Supplementary files

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Table S1.. Basic information of the 155 apple accessions used on this study.

Accession	Nº	Classification	Skin color	Flesh color
Aciprés	1	Spanish	Bicolor	Cream
Akane	2	Non-Spanish	Bicolor	White
Almenar_2 - MRF 46	3	Spanish	Bicolor	Cream
Ascara_1	4	Spanish	Bicolor	Cream
Ascara_2	5	Spanish	Bicolor	Cream
Astrakan Red	6	Non-Spanish	Bicolor	White
Audiena de Oroz	7	Spanish	Green	White
Augüenta	8	Spanish	Green	Greenish
Averdal_1	9	Non-Spanish	Red	Cream
Averdal_2	10	Non-Spanish	Red	Cream
Baujade	11	Non-Spanish	Green	Greenish
Bellaguarda Lardero - MSV 27	12	Spanish	Yellow	White
Belleza de Roma	13	Non-Spanish	Bicolor	Cream
Biscarri_1 - M 107	14	Spanish	Bicolor	White
Blackjon	15	Non-Spanish	Bicolor	White
Bofla	16	Spanish	Green	Cream
Boluaga	17	Spanish	Bicolor	Cream
Bossost_1 - MRF 75	18	Spanish	Bicolor	Greenish
Bossost_2 - MRF 76	19	Spanish	Brown	Cream
Bossost_4 - MRF 78	20	Spanish	Bicolor	Greenish
Bossost_5 - MRF 79	21	Spanish	Bicolor	Cream
Bost Kantoia	22	Spanish	Yellow	Cream
Cabdellà_2 - MRF 49	23	Spanish	Bicolor	Cream
Cabello de Angel	24	Spanish	Yellow	Cream
Calvilla de San Salvador	25	Spanish	Bicolor	Greenish
Camosa - MRF 42	26	Spanish	Bicolor	Cream
Camosa - MRF 60	27	Spanish	Bicolor	Cream
Camuesa de Daroca	28	Spanish	Green	White
Camuesa de Llobregat	29	Spanish	Green	White
Camuesa Fina de Aragón	30	Spanish	Bicolor	White
Carapanón	31	Spanish	Bicolor	White
Carrió	32	Spanish	Bicolor	Greenish
Cella	33	Spanish	Green	Cream
Ciri Blanc	34	Spanish	Green	White
Cirio - MRF 52	35	Spanish	Green	Cream
Cox's Orange Pippin	36	Non-Spanish	Bicolor	Cream
Cripps Pink	37	Non-Spanish	Bicolor	Cream
Cuallarga	38	Spanish	Green	Cream
Cul de Cirio - MRF 39	39	Spanish	Bicolor	Cream
De Agosto - MRF 57	40	Spanish	Bicolor	Cream
De Pera	41	Spanish	Yellow	Cream
De Valdés	42	Spanish	Bicolor	Cream
Delciri	43	Spanish	Yellow	White
Delcon	44	Non-Spanish	Bicolor	White
Delgared Infel	45	Non-Spanish	Red	White
Deljeni	46	Non-Spanish	Yellow	White
Delkistar	47	Non-Spanish	Bicolor	Cream
Delorgue Festival	48	Non-Spanish	Bicolor	Cream
Elista	49	Non-Spanish	Bicolor	White
Esperiega	50	Spanish	Yellow	Cream
Esperiega de Olba - M 106	51	Spanish	Bicolor	Cream
Eugenia	52	Spanish	Bicolor	Greenish
Evasni - Scarlet Spur	53	Non-Spanish	Bicolor	Cream
Florina	54	Non-Spanish	Bicolor	White
Fuji	55	Non-Spanish	Bicolor	Cream
Gala	56	Non-Spanish	Bicolor	White
Galaxy	57	Non-Spanish	Bicolor	Cream

Golden Delicious_675	58	Non-Spanish	Yellow	Cream
Golden Delicious Infel_972	59	Non-Spanish	Yellow	Cream
Golden Paradise	60	Non-Spanish	Yellow	Cream
Golden Smoothee	61	Non-Spanish	Yellow	Cream
Granny Smith_1	62	Non-Spanish	Green	Greenish
Granny Smith_2	63	Non-Spanish	Green	Greenish
Guillemes	64	Spanish	Bicolor	White
Hared	65	Non-Spanish	Bicolor	White
Helada	66	Spanish	Green	White
Hierro	67	Spanish	Bicolor	White
Idared	68	Non-Spanish	Bicolor	White
Irgo_2 - MRF 66	69	Spanish	Bicolor	Cream
Jonadel	70	Non-Spanish	Bicolor	White
Jonagored	71	Non-Spanish	Bicolor	Cream
Jonathan_1	72	Non-Spanish	Bicolor	Cream
Jonathan_2	73	Non-Spanish	Bicolor	Cream
Jubilee	74	Non-Spanish	Bicolor	Cream
Landetxo	75	Spanish	Bicolor	White
Les_1 - MRF 73	76	Spanish	Bicolor	Cream
Les_2 - MRF 74	77	Spanish	Bicolor	White
Mañaga	78	Spanish	Green	Greenish
Mañaga - MRF 43	79	Spanish	Bicolor	Cream
Marinera	80	Spanish	Bicolor	White
Marquinez	81	Spanish	Bicolor	White
McIntosh	82	Non-Spanish	Bicolor	Cream
Médulas_1 - MSV 38	83	Spanish	Bicolor	Cream
Melrose	84	Non-Spanish	Bicolor	Cream
Merrigold	85	Non-Spanish	Yellow	Greenish
Montcada_1 - MRF 82	86	Spanish	Bicolor	Cream
Morro de Liebre	87	Spanish	Bicolor	White
Nesple	88	Spanish	Bicolor	Cream
Normanda	89	Spanish	Bicolor	White
Nueva Starking	90	Non-Spanish	Red	White
Ortell	91	Spanish	Bicolor	White
Ortell - MSV 24	92	Spanish	Bicolor	White
Pera_2	93	Spanish	Yellow	Cream
Pera de Sangüesa	94	Spanish	Green	Cream
Peromingan	95	Spanish	Green	Greenish
Pero Pardo	96	Spanish	Green	Cream
Peruco de Caparroso	97	Spanish	Bicolor	White
Plaona	98	Non-Spanish	Green	Cream
Poma de San Juan - MRF 47	99	Spanish	Bicolor	White
Prau Riu_3	100	Spanish	Bicolor	Greenish
Prau Riu_4	101	Spanish	Bicolor	White
Prau Riu_5	102	Spanish	Green	Greenish
Prima	103	Non-Spanish	Red	White
Rebellón	104	Spanish	Bicolor	White
Red Delicious	105	Non-Spanish	Bicolor	Cream
Red Elstar	106	Non-Spanish	Bicolor	White
Red Rome Beauty	107	Non-Spanish	Bicolor	Cream
Redaphough	108	Non-Spanish	Red	Cream
Red Chief	109	Non-Spanish	Bicolor	White
Regal Prince_1	110	Non-Spanish	Bicolor	Cream
Regal Prince_2	111	Non-Spanish	Bicolor	Cream
Reguard_1 - MRF 53	112	Spanish	Bicolor	Cream
Reguard_2 - MRF 54	113	Spanish	Bicolor	Greenish
Reguard_4 - MRF 56	114	Spanish	Bicolor	White
Reina de Reinetas	115	Non-Spanish	Bicolor	White
Reineta Blanca Canada_1	116	Spanish	Green	Cream
Reineta Blanca Canada_2	117	Non-Spanish	Green	Cream
Reineta Blanca Canada_3	118	Spanish	Green	Cream

