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ARTICLE

Discrimination of grape varieties by Start Codon Targeted genotyping using partially degenerate primers

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ABSTRACT DNA fingerprinting of crop species should be technically simple and easy-to-perform, reproducible, and should provide sufficient amount of information. PCR-based methods can meet one or more of these criteria, but they often employ multiple discrete primers or require to test large number of arbitrary primers to provide enough information, which make these methods technically complicated. Our aim was to develop a simple, reproducible, PCR-based method for grape genotyping, which overcomes these limitations. We tested twelve, partly degenerate primers to genotype 14 Hungarian and international grape varieties and found one primer producing 17 polymorphic bands after data normalization, which was sufficient to separate the varieties. The discriminating power of this primer, in term of the number of polymorphic bands, PIC and Rp values, was the same or better than the SCoT primers with definite sequences described in previous studies. The phylogenetic tree obtained using sequences amplified with this primer was reliably consistent with the publicly available information about the genetic origin of some of the tested varieties. We developed a simple and accurate method to genotype grapevine, which provided sufficient amount of data to discriminate 14 varieties.
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KEY WORDS
degenerate primer
genotype
grapevine cultivar
PCR
SCoT marker

Introduction

PCR-based DNA fingerprinting techniques are popular in plant biology for genotyping, species/variety separation and phylogenetic studies, because they are relatively easy to perform. These methods can be broadly categorized into three groups (Poczai et al. 2013). Conserved DNA-, gene family-, transposon-, resistance gene- and RNA-based fingerprinting techniques require prior knowledge of the target gene sequences for primer design. RAPD, ISSR and AFLP fingerprinting methods use arbitrary primers and therefore no knowledge about the amplified sequences is needed. Targeted fingerprinting methods, such as SRAP (Sequence-Related Amplified Polymorphism) and SCoT (Start Codon Targeted) are between the arbitrary and other targeted techniques, since they require no or limited sequence information but still target genomic regions more or less specifically.

Of the targeted fingerprinting methods, SRAP genotyping employs 16-18 bp long forward and reverse primer pairs. The forward and reverse primers have constant, but different sequence, and their 3' triplet can be varied, which provide a certain level of amplification specificity. The SRAP molecular marker system was developed for *Brassica* (Li and Quiros 2001) and has been used in turf grass (Budak et al. 2004), bean (Alghamdi et al. 2012) and in a number of other crop species (Aneja et al. 2012). SCoT genotyping (Collard and Mackill 2009) is based on the amplification of genomic DNA using a single primer, which targets the conserved region around the start codon of highly (for example LEA, seed storage, mitochondrial, ribosomal, proline-rich and glycine-rich proteins, histones, globulins, calmodulins, just to name a few) and lowly (for example regulatory, signal transduction and cell wall proteins) expressed plant genes (Sawant et al. 1999). SCoT has been used to fingerprint rice (Collard and Mackill 2009), mango (Luo et al. 2010), potato (Gorji et al. 2011), peanut (Xiong et al. 2011), and ramie (Satya et al. 2015).

In grape (*Vitis vinifera*), which is a major crop worldwide with numerous international and very large number of local varieties, RAPD has been quite widely used for variety identification, polymorphism and diversity studies (Kocsis et al. 2005; Karataş and Ağaoğlu 2008; Salayeva et al. 2010; Butiuc-Keul et al. 2011; Zhao et al. 2011). SRAP and SCot genotypings were employed less frequently to study the relationship of cultivated grape varieties and/or wild grape species (Guo et al. 2012a; Liu et al. 2012).

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Ideally, a PCR-based genotypic method should produce a reasonable number of polymorphic bands, as only those have a diagnostic value. Moreover, this goal should be achieved using as few as possible primers or primer combinations. In methods such as RAPD, which use arbitrary primers, or in targeted fingerprinting, such as SRAP and SCoT, the design of primers is easy, since it can be done *in silico*. However, the problem with these methods is the large number of possible primer variations and consequently a large-scale testing of them is a major concern. For example, in RAPD random hexamers are used as primers and there are 4,096 variations of such oligonucleotides. In SRAP, the number of the 3' triplet variations for one primer can be 64, and because SRAP primers are used in pairs, 4,096 (64 x 64) combinations are possible. This number increases further by varying the core region of the primers. Even in SCoT genotyping, in which the number of possible primers is far less than in RAPD and SRAP, several dozens of primers have been tested (Collard and Mackill 2009).

In this study, we describe a simple and efficient SCoT genotyping of grapevine, in which we tested only twelve partially degenerate primers, and showed that a single primer was able to discriminate 14 cultivated international and local varieties being important for the Hungarian wine industry.

Materials and Methods

Young leaf samples of 14 Hungarian and international wine grape varieties (11 local 'Olaszrizling' ['Italian Riesling'] clones plus 'Furmint', 'Hárslevelű', 'Leányka', 'Ezerjó', 'Szürkebarát' ['Pinot Gris'], 'Rajnai Rizling' ['Rheine Riesling'], 'Chardonnay', 'Kékfrankos', 'Kadarka', 'Portugieser', 'Merlot', 'Pinot Noir' and 'Cabernet Savignon') were obtained from the vineyards of the Research Institute for Viticulture and Enology, National Agricultural Research and Innovation Center, Badacsony, Hungary.

DNA was isolated using the DNeasy Plant Mini Kit (Qiagen, Hilden, Germany) according to the instructions of the manufacturer, followed by an additional purification step using the Zymo OneStep PCR Inhibitor Removal Kit (Zymo Research, Irvine, CA, USA). DNA samples were quantified using a NanoDrop spectrophotometer (Thermo Fisher Scientific, Wilmington, DE, USA) and then diluted to 10 ng/µl for PCR.

PCR was performed in a 20 µl reaction volume comprising 40 ng DNA, 1 µM primer, 200 µM of each dNTPs, 1× final concentration of DreamTaq Green Buffer and 1.25 U DreamTaq Green DNA Polymerase (Thermo Fisher Scientific, Wilmington, DE, USA). The following PCR conditions were used: 1 cycle for 3 min at 94 ºC; 35 cycles of 94 ºC, 1 min, 50 ºC, 1 min, 72 ºC, 1 min; 1 cycle for 10 min at 72 ºC. PCR products were separated on 1% (w/v) agarose gel in 1× TBE buffer and the gels were photographed under UV illumination. Primer sequences (Table 1) were designed from the consensus sequences around the ATG start codon of highly and lowly expressed plant genes (Sawant et al. 1999), and were custom synthesized by Integrated DNA Technologies (Leuven, Belgium).

Gel images were analyzed by the freeware GelAnalyzer (www.gelanalyzer.com) using the "Valley-to-valley" option for background subtraction. Since diffuse bands can have a large total peak area, the peak height of the bands above the background was determined instead of the value of the total peak area. Peak height values in each sample were Z-score normalized in Excel, by which process the mean value and the standard deviation of the normalized intensities became 0 and 1, making the samples comparable. After normalization, the bands in each varieties with Z-score larger than the standard deviation of the normalized intensities (*i.e.* 1) were retained and allocated a value of 1, while the bands that were not present in a particular variety or had a Z-score smaller than 1 were dismissed and allocated the value of 0. The bands, which had only zero values in all varieties, were considered monomorphic, and the bands having both 1 and 0 values across varieties were considered as polymorphic. By this way, seventeen polymorphic bands were identified and the binary matrix obtained from their 0 and 1 values was used to perform cluster analysis of the samples using the R programming environment. The Euclidean distances between grape varieties were calculated using the "dist" function. Distance values were used to visualize the linkage-based clustering by the "hclust" function. Primer's Resolving power (Rp) and the Polymorphic Information Content (PIC) was calculated according to Gorji et al. (2011).

