Table S1. Available nitrogen in the soil (kg ha^{-1}; 0–30 cm) of the experiment sites in 2015 and 2016.

Time of Soil Sampling	2015	2016
Beginning of season [1]	111.5	37.2
Mid-season [2]	23.5	28.5
End of season [3]	7.0	19.4

[1] Jun 2nd, 2015 and May 20th, 2016.
[2] September 1st, 2015 and August 2nd, 2016.
[3] October 12th, 2015 and October 13th, 2016.

Figure S1. Organic low-input tomato production under a rainout shelter. (Photo: L. Chea)

Table S2. Year of release, breeding background, average fruit weight, and usual production systems of 60 tomato cultivars used in Germany, Switzerland, and Austria.

Cultivar Name	Year of Release	Breeder	Breeding Background	Average Fruit Weight (g)	Production Systems
Salad cultivars (>52g fruit^{-1})					
Previa F$_1$	2011 [2]	Gautier	CON	173.1	a,c
Garance F$_1$	2015 [2]	Agri Obtentions	CON	154.5	e
Green Zebra	1972 [3]	Wagner	ORG	153.0	c
Diplom F$_1$	1989 [4]	Hild	CON	136.8	b
Cappricia F$_1$	2009 [2]	Rijk Zwaan	CON	131.5	g
Rougella F$_1$	1999 [2]	Rijk Zwaan	CON	126.4	c
Sparta F$_1$	1994 [5]	Enza	CON	125.8	e
Bocati F$_1$	2011 [2]	Enza	CON	124.4	c,d
Phantasia F$_1$	2006 [2]	De Ruiter	CON	122.7	a,b
Mecano F$_1$	2004 [2]	Rijk Zwaan	CON	122.2	e,g
Hamlet F$_1$	2009 [2]	Nunhems	CON	120.4	d
Lyterno F$_1$	2010 [2]	Rijk Zwaan	CON	115.9	e,f,g
Nordica F$_1$	2014 [2]	Enza	CON	115.5	c,d,e
Moneymaker	1972 [2]	Hild	CON	113.8	a,c
Pannovy F$_1$	1991 [5]	Syngenta	CON	107.6	c,e
Roterno F$_1$	2007 [2]	Rijk Zwaan	CON	106.7	d,e,f
Hildares F$_1$	1978 [2]	Hild	CON	99.0	b
Bonner Beste	1955 [4]	Reinhold	ND	95.2	*
Tica	2011 [2]	Kultursaat	ORG	94.2	c,e
Ricca	2015 [6]	Reinsaat	ORG	92.1	e
Aroma	2015 [7]	Kultursaat	ORG	87.1	c

Rheinlands Ruhm	1945 [8]	Unknown	ND	85.0	b
Lukullus	1956 [4]	Reinhold	ND	83.9	*
Goldene Königin	1882 [14]	Unknown	ND	76.6	c,d
Harzfeuer F1	1959 [4]	IZQ	CON	76.4	a,b,c,d
Auriga	1980 [4]	Saatzucht Quedlinburg	CON	71.5	c,e
Haubners Vollendung	1950 [8]	Unknown	ND	70.3	*
Dorenia	2012 [2]	Kultursaat	ORG	68.2	a
Roi Humbert Jaune	1898 [9]	Unknown	ND	64.9	c
Hellfrucht	1955 [4]	Fetzer	ND	64.3	*
Campari F1	1996 [2]	Enza	CON	63.3	e,f
Matina	1978 [2]	Hild	CON	55.2	a,b,c,d
Black Plum	*1998* [10]	Unknown	ND	52.2	a,c
Cocktail cultivars (<52 g fruit^{-1})					
Amoroso F1	2005 [2]	Rijk Zwaan	CON	50.8	f,g
Annamay F1	2010 [2]	Enza	CON	46.0	e
Quedlinburger Frühe Liebe	1951 [8]	Unknown	ND	43.4	a
Ruthje	2008 [4]	Kultursaat	ORG	42.3	c,e
König Humbert	1880 [11]	Unknown	ND	37.7	*
Clou	2010 [2]	OOTP	ORG	34.4	a,b
Tastery F1	2011 [2]	Rijk Zwaan	CON	33.5	d,e,f,g
Primabella	2012 [2]	OOTP	ORG	28.1	a,c
Sakura F1	1999 [2]	Enza	CON	23.7	c,d,e,f
Black Cherry	*2009* [2]	Reinsaat	ND	23.0	c,d
Cerise Gelb	2005 [12]	OOTP	ND	22.9	a,b
Yellow Submarine	*2002* [2]	Unknown	ND	22.2	c
Zuckertraube	*1994* [2]	Reinsaat	ND	21.9	a,b,c
Dorada	2010 [2]	OOTP	ORG	21.3	a,b
Primavera	2010 [2]	OOTP	ORG	21.3	a,b
Philovita F1	2007 [2]	De Ruiter	CON	19.4	a,b,c
Trixi	2014 [4]	Kultursaat	ORG	19.3	c,e
Trilly F1	2006 [2]	ISI Sementi	CON	19.3	d
Benarys Gartenfreude[1]	1950 [4]	Benary	CON	18.5	*
Bartelly F1	2014 [2]	De Bolster	ORG	18.4	c,e
Golden Pearl F1	2008 [2]	Hild	CON	18.4	d
Resi	2010 [2]	OOTP	ND	17.3	a,b
Supersweet 100 F1	1992 [2]	Syngenta	CON	15.7	a,b,c,d,
Goldita	1997 [8]	De Ruiter/Arche Noah	CON	15.6	c
Sliwowidnij	*2012* [13]	Unknown	ND	9.6	C
Rote Murmel	*1995* [13]	Unknown	ND	5.7	a,b
Golden Currant	*1975* [13]	Unknown	ND	5.4	a,b