Reineta Encarnada	119	Spanish	Bicolor	Greenish
Reineta Gris	120	Spanish	Brown	Cream
Reineta Inesita Asua	121	Spanish	Bicolor	White
Reineta Regil	122	Spanish	Green	Greenish
Reneta	123	Spanish	Bicolor	White
Roja Valle Benejama	124	Spanish	Bicolor	White
Roser de la Reula - MRF 40	125	Spanish	Bicolor	Cream
Royal Red Delicious	126	Non-Spanish	Bicolor	White
Rubinete	127	Non-Spanish	Bicolor	Cream
Ruixou_1 - MRF 51	128	Spanish	Bicolor	Cream
San Felipe	129	Spanish	Bicolor	Greenish
San Miguel	130	Spanish	Bicolor	Cream
Sandia	131	Spanish	Bicolor	White
Sant Jaume	132	Spanish	Bicolor	Greenish
Sant Joan	133	Spanish	Bicolor	Greenish
Santa Margarida	134	Spanish	Bicolor	Greenish
Signatillis	135	Spanish	Green	White
Solafuente	136	Spanish	Bicolor	White
Starking_1	137	Non-Spanish	Bicolor	Cream
Starking_2	138	Non-Spanish	Bicolor	Cream
Starkrimson_1	139	Non-Spanish	Red	Cream
Starkrimson_2	140	Non-Spanish	Red	Cream
Taüll_1 - MRF 67	141	Spanish	Green	Cream
Telamon	142	Non-Spanish	Bicolor	Cream
Tempera	143	Spanish	Green	Greenish
Terrera	144	Spanish	Brown	Cream
Top Red Delicious	145	Non-Spanish	Red	Cream
Totxa	146	Spanish	Green	White
Transparente	147	Spanish	Green	White
Transparente Blanca	148	Spanish	Yellow	Greenish
Urarte	149	Spanish	Green	Greenish
Urtebete	150	Spanish	Green	Cream
Valsaina	151	Spanish	Bicolor	Cream
Verde Doncella_MRF 36	152	Spanish	Green	Cream
Verde Doncella_1	153	Spanish	Green	Cream
Verde Doncella_2	154	Spanish	Green	Cream
Vinçada Tardía - MRF 61	155	Spanish	Green	Cream

This table includes characteristics of the plant material previously mentioned in Mignard et al. (2021).

Table S2. Statistical significance of accession (A), year (Y), and their interaction (A x Y) on individual sugars and organic acids.

Source of variation	Units	Accession (A)	Year (Y)	A x Y
Sucrose	g kg^{-1}	$p < 0.0001$	$p < 0.0001$	$p < 0.0001$
Glucose	g kg^{-1}	$p < 0.0001$	$p < 0.0001$	$p < 0.0001$
Fructose	g kg^{-1}	$p < 0.0001$	$p < 0.0001$	$p < 0.0001$
Sorbitol	g kg^{-1}	$p < 0.0001$	$p < 0.0001$	$p < 0.0001$
Sugars	g kg^{-1}	$p < 0.0001$	$p < 0.0001$	$p < 0.0001$
Oxalic	g kg^{-1}	$p < 0.0001$	$p < 0.0001$	$p < 0.0001$
Citric	g kg^{-1}	$p < 0.0001$	$p < 0.0001$	$p < 0.0001$
Tartaric	g kg^{-1}	$p < 0.0001$	$p < 0.0001$	$p < 0.0001$
Malic	g kg^{-1}	$p < 0.0001$	$p < 0.0001$	$p < 0.0001$
Quinic	g kg^{-1}	$p < 0.0001$	$p < 0.0001$	$p < 0.0001$
Succinic + Shikimic	g kg^{-1}	$p < 0.0001$	$p < 0.0001$	$p < 0.0001$
Acids	g kg^{-1}	$p < 0.0001$	$p < 0.0001$	$p < 0.0001$

Data were evaluated by two-way variance (ANOVA)

Figure S1. Violin plots showing the variability between accessions (dots) and years of the sugars and organic acids parameters.

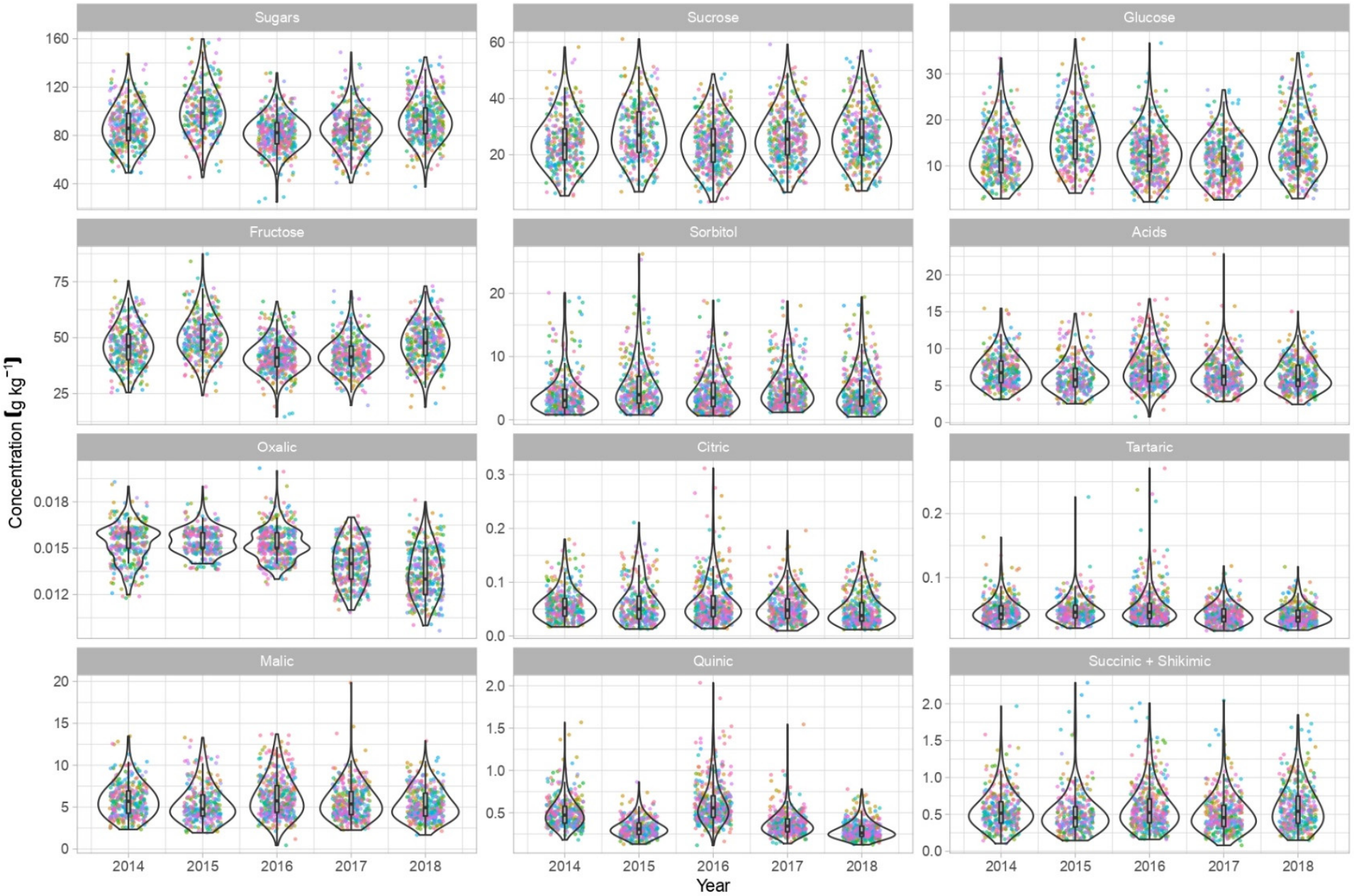

Table S3. Individual sugars and organic acids mean values (2014-2018) for the 155 apple accessions studied.

