

A COMPARATIVE STUDY ON N-USE EFFICIENCY OF CRIMSON SEEDLESS, SUPERIOR AND THOMPSON SEEDLESS GRAPEVINE VARIETIES

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ABSTRACT

A pot experiment was carried out to evaluate the growth and N-use efficiency of three grapevine varieties (Crimson Seedless, Superior and Thompson seedless). Nitrogen was added at five rates: 0, 10, 40, 80 and 120 mg N kg⁻¹ as ammonium nitrate (33.5 % N). Plant samples were collected after two and six weeks from the ending of nitrogen application treatments. The obtained results showed that, irrespective of varieties, increasing N-rates increased root, shoot growth and N-content but decreased N-use efficiency. However, Crimson recorded the highest values of all root, shoot growth parameters, N-content and N-use efficiency compared with the other two varieties. On the other hand, the interaction effect of N-rates and grapevine varieties showed that Crimson had the highest root length, root fineness values, root and shoot dry weight, shoot length, leaf area, N-content. Crimson recorded the highest nitrogen use efficiency at all N-rates compared with the two other grapevine varieties. Based on the result of the present study, Crimson variety can produce well under low N level and responded well to N-application.

Keywords: grapevine, fertilization, nitrogen, N-use efficiency, Crimson Seedless, Superior and Thompson Seedless

INTRODUCTION

Nitrogen (N) plays a major role in the growth and development of all parts of the grapevine. A significant amount of nitrogen is essential for normal vine growth (Bill *et al.*, 1998). In other hand, loss of nitrogen from the vineyard can occur in several ways. Nitrogen may be lost through leaching of nitrate, since it has a negative charge and is not tightly held by the negatively charged clay and organic matter. Nitrate thus moves readily downward with deep irrigation and rainfall. In waterlogged soils, oxygen concentration is low, causing some nitrate to be reduced to gaseous nitrogen by anaerobic bacteria and lost to the atmosphere. Some ammonium may be fixed by soil mineral complexes and become unavailable to plants and microbes. Erosion of surface soils may also remove nitrogen from the vineyard (Donna, 2004). Therefore, the potential for increasing N fertilizer efficiency in vineyards has greatly improved in recent years with new information on N fertilizer timing, the grapevine's N demand, maximizing irrigation efficiency (Bill *et al.*, 1998) and by identifying individual components that explained both uptake and utilization efficiency (Moll *et al.*, 1982).

Thus, this study was outlined to evaluate the impact of different nitrogen rates on growth and N-use efficiency of Crimson seedless, Superior and Thompson seedless grape cultivars.

MATERIALS AND METHODS

A pot experiment was carried out during 2006 season in Pomology department nursery, Faculty of Agriculture, Cairo University, to evaluate the impact of different nitrogen rates on growth and N-use efficiency of three grapevine varieties. These varieties were Crimson Seedless, Superior and Thompson seedless. 150 uniform wood cuttings of each of Crimson, Superior and Thompson were planted in plastic pots filled with 7 kg washed sand. One month ago after planting, 60 seedlings (rooted cutting) of each variety were chosen and equally shared between five treatments, each was replicated three times and each replicate was represented by four plants. Both phosphorus and potassium were added as basal dose at the rate of 40 mg P₂O₅ and 40 mg K₂O kg⁻¹ washed sand before planting using supper phosphate (15 % P₂O₅) and potassium sulphate (48 % K₂O) as a source of P and K, respectively.

Nitrogen was added at five rates: 0, 10, 40, 80 and 120 mg kg⁻¹ soil as ammonium nitrate (33.5 % N) as a source of nitrogen. The estimated amount of nitrogen fertilizer needed per pot at each rate was fractioned into equal 4 does added weekly. These treatments were arranged in a split plot design with three replicates in each treatment. The seedlings were then irrigated with tap water three times a week during experimental periods. Plant samples (leaves, stems and roots) were collected after two (first sampling time) and six weeks (second sampling time) from the ending of nitrogen application treatments.

Evaluation of the tested varieties and treatments was carried out through the following parameters:

1- Morphological parameters:

1-1 Root parameters:

1-1-1 Number of roots per plant

1-1-2 Root dry weight (g)

1-1-3 Total root length (estimated according to Neuman, 1966)

1-1-4 Root fineness {root length (m) / root fresh weight (g), according to Ryser and lambers (1995)}.

