doi: 10.17221/159/2015-CJFS

Effect of Grapevine Rootstocks on Qualitative Parameters of the Cerason Variety

Jiří TÉTHAL[1], Mojmír BAROŇ[1], Radek SOTOLÁŘ[1], Stefan AILER[2] and Jiří SOCHOR[1]

[1]Department of Viticulture and Oenology, Faculty of Horticulture, Mendel University in Brno, Lednice, Czech Republic; [2]Department of Fruit Production, Viticulture and Oenology, Faculty of Horticulture and Landscape Engineering, Slovak University of Agriculture in Nitra, Nitra, Slovak Republic

Abstract

Téthal J., Baroň M., Sotolář R., Ailer S., Sochor J. (2015): **Effect of grapevine rootstocks on qualitative parameters of the Cerason variety**. Czech J. Food Sci., 33: 570–579.

The Cerason variety is a hybrid from the cross of Merlan × Fratava varieties and its registration took place in 2008. In the category of fungus-resistant (PIWI) grapevine varieties, Cerason represents a very prospective variety. This study deals with effects of seven selected rootstock varieties (K 125AA, Amos, Börner, CR2, K5BB, K1SO4, and T5C) on qualitative parameters of Cerason juice. This experiment was established in 2011 in vineyards of Mendel University in Lednice. In the juice of the berries, the following parameters were monitored: concentrations of sugar, total acids, tartaric acid, malic acid, ratio of tartaric to malic acid (β-ratio), concentration of yeast assimilable nitrogen, and pH value. These parameters were monitored in seven-day intervals in the period of 6 weeks. The aim of this study was to identify those rootstock varieties that would be the most suitable for the given locality on the basis of contents of the aforementioned important substances. The best results were recorded in K125AA and K5BB rootstock varieties.

Keywords: grapevine variety; sugar concentration; total acids; tartaric acid; malic acid; yeast assimilable nitrogen; pH

Worldwide, scions of *Vitis vinifera* L. are grafted either onto rootstocks of American species of the genus *Vitis* L. or onto their interspecific hybrids of, which are primarily planted in modern vineyards (Weaver 1976). The selection and use of suitable rootstocks may help to solve problems caused by unsuitable soil and weather conditions; besides, it also enables to improve the system and measures of plant protection. In viticulture, the rootstock shows a general influence on both vegetative growth and reproductive parameters of plants. Rootstocks also directly influence yields of grafted varieties (Vršič & Vodovnik 2012). Kidman *et al.* (2014) reported that the rootstock influenced not only colour and weight of berries but also concentrations of sugars, acids and mineral substances (Kidman *et al.* 2014). Wine minerality is influenced more by the rootstock than by weather and/or soil conditions (van Leeuwen *et al.* 2004). When speaking about rootstocks, this effect is dependent on the ratio existing between the leaf area of the plant and its yield. The balanced uptake of nutrients and water as well as the re-distribution of individual elements within the grapevine plant are closely related to changes in the phenology of plants and it is well known that these processes are significantly influenced by rootstocks (Pulko *et al.* 2012). Resistance to yearly different conditions will be paid great attention with respect to the balanced quality of grapes. Growers generally agree that this is one of the possible ways how to control the quality of produced grapes (John 2012). When establishing a new vineyard, an appropriate rootstock and scion combination represents one of the first important steps on the way to success. In these experiments,

Supported by Internal grant of Mendel University in Brno, Project No. IGA 14/2014/591 ZF.

doi: 10.17221/159/2015-CJFS

attention paid to a wide spectrum of qualitative parameters of grapes enables to get a better understanding of relationships existing between the rootstock and the variety. This means that it is possible to recommend suitable combinations that would improve the quality of production not only from a limited viewpoint of sugar and acid concentrations in berries but also of grapes as a raw material with a complex of parameters that contribute to the final quality of grapes that, eventually, influences also the quality of produced wine (Keller *et al.* 2012).

MATERIAL AND METHODS

Vineyard characteristics. Grapes used for individual analyses were harvested in an experimental vineyard of the Mendelianum experimental station in Lednice na Moravě, Czech Republic. The elevation of this locality is 176 m and the region is characterised as dry, warm and with mild winters. The vineyard was planted in an open locality, mostly flat, slightly sloped and with enough solar radiation, facing to the north-east. The soil is characterised as loamy-sandy with 20–24% of clayey particles.

Experimental design. The Cerason variety was grafted onto seven different rootstocks (125 AA, Amos, Börner, CR2, K5BB, K1SO4, T5C). Vines were planted in 2005. They are pruned as plants of medium height and with one cane, each 8 to 10 buds. The spacing of grapevine plants is 1 m (in the row) and 2.2 m (between rows).

Description of the Cerason variety (synonym Mi-5-100). Cerason is a Czech variety that resulted from the crossing of Merlan (Merlot × Seibel 13 666) × Fratava (Blaufrankisch × St. Laurent). This variety shows a medium to vigorous growth and the annual shoots are robust and well matured. Leaves are dense and there are many lateral shoots on plants. The dates of bud burst and flowering are medium to early and grapes are mature in the first half of October. This interspecific hybrid shows a relatively good resistance to fungal diseases. Its resistance to mould diseases (above all to grey mould) is slightly reduced. Yields are slightly higher (10–15 t/ha), the sugar concentration in juice ranges from 18 kg to 20 kg of natural sugars in 100 l of juice (i.e. 18 °NM to 20 °NM) and the concentration of acids ranges from 8 g/l to 10.5 g/l.

Rootstocks. Altogether 7 different rootstock varieties were tested, all of them are routinely used in the viticultural practice. Two of them (K 5BB, Börner) are very vigorous, two are moderately vigorous (K 125AA, CR2), and the vigour of the remaining three (Amos, K1SO4, and T5C) is weak.

