Mitteilungen Klosterneuburg 62 (2012): 161-176

Results of Clonal Selection with the grapevine variety 'Olaszrizling' P. 2

János Werner and Pál Kozma

University of Pécs
Institute of Viticulture and Enology
HU-7634 Pécs, Pázmány P. u. 4
E-Mail: Werner.Janos@pte.hu

Clonal selection is necessary for the development of the biological basis of grapevine varieties to be able to cope with new market and environmental challenges. 'Olaszrizling' is a white grapevine variety that has been the most widely cultivated variety in Hungary for decades and it is of main importance in other countries of the Carpathian basin and Central Europe as well. 'Olaszrizling' is a late-ripening variety with good yield security and a high environmental adaptability. Its enological potential is rather wide: wines with a light, acid, fruity characteristic to full-bodied wines with higher alcohol content can be made from this variety. Clonal selection of 'Olaszrizling' started in the middle of the 20th century. The first aim was to raise the yielding performance, later other requirements followed. The P. 2 clone is one of the most widely cultivated 'Olaszrizling' clones of Hungary, which has a more balanced yield over vintages, and a better sugar accumulating ability than the basic variety. Its wine is full-bodied and aromatic with varietal character. In 2001 the Institute of Viticulture and Enology Pécs started subclonal selection of 'Olaszrizling' P.2 clone for quality improvement and yield security. Three subclones were submitted for state approval in 2012.
Keywords: 'Olaszrizling', improvement of biological basis, clone, selection, maintenance of varieties

Die Ergebnisse der Klonenselektion bei 'Olaszrizling' Klon P. 2. *Klonenselektion ist ein notwendiges Verfahren zur Weiterentwicklung der biologischen Basis von Rebsorten, um auf die neuen Herausforderungen des Marktes und der Ökologie zu reagieren. 'Olaszrizling' stellt schon seit Jahrzehnten in Ungarn die flächenmäßig bedeutendste Weißweinsorte dar, spielt aber auch in anderen Ländern des Karpatenbeckens bzw. in Mitteleuropa eine wichtige Rolle. 'Olaszrizling' ist eine spätreifende Sorte mit hoher Ertragssicherheit, die sich gut den jeweiligen Umgebungsbedingungen anpasst. Ihre önologische Bandbreite reicht von leichten, fruchtigen Weinen mit frischer Säure bis zu körperreichen Weinen mit höherem Alkoholgehalt. Die Klonenselektion von 'Olaszrizling' wurde in Ungarn in der Mitte des 20. Jahrhunderts begonnen. Das erste Ziel war die Erhöhung der Ertragskapazität, später folgten andere Anforderungen. Der Klon P. 2 ist einer der am weitesten verbreiteten Klone der Sorte 'Olaszrizling' in Ungarn, der im Vergleich mit der Basissorte eine ausgeglichenere Ertragskapazität und eine bessere Zuckerakkumulation hat. Sein Wein ist körperreich, aromatisch und sortentypisch. Das Forschungsinstitut für Rebe und Wein in Pécs hat im Jahre 2001 einen Selektionszyklus mit 'Olaszrizling' P. 2 begonnen, wobei das Ziel die Erhöhung der Ertragssicherheit und der Qualität war. Im Jahre 2012 wurden drei Subklone zur staatlichen Zertifizierung eingereicht.*
Schlagwörter: 'Olaszrizling', 'Welschriesling', Entwicklung der biologischen Basis, Klone, Selektion, Sortenerhaltung

Les résultats de la sélection clonale P. 2 *de 'Olaszrizling'. La sélection clonale resultant de clones de haute qualité correspond aux nouveaux défis du marché et de l'environnement en servant le développement des bases biologiques de la vigne. Le 'Olaszrizling' est depuis plusieurs dizaines d'années le cépage produit sur le plus grand territoire de Hongrie qui donne du vin blanc. Ce cépage joue un rôle important dans les vitucultures et vinicultures dans le Bassin des Carpates et en Europe centrale. Le 'Olaszrizling' est un cépage tardif qui s'adapte facilement aux conditions environmentales et très sûr. Ses possibilités en oenologie sont larges: léger, l'acidité vive, fruité; mais on peut également produire de ce cépage du vin charnu avec un teneur en alcool plus élevé. En Hongrie on a commencé la sélection clonale du 'Olaszrizling' au milieu du 20ème siècle. Le but primaire a été l'augmentation de la capacité de production qui a été*

completé plus tard par des exigences qualitatives. Le P. 2 est le clone le plus répendu de 'Olaszrizling' en Hongrie qui se dispose d'une capacité de production plus équilibrée et d'une meilleure capacité d'enrichissement en sucre. Son vin est charnu, aromatique d'un caractère variétal. L'Institut de Viticulture et de Viniculture de Pécs a lancé en 2001 un nouveau cycle de sélection du clone P. 2 de 'Olaszrizling' en visant l'augmentation de la sécurité de rendement et de la qualité. En 2012 nous avons annoncé 3 sub-clones à la qualification d'État.
Mots clés: 'Olaszrizling', le développement des bases biologiques, clones, sélection, conservation de cépage

Clonal selection is one of the most ancient plant breeding methods, its intentional application in grapevine cultivation became common in the second half of the 19th century (Sartorius, 1928; Steingruber, 1932; Király and Németh, 1957; Németh, 1958; Kozma, 1963; Schöffling, 1971; Füri and Németh, 1972; Luntz, 1979; Hajdu, 2006). Genetically inherited variability of vegetatively propagated plants, accumulation of favourable and unfavourable attributes are mainly due to bud mutations (Mullins et al., 1992; Schmid et al., 2009). Németh (1958, 1970) explained the importance of clonal selection along with the accumulation of knowledge about the varieties, the exploration of advantages and disadvantages of the varieties, the detection of the variability within a variety, the necessity of enhancement of the production value of varieties and the necessity of generating virus-free propagation material.
The maintenance of a variety requires systematic clonal selection to eliminate worthless variations. This way the performance of the variety can be enhanced (Bakonyi and Bakonyi, 1996; Schmid et al., 2009). The extra value of a clone can be demonstrated by the efficiency index of the selection work, which is the genetic progress (Füri et al., 1987). However co-cultivation of more clones of high value can prevent the erosion of genetic variability and unfavourable harvest results (Blaha, 1974; Becker, 1990). It is important that variants of varieties that have been cultivated for a long time on large acreage do not significantly alter the typicity of the wine, also because of the rules of protection of designation of origin (Regner et al., 2007). Enhancement of the production productivity of a variety is possible by positive selection, that is both clonal type (Kozma, 1963) and individual selection. Besides the genetic selection a phytosanitary selection also has to be carried out (Rüdel, 1973; Luntz, 1990; Hajdu, 1990).

Origin and classification of 'Olaszrizling'

The origin of 'Olaszrizling' has not been verified yet. According to Németh (1967b) and Kozma (1993) this variety is of Italian origin and according to Viala and Vermorel (1910) of Austrian origin. Goethe (1878), Turkovic and Turkovic (1952) and Babo (1930) presume that it originates from the Champagne, France, from the region of Marne. What we know for sure is, that this variety was introduced to Hungary after the phylloxera epidemy (Csepregi and Zilai, 1988).
'Olaszrizling' was classified into *V. byzantina* x *V. alemannica* x *V. mediterranea* species by Andrasovszky (1926), who created five species within *Vitis vinifera.* Németh (1967b), based on his natural classification system, placed 'Olaszrizling' into convarietas *occidentalis*, but did not classify it as subconvarietas. Kozma (1993) classified it later into the subconvarietas *italica.* On the contrary, Csepregi and Zilai (1988) and Hajdu (2003) placed it into the subconvarietas *gallica*. Németh (1958, 1962a, 1962b, 1966, 1967a, 1967b, 1968, 1970) studied 'Olaszrizling' under the morphological and agrobiological aspect. He identified seven subvarieties (Apró, Cifra, Nemes, Öreg, Repítős, Rúgós, Sallangos) within 'Olaszrizling'.
Well-known synonyms of 'Olaszrizling' are 'Welschriesling' (German speaking countries); 'Grasevina', 'Talijanska grasevina' (Croatia); 'Italijanski rizling' (Serbia); 'Rizling laski' or 'R. vlassky' (Czech Republic, Slovakia); 'Lasky rizling' (Slovenia); 'Rizling Wallachia' (Romania); 'Risling italico' (Italy); 'Riesling italien blanc' (France) (Goethe, 1878; Németh, 1967b; Rácz, 1997; Cindric et al., 2000).

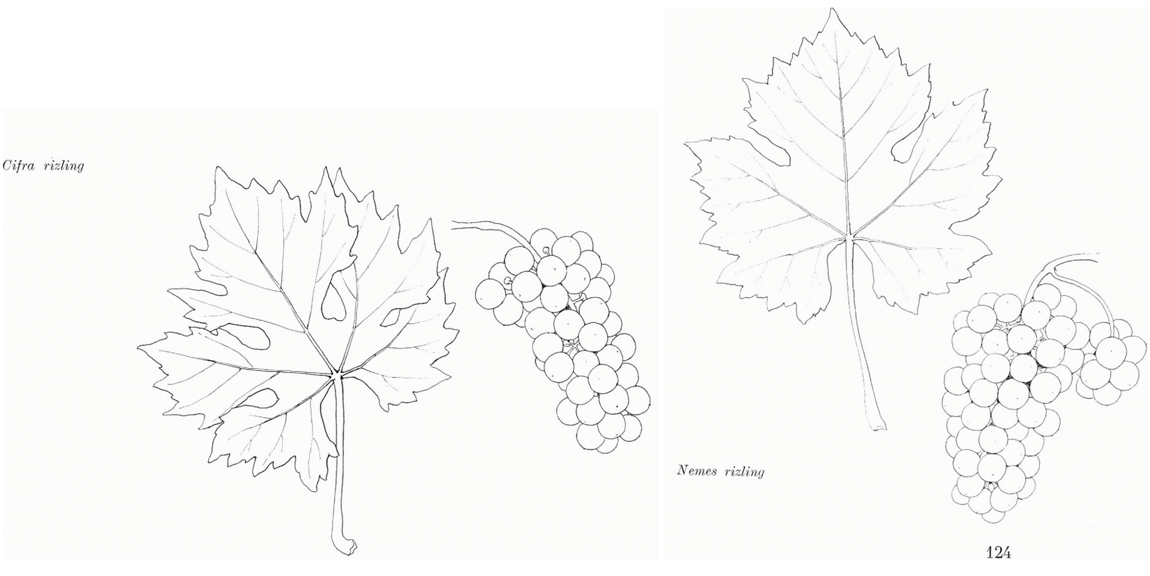
Importance and incidence of 'Olaszrizling'

