Growth and Vine Nutritional Status of Grapevine CVS Flame Seedless and Superior Grafted on Five Grape Rootstocks

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Abstract: This study was carried out during 2015 / 2016 and 2016/2017 seasons to elucidate the effect of five grape rootstocks namely Freedom, Salt Greek, Paulsen, Rechter and Harmony on growth and vine nutritional status of two grape scions namely Flame seedless and Superior grown under middle Egypt conditions. The best rootstocks towards growth and nutritional statues for Flame seedless grape scion were Freedom, Salt Greek, Paulsen, Rechter and Harmony, in descending order and for Superior grape seicon were Salt Greek, Freedom, Rechter, Paulsen and Harmony, respectively. In conclusion, it can be recommended to use Freedom and Salt Greek as good grape rootstocks for Flame seedless and Superior grapevines, respectively, since such two rootstocks have high compatibility and improve growth and vine nutritional status of grape scion. Meanwhile Harmony grape rootstock is not acceptable for both grape scions.

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1. Introduction

Many people mistakenly believe that fruit trees grow true to name from seeds. In reality, if you collect seed from a fruit grown on plant, the seeds will produce plants that will be a hybrid of two plants. The new plant will be the same kind of plant, but its fruit and vegetative portions may not look the same as the parent because the plant is "heterozy-gous" Therefore, all fruit trees must be vegetatively propagated by either grafting or budding methods. Fruit growers frequently uently use grafting techniques to top work new verities or strains of fruit onto established trees bearing veins named or obsolete varieties and to repair in gury or damage caused by mica, rabbits, deer, or mechanical means. Commercial nursery workers propagate new fruit trees, and producing a tree ready for planting takes several years. **(Lockwood and Ferree, 2014)**

However, biotic and abiotic stresses like disease, drought and salinity have restricted grape production and productivity worldwide. Selection and using resistant rootstocks against disease, drought, salinity and subsequent grafting are of great importance in major viticulture countries in the world **(Moretti,2005; Mielke et al.,1980.).** Rootstocks have recently gained great importance in the only consistently effective and successful strategy in major viticultural countries worldwide **(Celik and Odabas,1998; Verma et al., 2010)**. Therefore, wild grapes are increasingly being used as rootstocks to combat the problems related to stress environment and to improve scion performance. In addition, outlined seven major criteria for rootstocks choice in the order of their importance, nematode resistance, adaptability to high PH soils, saline soils, low PH soil, wet or poorly drained soil and drought **(Cookson et al., 2013; Darikova et al., 2011; Reynolds and Wordle 2001; Nicol et al., 1999).** In this respect, Freedom **(** V.champinii x 1613c**)** is highly resistant to phylloxera and nematodes it renders scion more vigorous; Salt Greek **(**V. champinii**)** rootstock is resistant to salinity and nematodes; Paulson 1103 (V.berlandieri X V. rupesistris) and 110 Richter **(**V.berlandieri X V. rupesistris**)** are highly resistant 0 to drought and phylloxera, well adapted to acidic soil and moderate resistant to salinity.

Many investigations proved effect of rootstocks such as Dog ridge, Salt Greek and Freedom achieved the best vegetative growth, leaf mineral content, fruit quality, and yield of grafted cultivars **(El- Gendy, 2013; Fardossi et al., 1995; Rizk- Alla et al. 2011)**.

Several factors may affect the success of grafting rate such as hormonal application, cold treatment of the cutting, compatibility between rootstocks and scion cultivars, time and type of grafting and environmental conditions **(Celik and Odabas,1998; Verma et al., 2010)**.

Most basic criterion for any rootstock cultivar choice is its compatibility with the scion cultivar. Complete fusion of the adjonining cambial tissues is critical to effective translocation of water, nutrients and growth regulators. Therefore, early and accurate

prediction of graft compatibility in nursery has great importance **(Petkou et al., 2004)**.

Incompatibility between rootstock and scion might result in a dieback of a graft. The differences in abundance of phenol compounds and starch below and above the graft union, as well as peroxidase amount at the union might serve as biochemical markers of the rootstock/scion incompatibility. Meanwhile, genetically and biochemically similar scion and rootstocks could improve graft compatibility **(Darkova et al., 2011; Gainza et al., 2015).**

The choice of the rootstock is important in terms of the power that it induces to the grafted variety **(Uzunova et al.,2016)**.

