

Microsatellite variability in grapevine cultivars from different European regions and evaluation of assignment testing to assess the geographic origin of cultivars

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Abstract: Nine microsatellite markers were chosen for the analysis of marker information content, genetic structure of grapevine cultivar gene pools and differentiation among grapevines sampled from seven European vine-growing regions (Greece, Croatia, North Italy, Austria, Germany, France, Spain, Portugal). The markers were found to be highly informative in all cultivar groups and therefore constitute a useful set for the genetic characterization of European grapevines. Similar and high levels of genetic variability were detected in all investigated grapevine gene pools. Genetic differentiation among cultivars from different regions was significant even in the case of adjacent groups as the Spanish and Portuguese cultivars. No genetic differentiation could be detected between vines with blue and white grapes, indicating that they have undergone the processes of cultivar development jointly. The observed genetic differentiation among vine-growing regions suggested that cultivars could possibly be assigned to their regions of origin according to their genotypes. This might allow to determine the geographical origin of cultivars with unknown background. The assignment procedure proved to work for cultivars from the higher differentiated regions, as e.g. from Austria and Portugal. As supplementation to the publication, the SSR alleles for the grapevine cultivars included in this study are shown below. The grapevine cultivars were genotyped at the microsatellite loci VVS 2 (Thomas and Scott 1993; TAG 86: 985-990), VVMD 5 and VVMD 7 (Bowers et al. 1996; Genome 39: 628-633), ssrVrZAG7, ssrVrZAG 21, ssrVrZAG 47, ssrVrZAG 62, ssrVrZAG 64, ssrVrZAG 79 and ssrVrZAG 83 (Sefc et al. 1999; Genome 42, 367-373). Allele sizes are shown in basepairs as determined by electrophoresis in an automated sequencer (ALFexpress Pharmacia) using the Fragment Manager software (Pharmacia).

Microsatellite genotypes of the cultivars included in the Austrian/German sample

Cultivar	VVS 2		VVMD 5		VVMD 7		VrZAG 21		VrZAG 47		VrZAG 62		VrZAG 64		VrZAG 79		VrZAG 83	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Blauburger	142	150	230	238	240	246	206	206	157	159	187	203	139	159	236	258	188	190
Blaufränkisch	142	142	224	238	236	246	202	206	157	172	193	203	139	159	236	250	188	194
Elbling	142	150	236	238	246	254	200	206	157	167	193	203	143	159	236	244	188	190
Geißtutte	138	142	230	244	236	244	202	214	159	163	185	187	139	159	250	258	188	194
Goldburger	134	142	236	236	236	244	190	200	167	167	193	195	159	163	250	258	194	200
Jubiläumsebe	150	150	230	238	240	244	200	200	159	167	187	203	143	163	250	258	188	194
Königsast	132	132	234	238	244	246	200	206	172	172	193	203	159	159	248	250	188	188
Müller Thurgau	142	150	224	226	244	254	202	202	159	159	193	193	137	163	242	244	194	200

Neuburger	130	150	224	238	244	250	200	206	167	172	191	203	139	143	250	250	188	190
Orangetraube	136	142	234	236	236	244	200	200	167	167	193	203	137	163	244	258	200	200
Österreichisch Weiß	142	152	224	232	236	244	206	206	159	172	195	203	143	159	242	248	188	190
Rheinriesling	142	150	224	232	246	254	202	206	159	167	193	203	137	159	242	244	188	194
Rotgipfler	132	150	230	244	236	254	200	200	161	167	187	195	139	143	250	250	188	190
Schlagerblut	136	142	230	236	236	252	206	206	159	172	193	203	139	159	242	248	188	190
Silvaner Grün	150	152	224	230	240	244	200	206	167	172	187	203	139	143	248	250	188	190
Veltliner Frührot	132	150	230	238	244	250	200	206	167	172	191	203	143	143	250	250	188	188
Veltliner Grün	132	150	230	230	244	254	200	204	167	172	193	203	139	143	244	248	194	200
Veltliner Rot	130	132	238	244	236	250	200	204	161	172	191	195	143	163	250	250	188	190
Wildbacher Blau	142	150	226	238	236	236	194	206	159	169	193	195	137	159	242	250	188	190
Zierfandler	132	132	238	238	240	250	200	206	167	172	187	191	143	163	244	250	188	188

