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CHEMICAL CONSTITUENTS OF GRAPEVINE FLAME SEEDLESS CHIP BUDDED ON THREE NEMATODE RESISTANT ROOTSTOCKS

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Abstract

The present study was carried out during two successive seasons of 2012 and 2013 in a private vineyard located at Sadat city, Menofia Governorate, Egypt. The main aim of this study is determining the chemical constituents such as carbohydrates, nitrogen, C/N ratio and nutrient contents as a result of grapevine Flame seedless Chip budded on three nematode resistant rootstocks. The chemical analysis illustrated that Freedom rootstock canes exhibited the greatest percentages of carbohydrates (39.53 and 39.86 %), total sugars (8.77 and 8.92 %), reducing sugars (7.45 and 7.57 %), non reducing sugars (1.32 and 1.35 %), polysaccharides (30.76 and 30.94 %), total nitrogen (1.16 and 1.19 %), soluble nitrogen (0.78 and 0.84), non soluble nitrogen (0.55 and 0.54 %), total indoles (0.29 and 0.30 mg/g F.W.) and free indoles (0.25 and 0.26 mg/g F.W.) for 2012 and 2013 seasons, respectively. The canes of Salt creek rootstock showed the largest C/N ratio (26.50 and 27.98) of 2012 and 2013 seasons respectively followed by Harmony rootstock (25.94 and 24.49). On the other hand, canes of Freedom rootstock exhibited the minimum values (23.5 and 22.9) in the two studied seasons, respectively. Leaf petiole of Flame seedless *cv.* grafted on Freedom rootstock in mid August in both seasons contained the greatest percentages of nitrogen (1.74 and 1.78 %), phosphorous (0.35 and 0.38 %), potassium (1.35 and 1.39 %), calcium (1.86 and 1.89 %), magnesium (0.55 and 0.57 %), manganese (38.8 and 45.2 ppm) and zinc (23.7 and 25.8 ppm). While, those grafted on Harmony rootstock contained the lowest percentages of nitrogen (1.48 and 1.50 %), phosphorous (0.17 and 0.19 %), potassium (1.19 and 1.22 %), calcium (1.49 and 1.51 %), magnesium (0.32 and 0.35 %), manganese (31.5 and 33.8 ppm) and zinc (19.7 and 22.1 ppm). In addition, leaf petiole of Flame seedless *cv.* grafted on Harmony rootstock contained the greatest iron content (117.10 and 124.33 ppm) in 2012 and 2013 seasons, respectively. Whereas, leaf petiole of the same scion grafted on Freedom rootstock showed the lowest figures iron content (79.42 and 79.85 ppm) in both seasons, respectively. On the other hand, leaf blade of Flame seedless *cv.* grafted on Harmony rootstock contained the greatest boron (66.13 and 62.72 ppm), sodium (0.36 and 0.33 %), chloride (1.06 and 1.03 %). While, those grafted on Freedom of both seasons exhibited the lowest values of boron (53.06 and 50.66 ppm), sodium (0.28 and 0.27 %), and chloride (0.99 and 0.95 %).

Key words: Flame seedless - Salt creek – Freedom -Harmony

Introduction

The present experiment dealt with the summer grafting using Chip budding technique (Yema budding) of Flame seedless *cv.* on Nematode resistant rootstock namely, Freedom, Harmoney and Salt creek in one date only (mid August) of 2012 and 2013 seasons, to discuss and interpret the obtained results, different chemical analyses were carried out such as the status of the nutritional and growth active substances of different rootstocks at the time of grafting, as well as growth parameters and the leaf mineral content of the scion. Cook and Lider (1964) found that the rootstocks had an effect on contents of K+ and P, where were higher in petioles of St. George rootstock than of 99-R rootstock. Furthermore, Hiroco *et al.,* (1970) postulated that the rootstock significantly affected the scion leaf content of N, P, K, Ca and Mg. The highest N content occurred in plants grafted on Rupestris du Lot, IAC313 and Golia. Phosphorus content was highest with Rupestris du Lot and Golia. Berlandieri × Reparia 420A produced the lowest K content. Danailov (1971) reported that the scion leaf content of N and k were highest on Kober 5BB rootstock, lowest on Chasselas x Berlandieri 41B and intermediate on Rupestris du Lotrootstock, while the leaf P were not affected by the rootstock. Filipp *et al.,* (1983) found that the leaf N, P and K content were differed significantly in Moldova and Dekabrskii vine cvs. that

grafted on Chasselas x Berlandieri Kober 5BB roostocks.