K 125AA (Kober 125AA) – *Vitis berlandieri* × *V. riparia*
Amos Severnyj (Malingre × *V. amurensis*) × Schwarzmann (*V. riparia* × *V. rupestris*)
Börner – *V. riparia* 183G × *V. cinerea* 'Arnold'
CR2 (Craciunel 2) – *V. berlandieri* × *V. riparia*
K 5BB (Kober 5BB) – *V. berlandieri* × *Vitis riparia*
K1SO4 – LE/K1 × SO4
T5C (Teleki 5C) – *V. berlandieri* × *V. riparia*

Samplings. Samples of grapes were collected in regular 7-day intervals within the period beginning on August 29 and ending on October 10, 2011. The sampling dates were as follows: 29 Aug; 5 Sept; 12 Sept; 19 Sept; 26 Sept; 3 Oct, and 10 Oct. In the experimental vineyard, an average sample of berries used for analyses was collected on 5 plants from different parts of bunches from different side of the row. Each sample consisted of 200 berries. Collected berries were transported in plastic bags to a laboratory where they were immediately crushed, with no maceration, and had to be analysed in the laboratory always on the day of sampling. The measurements were carried out in triplicate.

Estimation of sugar and organic acid concentrations. Contents were estimated by the HPLC method with the ion exclusion (Shimadzu LC-10A with a column thermostat CTO-10ACvp; the temperature of the column space was pre-set to 60°C). The separation took place under conditions of an isocratic regime with the mobile phase 2 mM of sulphuric acid (flow rate 0.75 ml/min) in the column Watrex Polymer IEX 10 μm H form; 250 × 8 mm with a pre-column 10 × 8 mm. The detection was performed by means of a DAD detector SPD-MAvp. The concentrations of sugars and organic acids were estimated at wavelengths 190 nm and 210 nm, respectively.

Estimation of pH and of total titratable acids. The estimation of pH value in undiluted samples was performed in the WTW pH 526 pH meter combined with the SenTix 21 pH electrode (Fisher Scientific, Pardubice, Czech Republic).

To estimate the concentration of total acids in the must, 10 ml of the tested sample were mixed with 10 ml of distilled water and the beaker with the sample was placed into an automatic titrator Titroline Easy (Germany) with a combined electrode. The sample was thereafter titrated with NaOH (doses of 0.1 M) until the equivalence point was reached (usually at pH values about 7).

Estimation of yeast assimilable nitrogen (YAN). Amounts of YAN were estimated by formol titration

doi: 10.17221/159/2015-CJFS

Table 1. Indicators of the sugar concentration dynamics

Experimental berries	Rootstock	Initial value	Final value	Difference*	Slope	Correlation coefficient (r)	Coefficient of determination (r^2)
A	K125 AA	16.35	23.22	6.88	1.15	0.98	0.96
B	Amos	17.03	22.49	5.46	0.91	0.99	0.98
C	Börner	16.31	22.40	6.09	1.01	0.93	0.87
D	CR2	15.31	22.89	7.59	1.26	0.90	0.82
E	K5BB	16.07	22.82	6.75	1.13	0.93	0.86
F	K1SO4	16.28	22.24	5.96	0.99	0.95	0.90
G	T5C	16.91	22.26	5.36	0.89	0.94	0.88

*final value – initial value

in the automatic titrator TitroLine Easy (Schott Instruments GmbH, Mainz, Germany). A sample of 0.1 mol/l solution of NaOH with the known factor was used as the titration agent. A volume of 10 ml of the sample was diluted with 10 ml of distilled water. For the estimation of titratable acids, the pH value was increased by additions of 0.1 mol/l of NaOH solution to 8.1. Thereafter, 10 ml of an aqueous (36–38%) formaldehyde solution (with pH 8.1) and the moisture were titrated again up to pH 8.1. After the end of titration, the total consumption of NaOH (in ml) was read on the titrator display (to the nearest two decimal places). This value was multiplied by the factor of NaOH solution and by the coefficient 140 and the concentration of YAN in the sample was calculated in mg/l.

RESULTS AND DISCUSSION

In this study, effects of 7 different rootstocks on the red wine variety Cerason were evaluated. The monitoring was performed in regular weekly intervals, viz. on 29. 08., 05. 09., 12. 09., 19.09., 26. 09., 03. 10. and 10. 10. 2011 (in the figures, these time intervals are plotted on the x-axis as values 0–6). Using the obtained data, several significant analytical parameters were evaluated.

All figures are divided to (A) K 125AA, (B) Amos, (C) Börner, (D) CR2, (E) K5BB, (F) K1SO4, and (G) T5C. The values are shown in the graphs with standard deviation. The linear regression is plotted in grey and its numeric parameters (i.e. slope, correlation coefficient and coefficient of determination – r^2) are in tables.

Evaluation of sugar concentration. Some rootstocks (Amos, T5C) produce smaller grapes with smaller berries on the one hand but with an increased capability to accumulate sugars on the other. In sunny and warm periods of autumnal weather, the values of the sugar concentration are comparable with those recorded in wine made of berries produced in the other five combinations of experimental rootstocks and Cerason scions. For making red wine of good

