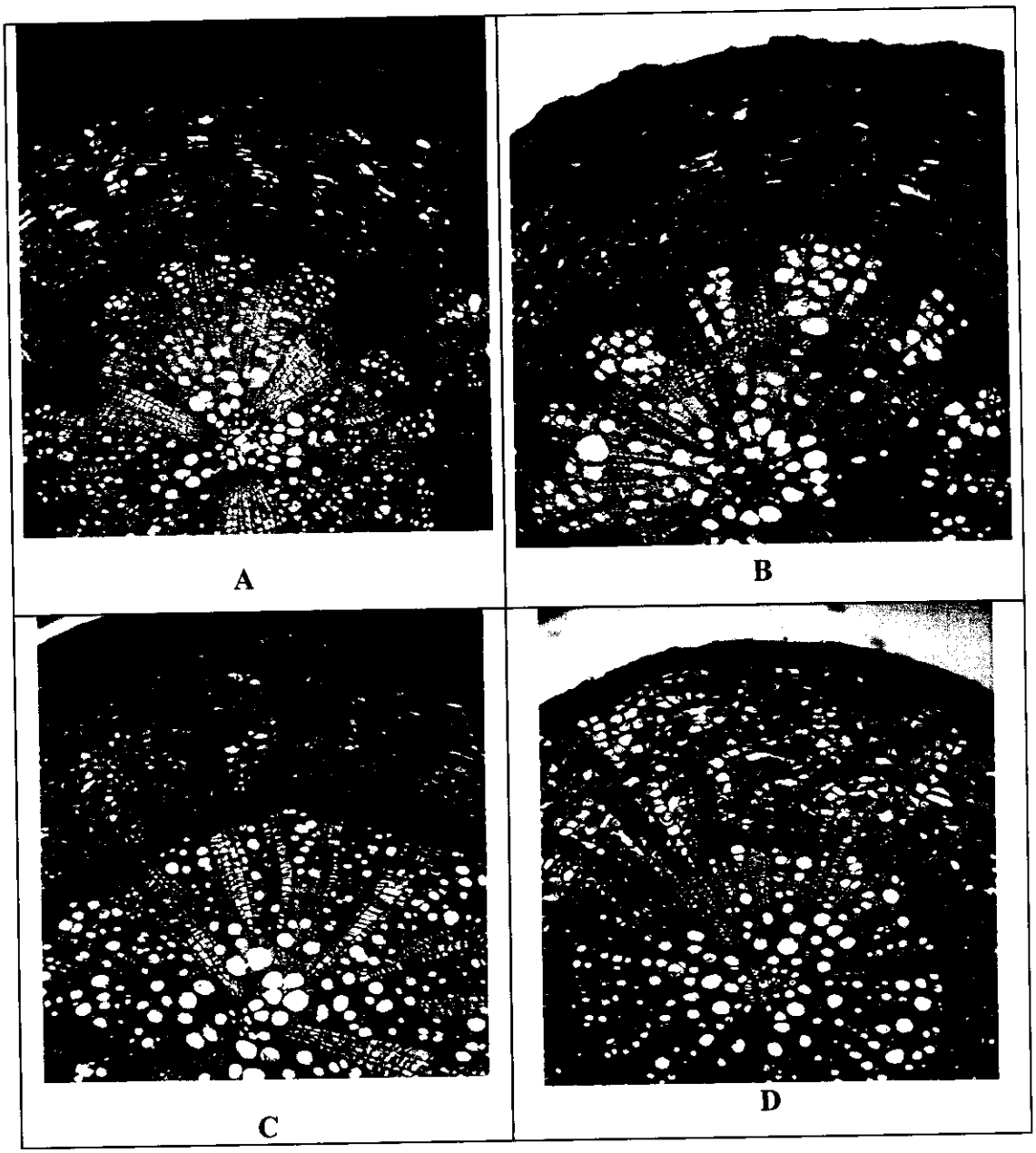

Fig. (4):

a- Cross section in root of Bitter almond rootstock 100 % F.C.

b- Cross section in root of Bitter almond rootstock 75 % F.C.

c- Cross section in root of Bitter almond rootstock 50 % F.C.

d- Cross section in root of Bitter almond rootstock 25 % F.C.

