

Supplemental Data

Acclimation of Leaf Nitrogen to Vertical Light Gradient at Anthesis in *Triticum aestivum* is a Whole Plant Process that Scales with the Size of Canopy

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Table S1 Name, country of origin, registration year, height, and anthesis date for the 16 cultivars of winter bread wheat used in this study. Crops were grown in the field at Clermont-Ferrand, France, during the 2006-2007 (CF07) and 2007-2008 (CF08) growing seasons and at Sutton Bonington, UK, during the 2006-2007 growing season (SB07). For crop height data are means \pm 1 s.e. for $n = 2$ N treatments \times 3 independent replicates. *P*-values of the main effects and their interactions from split-plot ANOVAs are reported for plant plant height. bl, unregistered INRA breeding lines

Cultivar name	Country of Origine	Registration year	Height (cm)			Anthesis date (day of the year) ^a		
			CF07	CF08	SB07	CF07	CF08	SB07
Alchemy	UK	2006	61.8 \pm 3.8	70.7 \pm 4.6	-	141 (+6)	151 (+2)	-
Beaver	UK	1990	53.9 \pm 4.0	69.2 \pm 5.6	-	141 (+6)	153 (+4)	-
Consort	UK	1995	58.9 \pm 3.9	69.0 \pm 6.2	-	141 (+6)	152 (+3)	-
Paragon	UK	1995	81.2 \pm 4.9	99.9 \pm 7.1	-	137 (+2)	151 (+2)	-
Rialto	UK	1995	63.6 \pm 5.1	75.3 \pm 4.7	80.7 \pm 3.8	135	149	155
Robigus	UK	2003	57.0 \pm 4.5	72.0 \pm 5.7	-	137 (+2)	151 (+2)	-
Savannah	UK	1998	61.6 \pm 5.5	71.8 \pm 5.8	85.9 \pm 2.2	140 (+5)	151 (+2)	155 (0)
Soissons	France	1988	63.9 \pm 4.7	68.9 \pm 2.7	-	128 (-7)	137 (-12)	-
Arche	France	1989	68.8 \pm 5.3	81.2 \pm 4.9	-	133 (-2)	144 (-5)	-
CF9107	France	bl	62.7 \pm 5.1	67.2 \pm 4.7	-	129 (-6)	143 (-6)	-
CF99102	France	bl	69.2 \pm 4.2	78.9 \pm 5.7	98.0 \pm 2.7	133 (-2)	144 (-5)	154 (-1)
Perfector	France	2004	60.2 \pm 4.3	70.9 \pm 4.6	82.1 \pm 2.9	134 (-1)	150 (+1)	154 (-1)
Quebon	France	2004	68.3 \pm 4.9	83.1 \pm 5.0	-	134 (-1)	149 (0)	-
Récital	France	1986	62.2 \pm 5.4	71.8 \pm 4.6	-	123 (-12)	136 (-13)	-
Renan	France	1989	64.3 \pm 5.0	74.4 \pm 5.2	-	130 (-5)	142 (-7)	-
Toisonдор	France	2004	51.8 \pm 5.4	63.3 \pm 4.5	-	129 (-6)	144 (-5)	-
Min			51.8	63.3	80.7	123	136	154
Max			81.2	99.9	98.0	141	153	155
Average			63.1	74.2	86.7	134	147	154
<i>P</i> -values								
N			< 0.0001					
Year			< 0.0001					
Genotype			< 0.0001					
N \times Year			0.1841					
N \times Genotype			0.3664					
Year \times Genotype			< 0.0001					
N \times Year \times Genotype			0.0071					

^a numbers in parenthesis are differences in days of anthesis relative to Rialto

Table S2 Soil characteristics at Clermont-Ferrand, France, during the 2006-2007 (CF07) and 2007-2008 (CF08) growing seasons and at Sutton Bonington, UK, during the 2006-2007 growing season (SB07).

Soil characteristics	CF07	CF08	SB08
Previous crop	sunflower	barley	oilseed rape
Soil textural class (USDA system)	clay	clay loam	clay loam
Soil particle size distribution (% of soil dry mass)			
Stone (> 2.0 mm)	< 2%	< 2%	< 2%
Sand (0.05-2.0 mm)	24.8	19.8	16.3
Silt (0.002-0.05 mm)	45.9	36.7	56.3
Clay (< 0.002 mm)	29.2	43.5	27.3
Maximum rooting depth (m)	0.6	0.9	1.6
Plant available soil water content (mm)	129	122	165
Apparent bulk density (Mg m ⁻³)	1.10	1.15	1.37
Organic matter (%)	2.9	3.1	3.0
Organic N in the top soil (0-40 cm layer; Mg N m ⁻²)	9.03	10.51	9.41
pH in water	8.2	8.1	7.6
Inorganic soil N (0-90 cm layer) at the end of winter (g N m ⁻²)	7.4	6.2	9.6