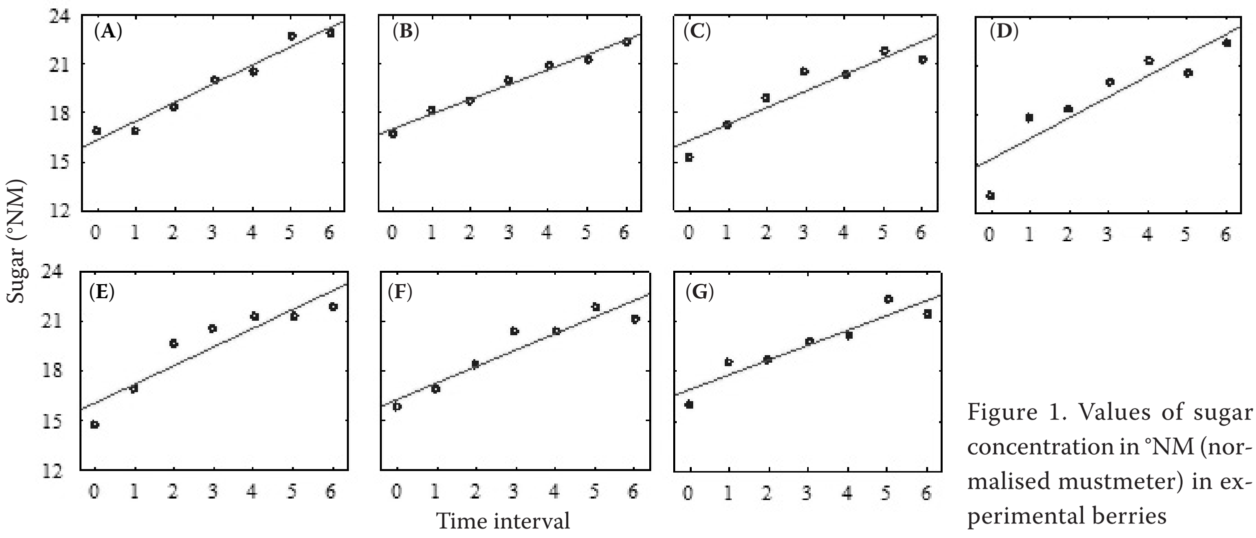

Figure 1. Values of sugar concentration in °NM (normalised mustmeter) in experimental berries

doi: 10.17221/159/2015-CJFS

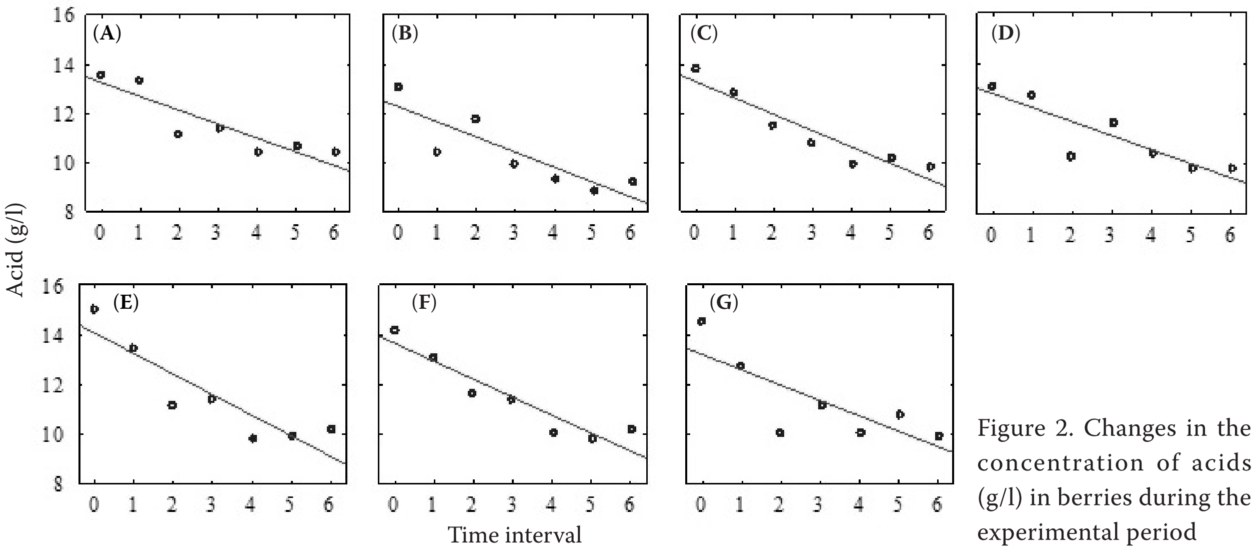

Figure 2. Changes in the concentration of acids (g/l) in berries during the experimental period

quality, it is sufficient to use grapes containing 23 kg of sugars in 100 l of juice (i.e. 23 °NM).

Changes in the sugar concentration observed within the period from August 29 to October 10, 2011 are presented in Figure 1 and Table 1. On the harvest day, the highest sugar concentration (23.22 °NM) was found in the K 125AA rootstock. In this experimental variant, values of the slope and of the initial concentration of sugars were 1.15 and 16.35 °NM, respectively, so that it could be concluded that in this case the process of grape ripening was the fastest. The lowest concentration of sugars was recorded in the combination with the T5C rootstock (22.26 °NM). In this experimental variant, the initial concentration of sugars was high (16.91 °NM) while the increase in the concentration of sugars was small (the difference was only 5.36). The highest rate of berry ripening was recorded in the experimental variant with the CR2 rootstock (the initial concentration of sugars was 15.31 °NM; at the moment of harvest, its value was as high as 22.89 °NM). The slope value was 1.26.

The sugar concentration in berries is a very important parameter because it predetermines the potential concentration of alcohol in wine (Conde *et al*. 2007; Perestrelo *et al*. 2014). In red varieties used for making red wine, the concentration of sugars should be higher because it guarantees also a higher concentration of alcohol. Traditionally, the winemakers strive to reach the maximum possible concentration of soluble substances and consider it to be an indicator of ripeness and quality of young wine (Palliotti *et al***.** 2014). Today, however, it is required to know not only residual sugar (RS) but also other parameters because too high values of RS may disturb the aromatic profile of wine or cause the degradation of pigments (Mori *et al*. 2007). Keller (2010) reported a sudden loss of acidity and/or a steep pH increase.