Cultivars shown in bold are the 20 cultivars selected from 2015 for further evaluation in 2016. Year of release in italic are not known with certainty.
IZQ = Institut für Züchtungsforschung Quedlinburg; OOTP = Organic Outdoor Tomato Project (www.uni-kassel.de/go/freilandtomatenprojekt, accessed on 01 August 2021).
[1] Syn. Freude, syn. Gardener's Delight; [2] European Commission [1]; [3] T. Wagner (2016) pers. comm.; [4] Bundessortenamt (2016) pers. comm. (www.bundessortenamt.de); [5] Bundessortenamt [2]; [6] Reinsaat (2015) pers. comm. (www.reinsaat.at); [7] S. Wedemeyer/Kultursaat e.V. (2016) pers. comm. (www.kultursaat.org); [8] Arche Noah (2015) pers. comm. (www.arche-noah.at); [9] Haage and Schmidt [3]; [10] ProSpecieRara

(2016) pers. comm. (www.prospecierara.de); [11] Munro [4]; [12] Dreschflegel [5]; [13] Culinaris (2015) pers. comm. (www.culinaris-saatgut.de); [14] Livin.gston and Smith [6]
Breeding background: CON = Conventional, ORG = Organic, ND = Not documented.
Weight per fruit = average weight per fruit (g) derived from the experiment 2015.
Suitable production system of the cultivars: a = organic outdoor, b = conventional outdoor, c = extensive organic indoor, d = extensive conventional indoor, e = intensive organic indoor, f = intensive conventional indoor, g = hydroponic, * = hardly grown anymore. This information was collected with extension services, research stations, breeders, seed companies, and the IPK Genebank.

Table S3. Statistics for 28 traits of 60 tomato cultivars.

