

## Supplemental Electronic Material

### Genetic characterization of an apple gene bank (part of the Austrian Fruit Collection) using microsatellite analysis reveals rare cultivars

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Genetic characterization is an important tool and a well established method for the maintenance of fruit collections. In this study apple trees from the gene bank "Kierling" (Klosterneuburg, Austria) were characterized by molecular markers. This orchard was planted in 1997. The varieties are grafted on seedling rootstocks and raised as half-standard trees. A total of 208 trees were analyzed and 95 different varieties could be identified. The use of 28 different microsatellites in seven multiplex reactions made it possible to compare the profiles obtained from various international databases. At the same time, a reference database with over 10.000 records from international publications and cooperations with other institutions was created by harmonization of the available data for this purpose. True-to-type analysis confirmed that most of the planted cultivars were correctly recorded, as expected. However, it was also possible to identify varieties, which were previously not known to be part of this gene bank, e.g. 'Orbai alma' or 'Fameuse'. Furthermore, it was discovered by parentage analysis that 'Rumer Gravensteiner', a local variety in Tyrol, is presumably a seedling of 'Landsberger Renette' and 'Schmidberger Renette'. Four cultivars could not be verified and identified, respectively, yet as no reference profile was found in any international data set a further pomological examination has to be done. However, one of these was determined to be related to 'Bittenfelder Sämling'.

**Keywords:** *Malus domestica* Borkh., SSR marker, genotyping, differentiation

Table S1: Genetic fingerprints of 95 cultivars and 13 reference cultivars obtained by using 18 microsatellite markers; ploidy level (in Italics) were assumed from the results. MUNQ codes are those of the cultivars, which were used for verification.

Acc.no.	Cultivar	Synonym	MUNQ of References	ploidy	CH01f02	CH01f03b	CH01h01	CH01h10	CH02c06	CH02c09	CH02c11	CH02d08
10-009	Adams Parmaine	Adams Pearmain	795	2n	183:187	141:174	122:126	100:112	246:254	257:259	233:237	233:258
10-012	Adersleber Calville		113	2n	185:193	162:174	120:137	100:104	254:256	241:257	231:233	221:258
03-002	Aldinger's George Cave		280	2n	187:210	141:162	122:137	100:106	234:242	235:259	223:227	254:256
14-009	Alexander	Kaiser Alexander	30	2n	173:193	174:182	118:120	100:104	256	241	227:231	221
10-013	Ananas Reinette		69	2n	187:210	174:180	122:126	94:100	246:254	257:259	231:233	233
11-002	Apfel aus Uelzen	Calville d'Ulzen	590	2n	185:208	162:174	120:124	112:139	232:256	235:257	221:241	215:258

Acc.no.	Cultivar	Synonym	MUNQ of References	ploidy	CH01f02	CH01f03b	CH01h01	CH01h10	CH02c06	CH02c09	CH02c11	CH02d08
11-004	Baldwin		849	3n	177:183:210	141:174:185	110:122:137	94:100:106	232:254	235:247:259	211:237	215:217:258
18-002	Baumann's Reinette		21	2n	173:183	141:182	110:126	100	220:232	247:259	221:237	215:233
11-007	Belle de Boskoop	Schöner aus Boskoop	886	3n	187:208	141:174:182	110:133:137	94:100	232:242	235:251:257	223:235:237	217:229:233
12-004	Bisquet		535	2n	187:210	141:174	126:133	100:108	246:258	235:243:253	235	215:250
11-006	Bittenfelder Sämling		1027	2n	177:187	141:182	120:133	100:118	232:254	245:251	227:235	217:227
06-005	Blenheim Orange	Goldrenette von Blenheim	376	3n	185:187	141:174:182	118:137	94:100	246:254:262	245:247:259	211:219:221	209:258
21-003	Boiken		108	2n	183:225	141:182	126	100	220:238	245:259	237:241	217:233
11-009	Börtlinger Weinapfel			2n	185:187	141	124:133	100:118	234:242	251:257	227:235	215:229
11-011	Bramley's Seedling		611	3n	181:187:208	141:174	122:126:137	100	234:252:258	235:247	223:231	215:258
11-014	Brettacher		883	3n	173:183:187	141:162:174	120:122:137	100:104:118	236:254	245:247	211:219:231	215:250:258
05-002	Cellini		110	2n	183:193	182	120:137	100:104	246:256	241:259	221:227	221:254
21-006	Champagner Reinette		91	2n	187	141:186	124:137	100:118	254	245:247	211:231	211:258
04-002	Charlamovsky		29	2n	175:204	148:174	116:120	100:137	210:256	241	219:241	258
06-002	Cox Orange		163	2n	208:210	162	124:137	100	242	235:259	221	256:258
14-006	De Grignon	Apfel aus Grignon		3n	177:183	141:162:174	124:126:135	94:100:112	220:232:236	235:245:257	211:231:237	229:233
14-015	Dutch Mignonne	Kasseler Renette	629	2n	185:187	141:182	133:138	100	232:242	251:257	235:237	217:229
12-006	Elise Rathke		66	2n	173:187	174	122:126	94:112	254:256	248:260	211:221	229:258
12-010	Falchs Gulderling			2n	173:185	141:162:174	120:148	104:112	220	245:251	211:221	258
06-007	Fameuse	Amerikanischer Schneeapfel	303	2n	173:177	174:180	122:133	104:112	236:252	247:259	219:241	215
12-012	Florianer Rosmarinapfel			2n	173:177	162:182	122:124	94:100	234:252	243:253:259	235:241	215:229
04-004	Fraas Sommerkalvill			2n	173:187	162:185	116:135	100:104	210:242	257:259	219:221	233:250
14-004	Framboise de Holovousy	Himbeerapfel aus Holowousy	452	2n	173:185	141:180	126:131	100	252:264	243:259	235:241	215:227
12-014	Galloway Pippin	Galloway Pepping	295	3n	173:183:185	141:162	118:122:137	94:100:108	232	245:247	211:237:239	215:233:258
15-001	Geflammt Kardinal			3n	173:183:208	141:174	120:137	94:106	220:232:252	235:243:253	211:223:231	229:259
06-004	Geheimrat Doctor Oldenburg		658	2n	193:210	180:182	118:126	100:104	254:256	241:259	227:231	219:233
07-003	Gloster 69		625	2n	183:195	141:182	120:124	96:100	238:252	245:257	211:219	217:221
16-005	Golden Delicious		65	2n	173:183	141:174	122:124	94:112	238:242	245:259	223:237	227:229
13-011	Graue Renette			2n	183:187	141:162	122:137	94:100	232:242:254	247:257	211:231	233:258