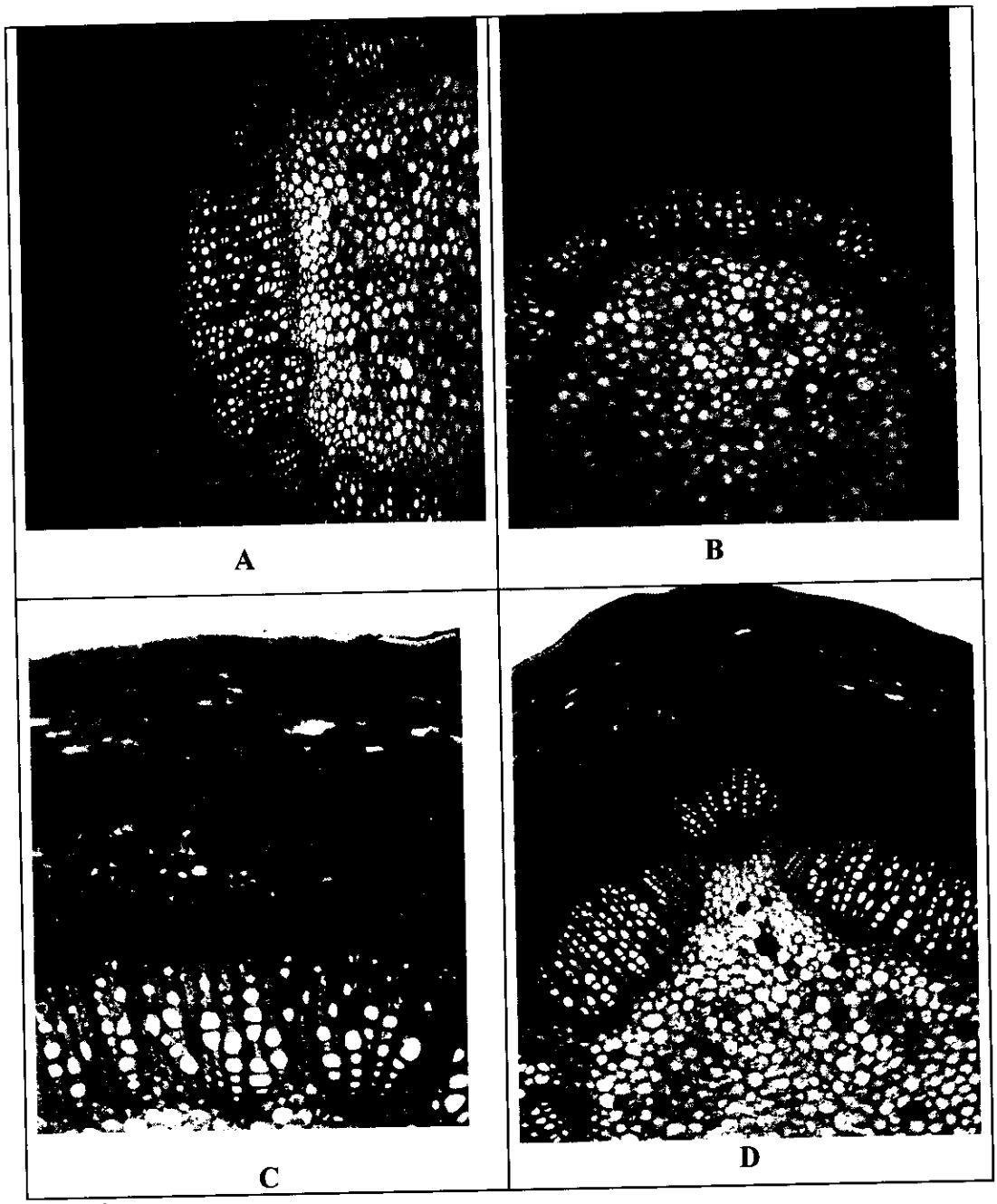

Fig. (5):

a- Cross section in stem of Ne plus ultra almond scion / Bitter almond rootstock 100 % F.C.
b- Cross section in stem of Ne plus ultra almond scion/ Bitter almond rootstock 75 % F.C.
c- Cross section in stem of Ne plus ultra almond scion/ Bitter almond rootstock 50 % F.C.
d- Cross section in stem of Ne plus ultra almond scion/ Bitter almond rootstock 25 % F.C.