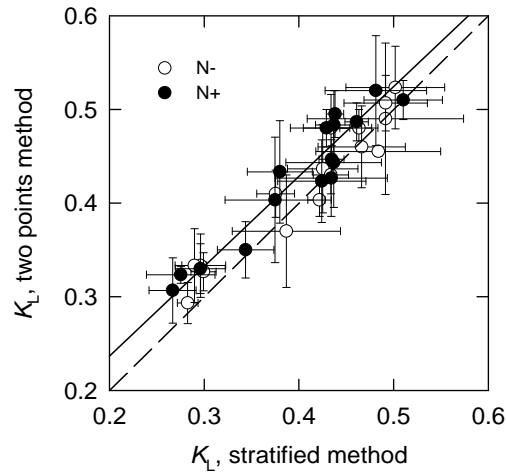


Fig. S1. Comparison of the two methods used to estimate the canopy light extinction coefficient (K_L) for wheat crops grown at Clermont-Ferrand, France, during the 2006-2007 growing season. Within a N treatment each point represents a different cultivar. In the stratified method, K_L was estimated from PPF_D measurements taken every 10 cm from the top of the canopy to the ground level. In the two point method, K_L was estimated from PPF_D measurements taken above the canopy and at ground level only. Data are means \pm 1 s.e. for $n = 3$ independent replicates. Dashed line is $y = x$. Solid line is reduced major axis linear regression ($y = 0.9293 x - 0.0483$, $r^2 = 0.929$, $d.f. = 30$, $P < 0.0001$).

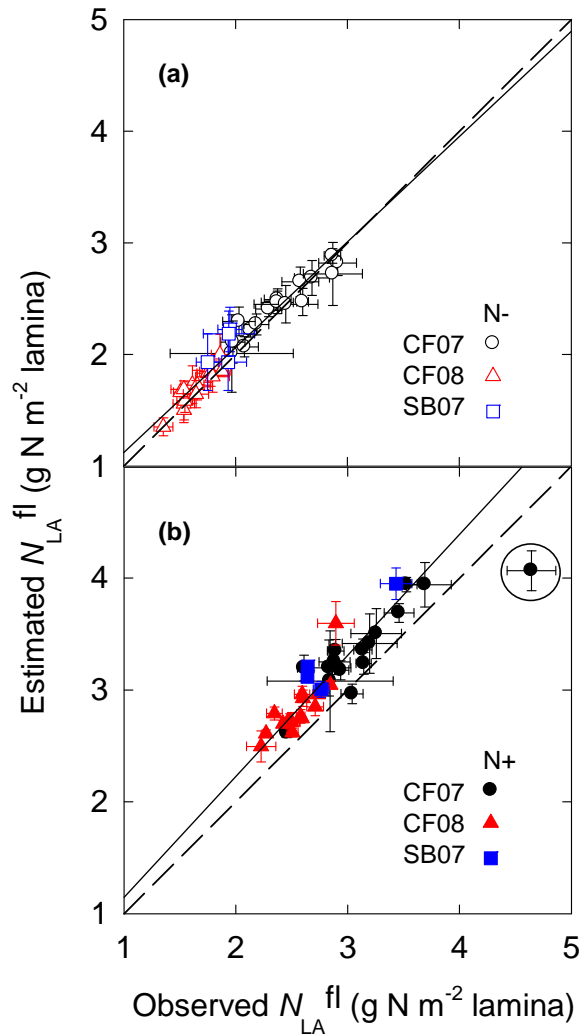


Fig. S2. Estimated versus observed flag leaf lamina N mass per unit leaf area (N_{LA}^{fl}) at anthesis for 16 cultivars of bread wheat grown under low (A) and high (B) N supply. Data are means \pm 1 s.e. for $n = 3$ independent replicates. Dashed line is $y = x$. Solid line is reduced major axis linear regression (for N-, $y = 0.944x + 0.176$, $r^2 = 0.951$, $d.f. = 34$, $P < 0.0001$; for

N+, $y = 1.081 x + 0.066$, $r^2 = 0.920$, $d.f. = 33$, $P < 0.0001$). For N+, the circled point (Soissons) was not included in the regression. N_{LA}^{fl} was estimated using Eqn 5.