Acc.no.	Cultivar	Synonym	MUNQ of References	ploidy	CH01f02	CH01f03b	CH01h01	CH01h10	CH02c06	CH02c09	CH02c11	CH02d08
13-013	Grüner Stettiner		1052	3n	173:210	141:162:174	116:118	100:112	220:238:260	243:245:257	211:221:237	227:250
07-001	Haferapfel			2n	191:225	141:174	120	100:104	210:220	235:241	219:227	219:229
14-001	Hauxapfel			2n	173:183	174:182	118:126	94:100	220:256	235:243:251	241	217:229
04-006	James Grieve		78	2n	208:210	162	124:126	100	242:254	235:251	221:241	233:258
14-007	Jonathan		57	2n	210	174	120:137	94:100	238:254	251:259	233:239	233:258
07-005	Kaiser Wilhelm		798	3n	187	141:182	118:137	94:100	246:250	235:247:259	211:221:233	233:256
14-014	Kardinal Bea			2n	173:187	182	118:135	100:104	242:254	241:259	221:231	221:258
10-007	King of the Pippins	Goldparmäne	37	2n	185:187	162:182	118:135	94:100	242:254	257:259	221:237	233:258
09-012	Klöcher Maschanzker			3n	173:185:195	141:162:174	118:120:122	94:100:104	248:252	235:247	227:233	215:256:258
07-008	Kronprinz Rudolf		1037	2n	173:187	162:174	122:124	100:104	246:254	245:247	219:227	215:250
15-003	Leven alma		260	3n	173:183:210	141:162	118:137	100	238:254	235:257	233:239	215:258
15-008	Luxemburger Triumph		199	3n	183:187:206	174	120:137	94:100:120	220:234:238	235:243:247	223:231:233	215:229
15-009	Maunzenapfel			2n	173:189	160:182	110:133	100	232:234	245:257	221:237	215:227
15-012	Mautapfel			3n	183	141:174	120:122	100:104	254:272	235:247	211:233:241	256:258
15-013	Mauthausener Limoni			2n	173:187	141:166	120:124	100	236:254	235:259	211:237	215:262
08-004	McIntosh		508	2n	177:208	162:174	120:122	94:100	232:256	235:259	231:233	215:233
13-007	Merveille de Vitry		326	2n	183:187	166:174	133:148	100	248:254	235:251	221:231	229
08-006	Minister von Hammerstein		672	2n	185:193	180:182	120:126	100:104	242:254	247:257	233	221:258
08-001	Mother	Lavanttaler Bananenapfel	488	2n	187:208	163:182	118:137	100:109	252:254	235	237:241	215:229
16-003	Oberösterreichischer Brünnerling			3n	173:183:187	141:160	110:120:124	100:104	232:254	235:247:253	211:227	215:250
08-007	Odenwaelder			2n	173:195	180:182	118:122	94:100	254:256	235:257	227:239	221:256
16-001	Ontario		17	2n	185	160:182	137	94:100	232:254	235:247	211:233	229:252
05-004	Orbai alma	Apfel aus Orba	2994	3n	173:193:210	162:174	114:126:137	94:100	254:256	241:257	219:227	215:229:258
08-010	Peasgood's Nonsuch	Peasgood Sondergleichen	51	2n	193:210	141:182	120:124	100	220:256	241:259	227:237	215:221
17-010	<i>Pomella verde brisca</i> or <i>Carrara brusca</i>		407	3n	173:177	164:174:182	116:118	100:104	220:236	243:247	237:241:265	213:227
16-009	Pomme d'or			3n	197:210	141:166:174	118:122:135	94:100	242:246:252	235:257	231:241	215:258
16-012	Prinz Albrecht von Preussen		657	2n	187:193	174:182	118:120	100:104	254:256	235:241	231	221:233

