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النمو الخضرى والجذرى والمحتوى العضوى والمعدنى لأوراق بعض أصول العنب وعلاقتها بنوع التربة وفترات الرى

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الملخص العربي

أجريت الدراسة خلال سنوات ٢٠٠٥ ، ٢٠٠٦ وإنتهت فى يناير ٢٠٠٧ وإشتملت على دراسة تأثير إختلاف نوع التربة (الرملية ، الطينية والجيرية) وفترات الرى (كل ٢ ، ٤ أيام) على المحتوى العضوى والمعدنى لأوراق أربعة أصول عنب: دوج ريدج ، هارمونى ، ١١٠٣ بولسن وطومسون سيدلس. ولقد أوضحت نتائج الدراسة أن أصل دوج ريدج تميز بزيادة النمو الخضرى والجذرى والمحتوى العضوى والمعدنى للأوراق فى أنواع التربة الثلاثة عند الرى كل يومين وأربعة أيام يليه أصل هارمونى ثم أصل ١١٠٣ بولسن ، بينما كان أقلهم أصل طومسون سيدلس .

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VEGETATIVE & ROOT GROWTH AND ORGANIC & CHEMICAL CONSTITUENTS OF SOME GRAPEVINE ROOTSTOCKS IN REALATION TO SOIL TYPE AND IRRIGATION PERIODS

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ABESTRACT: ***The present study was conducted during 2005 & 2006 seasons and terminated on 15 January, 2007. It aimed to study the effect of different soil types (S); sandy, clay and calcareous and irrigation periods (I); every two and four days on organic and chemical constituents of four grapevine rootstocks(R) namely; Dogridge (D), Harmony (H), 1103 Paulsen (P) and Thompson seedless (T). The present results indicated that the highest rootstock for vegetative & root growth and organic & chemical constituents when growing in the three soil types at two irrigation periods was Dogridge followed by Harmony and 1103 Paulsen rootstocks, while the lowest one was Thompson seedless.***

Key words: ***vegetative, root growth, organic constituent, chemical constituent, grapevine, rootstock, irrigation, soil.***

INTRODUCTION

Grapes are considered one of the most important commercial fruit crops in the world. The grape tree grows and produces high yield in a wide range of soils and climates. Also, the fruit has high nutritional value because of its high content of sugars, vitamins and minerals. Due to the recent restrictions forbidding the expansion of fruit areas in the Delta region in Egypt, most of new grapes plantation are established in newly reclaimed areas where different soil types are found. Calcareous soil is an example of soil type that induces many nutrition problems receiving considerable attention. High calcium carbonate in the soil seemed to be an important factor in decreasing the availability and absorption of certain trace elements by plants (Purvis and Davidson, 1948). In a drying soil, uptake of water and nutrients becomes progressively more difficult for grapevines; it has effect on growth and nutrient content (Keller, 2005). Also, many grape orchards have grown budded seedlings instead of stem cutting in the recent years due to the shortage of irrigation water as well as soil salinity (Somkuwar *et al*., 2006).

The objective of the present study is to investigate the growth four grapevine rootstocks namely; Dogridge, Harmony, 1103 Paulsen and Thompson seedless grown in three soil types; sandy, clay and calcareous at two irrigation periods; every two and four days.

MATERIALS AND METHODS

Long season study was conducted during the two growing seasons of 2005 & 2006 and terminated on 15 January, 2007 in a greenhouse at the Experimental Station, Faculty of Agriculture, Alexandria University. This investigation aimed to study the effect of different soil types (S); sandy, clay & calcareous and irrigation periods (I); every two and four days on plant growth and both organic & mineral constituents of four grapevine rootstocks (R) namely; Dogridge (D) (*Vitis champini*), Harmony (H) (*Vitis champini* × *1613*), 1103 Paulsen (P) (*Vitis*

***berlandiri* × *Vitis rupestris*) and Thompson seedless (T) (*Vitis vinifera*).**

Seventy two one-year-old plant cuttings as uniform as possible, were used in this study. The plants were divided into three groups (24 plants for each group). Each group was planted in sandy, clay and calcareous soils in clay pots No.25, twelve plants were irrigated at 2 days and others at 4 days with about one liter of tap water / pot from 15 June to 15 October of both seasons. Also, one liter of 1000 ppm Crystalone solution (N:P:K 20:20:20) was added to each pot weekly as a source of nutritive mineral salts starting at the first irrigation treatments until the end of each growing season. Vegetative growth parameters i.e. lateral shoots number were recorded at zero time and at the end of each season. Stem diameter (cm) was measured by a caliper at 5 cm height from the ground surface and pruning wood weight was determined on 15 January of 2006 & 2007 seasons. Dry weight of 10 leaves per plant was determined on 15 October of both seasons.