Berries were smaller in weaker rootstocks. Initially, the sugar concentration was higher but later on, in the period of rainy weather, their size and weight increased due to the intake of water; however, this intake of water resulted in a decrease in the sugar concentration. This

Table 2. Indicators of dynamics of changes in the concentration of total acids

Experimental berries	Rootstock	Initial value	Final value	Difference*	Slope	Correlation coefficient (r)	Coefficient of determination (r^2)
A	K125 AA	13.25	9.86	–3.39	–0.56	–0.90	0.81
B	Amos	12.26	8.57	–3.68	–0.61	–0.86	0.74
C	Börner	13.28	9.30	–3.98	–0.66	–0.94	0.89
D	CR2	12.79	9.45	–3.35	–0.56	–0.88	0.77
E	K5BB	14.07	9.10	–4.96	–0.83	–0.90	0.80
F	K1SO4	13.65	9.31	–4.34	–0.72	–0.94	0.89
G	T5C	13.21	9.50	–3.71	–0.62	–0.79	0.62

*final value – initial value

doi: 10.17221/159/2015-CJFS

Table 3. Indicators of dynamics of changes in the concentration of tartaric acid

Experimental berries	Rootstock	Initial value	Final value	Difference*	Slope	Correlation coefficient (r)	Coefficient of determination (r^2)
A	K125 AA	10.14	8.39	−1.75	−0.29	−0.74	0.55
B	Amos	10.23	8.02	−2.22	−0.37	−0.96	0.91
C	Börner	9.92	8.92	−1.00	−0.17	−0.75	0.56
D	CR2	9.85	8.95	−0.90	−0.15	−0.73	0.53
E	K5BB	10.65	8.39	−2.26	−0.38	−0.94	0.88
F	K1SO4	10.51	8.52	−1.98	−0.33	−0.86	0.73
G	T5C	11.02	7.47	−3.55	−0.59	−0.90	0.81

*final value – initial value

negative phenomenon was observed in 2011, when there were intensive rainfalls in the course of autumn. In hot weather, however, the situation may be quite opposite and the berries may shrink and lose up to 10% of weight so that the sugar concentration may increase by as much as 2 °Bx (Liu *et al*. 2011)

Evaluation of the concentration of total acids. In the stage of veraison, the highest concentrations of acids were recorded in experimental variants with rootstocks K5BB (14.07 g/l) and K1SO4 (13.65 g/l). The lowest initial (12.26 g/l) and final (8.57 g/l) concentrations of total acids were found out in the experimental variant with the Amos rootstock. The highest dynamics of the decrease in the concentration of total acids was recorded in the experimental variant with the K5BB rootstock; in this case values of the difference between the initial and the final concentration of total acids and of the gradient were 4.96 and 0.83, respectively. The lowest dynamics of these changes was found out in the experimental variant with the Amos rootstock (3.71) (Figure 2 and Table 2).

In wine, the most important acids are tartaric, malic, and lactic acid; smaller amounts of succinic, citric, and acetic acid are also significant. In grapes, the concentration of total acids usually ranges from 7 g/l to 10 g/l. However, the interactions between and the ratios of individual acids are more important than this concentration of total acids. On the one hand, the juice density increases with the increasing concentration of sugars while the concentration of acids decreases. This means that the ratio between the sugar concentration (i.e. refractometric dry matter) and the titratable acidity increases (Río Segade *et al*. 2013). Cerason is a variety that contains greater amounts of acids and for that reason it is necessary to harvest grapes in an optimum stage of ripeness and with the possibly lowest concentration of acids.

Evaluation of the concentration of tartaric acid. Changes in concentrations of tartaric acid that occurred during the process of berry ripening are presented in Figure 3. At the beginning of the study period, the highest concentration was recorded in

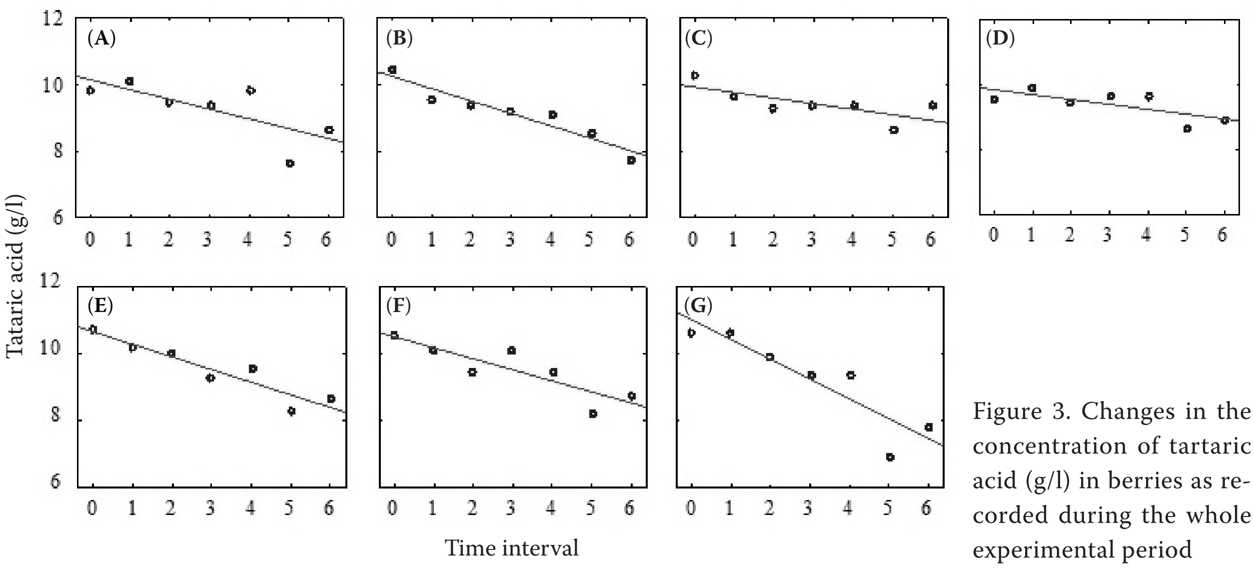

Figure 3. Changes in the concentration of tartaric acid (g/l) in berries as recorded during the whole experimental period

