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FERTILIZATION OF CRIMSON SEEDLESS GRAPEVINES WITH NITROGEN AND POTASSIUM

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ABSTRACT

During three successive seasons, fertilizing Crimson Seedless vines with N+K was studied. The vines were five years old, grown in a sandy soil. The vines were fertilized with three levels of nitrogen 10, 20 and 40 Kg/feddan each level was accompanied by three levels of K_2O; 50, 100 and 150 Kg/feddan. The control received 60 Kg N/feddan + 120 Kg K_2O/feddan which was the common fertilization applied in the farm. Nitrogen and potassium peaked 15 days before bloom then decreased at bloom, fruit set and véraison. Increasing N+K up to 40 Kg N/feddan + 100 Kg K_2O/feddan significantly increased number of clusters/vine, yield/vine and cluster and berry weight. This treatment was found to be the best one in this respect. TSS was significantly increased than the other treatments due to the application of 40 Kg N/feddan + 100 or 150 Kg K_2O/feddan. The treatments did not affect acidity in any season of the study. TSS/acid ratio followed similar trend of TSS. Chlorophyll increased as N+K were increased. High values were recorded for 40 Kg N/feddan + 150 Kg K_2O/feddan and 60 Kg N/feddan + 120 Kg K_2O/feddan (control). Anthocyanin increased in the treatments of 20 Kg N/feddan + 150 Kg K_2O/feddan and 40 Kg N/feddan + 50, 100 and 150 Kg K_2O/feddan. N% increased as N+K were increased whereas increasing K fertilization increased K%. Fertilizing Crimson Seedless vines with 40 Kg N/feddan + 100 Kg K_2O/feddan could be recommended.

INTRODUCTION

Nitrogen is one of the basic plant nutrients. It is essential for plant growth, a constituent of proteins and nucleic acids and hence of all protoplasm (Russell, 1978). Nitrogen is a component of chlorophyll phosphatides, alkaloids, enzymes and many other organic substances of plant cells. (Yagodin, 1984). The main sources of nitrogen for plant fertilization are nitrates and ammonium salts. Potassium is essential in plant nutrition. It is one of three elements commonly present in an insufficient short supply in the soil as to limit crop yield; It often needs to be added regularly in the fertilizer (Russell, 1978). Potassium differs from nitrogen in not being a constituent of the plant fabric. It is important in the synthesis of amino acids, proteins, photosynthetic process, intensifies the synthesis of carbohydrates, catalyze the activity of some enzymes, promotes the synthesis and accumulation of thiamin & riboflavin and is essential for the activity of guard cells (Russell, 1978; Clarkson & Hanson, 1980 and Yagodin, 1984).

Fertilization of table and wine grape cultivars attracted the attention of many investigators. For example, Peacock *et al.*, 1991 working on Thompson and Flame Seedless; Dhillon *et al.*, 2001, on Perlette, Thompson and Flame Seedless, Egalil *et al.*, 2003, on Ruby King; Conradie and Saayman, 1989, on Chenin blane; Kliewer *et al.*, 1983 on Carignane; Omar, 2000, on Thompson Seedless.

Crimson Seedless is a new red late ripening cultivar produced in USA and released in 1989. Being a new cultivar, more enough information about its fertilization are needed.

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This work was conducted in an attempt to estimate the amounts of N and K needed by Crimson Seedless vines and study the seasonal changes of both N and K before bloom till véraison.

MATERIALS AND METHODS

This study was carried out for three years, 2003 & 2004 and 2005 on 5-years old Crimson Seedless grapevines, supported by Gable system in a private vineyard located in Wadi Elmollak. The vines were planted in sandy soil (Table 1); 1.5 × 3 apart, cane pruned at the 1st week of February, leaving seven canes of 10 buds each and one renewal spur of two buds, for each cane. Fertigation system was followed.

Table (1) : Physical and chemical analysis of vineyard soil

Physical analysis		Chemical analysis	
Fine sand	70	E.C mmhos/cm	0.90
Coarse sand	15	pH	7.80
Silt	10	$CaCO_3$	1.78%
Clay	5	Total N	0.05%
Texture	Sandy	K	180.0 ppm

The design was randomized complete block with three replicates five vine each. Three levels of nitrogen 10, 20 & 40 Kg N/feddan were applied, each level was accompanied by 50, 100 & 150 Kg K_2O/feddan. The control was the fertilization program usually given to the vines which was 60 Kg N/feddan + 120 Kg K_2O/feddan. The nitrogen source was ammonium nitrate (33.5% N) and potassium was added as potassium sulphate (50% K_2O). The vines received the same horticultural practices and pesticides were applied whenever needed.

Nitrogen and potassium percentages were determined in petioles of mature leaves opposite to clusters on dry weight basis. The use of petioles is preferable in determining nitrogen because N in blades is in organic forms which mask differences in the level of other N forms available for assimilation such as NO_3 and NH_4, (Christensen, 1984). The determinations were carried out at different stages : 15 days before bloom, bloom, fruit set and véraison. Nitrogen was determined according to Pregl (1945), potassium (Brown and Lilleland, 1946). Chlorophyll was determined using the nondestructive chlorophyll meter (Minolta SPAD 502). It determines the relative amount of chlorophyll percent by measuring the transmittance of the leaf in two wave bands 600 to 700 and 400 to 500 nm) giving readings in arbitrary units, that are proportional to the amount of chlorophyll percent.

Bud fertility coefficient; number of clusters/vine, yield/vine and cluster and berry weight were determined. TSS (with hand refractometer); acidity (according to A.O.A.C. (1985), TSS/acid ratio was calculated and anthocyanin was determined (Hisa *et al.*, 1965).

