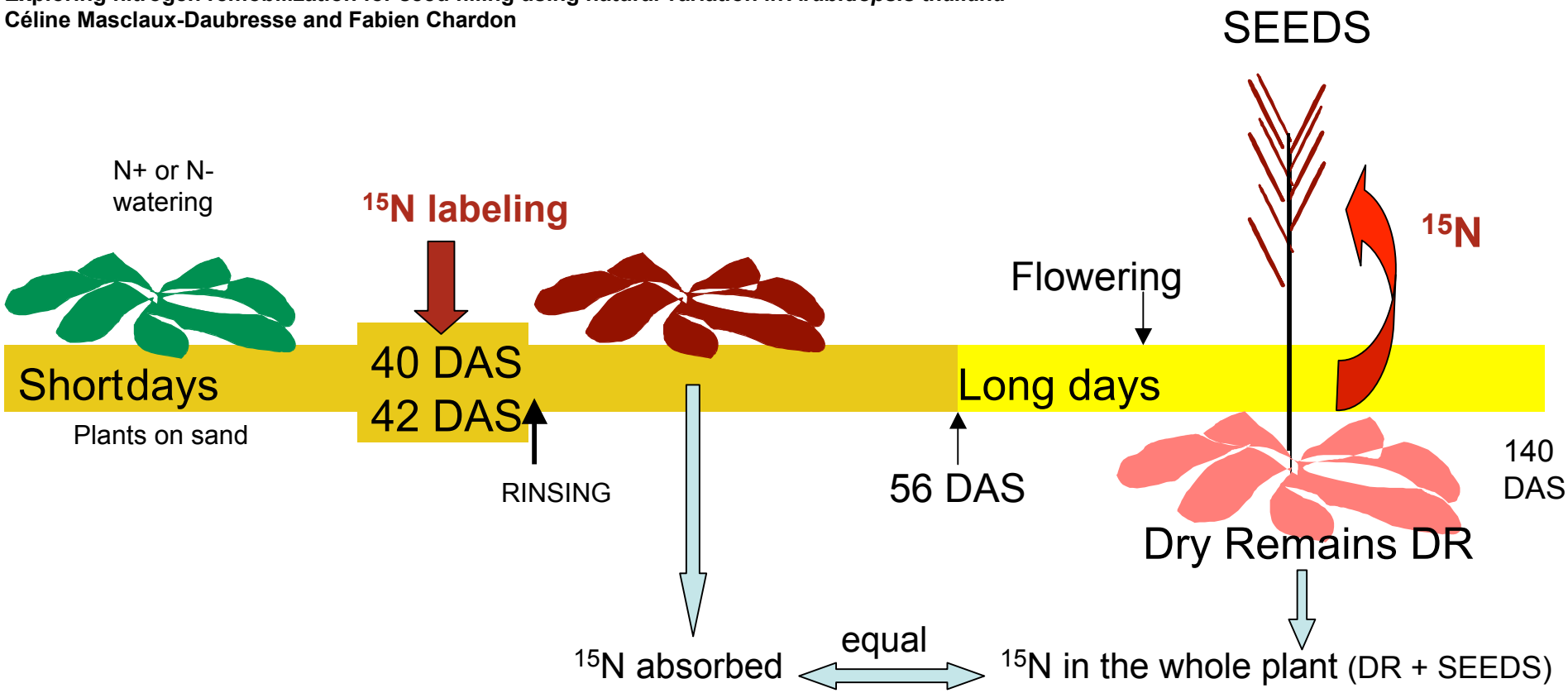
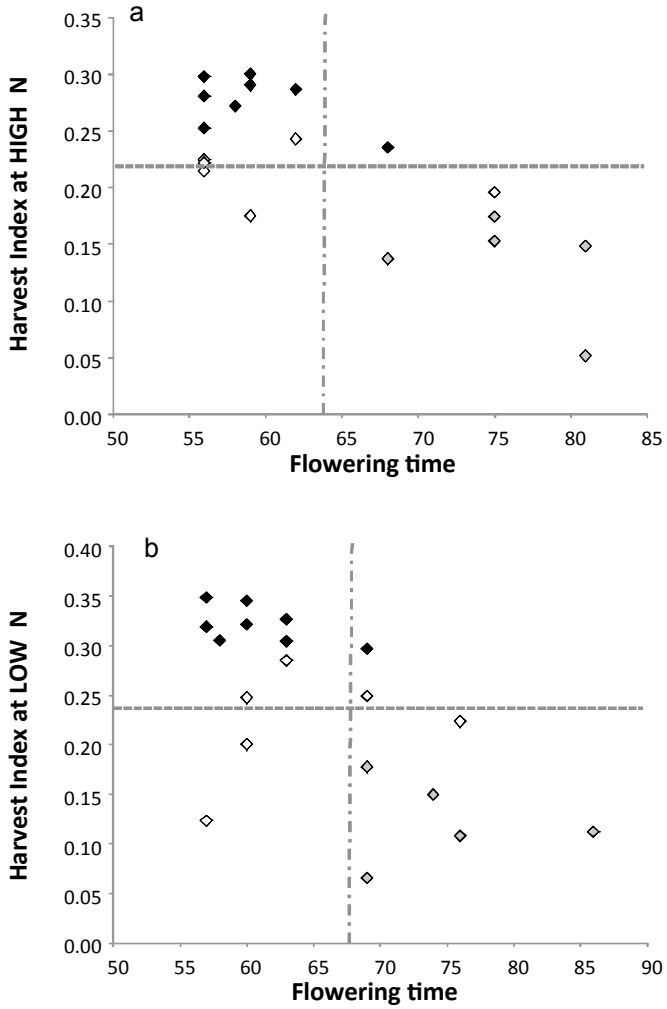