Parameters	Min	1Q	Median	3Q	Max	Mean	Variance	Significance	CV (%)
Plant morphological characteristics									
Plant height (cm)	183.0	235.0	264.0	299.3	356.0	268.4	1733.9	***	15.5
Leaf number (plant $^{-1}$)	32.0	36.0	39.0	42.0	57.0	39.7	26.2	***	12.9
Leaf and stem biomass (g plant^{-1})	562	1123	1388	1702	30640	1462	239077	***	33.4
Fruit yield (g plant^{-1})	540	2736	3504	4495	5797	3494	1366000	***	33.4
AFW (g fruit^{-1})	5.5	21.8	63.7	109.0	171.5	67.1	2127.0	***	68.7
Fruit number (plant^{-1})	18.0	42.0	56.5	110.8	295.0	78.5	2694.8	***	66.1
Harvest index	0.24	0.73	0.80	0.83	0.87	0.76	0.01	***	15.5
Leaf minerals (mg g^{-1} DM)									
C	375.0	384.3	388.0	393.8	406.0	388.8	49.6	***	1.8
N	20.5	22.9	23.9	25.9	28.6	24.2	3.3	***	7.6
P	1.4	1.6	1.7	1.8	2.2	1.7	0.0	***	9.0
K	19.6	24.3	26.5	29.0	33.4	26.5	10.1	***	12.0
Mg	2.6	3.4	3.7	4.2	6.1	3.9	0.6	***	19.3
Ca	36.7	46.9	52.2	56.9	69.2	52.1	51.2	***	13.7
S	4.1	5.2	6.0	6.8	8.1	6.0	0.7	***	14.4
Fruit minerals (mg 100 g^{-1} FW)									
P	21.3	24.7	28.0	31.1	55.5	28.9	35.2	***	20.5
K	211.3	243.2	274.2	295.8	441.3	272.5	1563.0	***	14.5
Mg	8.0	9.6	10.7	12.4	20.0	11.1	4.5	***	19.1
Ca	7.3	10.0	12.1	14.3	24.7	12.6	11.9	***	27.4
S	11.7	13.4	14.6	16.7	30.5	15.4	9.0	***	19.5
Fruit quality characteristics									
DM (%)	5.0	5.6	6.8	8.1	10.8	7.0	2.4	***	22.1
TSS (^{o}Brix)	3.7	4.4	5.1	6.3	8.7	5.5	1.6	***	23.4
TA (%)	0.25	0.32	0.35	0.40	0.53	0.36	0.03	***	14.7
TPC (mg GAE 100 g^{-1} FW)	1.1	1.6	1.9	2.3	4.4	2.0	0.3	***	29.5
Fruit color									
L*	47.7	51.1	53.4	55.5	69.7	54.2	19.8	***	8.2
a*	-11.0	14.1	19.6	22.6	27.4	16.3	82.1	***	55.7
b*	9.5	22.8	25.9	29.1	45.7	27.1	42.8	***	24.1
C*	11.4	29.5	33.4	37.2	46.1	33.2	32.3	***	17.1
^{o}h	46.2	48.6	51.7	57.8	107.5	58.5	261.1	***	27.6

Min = minimum value; 1Q = first quartile; 3Q = third quartile; Max = maximum value; CV = coefficient of variation; DM = dry matter; FW = fresh weight; AFW = average fruit weight; TSS = total soluble solid; TA = titratable acidity; TPC = total phenolic concentration; *** indicates significant difference among cultivars in each trait at $p < 0.001$.

Table S4. Analysis of variance (ANOVA) of cocktail and salad cultivars and mean comparison between these two groups of cultivars.