Duncan's multiple range test as outlined by Snedecor and Cochran (1980), was followed to compare between the treatments.

RESULTS AND DISCUSSION

- Nitrogen :

Leaf petioles sampled 15 days before bloom showed that N values were 2.01; 2.08; 2.23 & 2.83 as 10, 20, 40 & 60 Kg N/feddan were respectively applied. The values of N% resulting from the application of 10 & 20 Kg N/feddan were significantly lower than those of 40 & 60 Kg N/feddan.

The observation that increasing N application raised N% in leaf petioles in an ascending order was found to be true in samples taken at 15 days pre bloom, bloom, fruit set and véraison (Table, 2).

Increasing K rate from 50 to 100, 120 & 150 Kg K_2O/feddan increased N in leaf petioles for the three seasons of the study (Fig. 1). The average of the three seasons showed the same trend. Increasing both N and K rates increased N%. It is also obvious that control, 60 kg N/feddan + 120 kg K_2O/feddan increased N more than the application of 40 kg N/feddan + 150 kg K_2O/feddan, indicating that the increase was related to the rate of N application. A second possibility was revealed by Russell, (1978) that increasing the supply of a mobile ion of one sign can enhance the uptake of ions of the other sign. So, K^+ increases the uptake of NO^{3-}. Thirdly, K^+ functions as a carrier for NO_3^- during its absorption (Ben-Zioni *et al.*, 1971).

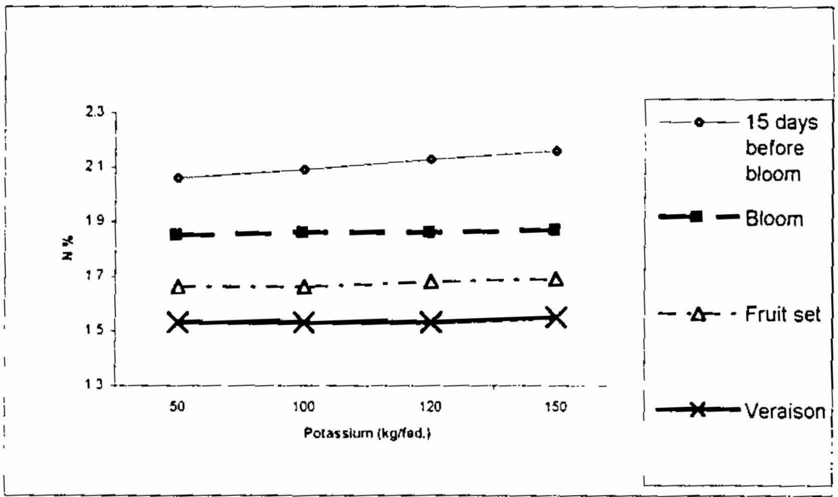

Fig. (1) : Effect of potassium fertilization on N% in leaf petiole of Crimson Seedless vines at four growth stages (average of three seasons)

Concerning the sampling stage (Table, 2), it is worthy to mention that the N peaked 15 days before bloom then decreased in a descending order at bloom, fruit set and véraison. The latter was found to have the lowest N compared to the other stages. In addition, increasing N application rate did not affect that trend (Table, 2).

Table (2) : Effect of nitrogen and potassium fertilization on seasonal changes of N in Crimson Seedless grapevines during three seasons