Previous studies showed that varying grape rootstocks had an announced variation among all grape scion towards their growth, root parameters and nutritional status**. (Sarooshi et al., 1982; Fardossi et al., 1995; Nikolaou et al., 2000; Reynolds and Wordle 2001; Hurtmann et al., 2002; Steriegles et al., 2004; Bettiga 2004; Dardeniz and Sahin 2005; Somkuwar et al., 2006; Koundouras et al 2008; Rizk-Alla et al., 2011; Stino et al 2011; Main et al., 2012; Keller et al., 2012; El-Gendy 2013; Kidmilogla and Guler,2014; Teker et al., 2014; Somkuwar et al.,2011; Desouky et al., 2015; Somkuwar et al., 2015; Mohamed 2017; Abdel-aal and Silem 2018).**

The main goal of this study was to assess in nursery the compatibility between two cultivars belong to Vitis vinefera, (i.e Flame seedless., and Superior seedless, with five grapevines rootstock, namely, Freedom (vitis champinii),, Salt Greek (Vitis champinii), Paulsen (V.berlandieri * v.reupestris) 110 Richter (V.berlandierix v.reupestris) and Harmony which appeared in the promotion on growth and vine nutritional status.

2. Materials and Methods

This present study was carried out during the two successive seasons of 2015/2016 and 2016/2017 seasons at the nursery and laboratory of Horticulture Dept.Pomoology branch, Fac. Of Agric., Minia district, Minia Governorate. Two grapevines scions belong to vitis vinifera i.e Flame seedless and Superior and five grape rootstocks namely Freedom, Salt Greek, Paulsen, Rechter, and Harmony were used.

All grape transplants were subjected to tongue graft feinique. The transplants were brought from Viticulture Res. Dept. Hort. Res. Instit. ARC. Giza. Transplants of Flame seedless and Superior grafted on the same age namely 12 months old. The transplants were planted in a black plastic bags 30x30 cm and filled with 5 kg clay soil. They were irrigated every week in Winter and every three days in Summer with tap water.

Also, the transplants were fertilized with Hoagland fertilizer twice a month and treated against insect pests and disease. At the end of each season (last week of Sept.). All transplants were excavated from soil to measure the following measurements:-

1- Vegetative growth aspects namely plant height (cm), number of leaves/plant, scion shoot length (cm), scion shoot thickness, plant thickness, main shoot length (cm), leaf area (cm^2) **(Ahmed and Morsy 1999)**, shoot/root plant dry weight, cane thickness wood ripening coefficient **(Bouard,1966)**, pruning wood weight, root distribution area (cm^2), main root length, number of secondary roots and dry weight.

2- Leaf total carbohydrate %, total phenols and total sugars % in the shoot above union region, C/N ratio, chlorophylls a & b, total chlorophylls and total carotenoids (mg/g f.w) **(Von.Westtsine 1957)** and uptake of N, P and K (dry multiplying dry weight of plant by percentage of each nutrient) **(Balo et al, 1988 and A.O.A.C,2000).**

Statistical analysis was done according to **(Sendecor and Cochran 1989).** Treatment means were compared using New L.S.D at 5%.

Table (1): Analysis of the tested soil

Constituents	Values
Particle size distribution	
Sand %	10.7
Slit %	9.0
Clay %	80.3
Texture %	Clay
pH (1:2.5 extract)	7.5
E.C. (1: 2.5 extract) ppm	210
O.M. %	2.0
$CaCO_3$ %	2.25
Total N%	0.10
Available P (Olsen method, ppm)	4.9
Available K (ammonium acetate, ppm)	488.5
EDTA extractable micronutrients (ppm):	
Fe	3.5
Mn	3.1
Zn	4.2
Cu	0.5

3. Results and Discussion

1- Vegetative growth aspects:-

Data in tables (1 & 2 & 3) show the effect of different grape rootstocks on plant height, number of laterals /plant; number of leaves/plant, scion shoot length, scion shoot thickness, main shoot length, leaf

area and shoot fresh weight of Flame seedless and Superior grapevines during s015/2016 and 2016/2017 seasons.

Table (2): Effect of different grape rootstocks on plants height, Number of laterals and leaves, length and thickness of scion shoot and plant thickness in grapevine cvs Flame seedless and Superior during 2015 / 2016 and 2016/2017 seasons.