doi: 10.17221/159/2015-CJFS

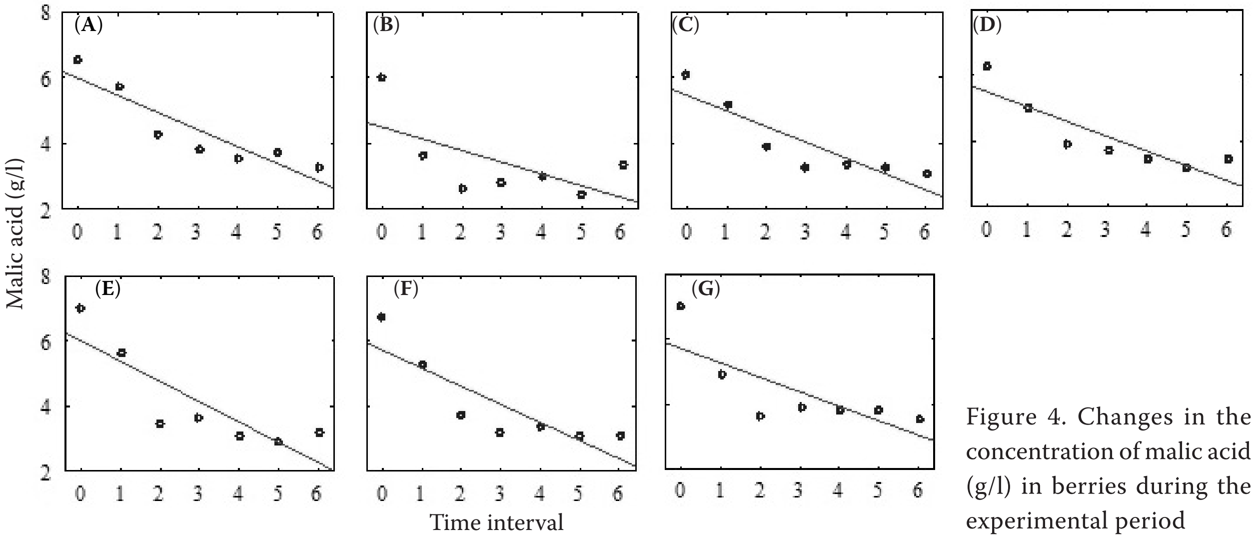

Figure 4. Changes in the concentration of malic acid (g/l) in berries during the experimental period

the experimental variant with the T5C rootstock (i.e. 11.02 g/l). However, it was only 7.47 g/l toward its end. As one can see in Table 3, this was the lowest value of all, so that it can be concluded that this rootstock-scion combination showed the highest dynamics of changes in acid concentrations. This rootstock showed the highest dynamics of the decrease (with a difference –3.55). The CR2 rootstock showed the lowest dynamics of changes in the concentration of tartaric acid: the measured value was four times lower than that recorded in the experimental variant with the T5C rootstock. In this experimental variant the slope value was only –0.9. In the final stage of ripening, the concentration of tartaric acid was the highest just in this experimental variant (i.e. 8.95 g/l). The air temperature plays an important role in the synthesis of individual acids. An intensive synthesis takes place at temperatures of 20–25°C and for that reason the berries ripening under conditions of a cool climate show an increased concentration of acids (above all of malic acid) (Dokoozlian 2000).

Tartaric acid is one of the most important acids in wine. During the process of grape ripening, its concentration is decreasing but these changes are not as fast as the degradation of malic acid. The concentration of tartaric acid decreased during the period of ripening (Dokoozlian 2000). This decrease was obviously caused by an increase in the volume of berries. As far as the taste of produced wine was concerned, tartaric acid was more desirable, above all because its taste was finer than that of malic acid.

Evaluation of the concentration of malic acid. The dynamics of changes in the concentration of malic acid is illustrated in Figure 4. The highest dynamics was found out in the experimental variant with the K5BB rootstock; in this case the slope was –0.62. The highest initial and the lowest final value were 6.00 and 2.27 g/l, respectively. The lowest dynamics of these changes was observed in the experimental variant with the Amos rootstock (–0.36). In this experimental variant, also the lowest initial concentration of malic acid was recorded (Table 4). The highest concentration of

Table 4. Indicators of malic acid concentration dynamics

Experimental berries	Rootstock	Initial value	Final value	Difference*	Slope	Correlation coefficient (r)	Coefficient of determination (r^2)
A	K125 AA	5.98	2.86	–3.11	–0.52	–0.90	0.82
B	Amos	4.50	2.36	–2.13	–0.36	–0.64	0.40
C	Börner	5.47	2.59	–2.88	–0.48	–0.89	0.79
D	CR2	5.49	2.80	–2.69	–0.45	–0.88	0.77
E	K5BB	6.00	2.27	–3.73	–0.62	–0.85	0.73
F	K1SO4	5.72	2.39	–3.33	–0.55	–0.86	0.74
G	T5C	5.71	3.05	–2.66	–0.44	–0.78	0.60

*final value – initial value

doi: 10.17221/159/2015-CJFS

Table 5. Indicators of assimilable nitrogen concentration dynamics

Experimental berries	Rootstock	Initial value	Final value	Difference*	Slope	Correlation coefficient (r)	Coefficient of determination (r^2)
A	K125 AA	97.75	193.87	96.13	16.02	0.83	0.69
B	Amos	87.36	248.26	160.90	26.82	0.92	0.84
C	Börner	92.23	137.22	44.99	7.50	0.79	0.63
D	CR2	85.97	185.95	99.98	16.66	0.94	0.89
E	K5BB	107.37	201.76	94.39	15.73	0.79	0.63
F	K1SO4	100.33	184.48	84.15	14.02	0.85	0.72
G	T5C	81.02	292.53	211.51	35.25	0.98	0.96

*final value – initial value

malic acid (3.05 g/l) was recorded in the experimental variant with the T5C rootstock.