Treatments		15 days pre bloom				Bloom				Fruit set				Véraison			
		Season			Avg.	Season			Avg.	Season			Avg.	Season			Avg.
N	K_2O	1	2	3		1	2	3		1	2	3		1	2	3	
10	50	2.00^{c}	1.99^{c}	1.95^{d}	1.98^{d}	1.75^{c}	1.78^{c}	1.80^{b}	1.78^{c}	1.62^{b}	1.60^{b}	1.60^{b}	1.61^{b}	1.55^{b}	1.50^{b}	1.54^{b}	1.53^{b}
	100	2.05^{c}	2.00^{c}	1.97^{d}	2.01^{d}	1.79^{c}	1.80^{c}	1.80^{b}	1.80^{bc}	1.65^{b}	1.60^{b}	1.60^{b}	1.62^{b}	1.50^{b}	1.50^{b}	1.52^{b}	1.51^{b}
	150	2.00^{c}	2.06^{c}	2.06^{c}	2.04^{d}	1.79^{c}	1.80^{c}	1.82^{b}	1.81^{b}	1.65^{b}	1.65^{b}	1.63^{b}	1.64^{b}	1.50^{b}	1.50^{b}	1.53^{b}	1.51^{b}
Avg.		2.00^{C}	2.02^{C}	1.99^{C}	**2.01^{C}**	1.78^{B}	1.79^{B}	1.81^{B}	**1.80^{B}**	1.64^{B}	1.62^{B}	1.61^{B}	**1.62^{B}**	1.52^{B}	1.50^{B}	1.53^{B}	**1.52^{B}**
20	50	2.05^{c}	2.05^{c}	2.03^{c}	2.04^{d}	1.88^{b}	1.87^{b}	1.78^{b}	1.84^{b}	1.65^{b}	1.70^{a}	1.60^{b}	1.65^{b}	1.54^{b}	1.50^{b}	1.50^{c}	1.51^{b}
	100	2.09^{c}	2.06^{c}	2.07^{c}	2.07^{cd}	1.85^{bc}	1.80^{c}	1.79^{b}	1.81^{b}	1.68^{ab}	1.68^{ab}	1.60^{b}	1.65^{b}	1.50^{b}	1.50^{b}	1.52^{b}	1.52^{b}
	150	2.11^{b}	2.09^{bc}	2.13^{bc}	2.11^{c}	1.86^{b}	1.82^{b}	1.80^{b}	1.83^{b}	1.70^{a}	1.68^{ab}	1.62^{b}	1.67^{ab}	1.51^{b}	1.50^{b}	1.53^{b}	1.53^{b}
Avg.		2.08^{C}	2.07^{C}	2.08^{C}	**2.08^{C}**	1.86^{AB}	1.83^{B}	1.79^{B}	**1.83^{B}**	1.68^{AB}	1.69^{AB}	1.61^{B}	**1.66^{B}**	1.52^{B}	1.50^{B}	1.52^{B}	**1.52^{B}**
40	50	2.15^{b}	2.10^{b}	2.20^{b}	2.15^{c}	1.90^{ab}	1.92^{ab}	1.96^{a}	1.93^{a}	1.70^{a}	1.70^{a}	1.73^{a}	1.71^{a}	1.52^{b}	1.55^{b}	1.54^{b}	1.54^{a}
	100	2.20^{b}	2.18^{b}	2.18^{b}	2.19^{b}	1.93^{a}	1.98^{a}	2.00^{a}	1.97^{a}	1.72^{a}	1.76^{a}	1.75^{a}	1.74^{a}	1.54^{b}	1.55^{b}	1.55^{a}	1.55^{a}
	150	2.40^{a}	2.30^{a}	2.38^{a}	2.36^{a}	1.99^{a}	2.00^{a}	2.00^{a}	2.00^{a}	1.75^{a}	1.73^{a}	1.74^{a}	1.74^{a}	1.61^{a}	1.60^{a}	1.59^{a}	1.60^{a}
Avg.		2.25^{B}	2.19^{B}	2.25^{B}	**2.23^{B}**	1.94^{A}	1.97^{A}	1.99^{A}	**1.97^{A}**	1.72^{A}	1.73^{A}	1.74^{A}	**1.73^{A}**	1.55^{B}	1.57^{AB}	1.56^{B}	**1.56^{B}**
60 control	120	2.79^{A}	2.84^{A}	2.86^{A}	2.83^{A}	1.86^{AB}	1.88^{AB}	1.85^{B}	1.86^{B}	1.77^{A}	1.77^{A}	1.79^{A}	1.78^{A}	1.65^{A}	1.68^{A}	1.67^{A}	1.67^{A}

Values with the same letter(s) are not significant at p≤ 0.05.

The effect of applying K on N% was similar to the mentioned trends (Fig. 2). The results are in accordance with Christensen (1984) and Dhillon *et al.*, (2001) on different grapevine cultivars.

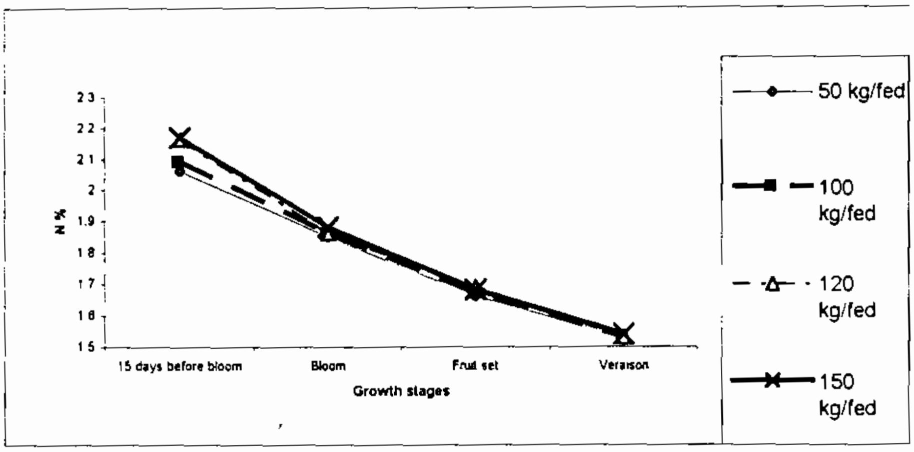

Fig. (2) : Effect of potassium fertilization of Crimson Seedless vines on seasonal changes of N% at four growth stages (average of three seasons)

- Potassium :

Table (3) showed that increasing N rate had no significant effect on K% in leaf petioles in the four studied stages. However, K% in the petioles was increased in the three seasons of the study as K rate application was increased. This result refers to N as being uneffective in increasing K% in leaf petioles, whereas increasing K fertilization had a positive effect on increasing K in petioles (Fig. 3). These results are in agreement with

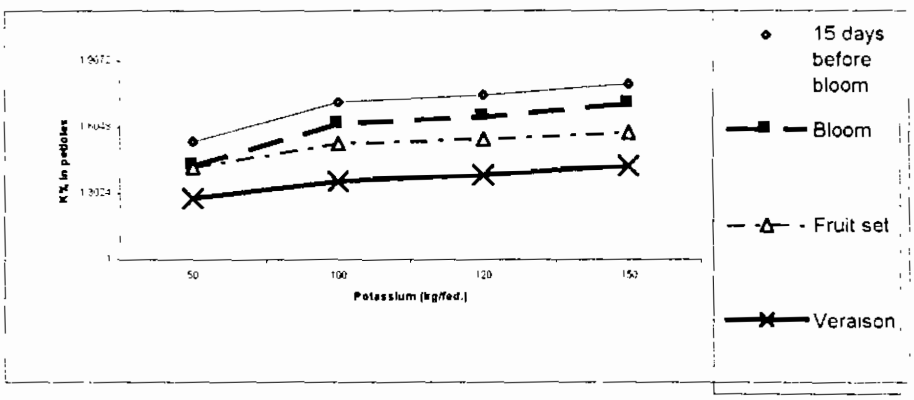

Fig. (3) :Effect of potassium fertilization on K% in leaf petiole of Crimson Seedless vines at four stages of growth (average of three seasons) Conradie and Saayman, (1989).