Cultivar	VrZAG7	
Blaufränkisch	155	155
Elbling	155	157
Geißtutte	155	157
Goldburger	155	157
Gutedel	108	155
Königsast	157	157
Neuburger	155	155
Ochsenauge	155	157
Orangetraube	155	155
Ortlieber	155	155
Österreichisch Weiß	155	155
Portugieser Blau	155	155
Rheinriesling	155	155
Rotgipfler	157	157
Schlagerblut	155	155
Schwarzgrobe	155	155

Silvaner Grün	155	155
Steinschiller	155	155
Veltliner Grün	155	157
Veltliner Frührot	155	155
Veltliner Rot	155	157
Wildbacher Blau	155	155
Zierfandler	108	155

Microsatellite genotypes of the cultivars included in the French sample

Cultivar	VVS 2		VVMD 5		VVMD 7		VrZAG 21		VrZAG 47		VrZAG 62		VrZAG 64		VrZAG 79		VrZAG 83	
Aligoté	13 2	13 6	22 6	238	23 6	236	20 0	206	15 7	16 7	19 3	19 5	15 9	16 3	24 2	24 4	18 8	20 0
Cabernet franc	13 8	14 6	22 4	238	23 6	260	19 0	200	15 9	16 7	19 3	20 3	15 7	15 9	24 6	25 8	19 4	20 0
Cabernet sauvignon	13 8	15 0	23 0	238	23 6	236	20 0	206	15 3	16 7	18 7	19 3	13 9	15 9	24 6	24 6	20 0	20 0
Chardonnay	13 6	14 2	23 2	236	23 6	240	20 0	206	15 9	16 7	18 7	19 5	15 9	16 3	24 2	24 4	18 8	20 0
Chenin blanc	13 2	15 0	22 6	230	23 6	254	20 0	204	15 3	16 7	18 7	19 3	14 3	16 3	24 6	25 0	18 8	18 8
Cot	13 2	15 0	22 6	236	23 6	260	19 0	200	16 7	16 9	18 7	20 1	13 9	15 9	24 4	25 8	19 0	19 4
Gamay	13 2	13 6	23 2	236	23 6	246	20 0	206	15 9	16 7	19 3	20 3	13 7	16 1	24 2	24 4	18 8	20 0
Merlot	13 8	15 0	22 4	234	23 6	244	20 0	200	16 7	16 9	19 3	19 3	13 7	15 9	25 8	25 8	19 4	20 0
Pinot	13 6	15 0	22 6	236	23 6	240	20 0	206	16 3	16 7	18 7	19 3	13 9	16 3	23 8	24 4	18 8	20 0
Sauvignon blanc	13 2	15 0	22 6	230	23 6	254	20 4	206	15 3	16 7	18 7	19 3	13 9	14 3	24 4	24 6	19 0	20 0
Semillon	13 2	13 2	23 4	236	23 6	254	20 0	206	15 3	16 3	18 7	19 3	13 7	15 9	24 6	25 0	18 8	20 0
Shiraz	13 2	13 2	22 4	230	23 6	236	19 0	206	16 7	16 9	18 7	19 3	13 9	14 3	24 4	25 0	19 4	19 4
St. Laurent	13 6	15 0	22 6	226	23 6	254	20 0	206	16 3	16 7	19 3	19 3	13 9	16 3	23 8	24 6	18 8	19 4

Cultivar	VrZAG7	
Aligoté	155	155
Cabernet franc	108	155
Cabernet sauvignon	155	155
Chardonnay	155	155

Chenin blanc	108	155
Cot	155	155
Gamay	155	155
Merlot	108	155
Pinot	155	155
Sauvignon blanc	155	155
Semillon	155	155
Shiraz	106	155