For some decades 'Olaszrizling' has been the most widely grown white grape variety in Hungary. 'Olaszrizling' also plays an important role in the viticulture and winemaking of Middle-European countries. It is a late-ripening variety, which is well adapted to different environments with long-living stocks. It is medium sensitive to grey rot, the sugar content of the must generally does not exceed 17 to 18 °KMW. (Csepregi and Zilai, 1988). Its enological possibilities are wide: a light, fruity, low-alcohol content wine with reductive technology or a late-harvest, full-bodied, aromatic and flavourful wine fermented (matured) in barrels can be produced from this variety (Diófási, 1995; Eperjesi, 1995). The cultivation area of 'Olaszrizling' reached 26.200 ha in 1960 in Hungary (Csepregi and Zilai, 1988). Its production area and its proportion started to decline in the 1980's due to the spread of international varieties (like 'Chardonnay', 'Sauvignon blanc') and newly bred varieties (like 'Cserszegi fűszeres', 'Ezerfürtű', 'Rizlingszilváni' resp. 'Müller Thurgau', 'Zalagyöngye') (Csepregi, 1993). Presently the production area of white grapevine varieties is 46.710 ha, 10 % of which is occupied by 'Olaszrizling' (Hnt, 2009 and 2011).

Selection breeding of 'Olaszrizling'

The performance of important grapevine varieties is based on selected clones (Hajdu, 2006). The productivity of 'Olaszrizling' can be enhanced efficiently by clonal selection (Németh, 1962b; Bakonyi, 1968; Cindric et al., 1987; Koruza et al., 1987; Grasmuck and Bauer, 2001; Kozma jr. et al, 2009; Kozma jr. et al., 2010). The development of the biological basis of 'Olaszrizling' and clonal selection based on scientific design started at the end of the 1940's in Hungary. In Keszthely Bakonyi and Jeszenszky selected genotypes with higher yield and a better sugar accumulation ability (Bakonyi, 1964; Tomcsányi, 1969). In Pécs Németh (1958, 1967b) found two ('Cifra rizling' and 'Nemes rizling') of the described subvarieties worth for selection (Fig. 1.). He selected P. 10 from the former and P. 2 from the latter.

Fig. 1: 'Cifra rizling' and 'Nemes rizling' (Németh, 1967b)



The main emphasis in the clonal selection of 'Olaszrizling' before the 1980's was on the enhancement of the yield and improvement of the quality. The clones registered as P. 2, a B. 5, a B. 14, a B. 20 and a G. K. 1 represent the results of the breeding work. From the 1980's to 1990's, the fruit quality and the yield stability were enhanced by subclonal selection of the existing clones (e.g. B. 5/8; B. 14/14; B. 20/14, G. K. 18, G. K. 37).

The clones differ from each other in growth vigour, ripening time, bunch structure, sugar content, acidity and in the quantity and quality of aroma compounds (Luntz, 1981; Bakonyi and Bakonyi, 1990; Kiss, 1990; Harsányi and Mádyné, 1999/2000, 2006; Kocsis, 2001; Bakonyi, 2002; Györffyné et al., 2003; Hajdu et al., 2011a, 2011b; Györffyné, 2012). Other countries also have their own 'Olaszrizling' clones and subclones selected by themselves: 25/8 – Slovakia (Horak and Havlik, 1977); 178 – Slovenia (Koruza et al., 1987); A 3-2 – Austria (Grasmuck and Bauer, 2001); SK-13, SK-54, SK-54/4, SK-61 – Serbia (Cindric, 1981; Cindric et al., 1987, 2000).

Material and methods

The selective breeding was conducted based on the 3-step method of Luntz (1990). This is the reduced method of the 4-step method by Németh (1958). Aim of the selection was to find and propagate clones with looser bunches, smaller berries, better sugar accumulation ability, higher resistance to rot and higher internal fruit quality.

First step of the 3-step selection method

In the vineyard of the Institute of Viticulture and Enology Pécs the variability of a 30-year-old 'Olaszrizling' clone P. 2 plantation was studied. In the plantation 75 elite stocks were selected between 2001 and 2009 (Table 1). The elite stocks were pruned for two 10-bud-long canes (umbrella training system). The density of the bunches, the size of the berries and the grade of rot were described using OIV descriptors (Oiv, 2009). The thickness of the berry skin and the intensity of aroma compounds were evaluated on a 1 to 5 scale. The average weight of bunch and berry, yield per stock, sugar content and acidity of the must and the pH were determined. The measured data were analysed by coherence analysis.

Third step of the 3-step selection method

The 10 subclones from the second step of selection were further propagated to 100 to 500 vines per subclone and planted on 1.5 ha in two different wine regions for viticultural and enological investigations. These experimental vineyards were established in 2007 in Pannonhalma Wine Region and in 2010 in Somló Wine Region.

Results

First step of the 3-step selection method

The 75 elite stocks, which had been initially separated for selection, showed significant variability in the morphological characters of the bunch and in the quantity

Table 1: Plant material of the selection

1st step of selection	2nd step of selection
Pécs, 75 elite stocks	Pécsvárad (P. 2/6; P. 2/10; P. 2/11; P. 2/16; P. 2/23; P. 2/29; P. 2/30; P. 2/37; P. 2/41; P. 2/61; control: P. 2) Kölesd (P. 2/6; P. 2/10; P. 2/11; P. 2/16; P. 2/23; P. 2/29; P. 2/30; P. 2/37; P. 2/41; P. 2/61; control: P. 2)

Second step of the 3-step selection method

The initial 75 elite stocks were propagated on 20 to 30 stocks on two sites, site Pécsvárad (wine region of Pécs) and site Kölesd (wine region of Tolna). From the 75 elite stocks 10 were investigated in parcels on the two sites between 2009 and 2011. The elite stocks were pruned for 4 x 2 buds (Royat-cordon). The results were compared to the control (clone P. 2) (Table 1). The density of the bunches, size of the berries and the grade of rot were described using OIV descriptors (Oiv 2009). The thickness of berry skin and intensity of aroma compounds were evaluated on a 1 to 5 scale. The productivity coefficients were evaluated based on the method by Csepregi (1982). The values were analysed by Student's T-test. For each subclone, in five repetitions, the amount of yield, average bunch weight, grade of rot, must sugar content, acidity and the pH were measured. The average berry weight was determined from 100 berries for each subclone. The results were evaluated by discriminant analysis. From the subclones wines were produced, which were evaluated by analytical and organoleptical methods.

of yield, thus this population was appropriate for finding individuals that fulfill the selection aims (Fig. 2 and 3).

Those stocks were selected, which significantly exceedet the average performance of the population, thus the extra production of the stock is genetically determined and did not occur by chance (Fig.3).

In Table 2 data of 10 elite stocks of highest performance were compared to the average performance of the 75 elite stocks. Progress in selection could be detected mainly in sugar accumulating capacity. Evaluation of the 10 most valuable elite stocks was continued in the second step of selection in a small parcel comparison assay (Table 1).

Second step of the 3-step selection method

Productivity coefficients

Productivity coefficients (relative and absolute) were measured in 2010 and 2011 in Pécs Wine Region (at site Pécsvárad) and in 2010 in Tolna Wine Region (at

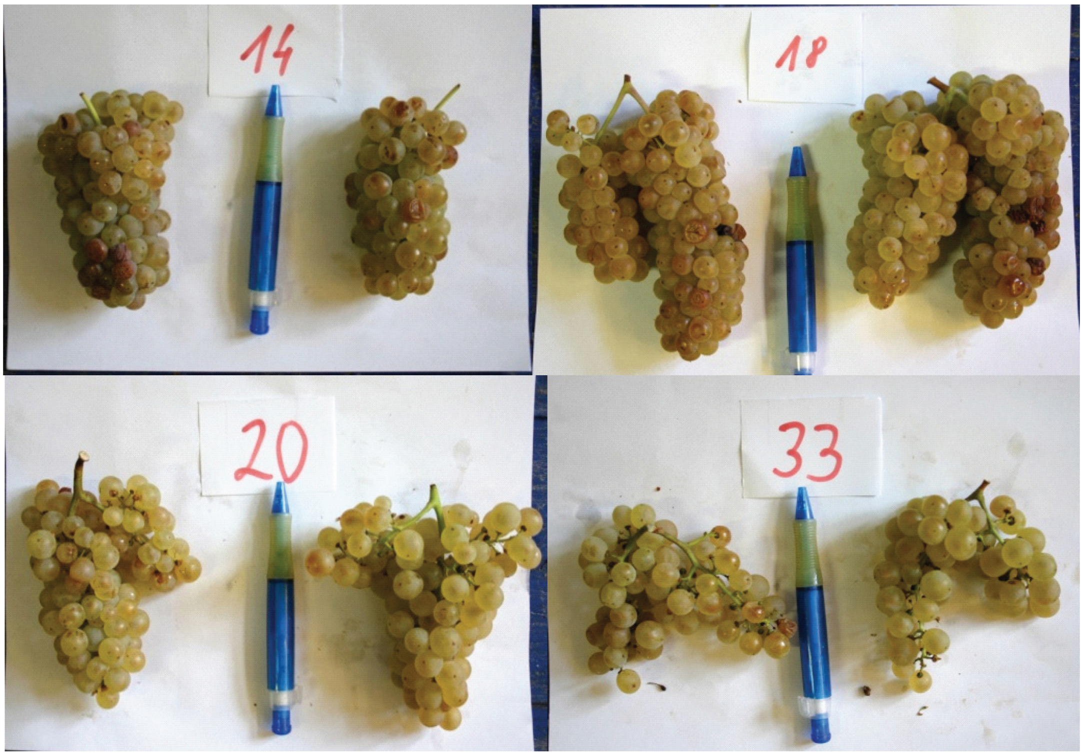


Fig. 2: Typical bunch types of the elite stocks (Pécs)