Method of measuring root length:

The method is based on the assumption that if a root is laid within an area, the longer the root the more intersections it will make, an average, with the number of intersections can be used to estimate the length of root by the following equation:

$$L = (\pi R N) 2H$$

Where L = root length (cm) of the counted sample.

R = area of screen cm²

N = number of intersection

H = length of hair line in the plain where the root are counted.

The N is calculated as (Sum of intersection / sum filed examined).

Root length per g of counted sample = L / C

Where C = dry weight of the counted sample.

Then: Total length of the root = (L / C) x total dry weight of the root.

1-2 Shoot parameters:

1-2-1 Shoot length (cm)

1-2-2 Shoot dry weight (g)

1-2-3 Average leaf area (cm²) using leaf area meter (model LI-3000)

Dry weight of roots and shoots (leaves and stems), were taken after drying at 70 °C

2- Chemical Measurements

2-1 Root and shoot nitrogen content

N-content was determined in the dry samples according to modified Microkeldhal method as described by Jackson (1967).

2-2 Nitrogen use efficiency

Nitrogen use efficiency was calculated as follows:

Nitrogen use efficiency =

{Whole plant dry mater in N-fertilized soil - whole plant dry mater in zero- N soil} / rate of applied nitrogen

Statistical analysis:

The obtained data were subjected to analysis of variance according to Snedecor and Cochran (1990) and means were separated by LSD at 5 % level.

RESULTS AND DISCUSSION

1- Effect of different nitrogen rates on the growth of various grapevine varieties seedling:

1-1 Number of roots:

In general, number of roots per seedling was significantly affected by nitrogen rates at both two samplings times (Table 1), the higher root number was obtained with 120 mg N kg⁻¹ soil at both two sampling times. Also, root number was significantly affected by grapevine varieties at the first sampling time, while this effect was insignificant at the second sampling time, Crimson recorded the highest root number at both two sampling times (Table 1).

Table 1: Effect of different nitrogen rates on number of root / seedling of various grapevine varieties.

First sampling time								
N-rates mg kg ⁻¹ soil	Crimson		Superior		Thompson		Mean	
0	19.67	bc	15.33	e	14.33	e	16.44	<i>B</i>
10	20.00	bc	16.00	e	15.00	e	17.00	<i>B</i>
40	20.67	bc	16.00	e	16.67	de	17.78	<i>AB</i>
80	23.67	a	19.00	cd	16.67	de	19.78	<i>A</i>
120	21.67	ab	19.60	cd	20.33	bc	20.53	<i>A</i>
Mean	21.13	A	17.17	B	16.60	B		
Second sampling time								
0	20.67	bcd	18.33	d	18.33	d	19.11	<i>B</i>
10	21.00	bcd	20.00	cd	19.67	cd	20.22	<i>AB</i>
40	22.00	abc	20.33	cd	20.00	cd	20.78	<i>AB</i>
80	24.33	a	22.00	abc	21.33	bc	22.56	<i>A</i>
120	23.33	ab	22.33	abc	23.33	ab	23.00	<i>A</i>
Mean	22.27	A	20.60	A	20.53	A		

The interaction between nitrogen rates and grapevine varieties significantly affected root number per seedling. The highest root number was obtained with Crimson seedling at 80 mg N kg⁻¹ soil through the two sampling times, while Superior and Thompson varieties recorded the highest root number at 120 mg N kg⁻¹soil. This mean that Crimson variety had a lower nitrogen requirement for the maximum root number compared with Superior and Thompson varieties. Similar results were obtained by Abou Sayed-Ahmed *et al.* (2000), Sourial *et al.* (2004) and El-Shahat *et al.* (2006).

1-2 Root dry weight:

Generally, the data in Table 2 showed a significant difference in root dry weight as a result of increasing N-rates during both two sampling times. The highest root dry weight was recorded under N application at 120 mg kg⁻¹ soil through both sampling times with net increased about 102% and 76% in 1st and 2nd sampling time respectively compared 0 N treatment. This result came in line with the finding of Ali *et al.* (1999) who reported that root weight was increased by increasing N application rate from 0 to 150 mg pot⁻¹.