Parameter	Cocktail Cultivars (n = 27)				Salad Cultivars (n = 33)			
	F-test	Mean ± SD	Min	Max	F-test	Mean ± SD	Min	Max
Plant morphological characteristics								
Plant height (cm)	***	294.7 ± 44.6	179.2	391.3	***	250.2 ± 38.1	158.0	367.0
Leaf number (plant^{-1})	***	43 ± 7	29	65	***	38 ± 4	21	51
Leaf and stem biomass (g plant^{-1})	***	1499 ± 687	337	4,621	***	1436 ± 421	386	2780
Harvest index	***	0.7 ± 0.2	0.2	0.9	***	0.8 ± 0.1	0.5	0.9
Fruit yield (g plant^{-1})	***	2579 ± 867	472	4650	***	4232 ± 1,007	1925	7209
Weight per fruit (g fruit^{-1})	***	23.5 ± 11.6	4.0	50.0	**	101.5 ± 32.0	52.0	174.0
Fruit number (plant^{-1})	***	122 ± 53	43	333	***	44 ± 12	15	101
Leaf minerals (mg g^{-1} DM)								
C	***	387.9 ± 9.1	369.9	414.8	***	389.6 ± 8.8	360.3	414.1
N	*	23.9 ± 3.2	17.0	34.5	ns	24.4 ± 3.0	17.3	31.9
P	***	1.7 ± 0.2	1.2	2.3	***	1.8 ± 0.2	1.4	2.3
K	***	26.0 ± 4.8	17.2	37.7	**	26.9 ± 4.0	18.5	37.3
Mg	***	4.2 ± 1.0	2.4	6.6	***	3.7 ± 0.7	2.2	5.9
Ca	***	53.7 ± 9.3	31.6	75.1	***	50.7 ± 7.9	30.7	74.7
S	***	5.7 ± 1.1	3.5	9.0	***	6.1 ± 1.2	3.5	9.6
Fruit minerals (mg 100 g^{-1} FM)								
P	***	35.1 ± 7.5	22.4	62.3	***	29.6 ± 4.6	20.2	43.0
K	***	293.1 ± 51.1	206.2	475.1	***	291.0 ± 40.8	202.1	410.0
Mg	***	11.9 ± 2.4	7.3	20.2	***	10.5 ± 1.7	6.7	15.2
Ca	***	15.9 ± 8.2	6.5	85.7	***	13.6 ± 3.9	5.0	28.2
S	***	18.2 ± 4.4	12.5	34.7	***	15.4 ± 2.3	10.8	23.4
Fruit quality characteristics								
DM (%)	***	8.0 ± 1.4	4.8	13.1	*	5.6 ± 1.0	3.1	8.4
TSS (◦Brix)	***	6.5 ± 1.2	3.9	9.2	***	4.4 ± 0.6	3.2	7.7
TA (%)	ns	0.4 ± 0.1	0.3	0.7	***	0.4 ± 0.1	0.2	0.9
TPC (mg GAE 100 g^{-1} FW)	***	260.1 ± 74.5	152.3	544.5	***	176.0 ± 41.0	107.2	324.4
Fruit color								
L*	***	52.7 ± 5.2	46.3	68.5	***	53.7 ± 3.4	46.7	68.1
a*	***	11.4 ± 7.3	-4.0	22.5	***	21.6 ± 7.8	-11.1	31.6
b*	***	26.0 ± 7.7	9.3	43.1	***	29.3 ± 5.6	18.2	53.2
C*	***	29.8 ± 6.2	10.9	43.2	***	37.4 ± 5.2	23.9	53.4
◦h	***	64.4 ± 16.1	44.1	96.2	***	53.6 ± 12.3	42.7	107.8

DM = dry matter; FW = fresh weight; TSS = total soluble solid; TA = titratable acidity; TPC = total phenolic concentration; ns= non-significant difference; *, **, and *** = significant difference at $p < 0.05$, $p < 0.01$, and $p < 0.001$ respectively.