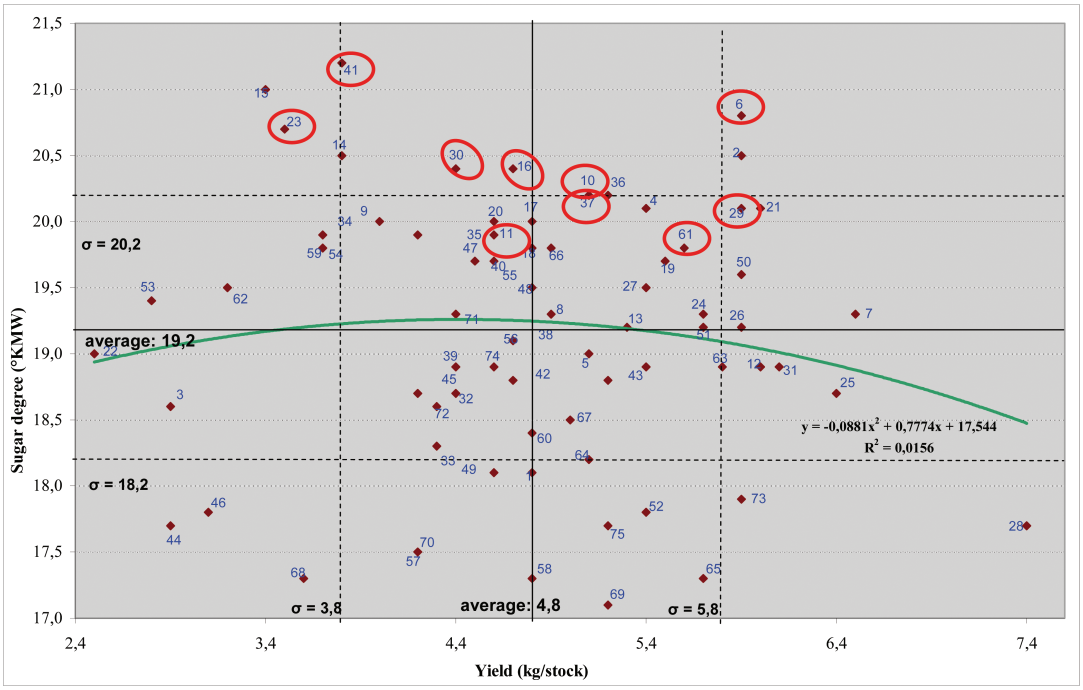


Fig. 3: Yield and must density of selected 'Olaszrizling' P. 2 elite stocks
(Pécs, 2001 to 2009)

Table 2: Comparison of 'Olaszrizling' P. 2; 10 elite stocks of highest to average performance of the 'Olaszrizling' P. 2; 75 elite stocks (Pécs 2001 to 2009); average harvest date: 09. October

Clone	Yield (kg/stock)	Vari-ance	Sugar (°KMW)	Vari-ance	Total acidity (g/l)	Vari-ance	Average bunch weight (g)	Vari-ance	Decay (%)	Vari-ance
6	5.9	2.0	20.8	1.4	6.7	1.4	151	33	22	18
10	5.1	1.9	20.2	1.6	7.0	1.4	141	51	16	16
11	4.6	1.8	19.9	0.8	7.0	1.4	147	28	9	5
16	4.7	1.9	20.4	1.1	7.9	1.6	124	38	7	3
23	3.5	2.7	20.7	2.1	7.0	1.5	110	35	4	1
29	5.9	2.3	20.1	2.2	7.4	1.4	135	43	6	5
30	4.4	1.6	20.4	1.7	6.8	1.4	133	40	18	9
37	5.1	3.3	20.2	2.1	7.5	1.5	130	53	21	19
41	3.8	2.4	21.2	2.0	7.1	2.0	134	29	25	33
61	5.6	2.5	19.8	1.8	7.0	1.5	111	52	16	23
Average of 10 clones	4.9	2.2	20.4	1.7	7.1	1.5	132	40	14	13
Average of 75 clones	4.8	2.3	19.2	1.8	7.2	1.4	131	39	12	11
Difference	0.1	-0.1	1.2	-0.1	-0.1	0.1	0.6	1.2	2.4	2.2

site Kölesd). It was realised that among the subclones there were significant differences with both productivity coefficients (Tables 3 and 4).

In the case of the absolute productivity coefficient, values of two subclones (P. 2/29, P. 2/61) were higher than the control at both sites. Subclone P. 2/37 had higher values for the absolute productivity coefficients in both years (2010 and 2011) at the Pécsvárad site.

In the case of the relative productivity coefficients there was no subclone that exceeded the value of the control in 2010 at both sites. In 2010 there were 3 subclones (P. 2/11, P. 2/29, P. 2/61) at Pécsvárad site and 4 subclones at Kölesd site (P. 2/10, P. 2/11, P. 2/37, P. 2/41) which gave significantly lower values in case of the relative productivity coefficients than the control (Tables 3 and 4).

There were two subclones in Pécsvárad of which the values of both productivity coefficients exceeded that

Table 3: Productivity coefficients (relative and absolute) of 'Olaszrizling' subclones (Pécsvárad, 2010, 2011)

	Control		P. 2/6		P. 2/10		P. 2/11		P. 2/16		P. 2/23	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Absolute coeff. of prod.	1,5	1,6	1,4$^{n.s.}$	1,9**	1,5$^{n.s.}$	1,7$^{n.s.}$	1,5$^{n.s.}$	1,5$^{n.s.}$	1,5$^{n.s.}$	1,6$^{n.s.}$	1,6**	1,6$^{n.s.}$
Relative coeff. of prod.	0,9	1,0	0,9$^{n.s.}$	1,3**	0,9$^{n.s.}$	0,9$^{n.s.}$	0,7*	1,0$^{n.s.}$	1,0$^{n.s.}$	1,0$^{n.s.}$	0,9$^{n.s.}$	1,1$^{n.s.}$

	Control		P. 2/29		P. 2/30		P. 2/37		P. 2/41		P. 2/61	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Absolute coeff. of prod.	1.5	1.6	1.6*	1.6$^{n.s.}$	1.4$^{n.s.}$	1.6$^{n.s.}$	1.6*	1.7*	1.5$^{n.s.}$	1.7$^{n.s.}$	1.6**	1.6$^{n.s.}$
Relative coeff. of prod.	0.9	1.0	0.8*	1.1$^{n.s.}$	0.8$^{n.s.}$	1.1$^{n.s.}$	1.2**	1.1$^{n.s.}$	1.0$^{n.s.}$	1.2**	0.8**	1.0$^{n.s.}$

- values of productivity coefficients were measured from the 1st and 2nd buds of the canes and on shoots developing from latent buds
- subclones were compared to the control
- significance level: 0,05 ≤ *; 0.01 ≤ **; n.s. = no significant difference

Table 4: Productivity coefficients (relative and absolute) of 'Olaszrizling' subclones (Kölesd, 2010)

	Control	P. 2/6	P. 2/10	P. 2/11	P. 2/16	P. 2/23	P. 2/29	P. 2/30	P. 2/37	P. 2/41	P. 2/61
Absolute coeff. of prod.	1.3	1.3$^{n.s.}$	1.4$^{n.s.}$	1.1**	1.2**	1.3$^{n.s.}$	1.5*	1.3$^{n.s.}$	1.4$^{n.s.}$	1.2*	1.5*
Relative coeff. of prod.	0.6	0.6*	0.5**	0.3**	0.6*	0.6$^{n.s.}$	0.8$^{n.s.}$	0.6**	0.5**	0.5**	0.6$^{n.s.}$

-values of productivity coefficients were measured from the 1st and 2nd buds of the canes and on shoots developing from latent buds
- significance level: 0,05≤*; 0.01≤**; n.s. = no significant difference

of the control in a statistically verifiable way (P. 2/37 in 2010, P. 2/6 in 2011).

Results of yield parameters

Figures 4, 5, 6, and 7 show the yield amount (kg/m²), the average bunch weight (g), sugar content of the must (°KMW) and titratable acidity of the must (g/l) at two sites in three vintages (Harvest did not happen at the optimal ripening stage in the very wet year of 2010.)

In case of most subclones considerable differences were observed mainly in the average bunch weights. All of the subclones showed lower values compared to the control one at the site of Kölesd. In the site of Pécsvárad four subclones (P. 2/10, P. 2/16, P. 2/29, P. 2/37) showed also lower or identical values compared to the control. We could not find remarkable differences in yield amount, in sugar content of the must (°KMW) and in acidity among subclones and sites. But the sugar content of the must (°KMW) of subclones P. 2/29 in Pécsvárad and P. 2/23 in Kölesd considerably exceeded that of the control variant. The titratable acidity of subclone P. 2/16 in Pécsvárad was considerably higher than that of all others.

