

Supplementary Material

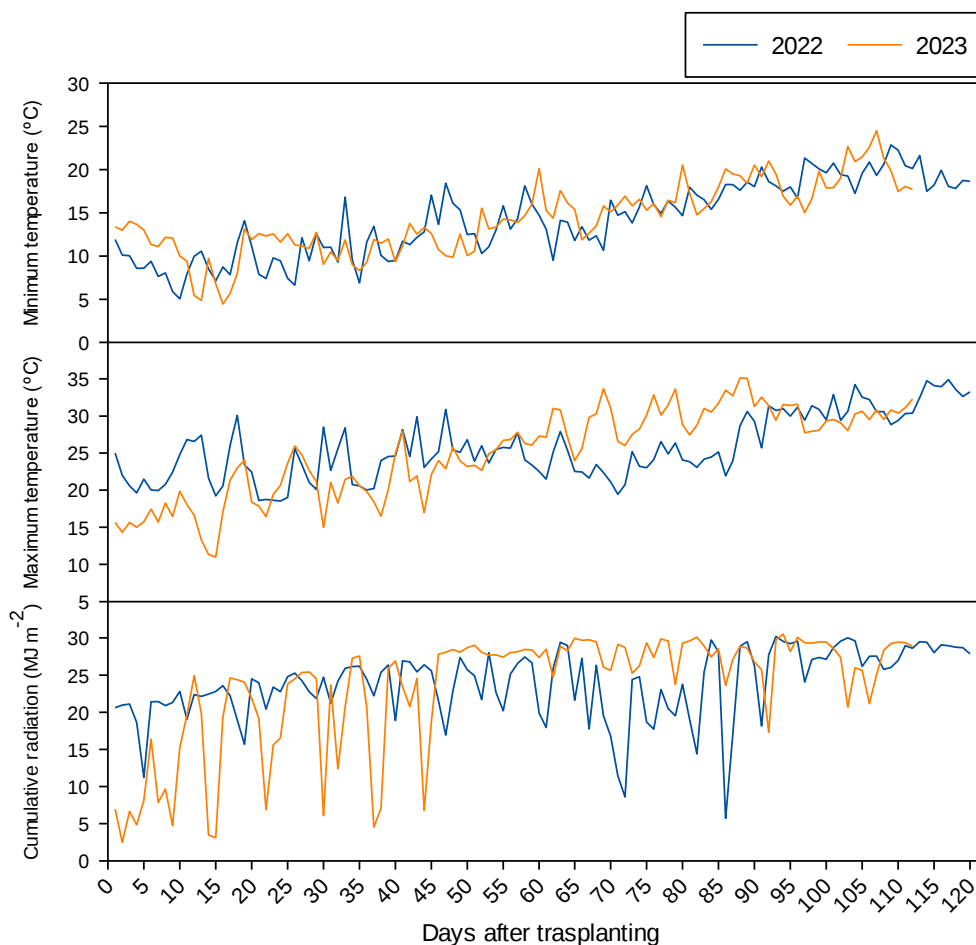


Figure S1. Evolution of minimum, maximum and cumulative radiation during the two cycles.

Table S1. Organic acids identified in the studied varieties by MS/MS approaches.

Peak no.	Compound	Rt (min)	[M-H] ⁻	ProdI*
1	Glutamic Acid	4,05	146	128, 102
2	Quinic Acid	4,38	191	93, 87, 85
3	Malic Acid	4,69	133	115 , 71
4	Isocitric Acid	4,77	191	155, 111 , 73
5	Malonic Acid	4,87	103	59 , 41
6	Shikimic Acid	5,02	173	93 , 73
7	Ketoglutaric Acid	5,21	145	101 , 57
8	Citric Acid	6,09	191	111 , 87
9	Succinic Acid	6,66	117	99, 73
10	Fumaric Acid	6,96	115	71
11	Glutaric Acid	10,97	131	113, 87 , 69

*Values in bold type are the most abundant ions.

Table S2. Carotenoides identified in the studied varieties by UV-vis HPLC.

Peak no.	Compound	Rt (min)	Longitud de onda (nm)	Type
1	All-T-Neoxanthin	7,05	444	Polar ¹
2	All-T-Violaxanthin	8,03	444	Polar ¹
3	Lutein	15,11	444	Polar ¹
4	Phytoene	18,02	287	Polar ¹
5	Phytofluene I	19,69	347	Polar ¹
6	Phytofluene II	21,15	347	Polar ¹
7	All-trans-Beta-carotene	24,63	444	Non-Polar ²
8	Deltacarotene1	25,88	444	Non-Polar ²
9	Deltacarotene2	26,25	444	Non-Polar ²
10	Deltacarotene3	28,20	444	Non-Polar ²
11	15 or 5' cis-Lycopene	29,50	444	Non-Polar ²
12	All-trans-Gammacarotene	29,68	444	Non-Polar ²
13	13 or 13' cis-Lycopene	30,17	444	Non-Polar ²
14	13 or 13' cis-Lycopene	30,82	444	Non-Polar ²
15	9 or 9' cis-Lycopene	32,20	444	Non-Polar ²
16	9 or 9' cis-Lycopene	32,47	444	Non-Polar ²
17	5 or 5' cis-Lycopene	33,01	444	Non-Polar ²
18	All-trans-Lycopene	34,63	444	Non-Polar ²
19	5 or 5' cis-Lycopene	35,02	444	Non-Polar ²

¹Carotenoids classified as polar were extracted using methanol:tetrahydrofuran (1:1, v/v) with 200mg MgO and 0.1% BHT (Flores et al., 2016). ²Carotenoides classified as non-polar were extracted using hexane:acetone:ethanol (2:1:1) with 0.1% BHT (Olives-Barba et al., 2006).