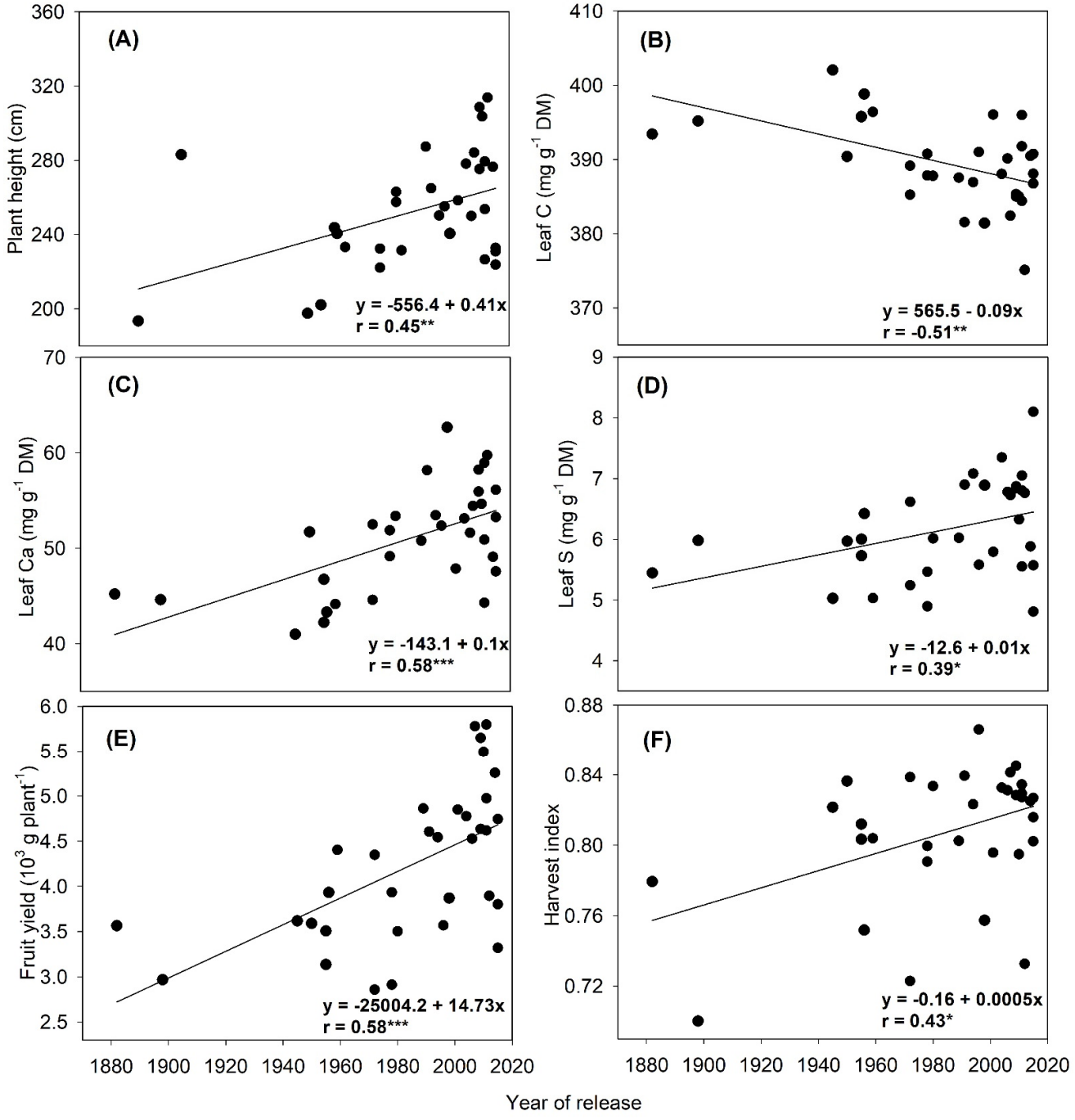

Figure S2. Performance of 33 salad tomato cultivars in organic low-input production in 2015. Pearson correlations between year of cultivar release with (**A**) plant height, (**B**) leaf C content, (**C**) leaf Ca content, (**D**) leaf S content, (**E**) fruit yield, and (**F**) harvest index. The correlation among cocktail cultivars was not significant. *, **, and *** = significant at $p < 0.05$, $p < 0.01$, and $p < 0.001$, respectively.