Variety	Nº	Sucrose	Glucose	Fructose	Sorbitol	Total Sugars	Oxalic	Citric	Tartaric	Malic	Quinic	Succinic + Shikimic	Total Acids
Aciprés	1	36.31	13.37	43.97	6.17	99.82	0.015	0.037	0.036	2.879	0.239	0.457	3.657
Akane	2	10.29	18.61	61.41	5.01	95.32	0.015	0.072	0.047	6.974	0.478	0.303	7.880
Almenar-2 (MRF 46)	3	22.90	17.23	45.11	5.52	90.76	0.016	0.035	0.053	3.536	0.373	0.756	4.762
Ascara 1	4	26.48	6.82	41.91	3.36	78.57	0.015	0.076	0.045	7.180	0.472	0.632	8.413
Ascara 2	5	31.19	6.98	45.27	4.72	88.16	0.015	0.097	0.035	5.486	0.355	0.417	6.399
Astrakan Roja	6	20.19	13.70	41.58	1.84	77.31	0.015	0.108	0.069	9.529	0.800	0.875	11.389
Audiena de Oroz	7	26.38	17.74	40.50	2.76	87.38	0.015	0.055	0.071	5.716	0.567	0.681	7.098
Augüenta	8	13.72	13.86	50.54	7.83	85.95	0.015	0.061	0.069	6.206	0.503	0.728	7.575
Averdal_1	9	19.14	14.08	42.03	4.62	79.87	0.014	0.024	0.043	3.956	0.374	0.680	5.084
Averdal_2	10	15.52	13.30	44.04	2.94	75.80	0.014	0.022	0.045	4.170	0.451	0.768	5.464
Baujade	11	38.48	16.47	31.39	2.17	88.51	0.014	0.048	0.033	5.836	0.348	0.233	6.505
Bellaguarda Lardero (MSV 27)	12	16.89	6.57	41.74	2.23	67.43	0.015	0.136	0.064	9.031	0.653	0.746	10.638
Belleza de Roma	13	34.00	8.51	47.75	3.04	93.30	0.015	0.054	0.037	5.243	0.352	0.625	6.317
Biscarri-1 (M 107)	14	30.32	10.13	43.00	4.23	87.68	0.014	0.033	0.031	4.409	0.380	0.400	5.260
Blackjon	15	24.02	14.22	42.55	3.20	83.99	0.015	0.063	0.043	6.672	0.453	0.468	7.708
Bofla	16	32.27	9.53	38.45	3.27	83.52	0.015	0.060	0.050	6.447	0.451	0.569	7.583
Boluaga	17	30.67	14.22	36.12	6.73	87.74	0.015	0.066	0.041	6.254	0.485	0.496	7.350
Bossost-1 (MRF 75)	18	19.94	12.31	44.83	4.20	81.28	0.015	0.087	0.057	7.833	0.658	0.786	9.429
Bossost-2 (MRF 76)	19	40.37	12.17	48.21	11.43	112.18	0.014	0.107	0.052	10.131	0.574	0.387	11.259
Bossost-4 (MRF 78)	20	29.07	19.40	45.19	7.51	100.64	0.014	0.051	0.045	5.115	0.402	0.625	6.244
Bossost-5 (MRF 79)	21	20.04	12.72	41.98	4.54	79.28	0.016	0.100	0.061	8.718	0.700	0.518	10.106
Bost Kantoia	22	40.75	8.30	44.76	2.42	96.23	0.015	0.036	0.040	4.780	0.314	0.623	5.799
Cabdellà-2 (MRF 49)	23	26.78	13.12	48.44	6.56	94.90	0.015	0.130	0.063	9.521	0.628	0.295	10.645
Cabello de Angel	24	27.38	7.97	37.41	4.10	76.85	0.015	0.021	0.030	3.409	0.385	1.116	4.967
Calvilla de San Salvador	25	16.78	17.99	45.46	2.60	82.83	0.015	0.081	0.062	7.640	0.472	0.518	8.781
Camosa (MRF-42)	26	28.26	9.78	51.76	9.98	99.78	0.016	0.032	0.080	3.846	0.369	0.545	4.880
Camosa (MRF-60)	27	22.61	14.62	45.70	4.07	87.00	0.016	0.058	0.055	5.288	0.567	0.637	6.614
Camuesa de Daroca	28	27.17	11.07	36.77	4.20	79.22	0.015	0.033	0.057	3.390	0.410	1.171	5.068
Camuesa de Llobregat	29	28.01	9.55	55.40	4.06	97.01	0.015	0.038	0.091	4.604	0.481	0.801	6.023
Camuesa Fina de Aragón	30	15.49	14.58	32.97	3.19	66.24	0.015	0.107	0.060	8.059	0.592	0.603	9.430
Carapanón	31	27.79	13.37	41.90	2.78	85.84	0.015	0.082	0.048	6.776	0.463	0.396	7.773
Carrió	32	25.33	15.81	39.31	4.17	84.61	0.014	0.053	0.048	4.938	0.379	0.848	6.275
Cella	33	38.70	8.56	41.17	6.30	94.72	0.015	0.036	0.049	3.264	0.296	0.502	4.157
Ciri Blanc	34	24.33	16.99	50.61	5.67	96.64	0.016	0.020	0.040	2.920	0.329	0.547	3.864
Cirio (MRF-52)	35	30.70	13.49	47.90	9.85	101.94	0.014	0.049	0.055	7.086	0.355	0.698	8.251
Cox's Orange Pippin	36	37.48	9.20	43.40	8.20	97.74	0.015	0.089	0.065	7.502	0.462	0.203	8.329
Cripps Pink	37	42.14	6.38	42.70	3.43	94.65	0.014	0.054	0.038	5.864	0.338	0.232	6.533
Cuallarga	38	20.82	17.85	50.67	2.44	91.77	0.015	0.094	0.080	6.145	0.465	0.913	7.705
Cul de Cirio (MRF 39)	39	23.05	18.99	53.03	8.06	103.12	0.015	0.018	0.034	2.781	0.272	0.515	3.628