At the termination of the experiment on 15 January 2007, all plants were carefully lifted from the pots and adhering soil particles on the roots were removed by washing with tap water. Roots and leaves of each plant were washed several times with tap water, rinsed three times with distilled water and separately oven-dried at 70^{o}C to a constant weight and root dry weight was determined per plant.

The dried leaf matter of each replicate were ground and digested by sulphuric acid and hydrogen peroxide according to Evenhuis and Dewaard (1980). Suitable aliquots were then taken for the determination of nitrogen, phosphorus, potassium, calcium, magnesium and iron. Total nitrogen and phosphorus were colorimetrically determined according to Evenhuis (1976) and Murphy and Riley (1962), respectively. Potassium was measured against a standard using a flame photometer Model 410. Calcium, magnesium and iron were determined by Perkin Elmer Atomic Absorption Spectrophotometer. The concentrations of nitrogen, phosphorus, potassium, calcium and magnesium were expressed as percent, while iron was expressed as ppm on dry weight basis of leaf matter.

Total leaf chlorophyll content was determined in a fresh leaf samples according to the method described by Yadava (1986), using a Minolta SPAD chlorophyllmeter model. Four readings were taken for each plant at the end of October, 2005 & 2006 and the results were expressed as SPAD units.

For free proline content determination, 0.1 g of dried leaf matter of each replicate was homogenized in 10 ml sulfosalicylic and determined according to the method described by Bates *et al.* (1973). Proline content was expressed as mg/g dry weight of leaf tissues was. The Total sugars in 0.5 g dried leaf matter were determined according to Malik and Singh (1980).

Soil and water samples were taken at the beginning of the experiment for analysis according to the method descri-bed by Chapman and Pratt (1978). The data of soil and water analysis are presented in Table (1).

The experiment was carried out as factorial with three factors; irrigation periods (every two and four days), soil types (sandy, clay and calcareous) and rootstocks (Dogridge, Harmony, 1103 Paulsen and Thompson seedless) i.e. 4 x 3 x 2= 24 treatment. The experiment was designed as randomized complete block design (RCBD) with three replicate for each treatment (24 x 3= 72 plant). The results obtained were statistically analyzed according to Snedecor and Cochran (1990) and least significant differences L.S.D at 0.05 compared the differences among means. Combined analysis of both seasons was carried out according to Gomez and Gomez (1984).

Table (1): Chemical properties of irrigation water and soil types.

Chemical properties	Irrigation water	Sandy soil	Clay soil	Calcareous soil
pH	7.65	7.90	7.80	8.15
EC dSm^{-1}	0.38	0.42	2.70	2.57
Na^{+} megq L^{-}	1.46	0.41	5.38	10.40
K^{+} megq L^{-}	0.11	0.18	1.10	0.63
Ca^{++} megq L^{-}	1.06	0.60	5.00	12.60
Mg^{++} megq L^{-}	1.45	0.70	3.00	1.08
HCO^{-3} megq L^{-}	1.57	0.24	5.00	6.51
CO_3^{--} megq L^{-}	0.00	0.00	0.00	0.00
CL^{-} megq L^{-}	1.48	0.75	20.00	11.34
SO_4megq L^{-}	1.04	0.98	2.63	4.20
$CaCO_3$ %	0.00	2.00	2.26	31.25
Organic matter %	00.00	0.16	0.85	0.32

RESULTS AND DISCUSSION

1- Vegetative and root growth:

The present results in Tables (2 – 6) for vegetative growth parameters showed that the values of shoots number/plant and pruning wood weight of D, H and P rootstocks were significantly higher than those of T rootstock. Also, D rootstock had the highest dry & pruning wood weight values comparing with those of H and P rootstocks. The T rootstock had the highest stem diameter and leaf dry weight as compared with those of D, H and P rootstocks. This might be due to relative tolerance of the above mentioned rootstocks to drought, lime and poor soil. Also, the Dogridge rootstock had a vigorous growth in the sandy soil. Mullins *et al.*, 1992 stated that *Vitis berlandiri* and *Vitis vinifera* L. cultivars are well adapted to the highly calcareous soil. In addition, Kadam *et al.*, 2005a reported that the relative drought tolerance of grape rootstocks could be ranked as follows: 1103P > Dogridge > Salt creek > 1613-C > 1616-C > SO_4. The present results also showed that calcareous soil significantly decreased shoots number/plant, leaf dry weight and pruning wood weight as compared with the other two experimental soil types. This might be due to the effect of the high calcium carbonate content in this soil (31.25%, Table 1) which is associated with several problems related to plant nutrition and growth (Kamel *et al.*, 1977).The 4 days irrigation period significantly decreased shoots number/plant, stem diameter, leaf dry weight and pruning wood weight comparing with 2 days. These results were in harmony with those obtained by Tosse and Torres, 1986, Abd El-Moteleb, 1991, Shawky *et al.*, 1996 and Kadam *et al.*, 2004. They found that when soil moisture content decreased by the lowest level of water application and increasing water stress level reduced vegetative growth of grapevine cultivars and rootstocks. In general, the three tested rootstocks (D, H and P) showed a higher vegetative growth indices comparing with T rootstock in the three experimental soil types at two irrigation

periods. Also, plant growth indices for D rootstock in the three soil types with 2 & 4 days irrigation period were more pronounced.

Table (2): Results of both 2005 and 2006 seasons combined analysis of shoots number per plant as affected by grapevine rootstocks (R), soil type and irrigation period.

Soil type (S)	Dogridge (D)			Harmony (H)			1103 Paulsen (P)			Thompson seedless (T)			Soil type mean
	Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			
	2	4	Avg.	2	4	Avg.	2	4	Avg.	2	4	Avg.	
Sandy	7.50	3.83	5.67	7.50	5.33	6.42	9.50	8.00	8.75	3.50	2.33	2.92	5.94
Clay	9.00	8.84	8.92	10.50	5.67	8.09	12.50	9.50	11.00	2.67	4.34	3.50	7.88
Calcareous	4.84	3.67	4.25	5.50	3.17	4.34	5.00	3.17	4.09	3.50	2.17	2.84	3.88
Average	7.11	5.45	6.28	7.83	4.73	6.28	9.00	6.89	7.95	3.22	2.95	3.08	
Irrigation period mean	6.79						5.00						

L.S.D. at 0.05	R	S	I	R X S	R X I	R X S X I
	0.63	0.55	0.45	1.10	0.89	1.55

Table (3): Results of both 2005 and 2006 seasons combined analysis of stem diameter (cm) as affected by grapevine rootstocks (R), soil type and irrigation period.

Soil type (S)	Dogridge (D)			Harmony (H)			1103 Paulsen (P)			Thompson seedless (T)			Soil type mean
	Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			
	2	4	Avg.	2	4	Avg.	2	4	Avg.	2	4	Avg.	
Sandy	0.76	0.62	0.69	1.14	0.47	0.81	0.83	1.37	1.10	1.12	0.98	1.10	0.91
Clay	1.06	0.96	1.03	0.76	0.59	0.68	1.18	1.28	1.23	1.21	1.24	1.23	1.03
Calcareous	0.81	0.70	0.76	0.83	0.69	0.76	0.74	1.06	0.90	1.44	1.24	1.34	0.94
Average	0.88	0.76	0.82	0.91	0.58	0.75	0.91	1.24	1.08	1.26	1.15	1.21	
Irrigation period mean	0.99						0.93						

L.S.D. at 0.05	R	S	I	R X S	R X I	R X S X I
	0.06	0.06	0.05	0.11	0.09	0.16

Table (4): Results of both 2005 and 2006 seasons combined analysis of leaf dry weight (g) as affected by grapevine rootstocks (R), soil type and irrigation period.