Acc.no.	Cultivar	Synonym	MUNQ of References	ploidy	CH01f02	CH01f03b	CH01h01	CH01h10	CH02c06	CH02c09	CH02c11	CH02d08
13-017	Queen	Königinapfel	54	2n	173:187	162:174	120:126	100	242:256	235:241	219:227	221:258
17-003	Red Boskoop	Roter Boskoop	886	3n	187:208	141:174:182	110:133:137	94:100	232:242	235:251:257	223:235:237	217:229:233
05-006	Reinette de Landsberg	Landsberger Renette	61	2n	187:193	162:182	120:137	94:104	242:256	241:247	231:233	221:258
16-016	Remsen			2n	173:183	141:182	110:122	100	238:248	247:255	233:251	211:260
21-001	Rheinischer Bohnapfel		774	3n	183:187	141:174	120:122:133	94:100	222:256:274	247	211:241	229:258
17-002	Rheinischer Krummstiel		461	2n	173:185	141:174	120:137	100	242:254	235	223	215:229
17-006	Ribston Pepping		907	3n	185:210	141:162:174	124:137:148	100	234:242:248	235:247:259	221:237:241	229:233:258
17-007	Rolling			2n	187:208	141:174	122:124	94:100	220:246	235:247	223:233	215:258
15-016	Rome Beauty	Morgenduft	334	2n	208:210	162:174	118:126	100	242:254	245:257	231:237	258
09-003	Rote Schafnase			2n	173:210	141:174	120:126	100:112	234:236	235:247	219:237	209:221
21-010	Roter Eiserapfel		877	3n	175:183:191	141:174:186	116:124	100	220:258	247:257	211:233:237	215:233:250
09-005	Roter Herbstkalvill		13	2n	177:208	174	126:137	100:112	252:254	257:259	241	254:258
17-014	Roter Jungfernapfel		1529	2n	173:183	141:174	120:122	100:104	220:254	245:257	231:241	250
09-002	Roter von Simonffy		1377	2n	173:208	174:182	124:146	94:109	220:252	235:251	211:223	256:258
18-005	Rousse Latour			2n	183:187	164:174	118:120	94:100	232:252	243:247	219:237	215:258
09-007	Rumer Gravensteiner			2n	173:193	162:174	122:137	100:104	220:256	235:241	227:231	229:256
18-007	Sauergrauech		670	2n	185:187	160:174	126:137	100	238:252	247:251	227:237	221:260
18-009	Schmidberger Renette		1051	2n	173:191	141:174	122	100	220:236	235:257	227:237	229:262
09-009	Schöner aus Wiedenbrück			3n	191:195	141:174	118:126:135	94:100	220:248	235:257	219:231:241	215:229:258
10-005	Schöner von Wiltshire			2n	177	141	126:135	100:112	254:256	235:245	223:235	229:254
19-002	Siebenkant			2n	173:185	148:180	118:126	100	254:264	243:259	227:233	250:258
10-002	Spartan		309	2n	177:183	174:182	120:122	94:100	254:256	235:247	211:233	215
19-005	Spätblühender Taffetapfel		301	2n	173:177	141:174	124:133	100:106	232:254	253:255	219:235	215
02-002	Stark Earliest		468	2n	173:191	162:166	126	100:112	220:258	245:259	221:231	215:229
10-003	Steirische Schafnase			2n	173:210	141:174	120:126	100:112	234:236	235:247	219:237	209:221
21-007	Steirischer Maschanzker		264	2n	173:185	141:162	120:122	94:106	254	235:247	227:233	215:258
20-001	Suislepper		239	2n	175:225	141:148	128:135	100:104	258:266	235:247	219:227	215
03-003	Transparente de Croncels	Apfel aus Croncels	62	2n	185:204	174:180	120:137	100:137	210:254	241:259	219:233	258
16-013	<i>unclear (Remfield)</i>			2n	183:185	174:180	126:137	100	254	247:257	211:237	233:260

Acc.no.	Cultivar	Synonym	MUNQ of References	ploidy	CH01f02	CH01f03b	CH01h01	CH01h10	CH02c06	CH02c09	CH02c11	CH02d08
07-007	<i>unknown 1</i>			2n	177:208	141:162:172	120:133	100:108	220:238:254	247:251	219:227	213:217
18-011	<i>unknown 2</i>			3n	173:208:210	162:174:186	122:126	94:112	246:254:258	235:247:251	233:237:265	215
01-001	White Transparent	Weißer Klarapfel	25	2n	185:191	141:148	118:120	100:104	220:254	247:251	221:227	219:229
14-005	Winter Banana	Winterbananenapfel	50	2n	183:185	162	120:124	94:100	232:238	235:259	223:233	227
13-001	Yellow Bellflower	Gelber Bellefleur	77	2n	177:183	162:182	122:137	100:112	238:254	235:259	223:233	227:250
Ref1	Michelin		217	2n	187	174	126:133	100:108	246:256	243:253	235	215:250
Ref2	<i>Malus floribunda</i> #821		998	2n	179:183	153	110:146	106:114	218:246	233:253	227:231	217:223
Ref3	Delicious		448	2n	183:187	141:182	122	94:100	220:252	247:257	211:237	215:221
Ref4	<i>Malus x robusta</i> 5		4627	2n	179:183	174	95:104	92:114	250:252	251	209:223	215:217
Ref5	M9 (Pajam 2)		638	2n	173:175	162:174	120:126	100:118	238:256	247	219:239	217:239
Ref6	Prima		267	2n	183:210	141:162	120:124	94:100	238:242	235:245	233:237	258
Ref7	Fiesta		763	2n	185:208	162:174	124:137	100	238:242	235:251	221:233	229:258
Ref8	Boiken		108	2n	183:225	141:182	126	100	220:238	245:259	237:241	217:233
Ref9	Durello di Forlì		411	2n	177:179	174:182	116:124	100	238:254	247:251	227:241	213:229
Ref10	Alexander		30	2n	173:193	174:182	118:120	100:104	256	241	227:231	221
Ref11	Kronprinz Rudolf		1037	2n	173:187	162:174	122:124	100:104	246:254	245:247	219:227	215:250
Ref12	Red Jonathan		57	2n	210	174	120:137	94:100	238:254	251:259	233:239	233:258
Ref13	King of the Pippins		37	2n	185:187	162:182	118:135	94:100	242:254	257:259	221:237	233:258

Acc.no.	Cultivar	CH03d07	CH04c07	CH04e05	CH05f06	GD12	GD 147	CH-Vf1	Hi02c07	CH01c06	CH01d08
10-009	Adams Parmaine	208:228	110:116	205	181:185	160	142	146:169	116:148	160:188	248:272
10-012	Adersleber Calville	208:220	108:114	201:205	171:189	160:164	142:155	146:179	112:148	160:190	238
03-002	Aldinger's George Cave	188:228	110:114	178	171:189	160:164	155	146	114:148	156:172	240:272
14-009	Alexander	188:220	112:114	178:201:226	171:179	160	144:155	146:179	112	154:190	240:254
10-013	Ananas Reinette	226:228	110:138	178	177:185	160:192	142:147	133:146	114	156:160	240:248
11-002	Apfel aus Uelzen	194:228	112:116	178:205	177:185	160	142:153	146:169	116	158:160	240:248
11-004	Baldwin	204:208:226	100:110:136	178	181:185:193	160:164	142:151:153	146:148	108:114:148	158:188	240:254:272
18-002	Baumann's Reinette	194:230	98:110:138	178	189	158:192	136:142	146:148	114:116	158:162	240:248