De Agosto (MRF 57)	40	24.96	12.53	40.67	8.90	87.07	0.015	0.078	0.059	5.392	0.497	0.576	6.611
De Pera	41	38.51	10.50	47.19	7.09	103.30	0.015	0.095	0.053	8.241	0.502	0.491	9.391
De Valdés	42	32.16	14.43	54.88	3.91	105.39	0.014	0.034	0.033	4.725	0.425	0.625	5.850
Delciri	43	18.08	16.90	46.69	4.65	86.33	0.016	0.029	0.045	2.683	0.282	0.705	3.752
Delcon	44	20.48	18.93	43.36	2.61	85.38	0.015	0.047	0.045	5.850	0.411	0.357	6.688
Delgared Infel	45	22.80	15.54	49.49	2.95	90.79	0.015	0.050	0.039	5.390	0.377	0.283	6.121
Deljeni	46	27.39	9.48	54.99	2.26	94.12	0.014	0.054	0.046	6.076	0.402	0.263	6.848
Delkistar	47	20.24	11.91	43.42	2.28	77.85	0.014	0.047	0.036	5.873	0.431	1.152	7.546
Delorgue Festival	48	16.83	15.88	52.78	1.46	86.95	0.015	0.038	0.033	4.745	0.327	0.353	5.504
Elista	49	29.53	7.64	40.87	3.01	81.04	0.014	0.099	0.050	7.528	0.438	0.507	8.630
Esperiega	50	34.85	11.13	41.92	4.54	92.44	0.015	0.055	0.052	6.153	0.404	0.483	7.155
Esperiega de Olba (M 106)	51	27.19	10.73	44.36	10.07	92.35	0.014	0.028	0.040	3.361	0.263	0.409	4.109
Eugenia	52	23.33	20.71	58.46	11.51	114.01	0.015	0.103	0.065	6.668	0.615	0.684	8.144
Evasni (Scarlet Spur)	53	18.27	15.12	43.09	2.71	79.18	0.015	0.026	0.048	3.898	0.397	0.857	5.234
Florina	54	34.40	10.91	42.90	5.97	94.18	0.015	0.056	0.040	5.531	0.390	0.319	6.343
Fuji	55	28.50	22.70	55.80	8.26	115.27	0.014	0.037	0.053	4.511	0.355	0.268	5.231
Gala	56	32.40	9.62	44.38	4.11	90.52	0.014	0.048	0.030	4.605	0.331	0.585	5.606
Galaxy	57	27.39	10.01	40.53	2.02	79.95	0.014	0.029	0.033	3.794	0.318	0.694	4.875
Golden Delicious 675	58	27.52	13.45	53.91	3.73	98.61	0.014	0.046	0.042	5.399	0.385	0.293	6.172
Golden Delicious Infel 972	59	26.66	15.60	49.71	3.24	95.21	0.014	0.039	0.040	4.918	0.302	0.356	5.662
Golden Paradise	60	27.21	13.32	46.24	2.10	88.88	0.014	0.040	0.039	4.256	0.384	0.533	5.259
Golden Smoothee	61	26.24	13.90	52.64	2.94	95.73	0.015	0.045	0.052	4.673	0.364	0.256	5.396
Granny Smith_1	62	23.46	12.71	41.85	1.87	79.89	0.014	0.047	0.045	6.428	0.397	0.217	7.142
Granny Smith_2	63	27.66	12.87	41.09	2.34	83.97	0.014	0.054	0.039	6.644	0.395	0.195	7.334
Guillemes	64	26.06	12.96	46.49	6.07	91.59	0.015	0.059	0.038	5.523	0.398	0.651	6.677
Hared	65	21.23	15.99	42.38	4.52	84.12	0.015	0.026	0.050	4.016	0.343	0.780	5.223
Helada	66	23.77	14.09	46.39	7.83	92.08	0.014	0.023	0.036	4.147	0.313	0.367	4.893
Hierro	67	35.58	8.22	46.32	3.71	93.82	0.015	0.066	0.029	6.904	0.465	0.433	7.904
Idared	68	23.19	9.18	44.98	1.75	79.11	0.015	0.044	0.036	5.492	0.358	0.279	6.217
Irgo-2 (MRF 66)	69	26.38	13.86	41.94	4.70	86.89	0.015	0.045	0.033	4.185	0.261	0.373	4.904
Jonadel	70	24.85	14.79	42.91	7.18	89.73	0.015	0.041	0.042	5.210	0.357	0.515	6.172
Jonagored	71	28.14	14.32	49.01	3.02	94.49	0.014	0.048	0.042	5.261	0.347	0.300	6.004
Jonathan_1	72	25.23	19.07	48.23	5.46	97.99	0.015	0.063	0.053	7.072	0.367	0.428	7.991
Jonathan_2	73	25.16	16.63	47.06	4.14	93.00	0.015	0.062	0.038	7.065	0.418	0.451	8.041
Jubilee	74	22.12	10.89	49.18	2.73	84.92	0.015	0.042	0.040	5.571	0.369	0.427	6.432
Landetxo	75	22.63	15.35	42.97	2.89	83.83	0.016	0.101	0.053	8.539	0.679	0.696	10.077
Les-1 (MRF 73)	76	10.94	20.42	45.58	4.91	81.85	0.015	0.066	0.090	3.661	0.456	0.638	4.918
Les-2 (MRF 74)	77	16.41	16.30	42.50	5.46	80.67	0.015	0.071	0.050	5.968	0.464	0.535	7.096
Magaña (MRF 43)	78	25.94	12.40	41.71	3.93	83.98	0.015	0.058	0.050	4.353	0.282	0.379	5.131
Mañaga	79	25.67	11.14	40.40	3.31	80.52	0.015	0.039	0.037	3.937	0.265	0.395	4.680
Marinera	80	17.45	11.82	40.48	1.79	71.54	0.015	0.061	0.057	6.565	0.555	1.623	8.870
Marquinez	81	14.93	10.51	37.29	1.94	64.67	0.015	0.092	0.053	8.302	0.617	1.039	10.112
McIntosh	82	17.99	7.53	50.71	2.44	78.68	0.014	0.058	0.026	6.551	0.396	0.230	7.270