Table 2: Effect of different nitrogen rates on root dry weight (g / pot) of various grapevine varieties.

First sampling time								
N-rates mg kg ⁻¹ soil	Crimson		Superior		Thompson		Mean	
0	0.80	bc	0.35	f	0.25	g	0.47	C
10	0.82	bc	0.49	e	0.31	fg	0.54	C
40	0.90	b	0.57	de	0.50	e	0.66	B
80	1.37	a	0.65	d	0.56	e	0.87	A
120	1.39	a	0.79	c	0.63	d	0.94	A
Mean	1.06	A	0.57	B	0.45	B		
Second sampling time								
0	1.81	d	1.42	f	0.99	g	1.407	B
10	2.41	b	1.59	e	1.25	f	1.75	B
40	2.50	b	1.94	c	1.36	f	1.94	AB
80	3.13	a	2.24	b	1.77	de	2.38	A
120	3.13	a	2.44	b	1.90	c	2.49	A
Mean	2.60	A	1.93	B	1.46	B		

Irrespective of N-rates, root dry weight was affected significantly by grapevine varieties. Crimson recorded significant highest root dry weight through the 1st and 2nd sampling time compared with the other grape varieties. These results are in harmony with those reported by Sourial *et al.* (2004) and El-Shahat *et al.* (2006). They showed that both root fresh and dry weight of ARG1 were increased than other grape rootstocks evaluated.

In addition such increment was pronounced when the interaction between N-rate X grape varieties was considered, through the first sampling time the highest root dry weight was observed with Crimson under 80 mg N kg⁻¹ soil while it was continued up to 120 mg N kg⁻¹ soil with respect Superior and Thompson. Through the second sampling time the highest root dry weight was observed with Crimson and Superior under 80 mg N kg⁻¹ soil

while with Thompson it was observed under mg N kg⁻¹ soil. This mean that Crimson variety had a lower nitrogen requirement for the maximum root dry weight compared with Superior and Thompson varieties This result was in harmony with El-Kassas (1976) who noted that Red Roomy had the highest increment in root weight than Thompson seedless, and the highest weight observed with high N level.

1-3 Root length:

Length of roots per plant was significantly affected by increasing N-rate from 0 to 120 mg N kg⁻¹ soil (Table 3). The longest root length was recorded with N application at 120 and 80 mg N kg⁻¹ soil through 1st and 2nd sampling time respectively. This result came in line with the finding of Stevanovic and Dzamic (1998). They reported that increased root length enhancement by nitrogen application. Also, Irrespective of N-rates, total root length was affected significantly by grapevine varieties. Crimson recorded the highest total root length in both sampling times (94.93 and 342.1 m respectively). These results are in conformity with the findings of Sourial *et al.* (2004). They reported a significant difference in total root length between tested grapevine varieties in both season of study. Dogridge grape vine rootstock revealed higher total length of roots / plant than Thompson seedless grapevine variety.

Regarding to the interaction effect between grapevine varieties and N-rates the data disclosed that Crimson had significantly the highest total root length compared with other grapevine varieties under all N-rates, and the highest total root length was observed with Crimson under 80 mg N kg⁻¹ soil through first and second sampling time. This mean that Crimson variety had more ability for produce longest root under different nitrogen rates compared with Superior and Thompson varieties.

Table 3: Effect of different nitrogen rates on total root length (m / seedling) of various grapevine varieties.

First sampling time								
N-rates mg kg ⁻¹ soil	Crimson		Superior		Thompson		Mean	
0	82.83	b	33.13	de	15.40	f	43.79	C
10	78.35	b	42.26	de	17.57	f	46.06	C
40	85.26	b	42.26	de	28.02	ef	51.84	BC
80	111.30	a	45.64	d	33.42	de	63.44	AB
120	117.00	a	62.37	c	35.99	de	71.78	A
Mean	94.93	A	45.93	B	26.08	C		
Second sampling time								
0	232.9	de	187.7	f	120.2	g	180.3	D
10	317.1	c	203.6	ef	136.2	g	219.0	C
40	360.5	b	212.0	ef	147.2	g	239.9	B
80	431.8	a	259.1	d	198.4	ef	296.4	A
120	368.5	b	263.2	d	211.7	ef	281.1	AB
Mean	342.1	A	225.12	B	162.7	B		