Acc.no.	Cultivar	CH03d07	CH04c07	CH04e05	CH05f06	GD12	GD 147	CH-Vf1	Hi02c07	CH01c06	CH01d08
11-007	Belle de Boskoop	204:208	110:116	178:213	171:177:189	150:158:192	129:142	148:152:179	114:116	158:162:188	240:248
12-004	Bisquet	228	100:116	205:221	179:189	160	142:144	146:148	114	158:186	240:272
11-006	Bittenfelder Sämling	190:208	108:136	178:213	177:179	172:192	129:142	148:179	114:116	158:170	240:254
06-005	Blenheim Orange	188:208:228	110:116	178:205	181:189	160	140:142	146:169	104:116:148	156:158:162	240:254:272
21-003	Boiken	228	110:138	221:226	185:189	164:192	136:147	146:148	114:116	156:160	240
11-009	Börtlinger Weinapfel	190:208	110:116	178:213	185:189	158:172	129:142	146:148	114:116	162:170	240:254
11-011	Bramley's Seedling	194:220:230	100:110	178:205	171:189	166:192	136:142:153	146:169	112:114:148	160:162:188	240:242:294
11-014	Brettacher	190:194:204	98:110:114	178:213:219	185:189	160	136:142	146:165	108:114	156:160	238:240
05-002	Cellini	188:208	110:112	178:201	171:185	150:160	144:149	169:179	104:112	154:162	254:272
21-006	Champagner Reinette	194:228	110	178:205:219	181:185	160:164	142:153	146:179	114	160:186	240:254
04-002	Charlamovsky	188:220	112:114	178:226	179:185	162:166	136:153	144:179	108:112	156:164	240:254
06-002	Cox Orange	220	110:116	178:203	171:189	160:164	144:155	146	114:148	160:170	240:254
14-006	De Grignon	194:208	98:114:122	178:205	181:189	160:170	142:153	146:179	114:131	156:160:188	240:250:256
14-015	Dutch Mignonne	208	110	178:205	177:189	158:192	129:142	148:179	114:116	158:162	240
12-006	Elise Rathke	194:228	100:114:136	178:209	179:189	160:162	136:157	146:179	114	156:160	240:254
12-010	Falchs Gulderling	188:228	110:144	178:205	177:183	160:168	153	146:169	106:116	160	240:248
06-007	Fameuse	192:193	108:110	178:205	177:189	160	142:155	146:179	112:114	160:162	254:272
12-012	Florianer Rosmarinapfel	194:210	98:110	205:213	177:185	160	136:153	177:179	112:114	160	240:248
04-004	Fraas Sommerkalvill	188:228	98:114	178:205	179:189	160:192	140:155	139:146	148	162	254
14-004	Framboise de Holovousy	194:220	110:120	178:205	171:189	160:162	142:151	146	112:148	160:162	240:256
12-014	Galloway Pepping	190:208:228	110	178:213:221	171:181	160:192	142	146:148	112:114:116	156	240:250:254
15-001	Geflammt Kardinal	188:194:204	110:114	178:205:213	171:179:187	160	142:151	146:167:179	108:114	158:162	240:254:270
06-004	Geheimrat Doctor Oldenburg	220:228	110:112	178:226	171:177	160	142:155	133:179	112:114	160:170	240:248
07-003	Gloster 69	208:228	124:136	178:207	179:189	160:166	142	146:179	114:116	160	240:254
16-005	Golden Delicious	190:208	98:116	178	181:189	160:200	142	146:179	108:114	156:162	250:272
13-011	Graue Renette	208:228	110:114	178:203	181:185	160:170	142	146:148	114	156:170:186	240:248:254
13-013	Grüner Stettiner	204:208:226	98:114:138	178:205:213	179:185:189	160:184	136:144	139:152:171	104:114	158:160:162	248:268:272
07-001	Haferapfel	188:204	114:132	178:226	179	162:164	136:149	146:179	108:148	160:162	240:254
14-001	Hauxapfel	204:228	110:114	213:226	179:185:189	160:192	136:142:149	146	106:114	156:160	240:248

