





Supplementary tables

Supplementary table 1. Phenotype of four apple cultivars used in this study at their commercial harvest time.

	<p>Hwangok</p> <p>Parentage: ‘Kougetsu’ × ‘Yataka Fuji’ Year released: 2009 Harvest date: September Fruit weight: 229 g Soluble solids: 15.0 °Brix Titratable acidity: 0.48 %</p>
	<p>Picnic</p> <p>Parentage: ‘Fuji’ × ‘Sansa’ Year released: 2008 Harvest date: September Fruit weight: 223 g Soluble solids: 14.2 °Brix Titratable acidity: 0.38 %</p>
	<p>Gamhong</p> <p>Parentage: ‘Spur Earliblaze’ × ‘Spur Golden Delicious’ Year released: 1992 Harvest date: October Fruit weight: 350-400 g Soluble solids: 17.8 °Brix Titratable acidity: 0.40 %</p>
	<p>Fuji</p> <p>Parentage: ‘Ralls Genet’ × ‘Delicious’ Year released: 1962 Harvest date: October Fruit weight: 300 g Soluble solids: 14.5 °Brix Titratable acidity: 0.28 %</p>

Supplementary table 2. Physiological characteristics of four apple cultivars used in this study at their commercial harvest time.

Cultivar	Fruit weight (g)	L/D ratio	Hunter's value		
			<i>L</i>	<i>a</i>	<i>b</i>
Hwangok	210.4±4.53	0.93±0.01	66.8±0.63	-8.8±0.43	29.5±0.36
Picnic	248.7±9.69	0.89±0.01	35.5±1.01	26.3±0.22	10.8±0.40
Gamhong	355.2±9.78	0.91±0.01	46.0±1.71	24.7±1.09	13.6±0.80
Fuji	362.7±12.0	0.86±0.01	41.6±0.38	19.8±0.44	13.7±0.24

	Firmness (N/φ11mm)	Titrateable acidity (%)	Soluble solids content (%)	Ethylene production (μL·kg ⁻¹ ·h ⁻¹)	Internal ethylene concentration (μL·L ⁻¹)	Starch pattern index (1-8)
Hwangok	59.7±1.23	0.55±0.01	15.6±0.11	3.49±0.41	4.90±0.27	5.32±0.11
Picnic	69.3±1.01	0.41±0.01	15.7±0.13	21.23±4.10	1.56±0.08	5.82±0.05
Gamhong	56.3±1.12	0.31±0.01	16.0±0.26	2.75±0.19	4.57±0.62	5.34±0.10
Fuji	52.3±1.39	0.32±0.01	13.7±0.16	1.95±0.11	2.21±0.39	5.48±0.07

^zMean ± standard error (*n*=15)

Supplementary table 3. Primer sets for qRT-PCR amplification of ethylene biosynthesis and receptor genes expression and PCR condition.

Gene name	Primer sequence
<i>MdACS1</i>	Forward: 5'-CTAGCGCGAACTCCCATAATC-3' Reverse: 5'-CCAGTTCCTGTTCGAGTAAAT-3'
<i>MdACO1</i>	Forward: 5'-GCACCAGCTAACTCACATCTT-3' Reverse: 5'-GAACGAGGCTATCGACATTCTG-3'
<i>MdETR2</i>	Forward: 5'-AGGCAAACAAAGGGATGACA-3' Reverse: 5'-AGAGTTAATTTTCATGCCCCGTATAA-3'
<i>MdActin</i>	Forward: 5'-TGACCGAATGAGCAAGGAAATTACT-3' Reverse: 5'-TACTCAGCTTTGGCAATCCACATC-3'

PCR condition

The cycling conditions were as follows: denaturation step at 95 °C for 10 min, followed by 45 cycles of denaturation at 95 °C for 20 s, annealing at 63 °C for 20 s, and extension at 72 °C for 20 s.