Malic acid is an organic acid responsible for the "green taste" of grapes and wine; its taste is sharp, coarse and with immature tones. In case that its concentration is very low, the wine is markedly flat, dull and characterless. During the process of ripening, the concentration of this acid markedly decreases. Higher concentrations of malic acid in wines (especially in reds) can be reduced by biological degradation.

Evaluation of the YAN concentration. The highest concentration of YAN was found out in juice made of berries produced in the experimental variant with the T5C rootstock (292.53 mg/l). Although this rootstock showed the highest values already at the beginning of the experiment, its dynamics of growth was the highest at all (35.25). A relatively high final concentration of YAN (248.26 mg/l) was found out also in the experimental variant with the Amos rootstock. However, the lowest dynamics of changes in the concentration of YAN was recorded in the experimental variant with the Börner rootstock. These results are shown in Table 5 and in Figure 5.

In the domain of oenology, the YAN concentration (i.e. that of free amino acids and ammonium ions) belongs to the most important parameters. The minimum concentration of YAN should be 140 mg/l (Vilanova *et al.* 2007). The concentration of YAN plays an important role in the course of alcoholic fermentation because it is indispensable for the propagation and growth of yeasts; it also supports the synthesis of aromatic compounds. According to Dokoozlian (2000), the concentration of amino acids is different and depends not only on the variety but also on the degree of ripeness. Proline and arginine are the most important free amino acids. In berries of cv. Thompson Seedless the concentration of arginine ranged from 300 to 800 mg/l.

The β-ratio. As shown in Figure 6 and Table 6, values of the β-ratio ranged from 1.71 to 2.56 at the beginning of berry ripening. At harvest, values of the β-ratio ranged between 2.30 and 3.14. The

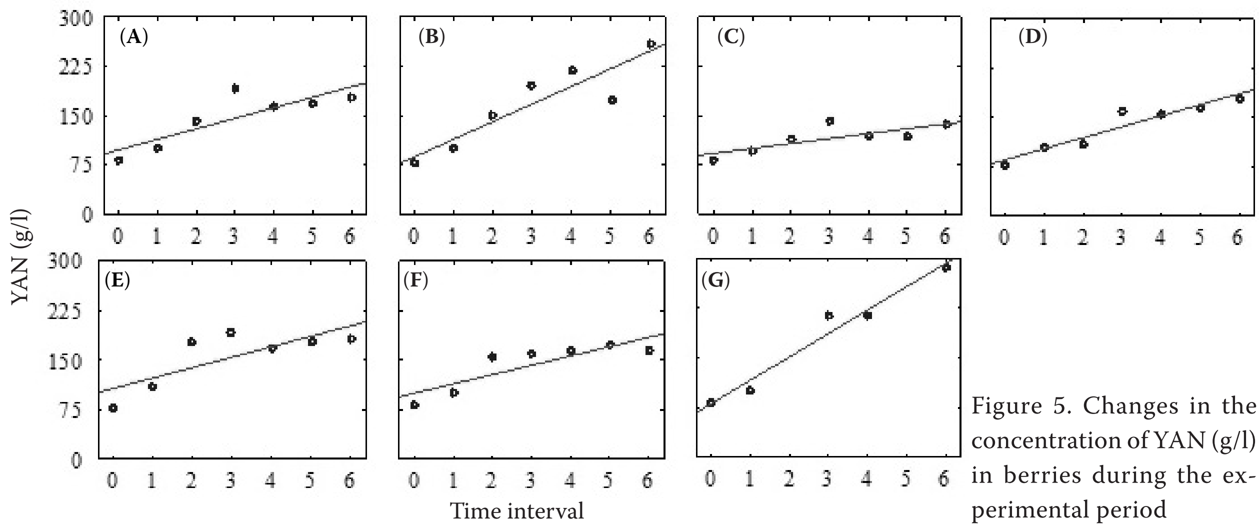

Figure 5. Changes in the concentration of YAN (g/l) in berries during the experimental period

doi: 10.17221/159/2015-CJFS

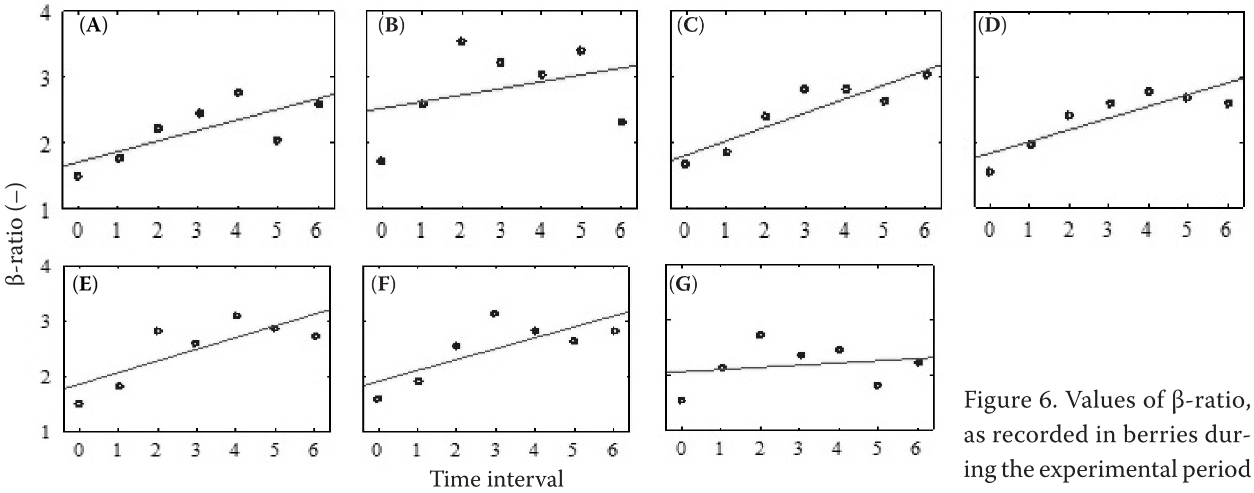

Figure 6. Values of β-ratio, as recorded in berries during the experimental period

