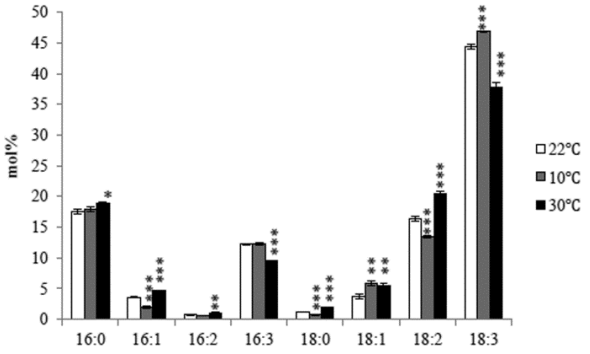
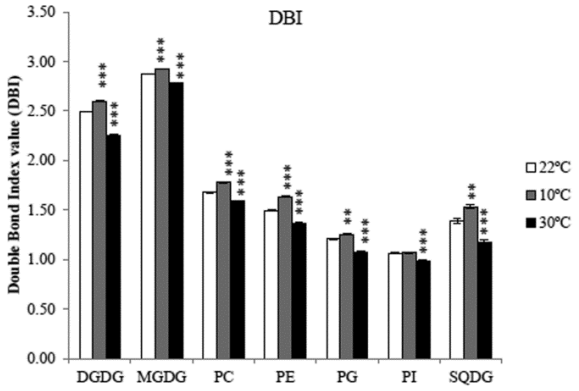
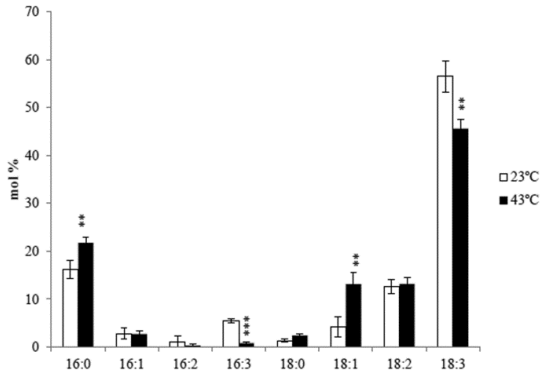


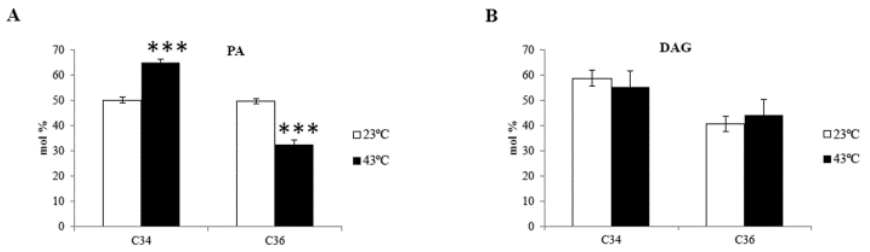
Supplemental Figure 1 Total fatty acid composition in leaves of Arabidopsis grown at 10, 22 and 30℃. Values are means ± SD of mol% (*n* = 4 individual plant). Statistically significant differences (two-tailed student t-test; *, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$) were calculated by comparisons between suboptimum temperature treatments (10℃ and 30℃) and the standard growth condition (22℃).



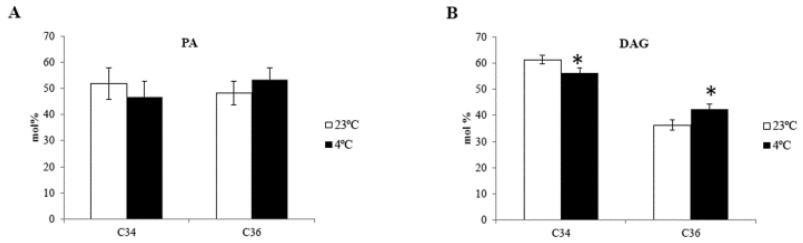
Supplemental Figure 2 Double bond index (DBI) values of individual lipid species of Arabidopsis grown at 10, 22 and 30℃. DBI values are calculated as described in "Materials and Methods". Values are mean ± SD from five biological replicates. *, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$.