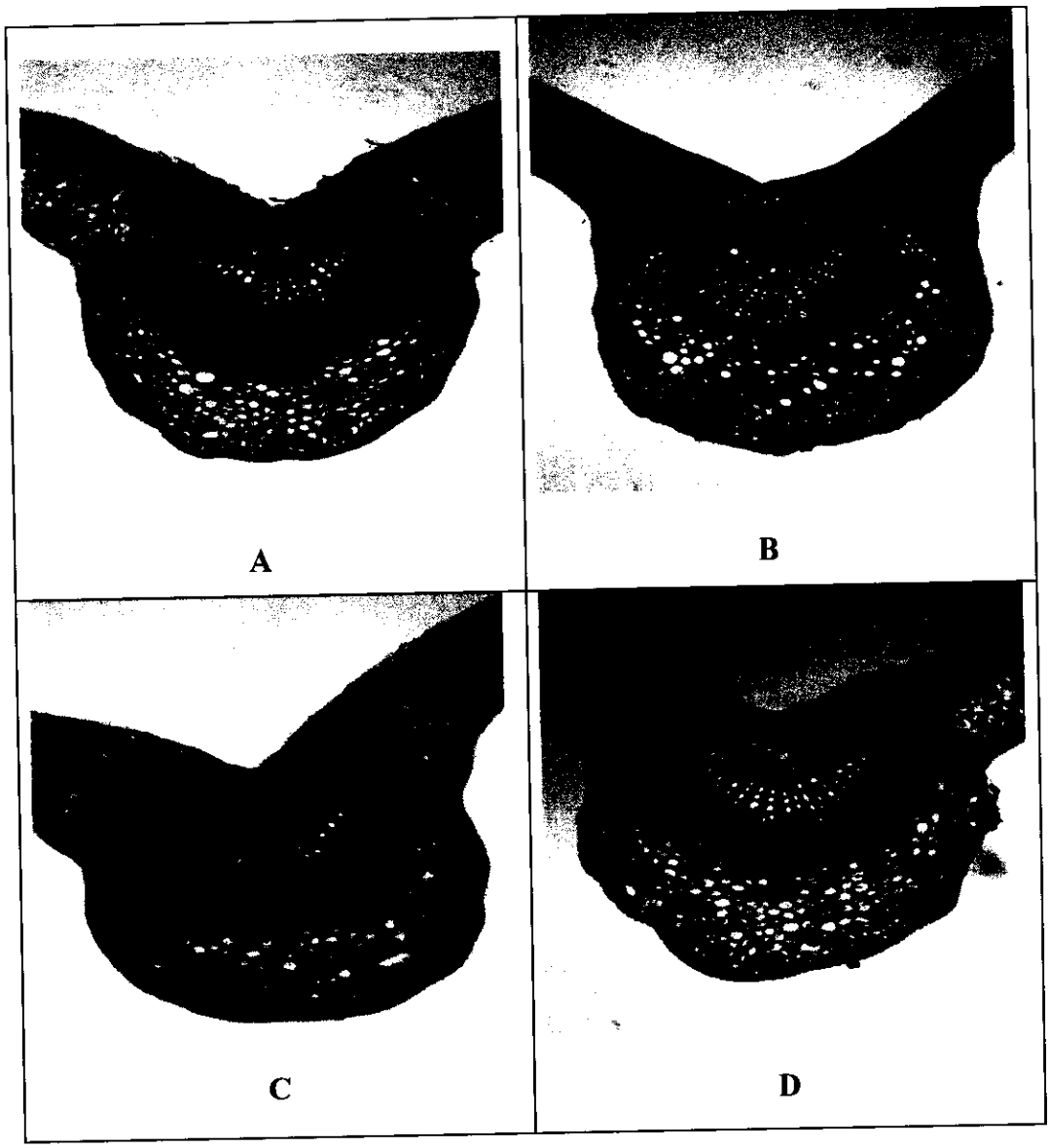

Fig. (6)

a- Cross section in leaf of Ne plus ultra almond scion/ Bitter almond rootstock 100 % F.C.
b- Cross section in leaf of Ne plus ultra almond scion/ Bitter almond rootstock 75 % F.C.
c- Cross section in leaf of Ne plus ultra almond scion/ Bitter almond rootstock 50 % F.C.
d- Cross section in leaf of Ne plus ultra almond scion/ Bitter almond rootstock 25 % F.C.