1-4 Root fineness:

In general, root fineness was significantly affected by nitrogen rates at both two sampling times (Table 4), root fineness was significantly reduced by increasing N-rate to 120 mg N kg⁻¹ soil. In this regard data cleared that, the highest root fineness was obtained with 0 N at both two sampling times. In addition, root fineness was significantly affected by grapevine varieties at both two sampling times, Crimson recorded the highest root fineness at both two sampling time while Thompson recoded the lowest values. In other word, root fineness of Crimson exceeded that of Thomson by about 77% and 29% in 1st and 2nd sampling time respectively.

The interaction between nitrogen rates and grapevine varieties significantly affected root fineness. The highest value of root fineness was obtained with Crimson seedling at 0 N, while the lowest value was obtained by Thompson under 120 mg N kg⁻¹ soil through the two sampling times. Fine roots are the main components of the root system through which plants absorb water and nutrients (De Silva, 1999), so this mean that Crimson variety had more ability for absorb nutrients such as nitrogen compared with Superior and Thompson varieties.

Table 4: Effect of different nitrogen rates on root fineness (m/g) of various grapevine varieties.

First sampling time								
N-rates mg kg ⁻¹ soil	Crimson		Superior		Thompson		Mean	
0	20.19	a	18.41	ab	11.64	d	16.75	A
10	18.59	ab	16.48	bc	10.70	d	15.26	AB
40	18.59	ab	16.24	bc	10.61	d	15.15	AB
80	18.65	ab	15.21	c	10.14	d	14.67	AB
120	15.35	c	15.21	c	10.32	d	13.62	B
Mean	18.27	A	16.31	A	10.68	B		
Second sampling time								
0	33.88	a	24.62	b-e	23.73	c-f	27.41	A
10	26.99	bc	24.85	bcd	21.45	ef	24.43	AB
40	27.00	bc	20.73	f	20.75	f	22.82	B
80	27.22	b	22.86	def	20.51	f	23.53	B
120	22.91	def	21.15	f	20.47	f	21.51	B
Mean	27.60	A	22.84	AB	21.38	B		

1-5 Shoot length:

Results presented in Table 5 illustrate the averages shoot length as affected by different nitrogen rates. Generally, Irrespective of grapevine varieties, the obtained results showed an obvious increase in shoot length due to N application rate. In this regard, shoot gained from seedling supplied with 120 mg N kg⁻¹ soil were the longest, such trend was true in both sampling time. The matched increase values of shoot under 120 mg N kg⁻¹ soil comparing with 0 N-rate was 88.99 % in the 1st sampling time and 83.43 % in the 2nd ones. These results are in conformity, with the finding of Bavaresco *et al.* (2001) who noted that shoot growth was increased by increasing N application rate to 16 g / pot / year. In addition, Shawky *et al.* (2004) on Thompson seedless grape transplants noted that, increased N from 0 to 5 g per plant resulted in the greatest shoot length.

Table 5: Effect of different nitrogen rates on shoot length (cm) of various grapevine varieties.

First sampling time								
N-rates mg kg ⁻¹ soil	Crimson		Superior		Thompson		Mean	
0	7.50	de	5.00	fg	4.67	g	5.72	C
10	7.83	d	5.50	efg	5.37	fg	6.23	C
40	11.17	bc	5.52	efg	5.47	efg	7.38	BC
80	13.10	ab	8.03	d	6.10	ef	9.08	AB
120	13.60	a	10.57	c	8.25	d	10.81	A
Mean	10.64	A	6.92	B	5.97	B		
Second sampling time								
0	9.67	ef	8.57	fg	7.67	g	8.63	D
10	11.67	d	9.00	fg	10.73	de	10.47	C
40	14.67	abc	13.67	c	11.20	de	13.18	B
80	16.33	a	14.67	abc	14.00	c	15.00	A
120	15.83	a	16.00	a	15.67	ab	15.83	A
Mean	13.63	A	12.38	A	11.85	A		

Irrespective of N-rate, Crimson seedless had the highest shoot length compared with other two varieties at both sampling times. In this respect Crimson recorded the highest shoot length (10.64 and 13.63 cm in both sampling times respectively). Moatamed (1993), Fawzy (1998) and Sourial *et al.* (2004), cleared that Dograide grape transplant were always had higher shoot length than Thompson grape transplant.