Supplemental Figure 3 Leaf fatty acid compositions of *A. lentiformis* grown at 23℃ and 43℃. Values represent average of four independent biological replicates. Statistically significant differences were calculated between 43 and 23℃ (two-tailed student t-test; *, $p < 0.05$; **, p value < 0.01; ***, p value < 0.001).



Supplemental Figure 4 Changes in PA (**A**) and DAG (**B**) subpools in *A. lentiformis* grown at 43℃ and 23℃. C34 represents C16/C18 or C18/C16 lipid molecules; C36 represents C18/C18 lipid molecules. Values represent average of five independent biological replicates. Statistically significant differences were calculated between 43℃ and 23℃ (two-tailed student t-test; *, $p < 0.05$; ***, p value < 0.001).



Supplemental Figure 5 Changes in PA (**A**) and DAG (**B**) subpools in wheat grown at 4℃ and 23℃. C34 represents C16/C18 or C18/C16 lipid molecules; C36 represents C18/C18 lipid molecules. Values represent average of three independent biological replicates. Statistically significant differences were calculated between 43℃ and 23℃ (two-tailed student t-test; *, $p < 0.05$; ***, p value < 0.001).

Supplemental Table 1 Leaf glycerolipid composition of Arabidopsis grown at 10, 22 and 30℃.

Value represents average of five independent samples. Statistically significant differences (two-tailed student t-test; *, $p < 0.05$) were calculated by comparisons between temperature treatments (10℃ and 30℃) and standard growth condition (22℃), respectively. C16 represents the sum of 16: 0, 16: l, 16:2 and 16:3; C18 represents the sum of 18:0, 18:1, 18:2 and 18:3.