Results

The aim of this study was to design a simplified SCoT genotyping method by reducing the number of potential primers, which should be tested in order to receive polymorphic bands. To do this, six sequences were extracted from each of the conserved nucleotide sequence around the start codon of genes expressed at high or low levels, respectively (Sawant et al. 1999). Each sequence carries the ATG start codon at different position and the surrounding sequences, in which some nucleotides are degenerate (Sawant et al. 1999). Thus, in contrast to definite primers used by others for SCoT genotyping, we used partly degenerate primers in our study (Table 1).

Using single primers, PCRs were performed and the products were analyzed by agarose gel-electrophoresis. No products were detected with primers LE3, LE4 and LE5. For all other primers, the total number of bands for any primer

Table 1. Primers used in this study.

Primer [a]	Sequence (5′-3′) [b]
HE1	AATGGCTNCCT/ACNAC/TA/CCC
HE2	CAATGGCTNCCT/ACNAC/TA/CC
HE3	ACAATGGCTNCCT/ACNAC/TA/C
HE4	AACAATGGCTNCCT/ACNAC/T
HE5	A/CAACAATGGCTNCCT/ACNA
HE6	TA/CAACAATGGCTNCCT/ACN
LE1	NATGGNGNNGNNANANCC
LE2	ANATGGNGNNGNNANANC
LE3	G/AANATGGNGNNGNNANAN
LE4	NG/AANATGGNGNNGNNANA
LE5	NNG/AANATGGNGNNGNNAN
LE6	NNNG/AANATGGNGNNGNNA

[a] HE and LE, primers from around the start codon sequence of highly and lowly expressed plant genes (Sawant et al. 1999); [b] The ATG start codon is underlined.

ranged from twelve (primer LE2) to 44 (primer HE3). With the exception of primer LE2, for which all bands were monomorphic, polymorphic bands outnumbered monomorphic ones (Table 2), although the polymorphic/monomorphic ratio varied substantially from 1.4 to 5.0 (Fig. 1). Band intensities were normalized as described in the Materials and Methods section to make samples comparable. Elimination of the bands whose normalized intensity was below the set threshold reduced the total number of bands in each sample (Table 2). Only polymorphic bands remained after normalization for primer HE6 (Table 2), but the obtained seven bands did not discriminate the 14 varieties (data not shown). Other primers did not discriminate the varieties either, due to the low number of polymorphic bands. For primer HE3, for which 44 bands were detected in the genotyping (Fig. 1), 17 polymorphic bands remained after the thresholding (Table 2 and Supplementary Table 1). This polymorphism obtained by primer HE3 was sufficient to completely discriminate the varieties, but did not discriminate between the ‘Olaszrizling’ (‘Italian Riesling’) clones. The intra-varieties discrimination power of primer HE3 is reflected by its high PIC and Rp values of 0.997 and 5.86, respectively.

Cluster analysis of the 14 varieties using the binary matrix generated from polymorphic bands obtained with primer HE3 revealed three major clusters (Fig. 3). In the top cluster, three well-separated clades were observed, containing ‘Chardonnay’, a mixture of both white and red varieties and ‘Merlot’, respectively. The middle cluster contains all of the ‘Olaszrizling’ (‘Italian Riesling’) clones and two Hungarian white grape varieties, ‘Hárslevelű’ and ‘Leányka’, and an international red variety, ‘Portugieser’. In the bottom cluster, two clades were observed, containing white (‘Pinot Gris’ and ‘Rheine Riesling’) and red (‘Kadarka’ and ‘Pinot Noir’) varieties, respectively.

Table 2. Numbers of bands obtained in grapes using degenerate SCoT primers.

Primer	Number of bands					
	Before normalization			After normalization		
	Total	Mono-morphic	Poly-morphic	Total	Mono-morphic	Polymor-phic
HE1	17	4	13	2	1	1
HE2	22	9	13	4	3	1
HE3	44	7	37	17	0	17
HE4	30	8	22	6	1	5
HE5	42	7	35	6	1	5
HE6	25	7	18	7	0	7
LE1	17	5	12	1	1	0
LE2	12	12	0	3	3	0
LE3	0	n.a.	n.a.	n.a.	n.a.	n.a.
LE4	0	n.a.	n.a.	n.a.	n.a.	n.a.
LE5	0	n.a.	n.a.	n.a.	n.a.	n.a.
LE6	26	6	20	4	1	3
Total	235	65	170	50	11	39

[a] n.a. = not applicable

Discussion

In this study, we described the Start Codon Targeted (SCoT) genotyping of 14 Hungarian and international grape varieties. We tested only twelve degenerate primers, which represent a significant reduction compared to other studies. In potato, Gorji et al. (2011) used 12 SCoT primers in 15 combination, although the theoretical number of combination for twelve primers is 144. In both rice and Chinese grape varieties, 36 primers were tested (Collard and Mackill 2009; Guo et al. 2012b), while in mango, peanut and ramie, 33, 18, and 20

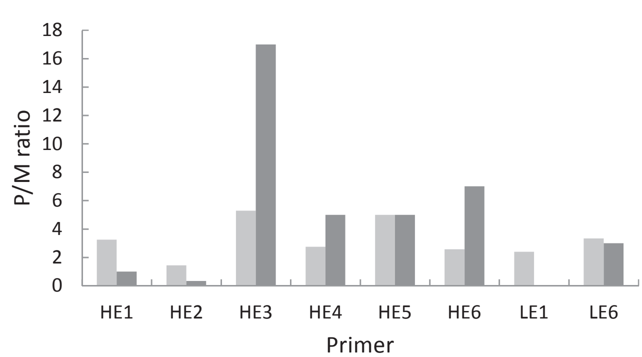

Figure 1. Ratios of the polymorphic/monomorphic (P/M) bands. ■: before normalization; ■: after normalization. For both before and after normalization, for primers with no polymorphic bands, no ratio is shown and for primers with no monomorphic bands, the number of polymorphic bands is shown (Table 2).