Acc.no.	Cultivar	CH03d07	CH04c07	CH04e05	CH05f06	GD12	GD 147	CH-Vf1	Hi02c07	CH01c06	CH01d08
04-006	James Grieve	194:220	110:112	178:203	171:189	160	136:155	146	118:148	160:162	240:256
14-007	Jonathan	204:208	114:116	178:205	185:189	160	136:153	146:179	114:148	188	240:272
07-005	Kaiser Wilhelm	190:208:228	110:116:136	178:205:211	181:189	160	136:140	146:169:179	106:116:148	156:158:162	240:254:272
14-014	Kardinal Bea	188:208	110:114	178:201	171:189	160	140:144	146	112:148	154:162	254
10-007	King of the Pippins	208:230	98:110	178:205	189	160	140:142	146	104:148	156:162	240:254
09-012	Klöcher Maschanzker	190:220:226	110:118	178:213	171:181:191	160:164	136:142:151	146	112:114:116	156:160:162	238:248:254
07-008	Kronprinz Rudolf	190:204	114:144	178:213	189:191	160:162	142:155	146:179	112:116	160:186	238:294
15-003	Leven alma	190:228	98:100:122	178:205:221	181:189	160:172	142:155	141:167:179	114:116	158:162:186	240
15-008	Luxemburger Triumph	194:220:228	110:116	178:201:213	171:185:189	160	136:149:153	146:177:179	108:114	156:160:186	240:272:294
15-009	Maunzenapfel	208:228	114:124	205:226	171:187	160	144:155	179	114:131	160:170	240:272
15-012	Mautapfel	228:230	110:114:138	178:205:213	175:185	158:164:170	142:147	146:179	108:116:148	156:158:172	240:254:272
15-013	Mauthausener Limoni	220:228	124:138	178:205	171:185	160:162	151:161	146:179	106:114	156:160	240:272
08-004	McIntosh	192:228	110	205:213	171:189	160:192	136:142	179	108:116	160:162	254:272
13-007	Merveille de Vitry	228:230	100:110	201:221	177:187	160:170	142:153	146:179	112:114	160:186	240
08-006	Minister von Hammerstein	194:228	110:112	201:205	181	160	142	146	112:148	154:186	240
08-001	Mother	226:228	118:134	178	177:185	160:164	140:142	146:179	108:114	156:160	242:256
16-003	Oberösterreichischer Brünnerling	190:228	110:124	178:213	171:185	162:164	142:151	146:179	108:114:127	156:160	240:248:272
08-007	Odenwaelder	190:204	110:112	178:201	177:181	160:164	144:159	144:165	112:114	156:158	240:254
16-001	Ontario	194:208	110	201:213	181:185	160	149:151	146:179	114	160:170	254:294
05-004	Orbai alma	206:228	98:114:120	178:205:213	179:189	160:168	142:157	146:169:181	112:139	160	268
08-010	Peasgood's Nonsuch	188:228	112:136	178:226	171:189	160	136:144	146	112:114	162:188	240
17-010	<i>Pomella verde brisca or Carrara brusca</i>	194:204	100:110:112	178:205:213	183:191	160:162:164	142:144:155	146:169	114	158:170	254:272
16-009	Pomme d'or	190:228	98:110	178:201:205	187:189	160:170	144:151	144:165:171	114	154:158:172	248:270
16-012	Prinz Albrecht von Preußen	188:194	98:114	205:226	179:189	160:192	144:151	146:179	104:112	154:162	240
13-017	Queen	188:194	112	178:226	171:179	160:192	136:155	146:179	112:114	154:162	254:256
17-003	Red Boskoop	204:208	110:116	178:213	171:177:189	150:158:192	129:142	148:152:179	114:116	158:162:188	240:248
05-006	ReINETTE de Landsberg	188:228	112:124	178:201	179:181	160:172	142:144	146	112:114	154:156	240
16-016	Remsen	194:220	110:144	178	189	162:164	149:155:161	146	104:108:114	160:172	240:248



Acc.no.	Cultivar	CH03d07	CH04c07	CH04e05	CH05f06	GD12	GD 147	CH-Vf1	Hi02c07	CH01c06	CH01d08
21-001	Rheinischer Bohnapfel	204:228:230	110:138	178:213:224	175:183:185	154:164:172	142:144	146:169:179	114:116:148	156:172	238:248:272
17-002	Rheinischer Krummstiel	226:228	116:138	178	187:189	160:162	136:142	146:152	108:112	156:162	240:254
17-006	Ribston Pepping	222:288	110:114:138	178:205	185:187	160:162:164	142:144:153	146:148	114:148	156:160:162	240:248
17-007	Rolling	194:228	98	178:205	187:189	160	153	148:179	112:114	156:162	254:272
15-016	Rome Beauty	194:208	110	201:205	189	160:162	136:147	146:169	114:116	158:188	248:254
09-003	Rote Schafnase	192:220	110:138	178:213	185:189	162:166	134:136	148:169	108:114	160	254:272
21-010	Roter Eiserapfel	194:204:228	110:138	178:205:213	179:189	160:162:164	136	141:148:167	108:116	160:162	240:250:254
09-005	Roter Herbstkalvill	194:228	100:110	178	185:189	160	144:149	146:179	108:148	162	250:270
17-014	Roter Jungfernapfel	190:228	98:120	178:213	185:189	160	129:136:151	146:179	106	156:158	240:248
09-002	Roter von Simonffy	194:228	110:144	178:205	171:177	162:164	142:153	146:169	112:116	160:188	250
18-005	Rousse Latour	208:228	100:124	213:221	179:181	160:192	142	146:169	114	160	240
09-007	Rumer Gravensteiner	188:230	112:124	178:201	179:189	170:192	142:155	146:171	112:131	154:162	240:254
18-007	Sauergraeuch	198:228	110:144	213:222	171:183	160:168	136:155	146:167	112:116	160:162	238:254
18-009	Schmidberger Renette	220:230	110:124:138	178	179:189	160:192	136:155	146:171:179	114:131	156:162	240:254
09-009	Schöner aus Wiedenbrück	208	110:124	178:205:221	171:179:185	160	136:144:153	146:179	108:114	156:162	240:248:254
10-005	Schöner von Wiltshire	228:230	98:108	201:221	181:189	160	142:153	146:179	112:114	162	238:254
19-002	Siebenkant	208:220	110:116	178:205	171:181	160:162	142:151	146:163	114:116	162:186	240:248
10-002	Spartan	192:228	110:136	207:213	181:189	160:164	136:157	171:179	112:116	160:162	240:272
19-005	Spätblühender Taffetapfel	190:228	114:138	178:213	181:185	160:162	136:144	146:179	104:114	160:172	240:254
02-002	Stark Earliest	208:228	110:138	178:224	179:183	162:192	155:159	146:179	112:116	156:162	240:248
10-003	Steirische Schafnase	192:220	110:138	178:213	185:189	162:164	134:136	148:169	108:116	160	254:272
21-007	Steirischer Maschankzer	190:228	110	178:213	171:181	160:164	142:151	146	114:116	156:160	248:254
20-001	Suislepper	226	112:136	178:226	181:183	160:166	149:155	169:179	108	156:160	254
03-003	Transparente de Croncels	208:220	112:116	205:226	179:181	162:164	142:153	144:146	108:148	156:186	240:248
16-013	<i>unclear (Remfield)</i>	210:228	110:116	178	177:185	164:192	142:157	148:179	112:127	156:160	254:256
07-007	<i>unknown 1</i>	190:210	108:110	205:213:219	179:185	164:192	142:149	146:179	106:114	154:170	240:272
18-011	<i>unknown 2</i>	194:198:228	110:114	178:201:221	171:179:191	160:162	136:142:155	146:169	112:114:116	156:160	238:242:254
01-001	White Transparent	190	114:132	207:213	179:183	160:162	136:142	146:179	112:148	156:162	240:254
14-005	Winter Banana	190	110:116	178:205	181:189	164:192	140:142	146:179	104:114	156:162	254