Glycerolipids	Total Polar Lipids (%)	Fatty acid composition (mol%)								C16/C18
		16:0	16:1[a]	16:2	16:3	18:0	18:1[b]	18:2	18:3	
DGDG										
10℃	15.9 ± 0.15	10.7 ± 0.71*	0.3 ± 0.12	0.6 ± 0.02*	3.1 ± 0.07*	0.5 ± 0.07*	0.9 ± 0.24*	3.6 ± 0.13*	80.3 ± 0.81*	0.17 ± 0.01*
22℃	16.0 ± 0.32	12.6 ± 0.31	0.4 ± 0.14	0.6 ± 0.01	2.8 ± 0.02	0.8 ± 0.03	1.3 ± 0.34	6.3 ± 0.27	75.3 ± 0.31	0.20 ± 0.00
30℃	17.9 ± 0.39*	17.9 ± 0.10*	0.8 ± 0.23	0.7 ± 0.04	1.7 ± 0.08*	1.5 ± 0.12*	2.1 ± 0.27*	9.9 ± 0.26*	65.6 ± 0.35*	0.27 ± 0.00*
MGDG										
10℃	41.1 ± 0.49*	0.8 ± 0.09*	0.4 ± 0.06*	1.3 ± 0.03*	37.5 ± 0.30*	0.1 ± 0.05	0.4 ± 0.12*	2.0 ± 0.12*	57.4 ± 0.18*	0.67 ± 0.01*
22℃	38.0 ± 0.83	1.4 ± 0.11	0.8 ± 0.04	1.5 ± 0.02	34.9 ± 0.19	0.1 ± 0.03	0.7 ± 0.14	3.7 ± 0.20	56.9 ± 0.36	0.63 ± 0.01
30℃	38.7 ± 0.60	2.2 ± 0.17*	1.6 ± 0.04	2.2 ± 0.02*	29.8 ± 0.35*	0.2 ± 0.08*	1.5 ± 0.18*	5.9 ± 0.14*	56.6 ± 0.21	0.56 ± 0.00*
PC										
10℃	16.6 ± 0.39*	26.1 ± 0.78*				1.5 ± 0.03*	4.7 ± 0.32	30.1 ± 0.23*	37.6 ± 1.04*	0.35 ± 0.01*
22℃	17.6 ± 0.64	28.5 ± 0.50				2.0 ± 0.03	5.0 ± 0.29	31.0 ± 0.44	33.6 ± 0.75	0.40 ± 0.01
30℃	16.1 ± 0.30*	28.6 ± 0.19				3.4 ± 0.09*	5.3 ± 0.41*	34.3 ± 0.42*	28.4 ± 0.50*	0.40 ± 0.00
PE										
10℃	11.4 ± 0.25*	30.2 ± 0.52*				1.0 ± 0.04*	4.1 ± 0.41*	34.9 ± 0.16*	29.8 ± 0.48*	0.43 ± 0.01*
22℃	12.4 ± 0.18	34.4 ± 0.55				1.8 ± 0.06	2.9 ± 0.37	36.0 ± 0.28	24.9 ± 0.48	0.52 ± 0.01
30℃	10.6 ± 0.11*	36.5 ± 1.25*				3.3 ± 0.20*	2.8 ± 0.57	38.9 ± 0.60*	18.5 ± 0.66*	0.58 ± 0.03*
PG										
10℃	10.1 ± 0.49	41.3 ± 0.50*	18.1 ± 0.38*			0.6 ± 0.05*	2.4 ± 0.37*	7.6 ± 0.25*	30.0 ± 0.80*	1.46 ± 0.05*
22℃	10.1 ± 0.17	32.4 ± 0.71	28.5 ± 0.78			1.0 ± 0.10	5.2 ± 0.74	11.5 ± 0.47	21.4 ± 0.51	1.56 ± 0.04
30℃	10.3 ± 0.02	29.5 ± 1.50*	33.4 ± 0.91*			1.3 ± 0.12*	9.0 ± 1.00*	14.8 ± 0.90*	11.9 ± 0.83*	1.70 ± 0.13*
PI										
10℃	3.0 ± 0.17	54.9 ± 1.26				1.7 ± 0.45	2.3 ± 1.47	18.9 ± 0.50*	22.1 ± 1.01	1.22 ± 0.06
22℃	3.5 ± 0.24	54.4 ± 1.10				1.9 ± 0.11	2.4 ± 0.71	20.3 ± 0.10	21.1 ± 0.45	1.19 ± 0.05
30℃	3.5 ± 0.12	55.0 ± 0.70				2.7 ± 0.20*	2.1 ± 0.81	23.9 ± 1.16*	16.4 ± 0.71*	1.22 ± 0.03
SQDG										
10℃	2.0 ± 0.20	44.7 ± 1.87				1.2 ± 0.33*	2.5 ± 2.20	3.9 ± 0.42*	47.6 ± 1.99*	0.81 ± 0.06
22℃	2.3 ± 0.09	46.8 ± 2.71				1.6 ± 0.18	3.0 ± 0.66	9.7 ± 0.68	38.9 ± 1.65	0.88 ± 0.10
30℃	2.8 ± 0.13	49.8 ± 2.83				2.6 ± 0.29*	4.6 ± 2.50*	16.6 ± 1.08*	26.5 ± 1.47*	1.00 ± 0.12

[a] represents sum of 16:1 *cis* and *trans* fatty acids.
[b] represents sum of 18:1 *cis* and *trans* fatty acids.

Supplemental Table 2 Leaf glycerolipid compositions of *A. lentiformis* grown at 23℃ and 43℃.

Values are means ± SD (*n* = 3). Statistically significant differences (two-tailed student t-test; *, p value < 0.05) were calculated between 43℃ and 23℃. C16 represents the sum of 16: 0, 16: l, 16:2 and 16:3; C18 represents the sum of 18:0, 18:1, 18:2 and 18:3.