T5C rootstock produced grapes containing higher amounts of malic acid. In this experimental variant, the β-ratio was 2.30. In this experimental variant, the dynamics of changes was the slowest of all (the difference between the initial and the final value was 0.24 and the slope value was only 0.04). On the other hand, the highest dynamics was recorded in three experimental variants (Börner, K5BB, K1SO4); in these experimental variants the slope was 0.21.

Table 6 shows a low correlation coefficient in B and G row. From the graph we can see that it is caused by the uneven distribution of values along the regression line. This distribution could be caused by variations in β-ratio, i.e. in the content of tartaric acid and malic acid during the ripening of grapes. The weather immediately before the collection of samples could have a large influence in this case.

The term β-ratio expresses the ratio existing between tartaric acid and malic acid; this parameter indicates the degree of ripeness. In ripe grapes the concentration of tartaric acid is high while that of malic acid is low. This means that the β-ratio shows an increasing trend during the growing season. The higher the value of β-ratio, the higher the concentration of tartaric acid and the better (i.e. finer) also the taste of produced wine (Fujishima *et al*. 2005).

Evaluation of pH. In all experimental variants, the pH values showed an upward trend. This was associated with the decreasing concentration of acids. At the beginning, the lowest pH was recorded in the experimental variant with the Börner rootstock (2.87). However, the highest pH at harvest was found out in the experimental variant with the T5C rootstock (3.67). In this case, also the highest dynamics of growth was recorded (0.12). As far as the other rootstocks were concerned, their final values were nearly comparable. At harvest, the lowest pH value (i.e. 3.34) was recorded in the experimental variant with the K125AA rootstock (Figure 7 and Table 7).

This is an important parameter that enables to assess the degree of grape ripeness. In juices used for making young wine, pH values ranged from 3 and 4. In

Table 6. Indicators of the β-ratio dynamics

Experimental berries	Rootstock	Initial value	Final value	Difference*	Slope	Correlation coefficient (r)	Coefficient of determination (r^2)
A	K125 AA	1.71	2.68	0.96	0.16	0.75	0.57
B	Amos	2.53	3.14	0.61	0.10	0.34	0.11
C	Börner	1.82	3.11	1.29	0.21	0.90	0.81
D	CR2	1.83	2.91	1.08	0.18	0.85	0.73
E	K5BB	1.86	3.12	1.26	0.21	0.78	0.60
F	K1SO4	1.91	3.09	1.18	0.20	0.77	0.59
G	T5C	2.06	2.30	0.24	0.04	0.21	0.04

*final value – initial value

doi: 10.17221/159/2015-CJFS

Table 7. Indicators of pH dynamics

Experimental berries	Rootstock	Initial value	Final value	Difference*	Slope	Correlation coefficient (r)	Coefficient of determination (r^2)
A	K125 AA	3.02	3.34	0.32	0.05	0.84	0.70
B	Amos	3.01	3.38	0.37	0.06	0.87	0.76
C	Börner	2.87	3.41	0.54	0.09	0.75	0.57
D	CR2	2.89	3.36	0.47	0.08	0.98	0.96
E	K5BB	2.93	3.38	0.45	0.07	0.85	0.72
F	K1SO4	2.94	3.38	0.44	0.07	0.95	0.91
G	T5C	2.96	3.67	0.71	0.12	0.89	0.78

*final value – initial value

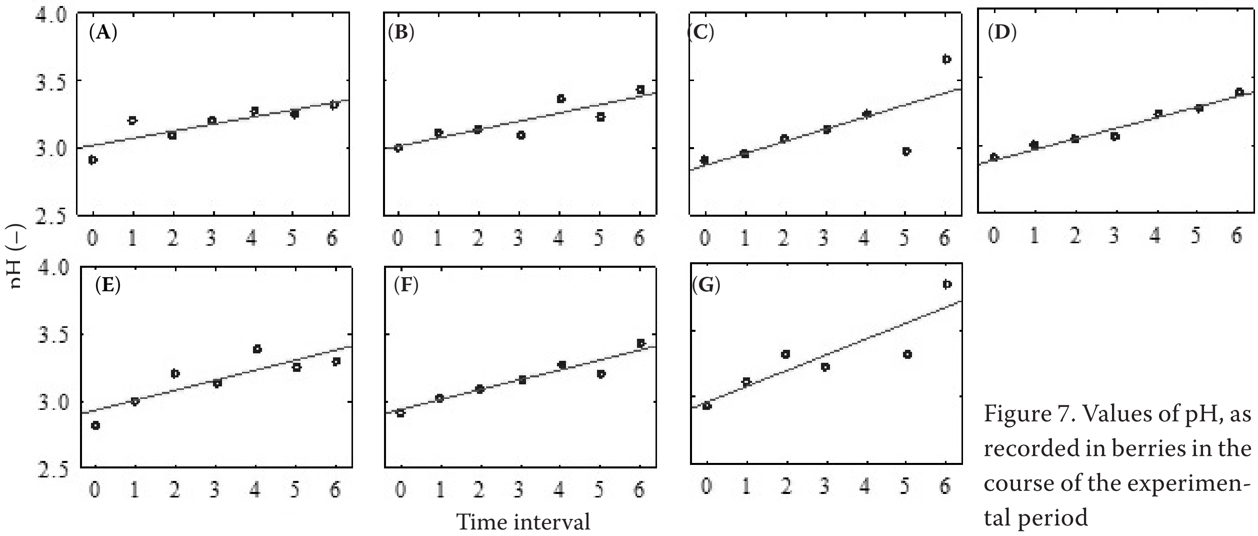

Figure 7. Values of pH, as recorded in berries in the course of the experimental period