Table (3) : Effect of nitrogen and potassium fertilization on seasonal change of K in Crimson Seedless grapevines during three seasons

Treatments		15 days pre bloom				Bloom				Fruit set				Véraison			
		Season			Avg.	Season			Avg.	Season			Avg.	Season			Avg.
N	K_2O	1	2	3		1	2	3		1	2	3		1	2	3	
10	50	1.52^{c}	1.50^{c}	1.52^{c}	1.51^{c}	1.46^{c}	1.42^{c}	1.41^{d}	1.43^{c}	1.46^{c}	1.41^{c}	1.40^{d}	1.42^{c}	1.20^{c}	1.25^{c}	1.23^{c}	1.23^{c}
	100	1.74^{b}	1.70^{b}	1.69^{b}	1.71^{b}	1.61^{b}	1.62^{b}	1.57^{c}	1.60^{b}	1.60^{b}	1.60^{b}	1.57^{c}	1.59^{b}	1.31^{b}	1.39^{ab}	1.35^{b}	1.35^{ab}
	150	1.75^{b}	1.73^{b}	1.75^{b}	1.79^{ab}	1.62^{b}	1.64^{b}	1.66^{b}	1.64^{b}	1.61^{b}	1.62^{b}	1.66^{b}	1.63^{b}	1.46^{a}	1.45^{a}	1.49^{a}	1.47^{a}
Avg.		1.67^{B}	1.64^{B}	1.65^{A}	**1.67^{A}**	1.62^{B}	1.56^{A}	1.55^{B}	**1.58^{A}**	1.58^{A}	1.58^{B}	1.54^{A}	**1.55^{A}**	1.32^{A}	1.36^{A}	1.36^{A}	**1.35^{A}**
20	50	1.53^{c}	1.55^{c}	1.55^{c}	1.54^{c}	1.45^{c}	1.45^{c}	1.40^{d}	1.43^{b}	1.44^{c}	1.45^{c}	1.41^{d}	1.43^{c}	1.31^{b}	1.30^{bc}	1.30^{b}	1.30^{b}
	100	1.75^{b}	1.70^{b}	1.72^{b}	1.72^{b}	1.63^{b}	1.65^{b}	1.62^{b}	1.63^{b}	1.61^{b}	1.65^{b}	1.61^{bc}	1.62^{b}	1.39^{a}	1.35^{b}	1.40^{a}	1.35^{ab}
	150	1.89^{a}	1.86^{a}	1.84^{a}	1.86^{a}	1.70^{a}	1.72^{a}	1.73^{a}	1.72^{a}	1.70^{a}	1.71^{a}	1.72^{a}	1.71^{a}	1.40^{a}	1.40^{a}	1.42^{a}	1.41^{a}
Avg.		1.72^{B}	1.70^{A}	1.70^{A}	**1.71^{A}**	1.59^{B}	1.61^{A}	1.58^{AB}	**1.59^{A}**	1.58^{B}	1.60^{A}	1.58^{A}	**1.59^{A}**	1.37^{A}	1.35^{A}	1.37^{A}	**1.36^{A}**
40	50	1.57^{c}	1.58^{c}	1.60^{c}	1.58^{c}	1.40^{c}	1.42^{c}	1.51^{c}	1.44^{c}	1.41^{c}	1.40^{c}	1.42^{d}	1.41^{c}	1.31^{b}	1.30^{bc}	1.31^{b}	1.31^{b}
	100	1.77^{b}	1.69^{b}	1.70^{b}	1.72^{b}	1.62^{b}	1.60^{b}	1.69^{b}	1.64^{b}	1.60^{b}	1.60^{b}	1.67^{ab}	1.62^{b}	1.39^{a}	1.39^{ab}	1.33^{b}	1.37^{a}
	150	1.85^{a}	1.88^{a}	1.87^{a}	1.87^{a}	1.77^{a}	1.75^{a}	1.76^{a}	1.76^{a}	1.74^{a}	1.74^{a}	1.76^{a}	1.75^{a}	1.40^{a}	1.42^{a}	1.37^{b}	1.40^{a}
Avg.		1.73^{B}	1.72^{A}	1.72^{A}	**1.72^{A}**	1.60^{B}	1.59^{A}	1.65^{A}	**1.61^{A}**	1.58^{B}	1.58^{A}	1.62^{A}	**1.59^{A}**	1.37^{A}	1.37^{A}	1.34^{A}	**1.36^{A}**
60 control	120	1.80^{A}	1.75^{B}	1.70^{B}	1.75^{A}	1.70^{A}	1.64^{B}	1.60^{B}	1.65^{A}	1.69^{A}	1.63^{B}	1.62^{BC}	1.65^{A}	1.39^{A}	1.39^{AB}	1.40^{BC}	1.39^{A}

Values with the same letter(s) are not significant at $p \leq 0.05$.