Soil type (S)	Dogridge (D)			Harmony (H)			1103 Paulsen (P)			Thompson seedless (T)			Soil type mean
	Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			
	2	4	Avg.	2	4	Avg.	2	4	Avg.	2	4	Avg.	
Sandy	0.23	0.21	0.22	0.17	0.14	0.15	0.21	0.23	0.22	0.29	0.37	0.33	0.23
Clay	0.22	0.21	0.22	0.17	0.13	0.15	0.18	0.19	0.18	0.27	0.21	0.24	0.20
Calcareous	0.18	0.18	0.18	0.15	0.13	0.14	0.15	0.15	0.15	0.22	0.17	0.20	0.16
Average	0.21	0.20	0.21	0.16	0.14	0.15	0.18	0.19	0.18	0.26	0.25	0.26	
Irrigation period mean	0.21						0.19						

L.S.D. at 0.05	R	S	I	R X S	R X I	R X S X I

	0.03	0.03	0.02	0.05	0.04	0.07

Table (5): Results of both 2005 and 2006 seasons combined analysis of pruning wood weight (g) as affected by grapevine rootstocks (R), soil type and irrigation period.

Soil type (S)	Dogridge (D)			Harmony (H)			1103 Paulsen (P)			Thompson seedless (T)			Soil type mean
	Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			
	2	4	Avg.	2	4	Avg.	2	4	Avg.	2	4	Avg.	
Sandy	37.01	26.28	31.64	25.94	19.39	22.66	31.60	21.82	26.71	16.32	13.90	15.12	24.03
Clay	36.33	15.08	25.70	34.14	16.92	25.53	20.78	14.65	17.72	31.88	11.22	21.55	22.63
Calcareous	26.57	13.19	19.88	24.79	11.61	18.20	15.88	11.00	13.44	7.97	9.95	8.96	15.11
Average	33.30	18.19	25.74	28.29	15.97	22.13	22.76	15.82	19.29	18.72	11.69	15.21	
Irrigation period mean	25.77						15.42						

L.S.D. at 0.05	R	S	I	R X S	R X I	R X S X I
	1.88	1.63	1.33	3.26	2.66	4.61

Table (6): Results of both 2005 and 2006 seasons combined analysis of root dry weight (g) as affected by grapevine rootstocks (R), soil type and irrigation period.

Soil type (S)	Dogridge (D)			Harmony (H)			1103 Paulsen (P)			Thompson seedless (T)			Soil type mean
	Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			
	2	4	Avg.	2	4	Avg.	2	4	Avg.	2	4	Avg.	
Sandy	32.20	29.34	30.77	18.48	9.15	13.82	37.68	25.31	31.50	20.39	14.75	17.57	23.41
Clay	18.41	8.53	13.47	8.24	10.04	9.14	14.00	9.40	11.70	12.23	8.59	10.41	11.18
Calcareous	17.39	17.65	17.52	13.27	8.41	10.84	10.32	8.24	9.28	13.41	8.93	11.17	12.20
Average	22.67	18.50	20.59	13.33	9.20	11.27	20.67	14.32	17.49	15.34	10.76	13.05	
Irrigation period mean	18.00						13.19						

L.S.D. at 0.05	R	S	I	R X S	R X I	R X S X I
	2.04	1.77	1.44	5.03	7.19	5.00

Moreover, the results of 2006 season presented in Table 6 showed that the D rootstock had the highest root dry weight comparing with the other rootstocks in the three experimental soil types under the two irrigation periods. The P rootstock had significantly higher root dry weight than those of H and T rootstocks in sandy soil with 2 & 4 days irrigation periods. Kadam *et al.*, 2004 reported that the highest fresh and dry weights of roots were noticed in 1103 P at irrigation regime (0.3 bar). In addition Sandy soil significantly raised root dry weight than those of clay and calcareous soil in the present results. This might be due to negative effect of increasing calcium carbonate content of calcareous soil, while clay soil decreased extensive root system laterally, mass of roots, number of roots, the deepest and root weight because of its long keeping soil moisture content. These results agreed with those reported by Mortensen (1972) and Perry *et al.* (1983) who found that the increasing $CaCO_3$ content reduced growth of roots and the highest growth & root dry weight of Dogridge rootstock were in sandy soil.