Glycerolipids		Total Polar Lipids (%)	Fatty acid composition (mol%)								C16/C18
			16:0	16:1[a]	16:2	16:3	18:0	18:1[b]	18:2	18:3	
DGDG											
	23ºC	21.7 ± 0.42	13.9±1.18	0.4±0.05	0.1±0	2.5±0.07	1.4±0.06	2.5±0.12	4.8±0.14	74.4±1.16	0.20 ± 0.02
	43ºC	26.0 ± 0.13*	26.8±0.5*	0.5±0.01	0.1±0	0.2±0*	4.2±0.04*	8.6±0.27*	13.7±0.16*	45.8±0.39*	0.38 ± 0.01*
MGDG											
	23ºC	41.9 ± 0.31	1.5±0.21	0.4±0.02	0.6±0	14.6±0.25	0.2±0.03	1.7±0.24	2.3±0.3	78.6±0.46	0.21 ± 0.00
	43ºC	35.9 ± 0.62*	7.6±0.21*	0.7±0.02*	0.8±0*	2.7±0.01*	0.8±0.01*	5.5±0.16*	10.9±0.06*	71±0.42*	0.13 ± 0.00*
PC											
	23ºC	14.8 ± 0.80	26.1±1.83				2.5±0.64	17.8±0.49	28.3±1.12	24.5±1.46	0.37 ± 0.03
	43ºC	16.4 ± 0.51*	30.6±0.62*				2.6±0.05	37.8±0.76*	13.6±0.26*	14.5±0.58*	0.46 ± 0.02*
PE											
	23ºC	6.8 ± 0.25	23.9±0.45				1.8±0.29	9.7±0.66	42.7±0.55	21.5±0.19	0.32 ± 0.01
	43ºC	6.8 ± 0.23	31.5±0.54*				2.6±0.3*	20.9±0.35*	25.3±0.35*	19.2±0.2*	0.47 ± 0.01*
PG											
	23ºC	8.9 ± 0.22	35.5±0.26	23.6±0.4			1.1±0.16	4±0.15	13.4±0.39	22.2±0.42	1.45 ± 0.03
	43ºC	7.0 ± 0.19*	45±0.48*	23.4±0.22			2.3±0.04*	10.2±0.16*	13.2±0.27	5.8±0.28*	2.17 ± 0.07*
PI											
	23ºC	2.4 ± 0.06	46.8±1.91				3.7±0.8	8.1±0.22	23.1±1.57	18.4±1.01	0.88 ± 0.07
	43ºC	4.1 ± 0.28*	47.5±0.75				3.4±0.26	14.7±0.14*	17.3±0.11*	17.1±0.47	0.90 ± 0.03
SQDG											
	23ºC	3.6 ± 0.83	48.5±0.78				1.8±0.18	2.8±0.31	11.8±0.16	35.1±1.13	0.94 ± 0.03
	43ºC	3.7 ± 0.57	54.1±5.48				3.4±0.09*	10.6±1.27*	14.4±2.11	17.4±2.05*	1.20 ± 0.25

[a] represents sum of 16:1 *cis* and *trans* fatty acids.
[b] represents sum of 18:1 *cis* and *trans* fatty acids.

Supplemental Table 3 Fatty acid composition of plants grown at 22℃ (10 days) and after exposure to 5℃ for 3 weeks. C16 represents the sum of 16: 0 and 16: l; C18 represents the sum of 18:0, 18:1, 18:2 and 18:3. DBI, Double Bond Index.

Temperature treatment	Plants	Fatty acid composition (mol%)								C16/C18	DBI
		16:0	16:1[a]	16:2	16:3	18:0	18:1[b]	18:2	18:3		
22ºC, 10 days	WT	17.1±0.4	2.6±0.1	0.6±0.0	11.1±0.2	1.9±0.1	3.2±0.1	17.5±1.0	45.9±1.3	0.46±0.01	2.13±0.02
	gly1	15.9±0.6*	2.4±0.3	0.4±0.0*	4.3±0.1*	1.5±0.0*	4.3±0.1*	20.3±0.5*	51.0±0.0*	0.30±0.01*	2.14±0.01
	fad5	25.5±0.3*	3.0±0.1*	0.0±0.0*	0.0±0.0*	2.0±0.2	2.8±0.1*	18.1±0.4	48.6±0.6*	0.40±0.00*	1.88±0.01*
	act1	15.2±1.0*	2.4±0.2	0.0±0.0*	0.5±0.0*	2.0±0.0	7.0±0.6*	21.6±0.8*	51.5±2.3*	0.22±0.02*	2.08±0.05
5ºC, 3 weeks	WT	15.9±0.3	1.9±0.4	0.5±0.0	12.7±0.5	0.6±0.2	3.0±0.4	12.7±0.2	52.7±0.2	0.45±0.00	2.28±0.02
	gly1	14.2±0.1*	1.4±0.0	0.1±0.0*	3.2±0.1*	0.5±0.0	5.6±0.1*	21.1±0.2*	54.0±0.2*	0.23±0.00*	2.21±0.01*
	fad5	21.8±0.1*	1.7±0.3	0.0±0.0*	0.0±0.0*	0.7±0.2	3.4±0.1	16.5±0.1*	55.8±0.3*	0.31±0.01*	2.06±0.01*
	act1	12.9±0.1*	1.5±0.1	0.1±0.0*	1.0±0.0*	0.4±0.0	6.3±0.1*	22.3±0.1*	55.4±0.4*	0.18±0.00*	2.22±0.01*