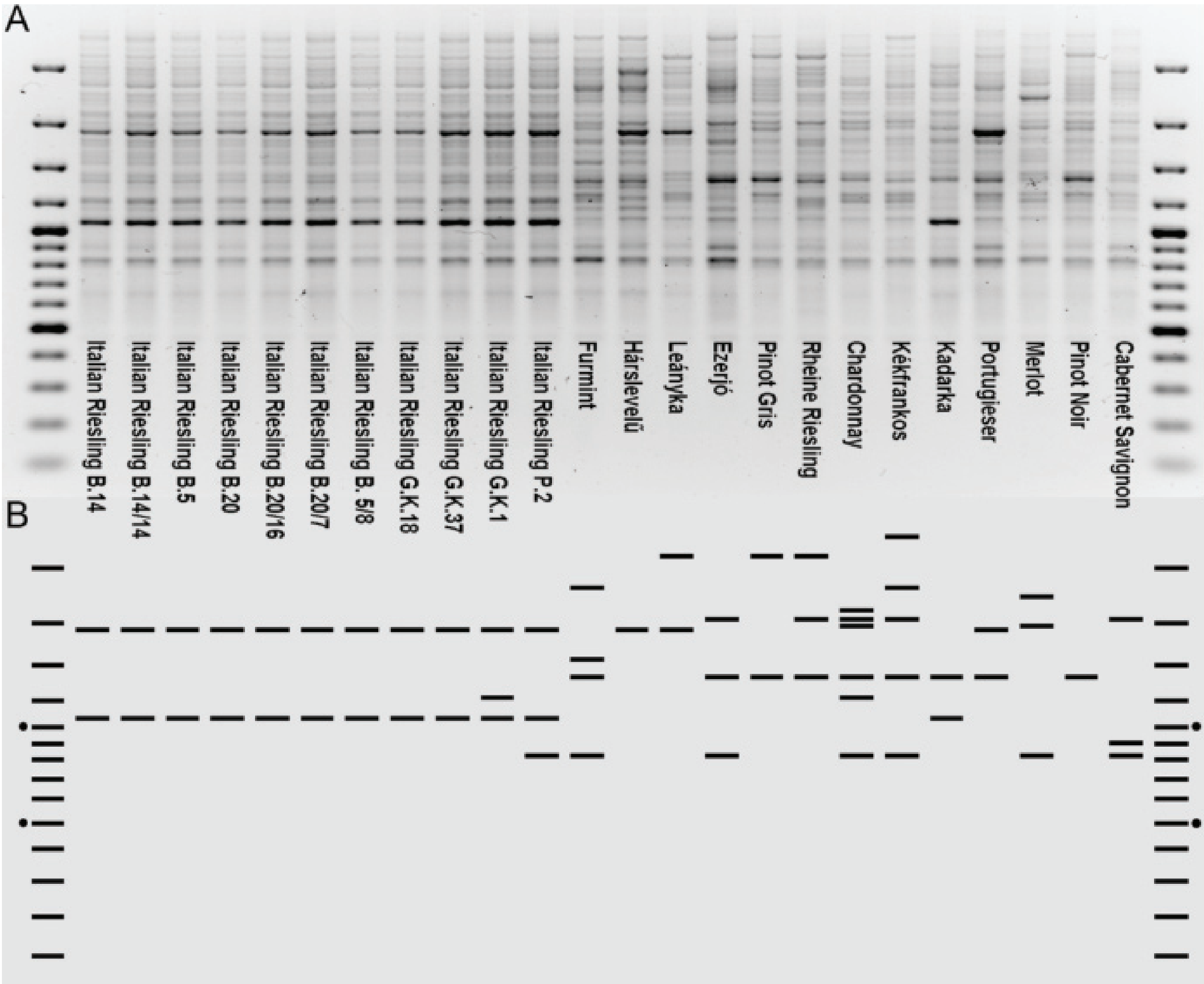

Figure 2. The genotyping profile of grape varieties obtained by the SCoT primer HE3. Panel A: image of the agarose gel electrophoretic separation of the PCR products. Panel B: simulated electrophoretic image of the polymorphic bands after normalisation and thresholding (Supplementary Table 1). The molecular marker is a 100 bp Plus DNA ladder. In Panel B, dots label the 500 and 1000 bp bands with stronger appearance in Panel A.

primers were evaluated, respectively (Luo et al. 2010; Xiong et al. 2011; Satya et al. 2015). In theory, the number of primers with definite sequence can be very high in SCoT genotyping, due to the degenerate nucleotides in the consensus sequence (Sawant et al. 1999). For example, if the degenerate primer HE3 used in this study were converted into definite-sequence primers, 160 primer sequences would be obtained. Therefore, by using degenerate primers, the same number of samples can be tested with less effort than by definite primers, or more samples can be tested, increasing the cost-effectiveness of the method.

Our study with the degenerate primers produced reliable results, compared to that of others with definite primers (Table 3) although, the 72% ratio of the polymorphic bands obtained in this study was only the fourth highest amongst compared studies. The number of polymorphic bands per degenerate primer was much higher than those achieved using definite primers (Table 3). Since three primers did not produce any band in our study, we achieved 235 bands in total by using only nine primers. Of these, 170 were polymorphic, and even after a strict normalization we obtained 39 polymorphic bands in total (Table 2). Here we would like to emphasize the importance of the normalization step in our method, because this can make data interpretation more objective. In contrast to the non-normalized data, where the mean value and the standard deviation vary from sample to sample, the applied Z-score normalization resulted in the same mean value and standard deviation, respectively, of the normalized band in-

Table 3. Comparison of the performance of SCoT genotyping studies.

Number of primers	Number of total bands[a]	Number of polymorphic bands	Polymorphic ratio (%)[b]	Average number of polymorphic bands per primer	Reference
13	n.g.	50	n.a.	3.8	Collard and Mackill (2009)
33	273	208	76	6.3	Luo et al. (2010)
15	130	26	20	1.7	Gorji et al. (2011)
18	157	60	38	3.3	Xiong et al. (2011)
17	131	122	93	7.2	Guo et al. (2012b)
20	136	119	87	5.9	Satya et al. (2015)
9	235	170	72	18.9	This study

[a] n.g. = not given; [b] n.a. = not applicable; in the "Number of primers" column, the boldface and underlined number indicates degenerate primers, normal lettering indicates definite primers.

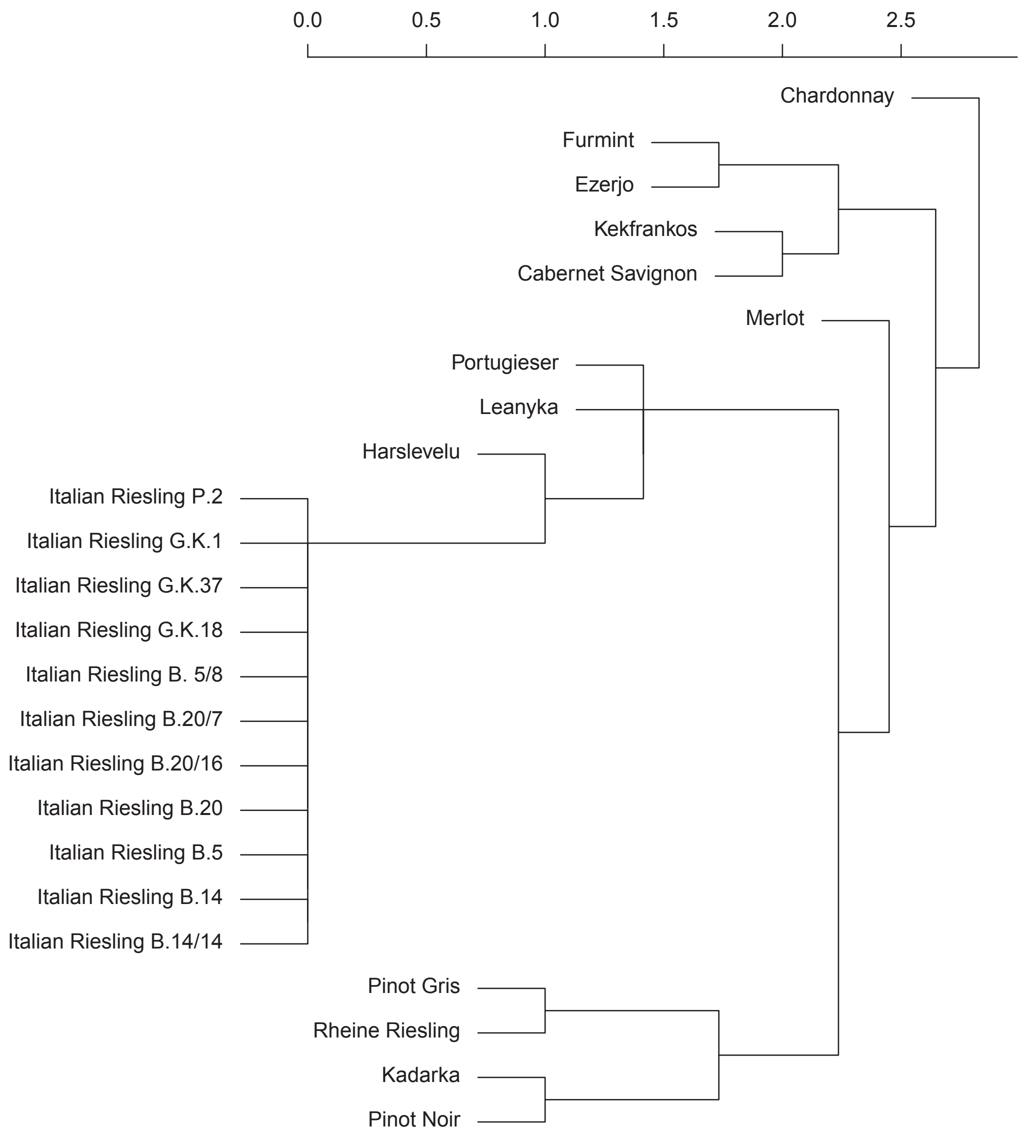

Figure 3. Cluster analysis of 14 grape varieties based on SCoT fingerprinting with primer HE3. Scale indicates Euclidean distance between the varieties.