Supplemental Fig.S1: For each accession, four plant repeats and two time repeat were performed. Seeds were sown on sand and grew in short days for 56 days after sowing (DAS) before transfer to long days. Plants were watered three times per week (on Monday, Wednesday and Friday) for 2 hours with nutritive solutions containing 2mM or 10mM nitrate $^{14}NO_3^-$. At days 40 and 42 after sowing, the unlabelled watering solutions were replaced by the labelled 2mM or 10mM nitrate solutions containing $^{15}NO_3^-$ (10% enrichment). Labelled solutions were provided to the plants for 24 hours long. After the 42 DAS labelling time, plants and sand were carefully rinsed several time using deionised water to remove any remaining $^{15}NO_3^-$ from the substrate. Plants were then grown until the end of their cycle, using unlabelled 2mM or 10mM nitrate $^{14}NO_3^-$solutions. At the end of plant cycle, when plants were dry, their dry remains (DR) and seeds (SEEDS) were separated to determine their dry weight (DW_{DR} and DW_{SEEDS}), the dry weight of one seed (DW_{1S}) and their concentration in nitrogen (N%), carbon (C%) and ^{15}N (enrichment E%). From measured traits, calculated traits were then computed.



Supplemental Figure S2: Correlations between harvest index and flowering time at HIGH N (a) and at LOW N (b) show continuous natural variation between accessions. Values are adjusted means from two biological repeats with four individual plants each. Accessions belonging to HI clusters L, M and H are represented by diamonds with light grey, white and black colours respectively. The horizontal hashed grey lines represent the mean of the core collection at HIGH N and the vertical hashed grey lines represent the mean at LOW N.

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Supplemental Table S1 : *Arabidopsis thaliana* accession provided by the Versailles Genetics and Plant Breeding Laboratory *Arabidopsis thaliana* Resource Centre (INRA Versailles France, http://dbsgap.versailles.inra.fr/vnat/). The 16 first accessions listed below are part of the 24 lines core collection defined previously by Mckhann et al. (2004) on the basis of genetic variability. From this 24 lines core collection, the 16 accessions retained have been selected on the basis of their close flowering time in short days. Col-0 and WS which are parental lines for most of the RILs populations and T-DNA mutants available at Versailles Ressource Center were added. Mr-0 was also added.

Accession name	Versailles identification number (AV)	Original Stock Center number (OSC)	Core collection	RILs populations Versailles (Col-0 as male)	Arabidopsis Identification Stock number (AIS)	City	Country	Altitude
Bl-1	42	N968	24		1440	Bologna	Italy	100-200
St-0	62	N1534	16		198	Stockholm	Sweden	1-100
Kn-0	70	N1286	24		111	Kaunas	Lithuania	1-100
Edi-0	83	N1122	24		57	Edinburgh	United Kingdom	1-100
Tsu-0	91	N1564	24	3 RV	210	Tsu	Japan	1-100
Stw-0	92	N1538	24		199	Stobowa/Orel	Russia	100-200
Mt-0	94	N1380	16		153	Martuba/Cyrenaika	Libya	100-200
Ge-0	101	N1186	16	17 RV	1582	Geneva	Switzerland	500-600
Ct-1	162	N1094	8	7 RV	53	Catania	Italy	1-100
Bur-0	172	N1028	8	20 RV	41	Burren (Eire)	Ireland	1-100
Mh-1	215	N1368	16		1639	M¸lhen (OstPr)	Poland	100-200
Oy-0	224	N1436	8	27 RV	933	Oystese	Norway	1-100
Shahdara	236	N929	8	13 RV, 33 RV		Shakdara River (Pamir)	Tadjikistan	3300-3400
Akita	252		24			Akita Pref.	Japan	
Sakata	257		24			Sakata, Yamagata Pref.	Japan	
N13	266	CS22491	16			Konchezero	Russia	
Mr-0	148	N1372			150	Monte/Tosso	Italy	1000-1500
Col-0	186	N1092		1 to 29 RV	52	Gorzow Wielkopolski (Landsberg/Warthe	Poland	1-100
WS	244	N915				Wassilewskija	Belarus	100-200

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Supplemental Table S2: Global ANOVA of dry weight (DW, g), N concentration (N%, mg 100mg^{-1} DW), C concentration (C%, mg 100mg^{-1} DW), C/N ratio, ^{15}N enrichment (E%; ^{15}N/N as %), HI (harvest index), NHI (nitrogen harvest index), ^{15}NHI (partition of ^{15}N in seeds), RSA ratio, NUE indicator (ΔNHI) and extra-remobilization (ΔRem) in the 19 Arabidopsis accessions grown under HIGH N and LOW N nutritions. Sums of square are presented for nutrition effects, genotype effects, repeat effects and nutrition*genotype, genotype*repeat, nutrition* repeat and nutrition* repeat*genotype interactions. Only significant effects (P<0.05 at least) are presented.