[a] represents sum of 16:1 *cis* and *trans* fatty acids.
[b] represents sum of 18:1 *cis* and *trans* fatty acids.

Supplemental Table 4 Leaf glycerolipid composition of wheat at 23℃ and 4℃. Values are means ± SD (n = 3). Statistically significant differences (*, p value < 0.05) were calculated between 4℃ and 23℃. C16 represents the sum of 16: 0 and 16: l; C18 represents the sum of 18:0, 18:1, 18:2 and 18:3.

Glycerolipids	Total Polar Lipids (%)	Fatty acid composition (mol%)						C16/C18
		16:0	16:1[a]	18:0	18:1[b]	18:2	18:3	
DGDG								
23℃	24.9 ± 0.50	9 ± 0.08		1.1 ± 0.07	0.7 ± 0.01	2.2 ± 0.04	87 ± 0.18	0.10 ± 0.00
4℃	26.4 ± 0.23*	7.7 ± 0.15*		0.9 ± 0.05*	0.8 ± 0.26	1.8 ± 0.47	88.8 ± 0.91*	0.08 ± 0.00*
MGDG								
23℃	42.7 ± 2.06	1 ± 0.03		0.2 ± 0.02	0.4 ± 0.01	3.7 ± 0.03	94.6 ± 0.08	0.01 ± 0.00
4℃	35.1 ± 0.25*	1.1 ± 0.04		0.2 ± 0.01	0.4 ± 0.04	1.9 ± 0.06*	96.4 ± 0.08*	0.01 ± 0.00
PC								
23℃	11.1 ± 0.40	24.3 ± 0.09		1.4 ± 0.09	4.6 ± 0.11	42.8 ± 0.5	26.8 ± 0.62	0.32 ± 0.00
4℃	15.5 ± 0.50*	21.4 ± 0.86*		1.3 ± 0.1	3.5 ± 0.57	39.2 ± 0.65*	34.6 ± 0.86*	0.27 ± 0.01*
PE								
23℃	4.6 ± 0.34	25 ± 0.44		1.5 ± 0.14	1.4 ± 0.33	49.3 ± 0.58	22.8 ± 0.21	0.33 ± 0.01
4℃	8.0 ± 0.25*	24.3 ± 0.52		1 ± 0.23*	0.9 ± 0.01*	41.4 ± 0.33*	32.4 ± 0.47*	0.32 ± 0.01
PG								
23℃	10.2 ± 0.48	14.5 ± 0.13	37.5 ± 0.22	0.9 ± 0.18	1 ± 0.02	6.2 ± 0.09	39.8 ± 0.41	1.08 ± 0.01
4℃	9.9 ± 0.28	20.6 ± 0.26*	28.8 ± 0.72*	0.8 ± 0.08	1 ± 0.07	6.6 ± 0.34	42.1 ± 0.44*	0.98 ± 0.03*
PI								
23℃	1.3 ± 0.17	52.9 ± 3.78		4.1 ± 3.96	0	23 ± 1.05	20 ± 0.82	1.13 ± 0.18
4℃	1.4 ± 0.03	46.4 ± 2.22		3.3 ± 0.1	1 ± 1.78	21.4 ± 0.67	27.9 ± 1.11*	0.87 ± 0.08
SQDG								
23℃	5.3 ± 0.30	25.5 ± 0.64		2 ± 0.41	0	4.6 ± 0.69	68 ± 1.33	0.34 ± 0.01
4℃	3.7 ± 0.11*	25.3 ± 1.1		1.9 ± 0.11	0	1.4 ± 0.31*	71.3 ± 1.3	0.34 ± 0.02

[a] represents sum of 16:1 *cis* and *trans* fatty acids.
[b] represents sum of 18:1 *cis* and *trans* fatty acids.