Microsatellite genotypes of the cultivars include in the Portuguese sample

Cultivar	VVS 2		VVMD 5		VVMD 7		VrZAG 21		VrZAG 47		VrZAG 62		VrZAG 64		VrZAG 79		VrZAG 83	
Alfrocheiro	142	150	224	236	250	254	200	202	157	167	187	199	139	141	250	250	188	194
Arinto de Bucelas	142	150	224	236	240	248	200	206	159	163	185	187	137	159	246	250	194	194
Arinto no Douro	134	150	236	238	236	254	206	206	159	167	187	193	137	159	246	250	188	190
Avesso	134	150	220	238	236	236	202	206	159	167	185	185	137	159	242	246	190	200
Azal Branco	150	156	224	230	236	244	202	202	159	163	193	203	137	159	246	250	194	194
Baga	142	154	230	238	236	236	194	200	157	167	187	203	137	143	246	250	194	200
Bical	132	144	224	238	236	260	200	206	157	163	187	193	141	165	250	250	194	200
Boal Cachudo	142	144	224	238	236	254	200	204	157	172	187	187	141	143	246	250	190	194
Boal Ratinho	136	144	220	238	246	254	202	204	159	172	187	203	141	159	246	246	188	190
Camarate	144	150	234	236	240	250	200	200	159	159	187	199	137	139	246	250	188	190
Esgana Cão	132	150	224	236	236	250	190	200	159	163	187	193	137	159	246	258	190	200
Fernão Pires	144	150	224	238	236	236	202	204	161	172	187	193	141	159	246	246	188	190
Jaen	144	150	224	234	250	250	202	204	159	167	187	193	137	139	246	250	194	194
Negra Mole	142	144	220	238	236	236	200	206	159	159	187	195	137	143	246	258	194	194
Periquita	142	144	234	236	240	254	200	202	157	159	187	187	137	141	246	250	188	190
Rabo de Ovelha	136	150	220	234	236	240	200	204	159	159	187	193	137	159	246	246	190	200
Ramisco	132	156	224	23	236	260	19	20	16	16	18	19	13	15	24	25	19	20

				6			0	2	1	3	7	5	7	9	6	0	4	0
Rufete	132	156	224	23 4	236	254	20 4	20 6	15 9	16 7	18 7	19 3	13 9	14 1	24 4	24 6	18 8	19 0
Saborinho	132	150	224	23 6	236	254	20 4	20 6	15 9	16 7	18 7	19 3	14 1	16 3	24 4	26 0	18 8	19 0
Terrantêz	144	150	220	22 4	236	254	19 0	20 4	15 7	16 7	18 7	19 3	14 1	16 3	25 0	25 0	19 0	19 4
Touriga Nacional	142	150	224	23 4	236	236	20 4	20 6	15 9	16 7	18 7	19 3	13 9	15 1	24 4	24 4	18 8	18 8
Trajadura	142	150	224	23 4	236	248	20 0	20 2	15 9	16 3	18 5	18 5	13 7	15 9	24 6	24 6	19 4	20 0
Trincadeira Preta	132	150	232	23 6	236	246	20 0	20 2	15 9	16 3	18 7	20 3	13 7	13 9	24 6	25 0	18 8	18 8
Verdelho	132	150	220	23 0	236	254	20 4	20 6	15 9	16 7	19 3	19 5	15 9	16 3	24 6	25 0	18 8	19 4
Vinhão	132	134	220	22 4	236	260	20 0	20 2	16 7	16 7	18 7	19 5	15 1	15 9	24 4	25 0	18 8	20 0
Viosinho	132	150	230	23 0	236	240	20 4	20 6	16 3	16 7	18 5	18 7	13 7	16 3	24 2	24 4	18 8	19 0
Vital	144	150	220	23 8	236	236	20 0	20 4	15 9	17 2	18 7	18 7	14 1	15 9	24 6	25 2	19 0	19 4

Cultivar	VrZAG7	
Alfrocheiro	155	155
Arinto de Bucelas	157	157
Arinto no Douro	157	157
Avesso	106	155
Azal Branco	155	157
Baga	108	157
Bical	155	157
Boal Cachudo	155	157
Boal Ratinho	108	155
Camarate	155	155
Esgana Cão	108	155
Fernão Pires	155	155
Jaen	155	155
Negra Mole	108	155
Periquita	108	155
Rabo de Ovelha	108	155
Ramisco	108	155
Rufete	106	155
Saborinho	106	157

Terrantéz	155	157
Touriga Nacional	155	157
Trajadura	155	157
Trincadeira Preta	155	155
Verdelho	155	157
Vinhão	155	155
Viosinho	106	155
Vital	108	157