Acc.no.	Cultivar	CH03d07	CH04c07	CH04e05	CH05f06	GD12	GD 147	CH-Vf1	Hi02c07	CH01c06	CH01d08
13-001	Yellow Bellflower	194:228	98:116	178:201	181:189	160	140:155	146:179	104:112	162	248:272
Ref1	Michelin	208:228	116	205	181:189	150:160	142	148:169	114	158:160	250:272
Ref2	<i>Malus floribunda</i> #821	166:188	112	191:201	189	160:182	129	133:165	112:133	156:160	238:242
Ref3	Delicious	208:228	122:138	178:207	181:189	158:164	142:157	171:179	112:114	160	240:254
Ref4	<i>Malus x robusta</i> 5	173:194	110:112	186	183:189	162	151:155	141:163	114:116	148:162	282:284
Ref5	M9 (Pajam 2)	228	110:118:134	201:224	177:183	160:170	144:157	169:171	114	162:188	240:288
Ref6	Prima	208:220	108:110	178:213	185:189	192:200	136:155	146:165	108:116	156:160	254:272
Ref7	Fiesta	208:220	110:116	203:230	171:181	160	151:155	146	114:148	160:170	254:272
Ref8	Boiken	228	110:138	221:226	185:189	164:192	136:147	146:148	114:116	156:162	240
Ref9	Durello di Forli	204:228	100:110	178:205	179:189	160	142:155	146	114	156:160	272
Ref10	Alexander	188:220	112:114	201:226	171:179	160	144:155	146:179	112	154:190	240:254
Ref11	Kronprinz Rudolf	190:204	114:144	178:213	189:191	160:162	142:155	146:179	112:116	160:186	238:294
Ref12	Red Jonathan	204:208	114:116	178:205	185:189	160	136:153	146:179	114:148	188	240:272
Ref13	King of the Pippins	208:230	98:110	178:205	189	160	140:142	146	104:148	156:162	240:254

Acc.no.	Cultivar	CH02b10	CH02h11a	CH01f07a	CH02c02a	CH02d12	CH03a04	COL	CH04c06	CH01b07	CH01b11
10-009	Adams Parmaine	123:133	116:122	177:195	125:177	191:199	120:120	219:229	178:184	91:97	197:199
10-012	Adersleber Calville	133:143	98:114	177:193	175:183	177:183	116:120	219:231	178:186	91:93	197:199
03-002	Aldinger's George Cave	131:137	98	173:193	141:158	195:199	90:130	229:241	173:180	91:93	197:199
14-009	Alexander	143	114:118	177:193	183:189	177	98:108	219:229	182:186	91	197:199
10-013	Ananas Reinette	131:133	122	177:197	175	191:199	92	219:231	178:184	91:101	199
11-002	Apfel aus Uelzen	121:125	116:122	189:193	125:127	199:207	92:100	219:231	173:190	91:93	197
11-004	Baldwin	123:131	98:116:122	177:195	175:185	199:201	116:120:120	219:231:239	173:178:190	85:101	197:199
18-002	Baumann's Reinette	107:157	98:100	189:197	181:183	183:199	92:94	217:231	180:184	89:91	197:199
11-007	Belle de Boskoop	121:123:125	100:116:122	193:195:197	165:177:179	181:195	92:114	229:231	178:182:196	85:91:93	197:199
12-004	Bisquet	123:131	98:122	193:197	129:195	183:199	92:116	231:239	178:194	91:115	197:199
11-006	Bittenfelder Sämling	125:133	98:116	193	165:167	181	92:98	219:231	178	85:91	197:199
06-005	Blenheim Orange	123:123:133	114:116:122	179:191:195	125:177	199:201	104:120	221:239	173:182:188	93:97	197:199:203