Also, the statistical analysis disclosed that Crimson in the 1st sampling time recorded the highest shoot length under N rate at 80 mg kg⁻¹ soil, while Superior and Thompson gave the highest at 120 mg N kg⁻¹ soil through 1st sampling time. However, through 2nd sampling time Crimson recorded the highest shoot length at 40 mg N kg⁻¹ soil, while the other two varieties recorded the highest shoot length at 80 mg N kg⁻¹ soil.

1-6 Shoot dry weight:

Irrespective of grapevine varieties (Table 6), increasing N-rate resulted in an obvious increase in shoot dry weight associated with higher N-rate (120 mg N kg⁻¹ soil) compared to the lower one (0 mg N kg⁻¹ soil). In this regard Mitra (1988) reported that shoot dry weight recorded with the higher N does. Also, similar results were recorded with Shawky *et al.* (2004).

Irrespective of N-rates, Crimson grapevine had the highest shoot dry weight through both two sampling times. Similar results were obtained by Sourial *et al.* (2004). At the first sampling time, all grape varieties recorded the highest shoot dry weight at 120 mg N kg⁻¹ soil, while through second sampling time the highest weight of shoot was obtained with Crimson seedling at 80 mg N kg⁻¹ soil, while Superior and Thompson varieties recorded the highest shoot weight at 120 mg N kg⁻¹ soil. This mean that Crimson variety had a lower nitrogen requirement for the maximum shoot dry weight compared with Superior and Thompson varieties. These results were in line with those reported by El-Kassas (1976) who found that top fresh and dry weight were increased significantly by increased N-rate, and Red Roomy had the highest top fresh and dry weight.

Table 6: Effect of different nitrogen rates on shoot dry weight (g / pot) of various grapevine varieties.

First sampling time								
N-rates mg kg ⁻¹ soil	Crimson		Superior		Thompson		Mean	
0	1.26	cd	0.83	f	0.67	g	0.92	CD
10	1.54	c	0.86	f	0.77	fg	1.06	CD
40	1.79	b	0.93	def	0.85	f	1.19	BC
80	1.92	b	1.08	de	0.88	ef	1.29	B
120	2.55	a	1.33	c	1.10	d	1.66	A
Mean	1.81	A	1.01	B	0.85	B		
Second sampling time								
0	1.90	efg	1.48	ghi	1.21	i	1.53	C
10	2.20	de	1.85	e-h	1.40	hi	1.82	BC
40	2.79	bc	2.00	ef	1.62	f-i	2.14	B
80	4.10	a	2.56	cd	2.31	de	2.99	A
120	3.70	a	3.12	b	2.88	bC	3.23	A
Mean	2.94	A	2.20	B	1.88	C		

1-7 Average leaf area:

In general, average leaf area per seedling was significantly affected by nitrogen rates at both two sampling times (Table 7), Irrespective of grape varieties, the highest leaf area was obtained with 120 mg N kg⁻¹ soil at both sampling times with a net increase in leaf area about 56% and 49% with N applied at 120 mg kg⁻¹ compare with control (0 N) through two sampling times respectively.

Table 7: Effect of different nitrogen rates on average leaf area (cm²) of various grapevine varieties.

First sampling time								
N-rates mg kg ⁻¹ soil	Crimson		Superior		Thompson		Mean	
0	54.78	de	34.33	g	33.85	g	40.99	C
10	56.82	de	35.67	g	34.67	g	42.38	C
40	69.17	b	39.67	fg	36.97	g	48.60	B
80	79.50	a	59.67	cd	45.48	f	61.33	A
120	76.00	a	64.12	bc	51.76	e	63.96	A
Mean	67.25	A	46.56	B	40.54	B		
Second sampling time								
0	58.50	fgh	51.33	h	39.83	i	49.89	C
10	61.83	d-g	54.33	gh	51.34	h	55.84	C
40	75.67	b	64.83	c-f	60.50	efg	67.00	B
80	86.67	a	65.28	c-f	69.33	bcd	73.76	AB
120	85.67	a	67.17	cde	71.00	bc	74.61	A
Mean	73.67	A	60.59	B	58.40	B		

The results presented in Table 7 indicated that Crimson Seedless grapes have a highest leaf area compare with superior and Thompson. These data are in harmony with those reported by Fawzy (1998), Nikos *et al.* (2004) and Fallahi *et al.* (2005). They found that differences of leaf area

between grape genotype could be attributed to the differences of vigation between cultivars.