tensities across varieties (see Materials and Methods). This makes data more comparable and by setting a threshold, under which normalized band intensity values were excluded from the analysis, the visual examination for the absence and the presence of bands can also be avoided. After normalization of data, one primer, HE3, produced 17 polymorphic bands (Supplementary Table 1) and a unique band pattern for each variety (Fig. 2). Thus it had a strong discrimination power reflected by its high PIC and Rp values of 0.997 and 5.86, respectively. For comparison, the highest PIC and Rp values reported by Gorji et al. (2011) and Satya et al. (2015) for a SCoT primer were 0.324 and 3.31, and 0.93 and 5.0, respectively. Although, a PIC value of 1.65 was reported in peanut, the highest number of polymorphic bands was only seven (Xiong et al. 2011). The best PIC value reported for a SCoT primer in grape was 0.91 (Guo et al. 2012b). From these comparisons we can conclude that the degenerate primer HE3 performed the same or even better than definite SCoT primers of other studies.

We wanted to know whether the phylogenetic tree produced by the 17 polymorphic markers is reliable, so we mined the literature to find any data, which might be consistent with the relationships between varieties in the tree. 'Cabernet Franc' was reported as one of the parents for both 'Merlot' and 'Cabernet Sauvignon' (Boursiquot et al. 2009) and this relationship was indicated by their position in the same cluster (Fig. 3). In the 'Pinot' family, the white 'Pinot Gris' variety is a mutant of the black variety 'Pinot Noir' (Yakushiji et al. 2006; Vezzulli et al. 2012), and these varieties were positioned in the same cluster (Fig. 3). 'Portugieser' might be related genetically to almost 100 red and white grape varieties (Regner et al. 1999). Although the Hungarian varieties, 'Hárslevelű' and 'Leányka', being in the same clade as Portugieser (Fig. 3), are not known as putative relatives of 'Portugieser' (Regner et al. 1999), a relationship between them is possible since white grapes have arisen from red varieties by mutations in MYB transcription factors regulating berry color (Walker et al. 2007). The exact genetic origin of the 'Riesling' and the Hungarian varieties included in this study is not known. It was reported, based on a RAPD study, that the Hungarian 'Ezerjó' and 'Hárslevelű' varieties are related (Kocsis et al. 2005), which, however, was not confirmed by our study. Guo et al. (2012b) analysed a number of Chinese and several international grape varieties using definite SCoT primers. Their analysis indicated that two varieties, 'Merlot' and 'Cabernet Sauvignon' are in closely related but separated clusters. Our above-described results are consistent with this and both analyses reflect to the written parentage of the two varieties (Boursiquot et al. 2009).

By employing degenerate primers, we were able to achieve a technically simple and easy to perform SCoT genotyping method, which discriminated 14 grape varieties and may be useful for genetic studies in grapes.

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Supplementary table

HE3 Bands

Band No.	Band Rf	Italian Riesling B.14		Italian Riesling B.14/14		Italian Riesling B.5		Italian Riesling B.20		Italian Riesling B.20/16		Italian Riesling B.20/7		Italian Riesling B. 5/8		Italian Riesling G.K.18		Italian Riesling G.K.37		Italian Riesling G.K.1		Italian Riesling P.2	
		Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score
1	0,247	1	-0,568	1	-0,651	3	-0,545	2	-0,564	2	-0,602	1	-0,693	2	-0,557	3	-0,555						
2	0,252																	2	-0,696	1	-0,757	3	-0,722
3	0,258	11	-0,250	16	-0,200	10	-0,337	11	-0,250	15	-0,229	18	-0,165	14	-0,153	13	-0,233	19	-0,150	22	-0,078	27	0,074
4	0,266																						
5	0,274	4	-0,472	4	-0,561	4	-0,515	3	-0,529	4	-0,544	7	-0,507	3	-0,523	4	-0,523	6	-0,567	5	-0,628	7	-0,590
6	0,279																						
7	0,286	14	-0,154	18	-0,140	15	-0,188	15	-0,110	22	-0,029	23	-0,009	19	0,015	20	-0,007	25	0,043	24	-0,013	28	0,107
8	0,294	3	-0,504	6	-0,501	4	-0,515	3	-0,529	3	-0,573	5	-0,569	3	-0,523	3	-0,555	2	-0,696	3	-0,692	2	-0,755
9	0,302	15	-0,123	14	-0,260	14	-0,217	12	-0,215	17	-0,172	16	-0,227	16	-0,086	15	-0,168	16	-0,246	18	-0,207	20	-0,158
10	0,309	5	-0,441	5	-0,531	5	-0,486	6	-0,424	8	-0,430	9	-0,444	6	-0,422	5	-0,491						
11	0,313																	8	-0,503	10	-0,466	10	-0,490
12	0,318																						
13	0,329	24	0,164	35	0,371	30	0,259	26	0,274	37	0,401	38	0,457	27	0,284	34	0,444	36	0,396	40	0,504	38	0,439
14	0,334																						
15	0,342	10	-0,282	15	-0,230	12	-0,277	9	-0,319	13	-0,287	11	-0,382	11	-0,254	15	-0,168	14	-0,310	16	-0,272	16	-0,291
16	0,350	7	-0,377	11	-0,350	8	-0,396	9	-0,319	10	-0,373	11	-0,382	9	-0,322	12	-0,265	10	-0,439	12	-0,401	13	-0,391
17	0,358	3	-0,504	2	-0,621	3	-0,545	2	-0,564	1	-0,630	1	-0,693	3	-0,523	3	-0,555	2	-0,696	2	-0,725	2	-0,755
18	0,372	17	-0,059	28	0,160	23	0,051	22	0,134	29	0,172	26	0,084	27	0,284	26	0,186	28	0,139	31	0,213	34	0,306
19	0,382																						
20	0,384	10	-0,282	14	-0,260	13	-0,247	9	-0,319	12	-0,315	14	-0,289	6	-0,422	11	-0,297	13	-0,342	16	-0,272	13	-0,391
21	0,391																						
22	0,394																						
23	0,400	96	2,454	127	3,134	116	2,822	97	2,752	134	3,181	130	3,318	105	2,909	108	2,829	126	3,285	125	3,253	118	3,092
24	0,410	11	-0,250	17	-0,170	15	-0,188	10	-0,284	11	-0,344	18	-0,165	11	-0,254	11	-0,297	18	-0,182	17	-0,240	21	-0,125
25	0,415																						
26	0,419	3	-0,504	7	-0,471	5	-0,486	8	-0,354	8	-0,430	7	-0,507	6	-0,422	6	-0,458	7	-0,535	8	-0,531	6	-0,623
27	0,426															3	-0,555						
28	0,429	0	-0,600	2	-0,621	2	-0,575	2	-0,564	2	-0,602	1	-0,693	1	-0,591			3	-0,663	1	-0,757	0	-0,822
29	0,436	3	-0,504	6	-0,501	3	-0,545	4	-0,494	8	-0,430	6	-0,538	2	-0,557	3	-0,555	6	-0,567	6	-0,595	5	-0,656
30	0,439																						
31	0,444	12	-0,218	10	-0,381	11	-0,307	9	-0,319	10	-0,373	12	-0,351	9	-0,322	8	-0,394	11	-0,407	12	-0,401	13	-0,391
32	0,455																						
33	0,460																						
34	0,464	9	-0,313	11	-0,350	10	-0,337	8	-0,354	10	-0,373	11	-0,382	6	-0,422	8	-0,394	12	-0,375	14	-0,337	14	-0,357
35	0,471	18	-0,027	21	-0,050	22	0,021	18	-0,005	19	-0,115	22	-0,040	15	-0,120	18	-0,072	23	-0,021	23	-0,046	23	-0,059
36	0,481	1	-0,568	1	-0,651	3	-0,545	1	-0,599	2	-0,602	2	-0,662	3	-0,523	1	-0,620	2	-0,696	0	-0,789	5	-0,656
37	0,491																						
38	0,501	35	0,514	46	0,701	41	0,587	36	0,623	48	0,716	47	0,737	32	0,452	37	0,541	53	0,942	58	1,086	54	0,969
39	0,513	8	-0,345	12	-0,320	11	-0,307	7	-0,389	10	-0,373	11	-0,382	4	-0,490	7	-0,426	21	-0,086	13	-0,369	14	-0,357
40	0,528																						
41	0,534	145	4,012	134	3,345	146	3,716	127	3,800	140	3,353	122	3,069	128	3,682	135	3,699	117	2,996	112	2,832	114	2,959
42	0,560																						
43	0,571	8	-0,345	6	-0,501	7	-0,426	8	-0,354	9	-0,401	12	-0,351	7	-0,389	7	-0,426	11	-0,407	15	-0,304	11	-0,457
44	0,591	36	0,545	43	0,611	39	0,528	26	0,274	37	0,401	48	0,768	26	0,250	30	0,315	48	0,781	55	0,989	58	1,102
	Sum	509	0	612	0	575	0	490	0	621	0	629	0	501	0	546	0	639	0	659	0	669	0
	Mean	18,85	0	22,67	0	21,3	0	18,15	0	23	0	23,3	0	18,56	0	20,22	0	23,67	0	24,41	0	24,78	0
	SD	31,44	1	33,29	1	33,56	1	28,65	1	34,9	1	32,16	1	29,72	1	31,03	1	31,15	1	30,93	1	30,15	1