Source global	DW_{DR}	$N\%_{DR}$	$E\%_{DR}$	DW_{SEEDS}	DW_{1S}	$N\%_{SEEDS}$	$C\%_{SEEDS}$	C/N_{SEEDS}	$E\%_{SEEDS}$	HI	NHI	^{15}NHI	RSA ratio	ΔNHI	ΔRem
Nutrition	113.1	671.7	0.84	6.98	73.8	69.4	537.5	1197.2		0.023	0.715	2.2	4.4		
Genotype	12.15	11.8	0.77	2.19	5654	11.136	960.580	176.637	0.60	1.113	0.432	3.7	6.5	1.3	2.6
Repeat	0.3	3.9	0.05								0.017		1.0		
Nutrition*Genotype	6.36	25.3	0.32	0.90	99.5	3.734	746.5	86.2	0.49	0.157	0.150	0.8	3.1	0.4	1.0
Genotype*Repeat	3.1	10.7	0.24	0.30	177.3		578.6	20.8	0.30	0.120	0.042	0.3		*0.3*	
Nutrition*Repeat		1.3					138.1	21.5			0.007				
Nutrition*Genotype*Repeat	2.4	8.6	0.32			3.8	391.0	23.3							
Residual	1.13	27.7	1.05	2.01	718.7	13.3	2415	113.85	1.22	0.48	0.27	1.3	4.8	1.7	3.2

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Supplemental Table S3: ANOVA of dry weight (DW, g), N concentration (N%, mg 100mg^{-1} DW), C concentration (C%, mg 100mg^{-1} DW), C/N ratio, ^{15}N enrichment (E%; ^{15}N/N as %), HI (harvest index), NHI (nitrogen harvest index), ^{15}NHI (partition of ^{15}N in seeds), RSA ratio, NUE indicator (ΔNHI) and extra-remobilization (ΔRem) in the 19 Arabidopsis accessions grown under HIGH N (10mM nitrate) nutrition. Sums of square are presented for genotype effects, repeat effects and genotype*repeat interactions. Only significant effects (P<0.05 at least) are presented.

Source HIGH N	DW_{DR}	$N\%_{DR}$	$E\%_{DR}$	DW_{SEEDS}	DW_{1S}	$N\%_{SEEDS}$	$C\%_{SEEDS}$	C/N_{SEEDS}	$E\%_{SEEDS}$	HI	NHI	^{15}NHI	RSA ratio	ΔNHI	ΔRem
Genotype	16.3	29.8	0.27	2.77	2712.9	8.8	513.8	100.2	0.58	0.45	0.33	1.1	53	1.1	2.15
Repeat		4.8	0.03				129.23	14.363					0.8		
Genotype*Repeat	5.2	17.9	0.17		144.8		296.4							0.5	
Residual	8.44	24.2	0.40	1.90	253.2	10.0	939.4	69.8	0.72	0.30	0.48	0.6	2.1	0.6	1.49

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Supplemental Table S4: ANOVA of dry weight (DW, g), N concentration (N%, mg 100mg^{-1} DW), C concentration (C%, mg 100mg^{-1} DW), C/N ratio, ^{15}N enrichment (E%; ^{15}N/N as %), HI (harvest index), NHI (nitrogen harvest index), ^{15}NHI (partition of ^{15}N in seeds), RSA ratio, NUE indicator (ΔNHI) and extra-remobilization (ΔRem) in the 19 Arabidopsis accessions grown under LOW N (2mM nitrate) nutrition. Sums of square are presented for genotype effects, repeat effects and genotype*repeat interactions. Only significant effects (P<0.05 at least) are presented.

Source LOW N	DW_{DR}	$N\%_{DR}$	$E\%_{DR}$	DW_{SEEDS}	DW_{1S}	$N\%_{SEEDS}$	$C\%_{SEEDS}$	C/N_{SEEDS}	$E\%_{SEEDS}$	HI	NHI	^{15}NHI	RSA ratio	ΔNHI	ΔRem
Genotype	2.4	7.3	0.83	0.39	3693.1	6.9	1094.0	168.9	0.49	0.83	3.16	3.4	0.6	0.8	1.4
Repeat	0.08	0.3		0.01	19.5			11.842					0.03		
Genotype*Repeat	0.7	1.2	0.44	0.13			757.4	28.2	0.34	0.08		0.2			
Residual	0.91	3.5	0.66	0.27	478.5	7.1	1475.5	60.4	0.46	0.218	1.21	0.7	0.5	0.9	1.7