Concerning the growth stage, it is obvious that K peaked 15 days pre bloom, then decreased at bloom, fruit set and véraison at any rate of N fertilization (Table, 3). Similar observation was found when potassium was applied at 50, 100, 120 & 150 kg K_2O/feddan (Fig. 4). The lowest K values were recorded at véraison stage. Although K has two absorption peaks, one at fruit setting and the other during ripening (Yu *et al.*, 1984), the petiole levels of potassium tended to decrease between bloom and véraison, as the demand of K was greatly increased at the beginning of ripening (Christensen, 1984), it seems, likely, that the vines are more efficient in using K at véraison which may explain the decrease of K in this stage. Omar (2000) reported similar results on Thompson Seedless vines.

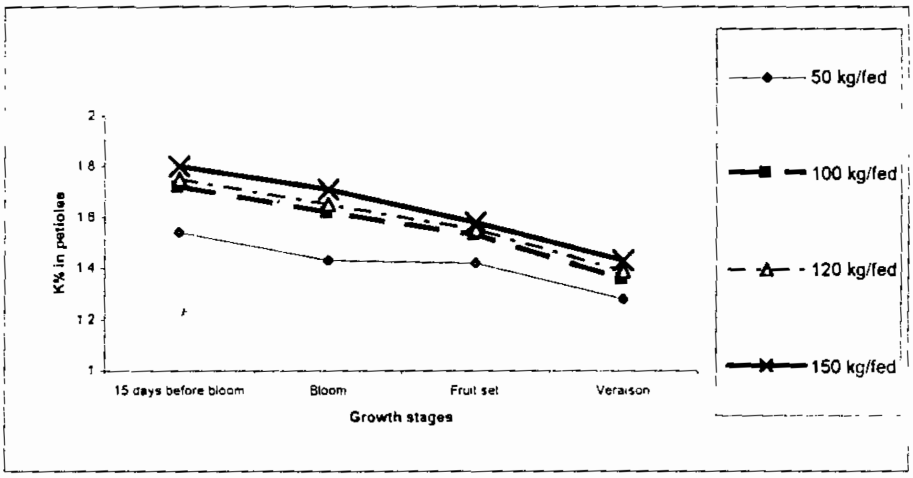

Fig. (4) : Effect of potassium fertilization of Crimson Seedless on seasonal changes of K% (average of three seasons)

Berry chemical characteristics :

Berry TSS was found to increase significantly as N + K increased with the exception of the control (60 kg N/feddan + 120 kg K_2O/feddan). Raising the amount of K in the presence of 40 kg N/feddan significantly increased TSS, compared with the control through the three seasons (Table, 4).

The application of N + K fertilizers had no significant effect on acidity of Crimson Seedless grapes.

TSS/acidity followed the TSS trend. Since the best results were observed with 40 kg N/feddan + 100 or 150 kg K_2O/feddan.

Anthocyanin responded positively to N + K application. So, higher anthocyanin content in berry skin was observed as a result of adding 40 kg N/feddan + 50, 100 or 150 kg K_2O/feddan. It is also clear that increasing the amount of K_2O increased anthocyanin content. This reveals the importance of the fertilization with potassium to increase anthocyanin and hence colouration. It seems that K activates some enzymes associated with the biosynthesis of anthocyanin.

Nitrogen content in the leaves has a high degree of correlation with the rate of photosynthetic activity (De Jong, 1982). Potassium is essential to the formation of starch and sugar (Kipps, 1970) and stimulated the efleux of sucrose from source to sink (Doman and Geiger, 1979). This explains the increase of TSS as a result of N + K addition (especially with higher rates).

- Chlorophyll :

Chlorophyll in the leaf of Crimson Seedless grapevines as affected by N + K fertilization is illustrated in table (4). Control vines which received 60 kg N/feddan + 120 kg K_2O/feddan showed higher values than the other treatments. For comparison, chlorophyll produced by 10 N + 150 K_2O < 20 N + 150 K_2O < 40 N + 150 K_2O < 60 N + 120 K_2O. That clearly showed that N is more effective in increasing chlorophyll than K. Since N is a component of chlorophyll molecule (Fogg, 1972).

- Bud fertility coefficient :

Increasing nitrogen fertilization from 10 to 40 kg/feddan was found to have a positive effect on bud fertility (Table, 5). The highest coefficient was recorded as 40 kg N/feddan + 100 kg K_2O/feddan were applied. These results indicate that this treatment meets the requirement of Crimson Seedless grapevines. Increasing nitrogen to 60 kg N/feddan + 120 kg K_2O/feddan (control) significantly decreased bud fertility compared to the above mentioned treatment. This may be ascribed to the negative correlation between petiole N content and fruitfulness (Srinivasan and Mullins, 1981). The fertilization of 40 kg N/feddan + 100 or 150 kg K_2O/feddan significantly increased bud fertility (Table, 5). Average of the three seasons showed that high bud fertility could be achieved at the application of 40 kg N/feddan + 100 or 150 kg K_2O/feddan to Crimson Seedless grapevines. The results are in line with those of Serinivasan and Mullins, 1981.

Number of clusters/vine, yield/vine and cluster and berry weight :

Number of clusters per vine was increased as N fertilization was increased to 40 kg N/feddan + 100 or 150 kg K_2O/feddan. The application of 10 and 20 kg N/feddan + K fertilization gradually increased number of clusters/vine with no significant differences. Yet, K fertilization + 40 kg N/feddan significantly increased the number of clusters per vine (Table, 5). Increasing N + K increased number of clusters per vine. The highest number was observed at 40 kg N/feddan + 100 or 150 kg K_2O/feddan in the 2nd and 3rd seasons. The average of the three seasons had the same trend. Cluster weight and yield as well as berry weight followed a similar trend. Yield was increased by 4, 18 and 43% as 10, 20 and 40 kg N/feddan were applied.