Bhargava *et al.,* (1984) demonstrated that the N content of petiole was highest percentage (1.26 %) of Anab-e-Shahi that grafted on Dog Ridge rootstock. In addition, Ulicevic and Pojovic, (1984) grafted Vranac on 6 rootstocks (Rupestris du Lot, Ruggeri 140, Kober 5BB, Paulsen 1103, Richter 110 and Richter 99). The leaf N content of Vranacwas the lowest when grafted on R99 and higher on P1103, Ru140 and Rdu Lot rootstocks. Phosphorus was higher in Vranac that grafted on Rdu Lot and on P1103 than on K51313 or R99. Potassium content was the most affected by rootstocks. El-Hawary (1987) investigated the effect of different 4 rootstocks cuttings (ARG, Berlandieri × Reparia, Romi Red and Couderc 1202) on their mineral contents. He stated that the highest leaf petiole mineral contents of N and K were attained by ARG stock and the P content was higher in ARG and Couderc than the other rootstocks. Simac *et al.,* (1990) studied the grafting effect of Granesh and Corignan vines on R99, Paulsen 1103 and Berlandier x Chasselas 4113 rootstocks. They found that leaf K content was differed considerably according to the rootstocks and cultivars. In addition, the K ratio was much higher in the leaves of Carignan *cv.* than Granech. On the other hand, the K:Mg ratio was lower in leaves of Carignan. Also, Volpe and Boselli (1990) stated that variousvine rootstocks appeared to influence the leaf content of N, P and K in the scions. They grafted Grenache and Coriganan vines on R99, Paulsen 1103 and (Berlandier x Chasselas 4113). The leaf K content was differed considerably according to the rootstocks and cultivars. Ruhl (1991) showed that the grafting of Djandjal Kare vines on Freedom rootstock lead to an increase of K content in the scion parts whereas it was decreased when grafted on 1103 Paulsen stock.

On August 15th in both seasons, one year old transplants of the three studied rootstocks were grafted with Flame seedless *cv.*, buds using the Chip budding technique.The main aim of this study is determining the chemical constituents such as carbohydrate, nitrogen, C/N and nutrient contents as a result of this treatment.

Materials and Methods

The present study was carried out during two successive seasons of 2012 and 2013 in a private vineyard located at Sadat city, Menofia Governorate, Egypt.

Chip budding of Flame seedless *cv.* on the three studied Nematode resistant rootstock. On August 15th in both seasons, one year old transplants of the three studied rootstocks were grafted with Flame seedless *cv.*, buds using the Chip budding technique. Chemical studies were done on one year-old canes before grafting dates of all rootstocks under investigation. For the present study, samples of about 10g. f. wt. were dried in air-oven at 70°C until constant wt. then ground and used for total carbohydrates and total nitrogen, soluble and non-soluble content determination. While for total sugars, reducing, non-reducing and polysaccharides content (%).

1. Total carbohydrates content (%) were determined at one year-old canes before grafting, about 100 mg of dried sample according to Hedge and Hofreiter, (1962).

2. Total sugars, reducing, non-reducing and polysaccharides content (%) were determined at one year-old canes before grafting, About 0.5 g of dry weight samples were determined calorimetrically according to the method of Smith *et al*., (1956) and the concentrations were calculated as g. glucose per 100 g dry weight.

3. Total nitrogen, soluble and non-soluble content (%) were estimated by using the modified Micro-kjeldahl method as described by Pregl, (1945) and Plumer, (1971). The total nitrogen of dried canes were determined using Kjeldahl method.

4. C/N ratio was calculated by dividing total carbohydrates content by total nitrogen content.

Nutrients contents of N, P, K, Ca, Mg, Fe, Zn, Mn, B, Na and Cl in scion leaves.

Leaf samples for all nutrients were taken in mid August from petioles of the 5th apical leaf of scion except for Boron which taken from leaf blade. This sampling date was adapted in the first and second experiments. But in the third experiment, leaf samples were taken in the first week of Oct. in both season (after two months of budding). Samples were digested using sulphoric acid and hydrogen peroxide according to (Parkinson and Allen, 1975) then the following determinations were carried out.

1. Total nitrogen (%) was determined in the digest solution by using the modified micro-kieldahl method as described by Pregl (1945) and Plumer (1971).

2. Total phosphorous (%) was determined in the acid digest; calorimetrically using Spectrophotometer using the chlorostomanous according to Jackson (1985) and Champmanand Pratt (1978).

3. Total potassium (%) was determined against a standard by using Flame photometer according to the method of Brown and Lilleland (1946) and Piper (1950).