Médulas-1 (MSV 38)	83	24.55	8.89	55.60	6.55	95.59	0.014	0.045	0.035	6.438	0.422	0.525	7.472
Melrose	84	15.44	18.55	50.45	3.12	87.56	0.014	0.045	0.040	5.571	0.375	0.405	6.444
Merrigold	85	19.10	10.69	45.33	2.09	77.21	0.015	0.100	0.054	7.152	0.377	0.540	8.230
Montcada-1 (MRF 82)	86	34.56	8.97	50.23	7.97	101.73	0.015	0.032	0.031	4.436	0.355	0.629	5.491
Morro de Liebre	87	11.47	16.34	40.00	3.32	71.13	0.015	0.024	0.037	4.114	0.324	0.520	5.026
Nesple	88	19.39	23.84	41.93	3.68	88.84	0.014	0.047	0.045	5.195	0.485	0.660	6.440
Normanda	89	21.86	14.90	44.42	5.13	86.31	0.015	0.039	0.031	4.996	0.362	0.389	5.825
Nueva Starking	90	25.57	14.81	45.25	5.06	90.70	0.014	0.026	0.038	3.766	0.389	0.700	4.927
Ortell	91	21.26	18.95	47.62	4.21	92.05	0.015	0.033	0.041	4.173	0.361	0.354	4.970
Ortell (MSV 24)	92	21.42	22.45	51.69	5.28	100.84	0.014	0.030	0.035	3.913	0.366	0.335	4.685
Pera 2	93	41.08	9.26	49.93	6.86	107.13	0.015	0.096	0.052	8.602	0.550	0.556	9.864
Pera de Sangüesa	94	26.42	12.22	50.74	5.51	94.89	0.015	0.060	0.052	6.124	0.340	0.573	7.158
Pero Pardo	95	18.86	11.52	35.84	3.51	69.73	0.015	0.106	0.040	9.523	0.622	0.543	10.845
Peromingan	96	28.73	12.96	50.83	7.85	100.38	0.014	0.050	0.052	5.760	0.371	0.518	6.758
Peruco de Caparroso	97	15.63	16.71	42.59	2.86	77.79	0.015	0.038	0.077	3.239	0.397	0.924	4.683
Plaona	98	24.33	11.30	37.50	1.20	74.33	0.014	0.029	0.037	4.091	0.314	0.480	4.960
Poma de San Juan (MRF 47)	99	17.77	9.00	45.88	2.31	74.97	0.015	0.067	0.076	3.779	0.381	1.677	5.988
Prau Riu 3	100	25.72	18.71	47.07	11.96	103.46	0.015	0.057	0.049	5.181	0.417	0.476	6.191
Prau Riu 4	101	24.45	13.30	43.03	6.18	86.96	0.016	0.080	0.061	7.188	0.589	0.386	8.312
Prau Riu 5	102	40.50	8.71	41.07	4.20	94.48	0.018	0.054	0.078	8.862	0.707	0.615	10.326
Prima	103	17.24	15.31	49.17	1.66	83.39	0.015	0.057	0.042	6.104	0.389	0.291	6.891
Rebellón	104	31.08	11.11	39.35	4.75	86.29	0.014	0.061	0.039	6.617	0.481	0.622	7.828
Red Chief	105	23.93	14.74	44.63	4.11	87.40	0.014	0.027	0.042	3.635	0.370	0.661	4.742
Red Delicious	106	35.81	7.55	42.87	3.86	90.09	0.014	0.073	0.044	6.913	0.450	0.429	7.917
Red Elstar	107	30.31	11.51	52.97	4.01	98.80	0.014	0.040	0.027	4.541	0.331	0.442	5.388
Red Rome Beauty	108	20.00	18.49	39.74	3.22	81.44	0.014	0.070	0.045	7.337	0.454	0.404	8.319
Redaphough	109	25.81	17.09	47.82	3.59	94.00	0.014	0.021	0.041	3.465	0.336	0.676	4.546
Regal Prince_1	110	28.70	12.18	47.96	2.99	91.83	0.015	0.039	0.033	4.301	0.333	0.705	5.418
Regal Prince_2	111	33.04	11.63	49.89	2.33	96.90	0.015	0.038	0.033	3.974	0.336	0.602	4.990
Reguard-1 (MRF 53)	112	26.46	22.41	56.90	6.21	111.98	0.016	0.041	0.032	4.055	0.337	0.314	4.788
Reguard-2 (MRF 54)	113	31.83	18.53	50.35	3.92	104.62	0.016	0.143	0.075	9.814	0.461	0.498	11.000
Reguard-4 (MRF 56)	114	29.02	10.07	44.43	2.08	85.60	0.014	0.039	0.032	4.436	0.360	0.779	5.654
Reina de Reinetas	115	27.97	18.68	44.03	3.31	93.98	0.015	0.051	0.042	5.553	0.372	0.424	6.451
Reineta Blanca Canada_1	116	44.47	9.69	50.60	8.04	112.80	0.015	0.071	0.042	7.765	0.439	0.482	8.808
Reineta Blanca Canada_2	117	32.87	8.18	42.45	8.33	91.83	0.014	0.068	0.035	8.310	0.504	0.460	9.384
Reineta Blanca Canada_3	118	37.51	8.20	45.41	7.36	98.48	0.014	0.065	0.042	7.651	0.579	0.438	8.783
Reineta Encarnada	119	36.26	10.85	41.08	4.65	92.84	0.015	0.057	0.040	5.945	0.432	0.668	7.149
Reineta Gris	120	39.88	10.38	50.33	8.91	109.51	0.015	0.076	0.051	9.013	0.579	0.563	10.289
Reineta Inesita Asua	121	29.29	13.18	54.30	4.44	101.21	0.015	0.089	0.052	7.303	0.491	0.539	8.484
Reineta Regil	122	32.86	17.79	60.60	10.36	121.61	0.014	0.036	0.041	7.267	0.447	0.443	8.243
Reneta	123	34.24	6.72	50.32	3.66	94.94	0.015	0.039	0.033	3.960	0.361	0.382	4.782
Roja Valle Benejama	124	32.17	6.23	47.99	4.94	91.34	0.014	0.037	0.027	3.737	0.312	0.356	4.476

Roser de la Reula (MRF 40)	125	25.23	13.26	47.48	8.97	94.93	0.015	0.076	0.037	4.930	0.381	0.332	5.764
Royal Red Delicious	126	24.15	17.60	51.14	8.51	101.40	0.014	0.029	0.051	4.600	0.412	0.575	5.675
Rubinete	127	32.76	15.53	49.30	3.69	101.28	0.014	0.055	0.054	5.839	0.336	0.248	6.541
Ruixou-1 (MRF 51)	128	24.41	24.29	44.82	10.97	104.49	0.015	0.041	0.038	3.908	0.354	0.331	4.681
San Felipe	129	19.72	7.07	49.98	3.14	79.90	0.015	0.043	0.077	3.931	0.322	0.632	5.012
San Miguel	130	21.82	12.61	45.34	8.87	88.64	0.014	0.035	0.061	4.636	0.419	0.242	5.401
Sandia	131	26.51	9.97	43.72	2.06	82.26	0.015	0.060	0.040	6.468	0.693	0.782	8.051
Sant Jaume	132	18.54	10.03	41.96	3.57	74.10	0.015	0.107	0.075	8.126	0.507	0.950	9.772
Sant Joan	133	17.31	14.62	35.51	2.44	69.87	0.016	0.050	0.061	5.769	0.612	0.924	7.423
Santa Margarida	134	20.19	9.05	36.83	2.13	68.20	0.016	0.119	0.079	10.234	0.717	0.903	12.061
Signatillis	135	20.77	8.29	45.89	3.30	78.25	0.015	0.069	0.049	6.364	0.531	0.574	7.595
Solafuente	136	28.46	11.43	36.35	2.49	78.72	0.014	0.060	0.037	5.672	0.397	0.510	6.684
Starking_1	137	24.04	14.40	45.85	4.49	88.41	0.014	0.027	0.044	4.208	0.432	0.656	5.374
Starking_2	138	27.31	13.75	46.11	5.32	92.49	0.014	0.025	0.040	3.707	0.362	0.622	4.764
Starkrimson_1	139	26.55	18.43	46.80	7.56	99.34	0.014	0.025	0.037	3.467	0.395	0.692	4.623
Starkrimson_2	140	27.08	18.01	46.11	7.50	98.71	0.015	0.028	0.039	3.657	0.353	0.663	4.747
Taüll-1 (MRF 67)	141	14.66	15.84	47.65	3.50	81.65	0.015	0.053	0.043	6.897	0.644	0.790	8.434
Telamon	142	11.91	16.08	50.51	1.88	80.39	0.015	0.063	0.038	5.196	0.458	0.344	6.106
Tempera	143	18.69	7.74	44.74	8.72	79.88	0.015	0.053	0.058	5.828	0.445	1.064	7.456
Terrera	144	41.95	10.64	47.22	12.29	112.10	0.015	0.093	0.044	9.768	0.724	0.426	11.065
Top Red Delicious	145	23.70	16.04	49.55	5.34	94.63	0.015	0.032	0.049	4.479	0.469	0.648	5.684
Totxa	146	30.94	10.98	52.26	6.72	100.90	0.015	0.046	0.039	5.922	0.531	0.461	7.008
Transparente	147	16.21	10.97	43.28	2.00	72.46	0.016	0.148	0.090	9.240	0.740	0.612	10.840
Transparente Blanca	148	15.38	7.72	38.24	2.35	63.69	0.016	0.140	0.066	9.141	0.764	0.734	10.790
Urarte	149	16.07	11.17	32.03	2.57	61.85	0.015	0.109	0.040	10.686	0.873	0.864	12.581
Urtebete	150	26.50	11.91	37.35	3.14	78.90	0.014	0.048	0.073	6.053	0.389	0.544	7.114
Valsaina	151	30.48	17.07	41.43	2.45	91.43	0.014	0.064	0.058	5.933	0.455	0.403	6.921
Verde Doncella (MRF 36)	152	18.64	8.24	44.01	2.26	73.15	0.015	0.120	0.058	9.137	0.724	0.684	10.731
Verde Doncella_1	153	24.85	12.45	43.18	7.40	87.88	0.014	0.043	0.041	3.206	0.288	0.316	3.901
Verde Doncella_2	154	22.21	10.33	38.55	7.31	78.40	0.014	0.037	0.036	2.842	0.235	0.266	3.424
Vinçada Tardía (MRF 61)	155	35.76	8.63	40.83	7.62	92.84	0.015	0.059	0.057	7.945	0.545	0.581	9.195