Band No.	Band Rf	Furmint		Hárslevelű		Leányka		Ezerjó		Pinot Gris		Rheine Riesling		Chardonnay	
		Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score
1	0,247														
2	0,252													5	-0,862
3	0,258	33	0,535	40	0,331			43	0,552	15	-0,297				
4	0,266			5	-1,038			2	-1,001			2	-0,747	1	-1,243
5	0,274	8	-0,672	6	-0,999			8	-0,774	6	-0,685	5	-0,589	6	-0,767
6	0,279														
7	0,286	17	-0,238	21	-0,412	50	1,064	2	-1,001	53	1,337	71	2,906	22	0,753
8	0,294									3	-0,814			8	-0,577
9	0,302	16	-0,286			12	-0,238	14	-0,547	11	-0,469	23	0,365	4	-0,958
10	0,309			55	0,917	22	0,104					22	0,312		
11	0,313	11	-0,527												
12	0,318							1	-1,039	11	-0,469	12	-0,218	12	-0,197
13	0,329			41	0,370	14	-0,170	35	0,249	14	-0,340	8	-0,430	20	0,563
14	0,334	44	1,065							8	-0,599				
15	0,342	5	-0,817	6	-0,999	3	-0,547	12	-0,623	12	-0,426	13	-0,165	16	0,183
16	0,350	16	-0,286	19	-0,490	13	-0,204	23	-0,206	23	0,047	12	-0,218	12	-0,197
17	0,358	1	-1,010			11	-0,273					3	-0,694	7	-0,672
18	0,372	18	-0,189	4	-1,077	13	-0,204	2	-1,001	28	0,262	4	-0,642	26	1,134
19	0,382					10	-0,307								
20	0,384	17	-0,238	46	0,565			64	1,348	28	0,262	57	2,165	32	1,704
21	0,391														
22	0,394	19	-0,141					15	-0,509	42	0,864	10	-0,324	25	1,039
23	0,400			118	3,380	148	4,423					2	-0,747		
24	0,410	35	0,631	47	0,604	15	-0,136	45	0,628	20	-0,082	8	-0,430	17	0,278
25	0,415					2	-0,581					4	-0,642	7	-0,672
26	0,419														
27	0,426	13	-0,431			9	-0,341			12	-0,426			15	0,088
28	0,429			23	-0,334			24	-0,168			12	-0,218		
29	0,436														
30	0,439					3	-0,547			4	-0,771	6	-0,536	4	-0,958
31	0,444	46	1,162	26	-0,217	3	-0,547								
32	0,455	3	-0,913												
33	0,460					17	-0,067							7	-0,672
34	0,464			6	-0,999							10	-0,324		
35	0,471	60	1,837	51	0,761	19	0,001	95	2,523	109	3,746	66	2,641	44	2,844
36	0,481	9	-0,624	14	-0,686	8	-0,376	8	-0,774			3	-0,694	3	-1,053
37	0,491	25	0,148			13	-0,204			43	0,907			16	0,183
38	0,501	15	-0,334	36	0,174	8	-0,376	10	-0,698	5	-0,728	11	-0,271	25	1,039
39	0,513	21	-0,045	36	0,174	8	-0,376	29	0,022	7	-0,642			5	-0,862
40	0,528	14	-0,382	34	0,096	23	0,139	36	0,287	15	-0,297	18	0,100	13	-0,102
41	0,534	3	-0,913												
42	0,560	4	-0,865									6	-0,536		
43	0,571	22	0,004	13	-0,725	10	-0,307	52	0,893	9	-0,556	15	-0,059	3	-1,053
44	0,591	95	3,526	47	0,604	21	0,070	77	1,840	26	0,176	16	-0,006	25	1,039
	Sum	570	0	694	0	455	0	597	0	504	0	419	0	380	0
	Mean	21,92	0	31,55	0	18,96	0	28,43	0	21,91	0	16,12	0	14,07	0
	SD	20,72	1	25,58	1	29,18	1	26,39	1	23,25	1	18,89	1	10,52	1