Grape rootstocks (B)	Plant height (cm.)						No of laterals /plant						No. of leaves/plant					
	2015/2016			2016/2017			2015/2016			2016/2017			2015/2016			2016/2017		
	Grape scions (A)																	
	a_1 Flame	a_2 Superior	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)
b_1 Freedom	101.0	106.3	103.7	98.5	105.2	101.9	16.0	14.0	15.0	16.0	15.0	15.5	51	50	50.5	52	51	51.5
b_2 Salt Greek	97.4	110.2	103.8	95.0	109.1	102.1	14.0	16.0	15.0	14.0	17.0	15.5	48	56	52.0	49	57	53.0
b_3 Poulsen	95.0	100.0	97.5	92.6	99.0	95.8	12.0	10.0	11.0	11	11	11.0	45	45.0	15.0	45	46	45.5
b_4 Rechter	94.2	103.1	97.8	90.4	102.1	96.3	10.0	12.0	11.0	9	13	11.0	42	48.0	45.0	42	48	45.0
b_5 Harmony	90.1	95.0	92.6	86.0	94.0	90.0	8.0	8.0	8.0	7	9	18.0	39	41.0	40.0	39	41	40.0
Mean (A)	95.2	102.9		92.5	101.9		12.0	12.0		11.4	13.0		45.0	48.0		45.4	48.6	
New L.S.D at 0.05%	A 2.1	B 2.3	AB 3.2	A 1.8	B 1.9	AB 2.7	A 1.0	B 2.0	AB 2.8	A N.S	B 2.0	AB 2.8	A 2	B 2	AB 2.8	A 2	B 2.2	AB 2.8
Characteristly	Scion shoot height (cm)						Scion shoot thickness (cm)						Plant thickness (cm)					
b_1 Freedom	71.0	77.0	74.0	69.0	75.0	72.0	4.9	5.5	5.2	5.0	5.7	5.4	18	16	17	18	17	17.5
b_2 Salt Greek	67.0	80.0	73.5	65.0	78.0	71.5	5.0	5.3	5.2	5.1	5.5	5.3	17	18	17.5	17	19	18
b_3 Poulsen	64.0	70.0	67.0	62.0	68.0	65.0	5.5	8.5	7.0	5.6	8.7	7.2	15	13	14	15	13	14
b_4 Rechter	61.0	73.0	67.0	59.0	71.0	65.0	6.9	7.0	7.0	7.0	7.3	7.2	13	15	14	13	16	14.5
b_5 Harmony	59.0	66.0	62.5	67.0	62.5	59.8	8.5	10.0	9.3	8.6	10.3	9.5	11	11	11	11	11	11
Mean (A)	64.0	73.2		62.4	70.9		6.2	7.3		6.3	7.5		15	15		15	15	
New L.S.D at 0.05%	A 1.7	B 1.B	AB 2.5	A 2	B 2.0	AB 2.8	A 1.4	B 1.2	AB 1.7	A 1.3	B 1.1	AB 1.6	A 2	B 2	AB 2.8	A 2	B 2	AB 2.8

Table (3): Effect of different grape rootstocks on shoot length, leaf area, shoot fresh weight, root fresh weight, shoot/ root and plant dry weight of grapevine cvs Flame seedless and Superior during 2015 / 2016 and 2016/2017 seasons.