For all traits, results were expressed in $g.kg^{-1}$ FW. AD, Aula Dei; EEAD, Experimental Station of Aula Dei; SP, Spain; USA, United States of America.

Table S4. Pearson's correlation coefficients between traits.

	Glu	Fru	Sor	Total Sugars	Oxa	Cit	Tar	Mal	Qui	Succ+ Shi	Total Acids
Suc	-.340**	ns	.339**	.639**	ns	ns	-.237**	ns	-.161*	-.291**	ns
Glu	-	.234**	ns	.285**	ns	-.218**	ns	-.245**	ns	ns	-.253**
Fru			.311**	.691**	ns	-.176*	ns	ns	-.218**	-.257**	-.187*
Sor	-	-	-	.651**	ns	ns	ns	ns	ns	-.188*	ns
Sugars					ns	-.231**	-.182*	ns	-.279**	-.402**	-.185*
Oxa	-	-	-	-	-	.344**	.452**	.266**	.415**	ns	.297**
Cit							.480**	.856**	.724**	ns	.861**
Tar	-	-	-	-	-	-	-	.347**	.464**	.349**	.404**
Mal									.803**	ns	.990**
Qui	-	-	-	-	-	-	-	-	-	.275**	.853**

Statistical significance at **: $P \leq 0.01$; *: $P \leq 0.05$; ns: not significant; Abbreviations: Suc, sucrose; Glu, glucose; Fru, fructose; Sor, sorbitol; Oxa, oxalic acid; Cit, citric acid; Tar, tartaric acid; Mal, malic acid; Qui, quinic acid; Succ+Shi, succinic + shikimic acid.

Figure S2. Hierarchical clustering heatmap of Pearson correlation coefficients over sugars and organic acids pairs (using Pearson distance and average linkage).

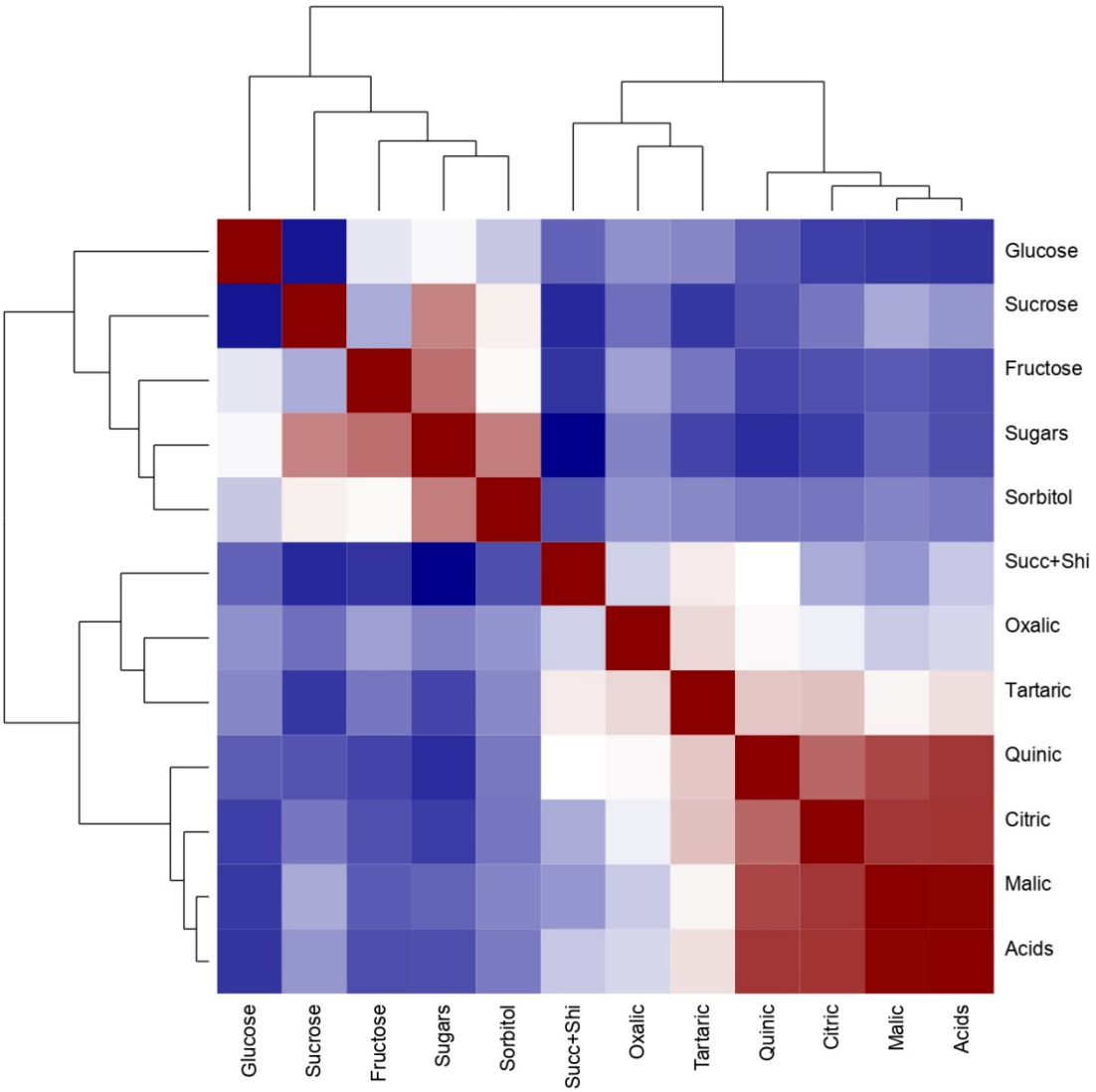

Table S5. Eigenvalues of the ten principal components of the PCA, and variance explained by each component.