4. Total calcium (%) was determined using an atomic absorption spectrophotometer according to Piper (1950).

5. Total magnesium (%): according to Mikhail (1976).

6. Total iron (ppm): according to A.O.A.C. (1985).

7. Total manganese (ppm): according to Bovay (1956).

8. Total zinc (ppm): according to Moti Singh and Chandhry (1948).

9. Total boron (ppm): according to Sullivan (1965).

10. Total sodium (%): according to Cook and Lider (1964).

11. Total chloride (%): according to Jackson (1985).

Statistical analysis

The statistical analysis of the present data was carried out using Analysis of Variance (ANOVA) according to Snedecor and Chocran (1990). The averages were compared using Duncan Multiple range test (Duncan, 1955) at 5 % level.

Results and Discussion

As shown in table 1 Freedom rootstock canes exhibited the greatest figures of total carbohydrates (39.53 and 39.86 %), total sugars (8.77 and 8.92 %), reducing sugars (7.45 and 7.57 %), nonreducing sugars (1.32 and 1.35 %) and polysaccharides (30.76 and 30.94 %) in the two following seasons, respectively. On the contrary, Harmony canes exhibited the minimum values of total carbohydrates (30.09 and 29.14 %), total sugars (6.74 and 7.22 %), reducing sugars (5.53 and 5.97 %), non-reducing sugars (1.21 and 1.25 %) and polysaccharides (23.35 and 21.92 %) in the two studiedseasons, respectively. However, differences in all the consideredparameters between Freedom and Salt creek rootstocks areinsignificant in both seasons.

Table 1: Total carbohydrates, sugars, Reducing sugars, Non - Reducing sugars and Polysaccharide Content (%) in canes of various studied rootstocks in mid August of 2012 and 2013 seasons.

Grafting date / Rootstocks		Total carbohydrates %	Total sugars %	Reducing sugars %	Non-Reducing sugars %	Polysaccharides %
2012	Freedom	39.53A	8.77A	7.45A	1.32A	30.76A
	Harmony	30.09B	6.74B	5.53A	1.20B	23.35B
	Salt creek	35.24AB	8.14A	6.82A	1.32A	27.10AB
2013	Freedom	39.86A	8.92A	7.57A	1.35A	30.94A
	Harmony	29.14B	7.22B	5.97B	1.25B	21.92B
	Salt creek	36.37AB	8.27AB	6.83AB	1.44A	28.10AB

Means having the same letter (s) in each Colum or row are in significantly different at 5%level.

Table 3: Total nitrogen ,phosphorous, potassium, calcium, and magnesium (%) in leaf petiole of Flame seedless scion grafted on the three studied rootstock with Chip budding method in mid August of 2012 and 2013.

Grafting date / Rootstocks		Total nitrogen%	Phosphorous %	Potassium%	Calcium%	Magnesium%
2012	Freedom	1.74A	0.35A	1.35A	1.86A	0.55A
	Harmony	1.48A	0.17B	1.19B	1.49B	0.32B
	Salt creek	1.54A	0.30A	1.28AB	1.64B	0.39B
2013	Freedom	1.78A	0.38A	1.39A	1.89A	0.57A
	Harmony	1.50A	0.19B	1.22A	1.51C	0.35B
	Salt creek	1.61A	0.33A	1.31A	1.68B	0.43B

Means having the same letter (s) in each Colum or row are in significantly different at5%level.

As shown in table 2 canes of Freedom rootstock exhibited the largest total N content (1.68 and 1.74 %), soluble nitrogen (0.78 and 0.84 %) and non-soluble nitrogen (0.90 and 0.90) while, canes of Salt creek rootstock exhibited the largest C/N ratio (26.50 and 27.98) in 2012 and 2013 seasons, respectively. On the other hand, canes of Harmony rootstock showed the minimum values of total N content (1.16 and 1.19 %), soluble nitrogen (0.65and 0.67) and non-soluble nitrogen (0.51 and 0.54 %). While, canes of Freedom rootstock recorded the minimum values of C/N ratio (23.53 and 22.91) in both seasons, respectively.

As shown in table 3 leaf petiole of Flame seedless *cv.* grafted on Freedom rootstock in mid-August contained the greatest nitrogen (1.74 and 1.78 %), phosphorous (0.35 and 0.38 %), potassium (1.35 and 1.39 %), calcium (1.86 and 1.89 %) and magnesium (0.55 and 0.57 %) in 2012 and 2013 seasons, respectively. However, no significant differences were detected in all the studied rootstocks in leaf N content as well as between Freedom and Salt creek rootstock in leaf P and K contents in both seasons.

