The Journal of Animal & Plant Sciences, 21(4): 2011, Page: 730-733
ISSN: 1018-7081

NUTRIENT CONTENTS OF 140 RUGGERI ROOTSTOCK CANES IN DORMANT SEASON

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ABSTRACT

This research was carried out to ascertain if there were significant differences in the mineral contents of 140 Ruggeri (140 Ru) canes collected during dormant period. Cuttings of the rootstock 140 Ru prepared for propagation of grafted grapevines were profiled for their mineral contents during two dormant seasons. Cuttings were sampled at four different times starting from leaf fall and divided into five sections. Mineral content changes in the dormant season and along the length of the canes were found to be significant to a limited extent (P value=0.05). The results showed that mineral content in 140 Ru rootstock canes slightly varied with sampling time and sampling section.

Key words: Grapevine, rootstock, cutting, minerals, 140 Ruggeri.

INTRODUCTION

Grape rootstock cuttings are prepared from one year old woods and contain four nodes. Rooting ability of a rootstock differs with the species, IBA (indole-3-butyric acid) concentration and biochemical composition of the mother vines (Satisha *et al.,* 2007). Belonging to different *Vitis* species, grape rootstocks vary in their storage of reserve nutrients and biochemical compositions (Satisha *et al.,* 2008). Carbohydrates stored in the canes are an indication of the health and vigor of the previous season's growth (Balasubrahmanyam *et al.,* 1978). High quantities of carbohydrates and nitrogen reserves such as starch increase the potential for callusing. The mineral content of the wood will eventually affect the growth of stocks in the nursery (Dardeniz, 2001).

In their previous works, Dardeniz *et al.* (2007, 2008) determined the best time and cane sections of 140 Ru to collect and use for propagation purposes. This research was conducted to determine if there were significant differences in the mineral contents of one-year old 140 Ru canes collected during four different dormant period and five sections.

MATERIALS AND METHODS

Cuttings of 140 Ru rootstock were taken during two dormant periods from the Fruit Propagation Station in Çanakkale, Turkey. All mother rootstock vines were managed the same in irrigation, fertilization, soil management, pruning and disease controlling. The vines were on the ground and spaced 2x2 m apart. Canes were randomly chosen on the basis of equal thickness. Eight canes about 4-6 m long per vine were selected and cut at four different times with fifteen days apart starting from the leaf fall (80% defoliation). They were later sectioned into 4-node segments from base to tip of the canes (nodes of 1-4, 5-8, 9-12, 13-16, and 17-20). The soil was sampled for analysis from the depths of 0-30, 30-60, 60-90 cm and found that it was loamy with pH around 7.5-8.0, low in organic matter, salinity, nitrogen and phosphorus and adequate in potassium. The trial was designed in randomized parcels with four replicates and three vines per replicate.

Cane segments were dried, ground and dried again according to Kacar and İnal, (2008). Phosphorus (P), potassium (K), copper (Cu), iron (Fe), magnesium (Mg), manganese (Mn), sodium (Na), and zinc (Zn) readings were done in ICP-AES (Inductively Coupled Plasma-Atomic Emission Spectroscopy) after wet digestion with CEM (Chemist, Electrical engineer, and Mechanical engineer) Microwave Digestion System in a microwave oven with nitric acid (HNO_3 65%, d=1.42) and hydrogen peroxide (30%). Carbon and nitrogen was read in an elemental C/N analyzer (LECO CN-2000, LECO Corporation, St. Joseph, MI) according to Dumas method (Horneck and Miller, 1998). Calibration was done with standard EDTA at the beginning and every other 30 samples. The carbon/nitrogen (C/N) ratio was derived using the respective values for carbon and nitrogen. The analysis for reducing sugar content was performed according to the dinitrophenol method (Ross, 1959). Sugar content (g $100ml^{-1}$) was obtained from the readings at 600 nm in ultraviyole-visible (UV-vis) spectrophotometer (model UV-1208, Shimadzu Inc., Japan). The control used for the experiments was made of 6 ml dinitrophenol and 2 ml distilled water.