The 4 days irrigation period decreased root dry weight comparing with 2 days in the present results. Shawky *et al.* (1996) found that the increasing water stress displayed a gradual decrease in the dry weight of root system of Banaty and Romi plants. In general, the tested D

rootstock showed a higher fresh & dry weight of root comparing with the three other rootstocks (H, P and T) in the three experimental soil types at two irrigation periods

2. Organic constituents:

Chlorophyll: It is clear from Table 7 the total chlorophyll content was highest in the H, D and P rootstocks and lowest in the T rootstock. Calcareous soil significantly raised it than those of sandy & clay soil, and the irrigation period did not affect it. This might be due to the tolerance of the above mentioned rootstocks to drought and lime. This suggestion agreed with Bica *et al.* (2000) who found that the vines grafted on 1103 P showed the highest total chlorophyll content. Kadam *et al.* (2005b) mentioned that the total chlorophyll content decreased with increasing water stress, and it was highest in 1103 P and lowest in SO_4 rootstock.

Proline: The results of each studied factor regardless of the others showed that; the T rootstock had significantly higher leaf proline level than those of D, H and P rootstocks. This might be due to the inheritance effect and relative tolerance of the three rootstocks (D, H and P) to drought, lime, salinity and poor soil compared to the Thompson seedless rootstock. In addition, calcareous soil significantly decreased leaf proline content than the clay and sandy ones. This might be due to the higher moisture content of clay soil, while sandy soil is dry and poor (Table 8). These suggestions is supported by Mullins *et al*. (1992) who showed that the *Vitis berlandiri* and *Vitis vinifera* L. species are well adapted to highly $CaCO_3$ percent in calcareous soil. Also, four days irrigation period caused the lowest values of leaf proline content compared to two days irrigation period. Abd El-Moteleb (1991) who found that under severe water stress, grapevine seedlings (Thompson seedless and Red Romi) synthesized about 10 folds of proline value compared with those grown under favourable water condition. Shawky *et al*. (1996) indicated that irrigation at 20, 40, 60 and 80% depletion of available water induced higher proline content in Red Romi vine cv. Also, they added that a high degree of water stress significantly increased leaf proline level. This suggestion agreed with those obtained by Russo *et al,* (2010).

Total sugars: As shown in Table 9 the leaf total sugars content did not significantly differ as influenced by the three rootstocks, soil types and irrigation periods. However, Abdullaev and Tagieva (1975) who reported that leaf sugars content was slightly greater in the leaves from un-irrigated vines compared with the irrigated ones. However, Ndung'u *et al.* (1996) reported an increase in that the soluble sugars content in the cane, trunks and roots of Riesling grapevines grown under water stress.

Table (7): Results of both 2005 and 2006 seasons combined analysis of leaf total chlorophyll content (SPAD units)* as affected by grapevine rootstocks (R), soil type and irrigation period.

Soil type (S)	Dogridge (D)			Harmony (H)			1103 Paulsen (P)			Thompson seedless (T)			Soil type mean
	Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			
	2	4	Avg.	2	4	Avg.	2	4	Avg.	2	4	Avg.	
Sandy	31.00	30.22	30.61	30.89	29.37	30.26	26.99	29.12	28.06	30.30	30.38	30.34	29.81
Clay	29.75	30.20	29.97	31.94	33.15	32.54	29.32	29.76	29.54	27.67	19.65	23.66	28.93
Calcareous	31.84	33.52	32.68	34.05	32.88	33.46	27.79	33.27	30.53	30.71	32.77	31.74	32.10
Average	30.86	31.31	31.09	32.29	31.88	32.09	28.03	30.71	29.38	29.56	27.60	28.58	
Irrigation period mean	30.19						30.38						

L.S.D. at 0.05	R	S	I	R X S	R X I	R X S X I

	1.91	1.65	N.S	3.30	2.70	4.67

*** Using a chlorophyll metter (model SPAD 502, Minolta Corporation, NJ, USA).**

Table (8): Results of both 2005 and 2006 seasons combined analysis of leaf proline content (mg/g dry weight of leaf tissues) as affected by grapevine rootstocks (R), soil type and irrigation period.

