Comparison of plant nutrients in the soil solution and bleeding sap of grapevine cvs.

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ABSTRACT :

In this study macro and micro nutrients of plants (N=NH_4 +NO_3 , P, K, Ca, Na, Zn, Mn, Fe and Cu) were determined both in soil solution and bleeding sap and compared each other. Bleeding sap was collected from the nine varieties of grapevine Cvs. grafted on 5BB rootstock and grown in different soil conditions. For all varieties, plant nutrients content in bleeding sap as higher than in soil solution exceptfor Ca and Na. While in soil solution Ca content was found at 10209 ppm, this value in bleeding sap was 49.20 ppm (Kozak Beyazý), 55.38 ppm (Trakya Ýlkeren), 50.37 (Cardinal) and 74.27 ppm (Tekirdað Çekirdeksizi) respectively. For the same varieties the Na values were as follows : 7.16 ppm (in soil solution) : 4.8, 3.23, 4.21, 4.58 ppm (in bleeding sap) respectively. K content in bleeding sap was higher than in soil solution for a few varieties, and lower in some varieties. Traces of Fe and Cu were found in both media.

INTRODUCTION

Near the end of winter or beginning of spring, the vine may exhibit the phenomenon of bleeding. If a cane is cut, liquid flows from the xylem tissues. More than a gallon can be collected from one cut cane. If the cane tips of a vine are cut off every day from 18.9 to 26.5 litres can be collected (9). The rate of exudation depends considerably on prevailing metabolic conditions. It decreases under the effects of inhibitors of anaerobiosis which depress metabolically mediated ion uptake. The rate of exudation is also influenced by the presence of specific ion species and their concentration in the nutrient solution (8). Mengel and Pflüger (7) found highest exudation rates when KCL was present in the external solutions due to the fact that both K^+ has a promotive effect on the water uptake and transport (7). Bleeding has no harmful effect on the vine (9).

Bleeding depending on the activity of living root cells and the pressure generated in the xylem vessels is termed root pressure. The usual mechanism of water absorption by vines root results from osmotic movement of water into roots. When soil solutes accumulate in the cell sap, water moves into the cells from the water in the solution (11). Nutrients or solutes may enter the root cells from the soil by diffusion which is movement from a location of high solute activity to one of lower activity. Root cells can accumulate nutrients in their vacuoles in concentration far higher than that in the soil solution. Movement of most mineral nutrients occurs in the vessels of the xylem and it is usually upward (9,11).

Many researches have reported that bleeding sap contain organic, inorganic substances and phytohormones. The composition of the bleeding sap changes according to the rootstocks and grape varieties. Chemical investigations of the bleeding sap were employed to quantify diurnal and temporal changes in the composition of xylem exudate. The maximum of water flux (8.2 - 18.5 ml/h) and solute flux (0.7-2.2 mM/h) took place at midday and minimum at night according to the soil temperature. The main inorganic substances are NH_4 (0.4-2.2 mM), Ca (0.9-2.2 mM) and K (0.2- 1.8 mM) for a total inorganic concentration of 2.6-6.1 mM (4).

The water flux (jv) osmotic potential (ψ) and total solute flux (js) for 4 cvs of *Vitis rotundifolia* (Fry, Noble, Cowart and Jumbo) grapevines were determined from the exudate of cut spurs. Authors concluded that there exists a circadian rhythm in water flux and solute flux exudating grapevines (1). The results are discussed on a physiological basis but also with respect to the fact that the xylem exudates serves as an indicator of the vine nutrient status (2). The rate of bleeding varied greatly with pruning date and its maximum coincided with bud break in cvs. The chemical profile changed markedly with pruning date (3). Laboratory and field experiment on xylem fluid chemistry of cvs Noble and Suwannee during budbreak are reported in view of fertilization effects. In Suwannee, water flux, xylem fluid osmolarity, solute flux and concentration of NH_4 , NO_3 organic acids and sugar in xylem exudate were no altered 3 weeks after field fertilization, while amino acid profile was changed (5).

The temporal qualitative and quantitative characteristics of xylem exudates from Chardonnay vines grown under controlled conditions were studied. K was the main mineral ion (7.3 mM) followed by Ca, P, NO_3 , SO_4, Mg and Cl (2.6, 2.5, 2.3, 1.6, 0.5 and 0.15 mM respectively). Mineral ion concentration remain fairly constant during the 1 week period of exudate collection except for K which increased constantly (6).

The influence of different cover crops on the quantity of bleeding sap was investigated as well as NO_3 content of soil, soil solution and bleeding sap. The results show the NO_3-N concentration in the bleeding sap being closely correlated with the NO_3-N concentration in the soil solution at high and normal levels of N fertilization. At a level lower than 200 µmol NO_3-N in the bleeding sap an additional N fertilization is recommended (10).

The purpose of this study was to determine macro and micro nutrients in soil solution and bleeding sap of grapevine cvs. and compare each them in different soil conditions.