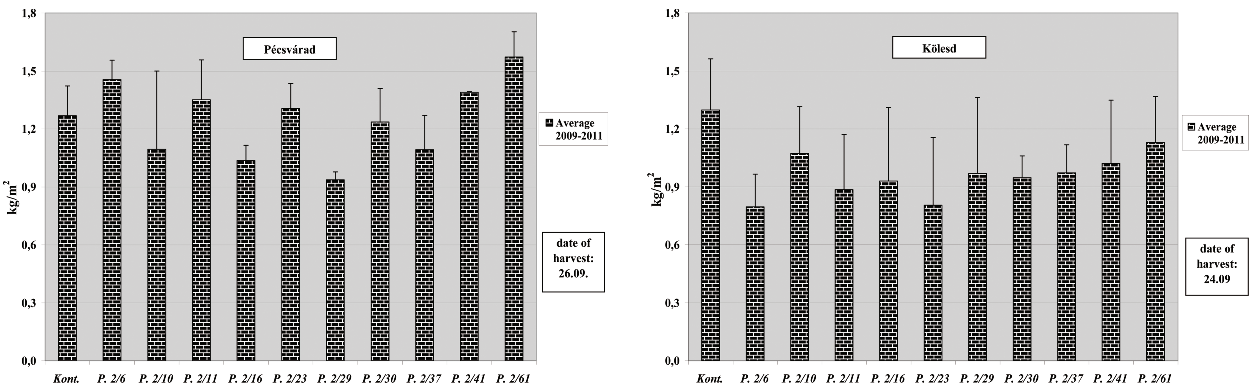


Fig. 4: Yield quantity of 'Olaszrizling' subclones (Pécsvárad and Kölesd, 2009 to 2011

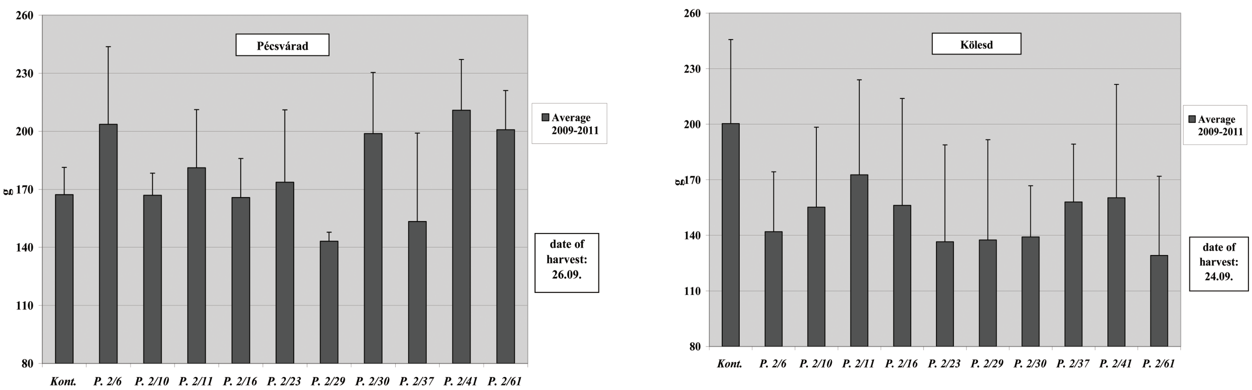


Fig. 5: Average bunch weight of 'Olaszrizling' sublones (Pécsvárad and Kölesd, 2009 to 2011

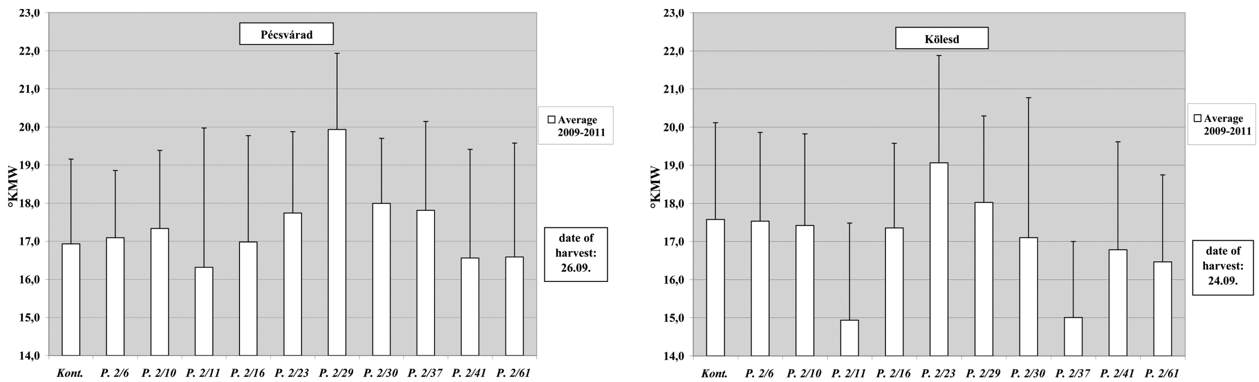


Fig. 6: Sugar content of the must of 'Olaszrizling' subclones (Pécsvárad and Kölesd, 2009 to 2011

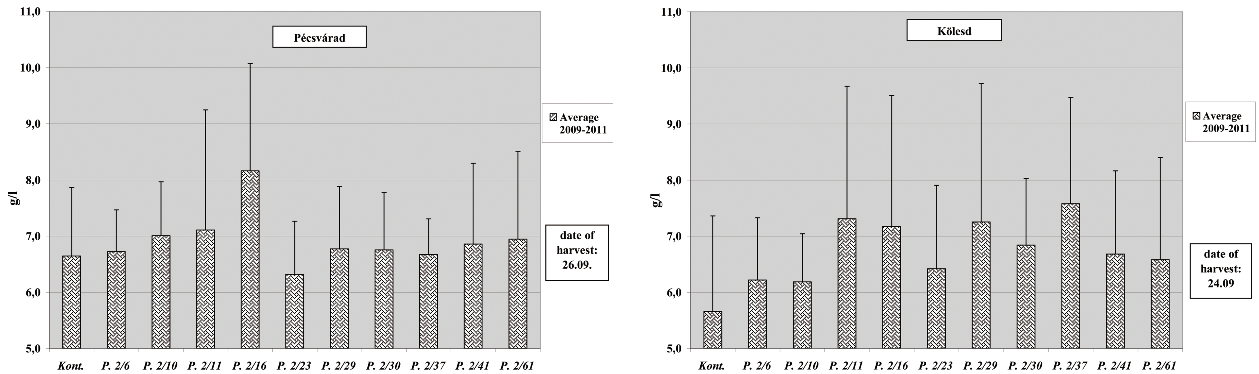


Fig. 7: Titratable acidity in the must of 'Olaszrizling' subclones (Pécsvárad and Kölesd, 2009 to 2011)

Correlations of the effect of sites and vintages were analysed by discriminant analysis, based on yield quantity, average bunch weight, sugar and acid content of the must.

Data were pairwise compared and evaluated: yield quantity to sugar content of must; average bunch weight to sugar content of must; sugar content of must to must acidity. Differences between subclones were analysed also by comparing sites and vintages.

Based on the analysis of all three years, differences between subclones (in percent of the whole variance) are due to yield quantity (kg/m^2: Pécsvárad 86.8 %; Kölesd 86.9 %), average bunch weight (g: Pécsvárad: 84.9 %; Kölesd: 62.3 %) and the sugar content of must (°KMW: Pécsvárad: 79.3 %; Kölesd: 70.8 %) (Table 5). Pairwise comparison of the parameters showed that the differences of yield quantity were nearly at the same level at the Pécsvárad site (77.5 % in 2009, 81.4 % in 2010, 78.7 % in 2011) and different at the Kölesd site (59.6 % in 2009, 91.6 % in 2010, 78.7 % in 2011) (Table 5).

The analysis of the ratio of yield to sugar content of must and the average bunch weight to sugar content of must at the Pécsvárad site is shown in Figures 8 and 9.

It can be stated that in two years (2009, 2011) the yield, average bunch weight and sugar content of must values of subclone P. 2/16 (= number 3/2009 and number 24/2011 in the figures) and subclone P. 2/29 (= number 5/2009 and number 26/2011 in the figures) show the most stable results (the least fluctuation) compared to all the other subclones and the control. In these cases the effect of the subclone surpassed the effect of the year. The differentiation of subclone P. 2/16 from the other subclones and the control was less, that of subclone P. 2/29 more significant.

At the Kölesd site in the differentiation of subclones the effect of the year was of main importance, which means that the different subclones did not affect the values of the examined parameters.

If, based on all of the examined parameters, the differences of the performance of the subclones are charac-

Table 5: Percentage of whole variance of 'Olaszrizling' subclones based on the pair-wise analysis of yield quantity – sugar content of must; average bunch weight – sugar content of must; sugar content of must – must acidity (Pécsvárad and Kölesd, 2009-2011)

Attribute, year / attribute, production area		Sugar content			Must total acidity		
		Pécsvárad	Kölesd	Pécsvárad-Kölesd	Pécsvárad	Kölesd	Pécsvárad-Kölesd
Yield	2009	77.5	59.6	82.1	x	x	x
	2010	81.4	91.6	66.1	x	x	x
	2011	78.7	78.7	86.2	x	x	x
	2009-2011	86.8	86.9	x	x	x	x
Average weight of bunches	2009	70.8	83.8	86.6	x	x	x
	2010	83.0	84.5	71.6	x	x	x
	2011	74.9	59.3	82.5	x	x	x
	2009-2011	84.9	62.3	x	x	x	x
Sugar content	2009	x	x	x	73.6	94.4	61.4
	2010	x	x	x	50.5	69.1	59.5
	2011	x	x	x	74.1	59.3	84.1
	2009-2011	x	x	x	79.3	70.8	x