The application of N and K did not significantly affect number of clusters/vine in the 1st season due to the formation of cluster primordia in the previous season. It is clear that raising N from 40 kg N/feddan + 100 kg K_2O/feddan to 60 kg N/feddan + 120 kg K_2O/feddan (control) significantly decreased yield/vine indicating that 40 kg N/feddan was nearly enough to satisfy the demand of Crimson Seedless vines in this location. Conradie and Saayman (1989) reported that increasing N fertilization up to 96 kg N/ha significantly increased yield.

Table (4) : Effect of nitrogen and potassium fertilization on chemical characteristics of Crimson Seedless grapes

Treatments		TSS				Acidity				TSS/acidratio				Anthocyanin				Chlorophyll			
		Season			Avg.	Season			Avg.	Season			Avg.	Season			Avg.	Season			Avg.
N	K_2O	1	2	3		1	2	3		1	2	3		1	2	3		1	2	3	
	50	15.0^{d}	15.5^{c}	16.0^{c}	15.5^{d}	0.81^{a}	0.72^{a}	0.75^{a}	0.76^{a}	18.5^{d}	21.5^{c}	21.3^{d}	20.4^{d}	0.69^{d}	0.61^{d}	0.60^{d}	0.63^{c}	34.3^{d}	33.6^{e}	35.1^{d}	34.4^{d}
10	100	15.5^{cd}	16.0^{c}	16.5^{bc}	16.0^{c}	0.75^{a}	0.70^{a}	0.75^{a}	0.73^{a}	20.2^{c}	22.6^{b}	22.0^{cd}	21.6^{c}	0.68^{d}	0.62^{d}	0.67^{d}	0.66^{e}	35.6^{d}	34.2^{e}	34.1^{d}	34.6^{d}
	150	16.5^{b}	16.0^{c}	17.0^{b}	16.5^{b}	0.76^{a}	0.72^{a}	0.74^{a}	0.74^{a}	21.7^{b}	21.7^{c}	23.3^{bc}	22.2^{c}	0.67^{d}	0.64^{d}	0.66^{d}	0.65^{e}	34.1^{d}	34.0^{e}	35.2^{d}	34.4^{d}
Avg.		15.7^{B}	15.8^{B}	16.5^{A}	**16.0^{B}**	0.77^{A}	0.71^{A}	0.75^{A}	**0.72^{A}**	20.1^{B}	21.9^{B}	22.2^{B}	**21.4^{B}**	0.68^{C}	0.62^{C}	0.64^{C}	**0.65^{C}**	34.7^{D}	33.9^{D}	34.8^{C}	**34.5^{D}**
	50	16.0^{bc}	16.5^{bc}	17.0^{b}	16.5^{b}	0.79^{a}	0.78^{a}	0.76^{a}	0.77^{a}	20.3^{bc}	21.2^{c}	22.4^{c}	21.3^{cd}	0.77^{c}	0.77^{c}	0.75^{c}	0.76^{d}	40.2^{c}	40.5^{d}	41.0^{c}	40.6^{c}
20	100	16.6^{b}	16.5^{bc}	17.0^{b}	16.5^{b}	0.79^{a}	0.70^{a}	0.76^{a}	0.75^{a}	20.3^{bc}	22.9^{b}	22.4^{c}	21.9^{c}	0.78^{c}	0.80^{c}	0.83^{b}	0.50^{c}	42.3^{c}	41.7^{c}	41.0^{c}	41.7^{c}
	150	16.5^{b}	16.5^{bc}	17.0^{b}	16.7^{b}	0.79^{a}	0.72^{a}	0.73^{a}	0.75^{a}	20.9^{b}	22.9^{b}	23.3^{bc}	22.4^{c}	0.83^{bc}	0.84^{bc}	0.86^{b}	0.84^{bc}	43.2^{c}	43.6^{c}	43.5^{c}	42.8^{c}
Avg.		16.2^{A}	16.5^{AB}	17.0^{A}	**16.6^{AB}**	0.79^{A}	0.73^{A}	0.75^{A}	**0.76^{A}**	20.5^{A}	22.3^{A}	22.7^{B}	**21.9^{B}**	0.79^{B}	0.82^{B}	0.81^{B}	**0.80^{B}**	41.9^{C}	41.9^{C}	41.8^{B}	**41.7^{C}**
	50	17.0^{ab}	17.0^{b}	17.1^{b}	17.0^{b}	0.77^{a}	0.77^{a}	0.75^{a}	0.76^{a}	22.1^{a}	22.1^{bc}	22.8^{c}	22.3^{c}	0.88^{b}	0.87^{b}	0.89^{b}	0.88^{b}	46.2^{b}	47.5^{b}	48.0^{b}	47.2^{b}
40	100	17.3^{a}	17.6^{ab}	18.0^{a}	16.7^{b}	0.75^{a}	0.74^{a}	0.73^{a}	0.74^{a}	23.1^{a}	23.8^{b}	24.7^{b}	23.9^{b}	0.95^{a}	0.94^{a}	0.98^{a}	0.96^{a}	47.2^{b}	47.5^{b}	48.0^{b}	47.2^{b}
	150	17.6^{a}	18.3^{a}	18.8^{a}	18.2^{a}	0.75^{a}	0.72^{a}	0.71^{a}	0.73^{a}	23.5^{a}	25.4^{a}	26.5^{a}	25.1^{a}	0.99^{a}	1.0^{a}	1.0^{a}	1.0^{a}	51.2^{a}	53.7^{a}	52.4^{a}	52.4^{a}
Avg.		17.3^{A}	17.4^{A}	17.6^{A}	**17.3^{A}**	0.76^{A}	0.74^{A}	0.73^{A}	**0.74^{A}**	21.7^{A}	23.8^{A}	24.7^{A}	**23.8^{A}**	0.94^{A}	0.94^{A}	0.96^{A}	**0.95^{A}**	48.2^{B}	50.2^{B}	50.1^{A}	**49.4^{B}**
60 control	120	16.2^{A}	17.0^{A}	17.3^{A}	16.8^{A}	0.77^{A}	0.74^{A}	0.71^{A}	0.74^{A}	21.0^{A}	23.0^{A}	24.4^{A}	22.8^{A}	0.79^{B}	0.75^{B}	0.76^{B}	0.77^{B}	52.9^{A}	55.6^{A}	53.8^{A}	54.1^{A}