Microsatellite genotypes of the cultivars included in the Croatian sample

Cultivar	VVS 2		VVMD 5			VVMD 7			VrZAG 21		VrZAG 47		VrZAG 62		VrZAG 64		VrZAG 79		VrZAG 83	
Babic	142	150	226	22 6	24 4	24 6	19 0	20 6	15 7	15 7	20 3	20 3	14 1	14 3	23 6	25 8	19 4	20 0		
Bogdanusa	142	150	220	22 6	23 6	24 6	19 0	19 0	16 1	17 2	18 7	18 9	13 7	15 9	24 6	25 0	19 0	19 4		
Debit	132	144	226	22 6	23 6	24 6	19 0	19 4	15 7	17 2	18 9	19 5	13 7	15 9	23 6	25 0	18 8	19 4		
Gegic	132	144	224	22 6	24 4	25 0	19 0	21 4	15 7	17 2	19 3	19 9	13 7	14 1	23 6	25 0	18 8	19 4		
Hravatica	150	152	224	23 6	23 6	24 4	19 0	20 2	15 7	15 7	18 7	20 3	14 3	16 3	25 0	25 0	19 4	19 4		
Kraljevina Crvena	134	142	232	23 8	23 6	24 4	20 2	20 4	15 7	16 1	19 3	19 5	13 9	14 3	25 0	25 0	19 0	19 4		
Lasina	132	132	226	24 4	23 0	23 6	19 4	20 4	15 7	15 9	19 5	19 5	15 9	16 3	23 6	24 8	19 0	19 4		
Malvazija Istarska	142	142	220	23 8	23 6	23 6	19 4	20 2	15 7	15 7	18 7	18 7	15 9	16 3	23 6	25 4	18 8	19 4		
Mirkovaca	134	134	224	23 8	23 6	24 6	20 0	20 4	15 7	15 9	19 5	20 3	13 9	15 9	25 0	25 0	19 4	19 4		
Plavec Zuti	132	132	226	23 8	23 6	23 6	20 0	20 6	15 9	17 2	18 7	19 5	15 9	16 3	24 2	24 8	18 8	18 8		
Plavina	132	142	230	23 4	23 6	24 6	20 0	20 6	15 7	16 7	18 7	19 9	14 3	16 3	23 6	24 2	18 8	19 4		
Posip	132	132	226	23 8	23 6	23 6	20 2	20 4	15 7	15 9	18 5	18 7	13 9	14 3	25 0	25 8	19 4	19 4		
Posip Crni	134	134	224	23 8	23 6	23 6	20 0	20 2	15 7	15 9	18 5	18 7	14 3	15 9	25 0	25 8	18 8	19 4		
Ranfol	132	132	232	24 4	23 6	24 6	20 0	20 6	15 7	15 9	19 5	20 3	14 3	15 9	23 6	25 8	18 8	18 8		
Skret	132	132	224	22 6	24 6	25 2	20 0	20 6	16 3	17 2	19 9	20 3	13 7	16 3	25 0	25 0	18 8	19 4		

Teran	134	154	224	22 6	24 4	24 6	19 0	20 0	16 7	16 7	19 1	19 3	15 1	16 3	23 8	25 0	18 8	19 4
Vela Pergolla	132	150	224	23 8	23 6	24 4	20 4	21 4	15 7	15 9	18 7	20 3	14 3	16 3	25 0	25 8	19 0	19 4
Vrbnicka Zlahtina	134	138	224	22 6	23 6	24 4	19 0	20 0	15 9	16 3	19 5	20 3	14 3	15 9	25 8	25 8	18 8	19 0
Zilavka	132	152	224	23 6	23 6	23 6	20 0	20 2	15 7	17 2	18 7	18 7	14 3	14 3	24 8	24 8	18 8	19 4

Cultivar	VrZAG7	
Babic	155	157
Bogdanusa	106	157
Debit	155	157
Dolcin	155	155
Gegic	106	155
Hravatica	108	157
Kraljevina Crvena	157	157
Lasina	108	157
Mirkovaca	155	157
Plavec Zuti	155	155
Plavina	155	157
Posip	155	157
Posip Crni	157	157
Ranfol	155	157
Skrljet	108	157
Teran	108	108
Vela Pergolla	108	155
Vrbnicka Zlahtina	157	157
Zilavka	155	155