Principal Component	Eigenvalue	Variance (%)	Cumulative variance (%)
1	4.27	35.59	35.59
2	2.39	19.90	55.49
3	1.55	12.94	68.43
4	1.07	8.94	77.37
5	7.65	6.37	83.74
6	6.50	5.42	89.16
7	5.31	4.43	93.59
8	4.36	3.64	97.23
9	2.18	1.81	99.04
10	1.14	0.95	99.99

Table S6. Eigenvectors of the five principal components (PCs).

Variable	PC 1	PC 2	PC 3	PC 4	PC 5
Sucrose	-0.23	0.64	-0.52	0.39	-0.01
Glucose	-0.31	0.00	0.66	-0.51	0.17
Fructose	-0.40	0.51	0.43	-0.09	-0.20
Sorbitol	-0.27	0.66	0.21	0.19	0.43
Sugars	-0.52	0.81	0.16	0.07	0.06
Oxalic	0.35	0.09	0.51	0.45	-0.51
Citric	0.86	0.29	-0.02	-0.15	-0.08
Tartaric	0.58	0.00	0.49	0.28	0.03
Malic	0.85	0.42	-0.16	-0.22	0.01
Quinic	0.88	0.18	0.10	-0.07	0.13
Succinic + Shikimic	0.37	-0.44	0.23	0.47	0.46
Acids	0.90	0.35	-0.11	-0.15	0.07

Abbreviations: Sugars, total sugars; Acids, total organic acids.

Table S7. Correlations between the different sugars and organic acids of the 155 accessions studied and the climatic traits.

	Suc	Glu	Fru	Sor	Total Sugars	Oxa	Cit	Tar	Mal	Qui	Succ+Shi	Total Acids
pre	0.305***	ns	ns	0.255***	0.226***	-0.363***	-0.364***	-0.377***	-0.294***	-0.478***	-0.239***	-0.353***
pre_day	ns	-0.149***	-0.101***	ns	-0.116***	-0.156***	ns	-0.086***	ns	-0.161***	ns	ns
tmx	-0.094***	0.062**	ns	ns	ns	0.05*	0.105***	0.105***	0.081***	ns	-0.054*	0.072**
tmn	-0.067**	0.066**	0.139***	ns	0.06*	-0.084***	ns	ns	ns	-0.127***	-0.056*	ns
tmd	-0.107***	0.054*	0.078**	ns	ns	ns	0.098***	0.084***	0.082***	ns	ns	0.07**
trg	-0.089***	ns	-0.091***	ns	-0.08***	0.199***	0.157***	0.188***	0.105***	0.191***	ns	0.116***
rh	0.174***	ns	0.053*	0.079***	0.128***	-0.353***	-0.241***	-0.276***	-0.191***	-0.386***	ns	-0.216***
rad	-0.313***	-0.056*	ns	-0.218***	-0.226***	0.228***	0.331***	0.307***	0.279***	0.346***	0.145***	0.314***

Statistical significance at ***: $P \leq 0.001$; **: $P \leq 0.01$; *: $P \leq 0.05$; ns: not significant. Abbreviations: Suc, sucrose; Glu, glucose; Fru, fructose; Sor, sorbitol; Oxa, oxalic acid; Cit, citric acid; Tar, tartaric acid; Mal, malic acid; Qui, quinic acid; Succ+Shi, succinic + shikimic acid; pre, total precipitation; pre_day, mean daily precipitation; tmx, mean daily maximum temperature; tmn, mean daily minimum temperature; tmd, mean daily temperature; trg, mean daily temperature range; rh, relative humidity; rad, solar radiation.

Table S8. Mean values of the mixed-effects model coefficients (int, intercept; pre, precipitation; trg, temperature range; rad, solar radiation) for the different sugar traits. Results are shown for each cluster, according to the accession's origin, and according to the skin colour.

		Cluster				Origin		Skin Colour				
		1	**2**	**3**	**4**	**Non-Spanish**	**Spanish**	**Bicolour**	**Brown**	**Green**	**Red**	**Yellow**
Suc	**int**	0.000[3]	-0.155[4]	-0.036	0.352[2]	-0.026	0.015	-0.035[Br]	1.382[Bi,Gr,Re]	-0.030[Br]	-0.345[Br]	0.236
	pre	0.109[2,3]	0.304[1]	0.300[1]	0.263	0.184	0.270	0.196[Gr]	0.337	0.376[Bi]	0.156	0.225
	trg	0.044[2]	0.203[1]	0.113	0.077	0.112	0.111	0.110	0.084	0.107	0.111	0.137
	rad	-0.172	-0.147	-0.081	-0.181	-0.156	-0.132	-0.131	-0.187	-0.121	-0.146	-0.241
Glu	**int**	0.170[4]	-0.073	0.108[4]	-0.414[1,3]	0.041	-0.023	0.112[Ye]	-0.417	-0.189	0.323	-0.422[Bi]
	pre	-0.327[2]	0.155[1,3,4]	-0.132[2]	-0.258[2]	-0.006[*]	-0.201[*]	-0.184	-0.007	-0.107	0.008	0.056
	trg	0.114	0.087	0.038	0.033	0.104	0.055	0.077	0.051	0.041	0.034	0.151
	rad	-0.277[2]	0.045[1,3,4]	-0.135[2]	-0.258[2]	-0.137	-0.152	-0.183	-0.105	-0.094	-0.146	-0.039
Fru	**int**	0.244[2,3,4]	-0.091[1]	-0.096[1]	-0.137[1]	0.025	-0.014	0.051	0.213	-0.156	-0.085	0.045
	pre	-0.448[2,3]	0.222[1,3,4]	-0.028[1,2]	-0.250[2]	-0.076	-0.141	-0.174	-0.155	0.027	-0.102	-0.093
	trg	-0.067	-0.134	-0.163	-0.143	-0.099	-0.137	-0.103	-0.250	-0.160	-0.230	-0.081
	rad	-0.314[2,3]	0.179[1,3,4]	-0.050[1,2,4]	-0.634[2,3]	-0.081	-0.131	-0.140	-0.186	-0.018	-0.148	-0.119
Sor	**int**	0.088	-0.209	-0.015	0.235	-0.361[*]	0.204[*]	-0.043[Br]	1.451[Bi,Gr,Re,Ye]	0.091[Br]	-0.104[Br]	-0.170[Br]
	pre	-0.003[2,3]	0.519[1,4]	0.496[1,3]	0.173[2,3]	0.368	0.271	0.301	-0.007	0.333	0.166	0.431
	trg	0.109[2]	0.338[1,3]	0.143[2]	0.209	0.273[*]	0.151[*]	0.199	0.303	0.186	0.325	0.092
	rad	-0.061[3]	0.157	0.278[1,4]	-0.057[3]	0.069	0.110	0.107	-0.326	0.147	-0.178	0.150
Sugars	**int**	0.216[2,3]	-0.168[1]	-0.060[1]	-0.010	-0.032	0.018	0.042[Br]	0.856[Bi,Gr,Re,Ye]	-0.164[Br]	-0.096[Br]	-0.004[Br]
	pre	-0.314[2,3,4]	0.390[1,4]	0.191[1]	-0.055[1,2]	0.088	0.042	-0.016	-0.047	0.247	0.007	0.158
	trg	0.039	0.103	0.003	-0.008	0.072	0.021	0.050	0.008	0.006	-0.016	0.085
	rad	-0.414[2,3]	0.018[1,4]	-0.095[1,4]	-0.390[2,3]	-0.208	-0.199	-0.232	-0.319	-0.087	-0.293	-0.198