Acc.no.	Cultivar	CH02b10	CH02h11a	CH01f07a	CH02c02a	CH02d12	CH03a04	COL	CH04c06	CH01b07	CH01b11
21-003	Boiken	135:155	98:114	197:205	141:169	199:201	92:112	219:231	184:196	91:115	197:199
11-009	Börtlinger Weinapfel	121:133	100:116	193	165	177:181	92:114	231	178:182	91	197:199
11-011	Bramley's Seedling	123:137	98:122	193:195	181:183	199:207	98:114	231:239	182:190	93	197
11-014	Brettacher	127:155	98:116:122	187:189:203	151:165:189	177:199:201	94:112:118	219:231	178:182	91	199:210
05-002	Cellini	123:143	114:116	177:179	165:183	177:199	90:120	219:221	180:186	91:93	197
21-006	Champagner Reinette	133:155	114:122	187:195	179:189	191:201	94:120	219:239	190	91:97	197:199
04-002	Charlamovsky	113:121	100:114	191:193	179:209	177:199	116:118	229:231	173:178	93	197
06-002	Cox Orange	119:131	98:122	173:195	155	199	104:120	229	173:188	93	199
14-006	De Grignon	127:131	116:122	189:195	179:181	191:199	92:116	219:229	178:186	93	197
14-015	Dutch Mignonne	121:125	100:116	193:195	165:179	181	92	229:231	178:196	85:93	197:199
12-006	Elise Rathke	131:145	116:122	175:177	147:175	181:191	116:118	219:231	182:186	91	195:201
12-010	Falchs Gulderling	131:155	98:122	189:191	181:185	199	98:104	205:239	173:180	85:89	197:199
06-007	Fameuse	127:133	116:124	191:193	179:191	177:207	104:118	231:239	173:178	93	199:201
12-012	Florianer Rosmarinapfel	119:131	116:120	175:189	175:183	177:181	104	231:233	182:186	85:91	195:205
04-004	Fraas Sommerkalvill	113:119	98:100	193:195	179:181	199:211	118:120	229:231	178:192	85:93	197:199
14-004	Framboise de Holovousy	129:133	98:116	193:197	173:183	197:207	114	231	186:190	93	197:203
12-014	Galloway Pepping	123:133:137	98:114:122	177:195	127:177:199	177:199:211	114:120	219:239	178:182:188	93	197:199
15-001	Geflammtter Kardinal	127:131:155	100:116:122	189:197	141:155:181	183:199:211	98:114:118	219:231	188:196	91	197
06-004	Geheimrat Doctor Oldenburg	133:143	114:122	193:197	173:189	177:191	92:98	229	173:182	91	199
07-003	Gloster 69	131:135	98:122	189:197	141:143	177:201	92:120	229:231	173:182	93	197
16-005	Golden Delicious	121:125	122:124	177:197	177:183	195:199	98:120	219:231	178:182	91:97	197:201
13-011	Graue Renette	119:125:133	100:122:126	177:193	125:181	191:199	112:120	219:231:239	178:182:188	93:97:101	197:199
13-013	Grüner Stettiner	123:131:155	114:116:124	177:197	143:177	181:195:199	100:116:120	219:231	178:188	91	197
07-001	Haferapfel	113:155	100:116	193	129:191	179:203	98:112	229:239	173:178	91	197:205
14-001	Hauxapfel	113:131	114:120	195:197	141:169	181:201	112:116	229:231	180:196	91:93	197
04-006	James Grieve	131:133	98:100	173:193	155:161	191:199	90:120	229	180:190	91:93	199:203
14-007	Jonathan	125:133	98:114	193:195	173:175	191:199	98:112	229:231	188	93:101	197
07-005	Kaiser Wilhelm	107:123:133	114:116:122	179:193:195	125:177	195:199	116:120:120	221:231:239	180:182:188	91:93.97	197:199
14-014	Kardinal Bea	119:143	114:122	177:179	183:189	177:199	92:108	219:221	182:188	91	197

Acc.no.	Cultivar	CH02b10	CH02h11a	CH01f07a	CH02c02a	CH02d12	CH03a04	COL	CH04c06	CH01b07	CH01b11
10-007	King of the Pippins	119:133	98:122	179:195	127:183	199:211	92:120	221:229	178:190	91:93	197:199
09-012	Klöcher Maschanzker	125:133	98:100:122	177:193:197	127:169	191:199:207	118:120	219:231	178:180:182	91:97	197:199:210
07-008	Kronprinz Rudolf	131:133	100:122	193:203	129:161	177:199	116:118	229:239	178	91:93	199:210
15-003	Leven alma	119:123:131	98:122	177:189:193	125:127:185	177:199:211	104:110:130	219:231	170:180:182	93:97	197:199
15-008	Luxemburger Triumph	125:137	114:116:122	193:197:205	141:179:183	177:181:217	114:118	219:229	178:182:188	85:93	195:197:199
15-009	Maunzenapfel	119:125	116:124	177:191	177	181:183	98:114	219:239	178:182	91:113	197:205
15-012	Mautapfel	121:133	114:122	177:197	127:131	195:199	92:106:116	219:231	180:194	93:97	197
15-013	Mauthausener Limoni	127:133	100:122	193:197	165:201	199:207	120	231	178:196	91	197:199
08-004	McIntosh	129:145	116:122	191:197	179	177:191	104:114	231:239	178:182	85	197:201
13-007	Merveille de Vitry	133:155	116:122	189:193	129:161	195:201	106:114	219:229	178:180	91	197
08-006	Minister von Hammerstein	119:133	114:122	177:193	175:179	177:199	120	219:231	180:188	91:97	195:199
08-001	Mother	131:133	100:122	195:197	125:173	207:211	120:120	231	173:188	101	199:201
16-003	Oberösterreichischer Brünnerling	129:133	100:122	191:193	127:165:169	199:207	92:114:120	219:231:239	178:188	91:93	199:210
08-007	Odenwälder	129:143	114:118	177:193	161:165	177:199	118	219:229	182:196	85	197:205
16-001	Ontario	133:155	116:122	195	127:167	181:199	118:120	229:239	182	97:115	195:197
05-004	Orbai alma	127:143	100:122:128	173:191	165:177	195:199	114:120	219:231:241	178:184	91:93	195:197
08-010	Peasgood's Nonsuch	143:157	114:122	193	177:189	177	116:116	231	186:190	87:89	197:199
17-010	<i>Pomella verde brisca or Carrara brusca</i>	127:155	112:122	189:193:199	157:179	185	98:112	219:223:239	178:190:196	91:93	197:199
16-009	Pomme d'or	119:123:131	116:120	193:197:205	129:179	199:207	104:112	219:229:231	178:180:182	89:91:93	197:203:205
16-012	Prinz Albrecht von Preußen	123:145	114:122	177:195	147:186	177:193	116:120	219:229	180:186	91:93	197
13-017	Queen	123:143	114:128	177:203	179:183	177:201	98:112	219:237	180:186	91	197:199
17-003	Red Boskoop	121:123:125	100:116:122	193:195:197	165:177:179	181:195	92:114	229:231	178:182:196	85:91:93	197:199
05-006	Reinette de Landsberg	119:143	114:122	177	177:182	177:191	108:120	219	188	91	197:199
16-016	Remsen	127:133	100:122	177:193	127:179	199	90:98	219:231	178:190	91:93	197:201
21-001	Rheinischer Bohnapfel	121:133	116:122	175:189:197	129:155:185	195:199	106:112	219:231	170:178:180	89:91	197
17-002	Rheinischer Krummstiel	119:133	116:122	195:197	141:186	177:199	100:118	219:231	180	85:93	197:199
17-006	Ribston Pepping	119:131	98:100:126	173:195:197	155:175	191:199	92:114:120	219:231:237	178:188	91:93	197:199
17-007	Rolling	131:155	122	197	141:155	183	116:120	219:231	182	89:91	197:199
15-016	Rome Beauty	119:155	116:122	177:195	129:181	191:199	116:118	219:229	178:188	93:101	197:199