The data obtained in two consecutive dormant seasons were pooled before statistical analysis in order to determine the effect of the collection time and nodal sections on macro- and micro nutrient contents. Analysis of variance test was performed with Minitab statistics program (Windows version 14), and differences among the means were compared using Duncan's multiple range test (Duncan, 1955). Interaction between time of collection and nodal sections was found to be insignificant, and therefore not reported.

RESULTS

Nutrient reserve of the canes of 140 Ru showed almost no significant changes depending on their nodal sections (Table 1). Nitrogen (N), sodium and carbon/nitrogen (C/N) ratio showed differences (P=0.05). Nitrogen contents of the canes were similar in the middle and upper sections. Basal section (1^{st}- 4^{th}) had lower amount of N compared to more upper parts (5^{th} and upper). Na content was also lowest in the basal section. It was generally similar along the canes, being highest in the internodes between 9^{th} and 12^{th}. C/N ratio was higher in the more basal nodes (1^{st} through 8^{th} nodes) decreasing as the cane length increased. Other structurally important nutrient reserves did not show statistically significant differences ranging at similar levels throughout the length of the canes.

Collection time projected more changes in the nutrient reserve contents of the 140 Ru canes (Table 2). Contents of nitrogen, carbon, manganese, copper, reducing sugars, and C/N ratio was influenced with the collection time. Nitrogen was highest at leaf fall, while carbon content showed variations during the study period. Mn and Cu were higher in the first month of collection, but later decreased. C/N ratio started low in the beginning and later increased.

Table 1. Effects of the sampling section on the mineral content of the 140 Ru cuttings

Sampling section	N (%)	P (%)	K (%)	C (%)	Fe (mg L^{-1})	Mg (mg L^{-1})	Zn (mg L^{-1})	Na (mg L^{-1})	Mn (mg L^{-1})	Cu (mg L^{-1})	Reducing sugar (g 100 ml^{-1})	C/N
Nodes 1-4	0.62 ± 0.03^{b}	0.13	0.42	45.3	100	1246	7.8	73 ± 1.98^{b}	24.6	6.5	0.15	95.1 ± 3.60^{a}
Nodes 5-8	0.64 ± 0.03^{ab}	0.14	0.42	45.2	95	1276	7.6	81 ± 2.78^{ab}	26.6	6.1	0.17	91.7 ± 4.36^{ab}
Nodes 9-12	0.64 ± 0.03^{ab}	0.13	0.43	45.2	89	1312	7.4	84 ± 3.04^{a}	25.9	6.6	0.20	86.4 ± 4.67^{b}
Nodes 13-16	0.67 ± 0.02^{a}	0.14	0.41	44.9	93	1235	7.6	79 ± 3.34^{ab}	27.6	6.5	0.15	83.7 ± 3.77^{b}
Nodes 17-20	0.66 ± 0.02^{a}	0.14	0.43	45.2	91	1240	7.5	77 ± 0.98^{ab}	27.1	5.7	0.15	83.7 ± 3.14^{b}
LSD	0.05	ns	ns	ns	ns	ns	ns	0.05	ns	ns	ns	0.05

Different letters in the same column are significantly different. ns: not significant. LSD: Least significant difference.

Table 2. Effects of the sampling time on the mineral content of the 140 Ru cuttings.