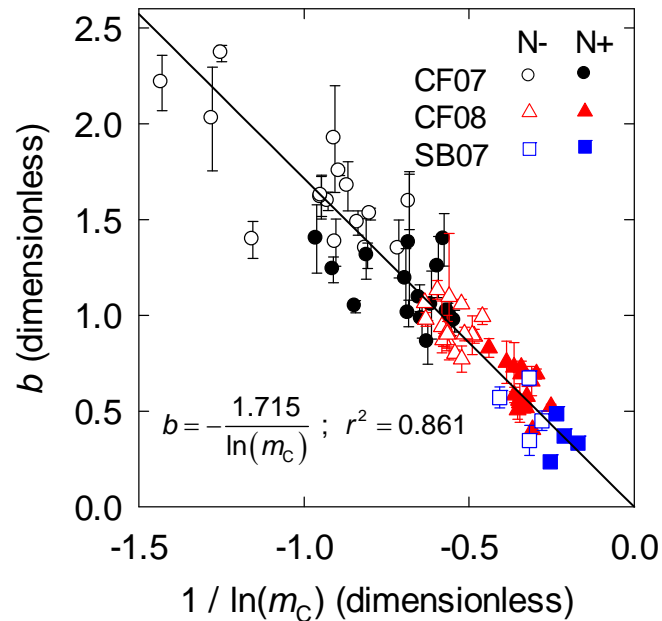


Fig. S3. Relationship between the ratio of nitrogen-to-light extinction coefficients (b) and the reciprocal of the natural logarithm of the canopy transmittance (m_c) at anthesis for 16 cultivars of bread wheat grown under low (N-) and high (N+) at Clermont-Ferrand, France, during the 2006-2007 (CF07) and 2007-2008 (CF08) growing seasons and for four cultivars grown at Sutton Bonington, UK, during the 2006-2007 growing season (SB07). Data are means \pm 1 s.e. for $n = 3$ independent replicates. Solid line is reduced major axis linear regression.

