First off the mark: early seed germination

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Supplementary Material

Darwin Review

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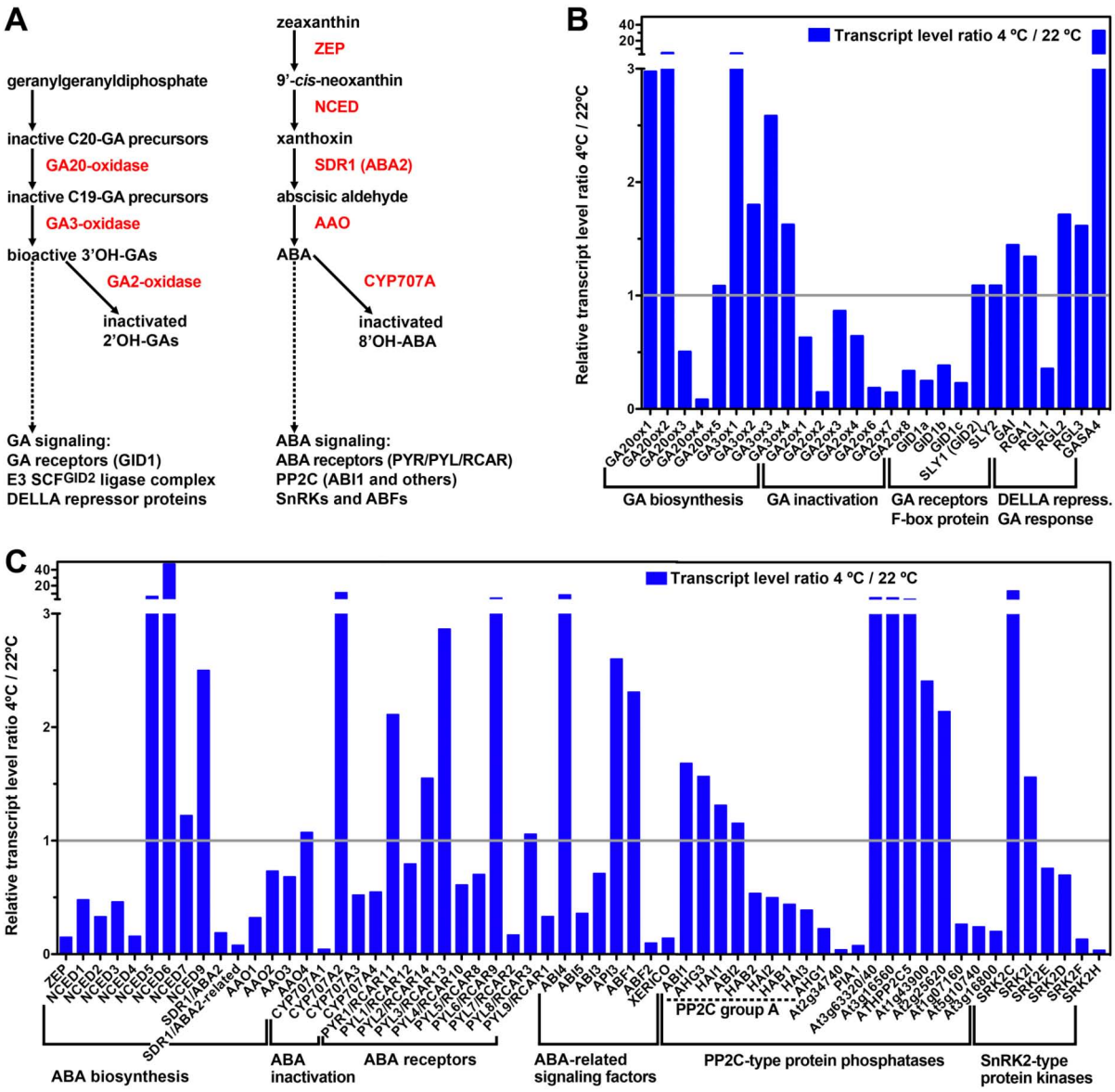
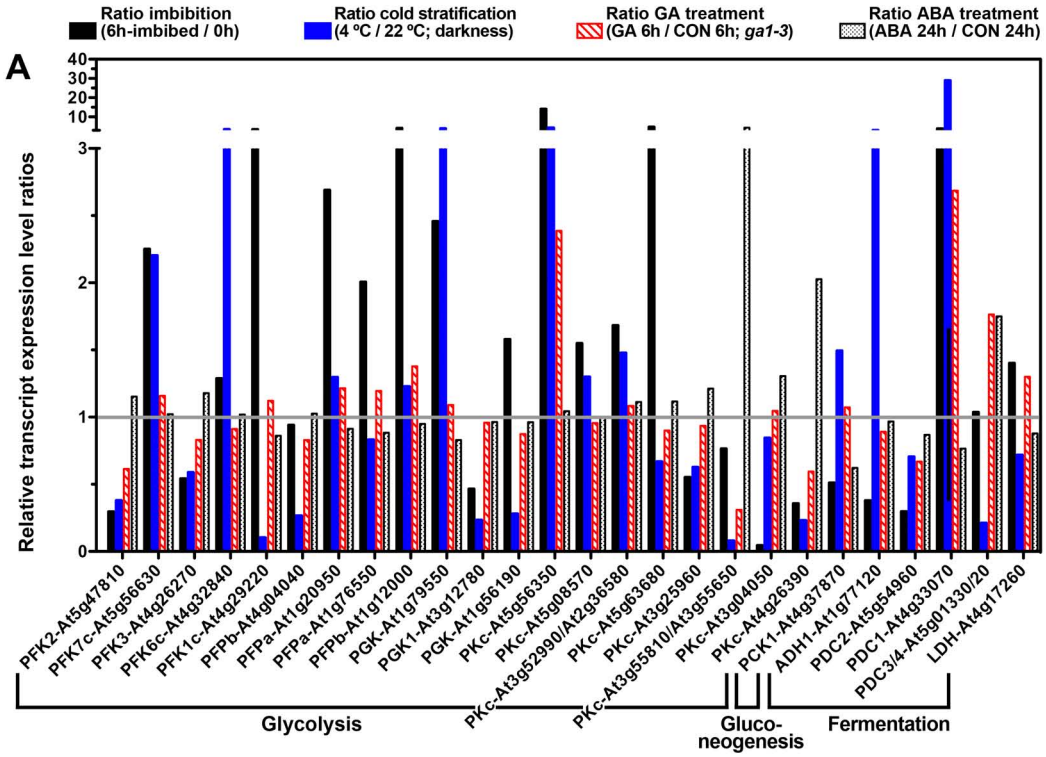
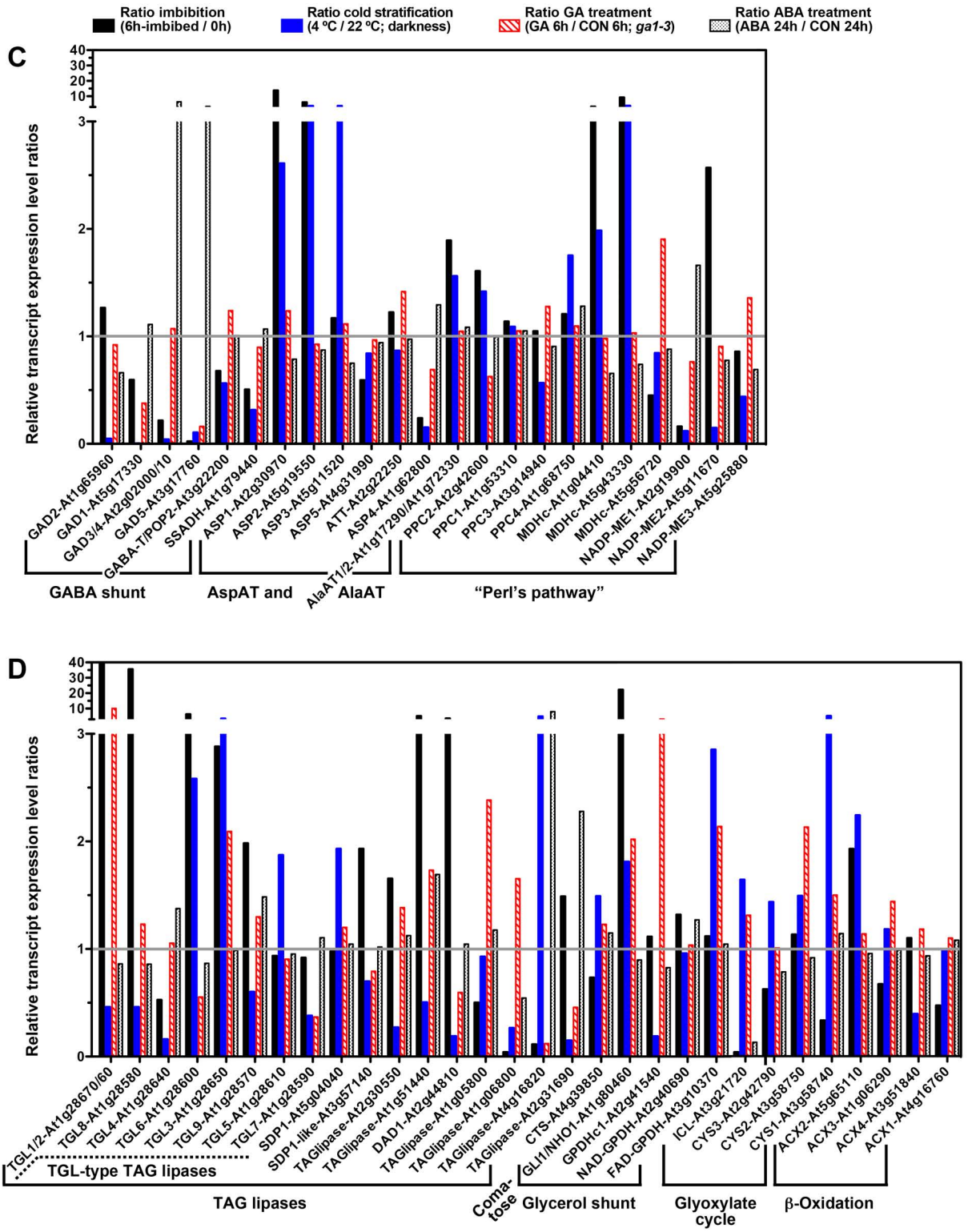