MATERIALS AND METHODS

For the experiment, 9 cvs (Kozak Beyazý, Trakya Ýlkeren, Cardinal, Tekirdað Çekirdeksizi, Çavuþ, Amasya Beyazý, Hamburg Misketi, Semillion, Cabernet Sauvignon) grafted on 5BB rootstock were selected. At the time of bleeding, four canes were selected from each vine and pruned to spur. Plastic bags were placed at tips of the short-pruned canes to collect the bleeding sap from the vines. Soil samples were taken for each cv and four analyses were made both for soil solutions and bleeding sap samples for each variety. These were accepted as replications to do analyses of variance. All the samples were analysed for total N (NH_4 + NO_3), P, K, Ca, Na, Zn, Mn, Fe and Cu. Analytical results of solutions were compared with those of bleeding sap.

RESULTS AND DISCUSSION

The data obtained from the soil solution and bleeding sap samples are presented and summarised in table 1.

In all varieties plant nutrients content in bleeding sap was higher than in soil solution except for Ca and Na. While in soil solution Ca content was found at 10209 ppm, this for Ca in bleeding sap was only 49.2 ppm (Kozak Beyazý), 55.38 ppm (Trakya Ýlkeren), 50.37 (Cardinal) and 74.27 ppm (Tekirdað Çekirdeksizi) respectively. In the same varieties this values for Na were as follows : 76.16 ppm (in soil solution) ; 4.8, 3.23, 4.21 and 4.58 ppm (in bleeding sap respectively. K content in bleeding sap was higher than in soil solution as seen in the table 1 for Kozak Beyazý (139.27 ppm). Tekirdað Çekirdeksizi (121.04 ppm), Çavuþ (108.1 ppm) and Hamburg Misketi (218.6 ppm) varieties. On the contrary K content in bleeding sap was less than in soil solution for Cardinal (49.17 ppm). Amasya Beyazý (60.26 ppm), Semillon (84.14 ppm) and Cabernet Sauvignon (68.76 ppm) varieties.

Plant nutrients concentration in bleeding sap being closely correlated with the levels of the soil solution. In this experiment inorganic ion composition of xylem saps such as Ca, Na, Zn, Mn, Fe and Cu were higher than in the soil solution as a result of excessive accumulation in xylem sap. Root cells can accumulate nutrients in their vacuoles in concentration far higher than in the soil solution.

Table 1. Comparison of Plant Nutrients in the Soil Solution and Bleeding Sap of GrapeVine Cvs.

Varieties	N (ppm) (NH_4+NO_3)		P (ppm)		K (ppm)		Ca (ppm)		Na (ppm)		Zn (ppm)		Mn (ppm)		Fe (ppm)		Cu (ppm)	
	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S	B	S
1. Kozak Beyazý	122.40 b	19.96 i	13.13 e	7.57 g	139.27 c	76.03 h	49.20 l	10209 a	4.80 e	7.16 b	0.31 cd	0.37 b	0.01 h	0.02 gh	Trace	Trace	Trace	0.88
2. Trakya Ýlkeren	48.40 d	19.96 i	19.65 c	7.57 g	74.73 f	76.03 h	55.38 i	10209 a	3.23 j	7.16 b	0.19 g	0.37 b	0.30 c	0.02 gh	Trace	Trace	Trace	0.88
3. Cardinal	121.50 a	19.96 i	30.75 a	7.57 g	49.17 l	76.03 h	50.37 k	10209 a	4.21 g	7.16 b	0.34 bc	0.37 b	0.13 e	0.02 gh	Trace	Trace	Trace	0.88
4. Tekirdað Çekirdeksizi	91.20 c	19.96 i	10.63 f	7.57 g	121.04 d	76.03 h	74.27 g	10209 a	4.58 e	7.16 b	0.26 de	0.37 b	0.07 fg	0.02 gh	Trace	Trace	Trace	0.88
5. Çavus	42.70 e	13.30 j	7.30 gh	6.86 h	108.10 b	84.32 f	52.00 j	7790.3 b	4.22 f	3.54 h	0.24 ef	0.17 g	0.07 fg	4.02 a	Trace	Trace	Trace	0.37
6. Amasya Misketi	32.33 g	13.30 j	5.62 i	6.86 h	60.26 k	84.32 f	93.10 d	7790.3 b	3.23 i	3.54 h	0.30 cd	0.17 g	0.02 gh	4.02 a	Trace	Trace	Trace	0.37
7. Hamburg Misketi	35.60 f	13.30 j	15.49 d	6.86 h	218.60 a	84.32 f	57.70 h	7790.3 b	5.80 c	3.54 h	0.24 ef	0.17 g	0.13 e	4.02 a	Trace	Trace	Trace	0.37
8. Semillon	47.80 d	13.30 j	25.61 b	6.20 i	84.14 g	164.62 b	83.11 f	6440 c	5.37 d	3.54 h	0.19 fg	0.46 a	0.11 ef	2.11 b	Trace	Trace	Trace	1.13
9 Cabernet Sauvignon	30.30 h	13.30 j	6.12 i	6.20 i	68.76 j	164.62 b	75.17 f	6440 c	2.93 k	3.54 h	0.08 h	0.46 a	0.22 d	2.11 b	Trace	Trace	Trace	1.13

Separation of means is based on Duncan's test. Means with the same letter do not differ significantly. Significance at %5 level. Each mean is average of four replications.
B= Bleeding sap ; S= Soil solution

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