Table S3. Phenolic compounds identified in the studied varieties by MS/MS approaches.

Peak no.	Compound	Rt (min)	[M-H] ⁻	ProdI*
1	Chlorogenic Acid-Like1	11.14	353	191 , 179
2	Homovallinic Acid-O-Hexoside 1	13.32	343	181 ,121
3	Caffeic-Acid-O-Hexoside 1	13.38	341	179 ,135
4	Caffeic-Acid-O-Hexoside 2	14.31	341	179 ,135
5	Homovallinic Acid-O-Hexoside 2	14.39	343	181 ,121
6	Ferulic-Acid-O-Hexoside 1	16.04	355	193 ,178
7	Caffeic-Acid-O-Hexoside 3	16.17	341	179 ,135
8	Cryptochlorogenic Acid	17.02	353	179, 173 , 135
9	Chlorogenic Acid	17.06	353	191 , 179
10	Ferulic-Acid-O-Hexoside 2	18.56	355	193 ,178
11	Caffeic Acid	19.06	179	135
12	Chlorogenic Acid-Like2	19.73	353	191 ,179
13	Coumaroylquinic Acid	22.28	337	191 , 163
14	p-Coumaric Acid	25.89	163	119
15	Ferulic Acid	28.99	193	149, 134
16	Rutin-O-Pentoside	30.00	741	609 , 300
17	Phloretin-C-Diglycoside	32.70	597	477, 417, 387, 357
18	Rutin	32.87	609	300
19	Dicaffeoylquinic 1	34.42	515	353, 191
20	Naringenin-O-Hexoside 1	35.88	433	271
21	Dicaffeoylquinic 2	35.98	515	353, 191
22	Kaempferol-3-O-Rutinoside	36.89	593	285
23	Naringenin-O-Hexoside 2	37.26	433	271
24	Dicaffeoylquinic 3	39.15	515	353, 191
25	Naringenin-O-Hexoside 3	40.00	433	271
26	Naringenin-O-Hexoside 4	42.09	433	271
27	Naringenin-O-Hexoside 5	44.00	433	271
28	Quercetin	49.21	301	179, 151
29	Naringenin	53.06	271	151 , 119

*Values in bold type are the most abundant ions.

Table S4. Concentration of the isocitric and quinic acid ($\mu\text{g g}^{-1}$ FW) and the p-values from a two-way ANOVA assessing the effects of variety, year and their interaction in the developed hybrids and their re-spective parents in 2022 and 2023 years.

	Isocitric Acid		Quinic Acid	
	2022	2023	2022	2023
UMH1139	79 $\pm$ 5 ^a	69 $\pm$ 2 ^a	60 $\pm$ 8	40 $\pm$ 3
MC1	90 $\pm$ 6 ^b	88 $\pm$ 6 ^b	66 $\pm$ 3	49 $\pm$ 5
UMH1139$\times$MC1	84 $\pm$ 1 ^b	90 $\pm$ 9 ^b	62 $\pm$ 1	50 $\pm$ 5
<i>Variety</i>	0***		0.067	
<i>Year</i>	0.482		0***	
<i>Variety x Year</i>	0.099		0.498	
UMH1200	71 $\pm$ 4 ^a	59 $\pm$ 3 ^a	49 $\pm$ 1 ^a	29 $\pm$ 3 ^a
MC1	90 $\pm$ 6 ^b	88 $\pm$ 6 ^b	66 $\pm$ 3 ^c	49 $\pm$ 5 ^c
UMH1200$\times$MC1	71 $\pm$ 4 ^a	65 $\pm$ 2 ^a	58 $\pm$ 3 ^b	40 $\pm$ 2 ^b
<i>Variety</i>	0***		0***	
<i>Year</i>	0.047*		0***	
<i>Variety x Year</i>	0.313		0.363	
UMH1139	79 $\pm$ 5 ^b	69 $\pm$ 2 ^a	60 $\pm$ 8	40 $\pm$ 3
MC2	70 $\pm$ 2 ^a	69 $\pm$ 3 ^a	56 $\pm$ 5	35 $\pm$ 1
UMH1139$\times$MC2	78 $\pm$ 1 ^b	80 $\pm$ 3 ^b	57 $\pm$ 1	38 $\pm$ 2
<i>Variety</i>	0***		0.190	
<i>Year</i>	0.241		0***	
<i>Variety x Year</i>	0.004*		0.956	
UMH1200	71 $\pm$ 4 ^a	59 $\pm$ 3 ^a	49 $\pm$ 1	29 $\pm$ 3
MC2	70 $\pm$ 2 ^a	69 $\pm$ 3 ^a	56 $\pm$ 5	35 $\pm$ 1
UMH1200$\times$MC2	74 $\pm$ 4 ^b	72 $\pm$ 2 ^b	54 $\pm$ 6	36 $\pm$ 2
<i>Variety</i>	0.001**		0.108	
<i>Year</i>	0.047*		0***	
<i>Variety x Year</i>	0.053*		0.768	

*, **, *** Significant differences between means at a 5, 1 or 0.1% probability levels, respectively. Different letters in the same column indicate significant differences according to Duncan's test at $p < 0.05$. Values are means $\pm$ SE (n=6).