[1; 2; 3; 4] Significant differences among clusters. The number corresponding to the cluster that showed a significant difference. [*]Significant differences among the origin. [Bi; Br; Gr; Re; Ye] Significant differences among skin colour. The Bi, bicolour; Br, brown; Gr, green; Re, red and Ye, yellow corresponding to the skin colour group which showed the significant difference. Abbreviations: Suc, sucrose; Glu, glucose; Fru, fructose; Sor, sorbitol; Sugars, total sugars; int, intercept; pre, total precipitation; trg, mean daily temperature range.

Table S9. Mean values of the mixed-effects model coefficients (int, intercept; pre, precipitation; trg, temperature range; rad, solar radiation) for the different organic acid traits. Results are shown for each cluster, according to the accession's origin, and according to the skin colour.

		Cluster				Origin		Skin Colour				
		1	2	3	4	Non-Spanish	Spanish	Bicolour	Brown	Green	Red	Yellow
Oxa	**int**	-0.015	-0.036	0.027	0.042	-0.130*	0.073*	0.001	-0.014	0.038	-0.135	-0.004
	pre	-0.612	-0.632	-0.671	-0.638	-0.635	-0.640	-0.629	-0.759	-0.664	-0.659	-0.596
	rad	-0.103	-0.080	-0.069	-0.093	-0.053*	-0.104*	-0.093	0.007	-0.085	-0.027	-0.094
Cit	**int**	-0.352[3,4]	-0.588[3,4]	0.406[1,2]	1.002[1,2,3]	-0.291*	0.165*	-0.024	1.009[Re]	0.107[Re]	-0.691[Br,Gr]	0.128
	pre	-0.210	-0.207	-0.252	-0.207	-0.192*	-0.237*	-0.224	-0.173	-0.227	-0.197	-0.209
	trg	-0.056	0.017	-0.026	0.005	-0.034	-0.010	-0.016	-0.023	-0.032	-0.076	0.031
	rad	0.122[4]	0.070[3,4]	0.151[2,4]	0.242[1,2,3]	0.135	0.133	0.126	0.280	0.144	0.104	0.149
Tar	**int**	-0.057[3]	-0.335[3,4]	0.236[1,2]	0.276[2]	-0.231*	0.131*	-0.074[Gr]	0.112	0.238[Bi]	-0.228	0.048
	pre	-0.380	-0.287	-0.385	-0.354	-0.311	-0.376	-0.365	-0.448	-0.385	-0.167	-0.285
	trg	0.010	0.054[3]	-0.014[2]	0.003	0.038*	0.001*	0.017	0.013	-0.011	0.050	0.034
	rad	0.008	-0.030[3,4]	0.096[2]	0.128[2]	-0.008*	0.068*	0.013	-0.002	0.093	0.077	0.083
Mal	**int**	-0.426[3,4]	-0.668[3,4]	0.453[1,2]	1.204[1,2,3]	-0.146	0.082	-0.096[Br]	1.560[Bi,Gr,Re,Ye]	0.260[Br]	-0.492[Br]	0.004[Br]
	pre	-0.160	-0.135	-0.192	-0.192	-0.151	-0.176	-0.165	-0.222	-0.161	-0.155	-0.191
	trg	-0.094[3,4]	-0.074[4]	-0.054[1,4]	-0.005[1,2,3]	-0.073	-0.059	-0.066	0.003	-0.048	-0.091	-0.088
	rad	0.142[2,4]	0.098[1,3,4]	0.170[2]	0.198[1,2]	0.152	0.143	0.140	0.205	0.158	0.125	0.162
Qui	**int**	-0.277[3,4]	-0.188[3,4]	0.232[1,2]	0.456[1,2,3]	-0.182*	0.103*	-0.078[Gr]	0.591	0.226[Bi]	-0.052	-0.112
	pre	-0.539[3,4]	-0.669[3,4]	-0.872[1,2]	-0.865[1,2]	-0.631*	-0.766*	-0.685[Br]	-1.171	-0.827	-0.638[Br]	-0.626[Br]
	trg	-0.058	-0.064	-0.057	0.050	-0.036	-0.047	-0.043	0.131[Bi,Re,Ye]	-0.065	-0.095	0.009
	rad	0.164[3]	0.057	0.042[1]	0.093	0.126	0.070	0.078	0.018	0.083	0.107	0.195
Succ+Shi	**int**	-0.347[2,4]	0.235[1]	0.059	0.153[1]	-0.256*	0.145*	-0.019	-0.265	0.118	0.013	-0.111
	pre	-0.095[3]	-0.213	-0.334[1]	-0.238	-0.156	-0.250	-0.202	-0.275	-0.320[Re]	0.046[Gr]	-0.212
	trg	-0.080	-0.143	-0.149	-0.114	-0.112	-0.128	-0.120	-0.146	-0.143	-0.078	-0.108
	rad	-0.044[3]	-0.132	-0.178[1]	-0.082	-0.102	-0.117	-0.111	-0.175	-0.138	-0.049	-0.078
Acids	**int**	-0.468[3,4]	-0.601[3,4]	0.449[1,2]	1.175[1,2,3]	-0.180*	0.102*	-0.097[Br]	1.480[Bi,Re,Ye]	0.263	-0.456[Br]	-0.004[Br]
	pre	-0.223[3]	-0.209[3,4]	-0.290[1,2]	-0.291[2]	-0.224	-0.262	-0.241	-0.334	-0.259	-0.215	-0.269
	trg	-0.109[3,4]	-0.097[3,4]	-0.055[1,2]	0.013[1,2,3]	-0.083	-0.066	-0.075	0.024	-0.055	-0.108	-0.093
	rad	0.120[2,4]	0.085[1,3,4]	0.136[2]	0.166[1,2]	0.127	0.119	0.117	0.164	0.131	0.109	0.134

[1; 2; 3; 4] Significant differences among clusters. The number corresponding to the cluster, which showed the significant difference. * Significant differences among the origin. [Bi; Br; Gr; Re; Ye] Significant differences among skin colour: Bi,bicolour; Br, brown; Gr, green; Re, red and Ye, yellow corresponding to the skin colour group, showing significant differences. Abbreviations: Oxa, oxalic acid; Cit, citric acid; Tar, tartaric acid; Mal, malic acid; Qui, quinic acid; Succ+Shi, succinic + shikimic acid; Acids, total organic acid; pre, total precipitation; trg, mean daily temperature range

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