Band No.	Band Rf	Kékfrankos		Kadarka		Portugieser		Merlot		Pinot Noir		Cabernet Savignon	
		Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score	Band peak height	Z-score
1	0,247					3	-0,724					2	-0,890
2	0,252					5	-0,647	6	-0,557	10	-0,314	4	-0,695
3	0,258	28	1,312										
4	0,266												
5	0,274	10	-0,340	2	-0,645	7	-0,569	6	-0,557	2	-0,682	4	-0,695
6	0,279			2	-0,645								
7	0,286	15	0,119	3	-0,611	19	-0,106			37	0,926		
8	0,294	2	-1,074			5	-0,647			3	-0,636		
9	0,302	5	-0,799	23	0,075	2	-0,763			8	-0,406	2	-0,890
10	0,309	8	-0,524	11	-0,337	10	-0,454	1	-0,793			18	0,671
11	0,313	2	-1,074										
12	0,318							4	-0,652	6	-0,498	2	-0,890
13	0,329	29	1,404	24	0,109			31	0,625	12	-0,222	7	-0,402
14	0,334					37	0,590			7	-0,452	16	0,476
15	0,342	11	-0,248	9	-0,405	3	-0,724			10	-0,314	5	-0,597
16	0,350	11	-0,248	17	-0,131	13	-0,338	96	3,697	15	-0,085	11	-0,012
17	0,358	9	-0,432					7	-0,510	2	-0,682	3	-0,792
18	0,372	6	-0,707	20	-0,028	12	-0,376	9	-0,415	19	0,099	7	-0,402
19	0,382	29	1,404	3	-0,611			15	-0,132			25	1,354
20	0,384									26	0,421		
21	0,391	17	0,303					42	1,145				
22	0,394			38	0,589					35	0,834	5	-0,597
23	0,400					107	3,294						
24	0,410	17	0,303	31	0,349	31	0,358	16	-0,084	14	-0,130	13	0,183
25	0,415	8	-0,524					3	-0,699				
26	0,419												
27	0,426	3	-0,983	9	-0,405	17	-0,183	5	-0,604	9	-0,360	6	-0,500
28	0,429												
29	0,436							4	-0,652				
30	0,439	4	-0,891			3	-0,724	9	-0,415	3	-0,636		
31	0,444			14	-0,234							8	-0,304
32	0,455			9	-0,405								
33	0,460	8	-0,524			3	-0,724	12	-0,273				
34	0,464											10	-0,109
35	0,471	44	2,781	51	1,034	72	1,942	14	-0,179	107	4,142	10	-0,109
36	0,481									4	-0,590		
37	0,491	22	0,762			27	0,203	27	0,436	38	0,972	17	0,574
38	0,501	16	0,211	4	-0,576	1	-0,801	29	0,530	3	-0,636	7	-0,402
39	0,513	9	-0,432	6	-0,508	8	-0,531	4	-0,652	4	-0,590	8	-0,304
40	0,528	19	0,486			26	0,165	16	-0,084	13	-0,176	9	-0,207
41	0,534			136	3,948								
42	0,560	6	-0,707	4	-0,576								
43	0,571	0	-1,258	4	-0,576	42	0,783	7	-0,510	9	-0,360	42	3,013
44	0,591	32	1,679	38	0,589	47	0,976	46	1,334	25	0,375	37	2,525
	Sum	370	0	458	0	500	0	409	0	421	0	278	0
	Mean	13,7	0	20,82	0	21,74	0	17,78	0	16,84	0	11,12	0
	SD	10,89	1	29,18	1	25,88	1	21,16	1	21,77	1	10,25	1

Threshold bands

Band No.	Band Rf	Italian Riesling B.14 Band peak height	Z-score	Italian Riesling B.14/14 Band peak height	Z-score	Italian Riesling B.5 Band peak height	Z-score	Italian Riesling B.20 Band peak height	Z-score	Italian Riesling B.20/16 Band peak height	Z-score	Italian Riesling B.20/7 Band peak height	Z-score	Italian Riesling B. 5/8 Band peak height	Z-score	Italian Riesling G.K.18 Band peak height	Z-score
1	0,247	1	-0,568	1	-0,651	3	-0,545	2	-0,564	2	-0,602	1	-0,693	2	-0,557	3	-0,555
2	0,252																
3	0,258	11	-0,250	16	-0,200	10	-0,337	11	-0,250	15	-0,229	18	-0,165	14	-0,153	13	-0,233
4	0,266																
5	0,274	4	-0,472	4	-0,561	4	-0,515	3	-0,529	4	-0,544	7	-0,507	3	-0,523	4	-0,523
6	0,279																
7	0,286	14	-0,154	18	-0,140	15	-0,188	15	-0,110	22	-0,029	23	-0,009	19	0,015	20	-0,007
8	0,294	3	-0,504	6	-0,501	4	-0,515	3	-0,529	3	-0,573	5	-0,569	3	-0,523	3	-0,555
9	0,302	15	-0,123	14	-0,260	14	-0,217	12	-0,215	17	-0,172	16	-0,227	16	-0,086	15	-0,168
10	0,309	5	-0,441	5	-0,531	5	-0,486	6	-0,424	8	-0,430	9	-0,444	6	-0,422	5	-0,491
11	0,313																
12	0,318																
13	0,329	24	0,164	35	0,371	30	0,259	26	0,274	37	0,401	38	0,457	27	0,284	34	0,444
14	0,334																
15	0,342	10	-0,282	15	-0,230	12	-0,277	9	-0,319	13	-0,287	11	-0,382	11	-0,254	15	-0,168
16	0,350	7	-0,377	11	-0,350	8	-0,396	9	-0,319	10	-0,373	11	-0,382	9	-0,322	12	-0,265
17	0,358	3	-0,504	2	-0,621	3	-0,545	2	-0,564	1	-0,630	1	-0,693	3	-0,523	3	-0,555
18	0,372	17	-0,059	28	0,160	23	0,051	22	0,134	29	0,172	26	0,084	27	0,284	26	0,186
19	0,382																
20	0,384	10	-0,282	14	-0,260	13	-0,247	9	-0,319	12	-0,315	14	-0,289	6	-0,422	11	-0,297
21	0,391																
22	0,394																
23	0,400	96	2,454	127	3,134	116	2,822	97	2,752	134	3,181	130	3,318	105	2,909	108	2,829
24	0,410	11	-0,250	17	-0,170	15	-0,188	10	-0,284	11	-0,344	18	-0,165	11	-0,254	11	-0,297
25	0,415																
26	0,419	3	-0,504	7	-0,471	5	-0,486	8	-0,354	8	-0,430	7	-0,507	6	-0,422	6	-0,458
27	0,426															3	-0,555
28	0,429	0	-0,600	2	-0,621	2	-0,575	2	-0,564	2	-0,602	1	-0,693	1	-0,591		
29	0,436	3	-0,504	6	-0,501	3	-0,545	4	-0,494	8	-0,430	6	-0,538	2	-0,557	3	-0,555
30	0,439																
31	0,444	12	-0,218	10	-0,381	11	-0,307	9	-0,319	10	-0,373	12	-0,351	9	-0,322	8	-0,394
32	0,455																
33	0,460																
34	0,464	9	-0,313	11	-0,350	10	-0,337	8	-0,354	10	-0,373	11	-0,382	6	-0,422	8	-0,394
35	0,471	18	-0,027	21	-0,050	22	0,021	18	-0,005	19	-0,115	22	-0,040	15	-0,120	18	-0,072
36	0,481	1	-0,568	1	-0,651	3	-0,545	1	-0,599	2	-0,602	2	-0,662	3	-0,523	1	-0,620
37	0,491																
38	0,501	35	0,514	46	0,701	41	0,587	36	0,623	48	0,716	47	0,737	32	0,452	37	0,541
39	0,513	8	-0,345	12	-0,320	11	-0,307	7	-0,389	10	-0,373	11	-0,382	4	-0,490	7	-0,426
40	0,528																
41	0,534	145	4,012	134	3,345	146	3,716	127	3,800	140	3,353	122	3,069	128	3,682	135	3,699
42	0,560																
43	0,571	8	-0,345	6	-0,501	7	-0,426	8	-0,354	9	-0,401	12	-0,351	7	-0,389	7	-0,426
44	0,591	36	0,545	43	0,611	39	0,528	26	0,274	37	0,401	48	0,768	26	0,250	30	0,315