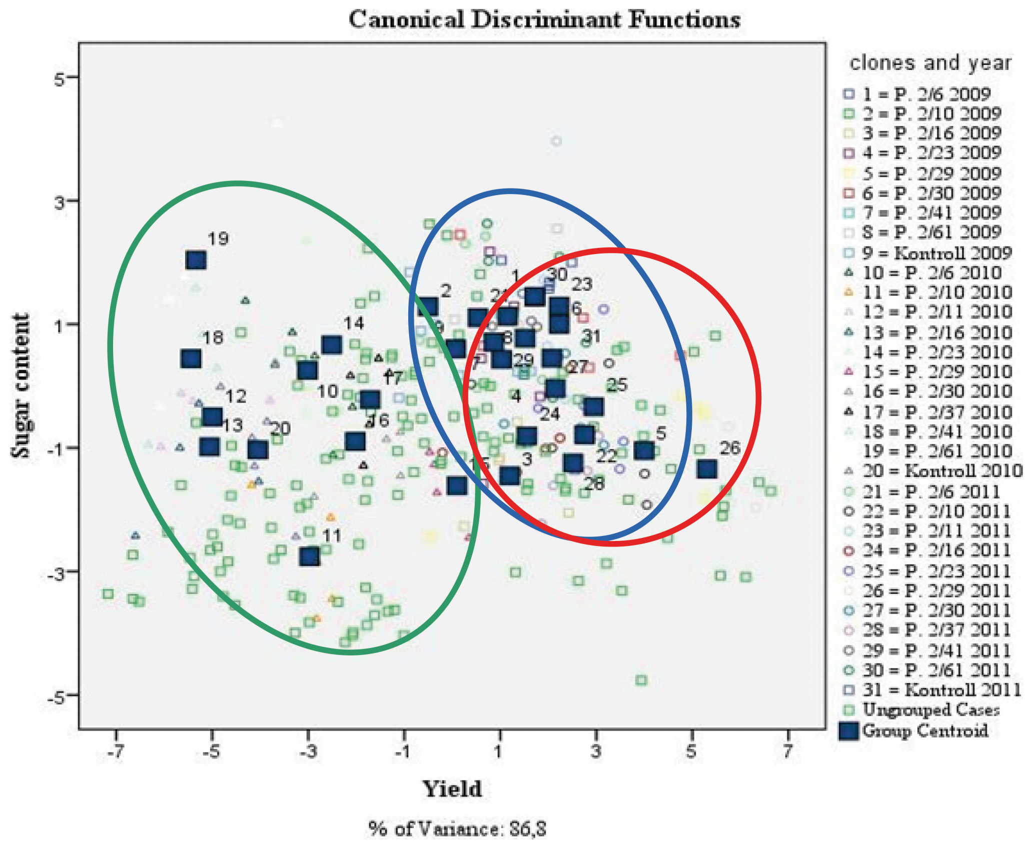


Fig. 8: Differentiation of subclones of 'Olaszrizling' and years by discriminant analysis based on yield and the sugar content of must (Pécsvárad)

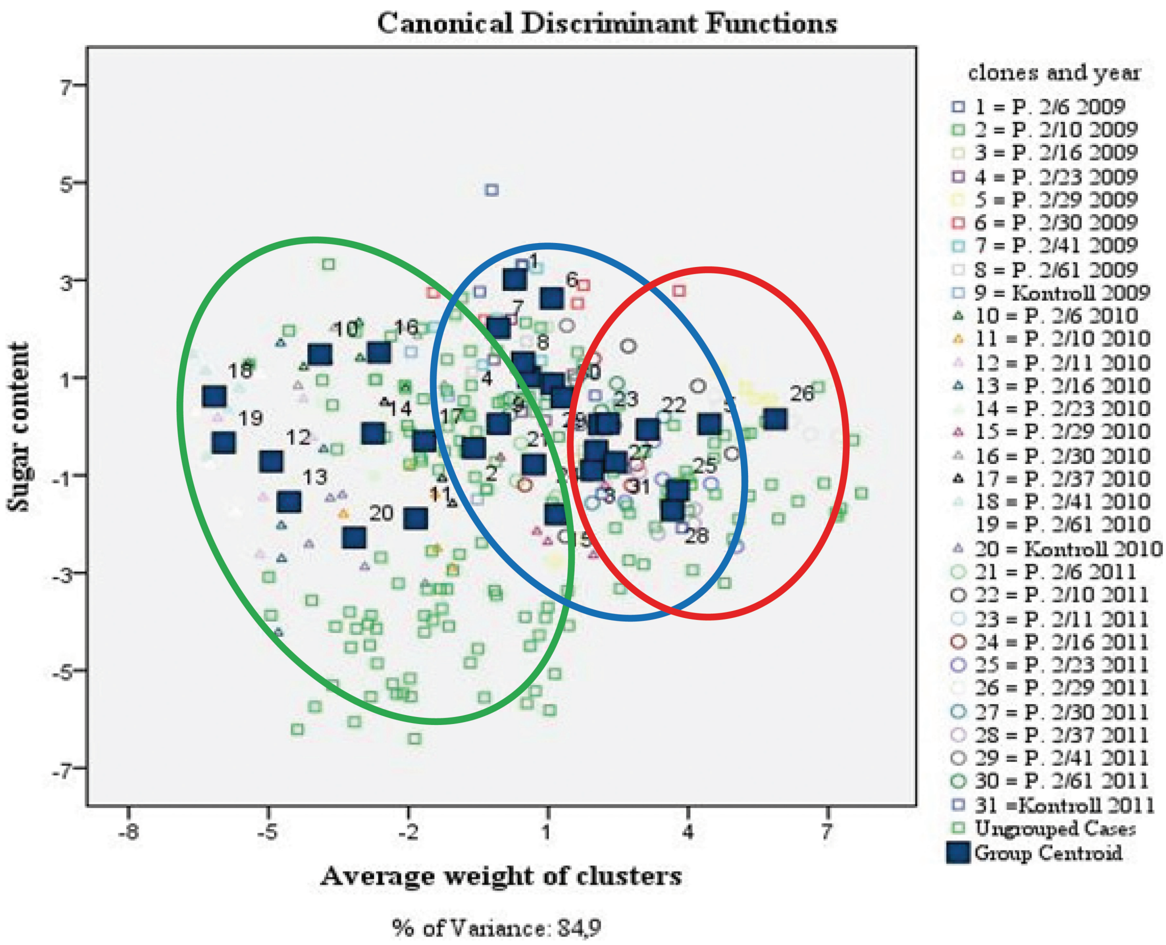


Fig. 9: Differentiation of subclones of 'Olaszrizling' and years by discriminant analysis based on average bunch weight and sugar content of must (Pécsvárad)

terized according to the years, then we can state, that differentiation between the subclones during the three examined years is only experienced in 2009 in the case of subclone P. 2/29. (Fig. 10; number 5 and 14). In other words besides the year the performance of the subclones was also strongly affected by the production site.

The rate of rot of subclones by year and site is displayed in Table 6. The average rotting value of the subclones varies between 2 % and 20 % in the years 2009 to 2011. The wet weather of 2010 caused a higher level of rot. It gave a possibility for thorough observation of the susceptibility to rot of the subclones. Three subclones (P. 2/16, P. 2/23, P. 2/29) showed remarkably lower values of rot at both sites in the average of years compared to the control and other subclones.

Bunch density has a big effect on the level of rot. Fewer berries cause looser clusters which can significantly reduce the damage.

Correlations between susceptibility to rot and berry weight of subclones from Pécsvárad can be seen in Figure 11. Higher berry weight resulted in higher rotting levels. Despite of higher berry weights in the case of subclones P. 2/10 and P. 2/61 a lower level of rotting could be obtained.

Enological results

The analytical results of wines are shown in Table 7 and the results of sensory evaluation in Table 8. There was no apparent difference of relevance between the production sites and subclones in the case of any exa-

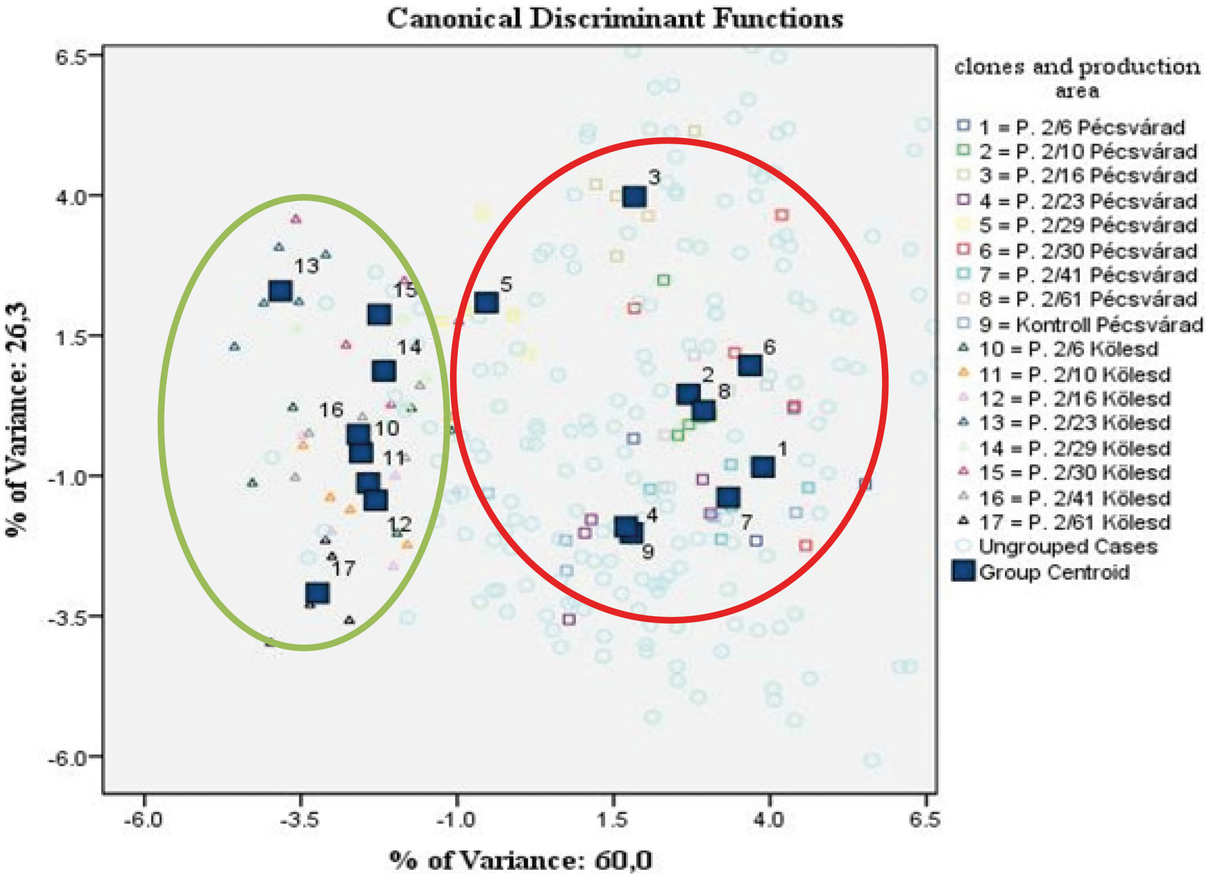


Fig. 10: The differentiation of subclones of 'Olaszrizling' and the production sites by discriminant analysis based on yield, average bunch weight, sugar content of must and must acidity (2009)