Soil type (S)	Dogridge (D)			Harmony (H)			1103 Paulsen (P)			Thompson seedless (T)			Soil type mean
	Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			
	2	4	Avg.	2	4	Avg.	2	4	Avg.	2	4	Avg.	
Sandy	125.45	40.75	83.10	134.39	39.78	87.08	122.25	66.84	94.55	113.96	132.38	123.17	96.97
Clay	41.83	69.51	55.67	106.35	101.39	103.88	98.20	81.22	89.71	134.69	64.70	99.70	87.24
Calcareous	43.89	120.29	82.09	37.53	60.83	49.18	52.65	28.74	40.75	57.26	54.38	55.82	56.95
Average	70.39	76.85	73.62	92.76	67.34	80.04	91.03	58.94	74.99	101.97	83.82	92.89	
Irrigation period mean	89.04						71.74						

L.S.D. at 0.05	R	S	I	R X S	R X I	R X S X I
	12.76	11.05	9.02	22.10	18.05	31.26

Table (9): Results of both 2005 and 2006 seasons combined analysis of leaf total sugars content (% on dry weight basis) as affected by grapevine rootstocks (R), soil type and irrigation period.

Soil type (S)	Dogridge (D)			Harmony (H)			1103 Paulsen (P)			Thompson seedless (T)			Soil type mean
	Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			
	2	4	Avg.	2	4	Avg.	2	4	Avg.	2	4	Avg.	
Sandy	4.98	4.74	4.86	4.81	5.02	4.92	5.32	4.17	4.75	4.40	4.67	4.54	4.76
Clay	4.65	5.16	4.91	4.35	4.42	4.39	4.81	4.16	4.49	4.03	4.41	4.22	4.50
Calcareous	5.05	3.75	4.40	4.85	5.07	4.96	5.55	4.80	5.17	4.36	4.04	4.20	4.68
Average	4.89	4.55	4.72	4.67	4.84	4.76	5.23	4.37	4.80	4.26	4.38	4.32	
Irrigation period mean	4.76						4.53						

L.S.D. at 0.05	R	S	I	R X S	R X I	R X S X I
	N.S	N.S	N.S	1.35	0.55	1.87

3. Chemical constituents:

Generally, the present results in Tables (10 - 15) showed that calcareous soil decreased leaf (N, P, K and Fe) levels, while, it caused significantly higher values of leaf calcium compared with those of sandy and clay soil. This might be due to the effect of the high calcium carbonate content in this type soil (31.25%, Table 1). This suggestion agreed with those obtained by Guillen *et al.* (1966), El-Gazzar *et al.* (1977) working on grapevine and El-Gazzar *et al.* (1981) working on carob seedlings. They reported that the calcium carbonate seemed to be an important factor in decreasing the availability and absorption of the different nutrient and calcareous soil increased in the contents of calcium in leaves and roots, whereas, it decreased leaf iron content. Also, the results indicated that the values of leaf (N, P, K, Ca and Fe) contents did not differ significantly with the effect of irrigation period in the present study. However the irrigation period at 4 days caused the highest leaf magnesium percent. This result agreed with those

obtained by Lavin (1986), Abd El-Moteleb (1991) and Shawky *et al.* (1996) who mentioned that the petiole content of N, P and K, respectively was not significantly affected by different irrigation treatments. While, Fardossi *et al.* (1993) reported that the growth of the grapevine cultivar Tramiar in German under drought conditions caused an increase in leaf Mg content. Cline *et al.* (1985) reported that Concord grapevine grown under drip irrigation system had lower concentrate-ion Mg in the petiole (0.59%) than that of the non-irrigated vine (0.7%). From the data listed it is clear that the T rootstock had significantly higher percentage of leaf potassium and magnesium than those of D, H and P rootstocks. The leaf potassium and iron contents of D & H rootstocks was significantly higher than that of P rootstock. Also, the D rootstock had significantly higher iron content than that of T rootstock only. The results indicated that the values of leaf phosphorus and calcium did not differ significantly among rootstocks. This might be due to the tolerance of the above mentioned rootstocks to drought and lime. This suggestion agreed with those reported by Mullins *et al.* (1992), Kadam *et al.* 2005a and Paranychianakis & Angelakis (2007) working on grapevine. They found that the *Vitis berlandiri* and *Vitis vinifera* L. cultivars are well adapted to the highly calcareous soil.