Microsatellite genotypes of the cultivars included in the Greek sample

Cultivar	VVS 2	VVMD 5	VVMD 7		VrZAG 21		VrZAG 47		VrZAG 62		VrZAG 64		VrZAG 79		VrZAG 83			
Akominato	13 2	150	226	23 2	24 6	24 6	19 0	20 6	15 9	16 3	20 1	20 3	13 7	13 9	24 6	25 8	19 0	19 4
Aetonychi	13 2	142	224	23 4	24 6	25 0	20 2	20 2	15 9	17 2	18 7	20 3	14 3	15 9	24 2	25 8	18 8	19 4
Agiorgitiko	14 2	144	230	23 8	24 0	24 6	20 4	20 6	15 3	16 3	19 9	20 1	14 3	14 3	24 6	24 6	18 8	19 0

Ákiki	15 0	150	232	23 4	24 0	24 6	20 2	20 6	15 7	16 3	18 7	18 7	13 9	15 9	24 6	25 0	19 4	19 4
Voidamato Lasithiou	13 2	142	224	23 4	24 0	24 6	20 0	20 2	15 9	15 9	18 7	19 9	14 3	14 3	25 0	25 8	19 4	20 0
Dafnia	13 4	142	232	24 4	24 0	24 6	20 6	20 6	15 7	16 1	18 7	18 7	13 9	15 9	24 6	24 6	18 8	20 0
Dermatas	13 2	142	224	23 8	24 6	24 8	20 6	20 6	15 9	16 1	19 9	20 1	13 7	14 3	24 6	25 8	19 0	19 4
Eftakoilo	14 8	152	224	23 0	23 6	24 8	19 0	20 6	15 7	17 2	18 7	20 3	13 9	14 3	24 6	25 6	18 8	19 4
Fokiano	13 2	142	224	23 8	24 0	24 6	19 0	20 6	16 3	17 2	18 5	19 9	13 9	14 3	24 2	25 6	18 8	18 8
Karatsova Naousis	13 4	142	232	24 4	24 0	24 4	20 2	21 4	15 9	16 3	18 5	19 9	15 9	15 9	25 0	25 8	19 0	19 4
Kolokythas Iefkos	13 4	150	232	23 4	24 4	25 0	20 6	21 0	15 7	17 2	19 5	20 3	13 9	13 9	25 0	25 6	18 8	20 0
Kotsifali	14 2	144	224	23 8	23 6	24 4	19 0	21 4	16 3	16 7	18 7	19 3	13 7	14 3	24 2	25 0	19 0	19 4
Krystalli	13 4	142	232	23 8	24 0	24 6	19 0	20 6	15 7	16 3	18 7	18 7	13 9	15 9	24 6	25 0	18 8	19 4
Kritiko mavro	13 2	148	230	23 6	23 6	24 2	19 0	20 2	15 9	17 2	18 7	20 3	13 9	15 9	25 4	25 6	18 8	19 4
Liatiko	13 4	142	238	23 8	23 6	24 0	20 6	20 6	16 3	16 3	19 9	20 3	13 9	14 3	24 6	25 0	18 8	19 4
Mantilaria	14 2	144	224	23 6	23 6	23 6	19 0	20 6	15 7	16 3	18 7	18 7	13 7	14 3	24 2	25 6	19 4	19 4
Mavrodaph ni	14 2	148	224	23 0	24 0	25 0	20 6	20 6	15 9	17 2	18 7	18 7	13 9	15 9	25 8	25 8	18 8	19 4
Merkouri	14 2	142	224	22 6	23 6	24 6	19 0	19 4	15 7	17 2	18 7	18 9	13 7	16 3	25 0	25 4	19 0	19 4
Moschofiler o	13 4	134	224	23 8	24 6	24 6	20 6	20 6	15 7	16 7	18 7	19 3	14 3	14 3	23 6	25 8	19 4	19 4
Nychato	15 0	150	236	23 6	24 4	24 8	19 0	20 6	15 9	17 2	18 7	20 3	14 3	15 9	25 0	25 6	18 8	19 4
Petrachladi	13 2	134	232	23 8	24 0	24 8	20 2	20 6	16 1	16 3	18 7	19 9	13 7	15 9	24 6	25 0	19 0	20 0
Plyto	14 4	150	226	23 8	23 6	25 0	19 0	19 0	15 9	16 3	18 7	18 7	13 7	13 9	25 0	25 8	19 4	19 4
Pseudosyri ko	14 2	148	224	23 0	23 6	23 6	19 0	20 6	15 9	17 2	18 5	19 5	13 9	15 9	25 0	25 0	18 8	19 4
Roditis kokkinos	14 2	142	236	24 4	23 6	24 6	20 0	20 0	15 9	17 2	18 7	19 3	13 7	15 9	25 0	25 0	18 8	19 4
Romeiko	14 2	144	238	24 4	23 6	24 6	20 6	20 6	15 7	16 5	18 7	19 5	14 3	15 9	25 0	25 0	19 4	19 4
Romeiko Machaira	13 0	142	224	24 4	24 4	24 6	20 0	20 0	15 3	15 7	18 7	18 7	14 3	15 9	24 6	25 0	18 8	19 0
Syriki	13 2	142	232	24 4	23 0	24 6	19 0	20 6	15 7	15 7	18 7	20 3	13 9	15 9	24 6	24 6	18 8	19 4