The interaction between nitrogen rates and grape varieties significantly affected average leaf area per seedling. The highest average leaf area was obtained with Crimson seedling at 80 mg N kg⁻¹ soil through the two sampling times, while Superior and Thompson varieties recorded the highest average leaf area at 120 mg N kg⁻¹ soil. This mean that Crimson variety had a lower nitrogen requirement for the maximum leaf area compared with Superior and Thompson varieties.

2- Effect of different nitrogen rates on N-content of various grapevine varieties:

2-1 Root N-content

In general, root N-content was significantly affected by nitrogen rates at both two sampling times (Table 8), the highest root N-content was obtained with 120 mg N kg⁻¹ soil at both two sampling times. Also, root N-content was significantly affected by grapevine varieties at the both sampling times, where Crimson recorded the highest roots N-content at both two sampling times (Table 8).

Table 8: Effect of different nitrogen rates on root N-content (mg/pot) of various grapevine varieties.

First sampling time								
N-rates mg kg ⁻¹ soil	Crimson		Superior		Thompson		Mean	
0	5.47	i	2.45	j	1.79	j	3.24	E
10	7.79	h	5.34	i	3.58	ij	5.58	D
40	15.63	d	10.30	fg	9.88	gh	11.94	C
80	25.83	b	12.85	e	12.11	ef	16.93	B
120	31.86	a	19.56	c	15.87	d	22.43	A
Mean	17.32	A	10.11	B	8.65	B		
Second sampling time								
0	8.32	fh	7.43	h	5.00	h	6.92	D
10	13.88	ef	9.15	fh	8.11	gh	10.38	D
40	20.61	cd	17.49	de	12.14	ef	16.75	C
80	28.04	b	23.14	c	19.64	cd	23.61	B
120	39.67	a	39.6	a	29.18	b	36.15	A
Mean	22.10	A	19.36	AB	14.81	B		

The interaction between nitrogen rates and grapevine varieties significantly affected roots N-content. The highest values of roots N-content was obtained at 120 mg N kg⁻¹ soil with Crimson only through the both two sampling times.

2-2 Shoot N-content

Nitrogen content per shoot was significantly affected by increasing N-rate from 0 to 120 mg kg⁻¹ soil (Table 9), the highest shoot N-content was obtained with 120 mg N kg⁻¹ soil at both two sampling times. This in agreement with Shawky *et al.* (2004). Also, shoot N-content was significantly

affected by grape varieties at both two sampling times, Crimson recorded the highest significantly shoot N-content (22.78 and 40.53 mg/plant at both two sampling time respectively). These data are in line with those reported by Grant and Matthews (1996) and Keller *et al.* (2001).

Table 9: Effect of different nitrogen rates on shoot N-content (mg/pot) of various grapevine varieties.

First sampling time								
N-rates mg kg ⁻¹ soil	Crimson		Superior		Thompson		Mean	
0	10.01	fg	5.83	hi	5.41	i	7.08	D
10	13.31	ef	9.18	gh	8.80	ghi	10.43	D
40	17.76	cd	12.81	ef	12.15	fg	14.24	C
80	27.01	b	17.65	d	16.20	de	20.29	B
120	42.41	a	25.59	b	21.09	c	29.70	A
Mean	22.10	A	14.21	AB	12.73	B		
Second sampling time								
0	12.67	fgh	10.09	gh	9.12	h	10.63	C
10	20.14	e	19.28	ef	16.86	efg	18.76	B
40	30.72	d	23.01	e	20.83	e	24.85	B
80	71.29	a	46.58	c	44.57	c	54.15	A
120	67.83	a	58.44	b	56.64	b	60.97	A
Mean	40.53	A	31.48	B	29.60	B		

The interaction between nitrogen rates and grape varieties significantly affected shoot N-content per seedling. The highest shoot N-content was obtained with Crimson seedling at 120 mg N kg⁻¹ soil through the 1st sampling time and with 80 mg N kg⁻¹ through the 2nd sampling time. Also, the data presented that crimson recorded the highest shoot N-content under any N-rate than Superior or Thompson. This mean that Crimson grapevines variety had the highest ability uptake nitrogen content compared with Superior and Thompson grapevines varieties.