Acc.no.	Cultivar	CH02b10	CH02h11a	CH01f07a	CH02c02a	CH02d12	CH03a04	COL	CH04c06	CH01b07	CH01b11
09-003	Rote Schafnase	127:137	100:122	189:193	175:177	199:205	100:116	219:229	182:186	89	201
21-010	Roter Eiserapfel	131:143:155	98:116:122	189:193	127:141	177:195:199	104:112:116	219:231	178	91	197:210
09-005	Roter Herbstkalvill	133:137	114:120	193:197	181:183	183:199	92:114	229:231	182:190	91:93	195:199
17-014	Roter Jungfernapfel	131:155	116:122	189	151:175	199	112:130	219	180:182	93	199:210
09-002	Roter von Simonffy	135:156	98:122	191:195	179:181	199	116:120	231:239	180:182	83:85	197:199
18-005	Rousse Latour	123:129	100:122	177:199	129	183:199	112:120	219:229	180:190	91:93	197:203
09-007	Rumer Gravensteiner	143:155	100:122	177	177:183	181:191	92:108	219	182:190	85:91	197:199
18-007	Sauergrauech	131	114:122	189	169:179	197:199	98:112	205:237	170:182	91	199
18-009	Schmidberger Renette	127:155	100:116	177:197	177:201	181:199	92:112:120	219:231	182	85:93	197:199
09-009	Schöner aus Wiedenbrück	122:131:137	98:116:122	189:197	179:183	177:191:201	98:112:114	219:229	173:180:196	91:101:115	197
10-005	Schöner von Wiltshire	125:131	100:120	195:203	141:147	199:211	116:132	231:239	178:186	85:93	197:199
19-002	Siebenkant	129:133	122	195:197	169:173	183:199	120	219:231:239	180	93:97	197
10-002	Spartan	129:155	116:126	191:197	141:181	177:199	114:120	231:239	173:182	83:85	199:201
19-005	Spätblühender Taffetapfel	125:133	116:122	193	167	177:183	116:120	219:231:239	173:182	91:97	199:205
02-002	Stark Earliest	123:155	98:122	173:197	131:177	207:211	98:104	219:241	173:182	93	197
10-003	Steirische Schafnase	127:137	100:122	189:193	175:177	199:205	100:116	219:229	182:186	89	201
21-007	Steirischer Maschanzker	133	100:122	177:193	127:169	199:207	120	219:231	178:182	91:97	199:210
20-001	Suislepper	127:143	100:116	173:207	127	177:199	116:116	213:219:231	178:190	93:99	197
03-003	Transparente de Croncels	113:133	100:122	191:193	125:209	199	118:120	229	173:178	93:97	195:197
16-013	<i>unclear (Remfield)</i>	131	122	189:197	129:157	195:199	112:120	219:231	182:186	85:101	197:203
07-007	<i>unknown 1</i>	133	116:122	193:195	155:165	181:185	98:106	231:239	178:182	85:91	197:199
18-011	<i>unknown 2</i>	131:157	122	177:193	175:179	177:191:207	112:114:118	219:229:231	170:182	93	187:197
01-001	White Transparent	133:155	98:100	173:177	143:177	179:199	98	219:241	173:178	95	197
14-005	Winter Banana	125:133	98:122	173:195	155:175	195	98:120	229:241	178:182	93:97	199:210
13-001	Yellow Bellflower	125:133	122:124	173:197	157:177	195:199	98:116	219:241	182:188	91:97	197:199
Ref1	Michelin	131:145	116	197	129:131	199:207	110:116	231	180:194	91:97	197
Ref2	<i>Malus floribunda</i> #821	115	122	195:197	155:177	191:205	90	213:233	188:192	85	207
Ref3	Delicious	131:157	122:126	197:205	141:143	177:199	94:120	219:231	182	85:91	197:199
Ref4	<i>Malus x robusta</i> 5	115:123	104:122	195:197	125:185	187:207	94:104	229	188	93	193:195

Acc.no.	Cultivar	CH02b10	CH02h11a	CH01f07a	CH02c02a	CH02d12	CH03a04	COL	CH04c06	CH01b07	CH01b11
Ref5	M9 (Pajam 2)	125:145	118	189:199	177:191	199:201	92:94	229:231	186:198	85:89	199:205
Ref6	Prima	121:125	118:124	189:193	177	191:199	104	219:233	178:182	93	199:201
Ref7	Fiesta	119:125	98:122	173:193	155:167	181:199	104:112	229:231	184:190	93:115	197:199
Ref8	Boiken	135:155	98:114	197:205	141:169	199:201	92:112	219:231	184:196	91:115	197:199
Ref9	Durello di Forli	133:135	100:124	193:197	181:183	185:199	116:118	231	178:182	91	199
Ref10	Alexander	143	114:118	177:193	183:189	177	98:108	219:229	182:186	91	197:199
Ref11	Kronprinz Rudolf	131:133	100:122	193:203	129:161	177:199	116:118	229:239	178	91:93	199:210
Ref12	Red Jonathan	125:133	98:114	193:195	173:175	191:199	98:112	229:231	188	93:101	197
Ref13	King of the Pippins	119:133	98:122	179:195	127:183	199:211	92:120	221:229	178:190	91:93	197:199