the course of the ripening process, pH values slightly increased. The optimum values were between 3.1 and 3.3. If the pH values exceeded the limit of 3.5, the risk of a high activity of microorganisms (above all bacteria and yeasts) increased as well. The predisposition of juices and young wine to production of volatile acids and to the occurrence of some wine diseases and other faults was higher. At increased pH values, the efficiency of sulphur dioxide decreased and the oxidation of juice and young wine was accelerated.

CONCLUSIONS

This study deals with the suitability of different rootstocks in relation to grafted scions of the Cerason variety. For the given climatic conditions, the best rootstock was selected on the basis of both qualitative and quantitative parameters. From the technological point of view, concentrations of sugars and of malic acid are the most important parameters because they determine the basic character of wine. As far as not only these but also other qualitative parameters were concerned, rootstocks K125AA and K5BB were always evaluated among the best ones. However, some differences between rootstocks under study were very small and in some cases they were even insignificant.

It can be concluded that soil and climatic conditions play a principal role. For that reason, the relevance of this study should be related only to given localities and years (vintages). Experiments can contribute to the development of a methodology of evaluation of suitable rootstocks.

References

Conde C., Silva P., Fontes N., Dias A.C.P., Tavares R.M., Sousa M.J., Agasse A., Delrot S.,Gerós H. (2007): Biochemical changes throughout grape berry development and fruit and wine quality. Food, 1: 1–22.

doi: 10.17221/159/2015-CJFS

Dokoozlian N.K. (2000): Grape berry growth and development. In: Rasin Production Manual. Okland, University of California. Agricultural and Natural Resources Publication: 30–37.

Fujishima H., Shiraishi M., Shimomura S., Horie Y. (2005): Effects of girdling on berry quality of Pione grapevine [*Vitis*]. Horticultural Research (Japan), 4: 313–318.

Whiting J. (ed.) (2012): Rootstock breeding and associated R&D in the viticulture and wine industry. Review August 2012. Adelaide, Grape and Wine Research and Development Corporation.

Keller M. (2010): Managing grapevines to optimise fruit development in a challenging environment: a climate change primer for viticulturists. Australian Journal of Grape and Wine Research, 16: 56–69.

Keller M., Mills L.J., Harbertson J.F. (2012): Rootstock effects on deficit-irrigated winegrapes in a dry climate: vigor, yield formation, and fruit ripening. American Journal of Enology and Viticulture, 63: 29–39.

Kidman C.M., Olarte Mantilla S., Dry P.R., McCarthy M.G., Collins C. (2014): Effect of water stress on the reproductive performance of Shiraz (*Vitis vinifera* L.) grafted to rootstocks. American Journal of Enology and Viticulture, 65: 96–108.

Liu X., Ma J., Liu Z.C. (2011): Phenolic maturity and the estimating methods of winegrapes: a review. In: Proceedings 7th International Symposium on Viticulture and Enology, April 20–22, 2011, Shaanxi, China: 82–91.

Mori K., Goto-Yamamoto N., Kitayama M., Hashizume K. (2007): Loss of anthocyanins in red-wine grape under high temperature. Journal of Experimental Botany, 58: 1935–1945.

Palliotti A., Tombesi S., Silvestroni O., Lanari V., Gatti M., Poni S. (2014): Changes in vineyard establishment and canopy management urged by earlier climate-related grape ripening: A review. Scientia Horticulturae, 178: 43–54.

Perestrelo R., Barros A.S., Rocha S.M., Câmara J.S. (2014): Establishment of the varietal profile of *Vitis vinifera* L. grape varieties from different geographical regions based on HS-SPME/GC.qMS combined with chemometric tools. Microchemical Journal, 116: 107–117.

Pulko B., Vršič S., Valdhuber J. (2012): Influence of various rootstocks on the yield and grape composition of Sauvignon Blanc. Czech Journal of Food Sciences, 30: 467–473.

Río Segade S., Giacosa S., Torchio F., De Palma L., Novello V., Gerbi V., Rolle L. (2013): Impact of different advanced ripening stages on berry texture properties of 'Red Globe' and 'Crimson Seedless' table grape cultivars (*Vitis vinifera* L.). Scientia Horticulturae, 160: 313–319.

van Leeuwen C., Friant P., Choné X., Tregoat O., Koundouras S., Dubourdieu D. (2004): Influence of climate, soil, and cultivar on terroir. American Journal of Enology and Viticulture, 55: 207–217.

Vilanova M., Ugliano M., Varela C., Siebert T., Pretorius I., Henschke P. (2007): Assimilable nitrogen utilisation and production of volatile and non-volatile compounds in chemically defined medium by *Saccharomyces cerevisiae* wine yeasts. Applied Microbiology and Biotechnology, 77: 145–157.

Vršič S., Vodovnik T. (2012): Reactions of grape varieties to climate changes in North East Slovenia. Plant, Soil and Environment, 58: 34–41.

Weaver R.J. (1976): Grape Growing. New York, John Wiley.

Received: 2015–04–01
Accepted after corrections: 2015–09–18

Corresponding author:

Doc. Ing. Jiří Sochor, Ph.D., Mendlova univerzita v Brně, Zahradnická fakulta, Ústav vinohradnictví a vinařství, Valtická 337, 691 44 Lednice, Česká republika; E-mail: sochor.jirik@seznam.cz