

**Table S1.** Analysis of variance table for (a) variety and nitrogen terms on Year 1 data and (b) variety and year terms on data from both years.

(a) Response: log[Yield]					
Df	Sum Sq	Mean	Sq	F-value	Pr (>F)
Variety	34	18.7364	0.5511	4.9733	2.371e-11 ***
Nitrogen	1	9.7363	9.7363	87.8683	4.405e-16 ***
Residuals	123	13.6291	0.1108	-	-

(b) Response: log[Yield]					
Df	Sum Sq	Mean	Sq	F-value	Pr (>F)
Variety	41	18.7347	0.45694	2.8213	9.87e-07 ***
Year	1	0.3633	0.36331	2.2432	0.1358
Residuals	192	31.0962	0.16196	-	-

**Table S2.** Mean, range (min and max), standard deviation (SD) and coefficient of variation (CV) of the physiological and biochemical traits measured in 35 *B. napus* lines.

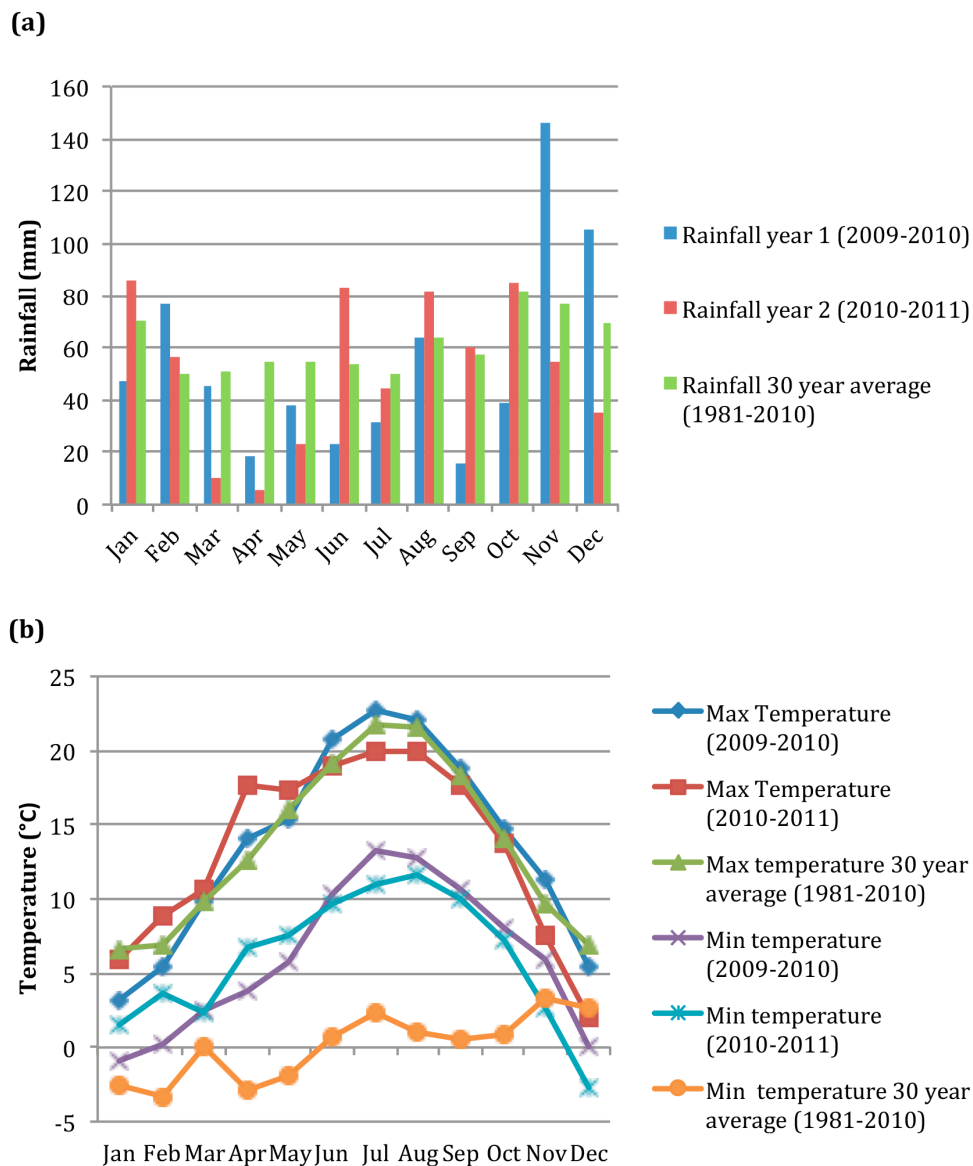
Category	Trait	Mean	Min	Max	SD	CV
Yield	Seed yield per plant (g)	15.08	5.29	31.87	5.094	0.338
	Thousand grain weight (g)	5.12	3.00	8.00	0.923	0.180
	MARVIN thousand grain weight (g)	5.13	3.40	7.69	0.823	0.160
Reproductive organs	Harvest Index	0.22	0.15	0.29	0.029	0.132
	Pod length (mm)	69.71	44.60	90.80	10.260	0.147
	Pod seed cavity length (mm)	57.83	33.60	74.60	8.967	0.155
	Number of pods on the main stem	24.00	8.00	45.80	7.013	0.292
	Pod weight (week 35; mg)	38.56	7.40	78.10	16.252	0.421
	Pod wall Chl a (Week 35; mg/g DW)	1.01	0.25	1.67	0.284	0.281
	Pod wall Chl b (Week 35; mg/g DW)	0.35	0.03	0.57	0.114	0.326
	Pod wall Car (Week 35; mg/g DW)	0.23	0.02	0.42	0.067	0.290
	Pod wall Chl a (Week 40; mg/g DW)	0.29	0.10	0.46	0.075	0.262
	Pod wall Chl b (Week 40; mg/g DW)	0.11	0.01	0.30	0.051	0.481
	Pod wall Car (Week 40; mg/g DW)	0.10	0.06	0.14	0.016	0.154
	Pod wall Chl a (Week 41; mg/g DW)	0.23	0.07	0.39	0.073	0.322
	Pod wall Chl b (Week 41; mg/g DW)	0.07	0.02	0.14	0.025	0.342
	Pod wall Car (Week 41; mg/g DW)	0.11	0.06	0.16	0.018	0.170
	Pod wall Chl a (Week 42; mg/g DW)	0.16	0.01	0.41	0.083	0.535
	Pod wall Chl b (Week 42; mg/g DW)	0.05	0.00	0.14	0.029	0.547
Pod wall Car (Week 42; mg/g DW)	0.11	0.03	0.15	0.021	0.200	
Pod wall Chl a (Week 43; mg/g DW)	0.08	0.00	0.28	0.057	0.750	