Table (10): Results of both 2005 and 2006 seasons combined analysis of leaf nitrogen content (% on dry weight basis) as affected by grapevine rootstocks (R), soil type and irrigation period.

Soil type (S)	Dogridge (D)			Harmony (H)			1103 Paulsen (P)			Thompson seedless (T)			Soil type mean
	Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			
	2	4	Avg.	2	4	Avg.	2	4	Avg.	2	4	Avg.	
Sandy	2.55	2.60	2.57	3.27	2.43	2.85	2.48	2.35	2.41	3.30	3.74	3.52	2.84
Clay	2.48	2.27	2.38	3.09	3.11	3.10	2.75	2.69	2.72	2.03	2.20	2.12	2.58
Calcareous	2.52	2.10	2.31	2.52	2.08	2.30	2.24	2.74	2.49	3.07	2.66	2.86	2.50
Average	2.51	2.33	2.42	2.96	2.54	2.75	2.49	2.59	2.54	2.80	2.87	2.84	
Irrigation period mean	2.69						2.58						

L.S.D. at 0.05	R	S	I	R X S	R X I	R X S X I
	0.34	0.29	N.S	0.59	0.48	0.83

Table (11): Results of both 2005 and 2006 seasons combined analysis of leaf phosphorus content (% on dry weight basis) as affected by grapevine rootstocks as (R), soil type and irrigation period.

Soil type (S)	Dogridge (D)			Harmony (H)			1103 Paulsen (P)			Thompson seedless (T)			Soil type mean
	Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			
	2	4	Avg.	2	4	Avg.	2	4	Avg.	2	4	Avg.	
Sandy	0.84	0.86	0.85	0.83	0.94	0.89	1.07	0.77	0.92	0.92	0.87	0.89	0.89
Clay	0.83	0.87	0.84	0.93	0.87	0.90	0.99	0.94	0.97	0.96	0.85	0.91	0.90
Calcareous	0.79	0.73	0.76	0.71	0.86	0.78	0.69	0.76	0.73	0.75	0.82	0.78	0.77
Average	0.82	0.81	0.82	0.82	0.89	0.86	0.92	0.82	0.87	0.88	0.86	0.86	
Irrigation period mean	0.86						0.84						

L.S.D. at	R	S	I	R X S	R X I	R X S X I

0.05	N.S	0.08	N.S	0.16	0.13	0.22

Table (12): Results of both 2005 and 2006 seasons combined analysis of leaf potassium content (% on dry weight basis) as affected by grapevine rootstocks (R), soil type and irrigation period.

Soil type (S)	Dogridge (D)			Harmony (H)			1103 Paulsen (P)			Thompson seedless (T)			Soil type mean
	Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			
	2	4	Avg.	2	4	Avg.	2	4	Avg.	2	4	Avg.	
Sandy	0.78	0.82	0.80	0.90	0.84	0.90	0.71	0.67	0.70	0.91	0.75	0.83	0.80
Clay	0.65	0.68	0.66	0.82	0.74	0.78	0.72	0.67	0.70	0.79	0.82	0.81	0.74
Calcareous	0.70	0.65	0.68	0.61	0.62	0.62	0.57	0.55	0.56	0.85	0.82	0.84	0.67
Average	0.71	0.72	0.72	0.78	0.73	0.76	0.67	0.63	0.65	0.85	0.80	0.82	
Irrigation period mean	0.75						0.72						

L.S.D. at 0.05	R	S	I	R X S	R X I	R X S X I
	0.06	0.05	N.S	0.10	0.08	0.14

Table (13): Results of both 2005 and 2006 seasons combined analysis of leaf calcium content (% on dry weight basis) as affected by grapevine rootstocks (R), soil type and irrigation period.