Band No.	Band Rf	Italian Riesling G.K.37 Band peak height	Z-score	Italian Riesling G.K.1 Band peak height	Z-score	Italian Riesling P.2 Band peak height	Z-score	Furmint Band peak height	Z-score	Hárslevelű Band peak height	Z-score	Leányka Band peak height	Z-score	Ezerjó Band peak height	Z-score	Pinot Gris Band peak height	Z-score
1	0,247																
2	0,252	2	-0,696	1	-0,757	3	-0,722										
3	0,258	19	-0,150	22	-0,078	27	0,074	33	0,535	40	0,331			43	0,552	15	-0,297
4	0,266									5	-1,038			2	-1,001		
5	0,274	6	-0,567	5	-0,628	7	-0,590	8	-0,672	6	-0,999			8	-0,774	6	-0,685
6	0,279																
7	0,286	25	0,043	24	-0,013	28	0,107	17	-0,238	21	-0,412	50	1,064	2	-1,001	53	1,337
8	0,294	2	-0,696	3	-0,692	2	-0,755									3	-0,814
9	0,302	16	-0,246	18	-0,207	20	-0,158	16	-0,286			12	-0,238	14	-0,547	11	-0,469
10	0,309									55	0,917	22	0,104				
11	0,313	8	-0,503	10	-0,466	10	-0,490	11	-0,527								
12	0,318													1	-1,039	11	-0,469
13	0,329	36	0,396	40	0,504	38	0,439			41	0,370	14	-0,170	35	0,249	14	-0,340
14	0,334							44	1,065							8	-0,599
15	0,342	14	-0,310	16	-0,272	16	-0,291	5	-0,817	6	-0,999	3	-0,547	12	-0,623	12	-0,426
16	0,350	10	-0,439	12	-0,401	13	-0,391	16	-0,286	19	-0,490	13	-0,204	23	-0,206	23	0,047
17	0,358	2	-0,696	2	-0,725	2	-0,755	1	-1,010			11	-0,273				
18	0,372	28	0,139	31	0,213	34	0,306	18	-0,189	4	-1,077	13	-0,204	2	-1,001	28	0,262
19	0,382											10	-0,307				
20	0,384	13	-0,342	16	-0,272	13	-0,391	17	-0,238	46	0,565			64	1,348	28	0,262
21	0,391																
22	0,394							19	-0,141					15	-0,509	42	0,864
23	0,400	126	3,285	125	3,253	118	3,092			118	3,380	148	4,423				
24	0,410	18	-0,182	17	-0,240	21	-0,125	35	0,631	47	0,604	15	-0,136	45	0,628	20	-0,082
25	0,415											2	-0,581				
26	0,419	7	-0,535	8	-0,531	6	-0,623										
27	0,426							13	-0,431			9	-0,341			12	-0,426
28	0,429	3	-0,663	1	-0,757	0	-0,822			23	-0,334			24	-0,168		
29	0,436	6	-0,567	6	-0,595	5	-0,656										
30	0,439											3	-0,547			4	-0,771
31	0,444	11	-0,407	12	-0,401	13	-0,391	46	1,162	26	-0,217	3	-0,547				
32	0,455							3	-0,913								
33	0,460											17	-0,067				
34	0,464	12	-0,375	14	-0,337	14	-0,357			6	-0,999						
35	0,471	23	-0,021	23	-0,046	23	-0,059	60	1,837	51	0,761	19	0,001	95	2,523	109	3,746
36	0,481	2	-0,696	0	-0,789	5	-0,656	9	-0,624	14	-0,686	8	-0,376	8	-0,774		
37	0,491							25	0,148			13	-0,204			43	0,907
38	0,501	53	0,942	58	1,086	54	0,969	15	-0,334	36	0,174	8	-0,376	10	-0,698	5	-0,728
39	0,513	21	-0,086	13	-0,369	14	-0,357	21	-0,045	36	0,174	8	-0,376	29	0,022	7	-0,642
40	0,528							14	-0,382	34	0,096	23	0,139	36	0,287	15	-0,297
41	0,534	117	2,996	112	2,832	114	2,959	3	-0,913								
42	0,560							4	-0,865								
43	0,571	11	-0,407	15	-0,304	11	-0,457	22	0,004	13	-0,725	10	-0,307	52	0,893	9	-0,556
44	0,591	48	0,781	55	0,989	58	1,102	95	3,526	47	0,604	21	0,070	77	1,840	26	0,176

Band No.	Band Rf	Rhine Riesling Band peak height	Z-score	Chardonnay Band peak height	Z-score	Kékfrankos Band peak height	Z-score	Kadarka Band peak height	Z-score	Portugeser Band peak height	Z-score	Merlot Band peak height	Z-score	Pinot Noir Band peak height	Z-score	Cabernet Savignon Band peak height	Z-score
1	0,247									3	-0,724					2	-0,890
2	0,252			5	-0,862					5	-0,647	6	-0,557	10	-0,314	4	-0,695
3	0,258					28	1,312										
4	0,266	2	-0,747	1	-1,243												
5	0,274	5	-0,589	6	-0,767	10	-0,340	2	-0,645	7	-0,569	6	-0,557	2	-0,682	4	-0,695
6	0,279							2	-0,645								
7	0,286	71	2,906	22	0,753	15	0,119	3	-0,611	19	-0,106			37	0,926		
8	0,294			8	-0,577	2	-1,074			5	-0,647			3	-0,636		
9	0,302	23	0,365	4	-0,958	5	-0,799	23	0,075	2	-0,763			8	-0,406	2	-0,890
10	0,309	22	0,312			8	-0,524	11	-0,337	10	-0,454	1	-0,793			18	0,671
11	0,313					2	-1,074										
12	0,318	12	-0,218	12	-0,197							4	-0,652	6	-0,498	2	-0,890
13	0,329	8	-0,430	20	0,563	29	1,404	24	0,109			31	0,625	12	-0,222	7	-0,402
14	0,334									37	0,590			7	-0,452	16	0,476
15	0,342	13	-0,165	16	0,183	11	-0,248	9	-0,405	3	-0,724			10	-0,314	5	-0,597
16	0,350	12	-0,218	12	-0,197	11	-0,248	17	-0,131	13	-0,338	96	3,697	15	-0,085	11	-0,012
17	0,358	3	-0,694	7	-0,672	9	-0,432					7	-0,510	2	-0,682	3	-0,792
18	0,372	4	-0,642	26	1,134	6	-0,707	20	-0,028	12	-0,376	9	-0,415	19	0,099	7	-0,402
19	0,382					29	1,404	3	-0,611			15	-0,132			25	1,354
20	0,384	57	2,165	32	1,704									26	0,421		
21	0,391					17	0,303					42	1,145				
22	0,394	10	-0,324	25	1,039			38	0,589					35	0,834	5	-0,597
23	0,400	2	-0,747							107	3,294						
24	0,410	8	-0,430	17	0,278	17	0,303	31	0,349	31	0,358	16	-0,084	14	-0,130	13	0,183
25	0,415	4	-0,642	7	-0,672	8	-0,524					3	-0,699				
26	0,419																
27	0,426			15	0,088	3	-0,983	9	-0,405	17	-0,183	5	-0,604	9	-0,360	6	-0,500
28	0,429	12	-0,218														
29	0,436											4	-0,652				
30	0,439	6	-0,536	4	-0,958	4	-0,891			3	-0,724	9	-0,415	3	-0,636		
31	0,444							14	-0,234							8	-0,304
32	0,455							9	-0,405								
33	0,460			7	-0,672	8	-0,524			3	-0,724	12	-0,273				
34	0,464	10	-0,324													10	-0,109
35	0,471	66	2,641	44	2,844	44	2,781	51	1,034	72	1,942	14	-0,179	107	4,142	10	-0,109
36	0,481	3	-0,694	3	-1,053									4	-0,590		
37	0,491			16	0,183	22	0,762			27	0,203	27	0,436	38	0,972	17	0,574
38	0,501	11	-0,271	25	1,039	16	0,211	4	-0,576	1	-0,801	29	0,530	3	-0,636	7	-0,402
39	0,513			5	-0,862	9	-0,432	6	-0,508	8	-0,531	4	-0,652	4	-0,590	8	-0,304
40	0,528	18	0,100	13	-0,102	19	0,486			26	0,165	16	-0,084	13	-0,176	9	-0,207
41	0,534							136	3,948								
42	0,560	6	-0,536			6	-0,707	4	-0,576								
43	0,571	15	-0,059	3	-1,053	0	-1,258	4	-0,576	42	0,783	7	-0,510	9	-0,360	42	3,013
44	0,591	16	-0,006	25	1,039	32	1,679	38	0,589	47	0,976	46	1,334	25	0,375	37	2,525