Grape rootstocks (B)	Mean shoot length (cm.)						Leaf area (cm2)						Shoot fresh weight (g.)					
	2015/2016			2016/2017			2015/2016			2016/2017			2015/2016			2016/2017		
	Grape scions (A)																	
	a1 Flame	a2 Superior	Mean (B)	a1	a2	Mean (B)	a1	a2	Mean (B)	a1	a2	Mean (B)	a1	a2	Mean (B)	a1	a2	Mean (B)
b1 Freedom	103.3	11.0	107.2	104.0	111.3	107.7	111.0	116.9	114.0	111.8	117.0	114.4	40	41	40.5	41.0	41.0	41.0
b2 Salt Greek	98.0	113.3	105.7	98.7	114.0	106.4	108.0	119.7	113.9	109.0	120.0	112.5	37.0	44.0	40.5	38.0	44.0	41.0
b3 Poulsen	96.0	104.1	100.1	96.7	105.0	100.9	105.5	111.0	108.3	106.3	112	109.2	34.0	36.0	35.0	35	37	36
b4 Rechter	94.0	108.0	101.0	94.7	108.6	101.7	101.0	114.0	107.5	101.1	115	108.1	31	38	34.9	31	39.0	35.0
b5 Harmony	91.0	99.0	95.0	90.9	99.5	95.5	97.0	108.5	102.5	96.8	108	102.4	28.0	29.5	28.8	28.0	30.0	29.0
Mean (A)	96.5	107.1		97.0	107.7		104.5	113.9		105.0	114.4		34.0	37.7		34.6	38.2	
New L.S.D at 0.05%	A 1.4	B 1.6	AB 2.3	A 1.6	B 1.7	AB 2.4	A 1.9	B 2.0	AB 2.8	A 1.9	B 2.0	AB 2.8	A 2.o	B 2.1	AB 2.9	A 2.0	B 2.2	AB 3.0
Characteristly	Root fresh weight (g.)						Shoo/root						Plant dry weight (g.)					
b1 Freedom	21.9	22.2	22.1	20.0	21.2	20.6	1.82	1.85	1.84	2.05	1.93	1.99	25.5	29.0	27.3	26.0	30.0	28.0
b2 Salt Greek	18.0	25.3	21.7	16.0	23.3	19.7	2.06	1.74	1.90	2.38	1.89	2.14	23.0	33.0	28.0	23.4	34.0	28.7
b3 Poulsen	14.0	16.0	15.0	12.0	14.0	13.0	2.43	2.25	2.69	2.99	2.64	2.82	20.0	21.0	20.5	20.5	22.5	21.5
b4 Rechter	11.9	18.9	15.4	9.8	16.8	13.3	2.61	2.01	2.31	3.16	2.32	2.74	18.0	24.0	21.0	18.6	25.5	22.1
b5 Harmony	9.5	11.5	10.5	8.0	9.5	8.8	2.95	2.57	2.76	3.51	3.16	3.34	16.0	18.0	17.0	16.7	19.9	18.3
Mean (A)	15.1	18.8		13.2	17.0		2.37	2.22		2.82	2.39		20.5	25.0		21.0	26.4	
New L.S.D at 0.05%	A 1.9	B 2.0	AB 2.8	A 1.9	B 2.0	AB 0.2	A 0.11	B 0.15	AB 0.2	A 0.11	B 0.15	AB 1.6	A 1.7	B 1.9	AB 2.7	A 1.6	B 1.8	AB 2.7

It is clear from the obtained data that varying grape rootstocks significantly varied the eight growth aspects namely plant height, number of leaves and laterals/ plant, scion shoot, length and thickness, main shoot length, leaf area and shoot fresh weight of Flame seedless and Superior grapevines. The maximum values were recorded due to grafting both grape cvs onto Freedom, Salt Greek, Paulsen, Rechter and Harmony, in descending order.

Grafting Superior scion onto Salt Greek rootstock had significances promotion on all growth aspects compared to the other grape stocks, Harmony grape rootstock recorded the lowest values of growth traits in both, Flame seedless and Superior grape vines, these results were true during both seasons.

2- Root parameters:

Root fresh and dry weight, shoot/ root; root distribution area, main root length and number of secondary roots / plant of Flame seedless and Superior as affected of different grape rootstock during 2015/2016 and 2016/2017 seasons are given in tables (2 & 3 & 4).

It is evident from the obtained data that Superior scion grafted on five grape rootstock had significantly the highest root parameters except shoot /root than the other grape scion namely Flame seedless onto the same grape rootstocks. These results were true during both seasons.

The maximum root parameters were recorded when both grape scion were grafted on grape root stocks namely Freedom, Salt Greek, Paulsen, Rechter and Harmony, in descending order.

In most casses, grafting Superior grape scion on Salt Greek rootstock had maximum values of root parameters and the lowest values were recorded on Flame seedless scion grafted on Harmony grape rootstock. These results were true during both seasons.

Leaf total carbohydrates %, total phenols, total sugars in the shoot above union region and C/N:-

Data in table (4) show the effect of different grape rootstocks on leaf total carbohydrates %, total phenols and total sugars % in the shoots above union region of Flame seedless and Superior grapevines during 2015/1016 and 20162017 seasons.

3-1 Leaf total carbohydrates:-

Leaf total carbohydrates was significantly unaffected among the two grape scion namely Flame seedless and Superior during both seasons.