Soil type (S)	Dogridge (D)			Harmony (H)			1103 Paulsen (P)			Thompson seedless (T)			Soil type mean
	Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			
	2	4	Avg.	2	4	Avg.	2	4	Avg.	2	4	Avg.	
Sandy	0.52	0.78	0.65	1.13	0.70	0.91	1.03	1.20	1.12	1.17	1.39	1.28	0.99
Clay	1.48	2.03	1.76	1.09	1.23	1.16	0.77	1.15	0.96	0.97	1.43	1.20	1.27
Calcareous	1.71	1.83	1.77	1.77	1.70	1.74	2.05	1.83	1.94	1.83	1.78	1.81	1.81
Average	1.24	1.55	1.39	1.33	1.21	1.27	1.28	1.39	1.34	1.32	1.53	1.43	
Irrigation period mean	1.29						1.42						

L.S.D. at 0.05	R	S	I	R X S	R X I	R X S X I
	0.18	0.16	N.S	0.31	0.26	0.44

Table (14) : Results of both 2005 and 2006 seasons combined analysis of leaf magnesium content (% on dry weight basis) as affected by grapevine rootstocks (R), soil type and irrigation period.

Soil type (S)	Dogridge (D)			Harmony (H)			1103 Paulsen (P)			Thompson seedless (T)			Soil type mean
	Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			
	2	4	Avg.	2	4	Avg.	2	4	Avg.	2	4	Avg.	
Sandy	0.19	0.23	0.21	0.25	0.24	0.25	0.15	0.23	0.19	0.41	0.40	0.41	0.26
Clay	0.21	0.33	0.27	0.35	0.28	0.32	0.30	0.32	0.31	0.15	0.28	0.22	0.28
Calcareous	0.32	0.41	0.36	0.22	0.30	0.26	0.26	0.26	0.26	0.31	0.32	0.32	0.30
Average	0.24	0.32	0.28	0.28	0.27	0.27	0.24	0.27	0.25	0.29	0.34	0.32	
Irrigation period mean	0.26						0.30						

L.S.D. at 0.05	R	S	I	R X S	R X I	R X S X I
	0.04	0.05	0.03	0.07	0.05	0.09

Table (15): Results of both 2005 and 2006 seasons combined analysis of leaf iron content (ppm on dry weight basis) as affected by grapevine rootstocks (R), soil type and irrigation period.

Soil type (S)	Dogridge (D)			Harmony (H)			1103 Paulsen (P)			Thompson seedless (T)			Soil type mean
	Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			Irrigation period (I) (days)			
	2	4	Avg.	2	4	Avg.	2	4	Avg.	2	4	Avg.	
Sandy	224.38	201.15	212.77	206.13	220.09	213.11	139.64	176.17	157.91	259.12	148.13	203.62	196.85
Clay	269.21	229.04	246.62	229.13	272.81	250.97	193.41	243.31	218.36	243.30	218.96	231.13	236.77
Calcareous	146.68	162.32	154.50	131.44	104.32	117.88	94.05	168.89	131.47	96.54	137.70	117.12	130.24
Average	213.42	195.84	204.63	188.90	199.07	193.99	142.37	196.13	169.24	199.65	168.26	183.96	
Irrigation period mean	186.08						189.83						

L.S.D. at 0.05	R	S	I	R X S	R X I	R X S X I
	10.73	9.29	N.S	18.59	15.18	26.29

CONCLUSION

From the above results it can be concluded that the Dogridge rootstock was the highest rootstock to obtain high vegetative and root growth as well as, an increase in the organic and chemical constituents when growing in the three soil types at two irrigation periods followed by Harmony and 1103 Paulsen rootstocks, while the lowest one was Thompson seedless.

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النمو الخضرى والجذرى والمحتوى العضوى والمعدنى لأوراق بعض أصول العنب وعلاقتها بنوع التربة وفترات الرى

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الملخص العربي

أجريت الدراسة خلال سنوات ٢٠٠٥ ، ٢٠٠٦ وإنتهت فى يناير ٢٠٠٧ وإشتملت على دراسة تأثير إختلاف نوع التربة (الرملية ، الطينية والجيرية) وفترات الرى (كل ٢ ، ٤ أيام) على المحتوى العضوى والمعدنى لأوراق أربعة أصول عنب: دوج ريدج ، هارمونى ، ١١٠٣ بولسن وطومسون سيدلس. ولقد أوضحت نتائج الدراسة أن أصل دوج ريدج تميز بزيادة النمو الخضرى والجذرى والمحتوى العضوى والمعدنى للأوراق فى أنواع التربة الثلاثة عند الرى كل يومين وأربعة أيام يليه أصل هارمونى ثم أصل ١١٠٣ بولسن ، بينما كان أقلهم أصل طومسون سيدلس .