Selected bands

		Italian Riesling B.14		Italian Riesling B.14/14		Italian Riesling B.5		Italian Riesling B.20		Italian Riesling B.20/16		Italian Riesling B.20/7	
Band No.	**Band Rf**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**
3	0,258	11	-0,250	16	-0,200	10	-0,337	11	-0,250	15	-0,229	18	-0,165
7	0,286	14	-0,154	18	-0,140	15	-0,188	15	-0,110	22	-0,029	23	-0,009
13	0,329	24	0,164	35	0,371	30	0,259	26	0,274	37	0,401	38	0,457
14	0,334												
16	0,350	7	-0,377	11	-0,350	8	-0,396	9	-0,319	10	-0,373	11	-0,382
18	0,372	17	-0,059	28	0,160	23	0,051	22	0,134	29	0,172	26	0,084
19	0,382												
20	0,384	10	-0,282	14	-0,260	13	-0,247	9	-0,319	12	-0,315	14	-0,289
21	0,391												
22	0,394												
23	0,400	96	2,454	127	3,134	116	2,822	97	2,752	134	3,181	130	3,318
31	0,444	12	-0,218	10	-0,381	11	-0,307	9	-0,319	10	-0,373	12	-0,351
35	0,471	18	-0,027	21	-0,050	22	0,021	18	-0,005	19	-0,115	22	-0,040
38	0,501	35	0,514	46	0,701	41	0,587	36	0,623	48	0,716	47	0,737
41	0,534	145	4,012	134	3,345	146	3,716	127	3,800	140	3,353	122	3,069
43	0,571	8	-0,345	6	-0,501	7	-0,426	8	-0,354	9	-0,401	12	-0,351
44	0,591	36	0,545	43	0,611	39	0,528	26	0,274	37	0,401	48	0,768

		Italian Riesling B. 5/8		Italian Riesling G.K.18		Italian Riesling G.K.37		Italian Riesling G.K.1		Italian Riesling P.2		Furmint	
Band No.	**Band Rf**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**
3	0,258	14	-0,153	13	-0,233	19	-0,150	22	-0,078	27	0,074	33	0,535
7	0,286	19	0,015	20	-0,007	25	0,043	24	-0,013	28	0,107	17	-0,238
13	0,329	27	0,284	34	0,444	36	0,396	40	0,504	38	0,439		
14	0,334											44	1,065
16	0,350	9	-0,322	12	-0,265	10	-0,439	12	-0,401	13	-0,391	16	-0,286
18	0,372	27	0,284	26	0,186	28	0,139	31	0,213	34	0,306	18	-0,189
19	0,382												
20	0,384	6	-0,422	11	-0,297	13	-0,342	16	-0,272	13	-0,391	17	-0,238
21	0,391												
22	0,394											19	-0,141
23	0,400	105	2,909	108	2,829	126	3,285	125	3,253	118	3,092		
31	0,444	9	-0,322	8	-0,394	11	-0,407	12	-0,401	13	-0,391	46	1,162
35	0,471	15	-0,120	18	-0,072	23	-0,021	23	-0,046	23	-0,059	60	1,837
38	0,501	32	0,452	37	0,541	53	0,942	58	1,086	54	0,969	15	-0,334
41	0,534	128	3,682	135	3,699	117	2,996	112	2,832	114	2,959	3	-0,913
43	0,571	7	-0,389	7	-0,426	11	-0,407	15	-0,304	11	-0,457	22	0,004
44	0,591	26	0,250	30	0,315	48	0,781	55	0,989	58	1,102	95	3,526

		Hárslevelű		Leányka		Ezerjó		Pinot Gris		Rheine Riesling		Chardonnay	
Band No.	**Band Rf**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**
3	0,258	40	0,331			43	0,552	15	-0,297				
7	0,286	21	-0,412	50	1,064	2	-1,001	53	1,337	71	2,906	22	0,753
13	0,329	41	0,370	14	-0,170	35	0,249	14	-0,340	8	-0,430	20	0,563
14	0,334							8	-0,599				
16	0,350	19	-0,490	13	-0,204	23	-0,206	23	0,047	12	-0,218	12	-0,197
18	0,372	4	-1,077	13	-0,204	2	-1,001	28	0,262	4	-0,642	26	1,134
19	0,382			10	-0,307								
20	0,384	46	0,565			64	1,348	28	0,262	57	2,165	32	1,704
21	0,391												
22	0,394					15	-0,509	42	0,864	10	-0,324	25	1,039
23	0,400	118	3,380	148	4,423					2	-0,747		
31	0,444	26	-0,217	3	-0,547								
35	0,471	51	0,761	19	0,001	95	2,523	109	3,746	66	2,641	44	2,844
38	0,501	36	0,174	8	-0,376	10	-0,698	5	-0,728	11	-0,271	25	1,039
41	0,534												
43	0,571	13	-0,725	10	-0,307	52	0,893	9	-0,556	15	-0,059	3	-1,053
44	0,591	47	0,604	21	0,070	77	1,840	26	0,176	16	-0,006	25	1,039

		Kékfrankos		Kadarka		Portugieser		Merlot		Pinot Noir		Cabernet Savignon	
Band No.	**Band Rf**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**	**Band peak height**	**Z-score**
3	0,258	28	1,312										
7	0,286	15	0,119	3	-0,611	19	-0,106			37	0,926		
13	0,329	29	1,404	24	0,109			31	0,625	12	-0,222	7	-0,402
14	0,334					37	0,590			7	-0,452	16	0,476
16	0,350	11	-0,248	17	-0,131	13	-0,338	96	3,697	15	-0,085	11	-0,012
18	0,372	6	-0,707	20	-0,028	12	-0,376	9	-0,415	19	0,099	7	-0,402
19	0,382	29	1,404	3	-0,611			15	-0,132			25	1,354
20	0,384									26	0,421		
21	0,391	17	0,303					42	1,145				
22	0,394			38	0,589					35	0,834	5	-0,597
23	0,400					107	3,294						
31	0,444			14	-0,234							8	-0,304
35	0,471	44	2,781	51	1,034	72	1,942	14	-0,179	107	4,142	10	-0,109
38	0,501	16	0,211	4	-0,576	1	-0,801	29	0,530	3	-0,636	7	-0,402
41	0,534			136	3,948								
43	0,571	0	-1,258	4	-0,576	42	0,783	7	-0,510	9	-0,360	42	3,013
44	0,591	32	1,679	38	0,589	47	0,976	46	1,334	25	0,375	37	2,525

Matrix

Italian Riesling B.14	Italian Riesling B.14/14	Italian Riesling B.5	Italian Riesling B.20	Italian Riesling B.20/16	Italian Riesling B.20/7	Italian Riesling B. 5/8	Italian Riesling G.K.18	Italian Riesling G.K.37	Italian Riesling G.K.1	Italian Riesling P.2	Furmint	Hárslevelű	Leányka	Ezerjó	Pinot Gris	Rheine Riesling	Chardonnay	Kékfrankos	Kadarka	Portugieser	Merlot	Pinot Noir	Cabernet Savignon
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	0	1	0
0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	1	1	0	0	1	0	1