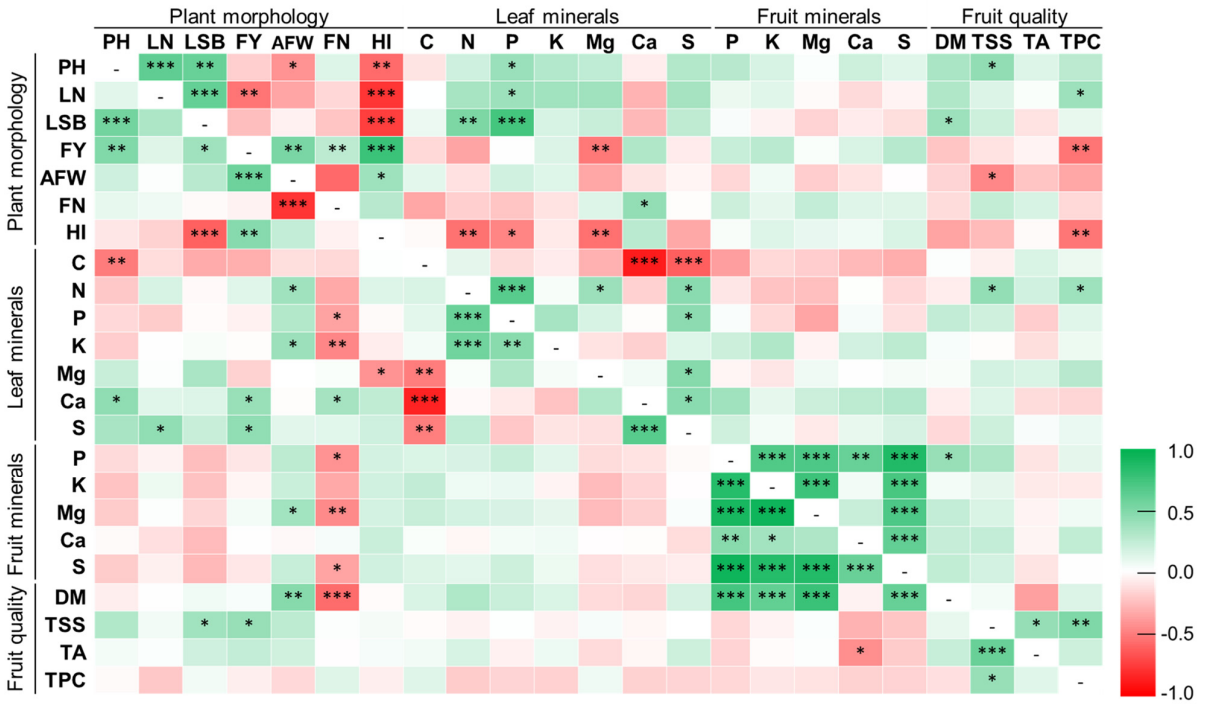

Figure S3. Correlation among plant morphology and fruit quality traits of salad (n = 33, lower diagonal) and cocktail (n = 27, upper diagonal) tomato cultivars. Color intensity represents the correlation coefficient. *, **, and *** indicate significant correlation at $p < 0.05$, $p < 0.01$, and $p < 0.001$, respectively. PH = plant height, LN = leaf number, LSB = leaf and stem biomass, FY = fruit yield, AFW = average fruit weight, FN = fruit number, HI = harvest index, DM = dry matter, TSS = total soluble solid; TA = titratable acidity; TPC = total phenolic concentration.

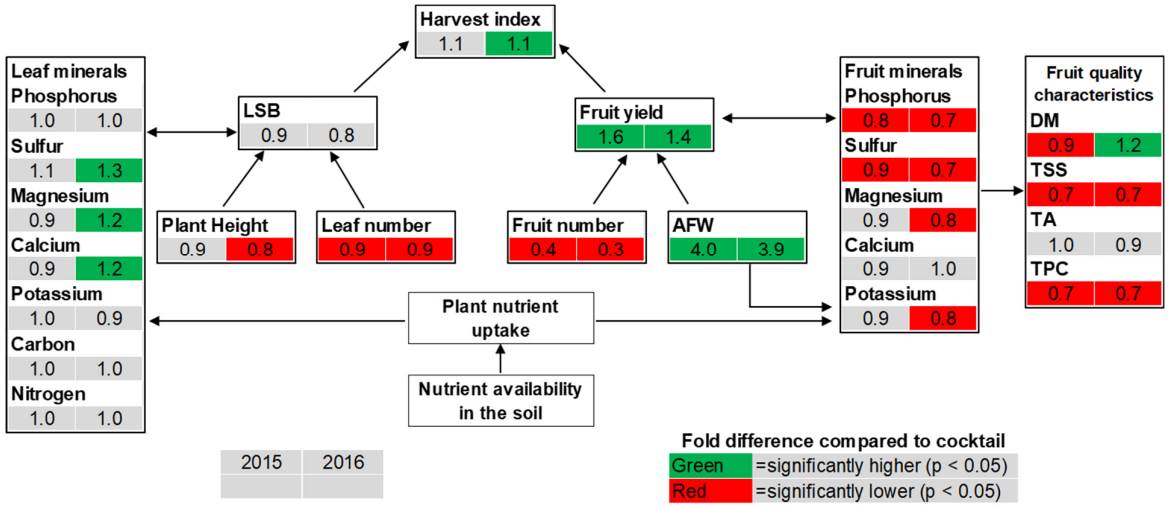

Figure S4. Summary of plant morphological characteristics and fruit quality of salad (n = 8) and cocktail (n = 12) cultivars grown in 2015 and 2016. The values are presented as fold differences between salad and cocktail cultivars (salad/cocktail). The significantly higher ($p < 0.05$) values of salad compared with cocktail cultivars are indicated in green and the significantly lower ($p < 0.05$) values are indicated in red. LSB = leaf and stem biomass; AFW = average fruit weight; DM = dry matter; TSS = total soluble solid; TA = titratable acidity; TPC = total phenolic concentration.

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