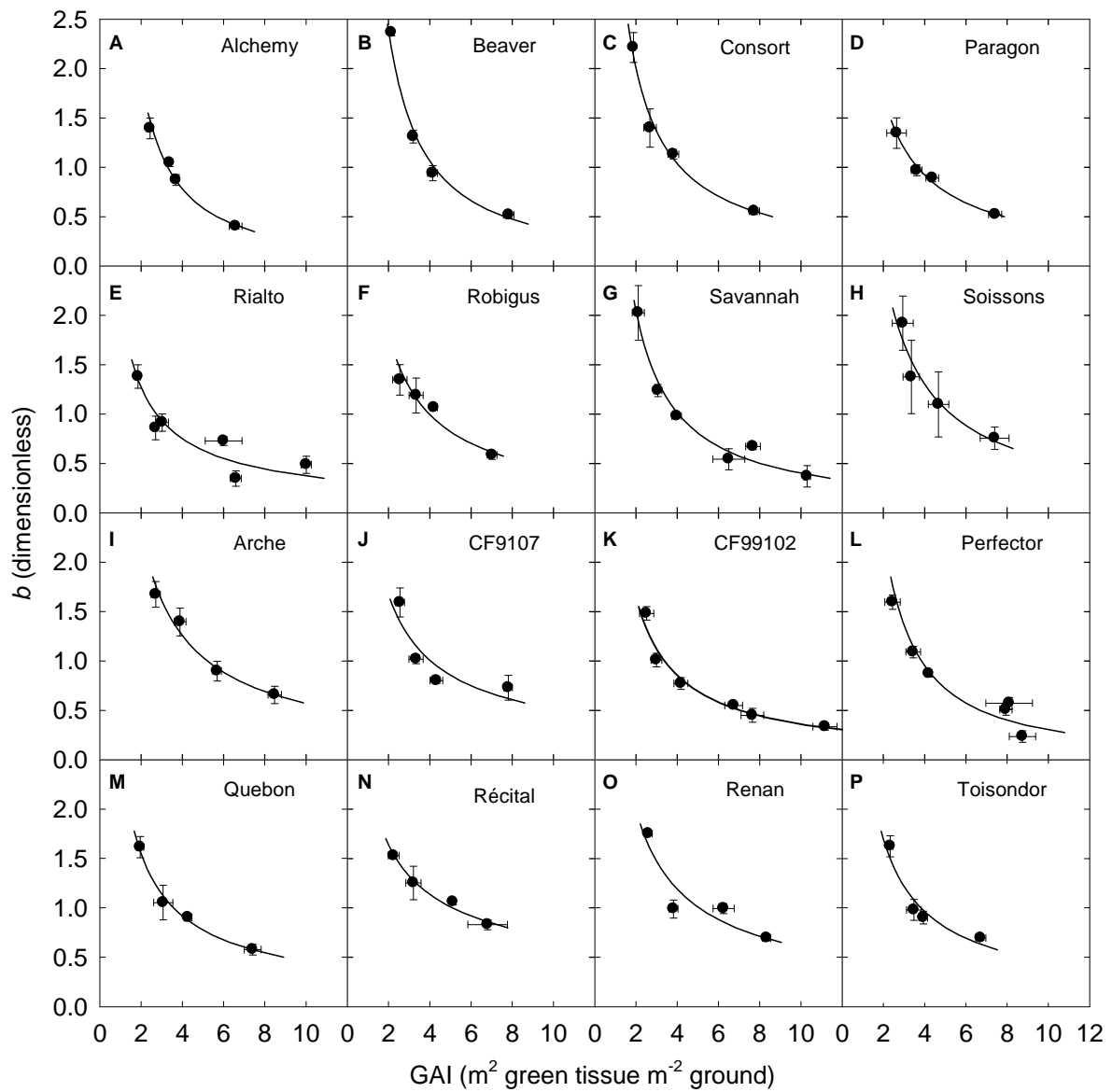


Fig. S4. Coefficient of leaf N distribution with respect to relative light (b) versus green area index (GAI) at anthesis for 16 cultivars of bread wheat. The name of the cultivar is given in the figures. Solid lines were fitted to the data by reduced major axis regression after logarithmic transformation of the function equation $b = \beta \times \text{GAI}^\alpha$. Data are means \pm 1 s.e. for $n = 3$ independent replicates.

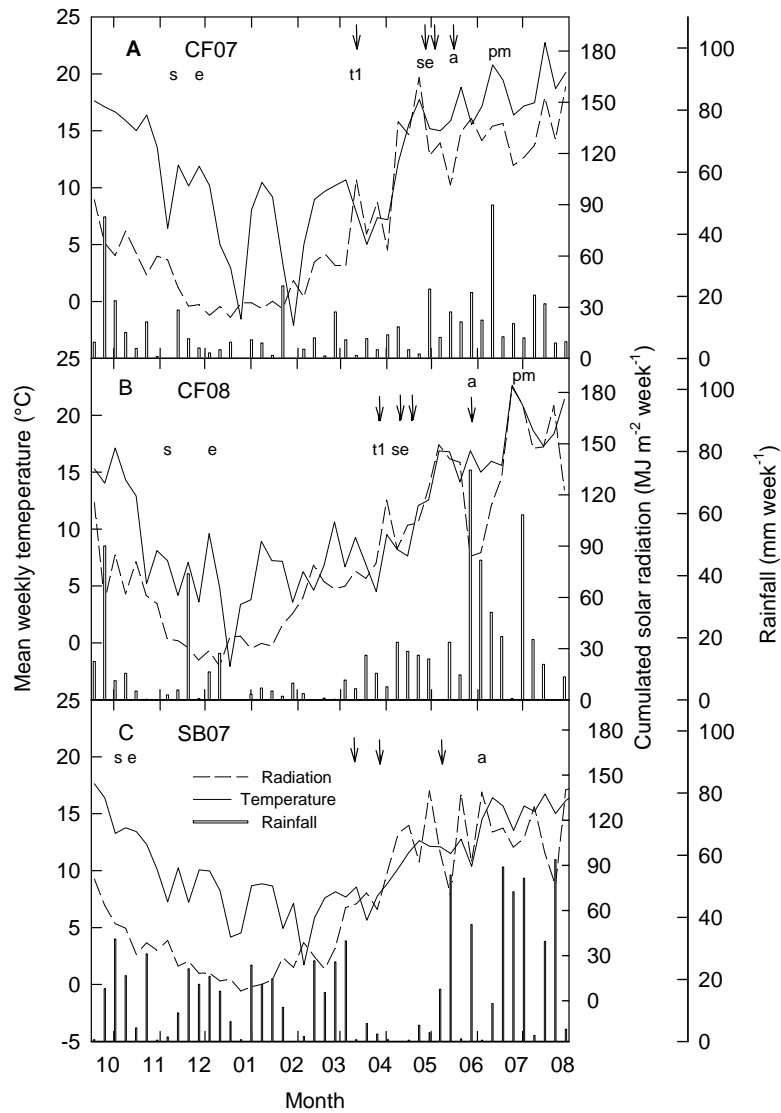


Fig. S5. Mean weekly temperature (solid lines), cumulated weekly solar radiation (dashed lines), and cumulated weekly rainfall (vertical bars) at Clermont-Ferrand during the 2006-2007 (A) and 2007-2008 (B) growing seasons and at Sutton Bonington (SB) during the 2006-2007 growing season (C). The letters indicate sowing (s), emergence (e), first tiller (t1), beginning of stem extension (se), anthesis (a), and physiological maturity (pm). The vertical arrows indicate N applications for the N+ treatment.