Sampling time	N (%)	P (%)	K (%)	C (%)	Fe (mg L^{-1})	Mg (mg L^{-1})	Zn (mg L^{-1})	Na (mg L^{-1})	Mn (mg L^{-1})	Cu (mg L^{-1})	Reducing sugar (g 100 ml^{-1})	C/N
Leaf Fall	0.70 ± 0.02^{a}	0.14	0.44	44.7 ± 0.17^{b}	89	1301	7.8	82	30.0 ± 1.28^{a}	7.1 ± 0.05^{a}	0.20 ± 0.17^{a}	76.4 ± 1.92^{b}
15 dalf	0.62 ± 0.04^{b}	0.14	0.42	45.2 ± 0.26^{ab}	89	1257	7.9	76	28.4 ± 0.50^{a}	6.9 ± 0.20^{a}	0.13 ± 0.01^{b}	81.1 ± 4.11^{b}
30 dalf	0.61 ± 0.02^{b}	0.13	0.41	44.9 ± 0.41^{b}	92	1264	7.3	79	23.8 ± 2.66^{b}	5.5 ± 0.29^{b}	0.15 ± 0.02^{ab}	96.1 ± 9.13^{ab}
45 dalf	0.64 ± 0.03^{ab}	0.13	0.42	45.9 ± 0.12^{a}	104	1230	7.3	77	23.2 ± 0.36^{b}	5.6 ± 0.44^{b}	0.17 ± 0.03^{ab}	106.2 ± 18.66^{a}
LSD	0.05	ns	ns	0.05	ns	ns	ns	ns	0.05	0.01	0.05	0.05

Different letters in the same column are significantly different. ns: not significant. dalf: days after leaf fall.
LSD: Least significant difference.

DISCUSSION

As the physiology and biochemistry of rootstocks vary under similar sets of management practices, the physiology and biochemical composition of the mother vines play an important role in the propagation, growth and development of vine, water-use efficiency, pest and disease tolerance, quality of grapes, etc. Each rootstock has its own inherent capacity to synthesize biochemical constituents, which influence cutting physiology, either directly or indirectly, after grafting (Satisha and Prakash, 2006). During dormancy, vines are not dead or completely inactive. Lombard (2003) stated that the vine remains metabolically active at a low level, during dormancy. Similar evaluation can be offered for grape rootstocks, as no significant changes were observed in the mineral content of its canes. C/N ratio and N contents of the canes were treated as the most significant indicators for lignifications. Other nutrient elements such as Mn showed some changes which require more detailed study to explain.

Gökbayrak *et al.* (2009) investigated the mineral content of 5 BB canes during dormant season. They reported significant changes of the macro and micronutrient elements, except for phosphorus. Nodal changes in the mineral contents, however were not detected except for N, K, Mg and Mn. Fardossi *et al.* (1996) found that the accumulation of potassium, calcium, magnesium and phosphor in different rootstocks varieties depended on variety and season. Hunter *et al.* (2004) studied mineral contents of five different rootstock mother materials during the rest period, and the mineral content of the rootstocks showed little variation. They also concluded that differences among the rootstocks might lead to differential fertilization in order to ensure optimum soil utilization and cost efficiency and to restrict soil and water pollution. Balasubrahmanyam *et al.* (1978) suggested that evaluation of nutrient reserves in canes could be used as an important consideration in limitation of crop level in grapevines, since vines with minimum bud load showed higher accumulation of carbohydrates in the canes of Italian Riesling.

In his study of the relationship between carbohydrate and N and the rooting of the stem cuttings, Sturve (1981) reported that a high C/N ratio promoted rooting, but did not accurately predict the degree of rooting response. Satisha *et al.* (2007) characterized ten grape rootstocks for their morphological, physiological and biochemical parameters using their leaves. They stated that optimum carbon/nitrogen ratios in the mother vines of these rootstocks helped attaining better rooting percentages of hardwood cuttings. Kaserer *et al.* (1990) studied the effects of the mineral contents of the canes on the development of shoots and roots of single bud cuttings of different grape cultivars. They reported differences in some of the minerals among the cultivars.

Conclusion: This research examined the differences in the mineral contents of 140 Ru canes collected during dormant period. The results showed that canes of 140 Ru rootstock induced a minor effect on its mineral matter content during sampling time and sampling section. Belonging to different *Vitis* species, grape rootstocks show variations in their mineral element reserves in the canes, which might play a role in their rooting capacity. The results obtained on mineral content of the rootstock canes could be useful for grape growers.

Acknowledgements: We thank Rukiye Tunçel and Nilay Münevver Baştaş for their much appreciated help during laboratory analyses.

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