It was significantly varied among the different grape rootstocks. The maximum values were recorded on grape rootstocks namely Freedom and Salt Greek and was minimized in grape rootstocks namely Harmony. These results were true during both seasons.

The maximum values were recorded on Flame seedless scion grafted on grape rootstock namely Freedom as well as in Superior scion grafted on Salt Greek. The height values of total carbohydrates were recorded on Flame seedless grafted onto Harmony rootstock. These results were true during both seasons.

3-2 Total phenols in the shoot above union region:-

Grapevine scion namely Flame seedless onto the five rootstocks significantly had the highest values of total phenols in the shoot above union region relative to the other grape scion namely Superior into the same grape rootstocks. These results were true during both seasons.

Grape rootstocks namely Salt Greek, Freedom, Paulsen, Rechter and Harmony, in ascending order gave the maximum values of total phenols in the shoots above union region. The lowest values were recorded on grape scion grafted onto Salt Greek and the highest values were recorded on grape rootstock namely Harmony.

The maximum total phenols was recorded on Flame seedless scion grafted on Harmony rootstock. The lowest values were recorded on Superior grape scion grafted on Salt Greek. These results were true during both seasons.

3-3 Total soluble sugars in the shoots above union region:-

It was varied significaly among the two grape scion namely Flame seedless and Superior grafted onto different grape rootstocks. Grape rootstock namely Superior had highest values relative to the other grape scion namely Flame seedless during both seasons.

Percentage of total soluble sugars in the shoots was significantly varied among the five grape rootstocks. It was maximized in grape scion grafted on grape rootstock Salt Greek and minimized in grape scion under Harmony grape rootstock. Similar trend was noticed during both seasons.

Grafting Superior scion onto Salt Greek significantly gave the highest values. The lowest values were recorded due to grafting Flame seedless scion onto Harmony grape rootstock. These results were true during both seasons.

3-4 The ratio between total carbohydrate and nitrogen in the leaves (C/N):-

It was maximized in Superior grape scion on different grapevines rootstocks compared to the other grape scion namely Flame seedless on the same grape rootstocks.

Grape rootstocks namely Salt Greek and Freedom achieved the maximum, and same values of total carbohydrate to N ration. The minimum values were recorded due to using Harmony as a rootstocks for both grape scions. These results were true during both seasons.

The maximum values were recorded on Superior scion grafted on Salt Greek and the minimum values were recorded appeared in Flame seedless scion onto Harmony grape rootstock. The same trend was noticed during both seasons.

Photosynthetic pigments and uptake of N, P and K by transplants:-

Tables (4 & 5) show the effect of different grape rootstocks on Photosynthetic pigments and uptake of N, P and K by transplants.

Table (4): Effect of different grape rootstocks on cane thickness, wood ripening, coefficient, pruning wood weight, root distribution area, Mean root length and number of secondary root of grapevine cvs Flame seedless and Superior during 2015 / 2016 and 2016/2017 seasons.