Category	Trait	Mean	Min	Max	SD	CV
	Pod wall Chl b (Week 43; mg/g DW)	0.03	0.00	0.11	0.025	0.806
	Pod wall Car (Week 43; mg/g DW)	0.09	0.02	0.15	0.028	0.326
	Pod wall Chl a (Week 44; mg/g DW)	0.01	0.00	0.08	0.013	1.182
	Pod wall Chl b (Week 44; mg/g DW)	0.01	0.00	0.06	0.012	1.000
	Pod wall Car (Week 44; mg/g DW)	0.03	0.00	0.10	0.028	0.824
	Pod wall Chl a remaining (Week 40; %)	30.83	14.10	147.80	16.329	0.530
	Pod wall Chl a remaining (Week 41; %)	79.99	40.00	138.90	20.123	0.252
	Pod wall Chl a remaining (Week 42; %)	66.09	10.40	184.20	26.035	0.394
	Pod wall Chl a remaining (Week 43; %)	58.00	4.00	583.30	72.140	1.244
	Pod wall Chl a remaining (Week 44; %)	19.41	0.00	100.00	19.788	1.020
	Pod wall Chl b remaining (Week 40; %)	42.58	5.30	448.30	61.815	1.452
	Pod wall Chl b remaining (Week 41; %)	78.61	16.10	200.00	32.352	0.412
	Pod wall Chl b remaining (Week 42; %)	72.94	13.30	178.60	31.980	0.438
	Pod wall Chl b remaining (Week 43; %)	69.91	0.00	263.00	62.129	0.889
	Pod wall Car remaining (Week 40; %)	54.73	22.50	600.00	65.088	1.189
	Pod wall Car remaining (Week 41; %)	102.74	76.50	143.50	13.973	0.136
	Pod wall Car (Week 42; %)	99.89	52.30	160.00	16.469	0.165
	Pod wall Car (Week 43; %)	82.04	19.60	161.80	23.742	0.289
	Pod wall Car (Week 44; %)	38.52	5.10	240.00	35.109	0.911
	Pod photosynthetic period (weeks)	9.86	8.00	12.00	1.067	0.108
	Number of seeds per pod	26.10	7.00	37.80	6.945	0.266
	Pod development stage (Week 35)	0.34	0.00	1.50	0.318	0.930
	Pod development stage (Week 40)	1.20	1.00	2.50	0.337	0.282
	Pod development stage (Week 41)	1.47	1.00	3.00	0.541	0.367
	Pod development stage (Week 42)	1.97	1.00	4.00	0.627	0.318
	Pod development stage (Week 43)	2.48	1.50	4.00	0.719	0.290
	Pod development stage (Week 44)	3.57	1.50	4.00	0.544	0.153
	Pod development stage (Week 45)	3.93	2.50	4.00	0.241	0.061
	Pod shatter date (week)	45.26	42.00	48.00	1.500	0.033
	Seed packing density	2.40	1.50	5.00	0.656	0.274
	Seed weight per pod at harvest (mg)	131.73	47.40	224.40	37.035	0.281