Crimson had a higher root dry weight, root number, root length and root fineness. This vigor root growth resulted in higher N-content compared with the other varieties (Superior and Thompson). This in agreement with Nakamura *et al.* (2002), Mingtan *et al.* (2003) and Becker *et al.* (2006).

2- Nitrogen use efficiency in response to nitrogen rates and grapevine varieties:

In general, nitrogen use efficiency decreased significantly with increasing nitrogen rates and it was differed significantly among grapevine varieties (Table 10), while it was greater at lower than higher nitrogen rates through both sampling times, Crimson had the highest nitrogen use efficiency compared with tow other varieties. Results in Table (10) show that the interaction between N-rates and grapevine varieties significantly affected nitrogen use efficiency. The highest value was obtained with Crimson at lower N- rate during both sampling times.

Table 10: Nitrogen use efficiency in response to nitrogen rates and grapevine varieties.

First sampling time								
N-rates mg kg ⁻¹ soil	Crimson		Superior		Thompson		Mean	
10	3.43	a	3.24	a	2.33	b	3.0	A
40	2.24	b	1.13	cd	1.54	c	1.64	B
80	2.19	b	1.0	d	0.98	d	1.39	B
120	2.23	b	1.12	cd	1.00	d	1.45	B
Mean	2.52	A	1.62	B	1.46	B		
Second sampling time								
10	12.86	a	7.76	b	6.33	b	8.98	A
40	5.63	bc	3.73	cd	2.76	d	4.04	B
80	6.27	b	3.38	d	3.51	cd	4.39	B
120	3.71	cd	3.16	d	3.07	d	3.31	B
Mean	7.12	A	4.51	AB	3.92	B		

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دراسة مقارنة على كفاءة استخدام النيتروجين في أصناف العنب, كريمسون سيدلس
و سوبيريور و طومسون سيدلس
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نفذت تجربة أصص لتقييم النمو وكفاءة استخدام النيتروجين لثلاثة أصناف من العنب وهى كريمسون سيدلس وسبيريرور و طومسون سيدلس. أضيف النيتروجين بخمسة معدلات (صفر، 10، 40، 80، 120 ملجرام / كيلو جرام تربه) باستخدام سماد نترات الأمونيوم (33.5 % نيتروجين) كمصدر للنيتروجين ولقد تم أخذ عينات النبات بعد أسبوعين وستة أسابيع من نهاية إضافة معاملات النيتروجين. وقد دلت النتائج المتحصل عليها على انه بصرف النظر عن تأثير أصناف العنب، فقد أدت زيادة معدلات النيتروجين إلى زيادة نمو كل من الجذور والأجزاء الخضرية والمحتوى النيتروجينى وقللت من كفاءة استخدام النيتروجين. علاوة على ذلك فقد أظهرت النتائج أن صنف العنب كريمسون سيدلس سجل أعلى القيم لقياسات كل من الجذور والأجزاء الخضرية والمحتوى النيتروجينى وكذلك كفاءة استخدام النيتروجين مقارنة بالصنفين الأخرين. ومن ناحية أخرى فقد دل التأثير المشترك لكل من معدلات النيتروجين وأصناف العنب على أن صنف العنب كريمسون سيدلس حقق أعلى طول للجذور وأعلى القيم لدرجة نعومة الجذر وكذلك الوزن الجاف لكل من الجذور والأجزاء الخضرية مع تحقيق أعلى طول للفرع ومساحة الورقة والمحتوى النيتروجينى. كما سجل صنف العنب كريمسون أعلى كفاءة فى استخدام النيتروجين عند كل مستويات النيتروجين بالمقارنة بالصنفين الأخرين وأنه بناء على نتائج البحث الحالى، فإن صنف العنب كريمسون سيدلس يمكن أن ينجح بدرجة جيدة فى الأراضى المنخفضة فى محتواها من النيتروجين وكذلك فإنه يستجيب بصورة أفضل لإضافة النيتروجين.