Grape rootstocks (B)	Cane thickness (cm.)						Wood repining coefficient						Pruning wood weight/ vine (kg.)					
	2015/2016			2016/2017			2015/2016			2016/2017			2015/2016			2016/2017		
	Grape scions (A)																	
	a_1 Flame	a_2 Superior	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)
b_1 Freedom	7.9	15.0	11.5	8.2	16.7	12.5	0.91	0.89	0.90	0.89	0.91	0.90	2.71	2.70	2.71	2.51	2.50	2.51
b_2 Salt Greek	8.0	15.3	11.7	8.0	17.0	12.5	0.87	0.93	0.90	0.89	0.95	0.90	2.50	2.90	2.70	2.30	2.70	2.50
b_3 Poulsen	8.6	12.3	10.5	8.8	14.0	11.4	0.84	0.77	0.81	0.80	0.79	0.80	2.30	2.31	2.31	2.11	2.10	2.11
b_4 Rechter	9.9	13.3	11.6	10.1	15.0	12.6	0.77	0.81	0.79	0.74	0.84	0.79	2.12	2.50	2.31	1.92	2.30	2.11
b_5 Harmony	11.6	11.6	11.6	11.6	13.0	12.3	0.71	0.73	0.72	0.70	0.72	0.71	1.96	2.11	2.04	1.76	1.90	1.83
Mean (A)	9.2	13.5		9.3	15.1		0.82	0.83		0.79	0.84		2.32	2.50		2.12	2.30	
New L.S.D at 0.05%	A 0.4	B 0.4	AB 0.6	A 0.4	B 0.5	AB 0.7	A 0.04	B 0.3	AB 0.4	A 0.03	B 0.03	AB 0.04	A 0.15	B 0.18	AB 0.23	A 0.12	B 0.14	AB 0.20
Characteristly	Root distribution area (m^2)						Mean root length						No. of secondary roots					
b_1 Freedom	295.3	266.0	280.7	297.0	266.9	282.0	39.0	41.0	40	40	42	41	60	61	60.5	60	60	60
b_2 Salt Greek	281.0	280.0	280.5	282.7	280.9	281.8	36.6	45.0	40.8	37.6	46	41.8	55	67	61.0	56	66	61
b_3 Poulsen	251.0	239.0	244.6	251.8	240.0	245.9	35.0	36.0	35.5	36	38	37	50	50	50.0	49	49	49
b_4 Rechter	231.0	253.0	242.0	231.9	254.0	243.0	32.0	38.0	35.0	33	39	36	46	59	52.5	47	58	52.5
b_5 Harmony	211.3	221.0	216.2	213.0	222.0	226.5	29.0	31.0	30.0	30.0	32	31	40	43	42.5	39	44	41.5
Mean (A)	253.7	251.8		251.7	252.8		34.3	38.2		35.3	39.4		50.2	56.4		50.2	55.4	
New L.S.D at 0.05%	A N.S	B 11.3	AB 15.9	A N.S	B 12.6	AB 17.8	A 1.0	B 1.1	AB 1.6	A 1.0	B 1.1	AB 1.6	A 2.0	B 2.0	AB 2.8	A 2.0	B 2.0	AB 2.8

4-1 Photosynthetic pigments:-

Grafting superior grape scion onto the different grape rootstocks significantly enhanced chlorophylls a & b, total chlorophylls and total carotenoids relative to the other grape scion namely Flame seedless grafted on the same grape rootstocks.

Varying grape rootstocks had significant effect on photosynthetic pigments of two grape scions namely Flame seedless and Superior.

Using grapevine rootstocks namely Salt Greek, Freedom, Paulsen, Rechter and Harmony, in descending order for both scion was significantly very effective in enhancing all Photosynthetic pigments. The maximum values were recorded in Salt Greek rootstock. Grape rootstock namely Harmony exhibited the lowest values. Similar results were announced during 2015/2016 and 2016/2017 seasons.

The interaction between different scions and rootstocks of grape had significant effect on all Photosynthetic pigments. The highest values were recorded on Superior scion grafted on Salt Greek. Using Harmony grape rootstock for Flame scion gave the lowest values. These results were true during both seasons.

4-2 Uptake of N, P and K by transplants:-

Varying grape scion grafted on some grape rootstocks had significant effect on uptake of N, P and K by transplants Superior grape scion recorded higher uptake of N, P and K than Flame seedless grape scion on the same grape rootstocks. Similar trend was noticed during both seasons.

Grafting both grape scions (Flame seedless and Superior) onto grape rootstocks namely Salt Greek, Freedom, Paulsen, Rechter and Harmony, in descending order significantly was accompanied with enhancing the uptake of N, P, and K by plants. The maximum values were recorded in scion grafted on Freedom rootstocks. Similar results were announced during both seasons.

The minimum values were recorded on Superior scion grafted on Salt Greek rootstock. The lowest values were recorded on Flame seedless scion grafted. These results were true during both seasons.

Table (5): Effect of different root dry weight, total carbohydrate %, total phenols in the shoot above union region, total sugars % in the shoot above union region, C/N and chlorophyll a in the leaves of grapevine cvs Flame seedless and Superior during 2015 / 2016 and 2016/2017 seasons.