Table 6: Rotting rates of subclones of 'Olaszrizling' in percentage (Pécsvárad and Kölesd, 2009 to 2011)

Subclones	2009		2010		2011		Average	
	Pécsvárad	Kölesd	Pécsvárad	Kölesd	Pécsvárad	Kölesd	Pécsvárad	Kölesd
Control	0	9	9	35	0	2	3	15
P. 2/6	0	10	25	51	0	0	8	20
P. 2/10	0	6	8	29	0	1	3	12
P. 2/11	0	7	15	15	0	0	5	7
P. 2/16	0	3	9	12	0	0	3	5
P. 2/23	0	9	18	18	0	0	6	9
P. 2/29	0	8	13	18	0	2	4	9
P. 2/30	0	10	15	33	0	5	5	16
P. 2/37	0	5	26	27	0	0	9	11
P. 2/41	0	10	19	52	1	1	7	21
P. 2/61	0	10	6	18	0	2	2	10

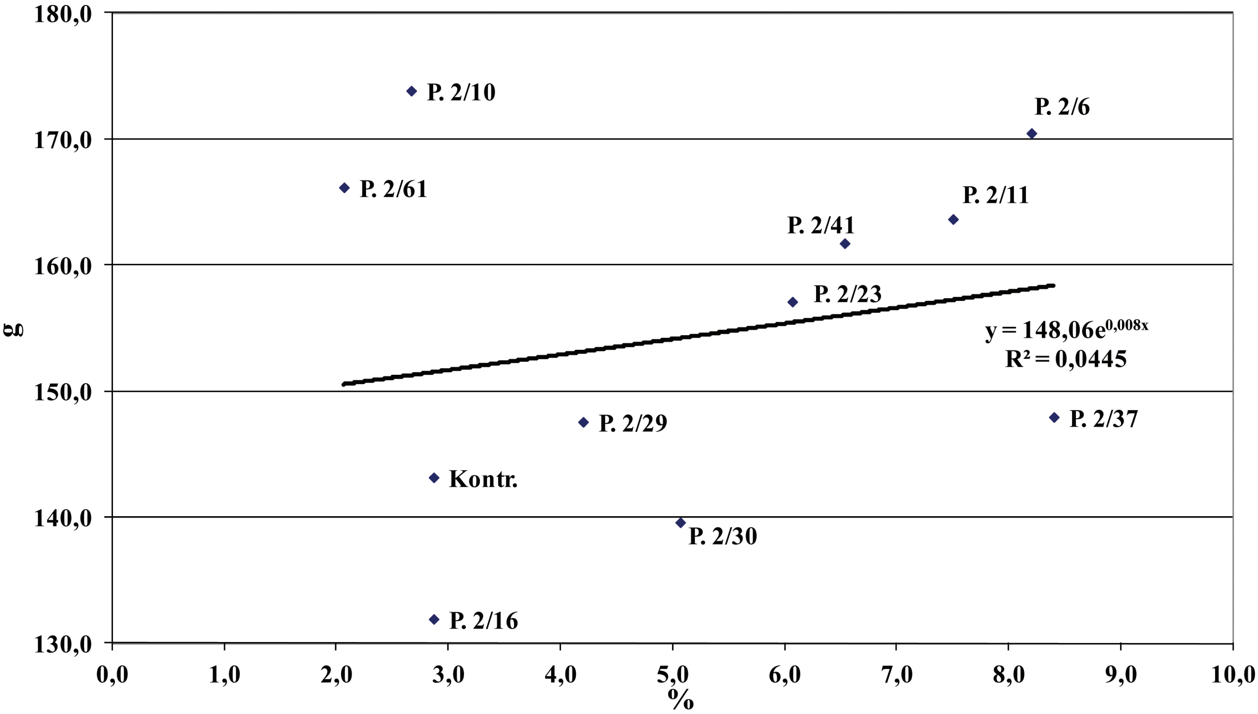


Fig. 11: Correlation between level of rotting and berry weight (100 berries) of subclones of 'Olaszrizling' (Pécsvárad, 2009 to 2011)

mined parameter.

The profile analysis evaluation of the 2011 wines of the subclones is displayed in Figures 12, 13 and 14. The wines of the year 2011 were especially suitable for the evaluation of the subclones of 'Olaszrizling'. More relevant differences among the subclones were apparent at the Pécsvárad site. There the wine quality of the subclones substantially surpassed the performance of the control P. 2. Subclone P. 2/16 was outstanding in fragrance, subclone P. 2/23 in flavour and aroma content, subclone P. 2/30 in perfume fragrance and aroma values. The wine samples from the Kölesd site showed no difference between the quality of the subclones, their performance was identical to that of the control. Based on the viticultural and enological results three

Table 7: Analytical values of wines of subclones of 'Olaszrizling' (Pécsvárad and Kölesd, 2009 to 2011)

Pécsvárad					Kölesd				
Clones/ Attribute	Total acidity (g/l)	pH	Alcohol content (% v/v)	Sugar-free extract g/l	Clones/ Attribute	Total acidity (g/l)	pH	Alcohol content (% v/v)	Sugar-free extract (g/l)
Control	7.1	3.06	11.5	22.2	Control	-	-	-	-
P. 2/6	6.7	3.19	12.2	19.9	P. 2/6	6.7	3.15	12.0	22.3
P. 2/10	6.7	3.18	11.9	19.4	P. 2/10	7.1	3.11	11.4	23.1
P. 2/11	7.6	3.11	12.0	21.6	P. 2/11	7.8	3.11	10.6	21.7
P. 2/16	7.2	3.14	12.0	20.0	P. 2/16	7.2	3.18	12.0	21.7
P. 2/23	7.3	3.07	12.2	20.5	P. 2/23	6.9	3.19	12.3	22.7
P. 2/29	6.8	3.06	12.0	22.5	P. 2/29	7.2	3.15	12.5	20.3
P. 2/30	7.3	3.14	12.3	20.6	P. 2/30	6.7	3.20	12.2	21.8
P. 2/37	6.9	3.13	10.9	21.6	P. 2/37	7.0	3.24	11.0	21.4
P. 2/41	7.0	3.15	11.8	20.2	P. 2/41	6.5	3.25	11.9	24.1
P. 2/61	7.4	3.11	10.7	20.5	P. 2/61	6.7	3.22	11.8	20.8

Table 8: Sensory evaluation of wines of subclones of 'Olaszrizling' (Pécsvárad and Kölesd, 2009-2011)

Clones/ Attribute	2009		20010		2011		Average	
	Pécsvárad	Kölesd	Pécsvárad	Kölesd	Pécsvárad	Kölesd	Pécsvárad	Kölesd
Control	18.1	-	17.9	-	16.5	17.7	17.5	17.7
P. 2/6	17.9	18.2	17.5	17.9	17.6	17.7	17.7	18.0
P. 2/10	17.8	17.9	17.5	18.0	17.6	17.6	17.6	17.8
P. 2/11	-	-	17.6	17.7	17.4	17.5	17.5	17.6
P. 2/16	18.2	18.0	17.5	17.8	17.6	17.4	17.8	17.7
P. 2/23	18.2	17.6	17.9	17.9	17.6	17.6	17.9	17.7
P. 2/29	18.6	18.3	17.7	17.8	16.5	17.5	17.6	17.8
P. 2/30	18.5	18.7	18.0	17.8	17.8	17.9	18.1	18.1
P. 2/37	-	-	18.0	17.5	17.3	17.6	17.6	17.5
P. 2/41	18.1	18.1	17.5	17.7	17.8	17.6	17.8	17.8
P. 2/61	18.6	18.3	17.7	17.9	17.3	17.3	17.9	17.8

subclones (P. 2/16, P. 2/23, P. 2/30) were submitted for registration.

Discussion

A significant selectional progress has been made in growth vigour, bunch structure and the contents must by selection. Significant differences could be shown in productivity of subclones. In the difference of productivity coefficients between the production sites different climatic features may also have played a role.
Among examined subclones, P. 2/16, a P. 2/23, a P. 2/29 and a P. 2/30 showed advantageous bunch clusters, lower average berry weight, lower levels of rotting