Theiako	14 2	142	224	23 6	23 6	24 6	19 0	20 6	15 7	15 9	19 3	20 3	13 7	14 3	25 4	25 8	19 4	19 4
Thrapsathiri	13 2	142	238	24 4	23 6	24 6	19 0	20 6	15 7	16 3	18 7	19 9	13 7	15 9	24 2	25 6	18 8	19 4
Tsaousi	13 4	150	226	23 6	24 4	24 6	20 6	20 6	15 7	16 1	18 7	20 3	13 9	14 3	24 6	24 8	18 8	19 0
Vidiano	14 4	144	236	23 8	23 6	24 6	20 2	20 6	16 3	16 5	18 7	19 9	13 7	15 9	24 2	25 0	19 4	19 4
Zakynthino	14 2	142	224	23 8	23 6	24 0	19 0	20 6	15 7	16 1	18 7	19 9	13 7	14 3	24 4	25 0	18 8	19 4

Cultivar	VrZAG7	
Akominato	108	155
Aetonychi	155	157
Agiorgitiko	106	155
Ákiki	106	155
Vertzami	157	157
Voidamato Lasithiou	155	157
Dafnia	106	157
Eftakoilo	157	157
Karatsova Naousis	155	157
Karystino	155	157
Kolokythas lefkos	155	155
Kritiko mavro	106	157
Liatiko	108	108
Mantilaria	155	157
Merkouri	106	155
Moschofilero	155	157
Nychato	106	155
Petrachladi	157	157
Piperionos	157	157
Plyto	106	155
Roditis kokkinos	155	157
Romeiko	106	106
Romeiko Machaira	157	157
Savvatio	157	157
Sideritis	106	157
Syriki	106	108
Theiako	108	108
Thrapsathiri	108	157
Tsaousi	157	157