Supplementary Figure S1. Regulation of GA- and ABA-related transcripts by cold stratification of *Arabidopsis thaliana* seeds. **(A)** Important steps in gibberellin (GA) and abscisic acid (ABA) biosynthesis, degradation and signaling. ZEP = zeaxanthin epoxidase, NCED = nine-cis-epoxycarotenoid dioxygenase, SDR1/ABA2 = short-chain dehydrogenase reductase, AAO = abscisic aldehyde oxidase, CYP707A = ABA 8'-hydroxylase. **(B)** and **(C)** The transcript level ratios 4 ºC / 22 ºC for GA- and ABA-related genes calculated from seeds incubated for 96 h in darkness (Yamauchi *et al.*, 2004), data are available via the seed-specific eFP-browser at www.bar.utoronto.ca (Winter *et al.*, 2007; Bassel *et al.*, 2008).


A
Ratio imbibition
(6h-imbibed / 0h)
Ratio cold stratification
(4 ºC / 22 ºC; darkness)
Ratio GA treatment
(GA 6h / CON 6h; ga1-3)
Ratio ABA treatment
(ABA 24h / CON 24h)
Relative transcript expression level ratios
PFK2-At5g47810
PFK7c-At5g56630
PFK3-At4g26270
PFK6c-At4g32840
PFK1c-At4g29220
PFPb-At4g04040
PFPa-At1g20950
PFPa-At1g76550
PFPb-At1g12000
PGK-At1g79550
PGK1-At3g12780
PGK-At1g56190
PKc-At5g56350
PKc-At5g08570
PKc-At3g52990/At2g36580
PKc-At5g63680
PKc-At3g25960
PKc-At3g55810/At3g55650
PKc-At3g04050
PKc-At4g26390
PCK1-At4g37870
ADH1-At1g77120
PDC2-At5g54960
PDC1-At4g33070
PDC3/4-At5g01330/20
LDH-At4g17260
Glycolysis
Gluco-neogenesis
Fermentation
B
Relative transcript expression level ratios
PDH-E1b-At5g50850
PDH-E1a-At1g59900
PDH-E1a-At1g24180
CYS4-At2g44350
CYS5-At3g60100
SCoSb-At2g20420
SCoSa-At5g08300
SCoSa-At5g23250
SDH3-1/2-At5g09600/At4g32210
SDH1-1-At5g66760
SDH4-At2g46505
SDH2-1-At3g27380
SDH2-2-At5g40650
SDH1-2-At2g18450
MDHm-At1g53240
MDHm-At3g15020
NAD-ME1-At2g13560
NAD-ME2-At4g00570
G6PD5c-At3g27300
G6PD6c-At5g40760
6PGDH-At3g02360
6PGDH-At1g64190
6PGDH-At5g41670
PDH and TCA
OPPP



Supplementary Figure S2. Regulation of transcripts for the energy metabolism of *Arabidopsis thaliana* seeds by imbibition (ratio 6h/dry of Col seeds incubated in the light at 22 ºC), cold stratification (ratio 4 ºC / 22 ºC after 96h of dark incubation of Col seeds), GA (ratio +GA/-GA of GA-deficient *ga1-3* seeds at 6h) and ABA (ratio +ABA/-ABA of L*er* seeds at 24h), data are available via the seed-specific eFP-browser at www.bar.utoronto.ca (Winter *et al.*, 2007; Bassel *et al.*, 2008).

Supplementary Table 1. Transcriptome analysis for energy metabolism genes during *Arabidopsis thaliana* germination *sensu strictu* and its regulation by hormones and cold stratification. The seed-specific eFP-browser and the eNorthern tool at www.bar.utoronto.ca were used to analyse transcript expression patterns based on global transcriptome analyses during Arabidopsis seed germination (Winter *et al.*, 2007; Bassel *et al.*, 2008). The time course of transcriptional changes of key metabolic enzyme genes during the early phase of germination (dry seed (0h) to 24h) of non-dormant, non-stratified Arabidopsis Col seeds are listed as relative values (Nakabayashi *et al.*, 2005; Preston *et al.*, 2009); in addition the absolute values in dry seeds and at 6h are listed (in red). The imbibition-mediated transcript expression patterns the ratios 6h/dry were calculated and classified as follows: up-regulation if ratio ≥2, equal if ratio 0.5 to 2, down-regulation if ratio ≤0.5, up24 if up-regulation is only evident at 24h. The transcript regulation patterns by moist cold-stratification were determined from the ratios 4ºC / 22ºC of seeds imbibed in darkness for 96h (Yamauchi *et al.*, 2004). The regulation by gibberellins (GA) was analysed by calculating the ratios obtained with 6h-imbibed GA-deficient *ga1-3* seeds ±GA (RIKEN transcriptome sets at www.bar.utoronto.ca). The regulation by abscisic acid (ABA) was analysed by calculating the ratios obtained with 24h-imbibed L*er* seeds ±ABA (RIKEN transcriptome sets at www.bar.utoronto.ca). The column "proteome analysis" contains the corresponding protein expression patterns for germination *sensu strictu* compiled from the following publications: (1) Arabidopsis whole seed, germination *sensu strictu* after cold-stratification (Fu et al. 2005). (2) Arabidopsis whole seed, germination *sensu strictu*, www.seedproteome.com. (3) *Lepidium sativum* endosperm cap, germination *sensu strictu*, no cold-stratification (Müller et al. 2010). (4) Arabidopsis whole seed ratio, germination *sensu strictu*, α-amanitin/control (Rajjou et al. 2004). (5) Arabidopsis whole seed, germination *sensu strictu* (Gallardo et al. 2001).

→ *see separate Excel file*