Category	Trait	Mean	Min	Max	SD	CV
	Seed area (mm <sup>2</sup> )	212.88	168.64	276.26	21.324	0.100
	Seed moisture (%)	3.94	2.86	4.87	0.348	0.088
	Seed lipid (%)	53.27	44.50	58.20	3.079	0.058
	Seed protein (%)	15.83	12.40	20.70	1.669	0.105
	Seed glucosinolate (µmol/g)	39.84	0.00	109.00	35.946	0.902
	Seed glucosinolate I30 (µmol/g)	30.75	5.00	62.00	18.849	0.613
	Seed palmitic acid (% lipid)	3.90	2.86	4.71	0.466	0.119
	Seed stearic acid (% lipid)	1.55	0.61	2.03	0.411	0.265
	Seed oleic acid (% lipid)	59.64	6.70	91.40	28.970	0.486
	Seed linoleic acid (% lipid)	17.83	12.70	22.00	2.640	0.148
	Seed linolenic acid (% lipid)	7.29	3.80	11.90	2.007	0.275
	Seed erucic acid (% lipid)	22.67	1.30	67.80	16.643	0.734
	Oil:protein	3.42	2.20	4.68	0.505	0.148
	Seed weight per pod (Week 40; mg)	104.40	45.00	178.00	28.394	0.272
	Seed weight per pod (Week 41; mg)	102.38	38.00	195.00	31.588	0.309
	Seed weight per pod (Week 42; mg)	128.91	55.00	198.00	32.926	0.255
	Seed weight per pod (Week 43; mg)	137.41	59.00	206.00	36.761	0.268
	Seed weight per pod (Week 44; mg)	130.79	39.00	207.00	41.283	0.316
	Flowering start date (week)	33.09	30.00	34.00	1.168	0.035
	Flowering window (days)	35.25	15.00	64.00	8.564	0.243
Vegetative organs	Plant height (cm)	148.36	72.00	180.40	20.591	0.139
	Length of the main stem containing pods (cm)	41.00	17.00	64.20	9.289	0.227
	Stem area (mm <sup>2</sup> )	175.81	104.83	311.02	40.809	0.232
	Total number of branches	12.25	4.80	31.20	4.791	0.391
	Number of branches coming off the main stem	7.57	5.20	17.20	1.600	0.211
	Stem stiffness	8.66	4.00	9.00	0.841	0.097
	Plant above ground biomass (g)	67.18	36.22	138.02	17.514	0.261
	Plant vegetative mass at harvest (g)	52.10	30.92	108.71	12.961	0.249
	Vegetative:reproductive mass	3.74	2.52	6.14	0.727	0.195
Leaves	Lower leaf Chl a (Week 27; mg/g DW)	7.27	5.21	16.38	1.785	0.246
	Lower leaf Chl b (Week 27; mg/g DW)	3.33	1.32	18.71	2.654	0.796
	Lower leaf Car (Week 27; mg/g DW)	1.50	1.17	2.33	0.249	0.166
	Lower leaf Chl a (Week 31; mg/g DW)	7.48	2.20	11.53	1.551	0.207
	Lower leaf Chl b (Week 31; mg/g DW)	2.53	0.78	3.88	0.561	0.222
	Lower leaf Car (Week 31; mg/g DW)	1.54	1.08	2.20	0.250	0.162
	Lower leaf Chl a (Week 35; mg/g DW)	0.58	0.00	3.61	0.851	1.465