Vidiano	106	108
Zakynthino	106	155

Microsatellite genotypes of the cultivars included in the Spanish sample

Cultivar	VVS 2		VVMD 5		VVMD 7		VrZAG 21		VrZAG 47		VrZAG 62		VrZAG 64		VrZAG 79		VrZAG 83	
Airen	14 2	144	22 4	232	24 0	250	20 0	206	15 9	17 2	18 7	19 9	13 7	14 3	24 6	25 8	19 0	19 4
Alarije	14 2	144	23 2	234	23 6	236	20 4	206	16 3	17 2	18 7	18 7	13 7	13 9	25 0	25 6	19 0	19 4
Blanca Cayetana	13 6	144	23 2	234	24 0	246	20 0	204	15 9	15 9	18 7	20 3	13 7	13 9	24 6	24 6	19 0	19 0
Bobal	14 4	146	22 6	232	23 6	240	19 0	206	15 9	16 7	18 7	18 7	14 3	15 9	24 2	24 6	19 4	19 4
Garnacha	13 6	144	22 4	238	23 6	240	20 2	204	17 2	17 2	18 7	18 7	13 7	14 3	25 6	25 6	18 8	19 0
Garnacha Tintorera	13 2	144	22 4	236	23 6	240	20 0	204	15 9	17 2	18 7	18 7	13 7	15 9	24 2	25 6	18 8	19 0
Godello	15 0	156	22 4	236	23 6	240	20 0	214	16 3	16 7	18 5	18 7	14 1	16 1	25 0	25 0	18 8	19 0
Juan Ibanez	14 2	144	23 2	234	23 6	244	20 4	206	15 9	16 7	18 7	20 3	13 9	14 3	24 2	24 6	18 8	19 0
Macabeo	13 2	144	23 2	234	23 6	236	20 4	204	16 7	17 2	18 7	18 7	14 3	15 9	24 2	25 6	19 0	19 4
Malvar	14 2	144	23 4	238	23 6	240	20 4	206	15 7	17 2	18 5	18 7	13 9	14 3	25 0	25 6	19 0	19 4
Maturana	14 2	150	23 0	234	23 6	240	20 0	214	16 3	16 7	18 5	18 7	13 9	16 3	24 4	25 0	19 4	20 0
Matza zuri	13 2	150	22 4	232	23 6	236	20 0	206	15 9	16 7	19 5	19 5	13 9	15 9	24 2	25 0	18 8	20 0
Mouraton	13 6	150	23 2	236	24 6	254	20 0	200	15 9	16 7	18 7	20 3	13 9	13 9	24 6	25 0	18 8	19 0
Mersegue ra	14 2	144	23 8	238	23 6	240	20 4	206	16 3	17 2	18 5	18 7	14 3	14 3	24 6	25 0	19 0	19 4
Monastrell	13 2	150	22 4	238	24 6	246	20 0	204	15 7	16 7	18 7	20 3	15 9	15 9	25 0	26 0	19 0	20 0
Ondarrabi Beltza	13 2	138	22 4	234	24 6	260	20 4	206	16 7	16 7	19 9	20 3	15 9	15 9	24 4	24 6	19 4	20 0
Pedro Ximenez	13 2	144	23 4	238	23 6	236	19 0	206	15 9	16 3	18 7	18 7	13 9	14 3	24 2	24 6	18 8	19 4
Tempranillo	14 2	144	23 4	234	23 6	250	20 4	206	16 1	16 1	19 5	19 9	14 1	14 3	24 6	25 0	19 4	19 4
Verdejo tinto	14 2	150	23 6	236	23 6	254	20 0	204	15 3	16 7	18 7	18 7	13 9	15 9	24 4	24 6	19 0	20 0
Zalema	13	144	23	238	23	236	20	206	15	15	18	19	13	13	24	25	19	19

	2		4		6		4		9	9	7	5	7	7	6	6	0	4
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Cultivar	VrZAG7	
Airen	108	157
Alarije	155	157
BlancaCayetana	108	155
Bobal	155	157
Garnacha	155	157
Godello	155	157
Juan Ibanez	155	157
Macabeo	155	157
Malvar	155	157
Maturana	155	157
Matza zuri	155	155
Merseguera	155	157
Monastrell	108	155
Mouraton	155	155
Ondarrabi Beltza	108	155
Pedro Ximenez	108	155
Tempranillo	155	155
Verdejo tinto	155	157
Zalema	108	157

Microsatellite genotypes of the cultivars included in the Italian sample

CULTIVAR	VVS 2		VVMD 5		VVMD 7		VrZAG 21		VrZAG 47		VrZAG 62		VrZAG 64		VrZAG 79		VrZAG 83	
Aglianico	150	154	230	244	236	236	190	190	161	167	187	187	137	159	244	244	194	200
Albarola	132	154	230	234	240	260	200	202	157	159	187	193	139	159	248	258	194	194
Avana'	132	154	224	224	244	244	190	206	163	163	193	193	143	159	238	242	188	194
Avarengo	138	154	224	230	244	244	190	202	157	163	193	193	159	163	248	258	188	194
Barbera	132	134	224	224	246	250	190	200	163	167	191	199	159	163	242	258	188	194
Barbera bianca	132	142	224	238	244	250	206	214	157	159	199	203	159	163	250	260	188	194
Bonarda Piemonte se	142	154	244	244	246	252	206	206	163	172	199	203	163	163	238	250	188	194