Table 2: Nitrogen content % and C/N ratio in canes of various studied rootstocks in mid August of 2012 and 2013 seasons.

Grafting date / Rootstocks	2012				2013			
	Total nitrogen %	Soluble nitrogen %	Non- Soluble nitrogen %	C/N ratio	Total nitrogen %	Soluble nitrogen %	Non- Soluble nitrogen %	C/N ratio
Freedom	1.68A	0.78A	0.90A	23.53B	1.74A	0.84A	0.90A	22.91C
Harmony	1.16C	0.65B	0.51B	25.94A	1.19B	0.67B	0.54B	24.49B
Salt creek	1.33B	0.75A	0.58B	26.50A	1.30B	0.77B	0.53B	27.98A

Means having the same letter(s) in each Colum or row are in significantly different at5%level.

Table 4: Total iron, manganese, and zinc (ppm) in Leaf petiole of Flame seedless scion grafted on the three studied rootstock with Chip budding method in mid August of 2012 and 2013.

Grafting date	Rootstocks	Iron (ppm)	Manganese (ppm)	Zinc (ppm)
2012	Freedom	79.42B	38.84A	23.73A
	Harmony	117.10A	31.47B	19.70B
	Salt creek	105.19AB	35.88AB	21.68AB
2013	Freedom	97.85B	45.15A	25.84A
	Harmony	124.33A	33.77B	22.09A
	Salt creek	111.16AB	37.65B	23.83A

Means having the same letter(s) in each Colum or row are in significantly different at 5%level.

Table 5: Sodium, Chloride (%) in leaf petiole and Boron (ppm) in leaf blade of flame seedless scion grafted on the three studied rootstock with Chip budding method in mid August of 2012 and 2013 seasons.

Grafting date	Rootstocks	Sodium %	Chloride %	Boron (ppm)
2012	Freedom	0.28B	0.99 A	53.06 B
	Harmony	0.36 A	1.06 A	66.13 A
	Salt creek	0.30 B	1.01 A	54.97 B
2013	Freedom	0.27 B	0.95 A	50.66 B
	Harmony	0.33 A	1.03 A	62.72 A
	Salt reek	0.29 B	0.98 A	53.64 B

Means having the same letter (s) in each Colum or row are in significantly different at 5% level.

Data present in table 4 clearly indicated that leaf petiole of Flame seedless *cv.* grafted on Harmony rootstock contained the greatest iron content (117.10 and 124.33 ppm) in 2012 and 2013 seasons, respectively. Whereas, leaf petiole of the same scion grafted on Freedom rootstock showed the lowest Fe content (79.42 and 97.85 ppm) in both seasons, respectively. On the other hand, leaf petiole of Flame seedless *cv.* grafted on Freedom rootstock contained the greatest manganese content (38.84 and 45.15 ppm) and zinc (23.73 and 25.84 ppm) in 2012 and 2013 seasons, respectively opposite to leaf petiole of the same scion grafted on Harmony rootstock (31.5 and 33.8 ppm) for Mn (19.70 and 22.09 ppm) for Zn in the two studied seasons, respectively. However, differences in leaf Fe and Zn contents between the first and third rootstock were negligible in both seasons.

As shown in table 5 scion leaves exhibited the lowest amounts of Na (0.28 and 0.27 %), Cl (0.99 and 0.95 %) and B (53.06 and 50.66 ppm) in both seasons when the scion was grafted with chip method on Freedom rootstock. The opposite was shown when the grafting was done on Harmony rootstock [(0.36 and 0.33%), (1.06 and 1.03%) and (66.13 and 62.72 ppm)] for Na, Cl and B, respectively. However, differences in the three studied nutrients between Freedom and Salt creek rootstock are insignificant in both seasons.

The obtained results proved that Freedom rootstock exhibited the greatest chemical constituents in comparing with the other studied rootstocks namely Harmoney and Salt creek.

The chemical analysis illustrated that Freedom rootstock canes exhibited the greatest percentages of carbohydrates, total sugars, reducing sugars, non reducing sugars, polysaccharides, total nitrogen,soluble nitrogen, non soluble nitrogen, total indoles and free indoles for 2012 and 2013 seasons, respectively.

Leaf petiole of Flame seedless *cv.* grafted on Freedom rootstock in mid August in both seasons contained the greatest percentages of nitrogen, phosphorous, potassium, calcium, magnesium, manganese and zinc.

On the other hand, leaf petiole of the same scion grafted on Freedom rootstock showed the lowest figures of iron content, boron, sodium and chloride in both seasons in comparing with the other studied rootstock.

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