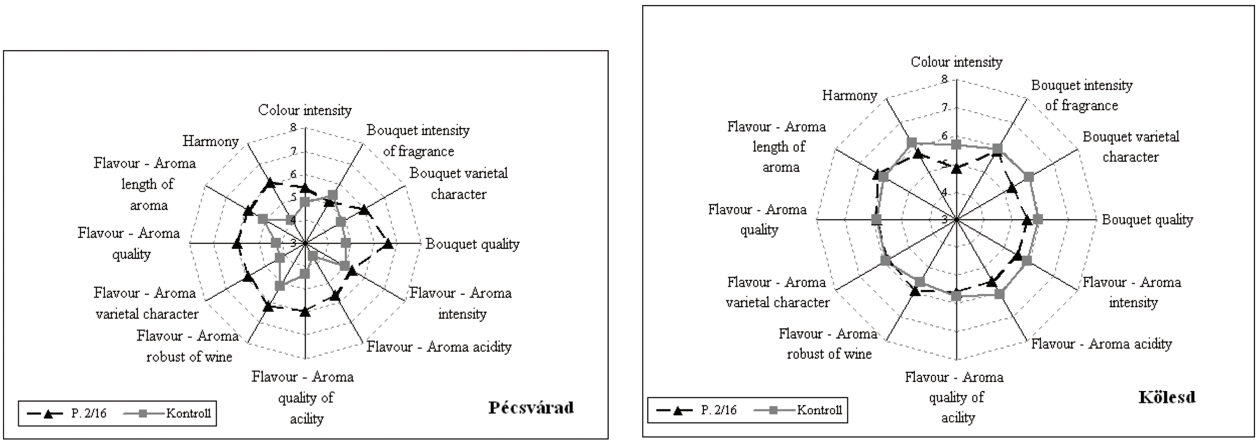


Fig. 12: The profile analysis evaluation of the 2011 wine of subclone P. 2/16 of 'Olaszrizling' (Pécsvárad and Kölesd)

and wine among clones and subclones of 'Olaszrizling' selected in previous decades (Bakonyi, 1968; Cindric, 1981, Luntz, 1981; Harsányi and Mádyné 1999/2000, 2006; Cindric et al., 2000; Kocsis, 2001; Grassmuck and Bauer, 2001; Bakonyi, 2002; Györffyné et al., 2003).
The possibility of subclone selection of the clone P. 2 proves the emergence of variability within the clone. Examinations of elite stocks and selected subclones confirm that the quality of clone P. 2 can be improved and higher levels of quality at the same time.
Besides the year, the production site also significantly influenced the performance of subclones of 'Olaszrizling' P. 2. However, the performance of the subclones P. 2/16 and P. 2/29 is clearly explainable by genetic background beyond any influence of year and production site.
Cindric et al. (2000) and Grassl (2008) also mention that in the case of 'Olaszrizling' the performance of the clones may be highly dependent on the ecologi-

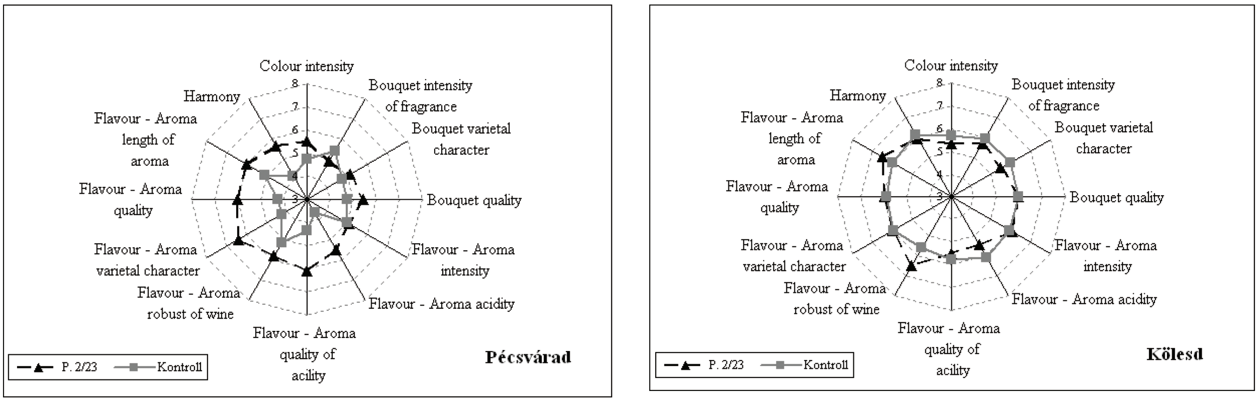


Fig. 13: The profile analysis evaluation of the 2011 wine of subclone P. 2/23 of 'Olaszrizling' (Pécsvárad and Kölesd)

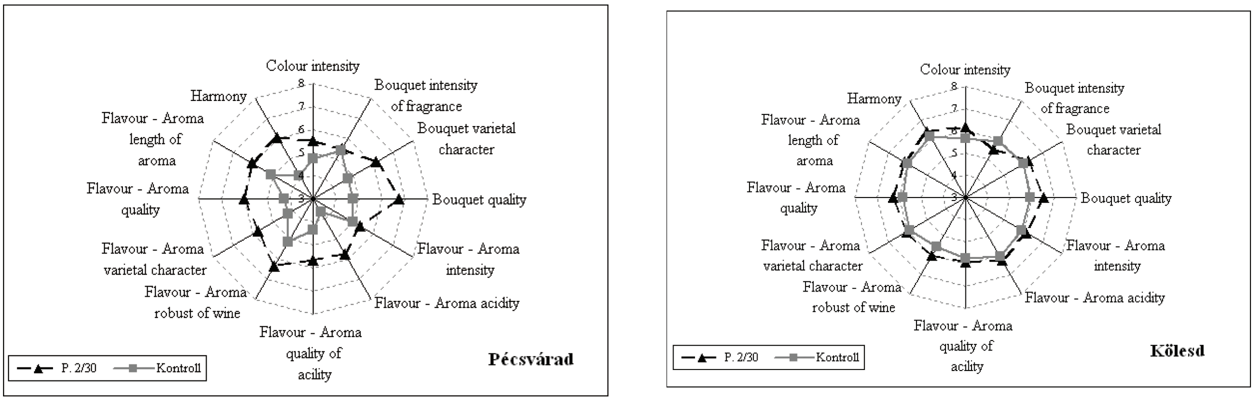


Fig. 14: The profile analysis evaluation of the 2011 wine of subclone P. 2/30 of 'Olaszrizling' (Pécsvárad and Kölesd)

cal features of the production area. This is supported by of the experimental results from Badacsony, Hungary, where the values of locally selected clones and subclones were the most favourable (Györffyné, 2012).This also proves that the importance of a production that is specific to the production site in the case of clones must be emphasized as well.

Regner et al. (2007) – with respect to the variety 'Zöld veltelíni' ('Grüner Veltliner') – mention that although the wines of its clones prove identical in measurable elements and the quality of the wines is highly influenced by the year, the sensory evaluation differentiates between the clones by the results of official national variety experiments (NÉBIH: National Institute for Agricultural Quality Control; Harsányi and Mádyné, 1999/2000 and 2006) and the research of the Research Institute for Viticulture and Enology, Badacsony (Györffyné et al., 2003). The differing wine quality of the clones and subclones of 'Olaszrizling' depending on production sites is described. The sensory evaluation of the wines of subclones of P. 2 analysed by profile analysis confirms that in the components (fragrance, aroma) of each wine there may be considerable differences. Among the subclones with smaller-sized berries the wine of P. 2/16 has a more intensive varietal aroma, the wine of P. 2/23 has typicity and is full-bodied.

Conclusion

Our results confirm former experimental results that an effective enhancement of quality and performance of 'Olaszrizling' is possible through clonal selection

(Németh, 1958, 1962b; Bakonyi, 1968; Horak and Havlik, 1977; Koruza et al., 1987; Luntz, 1981; Bakonyi and Bakonyi, 1990; Wunderer et al., 1991; Grasmuck and Bauer, 2001; Cindric, 1981; Cindric et al., 1987, 2000; Györffyné et al., 2003).
'Olaszrizling' P. 2 had a considerable variability of forms within the plantation assigned for selection, and thus it was suitable for choosing subclones that fulfill selectional requirements the most.
In the 2nd step of the selection a statistically verifiable difference arose between the productivity coefficients of subclones. The values were also affected by year and production site.
Based on discriminant analysis the difference of the viticultural performance was mostly due to yield, average bunch weight and sugar content of the must. Considerable differences arose in the performances of the clones depending on production site.
In the analytical and sensory evaluation of wines no considerable differences were apparent between subclones or production sites. In the sensory evaluation of 2011 wines, however, among the subclones more relevant differences were found within the Pécsvárad production site. There the wine quality of subclones surpassed the performance of the control P. 2 substantially. Based on their viticultural and enological results three subclones (P.2/16,P. 2/23, P.2/30) were submitted for registration in 2012.

References

Andrasovszky, J. (1926): Ampelográfiai tanulmányok. Ampelológiai Intézet évkönyve 8. – Budapest, 1926

Babo, L. (1930): Szőlőművelés. In: Pettenkoffer, S.: Pátria Irodalmi Vállalat és Nyomdai Részvénytársaság. – Budapest, 1930

Bakonyi, K. (1964): Az '*Olasz rizling*' szőlőfajta néhány klónja és szelektálása. - Keszthelyi Agrártudományi Főiskola, Kertészeti Tanszék. Doktori értekezés, 1964

Bakonyi, K. 1968: '*Olasz rizling*' szőlőfajta klónszelektálása és klónjainak értékelése. A Keszthelyi Agrártudományi Főiskola Közleményei 10(15): 1-43

Bakonyi, K. and Bakonyi, L. 1990: A klónszelektálás eredményei a Pannon Agrártudományi Egyetem Keszthelyi Mezőgazdaságtudományi Karán. Szőlőtermesztés és Borászat 12(1/2): 20.

Bakonyi, K. and Bakonyi, L. 1996: Mit ér az '*Olasz rizling*' ma? (II. rész). Borászati Füzetek 8(1): 3.

Bakonyi, L. 2002: A szőlő szelekciós nemesítése és jelentősége borvidékeinken. Int. J. Hortic. Sci. 8(1): 19-23

Becker, H. 1990: A szőlő klónszelekciója a Német Szövetségi Köztársaságban, összehasonlítva a többi országgal. Szőlőtermesztés és Borászat 12(1/2): 7-10

Blaha, J. 1974: Über die Variabilität der morphologischen Eigenschaften der Trauben bei der Klonselektion. Z. Pflanzenzüchtung 71(1): 85-92

Cindric, P. 1981: Prilog poznavanju vrednosti nekih klonova sorte italijanski rizling. Vinogradarstvo i Vinarstvo 14(35/36): 73-77

Cindric, P., Kovac, V. und Vukmirovic, N. 1987: Klonselektion der Sorte ‚Olaszrizling'. Schweiz. Landw. Forsch. 26: 288-290

Cindric, P., Korac, N. and Kovac, V. (2000): Sorte vinove loze. - Novi Sad, 2000

Csepregi, P. (1982): A szőlő metszése és fitotechnikai műveletei. – Budapest: Mezőgazdasági Kiadó, 1982

Csepregi, P. (1993): Szőlőfajták 1961-1990 között létesített üzemi ültetvényeinek területe ötéves bontásban. Szőlőtermesztés III. Fajtaismeret. In: Csepregi, P.: Szőlőtermesztési ismeretek, p. 157-165. – Budapest: Mezőgazdasági Kiadó, 1993

Csepregi, P. and Zilai, J. (1988): Szőlőfajta-ismeret és – használat. – Budapest: Mezőgazdasági Kiadó, 1988

Diófási, L. 1995: Jól gazdálkodunk-e az ‚*Olasz rizling*' fajtával? Borászati Füzetek 7(4): 5-7

Eperjesi, I. 1995: Mit ér az ‹*Olasz rizling*' ma? Borászati füzetek 7(4): 4.

