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BRIEF COMMUNICATIONS

MINERAL AND ORGANIC NUTRIENTS IN SIEVE TUBE EXUDATE AND XYLEM VESSEL SAP OF QUERCUS RUBRA L.

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On October 10, 1974, sieve tube exudate samples were collected from a small number of 16–20 years old *Quercus rubra* trees growing in the woods near Lunteren. The method of collection was the one described by HARTIG (1858) and applied by MÜNCH (1930). Small cuts were made in the bark at a height of about 1.7 m and exuding drops were picked up with hard-glass capillaries.

On October 27, when about half of the leaves had dropped, two of the trees were almost completely cut off at a height of 1.8 m. The tree parts above the cuts came down and their branches were chopped away, leaving stem parts of about 4 m length partly connected with the bottom parts of the stems but making an angle with them in a downward direction. From the lowest wound surface a water-like fluid flowed out the wood with a rate of about 25 ml in 20 min. The first ml were disregarded as they contained some saw dust and other contaminants of the cut surface. The fluid collected in this way is considered to represent the xylem vessel contents, which due to the very wet autumn, the early dropping of the leaves and the probably still active root system was apparently abundantly present in the wide xylem vessels. One week later, under similar weather conditions, only 2 ml could be collected from one of the two trees cut down for this purpose.

Although sieve tube exudates of many woody plants have been described in literature (e.g. MÜNCH 1930, HUBER 1956, ZIEGLER 1956, CRAFTS & CRISP 1971) little information exists on their mineral composition. Xylem vessel saps have also often been investigated by a number of authors (for a review e.g. BOLLARD 1960). With the exception of xylem exudates from decapitated root systems, they have seldom been obtained without an externally applied pressure or suction. Such saps may be contaminated by the contents of living cells. For climbers a simple emptying of their very wide vessels following double cutting has been described (MOLISCH 1898; GESSNER 1956, 1965) but no detailed analyses of such saps have been reported. FIFE et al. (1962) have compared xylem and sieve tube fluid of sugar beet, but their analyses did not include the various inorganic ions.

Both the sieve tube exudate and the xylem vessel fluids were analysed by standard laboratory methods. The results, presented in the table, have led to the following conclusions:

Table 1. Nutrients in xylem vessel sap and sieve tube exudate of *Quercus rubra* L.

	Xylem vessel sap		Sieve tube exudate
	I	II	
pH	4.9–5.0	4.9–5.0	7.5
electric conductivity (10^{-4}Ohm^{-1}cm^{-1}, 25 °C)	593	672	2750
dry matter content, mg/ml		1.4	220
idem, mg/g fresh weight		1.4	204
sucrose, mg/ml		0.128	140
reducing sugars, mg/ml		0.299	38
ash, mg/ml		0.476	4.88
idem, mg/g dry weight		334	22.2
potassium, mg/ml	0.170	0.177	2.10
idem, mg/g ash		377	431
sodium, mg/ml	0.0018	0.0040	0.037
idem, mg/g ash		8.4	7.5
calcium, mg/ml	0.0175	0.0180	0.049
idem, mg/g ash		38	10
magnesium, mg/ml	0.010	0.0115	0.077
idem, mg/g ash		24	15.7
phosphorus, inorganic and labile, mg/ml	0.011	0.005	0.052
idem, total, mg/ml		0.005	0.219
idem, total, mg/g ash		9.45	44.8
nitrogen, Kjeldahl, mg/ml		0.055	6.58
idem, mg/g dry weight		40	29.9

1. The xylem vessel sap is unlikely to be contaminated with appreciable amounts of sieve tube exudate since the total solute and sucrose contents of the latter are about 150 and 1100 times higher than of the xylem sap.
2. the ionic composition of the sieve tube exudate cannot be derived from a contamination with xylem sap, as for example a 10% contamination (on a volume basis) would only give a change in total minerals of the sieve tube exudate of about 1%, but would also mean that the dry matter content of the sieve tube fluid would be 10% higher than the actually found high value.
3. On an ash-weight basis the K, Na, and to a less extent, the Mg contents of the sieve tube exudate and the xylem vessel fluid are similar, while the Ca content of the xylem sap is about five times that of the sieve tube exudate.
4. The xylem sap contains only inorganic or possibly some labile P-compounds, while the sieve tube exudate contains about 60 times more, mainly stable organic P-compounds.
5. The sieve tube exudate is very rich in nitrogenous substances, a phenomenon well known for *Quercus* sieve tube exudates collected in the autumn (ZIEGLER 1956).
6. With respect to both the carbohydrates and the inorganic solutes the sieve tube exudate of *Quercus rubra* has a composition very similar to that of the palm *Arenga saccharifera* Labill, and the Agavacea *Yucca flaccida* Haw

(VAN DIE 1974), the Euphorbiacea *Ricinus communis* (VAN GOOR & WIERSMA 1974) and the Leguminosae *Spartium junceum* and *Lupinus albus* (PATE et al. 1974).

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