Values with the same letter(s) are not significant at $p \leq 0.05$.

Table (5) : Effect of nitrogen and potassium fertilization on bud fertility, yield and some physical characteristics of Crimson Seedless grapes

Treatments		Bud fertility %				Number of clusters per vine				Cluster weight (g)				Berry weight (g)				Yield /vine			
		Season			Avg.	Season			Avg.	Season			Avg.	Season			Avg.	Season			Avg.
N	K_2O	1	2	3		1	2	3		1	2	3		1	2	3		1	2	3	
	50	27.5^{a}	28.8^{d}	28.8^{d}	28.4^{d}	22^{a}	23^{d}	23^{d}	22.7^{e}	392.4^{cd}	382.8^{d}	389.2^{d}	388.1^{d}	3.11^{c}	3.00^{c}	3.00^{b}	3.04^{d}	8.63^{b}	8.80^{d}	8.95^{d}	8.79^{c}
10	100	27.5^{a}	30.0^{d}	30.0^{cd}	29.2^{d}	22^{a}	24^{d}	24^{d}	23.3^{e}	396.7^{cd}	394.1^{c}	394.7^{cd}	395.2^{c}	3.00^{d}	3.10^{c}	3.10^{b}	3.07^{d}	8.73^{b}	9.46^{cd}	9.54^{cd}	9.22^{bc}
	150	28.8^{a}	30.0^{d}	31.3^{c}	30.0^{cd}	23^{a}	24^{d}	25^{cd}	24.0^{d}	388.1^{d}	395.3^{c}	395.9^{c}	393.1^{c}	3.11^{c}	3.15^{c}	3.17^{b}	3.14^{cd}	9.16^{a}	9.49^{c}	9.90^{c}	9.52^{b}
Avg.		27.9^{A}	29.6^{C}	30.0^{BC}	**29.2^{B}**	22.3^{A}	23.7^{BC}	24.0^{BC}	**23.3^{BC}**	392.4^{BC}	390.7^{CD}	393.3^{C}	**392.1^{C}**	3.07^{C}	3.08^{C}	3.09^{C}	**3.08^{C}**	8.84^{A}	9.25^{BC}	9.46^{C}	**9.18^{BC}**
	50	28.8^{a}	31.3^{cd}	31.3^{c}	30.5^{c}	23^{a}	25^{cd}	25^{cd}	24.3^{cd}	399.1^{cd}	398.9^{c}	398.7^{c}	398.9^{c}	3.20^{c}	3.26^{bc}	3.29^{b}	3.25^{c}	9.18^{a}	9.57^{c}	9.97^{c}	9.57^{b}
20	100	28.8^{a}	31.3^{cd}	32.5^{c}	30.8^{c}	23^{a}	25^{cd}	26^{c}	24.7^{c}	400.6^{c}	399.1^{c}	399.6^{c}	399.8^{c}	3.33^{bc}	3.35^{b}	3.37^{ab}	3.35^{b}	9.21^{a}	9.98^{c}	10.79^{c}	9.99^{b}
	150	28.8^{a}	33.8^{c}	33.8^{c}	32.1^{bc}	23^{a}	27^{c}	27^{c}	25.7^{c}	420.0^{b}	416.0^{b}	415.2^{b}	417.0^{b}	3.45^{b}	3.41^{b}	3.42^{a}	3.43^{b}	9.66^{a}	12.06^{b}	12.96^{b}	11.56^{a}
Avg.		28.8^{A}	32.1^{B}	32.5^{B}	**30.9^{B}**	23.0^{A}	25.7^{A}	26.0^{B}	**24.9^{B}**	406.6^{B}	404.7^{B}	404.5^{B}	**405.2^{B}**	3.33^{B}	3.34^{BC}	3.36^{B}	**3.34^{B}**	9.35^{A}	10.54^{B}	11.24^{B}	**10.37^{B}**
	50	27.5^{a}	37.5^{b}	38.8^{b}	34.4^{b}	22^{a}	30^{b}	31^{b}	27.7^{b}	427.0^{ab}	420.0^{ab}	415.5^{b}	420.8^{ab}	3.60^{ab}	3.55^{ab}	3.54^{a}	3.56^{a}	9.39^{a}	13.64^{ab}	13.71^{a}	12.25^{a}
40	100	27.5^{a}	41.3^{a}	43.8^{a}	37.5^{a}	22^{a}	33^{a}	35^{a}	30.0^{a}	430.0^{a}	422.0^{a}	428.3^{a}	426.8^{a}	3.65^{a}	3.60^{a}	3.60^{a}	3.62^{a}	9.46^{a}	13.93^{a}	14.29^{a}	12.56^{a}
	150	28.8^{a}	41.3^{a}	43.8^{a}	37.3^{a}	23^{a}	33^{a}	35^{a}	30.3^{a}	436.0^{a}	430.0^{a}	422.4^{a}	429.5^{a}	3.70^{a}	3.62^{a}	3.65^{a}	3.66^{a}	10.03^{a}	14.19^{a}	14.3^{a}	12.86^{a}
Avg.		27.9^{A}	40.0^{A}	42.1^{A}	**36.4^{A}**	22.3^{A}	32.0^{A}	33.7^{A}	**29.3^{A}**	$431\ 0^{A}$	424.0^{A}	422.1^{A}	**425.7^{A}**	3.65^{A}	3.59^{A}	3.60^{A}	**3.61^{A}**	9.63^{A}	13.92^{A}	14.12^{A}	**12.56^{A}**
60 control	120	27.5^{A}	28.8^{C}	28.8^{C}	28.4^{B}	22^{A}	23^{C}	23^{C}	22.7^{C}	388.0^{C}	384.1^{D}	387.3^{C}	386.5^{C}	$3\ 70^{A}$	3.72^{A}	3.75^{A}	3.72^{A}	8.54^{A}	8.83^{C}	8.91^{C}	8.76^{C}