Bosco	13 2	134	224	234	23 6	26 0	190	20 6	159	16 3	18 7	19 5	14 3	15 9	25 0	25 8	18 8	19 4
Brachetto d'Acqui	13 2	138	226	234	23 0	24 4	206	20 6	157	15 7	19 3	19 5	14 1	16 3	24 8	25 4	18 8	19 4
Cortese	13 2	150	224	234	24 6	24 6	190	20 2	157	16 1	19 9	20 1	14 3	14 3	24 6	24 6	19 0	19 4
Croatina	13 8	150	234	234	24 4	24 6	190	20 6	167	17 2	18 5	19 5	13 7	15 9	24 4	24 4	19 0	19 4
Dolcetto	13 8	142	232	244	24 4	25 2	206	20 6	157	17 2	20 3	20 3	13 7	15 9	24 8	25 0	19 4	20 0
Erbaluce	14 4	150	224	226	24 4	25 0	202	20 2	157	16 3	19 3	19 9	13 7	14 3	24 2	25 4	18 8	19 4
Fiano	15 4	154	224	226	23 6	23 6	190	20 2	161	16 7	18 7	19 3	13 7	14 3	24 4	25 0	19 0	19 4
Grignolino	13 2	134	224	244	24 4	25 2	190	20 0	159	16 7	19 3	20 3	14 1	16 3	25 0	25 8	19 4	20 0
Lambrusc a di Alessandr ia	14 2	150	224	238	25 0	25 2	200	20 6	157	17 2	19 9	20 3	15 7	15 9	25 0	25 0	18 8	19 4
Malvasia Casorzo	13 2	150	226	238	25 0	25 0	200	20 6	157	15 7	19 5	19 9	15 7	15 9	24 2	25 0	18 8	18 8
Malvasia Schierano	13 2	134	234	234	24 6	24 6	206	20 6	157	16 7	18 5	19 5	15 9	15 9	24 4	25 4	18 8	19 4
Nebbiolo Lampia	15 4	154	230	234	24 4	24 6	190	19 0	163	16 7	19 3	19 9	14 1	14 9	24 2	25 0	19 4	20 0
Neiret pinerolese	13 2	136	224	226	23 6	24 6	200	20 6	157	17 2	18 7	19 3	13 7	16 3	25 0	25 0	18 8	20 0
Neretta cuneese	13 8	142	224	236	24 4	26 0	200	20 6	159	17 2	19 3	20 3	15 9	16 3	23 8	25 8	18 8	19 4
Pelaverga Pagno	13 2	150	226	234	24 4	25 0	190	20 2	157	16 7	19 3	19 3	13 9	16 3	25 0	25 8	18 8	20 0
Quagliano	13 2	142	224	224	23 6	24 0	190	20 4	157	16 7	18 7	18 7	15 7	15 9	25 0	25 4	19 0	20 0
Refosco ped. rosso	13 2	132	224	230	23 8	24 6	190	20 0	159	16 7	19 3	19 3	14 3	16 3	25 0	25 8	19 4	20 0
Sangiove se	13 2	132	224	234	23 6	26 0	202	20 4	157	16 3	19 3	19 5	13 7	13 9	24 2	25 8	19 0	19 4
Teroldego	13 6	154	224	226	23 6	24 4	190	19 4	157	16 3	19 3	19 3	14 9	16 3	24 2	25 4	19 4	20 0
Trebbiano toscano	13 2	142	224	230	24 6	25 0	202	20 6	157	16 1	19 3	19 9	13 7	16 3	24 4	25 0	18 8	19 4
Uva rara	13 2	142	234	238	24 4	24 6	190	20 6	163	16 7	19 5	19 9	13 7	13 9	24 2	24 2	18 8	19 4
Vermentin o	13 2	150	232	236	24 6	24 6	200	20 4	157	15 9	19 9	20 3	13 7	13 7	24 8	25 8	19 0	19 4
Vespolina	14	154	234	238	24	24	190	19	163	16	19	19	14	15	24	25	19	19

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Cultivar	VrZAG7	
Albarola	155	155
Avana'	108	157
Avarengo	108	108
Barbera bianca	155	157
Bonarda Piemontese	155	155
Bosco	155	157
Brachetto d'Acqui	108	155
Cortese	155	157
Croatina	155	157
Dolcetto	108	155
Erbaluce	157	157
Grignolino	108	157
Malvasia Casorzo	157	157
Malvasia Schierano	155	155
Nebbiolo Lampia	157	157
Neiret pinerolese	108	155
Neretta cuneese	108	155
Pelaverga Pagno	108	108
Quagliano	155	157
Refosco ped. rosso	108	157
Sangiovese	155	157
Uva rara	108	155
Vermentino	155	157
Vespolina	108	157