Supplemental Table 5. Primers pairs used for in this study.

Gene Name	AGI ID	Forward primer (5'→3')	Reverse primer (5'→3')
ACTIN2	*AT3G18780*	AACCCAAAGGCCAACAGAGA	AAGGTCACGTCCAGCAAGGT
AAPT1	*AT1G13560*	GGGAACGCGGAAGAAACGCA	CCCCTATAGAGAGCGGCGAA
AAPT2	*AT3G25585*	TTTGGATTCCTTGTGGGAAG	GAACCCCGTCGTTGAGTCTA
ATPIS1	*AT1G68000*	GGCTTTGACATTGTTCGGTT	GATCAAGGCTTCTGCTGCT
ATPIS2	*AT4G38570*	CTGTGGATGGATGGTGCGCT	AGAAGACAGGCTGTGCTGAC
NMT1	*AT3G18000*	CCCGATTCGACGTTGTGCGA	TGGCCTTCGACGGCGAGTCT
PECT1	*AT2G38670*	TTCTGGCGTGCCGCTACGTG	GCTCTCGGCTACTGTCCCAT
FAD2	*AT3G12120*	CCTTCCTCCTCGTCCCTTAC	CTCTTTCGAGGGATCCAGTG
FAD3	*AT2G29980*	TCAAACCCTTTCTTCACCACA	TTGGTCCATAGCAACAACCA
PGPS2	*AT3G55030*	TGTCGCCACCGCCCTTCTTC	TCCACCGTCGCGGTGTCTTC
MGD2	*AT5G20410*	ACGGTCATGGCCCTTGCAGA	CCGTCGCCGCTTGTTACGGA
MGD3	*AT2G11810*	CACTGATTTGCGGCCTCCCA	GGGTGAAAACTCCAGCCCCA
DGD1	*AT3G11670*	GTGCAAGAAGCAATGACGA	GTTGCTGCTTCCCAAGAGAG
DGD2	*AT4G00550*	GTGTGTTTGCGTCATCTTC	CCAAAAGCTGTTCTGGAAG
ACT1	*AT1G32200*	TTCTCGCGGCGGCGTTAGTG	GCTCACTCGGCGTCTCACCG
ATS2	*AT4G30580*	GCCAACGGGTAGTGAAGGTA	GTTGCAAAGAACATCCGCTT
PGP1	*AT2G39290*	TCTTCACCGCCTCCGTCGCA	GCGGCGACACGACCAAGTGT
PAP1	*AT2G01180*	GTCAAGGAAGGCCACAAGAG	GCCTTGATTTTGCCAGAGAG
MGD1	*AT4G31780*	GTTACATCGCTGGTCAAGAG	TGCCGGTCCAAACCAATCCG
FAD5	*AT3G15850*	TGGGTTTTGGTTCAGTCACA	TAGGTGGTTCGAAGGAATCG
FAD6	*AT4G30950*	CCGTGGTATCTGCTACCGTT	TAGGAAGGCGAGAGTACCCA
FAD7	*AT3G11170*	TCGCTATCGTCTTTGCATTG	GCCAATAGAGAGGCCAAACA
FAD8	*AT5G05580*	TCCTTTGCCTGAAAGCATCT	GAAAGGGTATGCGAGCATTG
SQD1	*AT4G33030*	CCCGGCAAAAGCTGGTGAGT	GCCCAAGCTTTGAACCCGCT
SQD2	*AT5G01220*	GCAAGCTCCGCTTCTGTGGA	AGCGGCGCATCAATCTCCGA