Grape rootstocks (B)	Root dry weight (g)/plant						Leaf total carbohydrate %						Total phenols in the shoot above union region					
	2015/2016			2016/2017			2015/2016			2016/2017			2015/2016			2016/2017		
	Grape scions (A)																	
	a_1 Flame	a_2 Superior	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)
b_1 Freedom	1.71	1.60	1.66	1.80	1.70	1.75	18.4	17.3	17.9	18.5	17.4	18.0	170	160.0	165.0	171.0	159	165
b_2 Salt Greek	1.50	1.80	1.65	1.60	1.90	1.75	17.5	18.3	17.9	17.6	18.4	18.0	176	150.0	163.0	177	149	163
b_3 Poulsen	1.31	1.15	1.23	1.41	1.25	1.33	16.4	15.1	15.8	16.5	15.1	15.8	181	190	185.5	182	188	185.0
b_4 Rechter	1.15	1.45	1.30	1.25	1.55	1.40	15.2	16.2	15.7	15.3	16.3	15.8	195	185	190.0	196	184	190.0
b_5 Harmony	0.95	1.00	0.98	1.01	1.11	1.06	13.9	14.1	14.0	14.0	14.2	14.1	201	196	198.5	205	195	200
Mean (A)	1.32	1.40		1.41	1.50		16.3	16.2		16.4	16.3		184.6	176.2		186.2	175	
New L.S.D at 0.05%	A 0.08	B 0.12	AB 0.17	A 0.07	B 0.11	AB 0.16	A N.S	B 1.0	AB 1.4	A 1.0	B 1.0	AB 1.4	A 4.1	B 4.2	AB 5.9	A 4.3	B 4.4	AB 6.2
Characteristly	Total sugars %						C/N						Chlorophyll a					
b_1 Freedom	1.22	1.25	1.24	1.30	1.35	1.33	9.6	9.9	9.8	9.4	9.7	9.6	8.0	8.0	8.0	8.1	7.9	8.0
b_2 Salt Greek	1.12	1.40	1.26	1.20	1.50	1.35	9.4	10.2	9.8	9.2	10.0	9.6	6.9	8.9	7.9	7.0	8.8	7.9
b_3 Poulsen	0.90	0.80	0.85	0.98	0.90	0.94	9.2	9.4	9.3	9.0	9.2	9.1	6.0	6.4	6.2	5.9	6.3	6.1
b_4 Rechter	0.76	0.99	0.88	0.94	1.09	1.01	8.9	9.7	9.3	8.7	9.5	9.1	4.9	7.4	6.2	5.0	7.4	6.2
b_5 Harmony	0.61	0.69	0.65	0.69	0.79	0.74	8.7	8.9	8.8	8.5	8.7	8.6	4.1	5.0	4.6	4.0	5.0	4.5
Mean (A)	0.92	1.03		1.02	1.13		9.2	9.6		9.0	9.4		6.0	7.1		6.0	7.1	
New L.S.D at 0.05%	A 0.09	B 0.10	AB 0.14	A 0.10	B 0.11	AB 0.15	A 0.2	B 0.2	AB 0.3	A 0.2	B 0.2	AB 0.3	A 0.4	B 0.4	AB 0.6	A 0.4	B 0.4	AB 0.6

Table (6): Effect of different grape rootstocks on chlorophyll b, total chlorophylls, total carotenoids in the leaves and uptake of N, P and K on dry plants of grapevine cvs Flame seedless and Superior during 2015 / 2016 and 2016/2017 seasons.