Category	Trait	Mean	Min	Max	SD	CV
	Lower leaf Chl b (Week 35; mg/g DW)	0.23	0.00	1.56	0.329	1.437
	Lower leaf Car (Week 35; mg/g DW)	0.47	0.11	1.42	0.226	0.482
	Lower leaf Chl a remaining (Week 31; %)	107.88	24.90	179.70	29.988	0.278
	Lower leaf Chl b remaining (Week 31; %)	36.45	8.80	62.80	10.563	0.290
	Lower leaf carotenoid remaining (Week 31; %)	105.30	67.60	167.00	22.311	0.212
	Lower leaf Chl a remaining (Week 35; %)	8.19	0.00	79.00	12.869	1.571
	Lower leaf Chl b remaining (Week 35; %)	3.21	0.00	27.40	4.778	1.491
	Lower leaf Car remaining (Week 35; %)	30.68	6.70	132.40	16.191	0.528
	Upper leaf Chl a (Week 35; mg/g DW)	2.49	1.08	4.43	0.648	0.260
	Upper leaf Chl b (Week 35; mg/g DW)	0.82	0.36	1.44	0.225	0.275
	Upper leaf Car (Week 35; mg/g DW)	0.59	0.26	0.99	0.140	0.236
	Upper leaf Chl a (Week 40; mg/g DW)	0.92	0.00	2.84	0.687	0.747
	Upper leaf Chl b (Week 40; mg/g DW)	0.36	0.00	1.24	0.246	0.693
	Upper leaf Car (Week 40; mg/g DW)	0.41	0.03	0.90	0.181	0.439
	Upper leaf Chl a remaining (Week 40; %)	38.31	0.00	145.76	30.906	0.807
	Upper leaf Chl b remaining (Week 40; %)	45.26	0.00	154.12	33.625	0.743
	Upper leaf carotenoid remaining (Week 40; %)	71.09	5.64	170.99	31.997	0.450
	Early leaf Chl a	1.21	0.80	1.62	0.171	0.142
	Early leaf Chl b	0.59	0.09	1.65	0.290	0.494
	Early leaf Car	0.32	0.19	0.43	0.045	0.142
	Canopy leaf Chl a	1.00	0.76	1.23	0.110	0.110
	Canopy leaf Chl b	0.37	0.10	0.72	0.134	0.364
	Canopy leaf Car	0.14	0.07	0.23	0.037	0.261
	Canopy leaf NO <sub>3</sub> -N (µg/g DW)	8.88	1.53	19.59	4.841	0.545
	Canopy leaf N (% DW)	2.40	1.74	3.43	0.342	0.142
	Canopy leaf Ca (% DW)	1.88	0.93	2.81	0.381	0.203
	Canopy leaf K (% DW)	1.83	1.11	2.86	0.437	0.239
	Canopy leaf Mg (% DW)	0.13	0.04	0.24	0.040	0.308
	Canopy leaf P (% DW)	0.38	0.27	0.49	0.053	0.141
	Canopy leaf Na (µg/g)	658.44	159.19	2637.25	445.750	0.677
	Canopy leaf Mn (µg/g)	44.31	20.52	73.52	12.087	0.273
	Early leaf NO <sub>3</sub> -N (µg/g)	666.06	58.65	1692.72	409.824	0.615
	Early leaf N (% DW)	5.77	4.83	7.10	0.398	0.069
	Early leaf Ca (% DW)	0.88	0.49	1.67	0.242	0.276
	Early leaf K (% DW)	2.87	2.00	3.49	0.300	0.105
	Early leaf Mg (% DW)	0.19	0.16	0.23	0.016	0.084
	Early leaf P (% DW)	0.94	0.73	1.23	0.096	0.102
	Early leaf Na (µg/g)	644.86	297.68	1239.03	229.735	0.356

Category	Trait	Mean	Min	Max	SD	CV
Whole plant	Early leaf Mn ( $\mu\text{g/g}$ )	42.76	27.38	142.04	13.279	0.311
	Number of seeds per plant	3039.35	1216.72	6753.03	1153.065	0.379
	Number of pods per plant	124.30	49.21	321.77	49.686	0.400
	Pod spacing on the main stem (mm/pod)	1.95	0.90	5.10	0.774	0.398
	Plant growth stage (Week 27)	1.34	1.00	3.00	0.493	0.369
	Plant growth stage (Week 31)	3.04	2.50	4.00	0.314	0.103
	Plant growth stage (Week 35)	4.93	4.50	5.00	0.170	0.034



**Figure S1.** Monthly figures for (a) total rainfall and (b) mean maximum and minimum temperature at Rothamsted Research ( $51^{\circ}48'32.6376''\text{N}$ ,  $000^{\circ}21'22.5432''\text{W}$ ) between 2009 and 2011.