Values with the same letter(s) are not significant at $p \leq 0.05$.

Furthermore, K fertilization with 45 kg K/ha increased yield. However, increasing K to 90 kg/ha had no significant effects. Also, the increase in yield may be due to the adequate supply of N which is necessary for inflorescence primordia formation and differentiation of flowers (Pérez-Harvey, 2000). The decrease in the yield in control treatment (60 kg N/feddan + 120 kg K_2O/feddan) may be due to the high rate of N which can result in the reduction of fruitfulness (Srinivasan and Millins, 1981) or the low bud fruitfulness caused by low light conditions (Pérez and Kliewer, 1990).

From the foregoing results, it is concluded that the fertilization of Crimson Seedless vines with 40 kg N/feddan + 100 kg K_2O/feddan was enough to increase yield with the suitable quality of grapes. In addition, this by its turn decrease, the amount of N fertilizer by 33% and K by 17%.

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تسميد عنب الكريمسون سيدلس بالنيتروجين والبوتاسيوم

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أضيفت مستويات مختلفة من السماد النيتروجيني + البوتاسي إلي كروم عنب الكريمسون اللابذري عمر ٥ سنوات المنزرع في تربة رملية ، استمرت التجربة لمدة ثلاث سنوات . كانت مستويات النيتروجين هي ١٠ ، ٢٠ ، ٤٠ كيلوجرام نتروجين/فدان ، احتوي كل مستوي من المستويات الثلاثة السابقة علي ثلاث مستويات من البوتاسيوم هي ٥٠ ، ١٠٠ ، ١٥٠ كيلوجرام أكسيد بوتاسيوم/فدان. وكانت المقارنة هي معاملة المزرعة : ٦٠ كيلوجرام نتروجين/فدان + ١٢٠ كيلوجرام أكسيد بوتاسيوم/فدان. إزدادت نسبة النيتروجين في أعناق الأوراق بزيادة كمية النيتروجين أو البوتاسيوم المضاف ، أما البوتاسيوم فقد إزداد نتيجة زيادة كمية البوتاسيوم المضاف. وقد وجد أن النيتروجين والبوتاسيوم يزدادان عند ١٥ يوم قبل التزهير ثم يأخذان في التناقص بعد ذلك أي عند التزهير ، العقد ، بداية النضج. ادت زيادة التسميد بالنيتروجين + البوتاسيوم إلي زيادة معنوية في متوسط عدد العناقيد للشجرة ومحصول الشجرة ووزن العنقود والحبة خصوصاً عند إضافة ٤٠ كيلوجرام نتروجين/فدان + ١٠٠ كيلوجرام أكسيد بوتاسيوم/فدان. لم تؤثر المعاملات علي الحموضة معنوياً، إلا أن الـ TSS إزداد معنوياً.

عند المعاملة ٤٠ كيلوجرام نتروجين + ٥٠ ، ١٠٠ ، ١٥٠ كيلوجرام أكسيد بوتاسيوم اتخذت نسبة TSS/acid اتجاهاً مماثلاً لإتجاه الـ TSS . زاد الكلوروفيل معنوياً بازدياد التسميد النيتروجيني + البوتاسي ، وكانت أعلي القيم ناتجة عن المقارنة ، ٤٠ كيلوجرام نتروجين/فدان + ١٥٠ كيلوجرام أكسيد بوتاسيوم/فدان. أما الأنثوسيانين فقد إزداد نتيجة المعاملة ٢٠ كيلوجرام نتروجين/فدان + ١٥٠ كيلوجرام أكسيد بوتاسيوم/فدان ، وكذلك ٤٠ كيلوجرام نتروجين/فدان + ٥٠ ، ١٠٠ ، ١٥٠ كيلوجرام أكسيد بوتاسيوم/فدان.

أوضحت الدراسة أن تسميد العنب صنف الكريمسون اللابذري بـ ٤٠ كيلوجرام نتروجين/فدان + ١٠٠ كيلوجرام أكسيد بوتاسيوم/فدان يعد كافياً لهذا الصنف كما يحقق خفضاً قدره ٣٣% في كمية النيتروجين ، ١٧% في كمية البوتاسيوم.