Grape rootstocks (B)	Chlorophyll b (mg / g f.w)						Total chlorophylls (mg / g f.w)						Total carotenoids (mg / g f.w)					
	2015/2016			2016/2017			2015/2016			2016/2017			2015/2016			2016/2017		
	Grape scions (A)																	
	a_1 Flame	a_2 Superior	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)	a_1	a_2	Mean (B)
b_1 Freedom	2.9	3.1	3.0	3.0	3.2	3.1	10.8	11.1	11.0	0.1	11.9	11.1	3.0	3.0	3.0	3.1	3.0	3.1
b_2 Salt Greek	2.7	3.5	3.1	2.8	3.6	3.2	9.6	13.4	11.3	9.8	12.4	11.1	2.6	3.6	3.1	2.7	3.6	3.2
b_3 Poulsen	2.3	2.3	2.3	2.3	2.4	2.4	8.3	9.0	8.7	8.2	8.7	8.5	2.2	2.0	2.1	2.3	2.0	2.2
b_4 Rechter	1.8	2.7	2.3	1.8	2.8	2.3	6.7	10.2	8.5	6.8	10.2	8.5	1.8	2.5	2.2	1.9	2.5	2.2
b_5 Harmony	1.3	1.5	1.4	1.3	1.5	1.4	5.4	6.5	6.0	5.3	6.5	5.9	1.4	1.5	1.6	1.4	1.6	1.5
Mean (A)	2.2	2.6		2.2	2.7		8.2	10.0		8.2	9.8		2.2	2.5		2.3	2.5	
New L.S.D at 0.05%	A 0.4	B 0.4	AB 0.6	A 0.4	B 0.4	AB 0.6	A 0.5	B 0.5	AB 0.7	A 0.5	B 0.5	AB 0.7	A 0.3	B 0.4	AB 0.6	A 0.2	B 0.4	AB 0.6
Characteristly	N uptake (mg/plant)						P uptake (mg/plant)						k uptake (mg/plant)					
b_1 Freedom	500.0	510.0	505.0	510	519	514.5	71.9	60.9	66.4	72.1	61	66.6	311	315	313	307	311	309
b_2 Salt Greek	410.0	550	480.0	420	559	489.5	52.0	71.0	61.5	52.5	71	61.8	283	339	311	280	340	310
b_3 Poulsen	390.0	399	394.5	400	411	405.5	41.0	42.0	41.5	41.9	42	42.0	271	280	275.5	267	276	271.5
b_4 Rechter	330.0	420	375.0	341	430	385.5	29.0	50.0	39.5	30.0	50	40.0	260	300	280.0	256	300	278.0
b_5 Harmony	258.0	271	264.5	270	280	275.0	19.2	22.2	20.7	20.0	22.9	21.5	251	260	255.5	274	251	249.0
Mean (A)	377.6	430..0		388.2	439.8		42.6	43.3		49.4	9.4		275.2	298.8		271.4	295.6	
New L.S.D at 0.05%	A 30.0	B 31.3	AB 44.1	A 29.9	B 30.0	AB 42.3	A 5.1	B 4.9	AB 6.9	A 4.9	B 5.0	AB 6.9	A 6.0	B 5.1	AB 7.2	A 6.0	B 5.1	AB 7.2

4. Discussion

The great variation on growth and root parameters, total carbohydrates, total phenol and soluble sugars in the soot above union region, C/N, photosynthetic pigments and uptake of N, P and K by transplants among different scions and rootstocks of grape could be attributed to the degree of grafting success and the compatibility levels between grape rootstocks and scion, healing of grafts, low content of sugars of shoot above and under union region, higher content of phenols in the same pervious region, poor rooting and callus formation in the union zone**. Hartmann et al (2002),** recorded that graft incompatibility among rootstocks and scions in grape occurs due to anatomical, physiological and genetic reasons. **Sivritepe and Turkmen (2001), Vrsic et al (2004), Todic et al (2005); Kim et al (2005), Dardeniz and Sahin (2005), Bona et al (2007); Kamilogiu and Guler (2014) and Somkawar et al (2015)** all of them found that grafting ratio, graft compatibility rate and grafting success proved to be essential for behaviour of scions in the future.

These results are in agreement with those obtained by (**Lockwoodand Ferree,2014; Moretti,2005; Mielke et al.,1980; Celik and Odabas,1998; Verma et al., 2010; Cookson et al., 2013; Darikova et al., 2011; Reynolds and Wordle 2001; Nicol et al., 1999; El- Gendy, 2013; Fardossi et al., 1995; Rizk- Alla et al. 2011; Celik and Odabas,1998; Verma et al., 2010; Petkou et al., 2004; Darkova et al., 2011; Gainza et al., 2015**; **Uzunova et al.,2016; Sarooshi et al., 1982; Fardossi et al., 1995; Nikolaou et al., 2000; Reynolds and Wordle 2001; Hurtmann et al., 2002; Steriegles et al., 2004; Bettiga 2004; Dardeniz and Sahin 2005; Somkuwar et al., 2006; Koundouras et al 2008; Rizk-Alla et al., 2011; Stino et al 2011; Main et al., 2012; Keller et al., 2012; El-Gendy 2013; Kidmilogla and Guler,2014; Teker et al., 2014; Somkuwar et al.,2011; Desouky et al., 2015; Somkuwar et al., 2015; Mohamed 2017; Abdel-aal and Silem 2018).**

Conclusion

It can be recommended to use Freedom and Salt Greek as good grape rootstocks for Flame seedless and Superior grapevines, respectively, since such two rootstocks have high compatibility and improve growth and vine nutritional status. Meanwhile Harmony grape rootstock is not acceptable for both grape scions.

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