Füri, J. and Németh, M. 1972: Stand der Leistungsselektion bei der Rebe in Ungarn. Wein-Wiss. 27(3/4): 79-86

Füri, J., Hajdu, E. und Csenki, R. 1987: Genetische Selektion in den Weintraubensorten ‚*Lindenblättriger*', ‚*Irsai Olivér*', und ‚*Steinschiller*'. Schweiz. Landw. Forsch. 26: 282-287

Goethe, H. (1878): Handbuch der Ampelographie. – Graz: Leykam, 1878

Grasmuck, K. und Bauer, K. 2001: Zertifiziertes Rebenvermehrungsgut: Steirische Klone im VR-Projekt. Zugelassene ‚*Neuburger*' Klone der Weinbauschule Krems/D. Der Winzer 57(12): 21-24

Grassl, J. 2008: Ergebnisse vierjährigen Mikrovinifikationen: Welcher Klon ist der beste? Der Winzer 64(3): 22-24

Györffyné, J.G. 2012: Újabb klónok Badacsonyból. Kertészet és Szőlészet 61(3): 18-19

Györffyné, J.G., Májer, J. and Pernesz, G. (2003): Grape varieties from Badacsony registered for state recognition. Lippay-Ormos-Vas Scientific Conference. Hortic. Sci., p. 505 (Abstract). – Budapest, 2003

Hajdu, E. 1990: A klónszelekció kecskeméti eredményei és kutatási feladatai. Szőlőtermesztés és Borászat 12(1/2): 10-14

Hajdu, E. (2003): Hungarikumok. Magyar szőlőfajták. – Budapest Mezőgazdasági Kiadó, 2003

Hajdu, E. 2006: Grape vine breeding by selection and its results in Hungary. Kertgazdaság 38(4): 39-45

Hajdu, E., Cindric, P. and Korac, N. (2011a): Honosított szőlőfajták. '*Olasz rizling*'. In: Hajdu, E. (szerk.): Szőlőfajták, szaporítóanyaguk és betegségeik. p. 62-63, 99-100. – Budapest: Agroinform, 2011

Hajdu, E., Korac, N., Cindric, P., Ivanisevic, D. and Medic, M. 2011b: The importance of clonal selection of grapevine and the role of selected clones in production of healthy propagating stocks. Int. J. Hortic. Sci. 17(3): 15-24

Harsányi, J. and Mády, R. 1999/2000: Szőlő- és gyümölcsfajták. Leíró fajtajegyzék. National Institute for Agricultural Quality Control. – Budapest, 1999/2000

Harsányi, J. and Mády, R. 2006: Szőlő- és gyümölcsfajták. Nemzeti Fajtajegyzék. Szaporításra egyedileg engedélyezett fajták jegyzéke. National Institute for Agricultural Quality

Control. – Budapest, 2006
HNT (2009, 2011): Szőlőültetvények területi adatai borvidékenként, statistics. – Budapest (National Council of Winecommunity)
Horak, J. and Havlik, J. 1977: Z vysledku klonové selekce révy vinné. Vinohrad 15(10): 230-231
Király, F. and Németh, M. 1957: Szőlőnemesítés 1950-1957. A Szőlészeti Kutató Intézet Pécsi Telepének beszámolója az 1957. évi kísérletekről. Pécs 7(1): 54-59
Kiss, E. 1990: A klónszelekció eredményei Badacsonyban. Szőlőtermesztés és Borászat 12(1/2): 15-17
Kocsis, L. (2001): Államilag minősített szőlőfajták, államilag minősített klónok, szőlőfajtajelöltek. Veszprémi Egyetem Georgikon Mezőgazdaságtudományi Kar Kertészeti Tanszékének Kiadványa. – Keszthely, 2001.
Kozma, P. (1963): A szőlő termékenységének és szelektálásának virágbiológiai alapjai. – Budapest: Akadémiai Kiadó, 1963
Kozma, P. (1993): A szőlő és termesztése II. A szőlő szaporítása és termesztéstechnológiája. – Budapest: Akadémiai Kiadó, 1993
Kozma, P. jr., Werner, J. and Forgács, B. 2009: Evaluation and clone selection of 'Hungarica' grapevine varieties to increase the range of choice of grape varieties for quality wine production. Hungarian Agric. Res. 18(3/4): 25-30
Kozma, P. jr., Werner, J., Csikászné, K. A. and Hoffmann, S. 2010: The heritage of Németh Márton in Pécs, the effect of his like-work on the viticulture of today. Kertgazdaság 42(3/4): 56-72
Kozma Jr., P. and Werner, J. 2007: Subclonal selection of 'Welschrieling' P. 2. Lippay-Ormos-Vas Scientific Conference. Horticultural Science, Abstract, Budapest, Hungary, 257
Koruza, B., Zafosnik, A. and Petan, P. 1987: The results of clonal selection (*Vitis vinifera L., cv. 'Olaszrizling'*) in Slovenia. Zbornik Biotehniske Fakultete v Ljubljani (49): 137-147
Luntz, O. 1979: A szőlő fajtafenntartás, a klónszelektálás, valamint a honosítás helyzete és eredményei. Szőlőtermesztés és Borászat 2(1): 24-25
Luntz, O. 1981: A Balaton-felvidéki szőlőtermesztés fejlesztéséhez ajánlott új klónok és hibridek. Szőlőtermesztés és Borászat 3(2): 13-15
Luntz, O. 1990: A klónszelekció hazai helyzete és eredményei. Szőlőtermesztés és Borászat 12(1-2): 2-7
Màjer, J. and Györffyné, J. G. 2010: Fajtaajánló. Badacsonyban nemesített szőlőfajták. http://www.szbki-badacsony.hu/index, (10.10.2010)
Mullins, M.G., Bouquet, A. and Williams, L. E. (1992): Biology of the grapevine. – Cambridge: Cambridge Univ. Press, 1992
Németh, M. 1958: A borszőlőfajták összehasonlító értékvizsgálata és klónszelektálása. Szőlészeti Kutató Intézet Évkönyve 11(1): 261-326
Németh, M. 1962a: A klónszelektálás eredményei. A Szőlészeti Kutató Intézet kutatási eredményei (1): 58-60
Németh, M. 1962b: Az '*Olasz rizling*' alakjai és termesztési értékei a Mecseki Borvidéken. Kertészet és Szőlészet 11(12): 16-17
Németh, M. (1966): Borszőlőfajták. In: Hegedűs, Á., Kozma, P. and Németh, M.: Magyarország kultúrflórája. A szőlő. – Budapest: Akadémiai Kiadó, 1966
Németh, M. 1967a: Klónszelekciós szőlőnemesítés módszerei Pécsett és az elért eredmények. Szőlő- és Gyümölcstermesztés (3): 41-92
Németh, M. 1967b: Ampelográfiai album – termesztett borszőlőfajták 1. – Budapest: Mezőgazdasági Kiadó, 1967
Németh, M. 1968: Az '*Olasz rizling*' alfajtái, tekintettel a tetraploidokra. Az Országos Szőlészeti és Borászati Kutató Intézet Évkönyve (13): 159-190
Németh, M. 1970: A szőlőfajták hozamnövelése és minőségjavítása klónszelektálással. Agrártudományi Közlemények 29(3): 437-443
Oiv (2009): Oiv descriptor list for grape varieties and Vitis species (2nd edition). – Paris: Organisation Internationale de la Vigne et du Vin, 2009
Rácz, J. (1997): Kétszáz magyar szőlőnév. – Budapest: Magyar Nyelvtudományi társaság, 1997
Regner, F., Hack, R., Hanak, K., Schreiner, A., Beisert, R. und Rauhut, D. 2007: Variabilität innerhalb der Rebsorte *'Grüner Veltliner'*. Mitt. Klosterneuburg (58): 105-116
Rüdel, M. 1973: Vergleichende Untersuchungen zur Bewertung der Selektionsmerkmale bei reisigkranken Reben. 2. Ausprägung von Krankheitsmerkmalen an Reben. Wein-Wiss. 28(3): 147-159
Sartorius, O. 1928: Über die wissenschaftlichen Grundlagen der Rebenselektion in reinen Beständen. Z. Pflanzenzüchtung (13): 79-86
Schmid, J., Manty, F. und Lindner B. (2009): Geisenheimer (Geisenheimer Berichte, 67)
Schöffling, H. 1971: Orientierungsdaten zum Klonen-Neuaufbau. Dt. Weinbau 26(2): 51-54
Steingruber, P. 1932: Die Grenzen des Erfolges bei Selektion im Weinbau. Gartenbauwissenschaft 7: 178-195
Tomcsányi, P. (1969): A szőlő nemesítése. A szőlőnemesítés alapjai és történeti fejlődése. In: Kapás, S. (szerk.): A magyar növénynemesítés. p. 685-686. – Budapest: Akadémiai Kiadó, 1969
Turkovic, Z. and Turkovic, G. (1952): Ampelografski atlas; 1. – Zagreb, 1952
Viala, P. et Vermorel, V. (1910): Traité général de viticulture. Ampélographie. Tome 1 – 7. – Paris: Masson, 1910
Wunderer, W., Mayer N. und Schmuckenschlager, J. 1991: Ergebnisse einer Leistungsprüfung von ‚*Welschriesling*'-Klonen. Mitt. Klosterneuburg (41): 186-189

Received November 6, 2012